City of Newcastle

Stockton Beach Nourishment

Review of Environmental Factors for sand placement

9 February 2023

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Document Summary

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Executive summary

Background

In 2020 the Stockton Coastal Management Program (CMP) was adopted by City of Newcastle (CN). Targeted analysis from a sediment transport study undertaken for the CMP has shown that the ongoing sand loss rate within the Stockton CMP area is approximately 146,000m^3 per year which is likely to increase with time.

The CMP identified that beach erosion at Stockton has had a devastating effect on the local community. Stockton Beach is of high intrinsic value to the Stockton and Newcastle community, and visitors, who have a strong desire to preserve and protect its natural environment and character. Mass sand nourishment has been identified as the only technically feasible solution that sustainably meets CN's and the community's objectives of asset protection and beach amenity over the long term. Mass nourishment, with a 10 yearly renourishment period, would likely provide adequate coastal protection to eliminate the need for coastal protection structures beyond the immediate term. The nourishment volume required to achieve coastal protection was estimated to be 2.4 million m^3 of sand. Sand would be placed in the southern end of Stockton Beach which is located on a sand peninsula immediately north of one of NSW's largest coastal rivers, the Hunter River.

Terrestrial sand supply and placement by trucks is excluded from this Proposal. The potential environmental impacts of any dredging of sand will be undertaken separately by the dredging proponents when potential sources become available.

This Review of Environmental Factors (REF) has been prepared by Bluecoast Consulting Engineers and Blue Sky Planning and Environment with the support of H20 Consulting Group, Cosmos Archaeology and McCardle Cultural Heritage, on behalf of City of Newcastle. For the purposes of the Proposal, City of Newcastle (CN) is the proponent and the determining authority under Division 5.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The purpose of this REF is to describe the proposed beach nourishment, to document the likely impacts of the Proposal on the environment, and to detail mitigation and management measures to be implemented.

Statutory position

As the Proposal is for the purpose of foreshore management activities and is to be carried out on behalf of a public authority (Council), it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* and development consent is not required. The Proposal does not require a referral to the Australian Government under the EPBC Act.

This REF fulfils CN's obligation under Section 5.5 of the EP&A Act to examine and fully consider possible all matters affecting or likely to affect the environment by reason of the activity.

Works methodology

The exact work methodology would depend on the volumes, sand source, tidal and weather conditions, and the executing contractor work method; however, sand placement options are likely to include:

- Pumping ashore directly from a dredge using pipelines and land-based earthmoving equipment
- 'Rainbowing' from a dredge involving sand slurry being jetted from the bow of the vessel
- Bottom dumping to nourish the nearshore zone.

Because terrestrial sand sources and trucking of sand is excluded from the Proposal, sand placement will primarily be achieved via marine plant and a system of pumps/floating pipelines. Earthworks may be required on an "as needs" basis on the beach and would typically involve one or two vehicles at a time such as front-loaders or bulldozers for setting up the construction site at the start of the project and levelling the beach at the end of the operations. The amount of earthworks required is likely to be minimal. It is proposed to make two compound sites available for use during sand placement activities. These sites are the car parking area located near Little Beach and the open area near Dalby Oval. These would only be used intermittently for short periods of time.

Source and quantity of sand

The total quantity of sediments for the mass nourishment is approximately 2.4 million m^3. It is likely that the sediment would be placed over a ten-year period. The source of sand for nourishment of Stockton Beach is not selected at this stage. Provided that it complies with the Sand Management Guidelines (RHDHV, 2021), nourishment sand could come from a range of possible places including offshore, the Hunter River or other opportunistic sources.

Consultation

Stakeholder and community consultation regarding the management of the Stockton coastal zone has been ongoing for over a decade. In February 2018 the Stockton Community Liaison group was formed, consisting of a group of leading community members that joined together to share community views and knowledge of local issues with CN and seek a long-term solution to erosion at Stockton Beach. The CLG has been meeting frequently since 2018 and continues to meet regularly and advise CN during development of the Extended Stockton CMP. Stockton community representatives of the CLG, including representatives from Worimi Local Aboriginal Land Council, provide an information network between CN and the Stockton community to better understand the concerns of the community and provide meaningful feedback towards the development of long-term management solutions to the erosion at Stockton Beach.

Consultation has been ongoing with key agency stakeholders since the inception of the project. Consultation was undertaken with state agencies and authorities during the preparation of this REF, to determine agency requirements for the consideration of the potential environmental impacts of the Proposal. The draft Aboriginal Cultural Heritage Assessment was undertaken to meet the Heritage NSW Aboriginal Cultural Heritage consultation requirements. The draft report was sent to all Registered Aboriginal Parties. Two responses were received from Karuah Indigenous Company and Nur-Run-Gee. Both were satisfied with the report.

Environmental Assessment

All aspects of the environment potentially impacted by the Proposal have been considered in this REF:

- Coastal processes
- Water quality and contamination
- Air quality
- Noise and vibration
- Landscape character and visual impact
- Biodiversity
- Socioeconomics
- Traffic and access
- Aboriginal cultural heritage
- Historic heritage

- Waste management
- Climate change
- Cumulative impacts.

The assessment concludes that the Proposal would prevent the loss of public assets and improve beach amenity and recreational opportunities and is also likely to prevent the loss of culturally important sites and heritage items and improve the biodiversity outcomes for the area.

The Proposal is in the public interest because it would achieve social, biophysical, and economic benefits. The community have expressed a strong desire for all levels of government to take urgent action to address the coastal recession issues at Stockton and the Proposal would be a significant step in achieving the community's desired outcome.

With the implementation of the Safeguards proposed in this REF, the Proposal is unlikely to have a significant negative impact on any matter relevant under NSW or Commonwealth legislation.

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1. Introduction

1.1 Proposal identification

In 2020 the Stockton Coastal Management Program (CMP) was adopted by the City of Newcastle (CN). That program identified that beach erosion at Stockton has had a devastating effect on the local community. Targeted analysis from a sediment transport study showed that the ongoing sand loss rate within the Stockton CMP area is approximately 146,000m^3 per year which is likely to increase with time.

Stockton Beach is of high intrinsic value to the Stockton and Newcastle community, and visitors, who have a strong desire to preserve and protect its natural environment and character whilst responding to a changing climate. The Stockton CMP was developed in partnership with the local community and is the culmination of more than a decade of community engagement to ensure that the management actions proposed in the CMP to restore beach amenity and protect coastal assets, meet community expectations.

Mass sand nourishment has been identified as the only technically feasible solution that sustainably meets CN's and the community's objectives of asset protection and beach amenity over the long term. Mass nourishment, with on-going sand renourishment, would provide adequate coastal protection to eliminate the need for coastal protection structures beyond the immediate term. The nourishment volume required to achieve coastal protection objectives was estimated to be 2.4 million m^3 of sand.

Sand will be placed along the southern end of Stockton Beach which is located on a sand peninsula immediately north of one of NSW's largest coastal rivers, the Hunter River (see Figure 1). Stockton Beach is Worimi country.

This Review of Environmental Factors (REF) has been prepared in order to provide information on all potential matters arising from the proposed placement of sand as beach nourishment which affect, or are likely to affect, the environment.

1.2 Scope of this REF

The Proposal is described in more detail in Chapter 3 of this REF. An overview of the scope of this REF is:

- Sand placements at Stockton Beach for the purpose of beach nourishment as per *Sand placement concept design* (Appendix A) and further described in Section 3. The sand placement approvals are intended to provide the basis for receiving suitable nourishment sand from a range of sources and/or exercises.
- It does not include the sourcing of the sand (e.g., by dredging) used for beach nourishment. The potential environmental impacts of any dredging (or other sand sourcing activity) will be undertaken separately by the dredging or nourishment proponents when potential sources are identified.
- Under this Proposal, the compatibility of the material placed as beach nourishment is to comply with the *Stockton Beach Sand Management Guidelines* (RHDHV, 2020).
- Terrestrial sand supply and placement by trucks is excluded from this Proposal.
- The sand placement area, as shown in Figure 1, forms the basis for the environmental assessments presented herein except for the Aboriginal Cultural Heritage Assessment (ACHA). ACHA results exclude approximately 400m of northern part of the sand placement area. The area adopted by the ACHA is shown in Figure 1.1 to 1.3 in Appendix C and this REF therefore covers

this smaller area. An extended ACHA is currently being undertaken and an addendum to this REF will be sort to cover the sand placement area shown in Figure 1.

Figure 1: Map of the proposed nourishment area at Stockton Beach.

1.3 Land ownership

There are several owners and/ or managers of land along the Stockton foreshore and beach, as shown in Figure 2. The proposed sand nourishment area is predominately on Crown Land. The area shown in purple is Crown land managed by Council (CN). Land below the mean high-water mark to 3 nautical miles out to sea is Crown land. A Crown Land Licence or appointment as Crown Land Manager will be required prior to sand placement works on this land. CN will need to apply for Crown Land licence or request appointment as Crown Land Manager.

Figure 2: Land ownership.

1.4 Purpose of the report

This Review of Environmental Factors (REF) has been prepared by Bluecoast Consulting Engineers and Blue Sky Planning and Environment with the support of H20 Consulting Group, Cosmos Archaeology and McCardle Cultural Heritage, on behalf of City of Newcastle. For the purposes of the Proposal, City of Newcastle (CN) is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of this REF is to describe the Proposal, to document the likely impacts of the Proposal on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposed works and assessment of associated environmental impacts has been undertaken in the context of section 171 of the *Environmental Planning and Assessment Regulation 2021*, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (DUAP, 1995/1996), the *Biodiversity Conservation Act 2016 (BC Act)*, the *Fisheries Management Act 1994* (FM Act) and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In doing so, the REF helps to fulfil the requirements of Section 5.5 of the EP&A Act that CN examine and consider, to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the Proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act.
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in Section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report.
- The potential for the Proposal to significantly impact any matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian Government Department of Agriculture, Water and Environment for a decision by the commonwealth minister for the Environment on whether assessment and approval is required under the EPBC Act.

2. Need and options considered

2.1 Preamble

This chapter describes the need for the Proposal in terms of its strategic context and operational need. It identifies the various options considered and the selection of the preferred option for the Proposal.

2.2 Strategic need for the Proposal

In February 2020, following severe erosion, Stockton Beach was declared a Natural Disaster Zone.. The extent of the coastal erosion problem is reflected in the eroded beach state, community frustrations and escalating coastal management costs (see Figure 3). While typically triggered by storms, the underlying erosion problem is caused by a persistent net loss of sand from southern Stockton Beach. A Sand Movement Study (Bluecoast, 2020a) estimated that about 146,000m^3 (total) of sand is lost from Stockton Beach each year with only 34,000m^3 of sand placed annually to offset these on-going losses (Bluecoast, 2020a).

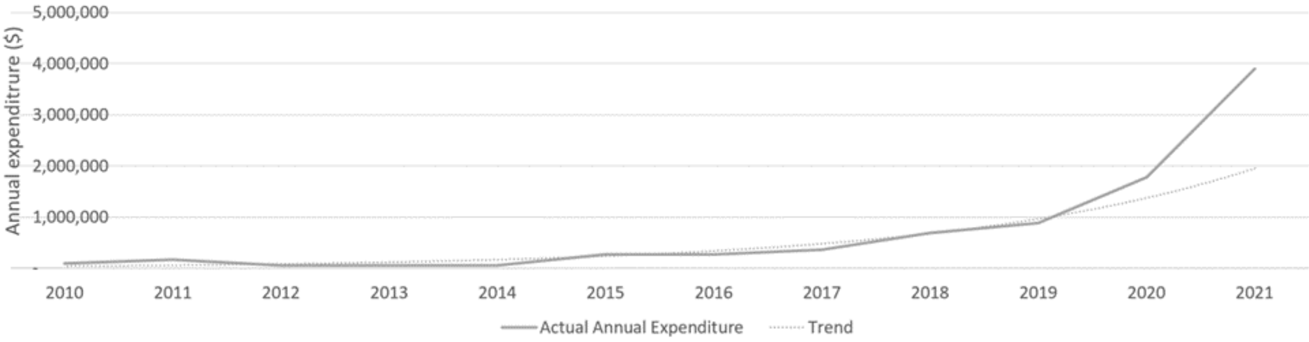

Figure 3: Last 11-years of annual expenditure on coastal management at Stockton Beach by CN (Source: Bluecoast).

In this context, a proactive whole of government approach is required to ensure that opportunities for additional sand placements at Stockton are realised. The certified Stockton CMP 2020 and the Extended Stockton CMP (nearing completion) both identify large scale (mass) sand nourishment as the preferred solution that sustainably meets CN and the community's objectives of asset protection and beach amenity for this area. The existing level of exposure to coastal hazards and mounting community pressure dictate the urgency of effective intervention.

2.3 Existing coastal protection measures

The ongoing coastal erosion of Stockton Beach observed since the construction of the training breakwaters on the Hunter River and artificial deepening of the entrance channel for deep-water shipping has required the implementation of a range of coastal protection measures. Figure 4 provides a timeline of the most notable human interventions at Stockton since the 1800s and a map of the coastal protections that are still in place at the time of writing this document.

A more complete list of the most recent coastal protections measures is provided hereafter:

- **1989** The rock revetment at Mitchell Street was constructed to protect shoreward assets and property for approximately 600m of shoreline.
- **1996** A geotextile sandbag wall was constructed in front of the Stockton Surf Life Saving Club (SSLSC) .

- **2005** Maintenance dredging of 153,000 cubic metres of sand from the harbour entrance areas using TSHD Brisbane with the sand dumped offshore (DHI, 2006).
- **2016** The rock revetment fronting the SSLSC clubhouse was constructed to replace the sandbag wall. This structure protects shoreward assets for approximately 145 m of shoreline in the southern Stockton embayment.
- **2019** A very large geotextile container seawall was built along approximately 100m length of shoreline to protect Hunter Water land from coastal erosion (see Figure 8).
- **2020** Cabins were removed from the caravan park due to beach erosion following a large wave event in February 2020 (see Figure 5). Emergency sandbagging and beach scraping was undertaken north of the SSLSC seawall in July 2020 in preparation for a second east coast low in late July 2020 (see illustrative photo in Figure 5)
- **2021** A rock-bag protection structure was constructed immediately north of Mitchell Street seawall, in front of Barrie Crescent Reserve, to replace emergency sand bagging which failed during an east coast low around the 15 July 2020 (see Figure 6). The structure covers a 210m section of coastline.
- **2021** Concrete tank traps, removed from the shoreline in October 2020, were relocated toward the front of Hunter Water's land along Fullerton Street as an interim protective measure until the dune restoration project is complete.
- **2009 – 2021** Newcastle Port Corporation (NPC) begin placing dredged clean sand of marine origin in the nearshore of Stockton Beach in 2009. This sand required dredging as part of their routine dredging operations to maintain the navigation channel. Due to the shorter sailing distance the practice offered operational and economic benefits to the port relative to disposal offshore.
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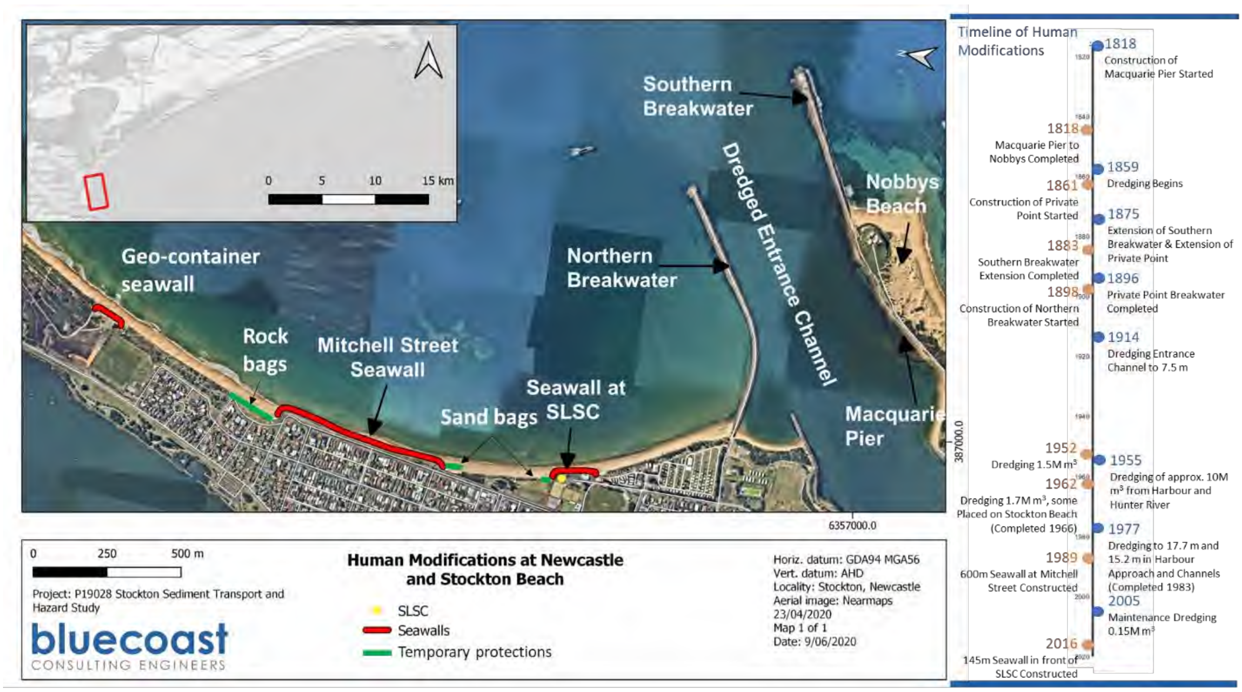

Figure 4: Map of existing coastal protections and timeline of notable human modifications at Stockton.

Figure 5: Cabins being removed from the caravan park due to beach erosion following a large wave event in February 2020 (source: M. Bardsley).

Figure 6: Erosion scarp and failing emergency coastal protection works at Griffith Ave (north of the Mitchell Street seawall) following an east coast low around the 15th July 2020 (source: CN).

Figure 7: Emergency coastal protection works underway north of SSLSC seawall in preparation for a second east coast low in late July 2020 (source: M. Bardsley).

Figure 8: Construction of sea wall in front of the Hunter Water site (Source: Newcastle Herald, 2019).

2.4 Proposal objectives and design criteria

2.4.1 Proposal vision and objectives

The objectives of the proposed nourishment are to:

1. restore the sandy buffer to provide an acceptable level of coastal protection and beach amenity
2. maintain the acceptable sandy buffer by restoring the natural sand supply.

Objective 1 is planned to be achieved by the delivery of mass nourishment while the regular and on-going sand top-ups maintain the buffer to achieve objective 2. Nourishment sand is to be sourced from outside the active coastal profile in the Stockton Bight sediment compartment.

2.4.2 Design criteria

To fully appreciate the dynamics of the beach system a 'sand movement study' of the entire Stockton Bight sediment compartment was completed in accordance with the NSW *Coastal Management Act 2016* (Bluecoast, 2020). The sand movement study estimated that about 146,000m^3 of sand is lost from Stockton Beach each year[1]. The main causal mechanism of the long-term erosion observed at Stockton Beach[2] is explained by:

1. The blockage of natural sand supply from the Hunter River entrance and further south due to the impact of the deep-water shipping channel (formed by the entrance training breakwater and artificially deepened channel) which represents a physical barrier to natural sand bypassing. The on-going dredging activities required to maintain the channel depths result in the cumulative extraction of large quantities of marine sand from the coastal sediment compartment; and

2. The natural net northward movement of sand that, under the action of waves, acts to move sand out of the southern embayment.

As a result, the erosion at Stockton has proceeded beyond an acceptable natural sandy buffer (i.e., the buffer does not provide an acceptable level of coastal protection or beach amenity).

2.5 Alternatives and options considered

2.5.1 Methodology

The overall methodology adopted during Stockton CMP 2021 to select the preferred management option for Stockton Beach is presented in Figure 9. The following sections detail the development and assessment process of the longlist and shortlist of management options and the preferred management option.

[1] On average sand, sourced from the port dredging activities, has been placed at a rate of 34,000m^3/yr, resulting in a net sand loss rate after port sand placements of 112,000m^3/yr (Bluecoast, 2020).
[2] Here Stockton Beach is taken to mean southern embayment from the breakwater to Fort Wallace and across the full coastal profile from the crest of the dune down to the closure depth for wave driven sand movements.

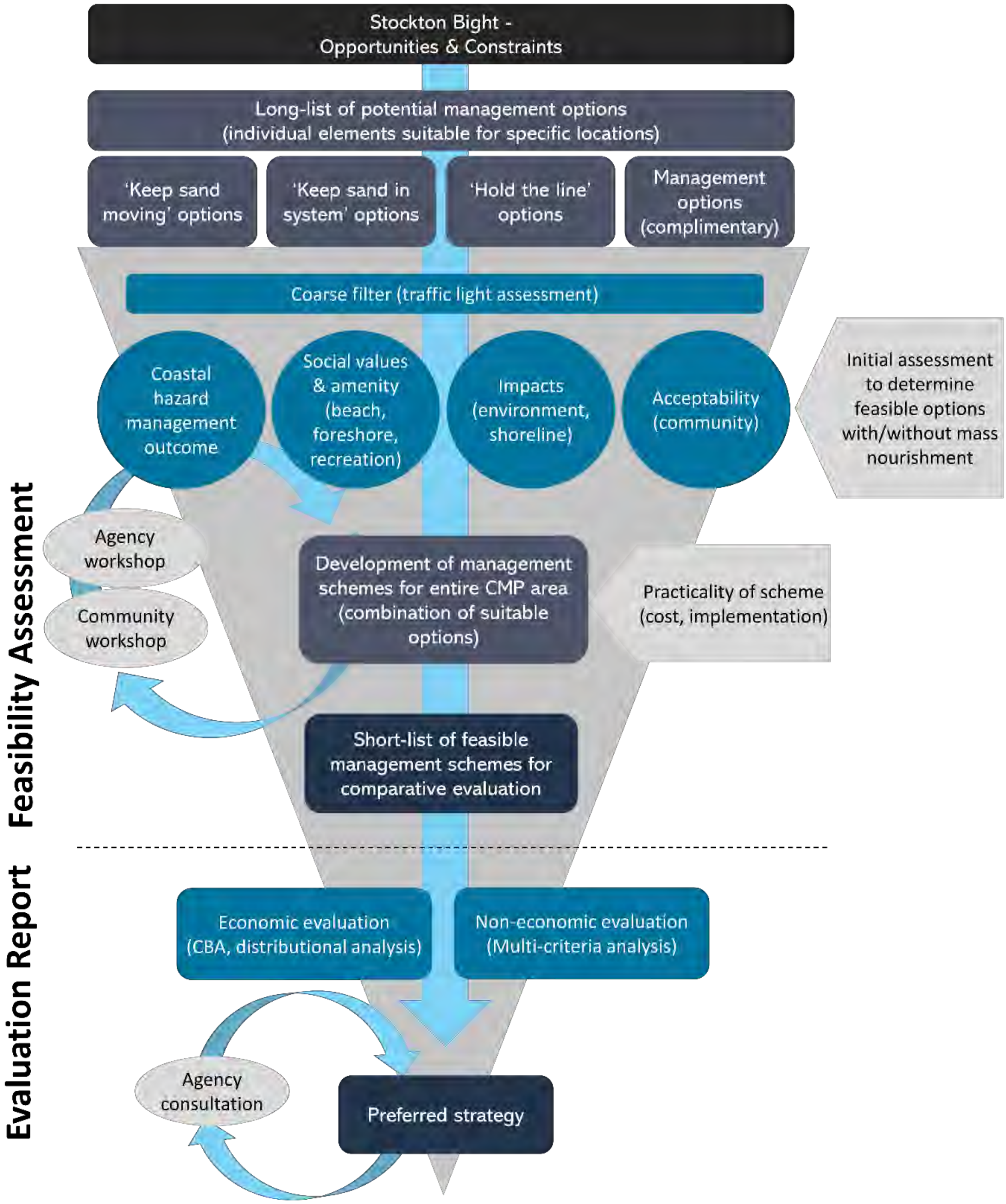

Figure 9: Overview of the methodology for selecting the preferred management option for Stockton Beach.

2.5.2 Longlist of potential management options

Potential management options were characterised under three key themes based on the way they address the main causal mechanism underlying Stockton's beach erosion problem. The three key themes for the coastal management solutions considered were:

- **'Keep sand moving'** – these solutions work by reinstating the natural supply of sand into the southern embayment. That is, they remove the causal mechanism number 1. Regular and on-going supply of sand to the management area will maintain the sandy buffer and when delivered in combination with mass nourishment the buffer will be maintained at acceptable levels. To maintain the sandy buffer the sand supply rate should match the northward outflow rate. No downdrift erosion impacts would be expected as these solutions are aimed at 'keeping sand moving' (i.e., they work with nature). Under this theme, the following options were considered:
    - Maintenance (ongoing) sand placement from external sources
    - Fixed sand bypass system
    - Modification/ removal of breakwater(s) and navigation channel
- **'Keep sand in the system'** – these solutions work by retaining sand in the management area by (locally) slowing down northward longshore sand transport rates. That is, they reduce or reverse causal mechanism number 2. The options to 'keep sand in the system' involve either shoreline control structures or sand back passing (i.e., recycling of sand in an updrift (southerly) direction). None of these options introduce new sand into the management unit and all the structural solutions will be required to be combined with mass nourishment. While these options have high capital costs, they would reduce the need for ongoing sand renourishment in the southern compartment. Due to the obstruction created in the northward flow of sand, these solutions would all have a downdrift impact (i.e., they would realign the northern shoreline landward to a degree). This downdrift impact would be reduced/eliminated if the southern compartment is filled and regularly topped up with enough sand to offset downdrift sand movements. Under this theme, the following options were considered:
    - Shore based control structures:
        - Groyne (groyne field and single groyne)
        - Artificial headland
    - Offshore control structures:
        - Offshore breakwater
        - Artificial reef
    - Sand backpassing
        - Sand pumping
        - Sand trucking
- **'Hold the line'** – these solutions do not address the causal mechanisms of sand loss in the management area. Instead, they act as a last line of defence against coastal erosion irrespective of sand movements. Without any extra supply, northward sand movements will continue to erode the sand seaward of the protection works until the sandy buffer is exhausted. If well designed the options will protect the sand and built assets landward of the structures from erosion. These options will also have downdrift impacts and ultimately shift the erosion problem further north. Under this scheme, the following options were considered:
    - Seawall/ revetment
    - Buried terminal revetment

- Lastly, a fourth management theme (i.e., **'complementary management'**) was considered which comprises options that are complementary to the above list and do not provide adequate benefits or are not feasible/acceptable on their own. Under this theme, the following options were considered:
  - Dune building/ stabilisation
  - Beach scraping (nature assisted beach enhancement)
  - Planned asset relocation (public assets)
  - Planned retreat (private assets)
  - Planning/ development controls
  - Buffer area

2.5.3 Option assessment

A coarse filter was applied to rule out the potential management options that were deemed not feasible. For this initial screening only mandatory assessment criteria were considered. The mandatory criteria are a sub-set of the full list of assessment criteria used in the multi-criteria assessment. The filter applied a traffic light type assessment where 'Go', 'Slow', 'Stop' were assigned 3, 2, 1 numeric point(s), respectively. The total score was calculated as the sum across the four mandatory criteria and was considered as follows:

- 'Stop' options were not progressed further. This was assigned if the total score across the four mandatory assessment criteria was below 8 points.
- 'Slow' options were not progressed to the preferred management schemes and would require additional investigation to understand if they are feasible/ acceptable. This was assigned if the total score was 8 points.
- 'Go' options were deemed feasible. This was assigned if the total score was above 8 points.

Based on the initial screening results, four medium- to long-term coastal management schemes were shortlisted for further development and analysis. An overview of these four shortlisted options is provided in Table 1.

Following refinement of the shortlisted options, an economic and multi-criteria assessment was carried out, including community and stakeholder consultation (Bluecoast, 2021. An overview of the results of the economic and non-economic evaluation of the four shortlisted coastal management schemes is provided in Table 2.

Table 1:Overview of CMP 2021 coastal management schemes.

Scheme	Theme	Description	Capital cost ($M)	Annualised maintenance cost ($M)
1. Mass nourishment with regular sand top-ups	*Keep sand moving*	Mass nourishment followed by annual sand placements equivalent to the annual long-term loss rate at Stockton.	21.40	0.55

Scheme	Theme	Description	Capital cost ($M)	Annualised maintenance cost ($M)
2. Mass nourishment and artificial headland	*Keep sand in the system*	Mass nourishment and the construction of a rock-armoured artificial headland to the north of the Stockton township.	35.23	0.46
3. Mass nourishment and artificial reef	*Keep sand in the system*	Mass nourishment and the construction of an artificial rock reef to the north of the Stockton township.	35.40	0.50
4. Mass nourishment and sand backpassing	*Keep sand in the system*	Mass nourishment and the construction of a sand backpassing system. Ongoing operation would recirculate sand back to the beach fronting the township.	26.10	1.00

Table 2: Overview of the economic and non-economic evaluation the coastal management schemes.

Coastal management scheme	Economic (BCR)	Non-economic (MCA score)
Scheme 1 – MN + Sand top-ups	3.3	2.7
Scheme 2 – MN + Artificial headland	1.8	2.0
Scheme 3 – MN + Artificial reef	2.0	2.4
Scheme 4 – MN + Backpassing	2.0	2.1

Note: MN – Mass nourishment, BCR – Benefit-cost ratio, MCA – Multi-criteria assessment

2.6 Preferred option

Following a process of engagement with relevant government agencies, a collective agreement was reached for the Scheme 1. This scheme adopts a 'keep sand moving' approach to restore the natural supply of sand to Stockton. It consists of a mass nourishment to restore the sandy buffer and regular and on-going sand top-ups to maintain the buffer. This scheme seeks to restore the natural supply of sand to the Stockton sediment compartment at a rate equivalent to the long-term net sand loss rate (estimated to be 146,000m^3/year). Sand would be sourced from outside the active coastal profile in the Stockton Bight sediment compartment (i.e., it would introduce new sand into the coastal system).

3. Description of the Proposal

3.1 Overview

This chapter describes the Proposal and provides a description of existing conditions, the design parameters, the nourishment methods and associated infrastructure and activities.

3.2 The Proposal

CN's adopted coastal management strategy, confirmed under the Extended Stockton CMP is 'Scheme 1: Mass nourishment on-going sand top-ups'. Scheme 1 involves mass nourishment to restore the sandy buffer and regular and on-going sand top-ups to maintain the buffer. Under the 'keep sand moving' approach (see Section 2.5.2), this scheme seeks to restore the natural supply of sand to the Stockton sediment compartment.

The sand placements would act to restore and maintain the volume of sand in the active coastal profile observed in the early 1990's. Given historical sand movements are reasonably well understood, there would be a high degree of confidence in the fate and longevity of the nourishment material. There would likely be some initial period of enhanced sand loss as the system adjusts to the mass nourishment. After which and assuming no material change in the wave climate, sand placed in the south would be expected to move northward at the natural transport rate, providing ongoing supply of sand to the northern CMP area.

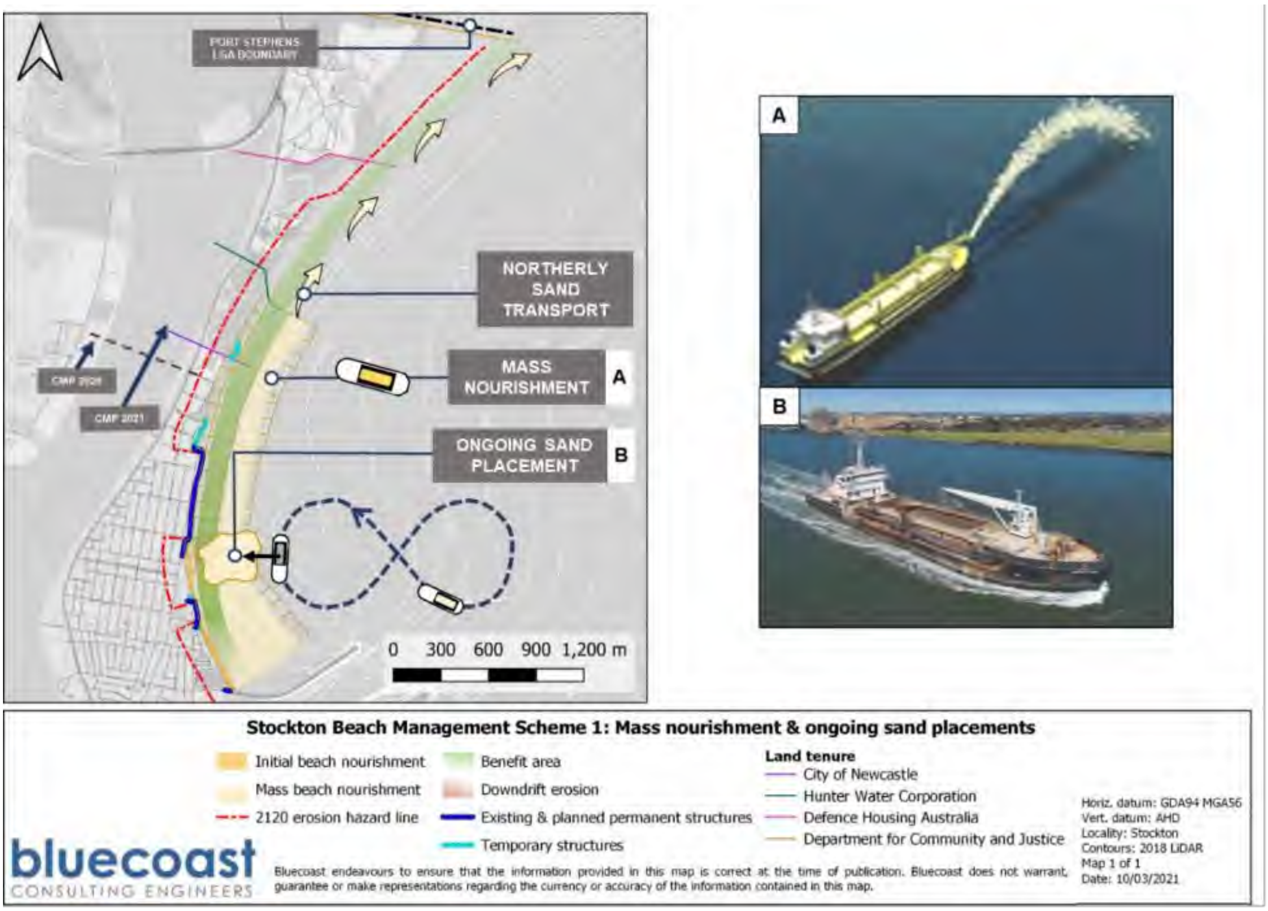

Figure 10: Key design features of Scheme 1.

3.3 Design

The concept design, included in Appendix A, would be further refined at the detailed design stage; however, all works will be undertaken within the same nourishment footprint. The key design features of the concept design are provided in Table 3. Figure 11 shows the location of the proposed mass nourishment. Figure 12 shows adopted pre- and post-nourishment coastal profile for Stockton Beach.

Table 3: Key design parameters for amenity nourishment concept sand placements.

Design parameter	Description
Mass nourishment volume	An initial mass nourishment of Stockton Beach of 2,400,000m^3 will be placed within the footprint shown in Figure 11. The 2.4Mm^3 quantity assumes the placed sand has an equivalent grain size distribution to the native beach sand. In line with the Stockton CMP, the target morphology for mass nourishment sand placements is guided by nature in that it is based on the coastal profile observed at Stockton in the 1990s, when the southern compartment had a greater volume of sand. The CMP states that in consideration of the average annual rate of sand loss (i.e., 146,000m^3/year), placement of 2.4M m^3 of sand to the southern compartment will revert the coastal profile back in time around 22 years. If 2020 is selected as the pre-nourishment beach, then around 1998 is representative of a post-nourishment beach.
Annual maintenance volume	Sand top-ups at a rate equivalent to the long-term sand loss rate at Stockton (estimated to be 146,000m^3) following the initial mass nourishment. Sand placements to top up the sand buffer would be undertaken on an approximately annual basis and in perpetuity (or until an alternative strategy is implemented). Sand top-up may come from a range of sources including suitable sediments from the Port of Newcastle’s maintenance dredging.
Alongshore extent	Sand placement over a 2,800m stretch of beach from the northern breakwater and up to a point 800m north of Meredith Street. The CMP identified this area as being most vulnerable to coastal hazards.
Cross shore extent	Full active coastal profile down to the depth of sand movements in moderate storm events, i.e., approximately -10m below AHD. Like the nourishment on the upper beach, the additional sand on the lower profile would provide a protective buffer against storm erosion.
Sediments	Clean marine sand is to be selected for beach nourishment. Sediments should be similar in grain size (or slightly coarser) and similar in colour to native beach material. The source material compatibility (i.e., contamination level and proportion of fines) needs to be assessed as per the current and relevant sand management guideline. Stockton Beach Sand Management Guideline (RHDHV, 2020) is the applicable guideline to assess compatibility.
Sources of sediments	Provided compliance with the Sand Management Guidelines (RHDHV, 2021), nourishment sand could come from a range of possible sources including: offshore, Hunter River or other opportunistic sources. Please refer to section 3.4.5. Terrestrial sand supply is excluded on cost and acceptability basis.
Placement methods	Placement of sand would essentially be undertaken by marine means, with exception temporary land-based structures/ machinery on the beach. The placement methods would depend on the volumes, sand source and the executing contractor work method. Mass nourishment requires the delivery of large volumes of material and favours full ‘profile nourishment’.

Design parameter	Description
	Placement methods may typically include one or several of the following methods: • Pumping ashore to nourish the visible beach, including spreading and reprofiling by earthmoving equipment on the beach • Rainbowing to nourish the surf zone • Bottom dumping to nourish the nearshore Placement by trucks is excluded on cost and acceptability basis.

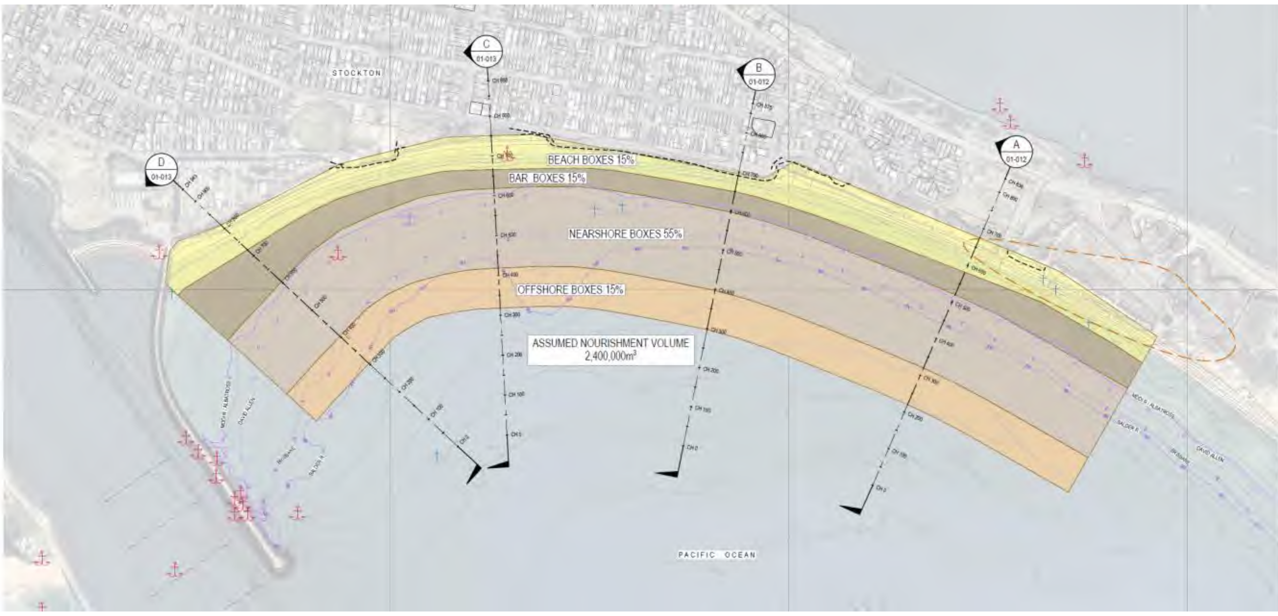

Figure 11: Location of the proposed mass nourishment (source: Bluecoast, 2022).

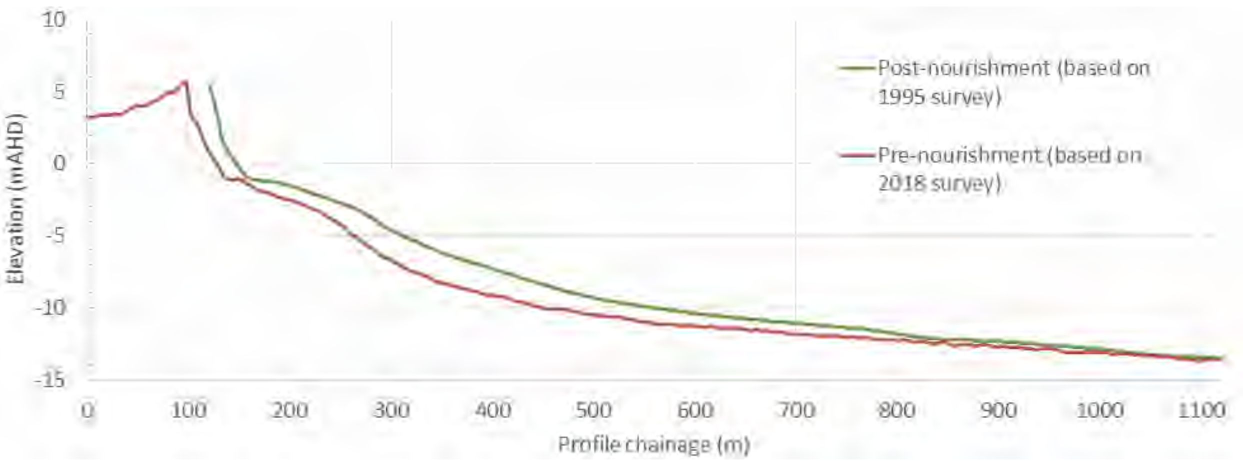

Figure 12: Adopted pre- and post-nourishment coastal profile for Stockton Beach (Bluecoast, 2022).

3.4 Construction activities

3.4.1 Work methodology

To achieve nourishment of the full coastal profile at Stockton Beach a combination of placement methods would be required. The exact work methodology would depend on the volumes, sand source, tidal and weather conditions, and the executing contractor work methods. Table 4 provides a summary of the ways sand may be placed for beach nourishment and the typical work methods that would be used to place material in each area of the of the coastal profile at Stockton Beach. A graphical conceptual overview is provided in Figure 13.

Table 4: Placement options for beach nourishment.

Placement option	Example
Pumping ashore to nourish the visible beach (see ‘C’ in Figure 13) Pumping sand ashore onto the visible beach aims to broaden the existing beach and the existing dune systems (if present/accessible). The process would likely involve also pumping sand into the surf zone using floating pipe outlets. For this project, a typical approach may consist of: • **Pump sand slurry directly from dredge up to approximately 1.5km. Sand could be pumped from either a TSHD or CSD across the northern breakwater at southern Stockton and/or across the peninsula at northern Stockton** • **Additional equipment (e.g., pipeline, earth moving equipment on the beach, floating pipe outlet, slurry booster pumps for pumping beyond 1.5km etc) would be required. Some sections of pipeline could be buried (if conditions allow) and kept in place for future nourishment campaigns.** • **Sand placement in surf zone via floating pipe outlets to enhance post-nourishment profile for improved (perceived) longevity and swimming / surfing amenity May cause disruption on beach usage during operations** • **May have temporary visual impact as pumping onto subaerial beach is less effective in washing out fines from source material. Limitation on fines content for subaerial placements are set out in Stockton Beach Sand Management Guideline to minimise the risk of this.**	  Pump ashore operations for large scale beach nourishment in the USA.

<table>
<tr><th>Placement option</th><th>Example</th></tr>
<tr><td>

Rainbowing to nourish the surf zone (see ‘A’ and ‘B’ in Figure 13)

Some TSHD’s have ‘rainbow’ capabilities. This involves a sand slurry being jetted from the bow with the vessel positioned bow-in as close to the shore as possible. The objective is to widen the visible beach by moving the wave breaking zone seaward. The “losses” occur slowly and in a manner more consistent with a natural beach. For Stockton, a typical approach may require:

- **TSHD’s to transport material to the site and rainbow**
- **smaller TSHD’s with reduced draft rainbowing directly onto subaerial beach**
- **rainbowing to the surf zone provides some washing out of fines/ mixing with native sediment prior to arriving on the visible beach**

</td><td>

A medium sized TSHD rainbowing on the Gold Coast (source: City of Gold Coast).

</td></tr>
<tr><td>

Bottom dumping to nourish the nearshore (see ‘A’ and ‘B’ in Figure 13)

Bottom dumping of nourishment material is suitable in the outer surf zone and nearshore area depending on vessel draft. After the dredge (or barge) has filled its hopper**,** it travels to the sand placement area and it either opens hopper doors located at the bottom of the vessel or splits its hull (split-hopper). Split hopper is generally preferred as it allows for shallower placements. Nearshore placement aims to emulate a natural storm bar formation. If a storm arrives soon after beach nourishment, wave breaking may be triggered and thereby help protect the coast. However, if no storm arrives, the waves will redistribute the sand onshore.

For Stockton, a typical approach may consider:

- **the method provides cost-efficient placement and cycle times**
- **smaller TSHD with reduced drafts can place material in outer surf zone**
- **placed material would be ‘washed’ and efficiently sorted by the natural coastal processes with source material mixing with native material and likely to be virtually undetectable at the visible beach**
- **where this technique has been used in other NSW locations the beach response has been positive and there are**

</td><td>

Split hopper TSHD, the David Allan, placing material at Stockton Beach in August 2018 (RHDHV, 2020; photo: Peter Cousins).

</td></tr>
</table>

Placement option	Example
additional recreational benefits if pattern placement is used	

Figure 13: Conceptual diagram of feasible placement methods for beach nourishment at Stockton Beach.

3.4.2 Work hours and duration

Final work hours and project duration would largely depend on the volumes, sand source, tidal and weather conditions, and the executing contractor work method. Where possible standard construction hours would be adhered to for land-based activities, for the purpose of maintaining the amenity of the location. A noise management plan would be required for any land-based activities undertaken outside of standard construction hours. Marine-based plant would typically be located at least 150m offshore and is therefore unlikely to cause a reduction in amenity and is not required to adhere to standard construction hours.

Table 5 represents estimated duration of beach nourishment works in weeks, subject to suitable weather conditions, for a range of placement methods and TSHD plants as well as varying sand placement volumes. The proposed offshore placement operations would typically take place 24 hours a day, 7 days a week when sand becomes available. As described in Table 5.

Table 5: Estimated duration of beach nourishment works in weeks.

Delivery quantity	Small TSHD			Medium TSHD		
	BD	RB	PA	BD	RB	PA
Amenity/sand top-up volumes						
100,000	0.7	0.9	1.1	0.5	0.7	0.8
350,000	2.5	3.2	3.9	1.8	2.4	2.6
500,000	3.6	4.5	5.6	2.5	3.5	3.8
Mass nourishment volumes						
1,000,000	7.2	9.0	11.3	5.1	7.0	7.5
1,500,000	10.7	13.5	16.9	7.6	10.5	11.3
2,000,000	14.3	18.0	22.5	10.1	13.9	15.1
2,400,000	17.2	21.6	27.0	12.2	16.7	18.1
4,000,000	28.6	36.0	45.1	20.3	27.9	30.2

Note: BD = bottom dumping, RD = rainbowing and PA = pump ashore.

3.4.3 Plant and equipment

Depending on the source material depth and location, the following type of dredge vessel and land-based plant may be used for sand placement operations at Stockton Beach:

Trailer Suction Hopper Dredge (TSHD)

- suitable for dredging and transporting material (within hopper)
- suitable for placement via pipeline, bottom dumping or rainbowing
- requires water depth greater than 6-8m for dredging operation
- can operate in conjunction with other vessel traffic without overly affecting each other

Cutter Suction Dredge (CSD)

- requires relatively sheltered location for operation
- requires the installation of a pipeline to transport and place material at destination (potentially across navigation channel)
- is a stationary dredger and can cause delays to for vessel traffic when dredging in a shipping channel

Backhoe Dredge (BHD)

- dredging depth is typically limited to 20 to 30m
- requires relatively sheltered location for operation

- typically requires support barges for transport of material
- is a stationary dredger which can cause delays for vessel traffic when dredging in a shipping channel

Others

- Barges to transport sand or temporary equipment
- Pump, slurry booster pumps and floating pipelines for pumping ashore options
- Earthmoving equipment (bulldozers, excavators, wheel loader, Moxy trucks) for some operations
- Temporary sheds, signage, and barriers, etc.

3.4.4 Earthworks

Because terrestrial sand sources and trucking of sand is excluded, sand placement will primarily be achieved via marine plant and a system of pumps/floating pipelines. Earthworks may be required on an "as needs" basis on the beach and would typically involve one or two vehicles at a time such as bulldozers and excavators for spreading and profiling sand as well wheel loaders for moving pipe sections around the beach. The equipment would also be used to set up the construction site at the start of the project and demobilisation.

3.4.5 Source and quantity of sediments

The total quantity of sediments for the mass nourishment is approximately 2.4 million m^3. It remains to be determined if this volume will be placed in a single exercise or multiple smaller operations.

The source of sand for nourishment of Stockton Beach is not selected at this stage. Provided that it complies with the Sand Management Guidelines (RHDHV, 2021), nourishment sand could come from a range of possible places: offshore, Hunter River or other opportunistic sources. Terrestrial sand supply is excluded on cost and acceptability basis. Various sand sources have been identified for nourishment at Stockton Beach and include:

- The largest and most physically accessible source is offshore sand from the Newcastle inner-shelf sand sheet.
- Harbour (or estuarine) sands from capital or maintenance dredging within the Port of Newcastle channels (including future capital dredging planned in the South Arm) as an alternative to sea disposal. This includes Area E and the North Arm, both of which are cost effective sources.

3.4.6 Traffic management and access

Road access

Beach access for land-based machinery is currently possible King Street breakwater as well as at Griffith Avenue north of the Barrie Crescent, as shown on the aerial images below.

For any sand placement exercise requiring sand placements and profiling in the beach boxes, earthmoving equipment will be required on the beach. This would typically consist of bulldozers, excavators, wheel loaders and moxie trucks. This equipment comes in a range of widths. The King Street breakwater is currently being upgraded. The design includes a 2.4m wide beach access ramp. This width is sufficient for small earthmoving equipment, but it will limit access for medium to larger sized equipment. For a mass nourishment campaign, or other large nourishments beach box placements, smaller equipment will reduce efficiencies and could result in greater costs. The other possible access off the northern end of Barrier Crescent would require the fencing and pedestrian access be removed to be suitable for access by earthmoving equipment.

Road vehicles will be limited in time and in number and will typically consist of several trucks transporting specialised earthmoving equipment (i.e., at the start and end of each campaign). Depending upon the methodology for each campaign, land-based vehicles and equipment may not be required at all.

Figure 14: Aerial view of possible access to Stockton Beach for construction vehicles.

Sea access

The southern section of Stockton Beach is relatively shallow, restricting the access of deep draft vessels. In most cases vessels will be likely to travel via the Port of Newcastle, however vessels will also have the option of access via the north and east (offshore).

3.5 Ancillary facilities

It is proposed to make two compound sites available for use during sand placement activities. These sites are the car parking area located near Little Beach and the open area near Dalby Oval. These are shown in the photographs below. The areas would be used for storage of machinery and equipment, sites offices and amenities and vehicle parking for workers.

The compound sites will remain open to the public when not in use but will be closed off for short periods when they are required for the proposed works. This will be intermittent and infrequent. Pedestrian and traffic controls will be in place during the use of the proposed compound sites, and the community will be notified in advance of the sites being used. Note that the actual area to be used for each campaign is unlikely to encompass the entirety of each space outlined below.

Figure 15: Aerial view of proposed compound sites.

4. Statutory planning framework

4.1 Preamble

This chapter provides the statutory and planning framework for the Proposal and considers the provisions of relevant acts, regulations, state environmental planning policies and the local environmental plan.

4.2 Relevant Acts and Regulations

4.2.1 Environmental Planning and Assessment Act 1979

The objects of this Act are as follows:

a. *to promote the social and economic welfare of the community and a better environment by the proper management, development, and conservation of the State's natural and other resources,*

b. *to facilitate ecologically sustainable development by integrating relevant economic, environmental, and social considerations in decision-making about environmental planning and assessment,*

c. *to promote the orderly and economic use and development of land,*

d. *to promote the delivery and maintenance of affordable housing,*

e. *to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities, and their habitats,*

f. *to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage),*

g. *to promote good design and amenity of the built environment,*

h. *to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants,*

i. *to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State,*

j. *to provide increased opportunity for community participation in environmental planning and assessment.*

The Proposal is consistent with the objects of the Act as it promotes the social and economic welfare of the community by ensuring that Stockton Beach is available as a community space for public recreation. It promotes a better environment through the proper management of a natural resource (dredged sand) and protects the natural environment through the implementation of safeguards.

Part 5 – Infrastructure and environmental impact assessment

Subdivision 2 Duty of determining authorities to consider environmental impact of activities

Clause 5.5(1) of the Act requires that a determining authority in its consideration of an activity shall fully consider possible all matters affecting or likely to affect the environment by reason of that activity. This REF fulfills that requirement.

4.2.2 Environmental Planning and Assessment Regulation 2021

Clause 171 of the Regulations requires the determining authority to consider several environmental factors when considering the likely impact of an activity on the environment. This REF considers those factors in detail and Appendix B provides a summary of how the Proposal complies with the Regulations.

4.2.3 Coastal Management Act 2016

The objects of the Coastal Management Act (CM Act) are to '*manage the coastal environment of New South Wales in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the State, and in particular*:

a. *to protect and enhance natural coastal processes and coastal environmental values including natural character, scenic value, biological diversity and ecosystem integrity and resilience, and*

b. *to support the social and cultural values of the coastal zone and maintain public access, amenity, use and safety, and*

c. *to acknowledge Aboriginal peoples' spiritual, social, customary and economic use of the coastal zone, and*

d. *to recognise the coastal zone as a vital economic zone and to support sustainable coastal economies, and*

e. *to facilitate ecologically sustainable development in the coastal zone and promote sustainable land use planning decision-making, and*

f. *to mitigate current and future risks from coastal hazards, taking into account the effects of climate change, and*

g. *to recognise that the local and regional scale effects of coastal processes, and the inherently ambulatory and dynamic nature of the shoreline, may result in the loss of coastal land to the sea (including estuaries and other arms of the sea), and to manage coastal use and development accordingly, and*

h. *to promote integrated and co-ordinated coastal planning, management and reporting, and*

i. *to encourage and promote plans and strategies to improve the resilience of coastal assets to the impacts of an uncertain climate future including impacts of extreme storm events, and*

j. *to ensure co-ordination of the policies and activities of government and public authorities relating to the coastal zone and to facilitate the proper integration of their management activities, and*

k. *to support public participation in coastal management and planning and greater public awareness, education and understanding of coastal processes and management actions, and*

l. *to facilitate the identification of land in the coastal zone for acquisition by public or local authorities to promote the protection, enhancement, maintenance and restoration of the environment of the coastal zone, and*

m. *to support the objects of the Marine Estate Management Act 2014.'*

The proposed works are in the coastal zone, as defined by the CM Act 2016. The proposed works are consistent with the objects of the CM Act 2016 as they contribute to maintaining the coastal zone as a vital economic zone and to supporting a sustainable coastal economy by mitigating the impacts and risks of coastal hazards.

Part 3 of the CM Act 2016 applies to any public authority that exercises functions in connection with the coastal zone. Division 4 Clause 22 states:

(1) A local council is to give effect to its coastal management program and, in doing so, is to have regard to the objects of this Act.

A Coastal Management Program (City of Newcastle, 2020) has been prepared for Stockton and was adopted by Council on 17 June 2020. The Proposal is consistent with that Program.

4.2.4 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims *'to conserve, develop and share the fishery resources of the State for the benefit of present and future generations and to*:

- conserve fish stocks and key fish habitats, and
- conserve threatened species, populations and ecological communities of fish and marine vegetation, and
- promote ecologically sustainable development, including the conservation of biological diversity, and
- promote viable commercial fishing and aquaculture industries, and
- promote quality recreational fishing opportunities, and
- appropriately share fisheries resources between the users of those resources, and
- provide social and economic benefits for the wider community of New South Wales.

To meet these objectives, Part 7 of the FM Act outlines legislative provisions to protect fish habitat and Part 7A outlines provisions to conserve threatened species of fish and marine vegetation and their habitat.

An assessment of the potential impacts of the Proposal on marine ecology is included at Appendix E. The assessment concludes that the Proposal is unlikely to have a significant impact on any threatened species, marine vegetation, or habitat provided that the recommended safeguards and management measures are implemented during the proposed works.

Under Section 205 of the FM Act, a permit is required to harm (cut, remove, damage, destroy, shade, etc.,) marine vegetation including saltmarshes, mangroves, seagrass, and seaweeds. The Proposal is unlikely to involve any harm to marine vegetation and a Section 205 permit will not be needed for the Proposal.

4.2.5 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) and its supporting regulations set out the environmental impact assessment framework for threatened species, threatened ecological communities and Areas of Outstanding Biodiversity Value (formerly critical habitat) for Division 5.1 activities (amongst other types of development).

Under the BC Act, an assessment of significance must be completed to determine the significance of potential impacts to threatened species, populations and/or communities or their habitat. The preparation of a Species Impact Statement (SIS) based on the provisions of the BC and FM Act is not required for this Proposal.

The assessment of potential biodiversity impacts because of the Proposal is described in Chapter 6 of this REF and in detail at Appendix E.

4.2.6 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) focuses on environmental protection and provisions for the reduction of water, noise and air pollution and the storage, treatment, and disposal of waste. The POEO Act introduces licensing provisions for scheduled activities that are of a nature and scale that have a potential to cause environmental pollution. It also includes measures to limit pollution and manage waste. This Act is administered by the NSW Environment Protection Authority (EPA) who were consulted as part of this REF.

Schedule 1 Clause 39 of the POEO Act lists waste disposal (application to land) as a scheduled activity. Subclause (2)(e) states that this Clause does not apply to sites where only virgin excavated natural material (VENM) is received from off site and applied to land.

The POEO Act defines virgin excavated natural material (VENM) as *'natural material (such as clay, gravel, sand, soil or rock fines):*

n. that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities, and

o. that does not contain any sulfidic ores or soils or any other waste, and

p. includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved for the time being pursuant to an EPA Gazettal notice.'

The characteristics of the nourishment sand in relation to fines content, contamination and waste classification would conform with the Stockton Sand Management Guidelines (RHDHV, 2020). The Proposal includes only deposition of VENM on to Stockton Beach. A beach nourishment project does not require an Environment Protection Licence (EPL) under the POEO Act because it's not a scheduled activity under the Act. However, CN may voluntarily apply for an EPL as a non-scheduled activity to regulate water pollution and to provide a defence against accidental pollution of waters as a precaution. The EPA may not issue an EPL if they believe there's a low risk of pollution. In the case of the proposed project, monitoring, controls and thresholds would be in place to ensure that there will be only a low likelihood of water pollution occurring.

If the controls set out in the relevant guidelines and quality assurance specifications, and additional controls detailed in Chapter 6, are implemented, and monitored, there is unlikely to be any material water, noise, or air pollution impact.

4.2.7 Marine Safety Act 1998 and Marine Safety Regulation 2016

The objects of the *Marine Safety Act 1998* are:

> *(a) to ensure the safe operation of vessels in ports and other waterways,*
>
> *(b) to promote the responsible operation of vessels in those waters so as to protect the safety and amenity of other users of those waters and the amenity of occupiers of adjoining land,*
>
> *(b1) to provide an effective framework for the enforcement of marine legislation,*
>
> *(c) to provide for the investigation of marine accidents and for appropriate action following any such investigation,*
>
> *(d) to consolidate marine safety legislation.*

Consultation was undertaken with the NSW Maritime Operations and Compliance Unit to determine the potential impacts of the Proposal on the safety of maritime navigation and their recommendations have been included in Part 6 of this REF. The Proposal meets the objects of the *Marine Safety Act 1998*.

Under Section 18 of the *Marine Safety Act 1998*, the Proposal is an aquatic activity as it would be undertaken on navigable waters and would temporarily restrict the availability of those waters for normal use by the public.

As such, Section 97(1) of the *Marine Safety Regulation 2016* would require the work to be subject to an aquatic licence issued by Roads and Maritime.

4.2.8 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the protection of Aboriginal heritage values, national parks and ecological values. The Act makes it an offence to harm Aboriginal objects, places or sites without approval. An Aboriginal heritage Permit (AHIP) will not be needed for the Proposal as the proposal itself, when the southern area assessed in the ACHA is considered, is not expected to disturb any known items. If any sites are discovered during works, works at that location will cease and National Parks and Wildlife services contacted to ensure the appropriate management of these sites.

4.2.9 Heritage Act 1977

The *Heritage Act 1977* provides for the protection or conservation of buildings, works, maritime heritage (wrecks), archaeological relics and places of heritage value through their listing on various State and local registers. The Act makes it an offence to harm any non-Aboriginal heritage values without approval. The Historic Heritage Assessment at Appendix D demonstrates that the Proposal would have no significant impacts on any item of local, State or Commonwealth heritage value.

4.2.10 Marine Pollution Act 2012

The Marine Pollution Act 2012 sets out provisions to prevent pollution in the marine environment.

The Proposal is unlikely to result in any oil, noxious liquid, pollutant, sewage, or garbage discharge as controlled under this Act, provided that standard controls are implemented and monitored as described in Chapter 6.

4.2.11 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Australian Government for proposed 'actions that have the potential to significantly impact on matters of national environmental significance (MNES) or the environment of Commonwealth land'. These are considered in Appendix E and in chapter 6 of this REF.

The assessment of the Proposal's impact on MNES and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant matters or on Commonwealth land. Accordingly, the Proposal has not been referred to the Australian Government Department of Agriculture, Water and Environment under the EPBC Act.

4.2.12 Crown Land Management Act 2016

The Crown Land Management (CLM) Act 2016 provides for the ownership, use and management of Crown land of NSW. Under Section 2.18 and Division 5.6 of the CLM Act the Minister may grant a licence authorising the use or occupation of Crown land for any purpose that the Minister thinks fit.

It is anticipated that CN will apply for a long-term licence over the Crown land outside of the area it currently manages, to allow the Proposal to proceed. This would be the area of the proposed works below the mean high water mark.

Section 1.3 outlines the objects of the CLM Act:

> *(a) to provide for the ownership, use and management of the Crown land of New South Wales, and*
>
> *(b) to provide clarity concerning the law applicable to Crown land, and*
>
> *(c) to require environmental, social, cultural heritage and economic considerations to be taken into account in decision-making about Crown land, and*
>
> *(d) to provide for the consistent, efficient, fair and transparent management of Crown land for the benefit of the people of New South Wales, and*
>
> *(e) to facilitate the use of Crown land by the Aboriginal people of New South Wales because of the spiritual, social, cultural and economic importance of land to Aboriginal people and, where appropriate, to enable the co-management of dedicated or reserved Crown land, and*
>
> *(f) to provide for the management of Crown land having regard to the principles of Crown land management.*

The Proposal is consistent with the objects of the CLM Act as this REF has taken into consideration the environmental, social, cultural heritage and economic considerations of the use of Crown land for the proposed beach nourishment. It also provides for the management of Crown land in accordance with section 1.4 of the CLM Act which sets out the principles of Crown land management as addressed below:

> *(a) that environmental protection principles be observed in relation to the management and administration of Crown land, and*
>
> *(b) that the natural resources of Crown land (including water, soil, flora, fauna and scenic quality) be conserved wherever possible, and*
>
> *(c) that public use and enjoyment of appropriate Crown land be encouraged, and*
>
> *(d) that, where appropriate, multiple use of Crown land be encouraged, and*
>
> *(e) that, where appropriate, Crown land should be used and managed in such a way that both the land and its resources are sustained in perpetuity, and*

(f) that Crown land be occupied, used, sold, leased, licensed or otherwise dealt with in the best interests of the State consistent with the above principles.

The Proposal seeks to re-instate areas of important public space in such a way that both the land and its resources are sustained in perpetuity.

4.3 State Environmental Planning Policies

4.3.1 State Environmental Planning Policy (Transport and Infrastructure) 2021

This SEPP aims to facilitate the effective delivery of infrastructure across the State.

Chapter 2 – Infrastructure

Division 25 Waterway or foreshore management activities

Clause 2.164 of the SEPP permits development for the purpose of waterway or foreshore management activities to be carried out on any land by or on behalf of a public authority without consent.

Waterway or foreshore management activities are defined in the SEPP to include "*coastal management and beach nourishment, including erosion control, dune or foreshore stabilisation works".*

As the Proposal is for the purpose of coastal management and beach nourishment to address the impacts of coastal erosion and is to be carried out by or behalf of a Council, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* and development consent is not required.

The Proposal does not trigger an approval or development consent under *State Environmental Planning Policy (Resilience and Hazards) 2021* or *State Environmental Planning Policy (Planning Systems) 2021*.

Part 2.2 of the SEPP contains the provisions for consultation with public authorities prior to the commencement of certain types of development. Formal consultation under this SEPP is not triggered by the Proposal, however relevant agencies and authorities have been consulted for the preparation of this REF. The consultation responses are addressed in Appendix H.

Chapter 5 – Three ports – Port Botany, Port Kembla, and Newcastle

Clause 5.16 allows development for the purpose of environmental protection works to be carried out by or on behalf of a public authority without consent.

4.3.2 State Environmental Planning Policy (Resilience and Hazards) 2021

Chapter 2 – Coastal Management

The aim of this Chapter is to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the *Coastal Management Act 2016*, including the management objectives for each coastal management area.

Stockton Beach is in the NSW Coastal Zone and is mapped as both Coastal Environmental Area and Coastal Use Area. Although development consent is not required for the Proposal, the development controls for those areas are considered below.

Part 2.2 Development controls for coastal management areas

2.10 Development on land within the coastal environment area

Consideration / Control	Comment
(a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,	The integrity and resilience of the environment in the area is relatively low due to severe coastal recession. The Proposal would improve the integrity and resilience of the environment.
(b) coastal environmental values and natural coastal processes,	The Proposal would improve the value of the coastal environment in Stockton and mitigate the impacts of coastal processes.
(c) the water quality of the marine estate	Controls are proposed to protect water quality during works. The site is not located within a catchment area that feeds into a sensitive coastal lake. Although localised turbidity is likely during placement, it will be minor and temporary and no long-term adverse impacts are likely.
(d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands, and rock platforms,	There is minimal marine vegetation within the development footprint. The development may have a long-term positive impact on any marine vegetation, native vegetation, fauna habitat or undeveloped headlands and rock platforms.
(e) existing public open space and safe access to and along the foreshore, beach, headland, or rock platform for members of the public, including persons with a disability,	The Proposal would improve the safety and accessibility of the public coastal environment.
(f) Aboriginal cultural heritage, practices, and places,	Measures are proposed to protect the Aboriginal cultural heritage associated with the site.
(g) the use of the surf zone.	The Proposal would temporarily affect the surf zone whilst works are undertaken.

2.11 Development on land within the coastal use area

Consideration / Control	Comment
(i) existing, safe access to and along the foreshore, beach, headland, or rock platform for members of the public, including persons with a disability,	The Proposal would improve the safety and accessibility within the study area.
(ii) overshadowing, wind funnelling and the loss of views from public places to foreshores,	The Proposal would not result in any overshadowing, wind funnelling or the loss of views from public places to any foreshore.
(iii) the visual amenity and scenic qualities of the coast, including coastal headlands,	The Proposal would have a long term beneficial impact on the visual amenity and scenic quality of the Stockton coastline.

Consideration / Control	Comment
(iv) Aboriginal cultural heritage, practices, **and places,**	Addressed in previous table.
(v) cultural and built environment heritage,	The Proposal would have a long term benefit on the cultural and built environment heritage.

Stockton Beach is also subject to coastal erosion hazards. Although the Coastal Vulnerability Area is not yet mapped for the NSW Coastal Zone at Stockton Beach, the following considerations apply to the area:

2.9 Development on land within the coastal vulnerability area

Consideration / Control	Comment
(i) the proposed development is not likely to alter coastal processes to the detriment of the natural environment or other land,	The Proposal would mitigate the impacts of coastal process on the environment of the area.
(ii) the proposed development is not likely to reduce the public amenity, access to and use of any beach, foreshore, rock platform or headland adjacent to the proposed development,	The Proposal improve the public amenity, safety and accessibility within the study area.
(iii) the proposed development incorporates appropriate measures to manage risk to life and public safety from coastal hazards	The Proposal would have a long term beneficial impact on the safety of the coastline. The existing coastal environment of the area presents a risk to safety.

The Proposal is being undertaken to manage and respond to existing and future coastal processes and hazards.

Part 2.3 Miscellaneous

Clause 2.16(2) of the SEPP permits development for the purpose of coastal protection works to be carried out on land to which Chapter 2 applies by or on behalf of a public authority:

(a) without development consent—if the coastal protection works are:

(i) identified in the relevant certified coastal management program, or

(ii) beach nourishment,

Section 4(1) of the Coastal Management Act 2016 defines coastal protection works to mean:

(a) beach nourishment activities or works,

The Proposal falls within the definition of coastal protection works, as defined by the *Coastal Management Act 2016* and is therefore permitted without consent.

4.4 Local Environmental Plan

Newcastle Local Environmental Plan (LEP) 2012

The Proposal is in the RE1 Public Recreation zone. The objectives of the zone are:

- To enable land to be used for public open space or recreational purposes.
- To provide a range of recreational settings and activities and compatible land uses.
- To protect and enhance the natural environment for recreational purposes.

The Proposal is consistent with the objectives of the zone as it will protect and enhance Stockton Beach and foreshore for recreational purposes.

The Proposal is permissible without development consent pursuant to the Transport and Infrastructure SEPP. Therefore, the consent requirements of the LEP do not apply and the Proposal may be determined under Division 5.1 of the EP&A Act.

4.5 Confirmation of statutory position

As the Proposal is for the purpose of foreshore management activities and is to be carried out on behalf of a public authority (Council), it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* and development consent is not required.

The Proposal does not require a referral to the Australian Government under the EPBC Act.

This REF fulfils CN’s obligation under Section 5.5 of the EP&A Act to examine and fully consider possible all matters affecting or likely to affect the environment by reason of the activity.

5. Consultation

5.1 Preamble

This chapter discusses the consultation undertaken to date for the Proposal and the consultation proposed for the future.

5.2 Community involvement

Stakeholder and community consultation regarding the management of the Stockton coastal zone has been ongoing for over a decade. A summary of the key consultation undertaken to date are provided in Table 6.

Table 6: Summary of consultation activities.

Year	Consultation Activities
2008	Community workshop on the Stockton Coastline Management Study
2014	Consultation with the Newcastle Coastal Technical Working Group on the Newcastle Coastal Zone Hazards Study (BMT WBM, 2014(a)) and the Newcastle Coastal Zone Management Study (BMT WBM, 2014(b)
2016	Community workshops during the preparation of the Newcastle Coastal Zone Management Plan. Public exhibition of the Newcastle Coastal Zone Management Plan.

Year	Consultation Activities
2018	Town hall meeting at Stockton RSL Club venue attended by more than 200 people. Formation of the Stockton Inter-agency Advisory Committee. Public exhibition of Newcastle Coastal Zone Management Plan – Part A Stockton.
2018 - 2020	Formation of Stockton Community Liaison Group and subsequent focus groups – meetings held on an ongoing and regular basis. Formation of the Newcastle Coastal Planning Working Group Town hall meeting and drop-in session at Stockton RSL Club venue. Public exhibition of the draft Stockton CMP was delivered between 13 May 2020 - 10 June 2020. Copies of the draft Stockton CMP were distributed to members of the Stockton Community Liaison Group, accessed via postal requests for hard copies, websites downloads and via local bowling club.
2020 - 2022	Targeted community and stakeholder consultation by CN as part of the Extended Stockton CMP. Worimi LALC discussions held in February 2021. Community and stakeholder workshops held in January and February and community (online) survey of the four Extended CMP management schemes in April and May 2021.

Stockton Community Liaison Group: The Stockton Community Liaison Group (CLG) was formed by the Lord Mayor in February 2018. It consists of a group of leading locals that joined together to share community views and knowledge of local issues with CN and seek a long-term solution to erosion at Stockton Beach. Other NSW Government representatives have attended CLG meetings on an invitational basis.

The CLG has been meeting frequently since 2018 and continues to meet regularly and advise CN during development of the Extended Stockton CMP. Stockton community representatives of the CLG, including representatives from Worimi Local Aboriginal Land Council, provide an information network between CN and the Stockton community to better understand the concerns of the community and provide meaningful feedback towards the development of long-term management solutions to the erosion at Stockton Beach.

Newcastle Coastal Planning Working Group: The Newcastle Coastal Planning Working Group (NCPWG) was formed in 2019 to provide strategic guidance to the preparation of the Newcastle Coastal Management Program (Newcastle CMP). The NCPWG comprises members from key government and community stakeholders.

5.3 Government agency and stakeholder involvement

In line with CM Act (2016) statutory provisions, consultation has been ongoing with key agency stakeholders throughout the development of the CZMP (2018), the 2020 Stockton CMP and Extended Stockton CMP. This has included ongoing consultation with Port Stephens Council in relation to the management of the Stockton Bight Sediment compartment. Additional agencies were consulted in relation to the development of Stockton Coastal Zone Emergency Action Subplan (SCZEAS) 2020 through the Local Emergency Management Committee (LEMC).

Formal consultation has been undertaken with various government agencies and stakeholders for this REF including:

- NSW Department of Planning and Environment - Crown Lands Coastal Unit
- NSW Department of Communities and Justice - Infrastructure and Assets
- NSW Department of Primary Industries - Fisheries
- NSW Environment Protection Authority
- NSW Department of Premier and Cabinet - Specialist Services Team (Heritage)
- NTSCorp (Native Title Service Provider)
- Port of Newcastle
- Port Stephens Council
- Transport for NSW - Waterways Operations
- Worimi Local Aboriginal Land Council
- Port Authority of NSW
- Hunter and Central Coast Development Corporation
- Department of Planning and Environment - Biodiversity Conservation Division
- NSW National Parks and Wildlife Service
- Department of Regional NSW
- Defence Housing Australia
- Hunter Water

Issues that have been raised because of consultation with these agencies and stakeholders are included in Appendix H.

5.4 Ongoing or future consultation

The Stockton CLG and NCPWG and Worimi Land Council/Registered Aboriginal Parties will continue to be actively involved as the project evolves. It is intended to publicly exhibit the Extended Stockton CMP in early 2023, where the community will once again comment on the program and the proposed actions.

6. Environmental assessment

6.1 Introduction

This chapter of the REF provides a detailed description of the potential environmental impacts of the Proposal. All aspects of the environment potentially impacted upon by the Proposal are considered. This includes consideration of the factors specified in the guidelines *Is an EIS required?* (DUAP, 1995/1996) as required under clause 171(1) of the *Environmental Planning and Assessment Regulation 2021*. The factors specified in clause 171(2) of the *Environmental Planning and Assessment Regulation 2021* are also considered in Appendix B.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts and will be applied when relevant works are occurring.

6.2 Coastal processes

6.2.1 Methodology

Impacts of sand placement operations on coastal processes may include:

- changes in beach sediments in terms of grain size, colour, and composition. If the source sand (or borrow material) does not closely match the grain size of the native beach material, changes to the beach profile and rate of sand movements can occur. For example, if a smaller grain size is used erosion occurs at a faster rate than the native beach sands, the beach profile also tends to be flatter. The colour and composition of the borrow material is important to the post-nourishment appearance of the beach, potentially effecting public perception of the works, recreational amenity and tourism value.
- change to the local beach profile and/or hydrodynamics resulting from wave and currents interaction with the newly nourished seabed profiles (i.e., breaking point shifted further offshore), and
- change to sediment transport patterns which could ultimately lead to a variation in erosion and accretion that are usually observed along the coast (i.e., accretion decrease in the north).

The impact of the sand placement operations on coastal processes was assessed by comparing the present and post coastal dynamics. This was carried out using a conceptual sand movement model, and outputs of the numerical wave and morphological models developed Stockton CMP and further refined during the concept design of Stockton Beach nourishment for the Hunter and Central Coast Development Corporation (Bluecoast, 2022).

The assessment included the following tasks:

- Review of characteristics of the native beach sand and nourishment sand in terms of grading characteristics and density.
- Review of pre- and post-nourishment beach profiles and their potential effect on local hydrodynamics (wave patterns).
- Analysis of water depth following sand placement in comparison with the degree of natural seabed variability and historic envelope.
- Migration pathway of newly placed sand sediments (fines and sand) and potential change in sediment infilling of shipping channel.

6.2.2 Existing environment

A summary of key coastal processes is provided below:

- **Variable wave climate:** The Stockton Bight is exposed to a variable wave climate which can be characterised by:
  - Summers with lower energy waves (seasonal mean significant wave height of 1.3m and peak wave periods of 9.7s) from more easterly direction due to influence of north-east sea breezes and reduction in Tasman Sea and extra-tropical swells from the south. Spring is similar as summer but with a transition towards winter conditions.
  - Winter is characterised by higher energy southerly swells (seasonal mean significant wave height of 1.49m, peak wave periods of 11.6s from more southerly mean direction of 137°N). Autumn is similar as winter but with a transition towards summer conditions.

  - Stockton Beach is relatively well sheltered from swell waves due to the harbour infrastructure which result in lower wave heights and less strong coastal currents than at the more exposed areas further North in Stockton Bight (see example Figure 16).
  - Longer term (decadal) variation in mean directional wave power is primarily associated with El Niño Southern Oscillation (ENSO) which could theoretically result in periods of reversal of the net longshore transport direction; however, observational data do not show shifts in the orientation of beach compartments along Stockton Bight.

- **North-directed alongshore sand transport:** A net northward longshore transport, driven by the obliquely aligned southerly wave climate, is experienced along Stockton Bight compartment with significant alongshore variations in the rates (see Figure 17). The highest longshore transport rate occurs around Fort Wallace with lower rates in the south due to the wave sheltering provided by the port's breakwater and in the north due to a much-reduced wave obliquity. The gradients in longshore transport rates explain the pattern of erosion observed over the southern Bight (especially at Stockton Beach) and the accretion observed in the northern Bight.
- **Erosion of the southern embayment**: As evidenced by historical surveys (see Figure 18 and Figure 19), the southern embayment of Stockton Bight has experienced on-going erosion and steepening and deepening of the shoreface. For the area fronting the suburb of Stockton, the erosion has been exacerbated by the lack of sand supply from the south because of the port's breakwaters and deep navigation channel which form a physical barrier to natural sand movement, combined with the northerly littoral transport which continue to remove sand from the southern embayment and transport it further North. The observed historical envelope of beach compartment volume is estimated to be of 8,000,000m^3 at Stockton Beach Based (Bluecoast, 2022).
- **Sediments that constitute Stockton Beach:** Stockton Beach is composed of medium to coarse sand with an average grain size of 0.37mm. In-situ sediment sampling was undertaken at Stockton beach in 2011 (WorleyParsons, 2012b), with samples being taken from the dune, beach berm, swash zone, and nearshore area along three shore-normal beach transects (T1 to T3). Figure 20) shows the locations of these transects along the beach and includes particle size distribution (PSD) plots for each sample. The most exposed transect (T3) shows a clear relationship of increasing particle coarseness nearer the surf zone. The two southern transects (T1 and T2) show a fining with reduction in wave exposure (further south). D50 across the samples range from 0.27mm to 0.55mm. Fines do not typically exceed 1% and gravel is typically less than 10%. There is little variability in grain size across the beach profile. Shell contents do not generally exceed 11%.
- **Tidal and fluvial currents**: Modelled tidal and fluvial current speeds at the Hunter River entrance for a spring tide are presented in Figure 21. Current magnitudes through the entrance reach approximately 0.6m/s on a flood and 0.8m/s on an ebb tide which is expected with the addition of seaward fluvial currents on the ebb tide. These current vectors are directed offshore (northeast) of the study site and diminish in magnitude after 1km from the entrance channel. Overall, the impact of fluvial currents on the local hydrodynamics at Stockton Beach is minimal.

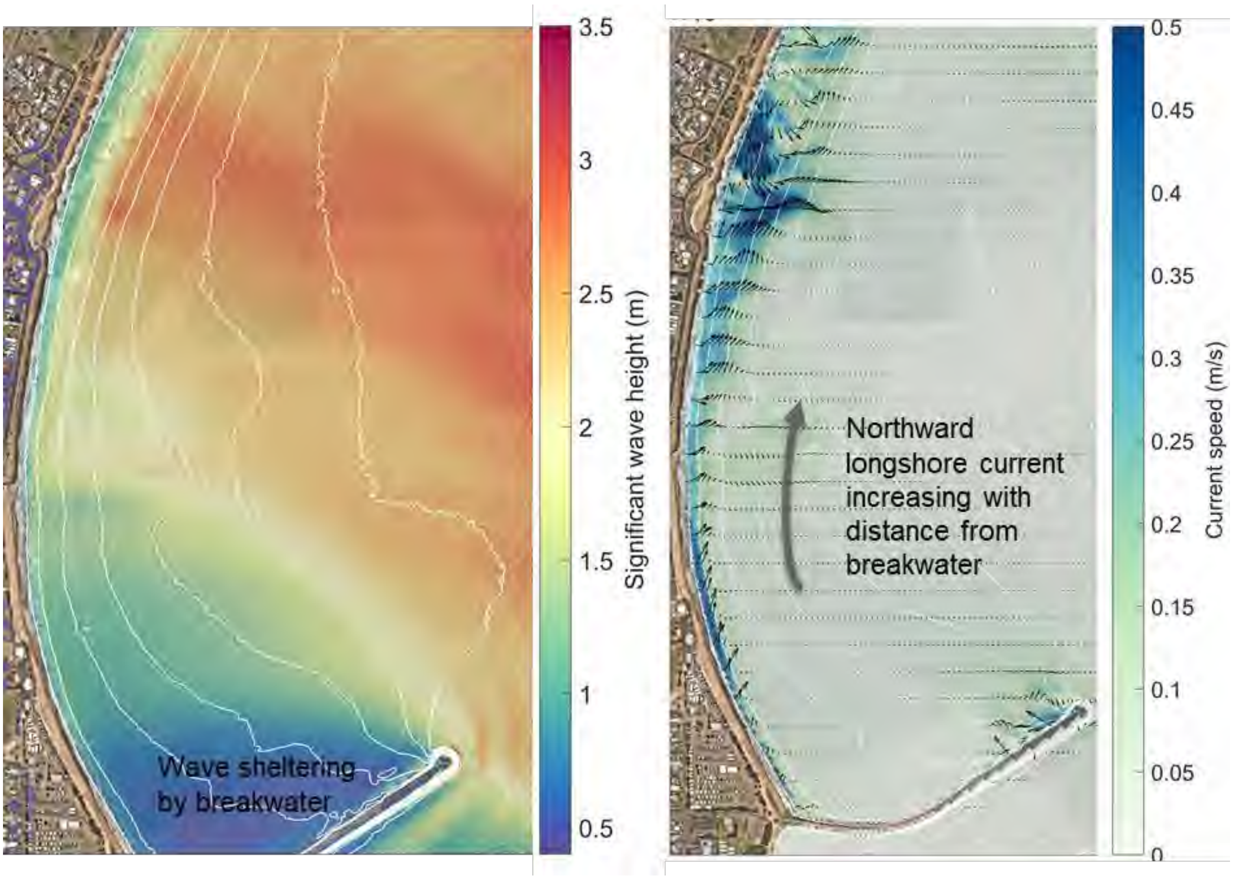

Figure 16: SWASH wave and current modelling results showing gradient in (left) significant wave heights and (right) longshore littoral currents.

Note: SWASH results show south-east wave event - significant wave height 3.5m, peak period 12s.

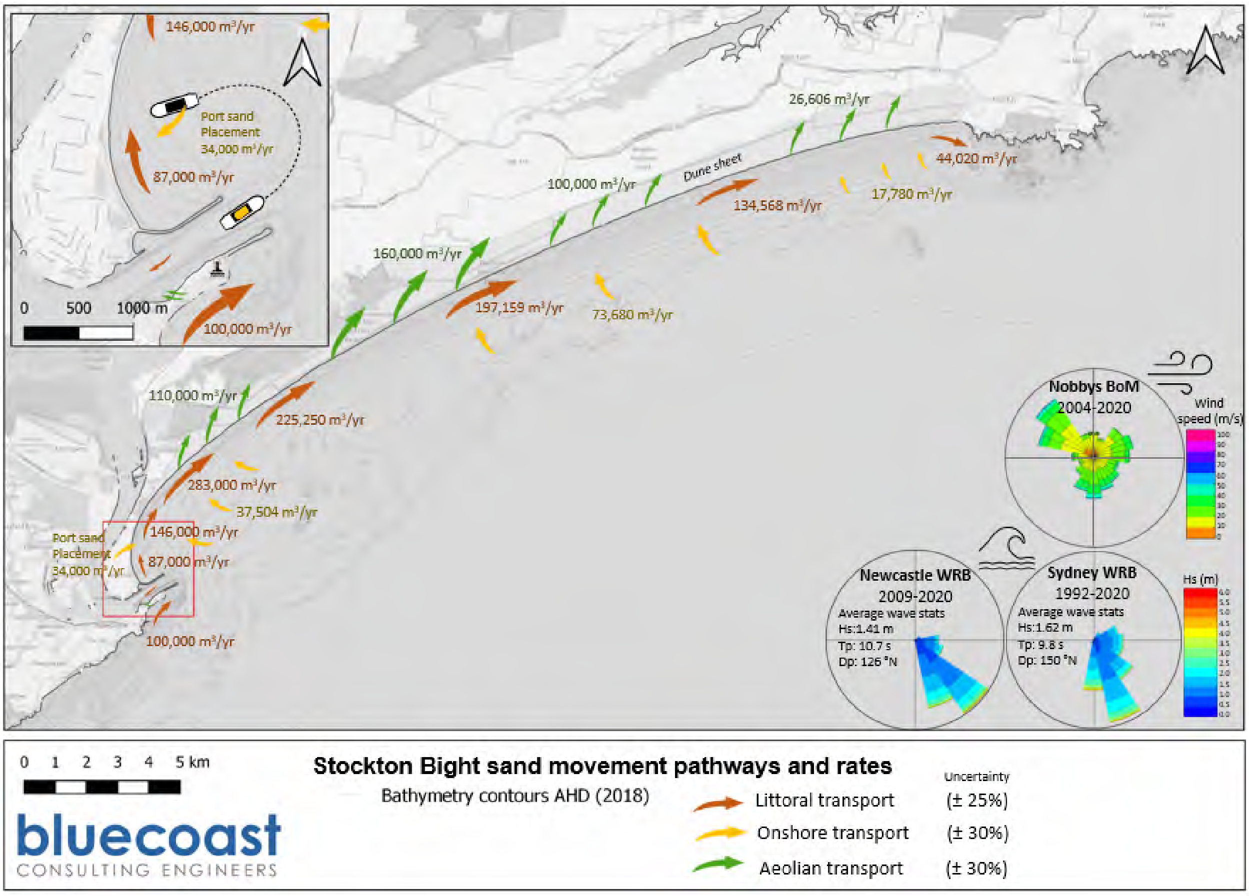

Figure 17: Quantified conceptual model of sand movements in the Stockton Bight compartment.

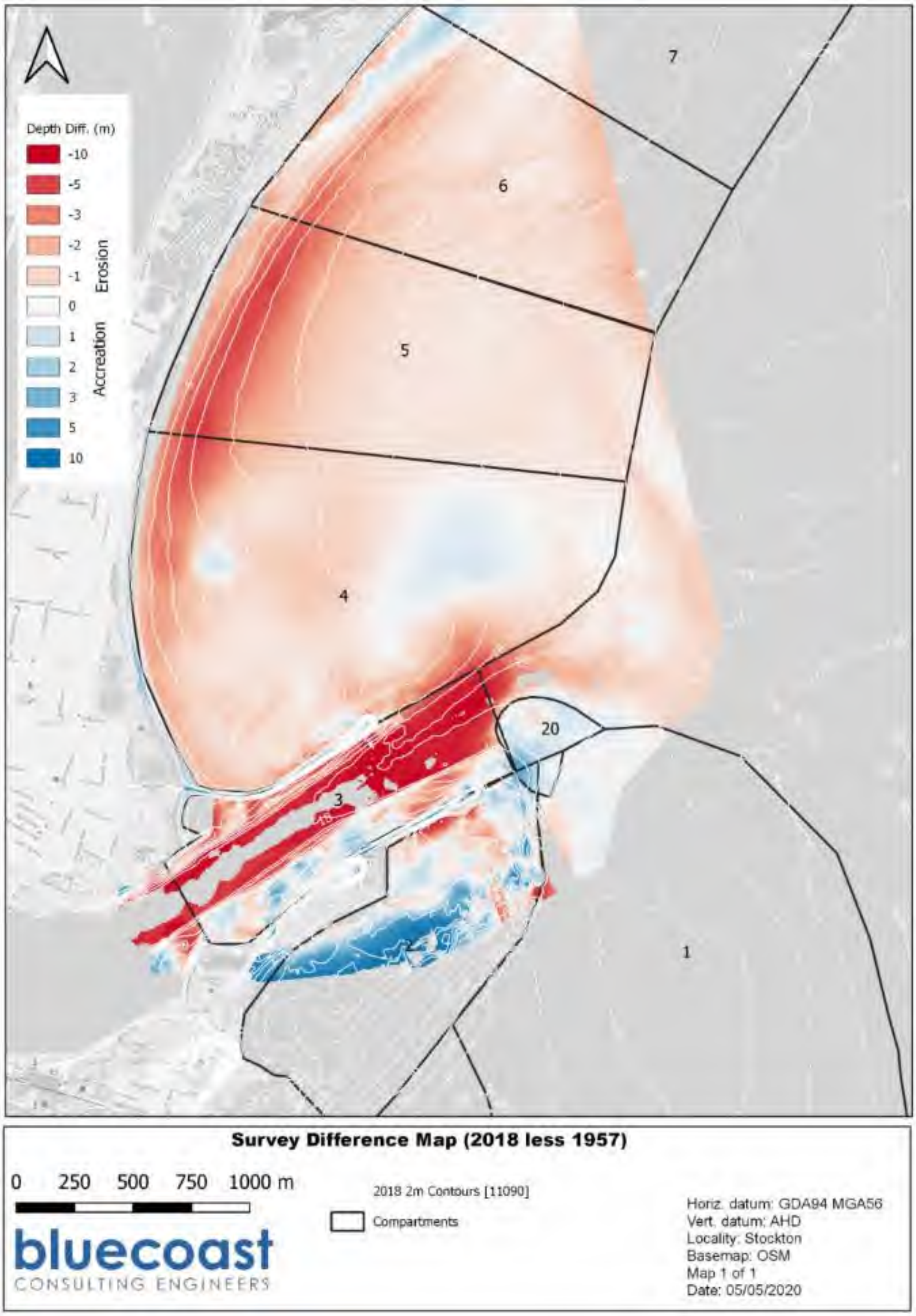

Figure 18: Survey difference map for 1957 relative to 2018 (source: Bluecoast, 2020a).

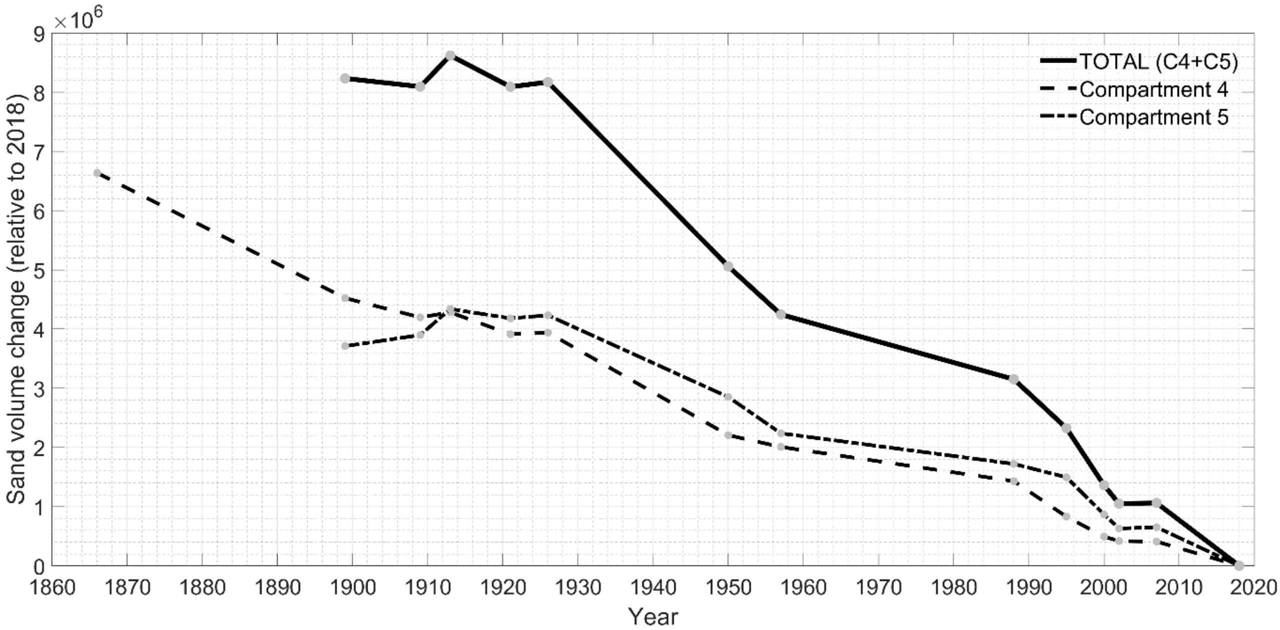

Figure 19: Long-term sand volume change at Stockton Beach (Compartments 4 and 5).

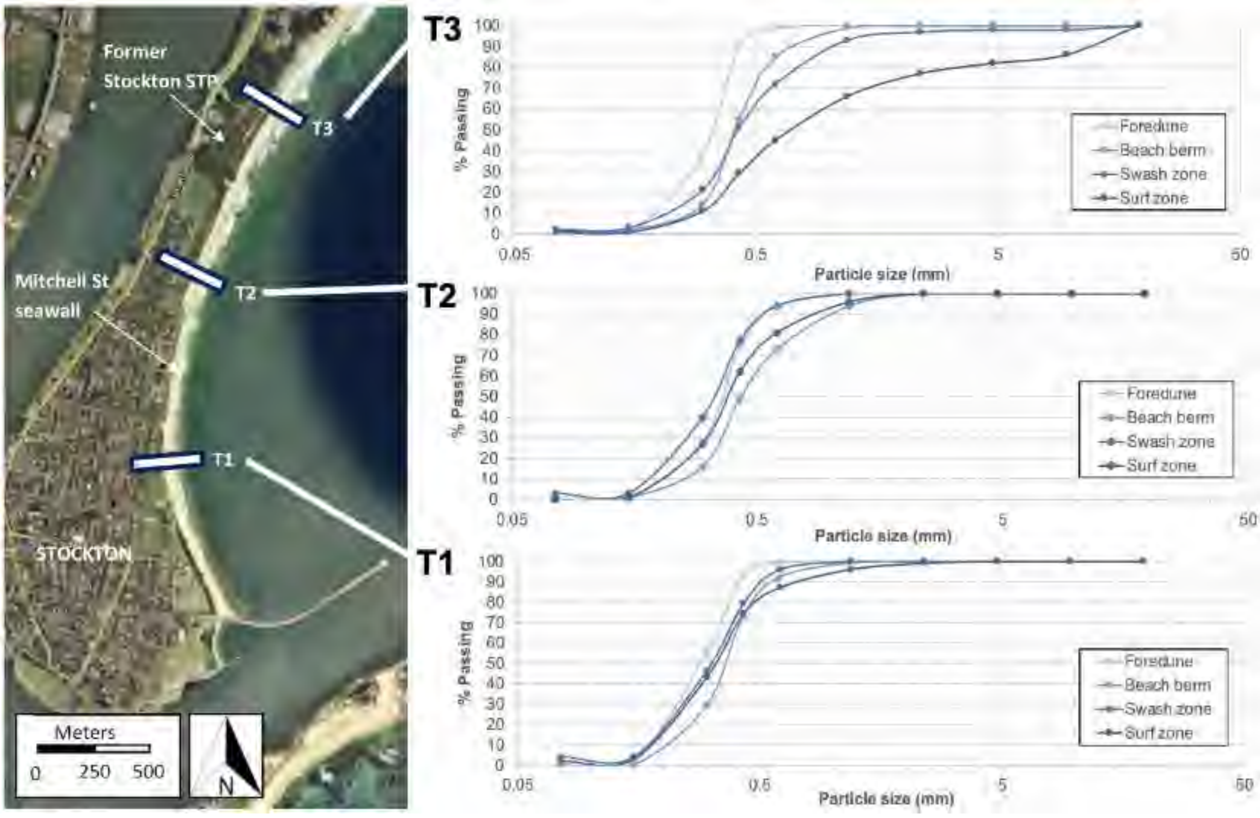

Figure 20: Grading curves at Stockton Beach (source: (RHDHV, 2020) from samples collected in 2011).

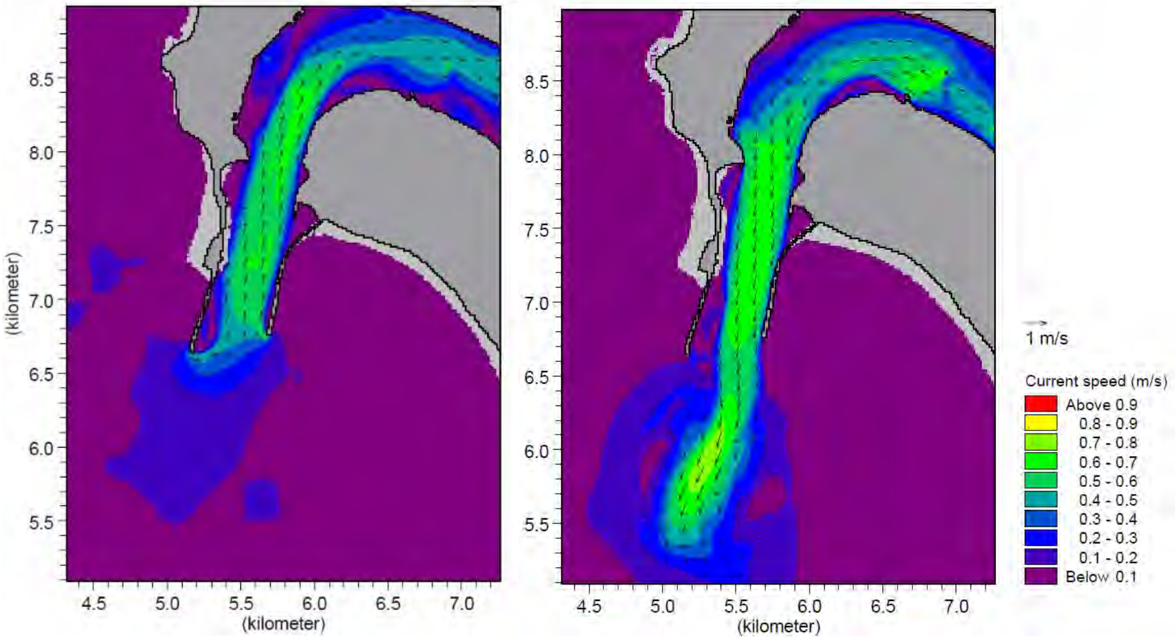

Figure 21: Peak flood (left) and ebb (right) tidal current speed map for a spring tide at the Hunter River entrance (source: DHI, 2009).

6.2.3 Beach nourishment

The nourishment should comply with the acceptance criteria for sand characteristics defined in the Stockton Beach sand management guideline (RHDHV, 2020) and the sand placement requirements defined in the Sand placement concept design (Bluecoast, 2022) and which are provided in Table 7.

Table 7: Acceptance criteria for grain size and post nourishment profiles for onshore and nearshore placement of sand at Stockton Beach.

Acceptability item	Acceptability criteria	
	Onshore placement (subaerial beach)	Nearshore placement (subaqueous beach)
Composition	The beach nourishment material shall be comprised of carbonate and silica particles and shall not contain organic matter, demolition material or other debris.	
	Sediment particles only	Sand or parent-sandstone material acceptable
Median grain size (D_{50})	The most compatible median grain size would be 0.35mm to 0.40mm (subject to change if justified through additional sampling and analysis of native beach sands, refer Section 6.2.2). Material outside of this median grain size range would be considered on a case-by-case basis, with a preference for slightly coarser material.	
Uniformity Coefficient ($Cu = D_{60}/D_{10}$)	Cu values less than 2	Cu values less than 2 are desirable. In practice, Cu values above 2 may need to be accepted if compatible sand is not available, and mixing will occur with the native sand.

Acceptability item	Acceptability criteria	
	Onshore placement (subaerial beach)	Nearshore placement (subaqueous beach)
Gravel content	Gravel fraction less than 2% by weight.	Gravel fraction less than 2% by weight is desirable. However, gravel fraction greater than 2% may be acceptable on a case-by-case basis.
Nourishment volume	Nourishment sand volume of 2,400,000m^3 of suitable sand along the 2,800m stretch along Stockton Beach (see section 3.3).	
Sand placement grid	A nourishment grid was developed defining a total of 100 placement boxes, arranged as 25 alongshore columns each with four cross-shore rows (see section 3.3).	

6.2.4 Potential impact

Impacts of the sand placement on coastal processes are expected to be limited whether it is in terms of the coastal profile/sediment composition, local hydrodynamics, or sand movement patterns due to the following reasons:

- The sand placement grid was designed to obtain a post-nourishment beach morphology within the historic envelope of observed beach conditions at Stockton Beach (a 2.4M m^3 sand placement would revert the coastal profile back in time around 22 years, see Table 3).
- For this REF, the nourishment sand will be of similar grain size (or slightly coarser) and density than the sand that constitute Stockton Beach and would therefore behave similarly under identical hydrodynamics forcings (i.e., sand would be picked up and transported at similar rates). Colour and composition also need to comply with the *Stockton Beach sand management guidelines*. Alternative borrow material should be considered on a case-by-case basis having regard to a wider range of factors that influence beach nourishment project. If the borrow material does not conform to the sand management guidelines, a new REF or an addendum to this REF is required.
- The volume of sand placements are misreported and/or do not migrate areas that would be classified as beneficial to beach health.
- Because of the above, waves and tides would propagate over bed conditions similar than the ones observed a couple of decades ago when Stockton Beach was less eroded, both in terms of water depths (seabed profile) and bed friction (intrinsically linked to sand characteristics). Therefore, post-nourishment sand movements patterns in Stockton Bight are expected to be a continuation of the trends observed in the past (see section 6.2.2).

6.2.5 Safeguards and management measures

Safeguards and management measures for coastal processes are provided in Table 8.

Table 8: Safeguards and management measures for coastal processes.

Impact	Environmental safeguards	Timing
General	A sediment quality management plan (SQMP) will be prepared and implemented as part of the PEMP. The SQMP will identify activities that will potentially impact the quality of native beach sediments as well as the mitigation measures to be implemented.	Pre-works
Inspections	Prior to major sand placement exercises (>250,000m^3 within 6-month period) and/or an initial inspection of the shoreline shall be undertaken by an experienced coastal engineer who is familiar with Stockton Beach. For on-going sand placements (e.g., from Port's maintenance dredging inspection should occur annually) annual inspections should be undertaken.	Pre-works
Monitoring, reporting and review	The development and implementation of a suitable monitoring program will be undertaken. The monitoring program would include sediment sampling and survey (hydrographic, beach and topographic) as recommended in *Concept sand placement design* (Appendix A). The monitoring program should include: • Pre- and post-sand placement surveys over the entire southern embayment from 50m inland of the dune crest to 25m water depth. For on-going sand placements, this should include an annual survey. • Comprehensive pre-placement (baseline) sediment sampling and analysis baseline exercise. • Assessment of compartment volume and sand movements on a regular basis including 12- and 36-month post-placement for major sand placements. • The material placer shall be required to provide suitable records such as the pre-works sediment testing, borrow area, method of extraction and placement, quantities placed, co-ordinates and nourishment box placed (e.g., bottom door opening and closing) as well as the dates of placements.	Pre-works, during works
Beach profile	Sediment should be placed in accordance with the *Concept sand placement design* (Appendix A) to avoid overfilling beach compartments and scarping. For beach box placements, the material should be spread in a manner that minimises changes to the natural beach and seabed profiles.	During works

6.3 Water quality and contamination

6.3.1 Methodology

The REF adopts the ambient water quality objectives for the receiving waters as stated in the Marine Water Quality Objectives for NSW Ocean Waters – Hunter and Central Coast (NSW Department of Environment and Conservation, 2005) and which are listed hereafter:

- To maintain or improve the ecological condition of ocean waters.
- To maintain or improve ocean water quality so that it is suitable for activities such as swimming and other direct water contact sports.
- To maintain or improve ocean water quality so it is suitable for activities such as boating and fishing where there is less bodily contact with the waters.
- To maintain or improve ocean water quality so that it looks clean and is free of surface films and debris.
- To maintain or improve ocean water quality to produce aquatic foods for human consumption (whether derived from aquaculture or recreational, commercial, or Indigenous fishing).

Potential impacts of sand placement operations could include increased turbidity and leaching of contaminants from floating equipment (i.e., accidental fuel and oil spills), which could ultimately be detrimental to natural habitats and fauna. To minimise such risks, potential impacts were evaluated, and suitable safeguard and management measures determined considering the following key aspects:

- National and state guidelines on dredging and sand placement operations (NAGD, ANZECC, National Acid Sulphate Soils Guidance, ASSMAC)
- Characteristics of the coastal environment where the sand will be placed:
  - wave and tidal dynamics
  - *in situ* water quality measurements and imagery
  - surficial seabed sand characteristics (i.e., sand grading and CN's Acid Sulphate Soils map)
- Characteristics of the nourishment sand in terms of fine contents and contamination levels in line with Stockton Sand Management Guidelines (RHDHV, 2020)
- Sand placement operations and dredged volumes described in section 3.

6.3.2 Existing environment

Turbidity

Stockton Beach is located immediately north of one of NSW's largest coastal rivers, the Hunter River which has a direct impact on the water quality off Stockton Beach. During major rainfall events, the river discharges large volumes of silt into the ocean, increasing the turbidity to surrounding waters such as during the June 2011 flood event (see Figure 24). On average, the annual sediment discharge from the river is about 10 times greater than the annual maintenance port dredging while one single extreme flood event (i.e., 50-year ARI) can released up to 40 times more (Patterson Britton, 1989). Over time, the marine ecosystem in the Newcastle Bight and more specifically in the placement zone and surrounding waters has adapted to episodes of turbidity and sediment loading due to the river, it's fine sediment load and flooding.

Since 2010, about 20,000 to 30,000m^3 of dredged sand from the harbour entrance (Area E) has also been placed each year off Stockton Beach (Royal Haskoning, 2021). Figure 22 shows an aerial photograph that captures a sand placement at Stockton by means of bottom-dumping. It is notes that this material is likely to be from Area E and clean marine sand. The surface plume appears as occurring in a discrete area at the placement site and as it is sand, it would be expected to settle rapidly with little residual turbidity.

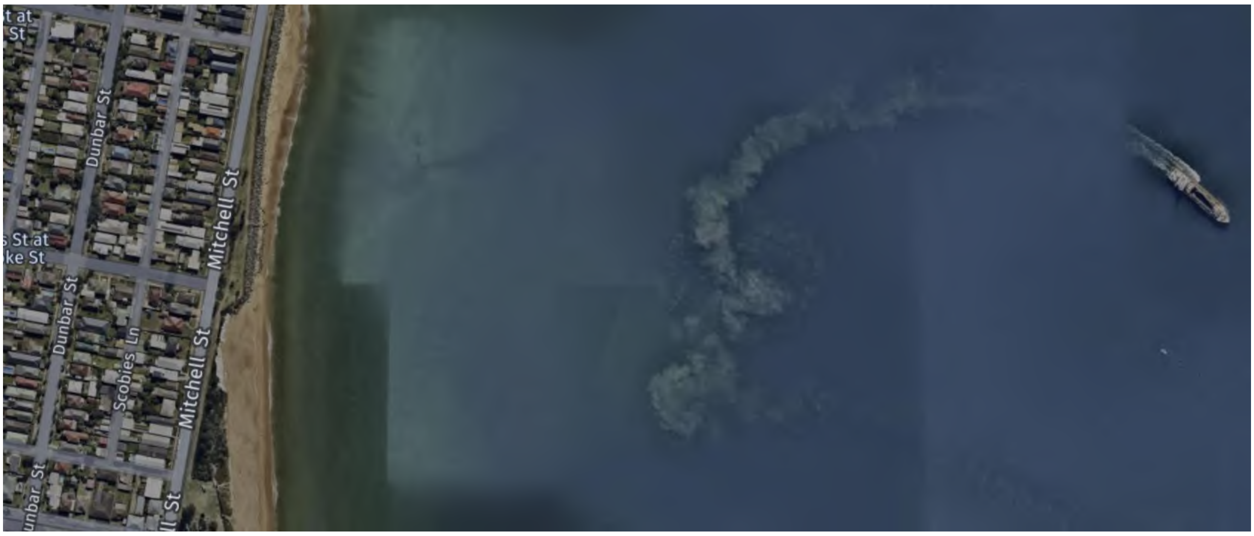

Figure 22: Aerial photograph capturing placement of nourishment material by David Allan on 23 April 2020 at Stockton Beach (source: Nearmaps).

Contamination

Waters off South Stockton Beach were rated as ‘good’ for swimming by DPE in 2021-2022 based regular tests of bacterial contamination levels (Enterococci) (DPE, 2022). No investigations of other contaminants were identified; however, due to the open ocean nature of the site it is unlikely to retain contamination from the neighbouring port activities.

Acid Sulphate Soils

Acid Sulphate Soils occur naturally in both coastal (tidal) and inland or upland (freshwater) settings. Left undisturbed, these soils are harmless, but when excavated or drained, the sulphides within the soil react with the oxygen in the air, forming sulfuric acid. In Australia the acid sulphate soils of most concern are those which formed within the past 10,000 years, after the last major sea level rise. The Newcastle Local Environmental Plan 2012 maps ASS Class 5 along Stockton Beach which warrants management measures for excavation works under 5 metres AHD only.

Figure 23: Photograph of turbid waters showing Hunter River in 2021 (source: Ron Boyd).

Figure 24: Aerial imagery from June 2011 showing Hunter River fine sediment plume.

6.3.3 Nourishment sand

The nourishment sand should comply with the acceptance criteria for fines contents and contamination levels defined in the Stockton Beach Sand Management Guideline (RHDHV, 2020) and which are provided in Table 9.

The nourishment sand should also not contain any Acid Sulphate Soils; adopted test acceptance criteria follow ASSMAC guidelines as this is not covered in RHDHV (2020). Note that given the low fines fraction accepted in the nourishment sand, presence of ASS is unlikely.

Table 9: Acceptance criteria for fine contents, contamination, and ASS levels of beach sand nourishment for onshore and nearshore placement of sand at Stockton Beach.

Acceptability item	Acceptability criteria	
	Onshore placement (subaerial beach)	Nearshore placement (subaqueous beach)
Fines content **i.e., particle sizes less than 75µm**	Fines fraction less than 10% by weight.	Fines fraction less than 10% by weight. **Note:** RHDHV (2020) accepts a fines content greater than 10% on a case-by-case basis but this is not covered in this REF
Contamination levels	Nourishment material shall be either virgin excavated material (VENM) as defined in the Protection of the Environment Operations Act or be excavated natural material (ENM) that has tested in accordance with the 'excavated natural material exemption 2014'.	For sediment to be considered suitable for Stockton Beach, the 95% upper confidence limit of the mean concentration of all contaminants must be below the screening levels in the 2009 National Assessment Guidelines for Dredging (NAGD).
ASS levels	No presence of Acid Sulphate contamination in the nourishment sand (no Actual ASS and no Potential ASS according to ASSMAC guideline).	

6.3.4 Potential impacts

Water quality impacts during sand placement would include elevated levels of turbidity compared to ambient levels and potential leaching of contaminants from floating equipment and earthmoving equipment. It is expected that such impacts on water quality can be managed through the effective implementation of safeguard and management measures.

Turbidity

Sand placement operations are expected to increase the level of turbidity in surrounding waters by the release of fines from the nourishment sand into the water column. Elevated turbidity levels are however expected not to be a significant issue for several reasons:

- The nourishment sand is predominantly sand, with a very low fine content.
- The placement area and surrounding waters are already accustomed to episodes of higher turbidity levels including:
  - widespread high turbidity associated with flooding of the Hunter River,
  - resuspension of seabed sediments by waves and currents which cause more turbid waters along the shore (in the swash and surf zone)
  - periodic placement of dredged sand off Stockton Beach from PoN's maintenance dredging (Royal Haskoning, 2021).
- For nearshore placement, sand would be bottom dumped via a split hopper at a depth well below the water surface and the material would plunge directly towards the seabed in a form of

'convective descent', with only a minor portion of the material forming a turbidity 'cloud' and migrating from the placement area to larger depths.

- For onshore placement, increased levels of turbidity will be localised along the beach where surrounding waters often contain larger concentration of suspended sediments in the water column because of wave action. If pumped ashore, increased levels of turbidity will be localised at around the pump exit point and conveyed in the water by water run off on the beach while rainbowing would spread fines across a wide area of the surf zone.
- Given the low fines fraction, resuspension of fines that settle at the bottom would be a slow process whereby currents and waves will naturally sort the new seabed sediments and fines be transported to greater depths as it is the case for the existing seabed which is composed of similar sand.

A surface water monitoring plan and containment measures (silt curtain or booms) are not required given low impact levels of sand placement operation on an environment that already experience high variations in turbidity.

ASS

The nourishment sand does not contain ASS. Onshore sand placement operations may cause minor disturbance of surficial beach sand (typically a few decimetres). These sediments are continually reworked by waves and currents and do not contain Acid Sulphate Soils. No management measures for ASS are therefore required.

Contamination

The nourishment sand is clean marine sand which should not bring new contaminants (i.e., heavy metals) into the waters providing the implementation of safeguards measures to confirm contamination levels.

The risks of leaching of contaminants from floating equipment and earthmoving equipment can have significant harmful and long-standing impact on natural habitats. Stringent safeguard measures would be implemented to manage such a risk.

6.3.5 Safeguards and management measures

Safeguards and management measures for water quality and contamination are provided in Table 10.

Table 10: Safeguards and management measures for water quality and contamination.

Impact	Environmental safeguards	Timing
General	A water quality management plan (WQMP) will be prepared and implemented as part of the PEMP (Project Environmental Management Plan). The WQMP will identify activities that will potentially reduce water quality and mitigation measures to be implemented.	All stages
Turbidity	Fines content (i.e., particle sizes less than 75µm) should be less than 10% by weight for onshore and nearshore placement.	Prior to operations
Sand Management Guideline	All sand placed on the beach must comply with the Stockton Beach Sand Management Guideline (RHDHV, 2020)	During operations
Contamination	Sampling and analysis reporting will be undertaken including testing for heavy metals, TBT, PAHs, OC pesticides, PCBs and TOC. Results are	Prior to operations

Impact	Environmental safeguards	Timing
	required to comply with NAGD criteria as mentioned in Stockton Beach Sand Management Guideline (RHDHV, 2020) before nourishment works take place.	
Litter	All other solid waste / litter generated (e.g., food scraps and packaging) during the works should be contained to prevent them entering the waterways. This waste should be disposed of appropriately onshore.	During operations
Spills and leaks	All dredge plants and associated equipment should be maintained and inspected regularly to minimise the risk of oil and fuel leaks. No refuelling of dredge plant or equipment should be undertaken onsite. Display of Material Safety Data Sheets (MSDS) on board the dredge and with stores of each substance used in the works (i.e., fuel, lubricants etc). An oil spill response kit should be kept on all boats and barges involved in the works and on land at the site compound. In the event of a spill, NSW Maritime and the EPA should be notified if it is a reportable incident.	During operations
Acid Sulphate Soils	Screening test according to ASSMAC guideline which demonstrate no actual or potential presence of ASS in nourishment sand. Reducible Sulphur test results should not exceed the "action criteria" (Stone et. al, 1998).	Prior to operations

6.4 Air quality

6.4.1 Methodology

The methodology was limited to a qualitative assessment due to the open, coastal location of the Proposal and the minor changes to air quality that would be likely because of the Proposal.

6.4.2 Existing environment

Although the study area is located within proximity to an industrial area, air quality for Stockton is typically categorised as "good" (NSW Government Planning and Environment, 2022).

During summer winds from the east-northeast are dominant at Stockton, bringing clean maritime air, while during winter winds from the northwest dominate at air quality can occasionally be poorer. During autumn and spring winds from the east-southeast dominate, also bringing clean maritime air. Calm conditions (less than 0.5 m/s windspeed) occur for 7.5% of the year while summer has the lowest percentage of calm conditions (Pae Holmes, 2011).

6.4.3 Potential impacts

Air quality impacts during sand placement would include temporary impacts associated with windborne sand particles, combustion sources from machinery including dredges and earthmoving equipment, and odours from dredged materials. It is also expected that potential air quality impacts can be managed through the effective implementation of mitigation measures.

Windborne sand particles: Temporary and very localised sand stockpiling is expected because of the Proposal. As such the airborne particle load generated over a typical placement day is likely to be minor and is not expected to result in reduced local air quality for significant periods. The sands placed on the beach will be clean and largely free of sediments and stockpiles will be shaped as soon as the sand is placed on to the beach. Sand will also typically be saturated and not prone to being blown by winds. The greatest impacts may occur when sand is “rainbowed” on to the beach from a TSHD.

Emissions from machinery: Potential air quality impacts include emissions of CO, NO_2 and SO_2 associated with combustion of diesel fuel and petrol from machinery, vessels, plant, and equipment. Based on the duration of each placement campaign, the number of emission sources and the scheduling of machinery (i.e., not all machinery would be operating simultaneously), potential emissions affecting air quality are expected to be minimal and would not affect the overall air quality in the locality.

Odours: There may be minor odour emissions from dredged sands which contain decomposing organic material. The criteria for the quality of sand that can be placed on the beach will ensure that any potential odour emissions from dredged sands are minimal. Communication with the local community will also ensure that the source of the odours is understood. This is likely to result in a greater level of tolerance.

6.4.4 Safeguards and management measures

Safeguards and management measures for air quality are provided in Table 11.

Table 11: Safeguards and management measures for air quality.

Aspect	Environmental safeguard	Timing
General	An air quality management plan (AQMP) will be prepared and implemented as part of the PEMP. The AQMP will identify activities that will potentially reduce air quality and mitigation measures to be implemented.	Pre-placement
Amenity	Potentially affected neighbours will be notified not less than 10 days prior to placement works. Notification will include arrangements for complaints.	Pre-placement
Training	Workers will be trained to familiarise them with the potential for air quality impacts and measures required to minimise potential impacts.	Pre-placement
Machinery	Construction vehicles, vessels, plant, and equipment should be maintained in good working order and switched off when not in use. No idling of construction vehicles or vessels is to be permitted.	During works
Dust	Works are not to be carried out during strong winds or in weather conditions where high levels of dust or airborne particulates are likely.	During works
Dust	Stockpiles or areas that may generate windborne sand particles are to be managed to suppress emissions.	During works
Complaints	A register of complaints will be kept during works. The register will include the details of the complaint and the actions that were taken to address the issue.	During works

6.5 Noise and vibration

6.5.1 Methodology

The Environment Protection Authority's (EPA) *Draft Construction Noise Guideline* (NSW EPA, 2021) sets out a qualitative assessment for times when noise-generating activities are unlikely to have significant noise impacts. The Guideline states that qualitative assessments are suitable for small low-risk infrastructure projects, like the Proposal, which are generally undertaken during standard construction hours.

6.5.2 Existing environment

The Proposal would be undertaken in a typical urban environment. Background noise would currently emanate from vehicles, vessels, the surf, and activities that are typical of recreation areas such as barking dogs, vehicles, and sporting activities. The existing noise environment would be moderate, with the noise amenity likely to be dominated by surf noise.

The noise receivers in proximity to the proposed works include a holiday park, café, residential dwellings, bowling club, and surf club.

6.5.3 Potential impacts

Noise-generating land-based infrastructure and machinery would include:

- Infrastructure for pumping ashore options (e.g., pipelines/ slurry booster pumps).
- Excavators, bulldozers, and other medium-sized earthmoving equipment.
- Rigid trucks for delivery of machinery

Holiday Park: Located approximately 10 – 50m from where land-based machinery and between 100m – 200m from where marine-based machinery (dredges) would be operating.

Residential dwellings: Located approximately 170m to the southern compound area and 65m to the northern compound area. All residential dwellings would be located over 100m from machinery working on the beach and primarily over 200m from marine-based machinery (dredges).

At the northern end of the Mitchell Street seawall dredges may be undertaking beach nourishment within 90m of residential dwellings. While these dwellings are reasonably close to where dredges may occasionally operate, these same houses are located within a relatively high background noise environment due to strong wave action in this location. It is likely that these residences would be reasonably tolerant of any noise generated from dredges as the works will result in the return of the beach in this location. Nourishment of this location would only occur when large volumes of sand are available at any one point in time (i.e., mass nourishment), therefore noise impacts from the Proposal would be infrequent.

In the southern end of the study area, nourishment would occur more frequently, under amenity scale works, with a small dredge located approximately 200m offshore from residential dwellings and around 100m offshore from the holiday park.

Recommended noise management levels are provided in Table 12.

Table 12: Recommended noise management levels (ICNG).

Period	Management Level L_{Aeq} (15min)
Residential recommended standard hours	Noise affected level: RBL + 10

Period	Management Level L_{Aeq} (15min)
	Highly noise affected level: 75 dB(A)
Residential outside recommended standard hours	Noise affected level: RBL + 5
Offices, retail outlets	70dB(A)

RBL = Rating Background Noise Level

The noise affected level represents the point above which there may be some community reaction to noise. Where the noise affected level is exceeded, all feasible and reasonable work practices to minimise noise should be applied and all potentially impacted residents should be informed of the nature of the works, expected noise levels, duration of works and a method of contact.

The highly noise affected level represents the point above which there may be strong community reaction to noise and is set at 75 dB(A). Where noise is above this level, respite periods may be required by restricting the hours when the loudest activities can occur, considering:

- Times identified by the community when they are less sensitive to noise.
- If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

6.5.4 Safeguards and management measures

Safeguards and management measures for noise and vibration are provided in Table 13 .

Table 13: Safeguards and management measures for noise and vibration.

Impact	Environmental safeguards	Timing
General	A noise and vibration management plan (NVMP) will be prepared and implemented as part of the PEMP. The BVMP will identify activities that will potentially reduce air quality and mitigation measures to be implemented.	Pre-works
Pumping ashore	Pipework will be buried where beach/dune area is sufficient.	During works
Hours of work (land-based)	Works will be undertaken during the ICNG recommended standard working hours of Monday to Friday 7am to 6pm, Saturday 8am to 1pm and no work on Sundays or public holidays. Where feasible, closures of roads and the boat ramp will not be undertaken during school holiday periods. If required for safety and efficiency reasons, work outside of standard working hours would be subject to TfNSW approval, notification, and a management plan.	During works
Complaints	A management procedure will be in place for noise and vibration complaints that may arise from the construction work. Each complaint must be investigated and appropriate noise and/or vibration amelioration measures be put in place to mitigate future exceedances.	During works

Impact	Environmental safeguards	Timing
Night-time works	Where complaints are received about night-time works, noise measurements should be carried out at the nearest residential receivers when the dredging vessel is operational..	

6.6 Landscape character and visual impact

Landscape character is the combined quality of the built, natural, and cultural aspects that make up an area and provide its unique sense of place. Landscape in the context of this REF is taken to include all qualities and characteristics of the local landform, vegetation, built form and infrastructure. It includes the beach and foreshore area including the public spaces, community facilities, businesses and private residences along Mitchell Street which make up the neighbourhood and landscape character.

6.6.1 Methodology

The potential visual impacts of the Proposal on the landscape character have been assessed through a site walkover and desktop study. The assessment considers the sensitivity of the existing landscape and the magnitude of the proposed changes to determine the likely visual impact on landscape character.

6.6.2 Existing environment

The landscape in the south of the study area is predominantly public space and infrastructure, with the low-rise holiday park located unobtrusively behind the beach, screened by dune vegetation. The modern two-storey residential character of Mitchell Street dominates the skyline in the north, with large lineal tracts of public space located between the houses and the beach. As the foreshore recedes, the areas of green public space and infrastructure are diminishing and being replaced with coastal protection structures and works.

Although the landscape retains value as a scenic coastal location, its amenity has been reduced in recent years due to significant coastal recession and the construction of coastal protection works. Areas once accessible for public recreation are now unsafe and no longer available for use, with some areas dominated by fencing and sandbags. The photos below show the coastal protection works within the study area and demonstrate the reduced amenity that is being experienced at Stockton due to coastal recession.

Figure 25: Facing south showing sandbags north of the holiday park.

Figure 26: Facing north showing no access from the northern breakwater.

Figure 27: Facing north showing coastal protection works adjoining public recreation spaces.

Figure 28: Facing north showing gabion baskets and rock protection.

6.6.3 Potential impacts

The proposed works would result in temporary visual impacts and a reduction in landscape character due to the movement of construction vehicles and materials and the erection of safety fences and work compounds. Impacts would be experienced by residents along Mitchell Street and recreational site users of the beach, public parks and paths, a café, Stockton Beach Holiday Park, Stockton SLSC, and tennis courts.

The construction works will be short term and once completed will result in significantly improved environmental protection against further erosion along Stockton Beach, which would improve the landscape character of the area by reducing the need for coastal protection structures and fencing and returning access to public areas that are currently closed.

The duration of works for each nourishment campaign is likely to vary from around one week to up to six weeks, depending on the methodology and volume of sand available. Works are not proposed outside of standard working hours, but if required for safety and efficiency reasons, would be subject to approval, notification, and a management plan to minimise impacts on the amenity. Land-based infrastructure required for pumping ashore options (e.g., pipelines, slurry booster pumps etc) is also likely to have a visual impact.

The visual sensitivity of the landscape is likely to be moderate. Although the works would be undertaken in a scenic location, the presence of coastal protection infrastructure detracts from the area's amenity and scenic quality. Therefore, the introduction of plant and machinery, and additional fencing, is unlikely to have more than a minor impact.

The Proposal is likely to be tolerated well by the community as it has strong and widespread community support.

6.6.4 Safeguards and management measures

Safeguards and management measures for landscape character are provided in Table 14.

Table 14: Safeguards and management measures for landscape.

Aspect	Environmental safeguards	Timing
Amenity	The works and compound areas will be always kept clean and clear of rubbish.	During works
Amenity	Pipework will be buried where the beach and dune area are sufficient.	During works
Light spill	Where lighting is to be used it would be directionally controlled to limit the impacts of light spill on surrounding areas.	During works
Visual character	When not in use compound areas will be returned to their pre-works state.	Post works

6.7 Biodiversity

6.7.1 Methodology

An Aquatic Ecology Assessment has been prepared for the Proposal and is included in full in Appendix E.

The methodology used for the Assessment included:

- Searches of relevant databases to identify threatened biodiversity, migratory species, and Matter of National Environmental Significance (MNES) that may potentially occur at the locality.
- Mapping of existing ecological features using survey data, aerial photography, and site investigation results.

A seven-part test of significance was undertaken for species likely to occur in or near the study area.

6.7.2 Existing environment

Searches of relevant databases identified sightings data for 72 items listings under the *Biodiversity Conservation Act 2016* within a 5km radius of the Project Area. These included:

- 65 Threatened or Migratory marine birds and/or shorebirds
- 4 Threatened or Migratory marine mammals
- 3 Threatened or Migratory marine reptiles.

In addition, six shark and fish species listed under the FM Act may also occur within the 5 km of the Project Area.

The searches identified the following MNES relevant to this study (i.e., marine/estuarine species or those that use marine/estuarine habitat) within 5 km radius of the Project Area:

- 86 Listed Threatened species
- 78 Listed Migratory species
- 6 Threatened Ecological Communities (TEC)
- 1 Wetland of International Importance (RAMSAR).

In addition to the above, the EPBC Protected Matters Report Search identified 108 protected marine species that include certain species of fish, along with some marine birds, reptiles, and mammals. While 13 marine mammals were identified as part of protected listings for cetaceans.

Of the Commonwealth listed threatened and/or migratory species, the following were identified for consideration as part of this assessment:

- 86 shorebirds or marine birds
- 8 marine mammals
- 5 marine turtles
- 13 sharks, rays, and fish, and
- 1 Threatened Ecological Communities (TEC).

A summary of all threatened and migratory species considered as part of this assessment, along with consideration of their likelihood of occurrence within the Study Area and potential to be impacted, is provided in Appendix E.

Shoreline habitat: The shoreline within the study area provides only very marginal roosting habitat for shorebirds. This may include the higher sections of rock armouring associated with the seawall and breakwater, and some very limited areas where shoreline vegetation remains, which are typically highly disturbed by development, erosion, and human activity. The presence of unvegetated sandy beach faces and foredunes, which provides the preferred habitat for many shorebirds to roost, was typically absent due to the erosion, which has removed sands on the beach face back to, and beyond the shoreline vegetation in places.

Intertidal habitat: Intertidal habitat within and adjacent to the Study Area consists of a sandy shoreline and artificial habitat provided by rocks associated with the seawalls and breakwater, as well as the remains of a shipwreck, located seaward of the sandy shoreline, along the breakwater. The sandy shoreline is typically comprised of marine sands, with associated infauna assemblages in lower tidal areas that are likely to include some small polychaetes, bivalves, and crustaceans. However, sampling of intertidal sediments found sediments to be highly deprived of any infauna and macrofauna within both the mid and lower intertidal areas and areas across all sites assessed within the Study Area, with only one Common Pipi (*Plebidonax deltoides)* sampled.

Intertidal sections of the rock armouring associated with the breakwater, was sparsely covered with common intertidal invertebrate species. Species including Coraline Algae (*Amphiroa anceps and Corallina officinalis*), Gulfweed (*Sargassum sp*.), fine green turfing algae, and Sea Lettuce (*Ulva sp*.), were commonly observed in lower intertidal areas within the area.

Intertidal sections of the breakwater may provide additional habitat for pinniped species at times, including Australian Fur Seals (*Arctocephalus pusillus doriferus*), which were seen basking along lower sections of the breakwater at the time of the survey.

Substantial deposits of marine debris and wrack were recorded on the shoreline at the southern end of the beach at the time of surveying. These included various sponges, kelp fronds (*Ecklonia radiata*), Port Jackson shark egg casings, and the common green seaweed species, Bootstrap Caulerpa (*Caulerpa filiformis*).

Subtidal habitat: Subtidal habitat within the Study Area is predominantly unvegetated marine sands with accumulations of seaweed and wrack in places. Bathymetry indicates that the seabed is gradually sloping to -7 m in the south and -11 m in the north. Soft sediment habitat is likely used by various demersal and benthic fish species that rest on the sea floor or partially bury themselves in the sediment to ambush prey, such as various species of rays, and flathead. The demersal fish species such as Whiting and Bream may use these areas to forage amongst the soft sediments for invertebrate prey. While surveys indicate that invertebrate items (infauna) are very deprived in shallow areas, they are likely to be more abundant in deeper areas behind the surf zone where erosional processes are likely to be less intense and frequent.

Hard substrata subtidal habitat is limited within the Study Area and predominantly artificial because of the breakwater and adjacent shipwrecks which are outside the Study Area. However, seabed mapping and aerial imagery indicate that some small outcrops of substrate occur which are likely maritime archaeological sites and shipwrecks. Aerial imagery indicates that these structures may be periodically covered by sand, indicating that sand movement resulting in smothering and erosion, is likely a regular process in these areas. In turn, this is expected to result in reduced marine growth and provision of only short-term refuge habitat for marine species that utilise hard substrata benthic habitats in the locality.

Rocky reef habitat that supports live macroalgae assemblages is likely limited to the breakwater, which is outside the Project Area. These macroalgae stands included dense kelp beds with moderate levels of growth of some brown macroalgae species. Several ascidian species and some small encrusting sponges were also recorded within this area. The rocky reef habitat associated with the breakwater transitioned into large boulders around the toe, with a dense covering of Bootstrap Caulerpa (*C. filiformis*) and intermittent patches of brown turfing algae associated with this habitat. The breakwater, boulders and shipwreck occurring along the breakwater, form complex habitats supporting a wide diversity of less cryptic fish, as well as Yellow-fin Bream (*Acanthopagrus australis*), Luderick (*Girella tricuspidata*) and Smooth Toadfish (*Tetractenos glaber*). At times threatened fishes such as the Vulnerable Black Rockcod (*Epinephelus daemelii*) may take refuge in habitat amongst these wrecks along the breakwater or the area may be used for foraging by a range of larger more predatory fish, sharks, and rays.

6.7.3 Potential impacts

Potential impacts for the biodiversity are provided in Table 15.

Table 15: Potential biodiversity impacts.

Potential Impact	Likelihood	Description
Physical disturbance or smothering of marine fauna and flora	Known	The Proposal is likely to result in some physical disturbance and potential smothering of marine fauna, particularly infauna associated with soft sediments located where nourishment activities occur. Additional species, likely to be impacted include some species of marine and shorebird species, which may experience some temporary disturbances to shoreline and intertidal foraging or roosting habitat because of nourishment works.
Modification or alteration of habitat	Known	The Proposal will result in smothering and changes to gradient and potential composition of sediments associated with the nourishment area. These changes have potential to have impacts on infauna which are an important food source to other species occurring within the area.
Sedimentation of adjacent habitat.	Possible	It is likely that there will be some movement of nourishment sediments within the locality, given the dynamic processes and movements of sediments associated with the location. Nearby hard substrata-based habitats may be impacted temporarily during placement of sediments; however, it is likely that this will be minimal and very short-term. No sensitive habitat types, including seagrasses or extensive reef systems, occur within the Study Area.
Potential for increased risk of vessel strike for marine fauna	Unlikely	Any increase in vessel movements within the Study Area is likely to be short-term and confined to repositioning of larger slow-moving vessels, which pose minimal risk of ship strike.
Introduction or spread of a marine pest species	Possible	Sediments used for nourishment are a potential vector for introduction or spread of introduced marine species. The potential risk will be dependent of the source of sediment used for nourishments
Potential for spread of microplastic and marine Debris	Possible	Given the extensive distribution of microplastics, their spread is likely unavoidable. Spread of marine debris is considered a much lower risk as it is assumed clean marine sands will be used.
Changes in water quality	Likely	The Proposal will result in changes to water quality because of increased turbidity and sedimentation during nourishment works. These changes are likely to be short term and temporary, with increased turbidity expected to dissipate within normal tidal regimes. The Study Area also regularly experiences naturally occurring, increased levels of turbidity during high levels of rainfall, due to its proximity to the Hunter Estuary.

Potential Impact	Likelihood	Description
Exposure to Acid Sulphate Soils (ASS)	Unlikely	It assumed that clean marine sands with minimal to no ASS risk will be used.
Mobilisation of contaminants	Unlikely	It assumed that clean marine sands with minimal contamination risk will be used.
Nutrification	Unlikely	It assumed that clean marine sands with minimal nutrient enrichment risk will be used.
Invasion or spread of non-native or invasive species	Possible	Sediments used in nourishment or equipment brought to site during construction works has potential to introduce non-native or invasive species to the site from other areas.
Introduction of disease or pathogens	Unlikely	No known diseases or pathogens have been identified as an environmental issue for marine fauna and flora in this locality, while no aquaculture occurs in the vicinity of the Project Area.
Attraction of fauna to area during nourishment	Possible	It is likely that some behavioural changes to species will occur during placement of sediments in the proposed nourishment area. These changes will be short term and limited to the direct time of impact, with no long- term impacts of ecological significance expected to occur for species within the Study Areas. Natural movements, utilisation of habitat and behaviours of species are likely to return to normal, post nourishment works.
Artificial lighting during construction works	Unlikely	It is assumed construction works will be undertaken during daytime hours.
Generation of construction noise with potential to impact on fauna behaviour	Possible	Some construction noise because of booster pumps and machinery use on the beach may be required at times.
Generation of underwater noise with potential to impact on fauna behaviour	Unlikely	Under water noise will be restricted to vessel noise, which is frequent in this locality with the regular shipping to and from the Hunter River.

Conclusion on significance of impacts

With adoption of the safeguards and management measures below, the Proposal is considered unlikely to have a significant impact on State and/or Commonwealth listed threatened aquatic biodiversity. As such, referral to the Department of the Environment under the EPBC Act is not required. Similarly, the preparation of a Species Impact Statement (SIS) based on the provisions of the BC and FM Act should not be required.

6.7.4 Safeguards and management measures

Safeguards and management measures for the biodiversity are provided in Table 16.

Table 16: Safeguards and management measures for the biodiversity.

Aspect	Environmental safeguards	Timing
General	A biodiversity management plan (BVMP) will be prepared and implemented as part of the PEMP. The BVMP will identify activities that will potentially reduce air quality and mitigation measures to be implemented.	Pre-works
Inspections	Inspections of the shoreline for nesting shorebirds should be undertaken within the 10 days prior to commencement of works and Pre- nourishment works by an experienced ecologist.	Pre-works
Monitoring	The development and implementation of a suitable monitoring program will be undertaken. The monitoring program would include sampling of soft sediment infauna within low intertidal and deeper subtidal areas behind the surf zone and be developed following the Before-After Control-Impact (BACI) framework (Underwood 1994). The monitoring program should include: • Multiple sites within Control and Impact locations • Replicate infauna samples (minimum 5) collected with a 0.5 mm sieve • Minimum of two baseline (Before) surveys within 12 months prior to nourishment. Minimum of two post nourishment (After) surveys within 18 months of completion of nourishment works.	Pre-works
Erosion and sedimentation	Adequate erosion and sediment control measures should be implemented to minimise mobilisation of any shoreline sediments directly from the source into the water or into adjacent stormwater drains, in accordance with the ‘Blue Book’ (Landcom 2004), where shoreline works above the High Water mark are required.	Pre-works, during works
Avoidance	Avoid placement of sands on habitat provided by the breakwater and adjacent shipwrecks to the south of the proposed Project Area	During works
Avoidance	Avoid nourishment of the beach areas if any shorebirds are found to be nesting within or adjacent (within 100m) the Project Area.	During works
Approach distances	All vessel operations and nourishment work (including rainbowing) should maintain suitable approach distances for any marine mammals or reptiles. This should include: • 100m from any whale including 300m in front and behind the animal • 50m from any dolphin or dugong and 150m if they have calves • 50m from any seal or turtle • 100m from any shorebirds found to be nesting, roosting, or feeding along the shore. During nourishment works, operations should be paused when the above approach distances cannot be maintained due to animals moving into the area. Should the nourishment works be found to be	During works

Aspect	Environmental safeguards	Timing
	attracting the animals in and the approach distance cannot be maintained, a fauna ecologist will need to need visit site and prepare a suitable management plan to control any risks to marine and avian fauna.	
Hydrocarbons	Hydrocarbons should not be stored on or near the works areas.	During works
Estuarine contaminants	An assessment for the potential for introduced marine species should be undertaken for any sediment source sites from within estuarine environments. For high-risk localities such as harbours this may require survey and sampling for species of concern.	During works
Sediments	The Sand Management Guideline must be adhered to, and the works must avoid the use of sediments for nourishment, which are substantially different in particle size distribution to the pre-nourishment site and where from sources with an elevated risk of: • Contaminants, nutrients, and ASS • Marine debris, plastics and microplastics • Potential; for introduced marine species.	During works
Beach profile	Sediment should be placed and spread in a manner that minimises changes to the natural beach and seabed profiles.	During works
Spills	All machinery should be routinely checked for leaks, with an emergency spill kit to be always kept on site. All staff are to be made aware of the location of the spill kit and trained in its use.	During works

6.8 Socio-economic

Socio-economic impact assessment (SEIA) involves analysing the social and economic consequences of a development. It involves identifying and evaluating likely changes to, or impacts on, communities and businesses because of a proposed development and to mitigate or manage impacts and maximise benefits.

6.8.1 Methodology

As the social and economic characteristics of Stockton were considered extensively for the cost benefit analysis (CBA) for the Stockton Beach coastal management program (Bluecoast, 2020b), the methodology for this section was limited to a desktop review of relevant sources.

6.8.2 Existing environment

The CBA (Bluecoast, 2020b) reports that approximately 100,000 people utilise Stockton beach annually. The beach is popular primarily for locals and visitors from the Hunter Valley for activities including swimming, fishing, nippers, and surfing. The holiday park at Stockton is the only caravan / motorhome camping park close to Newcastle CBD and is therefore popular with both international and domestic visitors.

Community consultation activities undertaken by CN have identified strong community opinions regarding Stockton beach, including:

- The beach is highly valued and is a critical asset to the community.

- The preference is to maintain a clean beach area providing enough width for recreational space which supports the current foreshore amenity and character.
- Stockton has a strong surf culture with a desire to maintain surf amenity near the residential areas.

The severe coastal erosion being experienced at Stockton has the potential to threaten several of the Strategic Directions in CN's community strategic plan:

Vibrant Safe and Active Public Places: These include the beach, which is the first asset to be lost to erosion and potentially the parkland and facilities that are behind the beach.

Liveable Built Environment: The loss of parkland and public spaces, services, and the road network present a serious risk to the overall 'liveability' of Stockton. It is likely that the liveability of Stockton is already being impacted even though the loss of facilities has been limited to date. A lack of confidence in the future viability of an area affects the sense of liveability felt by residents and visitors.

Open and Collaborative Leadership: This follows from the previous point and the 'sense of identity' of an area. The strategies around this Direction relate to long term planning and financial sustainability. Planning should consider the longer-term time frame, to ensure viability, minimise any future financial shocks and to increase the confidence of the Stockton community in the place where they live.

6.8.3 Potential impacts

There are likely to be minor temporary negative impacts during works, because of a loss in beach availability, and the loss of public space for compound and ancillary facilities (pipelines etc). The noise and loss of amenity associated with the placement works may also result in decreased visitation, thereby impacting local businesses. These impacts would all be minor and short-term.

The longer-term impacts of the proposed nourishment program are likely to be highly positive. The key benefits experienced will be an improved beach area and associated use values (tourism, amenity, healthy lifestyle, and activity) and reduced loss of property and land for both private and public landowners.

It is likely that the long-term benefits of the Proposal will significantly outweigh the short term negative socio-economic impacts of the Proposal.

6.8.4 Safeguards and management measures

Safeguards and management measures for the socio-economic aspects are provided in Table 17.

Table 17: Safeguards and management measures for socio-economic aspects.

Aspect	Environmental safeguard	Timing
Community engagement	A Communication and Stakeholder Plan (CSP) will be prepared and implemented to help provide timely and accurate information to the community during works. The CSP will include (as a minimum): • Procedures and mechanisms that will be used to engage with affected landowners, business owners and the wider community to identify potential access and parking impacts and develop appropriate management measures. • Procedures to keep the community informed about any associated changes to conditions (e.g., beach closures)	Pre-placement

Aspect	Environmental safeguard	Timing
	such as through advertisements in local media and advisory notices or variable message signs.	
Emergency access	Access for emergency vehicles will be always maintained during works.	During works
Notification	The local community will be provided with timely, accurate, relevant and accessible information about changed beach and traffic access arrangements and delays owing to nourishment activities.	During works

6.9 Traffic and access

6.9.1 Methodology

A desktop analysis and ground truthing of the local road network was undertaken to inform the assessment of the land-based traffic and access impacts and the most appropriate locations for machinery, plant and site worker vehicles.

6.9.2 Existing environment

The community of Stockton is located on a peninsula that is easily accessed from Newcastle via the B63 and Fullerton Street. The streets are primarily in a grid pattern, with Mitchell Street, a two-lane 50km/hr local road, running along most of the foreshore, up to Stone Street. On-street parking is available on most streets in Stockton. Off-street parking is reasonably limited, with the largest off-street parking area located south of the Stockton SLSC.

Pedestrian access is available along King Street, Pitt Street and Mitchell Street.

6.9.3 Potential impacts

During the proposed works, plant and machinery will utilise the local streets to access the compound areas and get access to the beach. Land-based plant and machinery is likely to include:

- Rigid trucks of variable size for delivery of machinery and equipment. Some trucks may include trailer combinations.
- Boats.
- Backhoes.
- Excavators (potentially up to 30 tonnes).

During nourishment campaigns, some areas of public parking such as the parking area near Little Beach and Dalby Oval will be used for compound areas, resulting in a net loss of public parking spaces. This would potentially place intermittent pressure on the surrounding road network. The timeframe for the use of public parking areas will vary widely, depending upon the volume of sand being placed on the beach. Up to 20 parking spaces may be lost in the short term during each campaign.

Beach access for land-based machinery is likely to occur at Pirate Point at the base of the northern breakwater as well at Griffith Avenue north of the Mitchell Street seawall. This would result in restricted access for the public during works, and potentially disrupt the use of pedestrian paths in the vicinity of the compound areas.

During nourishment campaigns placement of sand would be undertaken by marine means, except for the temporary land-based machinery on the beach as discussed above. The placement methods would depend on the volumes, sand source and the executing contractor work method. Placement methods would typically include one or several of the following methods:

- Pumping ashore to nourish the visible beach
- Rainbowing to nourish the surf zone
- Bottom dumping to nourish the nearshore

Marine-based traffic would be likely to access the site via the Hunter River and the Port of Newcastle. The advantages and disadvantages of the various methods available are described in Chapter 3 of this REF. All methods will result in varying levels of disruption to maritime traffic, though a trailer suction hopper dredge would cause the least disruption to maritime traffic and should be used as the preferred method when available.

6.9.4 Safeguards and management measures

Land traffic

Safeguards and management measures for land traffic are provided in Table 18.

Table 18: Safeguards and management measures for land traffic.

Aspect	Environmental safeguards	Timing
Plant and machinery	A Terrestrial Traffic Management Plan (TTMP) will be prepared and implemented as part of the PEMP. The TMP will include as a minimum: • Confirmation of routes for heavy vehicles. • Measures to maintain access to local roads and properties where applicable. • Site specific traffic control measures (including signage) to manage and regulate traffic movement. • Measures to maintain pedestrian and cyclist access. • Requirements and methods to consult and inform the local community of impacts on the local road network. • Access to compound sites and the beach including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • A response plan for any construction traffic incident. • Consideration of local events to minimise traffic conflict and congestion that may occur due to the cumulative increase in pedestrian and vehicle traffic. • Monitoring, review and amendment mechanisms.	Pre-works
Road closure	A road occupancy permit will be sought for the use of part or all of any Council road (including roadway, footpath or nature strip within Council road reserve) to carry out the works if required.	Pre-works

Aspect	Environmental safeguards	Timing
Traffic control	A traffic control plan will be prepared in accordance with the 'Traffic control at work sites manual' (RTA, 2010a) and Australian Standard 1742.3 Manual of uniform control devices	Pre-works
Traffic control	All traffic control plans will be implemented by a certified Traffic Controller who will be onsite during work hours to ensure all signage is provided in accordance with the requirements of the approved TMP.	During works
Traffic control	Pedestrian access will be safely maintained at all times.	During works
Traffic control	All trucks will enter and exit the site in a forward direction. All drivers will be linked via radio and called to the site when required to ensure no trucks queue.	During works
Traffic control	Where possible, current traffic movements and property accesses are to be maintained during the works. Any disturbance is to be minimised to prevent unnecessary traffic delays.	During works

Maritime Traffic

Safeguards and management measures for Maritime traffic are provided in Table 19.

Table 19: Safeguards and management measures for Maritime traffic.

Aspect	Environmental safeguards	Timing
Maritime Traffic Management Plan	A Maritime Traffic Management Plan (MTMP) will be prepared and implemented as part of the PEMP.	Pre-works
Written notification	Written notifications advising of the works including dates, times and navigation restrictions will be circulated to all commercial vessel operators that use the waters within and around Stockton not less than 21 days prior to works commencing.	Pre-works
Marine Notice	A legal Marine Notice advising vessel operators of the works including dates, times and navigation restrictions will be placed at visible locations at local boat ramps in Stockton. The Marine Notice will include any restrictions.	Pre-works
Works impacting navigation	Any works impacting on navigation during the construction phase will seek NSW Maritime support 21 days prior to works commencing. A full scope of works including dates and time frames is to be provided to the relevant Maritime Compliance Officer.	Pre-works
Signage	Signage advising waterway users of the works and the potential effect on navigation will be erected at the Proposal site at least two weeks prior to the commencement of works.	Pre-works

Aspect	Environmental safeguards	Timing
Contingency	A Vessel Recovery and Salvage Plan will be submitted to the NSW RMS. In the event that a barge or dredge becomes dislodged due to heavy seas or any other occurrence, the plan will include reference to contingencies around removal.	Pre-works
Maintenance of movements	Where possible, current vessel movements and public accesses to the waterway and foreshore are to be maintained during works. Any disturbance is to be minimised as much as practicable.	During works
Compliance with marine safety legislation	Any barge and all associated work boats will comply with the relevant Marine Legislation for survey, crewing, registration and safety equipment.	During works
Vessel visibility	Vessels will exhibit lights and day shapes in accordance with *International Regulations for Preventing Collisions at Sea*. Due to the high volume of, and close proximity to, vessel traffic, additional lighting of barge/work boats will be undertaken to increase vessel and plant visibility including when unattended at night.	During works
Ancillary equipment	Any cables including anchor cables, pipes and ancillary equipment which presents as a potential hazard to people or vessels will be appropriately marked, including the use of lights at night. Marking of objects will be clarified with the relevant NSW Maritime Boating Safety Officer prior to placement.	During works
Anchor hazards	Submerged cables may present as a hazard to craft anchoring. These hazards will be mitigated through measures including (but not limited to) the application of appropriate signage and lighting, written notification to stakeholders and broadcasting of marine safety alerts to prevent anchoring issues, or impact on vessels retrieving their anchors.	During works
Navigation aids	The relocation, removal or additional installation of navigation aids will be done in consultation with NSW Maritime.	During works
Marine Rescue	Marine Rescue will be advised when works are in progress so that a message can be broadcast at regular intervals to notify commercial and recreational vessels of the operations. In the first instance CN will provide Marine Rescue with the Marine Notice to broadcast the restrictions and general awareness of the works in progress. Changes to times or work methods will be notified to Marine Rescue, and barge and dredge contractors will log on and log off with Marine Rescue daily.	During works
Boating Safety Officer	Should the area around the maritime operations need to be closed at any time during the works, notification to the NSW RMS Boating Safety Officer will be undertaken as early as possible.	During works

6.10 Aboriginal cultural heritage

6.10.1 Methodology

An Aboriginal Cultural Heritage assessment has been undertaken for the Proposal. The report is included in Appendix C.

6.10.2 Existing environment

The regional environment would have provided resources, including fauna, flora marine and estuarine resources that would have allowed for sustainable occupation of the area. Within the project area, the landform of the mobile sand sheet has proven to be favoured for past Aboriginal land use north of Stockton Beach in land and along the beach areas with an abundance of sites and a variety of site types throughout this landform.

In relation to modern alterations to the landscape, in locations where sea walls have been constructed and construction works along the former beach dunes for holiday parks, significant land disturbances have occurred and would have destroyed/removed any evidence of past Aboriginal land uses at those locations. In terms of natural processes, several significant beach erosion events have occurred over the past few years resulting in the removal of beach sands along with any cultural materials that may have been present. Due to both human and natural processes, the project area is highly disturbed and the likelihood of cultural material remaining in the project area is negligible.

Located on the eastern coast of New South Wales, The Worimi are the Original Custodians of the Port Stephens Area. Their connection to Mother (earth) spans further than westernised conceptual boundaries and predominantly lies in the areas today, known as the Hunter River to Forster, and inland to the Barrington Tops.

A search of the AHIMS register showed that 39 known Aboriginal sites were recorded within two kilometres of the project area. Two sites were in the project area. The State Heritage Register, the National Heritage List, the Commonwealth Heritage List, the National Trust Heritage Register and the relevant Local Environmental Plan have no Aboriginal objects, sites or places listed in the project area.

6.10.3 Potential impacts

As the placement of sand will occur without any dredging or excavation of the current ocean floor in the project area, there are reduced to no impacts to the cultural and spiritual connection of the Worimi.

As no sites have been identified (in the southern ACHA site area) and is highly disturbed through the complete removal of the beach through storms and wave actions, therefore further investigations are not justified. An Aboriginal Heritage Impact Permit (AHIP) is not required as the proposal itself is not expected to disturb any known items. If any sites are discovered during works, works at that location will cease and National Parks and Wildlife services contacted to ensure the appropriate management of these sites.

Potential impacts on the archaeological record and cultural heritage value of the site may occur if unexpected finds are encountered or accidentally damaged.

6.10.4 Safeguards and management measures

Safeguards and management measures for Aboriginal cultural heritage are provided in Table 20

Table 20: Safeguards and management measures for Aboriginal cultural heritage.

Impact	Environmental safeguards	Timing
General	A Heritage Management Plan (HMP) will be prepared and implemented as part of the PEMP.	Pre-works
Works footprint	The works footprint will be modified to avoid the known sites identified in Appendix C.	Pre-works
Awareness	All staff, contractors and others involved in on-site works are to be made aware of the statutory legislation protecting sites and places of significance. Of particular importance is the National Parks and Wildlife Regulation 2019, under the National Parks and Wildlife Act 1974. This will be included as part of a cultural awareness program developed with the Registered Aboriginal Parties (RAPs) within the site induction requirements.	Pre-works
Management of cultural materials	The RAPs involved in the assessment must be included in the management of the Aboriginal cultural materials within the project area as the project progresses	All stages
Unexpected finds	If potential archaeological items are uncovered during the works, all works in the vicinity of the find must cease and CN and Worimi Local Aboriginal Land Council contacted immediately. Works are not to proceed in the zone of influence of the item until CN have indicated that the contractor is permitted to do so.	During works

6.11 Historic heritage

6.11.1 Methodology

An historic heritage assessment has been undertaken for the Proposal. This is included at Appendix D.

6.11.2 Existing environment

Known maritime sites within the area include two shipwrecks – Durisdeer and Berbice – and the remains of a ventilation shaft from the Stockton Colliery. There are potentially over 100 undocumented or unlocated shipwrecks within the study area. Based on the available information, the study area is considered to contain high archaeological potential.

6.11.3 Potential impacts

Cultural heritage sites can be damaged because of direct and indirect impacts by a variety of processes. Damage is categorised as mechanical, chemical, or biological:

Mechanical damage: is where the physical integrity of the site is affected by the impacts of wave, surge, current, sand abrasion as well as cultural behaviour such as dredging, dragging anchors or vessels running aground. Increases in mechanical damage to a site can result from increases in tidal flows and increased exposure of sites to sediment erosion.

Chemical damage: relates primarily to the corrosion of the metal components of a site. Changes in pH levels, salinity, light levels (heat) and water movement can dramatically increase electrochemical (corrosion) activity for metal components immersed in seawater.

Biological damage: occurs where organic materials, such as wreck or wharf timbers, are exposed to biological organisms such as marine borers and bacteria, and in some cases vegetation. In relation to marine heritage sites, increased biological damage will occur if hitherto buried sites, or partially exposed sites, are further exposed, due to sediment erosion.

If a marine heritage site suffers from one or more of the above categories of damage it will become further 'scrambled'. The term 'scrambled' refers to alterations made to a site that make it more difficult to interpret/understand – that is, it results in the loss of information whether it be the loss/deterioration of physical fabric or loss of context (the relationship between artefacts). The term 'transformation' is used to describe alteration of material (such as breaking/pulverising, corrosion, or marine borer damage) and the term 'translation' is used to describe the displacement (removal and/or dispersal) of material.

The scrambling of a marine heritage site reduces its overall cultural heritage significance. The degree of the reduction of cultural significance for a particular heritage site is related to the scale and extent of damage.

The potential impacts to the archaeological resource in the study area include the dumping of dredged material directly onto delicate sites and sediment accretion as the dumped sand moves with the tides and general water movement. The accretion of sediments around and over heritage sites is generally seen as a positive impact. The accumulation of sediment over a site, whether from changed environmental conditions or placement of dredged material will, in effect, protect the site from marine borers and will also protect sites from intrusion, disturbance and removal. Mechanical and chemical damage will also be reduced. Sediment accretion is also generally favourable for coastal/littoral sites. However, such accretion can also have a negative aspect by resulting in the covering of sites which renders them invisible, hence more susceptible to accidental damage.

Overall, the impacts to the maritime archaeological resource can be considered in a positive light. However, due to the uncertainty surrounding currently exposed sites, the following safeguards are recommended.

6.11.4 Safeguards and management measures

Safeguards and management measures for historic heritage are provided in Table 21.

Table 21: Safeguards and management measures for historic heritage.

Impact	Environmental safeguards	Timing
General	A Heritage Management Plan (HMP) will be prepared and implemented as part of the PEMP.	Pre-works
Recording of Items	Within the sand placement area, a remote sensing survey should be undertaken to accurately record the positions of maritime archaeological sites currently exposed. The purpose of this survey is recording the current condition of the known sites of Durisdeer and Berbice and to record targets that have been identified through aerial images and charts and other sites that may have been more recently exposed through erosion. Identified targets should be dived on by a qualified maritime archaeologist to record the site. Such recording would include: a) Development of a site plan to provide a baseline for comparison in the future.	Pre-works

Impact	Environmental safeguards	Timing
	b) High definition video and photography to record the current condition of the site and any identifying features to assist in identification if required.	
Buffer zones	Buffer zones will be placed around exposed maritime archaeological sites to avoid dredged material being placed directly overhead and crushing or destabilising them. These sites include Durisdeer and Berbice. Other maritime sites within the sand placement area will require the same buffer as determined by the remote sensing and diver survey. The diameter of these zones will be 50m so as to avoid direct impacts to delicate sites.	Pre-works
Impact Permit	A permit will be sought through the Australasian Underwater Cultural Heritage Database (AUCHD) managed by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW). While the overall impact of the works is likely to not be negative, the exposed wrecks may still experience impacts from either accretion or erosion resulting from the works.	Pre-works

6.12 Waste management

6.12.1 Existing environment

The material to be placed on Stockton Beach is clean marine sand. The suitability criteria for the placement of dredged sands on to Stockton Beach are detailed in the *Stockton Beach Sand Management Guideline* (Royal Haskoning DHV, 2020). These criteria will be applied to available sand sources to ensure that the sand is suitable to be used for nourishment.

6.12.2 Potential impacts

The sand placement is unlikely to generate any waste. A small amount of waste would be produced at the compound sites which would primarily be general waste from workers. Bins would be available within each of the compound sites.

6.12.3 Safeguards and management measures

Safeguards and management measures for waste management are provided in Table 22.

Table 22: Safeguards and management measures for waste management.

Impact	Environmental safeguards	Timing
Suitability of sands	The *Stockton Beach Sand Management Guideline* (Royal Haskoning DHV, 2020) will be used to determine the compatibility of potential nourishment material.	Pre-works
Compound site waste	Waste material is not to be left on site once the works have been completed for each campaign.	During works

6.13 Climate change

6.13.1 Strategic framework

The potential impacts of climate change within the Hunter region have been outlined as part of the Hunter Central Coast Regional Environmental Management Strategy (HCCREMS, 2010).

The Newcastle Climate Action Plan 2021-2025 (City of Newcastle, 2021) recognises that there is a global climate emergency and an urgent need for meaningful action on climate change. CN has formally committed to the principles and targets of the Paris Climate Agreement.

6.13.2 Potential impacts

The *Newcastle Coastal Management Program Scoping Study* (City of Newcastle, 2019) identifies the potential impacts of climate change on the coastal zone to include:

- Coastal inundation associated with sea level rise and storm surges
- Extreme rainfall, flooding and storms
- Changes to fire weather conditions
- Changes to average rainfall
- Changes to average and extreme temperatures

The relevant threats to the community identified in the document include impacts on beach amenity and the use of the coastal zone.

Of relevance to the proposed works, machinery and equipment that relies upon fossil fuel energy will be used in the beach nourishment campaigns.

6.13.3 Safeguards and management measures

Safeguards and management measures for climate change are provided in Table 23.

Table 23: Safeguards and management measures for climate change.

Aspect	Environmental safeguards	Timing
Emissions reduction	Heavy vehicles used in beach nourishment campaigns will rely upon electric fuel options where available.	Pre-works
Procurement processes	Procurement processes used for beach nourishment campaigns will apply Council's targets and policies for the use of sustainable and recycled materials, as well as low emissions.	Pre-works

6.14 Cumulative impacts

The study area for this assessment of cumulative impacts is the City of Newcastle coastline. The sustainable management of Newcastle's coastline as a 'whole' is required to ensure that the environmental, social, economic, and recreational qualities of the coast are maintained and enhanced in the present and retained for the use and enjoyment of the community into the future.

The management of Newcastle's coastline presents various and significant cumulative challenges including increasing development pressure and use of the coastal zone and increased community expectations for mitigation and management of coastal processes.

7. Environmental management

7.1 General

A number of safeguards and management measures have been identified in this REF in order to minimise adverse environmental impacts, which could potentially arise as a result of the Proposal. Should the Proposal proceed, these safeguards and management measures would be incorporated into the relevant stages of the works.

A Project Environmental Management Plan (PEMP) will be prepared to describe the safeguards and management measures identified, and management plans specific to the aspects and impacts identified in this REF will be prepared prior to the commencement of works.

The PEMP will be prepared by CN and will provide a framework for establishing how the safeguards will be implemented and who would be responsible for their implementation.

The PEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements.

7.2 Licensing and approvals

Licensing and approvals are provided in Table 24.

Table 24: Licensing and approvals.

Instrument	Requirement	Timing
Crown Land Management Act 2016	The Crown Land Management (CLM) Act 2016 provides for the ownership, use and management of Crown land of NSW. Under Section 2.18 and Division 5.6 of the CLM Act the Minister may grant a licence authorising the use or occupation of Crown land for any purpose that the Minister thinks fit.	Prior to the commencement of any works.

8. Justification and conclusion

This chapter provides the justification for the Proposal taking into account its biophysical, social and economic impacts, the suitability of the site, and whether or not the Proposal is in the public interest. The Proposal is also considered in the context of the objectives of the EP&A Act.

8.1 Justification

8.1.1 Social factors

The Proposal would prevent the potential loss of public assets and improve beach amenity and recreational opportunities (surfing, surf life saving etc). The Proposal is also likely to prevent the loss of culturally important sites and heritage items.

8.1.2 Biophysical factors

The Proposal would prevent the loss of habitat through restoring the beach to its natural form and encouraging native species back into the area.

8.1.3 Economic factors

The Proposal would improve tourism opportunities because of improved beach amenity and have a positive impact upon coast-dependant business (e.g., surf schools, cafes, real estate agents etc). The Proposal would also prevent the loss and damage of both public and private property and assets and improve land values.

8.1.4 Public interest

The Proposal is in the public interest because it would achieve social, biophysical and economic benefits. The community have expressed a strong desire for all levels of government to take urgent action to address the coastal recession issues at Stockton and the Proposal would be a significant step in achieving the community's desired outcome.

8.1.5 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

The precautionary principle: The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. It provides that, where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

This principle was considered during the options development. The precautionary principle has guided the assessment of environmental impacts for this REF and the development of mitigation measures as follows:

- Issues that may cause serious or irreversible environmental damage because of the proposed project, and where there is scientific uncertainty as to the nature of the damage, have been considered.
- Best available technical information, environmental standards and measures have been used to minimise environmental risks.
- The preferred option minimises impacts on marine ecology, with consideration of sensitive areas.
- Measures have been included to avoid or minimise potential damage to known items or areas of heritage significance.
- Conservative 'worst case' scenarios were considered while assessing environmental impact.
- Specialist studies were incorporated to gain a detailed understanding of the existing environment.

Intergenerational equity: Social equity is concerned with the distribution of economic, social, and environmental costs and benefits. Intergenerational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations. Intergenerational equity has guided the Proposal design as well as the assessment of environmental impacts for this REF and the development of mitigation measures as follows:

- A preferred option was selected that minimises impacts on sensitive ecological areas to ensure that such areas are conserved for future generations.

- Water quality measures were included into the design to ensure that the impacts on the marine environment are minimised both for the short and long term.
- An Aboriginal heritage assessment was carried out during the environmental assessment phase to avoid or minimise the potential for irreparable damage to occur to Aboriginal cultural heritage.
- The economic benefits for surrounding areas for the current and future generations were considered.
- Issues that have potential long-term implications were minimised or avoided through concept selection and application of management measures.
- Benefits that the project provides to current and future generations of the local community and the surrounding region that would maintain or enhance the health, diversity and productivity of the environment were identified.

Conservation of biological diversity and ecological integrity: Management measures have been included in this REF to avoid, minimise and/or mitigate impact on marine biodiversity, description from ecology report. The Proposal would contribute to restoring the biophysical environment to a more natural state.

Improved valuation, pricing and incentive mechanisms: The principle of internalising environmental costs into decision-making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things. The following matters are relevant:

- Environmental issues were considered as key matters in the option selection process and in the economic and financial feasibility assessments for the project.
- The value of the project to the community in terms of improved benefit, safety and amenity was recognised.

8.2 Conclusion

Significance of impact under NSW legislation

The Proposal is unlikely to have a significant negative impact on any matter relevant under NSW legislation.

Significance of impact under Commonwealth legislation

The Proposal is unlikely to have a significant negative impact on any matter relevant under Commonwealth legislation.

9. Certification

This Review of Environmental Factors provides a true and fair review of the Proposal in relation to its potential effects on the environment. It fully addresses possible all matters affecting or likely to affect the environment as a result of the Proposal.

[redacted]

Name: Evan Watterson

Position: Principal Coastal Engineer | Director

Company: Bluecoast Engineering

Date: 6 February 2023

I have examined this Review of Environmental Factors and accept it on behalf of City of Newcastle.

Name:

Position:

City of Newcastle

Date:

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11. Terms and acronyms used in this REF

Term/ Acronym	Description
AHD	Australian Height Datum
AS	Australian Standard
BC Act	Biodiversity Conservation Act 2016 (NSW)

Term/ Acronym	Description
CM SEPP	State Environmental Planning Policy (Coastal Management) 2018
EIA	Environmental Impact Assessment
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW.
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased.
FM Act	Fisheries Management Act 1994 (NSW)
Heritage Act	Heritage Act 1977 (NSW)
ICNG	Industrial Construction Noise Guideline
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LALC	Local Aboriginal Land Council
LEA	Lead Environmental Adviser for Transport for NSW
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
MHWM	Mean high water mark
MNES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
NPW Act	National Parks and Wildlife Act 1974 (NSW)
PEMP/ CEMP	Project/ Construction Environmental Management Plan
Piles	Foundations used to support marine structures and offshore platforms
Pontoon	A floating structure serving as a dock
QA Specifications	Specifications developed by Transport for NSW for use with road work and bridge work contracts let by Transport for NSW.

Term/ Acronym	Description
Seiching	The formation of a standing wave in an enclosed or partially enclosed body of water. The key requirement for formation of a seiche is that the body of water be at least partially bounded, allowing the formation of the standing wave which then sways back and forth.
TfNSW	Transport for NSW

Appendix A: Concept Design

bluecoast
CONSULTING ENGINEERS

Hunter & Central Coast Development Corporation

Hunter and Central Coast Development Corporation (HCCDC)

Sand placement concept design

Stockton Beach nourishment

9 February 2023

Report No: 190130_NourishmentDesign_R5.00

Document Summary

Document Title	Sand placement concept design
Project Name	Stockton Beach nourishment
Client	Hunter and Central Coast Development Corporation (HCCDC)
Report No.	190130_NourishmentDesign_R5.00

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contribution of data made available for the project by Port Waratah Coal Services. This information was provided at nil cost to the State, as a public service to the community of Stockton. Without this information, the study would not have been possible.

Foreword

City of Newcastle (CN) commissioned the Hunter Central Coast Development Corporation (HCCDC) in association with Bluecoast Consulting Engineers (Bluecoast) to undertake a Stockton Beach Nourishment project. This project included several studies that were centred around the identification and delivery of suitable sand to Stockton beach, consistent with key actions in CN's Stockton Coastal Management Program 2020 (CMP) and the work being completed through the Deputy Premier's Stockton Beach Taskforce (Stockton Taskforce). The broader Stockton Beach Nourishment project has been documented in a series of reports, including:

- Beneficial reuse of South Arm dredged material
- Addendum to Beneficial reuse of South Arm dredged material: Area E
- Sand placement concept design (this report)

This sand placement concept design report assesses site constraints, engineering feasibility as well as the design and implementation for the renourishment of Stockton Beach considering a range of material sources and volumes. A series of technical drawings are also provided.

Acknowledgment: City of Newcastle has prepared this report with financial assistance from the NSW Government through its Coastal and Estuary Grants Program. This document does not necessarily represent the opinions of the NSW Government or the Department of Planning and Environment.

Executive Summary

The placement of sand as beach nourishment at Stockton Beach is the key strategy of the City of Newcastle's (CN) Stockton Coastal Management Program (CMP). This report supports CN's ambition to fulfill this strategy. This report is part of a wider study by Hunter and Central Coast Development Corporation (HCCDC) and CN that relates to both the sourcing, delivery and placement of sand for the nourishment of Stockton Beach. HCCDC, a state entity providing project management services for the City of Newcastle (CN), engaged Bluecoast Consulting Engineers to provide advice on these matters.

This report, the sand placement concept design report, describes the preparation of concept sand placement designs that cover a range of sand placement volumes and sand sources. The objective of the concept sand placement designs is to provide a plan that allows CN to progress a Review of Environmental Factors (REF) and seek approval for beach nourishment at Stockton Beach. The concept design is generic in nature to provide the basis for realisation of beach nourishment from a range of material sources and quantities. Detailed design of the nourishment works would be required when a specific project is identified.

A concept sand placement design to renourish sand lost from Stockton Beach was completed. Key elements of the assessment were:

- assessment of the engineering feasibility at the placement site
- development of a concept design that is generic in nature to provide the basis for realisation of beach nourishment from a range of material sources and quantities
- performance assessment for a range of sand placement volumes as well as two specific example nourishment exercises
- estimates of sand placement costs for an assumed set of potential beach nourishment sand source and equipment.

Key findings of the study are:

- The most likely and cost-effective method for dredging and transporting sand to Stockton from any wave exposed areas (e.g., offshore on harbour entrance areas) is by employing a small to medium size Trailer Suction Hopper Dredge (TSHD).
- To achieve nourishment of the full coastal profile at Stockton a combination of placement methods is required.
- A nourishment grid was developed defining a total of 100 placement boxes. These are arranged as 25 alongshore columns each with four cross-shore rows.
- An amenity nourishment concept design is configured along an approximately 1,100m stretch of beach between the northern breakwater and the southern end of Mitchell Street seawall. The objective of this design is to enhance the recreational amenity of the beach and nearshore area (surf zone) and provide a level of protective buffer against storm erosion in the short-term.
- A mass nourishment design that, in addition to the amenity benefits, provides an adequate level of coastal protection over a 2,800m stretch of beach from the northern breakwater and up to a point 800m north of Meredith Street.

The nourishment concept designs presented herein adopted a target morphology which addresses the key objectives and constraints of the beach nourishment works. The final material properties, placement volumes, sequencing, and execution depends on the available sand source, approval conditions and proposed method by the executing contractor.

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Acronyms and Abbreviations

Acronyms and Abbreviations	
BHD	Backhoe dredger
CD	Chart Datum
CMP	Coastal Management Program, specifically the City of Newcastle's Stockton Coastal Management Program 2020
CSD	Cutter suction dredger
D50	Median grain size
EIS	Environmental Impact Statement
LAT	Lowest Astronomical Tide
NHTG	Newcastle Harbour Tide Gauge
PSD	Particle Size Distribution
REF	Review of Environmental Factors
SHB	Split Hopper Barge
SLSC	Surf Life Saving Club
TSHD	Trailing Suction Hopper Dredger
Agencies and entities	
CN	City of Newcastle
DPE	Department of Planning and Environment
DAWE	Department of Agriculture, Water and the Environment
EPA	NSW Environment Protection Authority
HCCDC	Hunter and Central Coast Development Corporation
NCIG	Newcastle Coal Infrastructure Group
NPC	Newcastle Port Corporation
PoN	Port of Newcastle
TfNSW	Transport for New South Wales

1. Introduction

1.1 About this report

The placement of sand as beach nourishment at Stockton Beach is the key strategy of the City of Newcastle's (CN) Stockton Coastal Management Program (CMP). This report supports CN's ambition to fulfill this strategy. CN, with support by the NSW State Government, are actively progressing environmental approvals work required to beneficially place material for beach nourishment at Stockton. The purpose of this report, along with the associated drawings (Appendix A), is to provide concept design information to inform the required environmental assessments. To provide flexibility the concept sand placement designs consider a range of material sources and volumes (from 'amenity' to larger 'mass' nourishment). The report addresses actions in the Stockton CMP 2020.

1.2 Project location

Stockton Beach is the longest beach in NSW. It is a beach that grades from highly developed in the south to natural along its central northern sections. It extends almost 32km from Birubi Point in the north to the mouth of the Hunter River in the south. It occupies Stockton Bight, also known as Newcastle Bight. The southern end of Stockton Beach (hereafter, Stockton Beach or Stockton) is located on a sand peninsula immediately north of one of NSW's largest coastal rivers, the Hunter River, see Figure 1. Stockton Beach is Worimi country.

Figure 1: Study area.

1.3 Context of this report

In February 2020, following severe coastal erosion, Stockton Beach was declared a Natural Disaster Zone. The extent of the erosion problem is reflected in the eroded beach state, community frustrations and escalating coastal management costs. While typically triggered by storms, the underlying erosion problem is caused by a persistent net loss of sand from southern Stockton Beach. The recent Sand Movement Study (Bluecoast, 2020a) estimated that on average about 146,000m^3 of sand is lost from Stockton Beach each year. The main causal mechanism of the long-term erosion observed at Stockton Beach is explained by:

1. The blockage of natural sand supply from the Hunter River entrance and further south due to the impact of the deepwater shipping channel, which is formed by the entrance training breakwaters, artificially deepened navigation channel and on-going maintenance dredging, which when combined represents a physical barrier to natural sand bypassing.
2. The natural net northward movement of sand that, under the action of waves, acts to move sand out of the southern embayment.

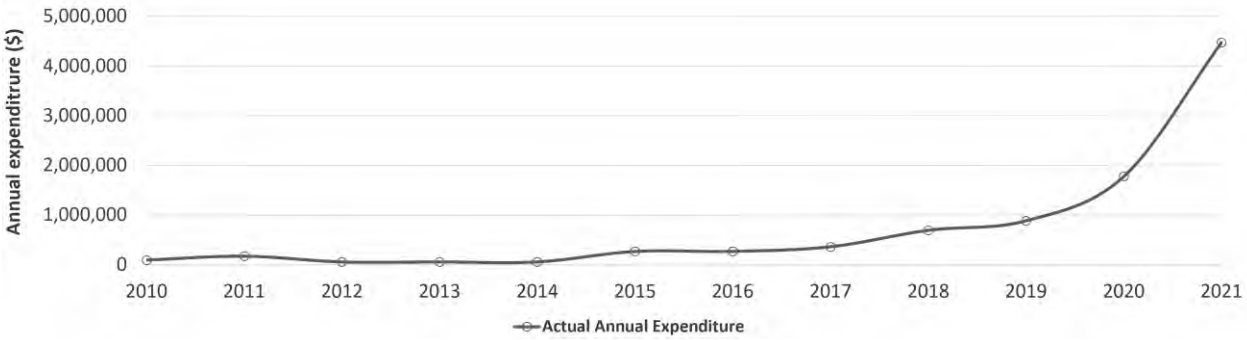


Figure 2: Last 11-years of CN's annual expenditure on emergency coastal management at Stockton Beach.

Note: Records of annual emergency expenditure sourced from CN. For the year 2021, expenditure include only the rock bag wall north of Meredith Street.

Between 1979 and 1983, capital dredging was undertaken to deepen the entrance channel to Newcastle Harbour. This included dredging of some 3 million m^3 of clean sand. The Newcastle City Alderman requested the sand be beneficial reused to nourish Stockton Beach. The then NSW Deputy Premier and former Minister for Public Works directed the Department of Public Works to examine this request. The feasibility report concluded:

"Due to the type of equipment available for use by the Dredging Contractor and the proposed method of operation of this equipment, suitable sand cannot easily be placed within the required limits of the beach profile without endangering the dredging equipment…..In conclusion it can be said that under different operational and geological circumstances the proposal to use dredging spoils from the deepening project to nourish Stockton Beach would be sound in both terms of engineering practicability and also from an economic point view."

Instead, 2.5 million m^3 of the clean sand was dumped offshore and the remaining 0.5 million m^3 was pumped around 5km to raise Kooragang Island. Both areas are outside the active coastal sediment compartment.

In 2010-2011 approximate 3 million m^3 of sand was removed from the South Arm and reused to create the NCIG's coal stockpile areas on Kooragang Island (WorleyParsons, 2012). NCIG also contracted dredging works to extract a further 1 million m^3 of clean sand from the river and dump it offshore outside the active coastal sand transport system. In 2017, Stolthaven dredged the berth pockets as part of their Mayfield 7 bulk liquids berth project. Despite a conditional approval that encourages reuse of suitable sand as beach nourishment, 180,000m^3 of sand was dumped offshore (water depth > 60m) on the dredge material grounds.

While much of the sand dredged from the Newcastle Harbour would have been ideal for beneficial reuse as beach nourishment, it has historically been dumped offshore. The key underlying reasons for this included:

- the approvals required to place the sand at Stockton Beach would have taken too long to obtain under the timeline of the respective dredging project
- assumptions regarding the limited capability of dredge equipment
- coordination between the material generator and the material receiver including consideration of any sand placement costs over and above that required for offshore disposal.

1.4 Project objectives

This report is part of a wider study by Hunter and Central Coast Development Corporation (HCCDC) and CN that relates to both the sourcing, delivery and placement of sand for the nourishment of Stockton Beach. HCCDC, a state entity providing project management services for the City of Newcastle (CN), engaged Bluecoast Consulting Engineers to provide advice on these matters.

A proactive approach from all levels of government is required to ensure that opportunities associated with future developments in Newcastle Harbour are not missed. The overall purpose of the study is to better prepare the City of Newcastle and the NSW State Government to:

1. Be the receiving entity for mass nourishment from any suitable source.
2. Deliver a smaller scale amenity nourishment campaign generated from a variety of potential sediment sources and initiatives.
3. Deliver ‘top up’ nourishment campaigns from a variety of potential sediment sources and initiatives to maintain the mass nourishment buffer.

Regarding objective 1, sand for mass nourishment may be delivered by the proponent of a future port development or from an offshore borrow area via a government-led project. The scope of the study Bluecoast are undertaking includes only borrow material from future port developments in the South Arm and does not consider offshore borrow areas or other mass nourishment borrow areas in Newcastle Harbour.

The overarching Stockton Beach nourishment study has two main components. These are:

- An assessment into the feasibility of sourcing sand from the seabed of Newcastle Harbour to renourish Stockton Beach (see Section 1.6).
- The preparation of concept sand placement designs that cover a range of sand placement volumes and sand sources (this report).

The objective of the concept sand placement designs is to provide a plan that allows CN to progress a Review of Environmental Factors (REF) and seek approval for beach nourishment at Stockton Beach. The concept design is generic in nature to provide the basis for realisation of beach nourishment from a range of material sources and quantities. Detailed design of the nourishment works would be required when a specific project is identified.

1.5 Scope and structure of this report

The scope of this report is in accordance with the project objectives and addresses the second component of this study, i.e., preparation of concept sand placement designs. The report sets out the required tasks as:

- **Section 2** provides background information on the project and the study area

- **Section 3** assesses the engineering feasibility at the placement site
- **Section 4** provides the concept design for sand placements at Stockton Beach
- **Section 5** provides a performance assessment for the sand placements
- **Section 6** presents cost estimates and durations for the sand placements
- **Section 7** provides a summary and recommendations
- Concept drawings of the sand placement design are provided in **Appendix A**.

1.6 Beneficial reuse report

The other main component of this study is a feasibility assessment into the beneficial reuse of material sourced from the seabed of Newcastle Harbour, specifically the South Arm, as beach nourishment. Constraints on this source, including contamination and proportion of fines, are considered in the assessment. This component is reported in the South Arm Beneficial Reuse report (Bluecoast, 2022). The objectives are:

- Verification of previously identified sand located in the South Arm within the approved future extension of shipping channels of the Port of Newcastle.
- Advice to facilitate coordination of beneficial reuse of sand arising from future capital dredging planned by others within the South Arm study area.
- Assessment of viability of dredging estuary sand within an area of existing approvals independent of capital dredging, as an alternative to terrestrial or offshore sand.

2. Background information

2.1 Stockton Beach Coastal Management Programs

City of Newcastle (CN) is progressing a sequence of integrated coastal management programs for its coastlines including Stockton. The Stockton CMP 2020 has been certified by the Minister and gazetted by CN. The Stockton CMP identified **beach nourishment** as its primary coastal management action to improve beach amenity and protect coastal lands. Further complimentary coastal management actions are currently under consideration for the extended Stockton CMP 2021.

Stockton CMP 2020 makes program and financial commitments for delivery of an *initial $4M million nourishment* campaign in 2021-2022 (Action # CH12, Table 9). The initial beach nourishment exercise is to provide interim improvements to beach amenity while larger scale mass nourishment is planned. This report responds to Action # CH10, which is to provide 'investigation, design, documentation and approvals' for the initial $4M nourishment campaign. CMP 2020 states that this initial nourishment exercise is:

- to be targeted at the Holiday Park and Dalby Oval frontages
- sourced from terrestrial or other permissible sand source.

In parallel, actions to obtain access for large scale mass nourishment and *ongoing* nourishment necessary into the future include investigations into the planning, approvals and funding mechanisms for various sand sources/opportunities (Actions # CH27 to CH32, Table 9) as well as partnerships (Action # CH46, Table 9). This report is related to Action # CH28 'seeking approval for beach nourishment works under Part 5 of EP&A Act covering receiving material from several sources for opportunistic nourishment campaigns.

2.2 Geomorphic setting

Stockton Beach is defined as the southern end of Stockton Bight, also known as Newcastle Bight. Stockton Bight is a 32km long beach (NSW's longest beach), the largest active dune system in Australia, one of the highest wave energy beaches in NSW and a beach that grades from highly developed in the south to natural along its central and northern sections. It is a beach that is impacted by waves, tides, river flows, wind and human modification, all of which vary alongshore. Combined, these present an extremely complex and dynamic natural system that within and through which, there is considerable sand movement.

Coastal sand barrier systems are common along the NSW coastline and are formed from long-term accumulation of marine sand by the action of waves, tide and winds. The coastal profile starts at the back of the dunes (if present) and tends to slope downward in an offshore direction. The profile can be divided into several zones displayed in Figure 3. The zones are divided based on their position on the profile (e.g., above water (sub-aerial) or below water (sub-aqueous) and for morphological processes largely driven by wave action (e.g., surf zone and closure depth beyond which active sand transport is not expected to be significant).

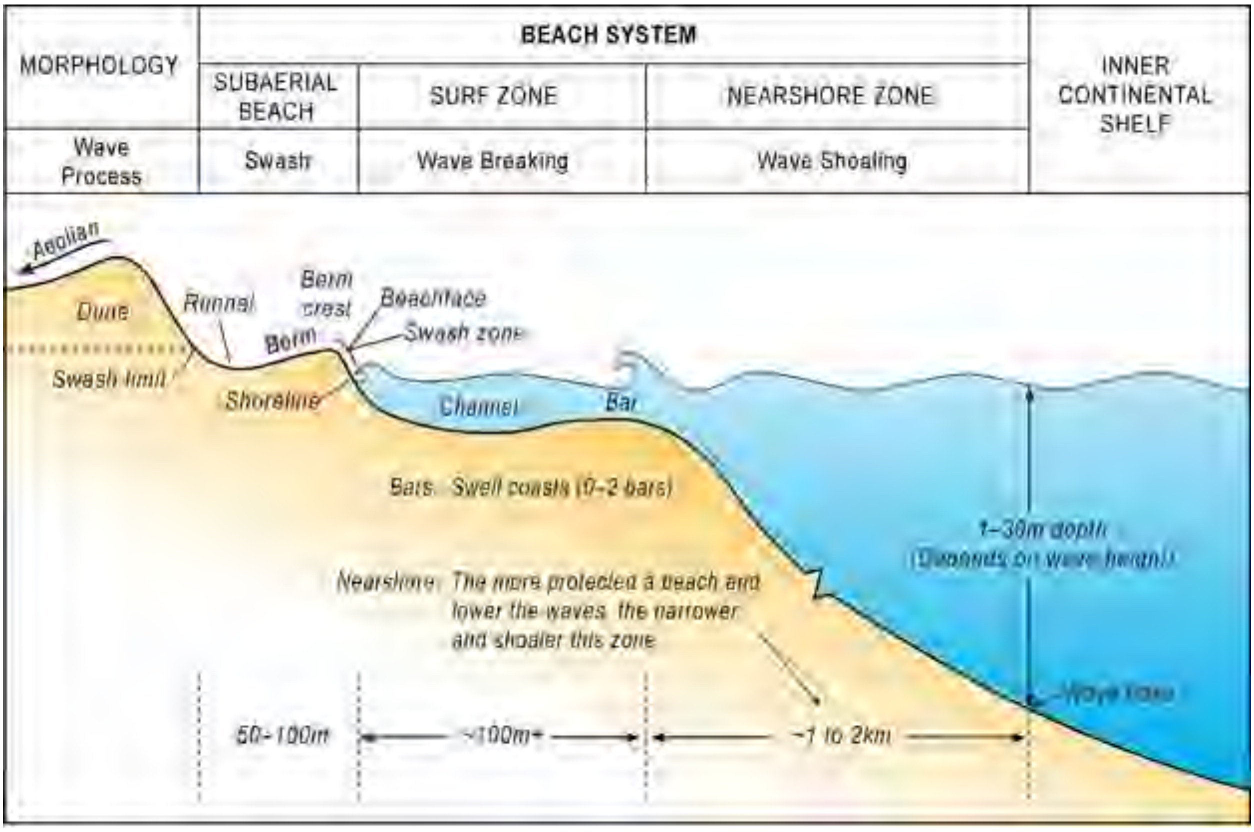


Figure 3: Definition of terms across the coastal profile (source: Short, 2012).

2.3 Existing environment at Stockton

Stockton Beach is a highly dynamic coastal environment and has experienced numerous coastal erosion events requiring, the construction of a range of temporary (e.g., sandbagging) and permanent protection measures. While historical analysis of erosion at Stockton suggested a cyclic nature of beach erosion and recovery, in recent years erosion has progressed beyond the extents of historical cycles. As described in Section 1.3, the erosion occurs due to the construction of the breakwaters and deep navigation channel which, when combined, represent a physical barrier to natural net northward sand movement. The erosion is impacting beach amenity and coastal assets. In recognition the NSW Government has declared Stockton Beach a 'Significant Open Coast Location' or coastal erosion 'hot-spot'. The NSW State Government and City of Newcastle are seeking a long-term solution to coastal management at Stockton Beach.

Bluecoast (2020a) developed a quantified conceptual sand movement model to link together the drivers and volumes of annual sand movement (see Figure 4). The most likely drivers for the observed sand volume changes were described based on observational data, previous literature, state-of-the-art numerical modelling and/or coastal processes knowledge. Wherever possible, the study used multiple lines of evidence to cross-check, validate and provide greater confidence in the findings. A net northerly longshore sand transport is fitted to explain the contemporary observations of sand volume changes. The southern Stockton Bight shows a net erosive trend while the northern area and dunes show a net gain in sand volumes. The pivot point of this trend was found approximately mid-way along the Bight where the shoreline turns more to the east. The highest annual net north-eastward sand transport rates were found adjacent to Fort Wallace, with transport rates gradually decreasing with alongshore distance in updrift and downdrift directions. The sand starvation of the southern embayment is compounded by a relatively lower natural onshore supply of marine sand compared to northern part of the Bight as well as periodic clockwise rotation of the Bight due to temporary variations in the offshore wave climate.

Most of the erosion in the southern embayment has been observed in the 'upper shoreface' (depths shallower than 10m), see Figure 5 and has been evident since survey records began over 200-years ago. More recently the erosion has had a greater effect on the beach face (i.e., the sub-aerial or dry beach), see Figure 6 and Figure 7. Based on volumetric analysis of historical topographic and bathymetric surveys the rate of sand loss from the full coastal profile within the southern embayment of Stockton Beach (compartments 4 and 5 in Figure 5) is estimated as 146,000m³/yr (±25%).

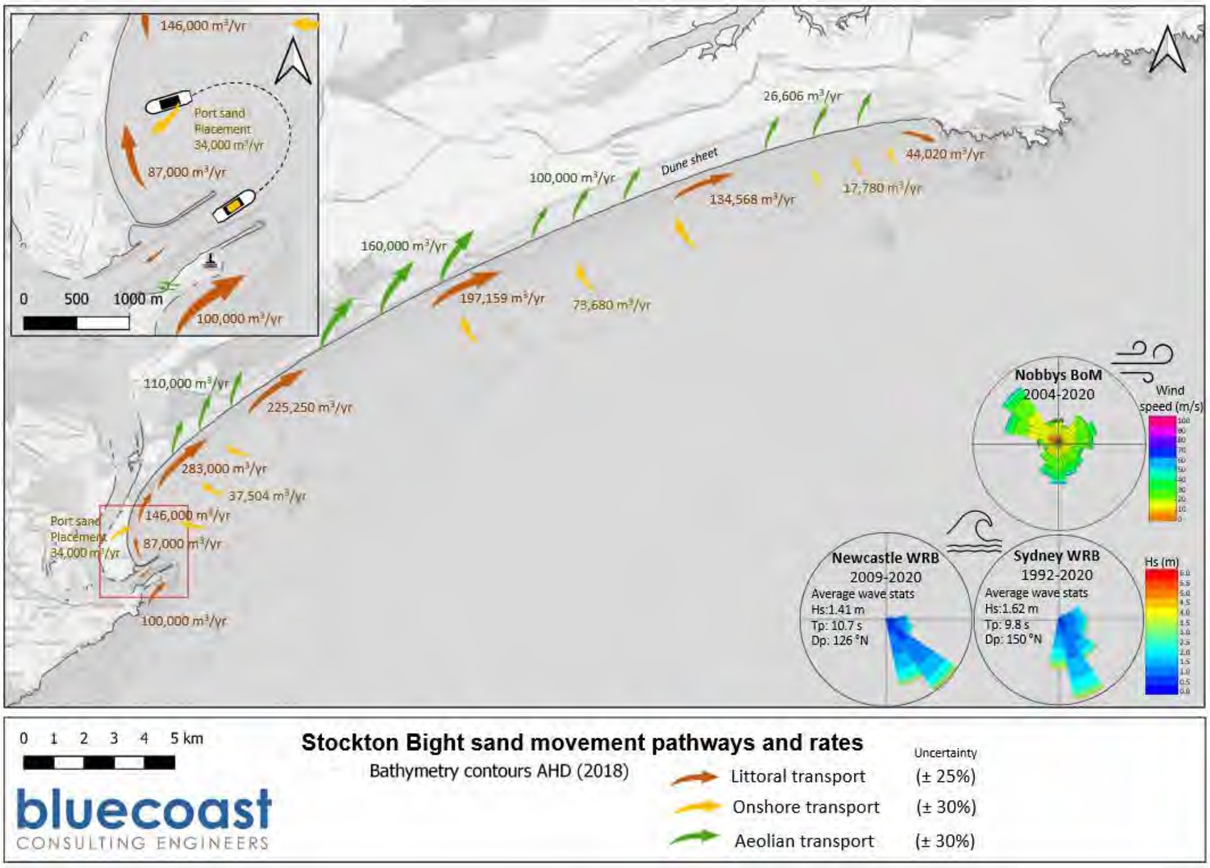


Figure 4: Quantified conceptual model of sand movements in the Stockton Bight (source: Bluecoast, 2020a).

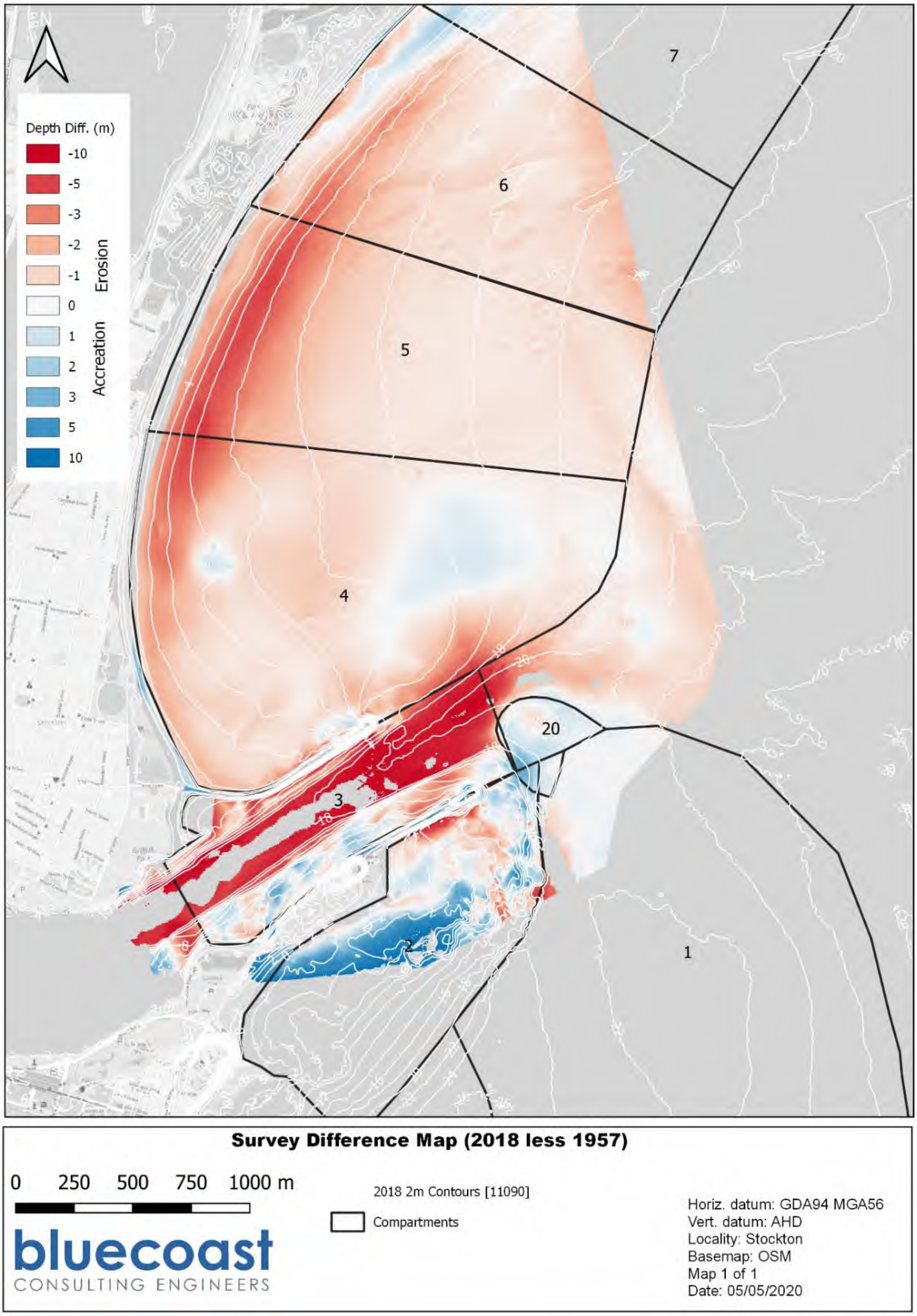


Figure 5: Survey difference map for 1957 relative to 2018 (source: Bluecoast, 2020a).

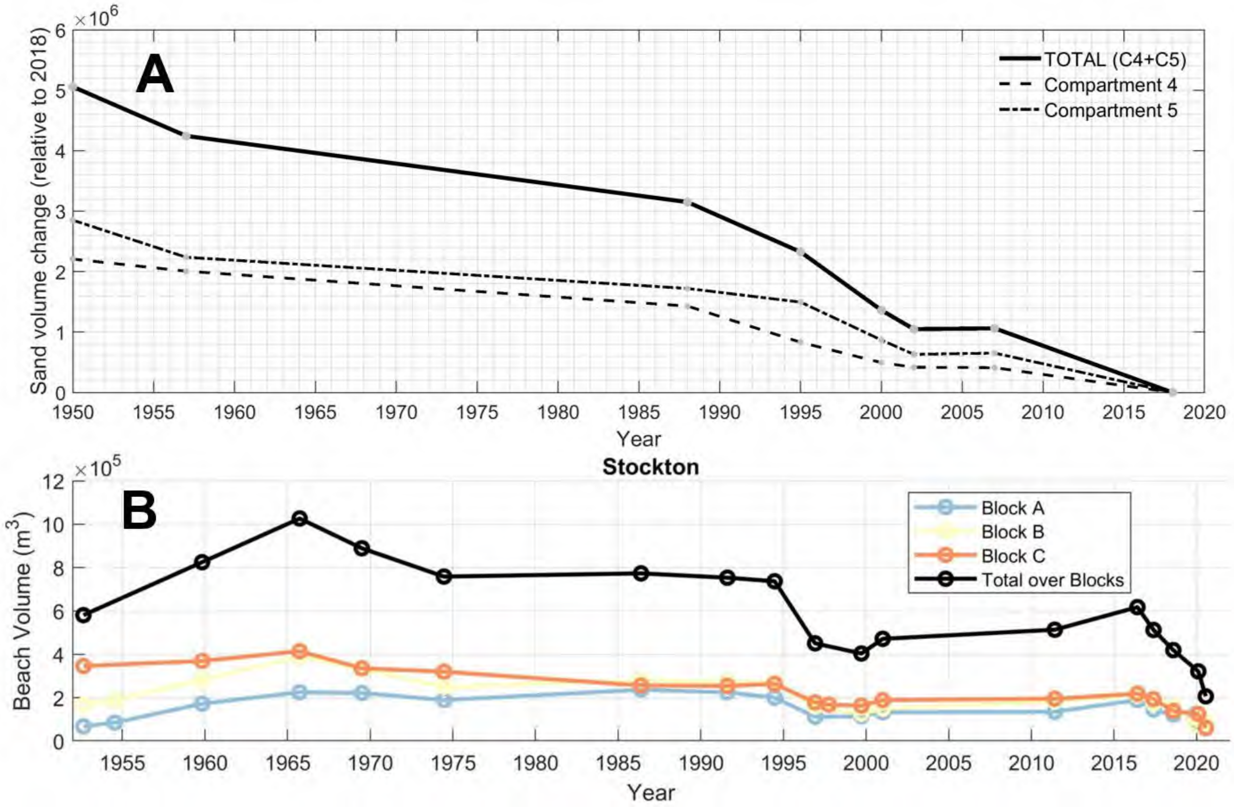


Figure 6: Timeseries of sand volume changes since 1950. A: Long term erosion of the upper shoreface in compartments 4 and 5 based on bathymetric survey. B: Beach volume change above 0m AHD based on photogrammetry (source: Bluecoast, 2020a).

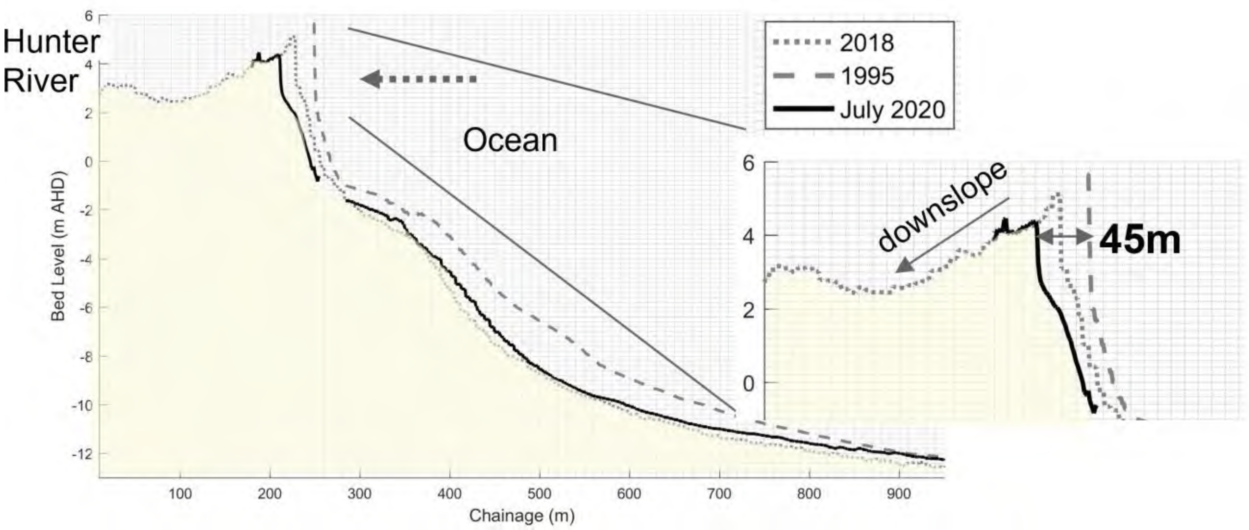


Figure 7: Receding coastal profile between 1995 and 2020 near Meredith Street (i.e., narrowest stretch of Stockton peninsula).

2.4 History of beach nourishment at Stockton

Beach nourishment is the placement of sand (or coarser material) to improve beach amenity and/or provide coastal protection for backshore assets. Beach nourishment is a “soft” management/engineering option and usually mimics natural beach and dune systems. Beach nourishment is regularly undertaken on the NSW coast, typically as placement of dredged material from channel/entrance maintenance. Larger scale beach nourishment (>1Mm^3) has not been undertaken in NSW since the initial Tweed Sand Bypassing (TSB) project’s dredging. Between 1995 and 1997 over 3Mm^3 of sand was dredged in NSW/Queensland and placed in Queensland. Sand extraction under the *Offshore Minerals Act 1999* requires authorisation through a mining licence. An applicant cannot apply for a mining licence without the Minister responsible for the *Offshore Minerals Act 1999* inviting applications.

Previous placement of sand at Stockton for the purpose of beach nourishment has been undertaken as follows:

- Regular (ongoing) nearshore placement of an annual average of 34,000m^3 of sand in approximately 8m water depth relative to AHD since 2009 in front of Mitchell Street seawall as part of Port of Newcastle’s navigation channel maintenance dredging. The sand placement site is dispersive with the bulk of the transport occurs firstly onshore and then into the littoral alongshore transport system with net northward movement. However, secondary sand transport pathway for the 2018 sand placement from the disposal site may be inferred from the surveys. It is recognised that these depend on the prevailing wave conditions at the time.

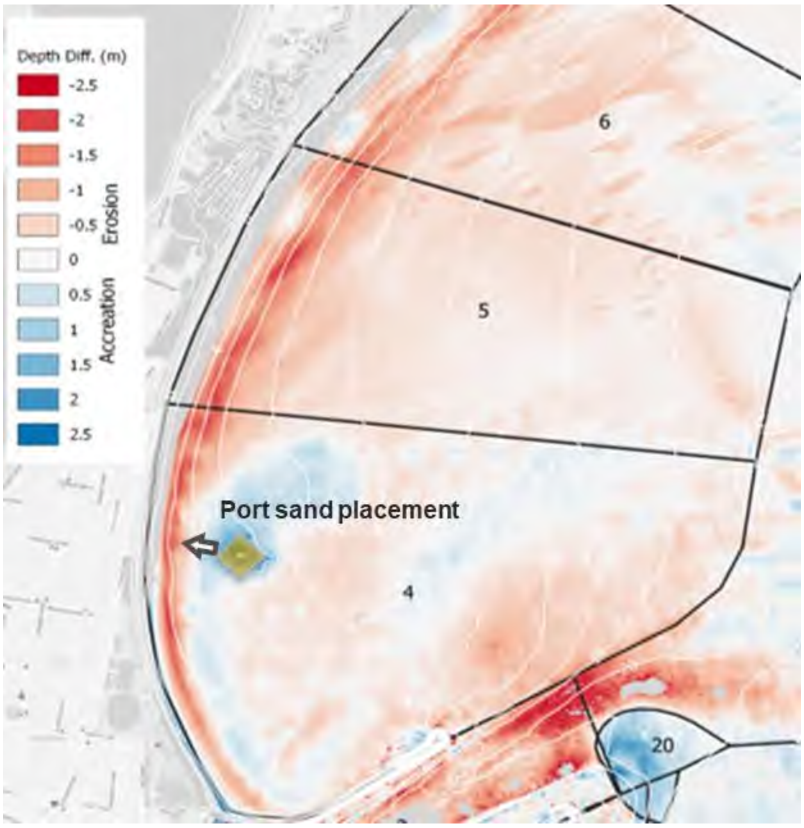


Figure 8: Seabed elevation difference between 2012 and 2018 showing the port’s sand placement in 2018.

- A pilot nourishment campaign was undertaken in December 2019 placing 3,500m^3 of sand from terrestrial quarries onto the subaerial beach in front of the Holiday Park (RHDHV, 2020; see Figure 9). The sand was delivered via 173 truckloads (32 tonne per truck) and distributed with a front loader within a 4-day period. The project cost was approximately $100/m³ (ex GST). Post-nourishment monitoring suggested that most of the placed material was lost from the subaerial beach within a 6-week period characterised with moderate wave conditions in absence of any significant events. It is noted that the source material grain size and colour was not as compatible with the native beach sand compared to marine sand sources.

It is unclear if beach nourishment placements were carried out prior to 2009 although there is reference to some sand placements in the 1960s.

Figure 9: Photographs from the December 2019 pilot nourishment campaign (left) in progress and (right) upon completion (source: RHDHV, 2020).

2.5 Sand placement site constraints

Relevant constraints in the project area that could potentially affect the sand placements were identified though a desktop review of existing information as well as previous community and stakeholder consultation.

A summary of the key constraints is provided in Table 1 and are mapped in Figure 10 to Figure 12.

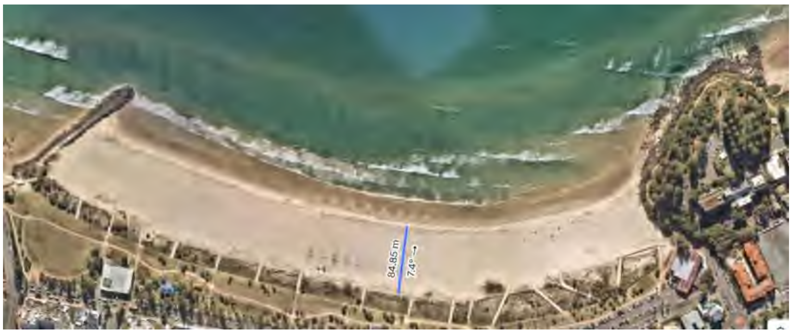
Table 1: Summary of key constraints relevant to beach nourishment at Stockton Beach.

<table>
<tr><th>Constraint category</th><th>Constraint</th><th>Description</th></tr>
<tr><td rowspan="2">Social</td><td>Beach usage</td><td>Disruption to beach usage requires consideration when choosing sand placement methods. Beach visitation at Stockton varies considerably between Little Beach (south of training wall), southern Stockton Beach and north of Mitchell St seawall as well as seasonally. Results from the CMP 2021 beach visitation survey are shown below.

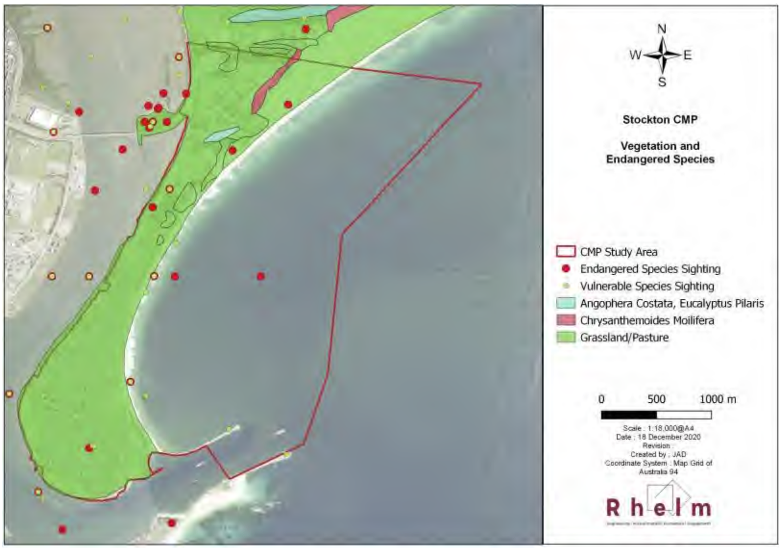
Beach visitation[1]

<table>
<tr><th rowspan="2">Beach</th><th colspan="2">Weekday</th><th rowspan="2">Weekend</th><th rowspan="2">Annual visitation</th></tr>
<tr><th>Normal</th><th>Summer holidays</th></tr>
<tr><td>South Stockton</td><td>188</td><td>319</td><td>526</td><td>82,001</td></tr>
<tr><td>North Stockton</td><td>63</td><td>107</td><td>138</td><td>21,384</td></tr>
<tr><td>Little Beach</td><td>59</td><td>100</td><td>280</td><td>31,389</td></tr>
</table></td></tr>
<tr><td>Beach width</td><td>An increase in beach width is expected to increase beach amenity. However, beyond a certain width, adding further square meters of sand will not improve beach amenity (indeed it may decrease overall amenity). For example, a recent community survey by Tweed Sand Bypassing[2] suggests that Coolangatta Beach (shown below) has been critised for being too wide (~85m from dune to high water mark). This is also raised in the NSW Sand Nourishment Guidelines (OEH, 2019).

Consideration needs to be given to perception of failure of a nourishment campaign by the community in regards to initial profile adjustments following sand placement. This is particularly the case for sand placements onto the sub-aerial part of the beach as the dry beach width typically reduces quickly, particularly following storm events.

</td></tr>
</table>

[1] Based on beach user count surveys undertaken by Rhelm between January and March 2021 as part of the Stockton CMP (Bluecoast, 2021)
[2] https://www.tweedsandbypass.nsw.gov.au/__data/assets/pdf_file/0007/1246309/012-3-Stakeholder-consultation-results-2020.pdf

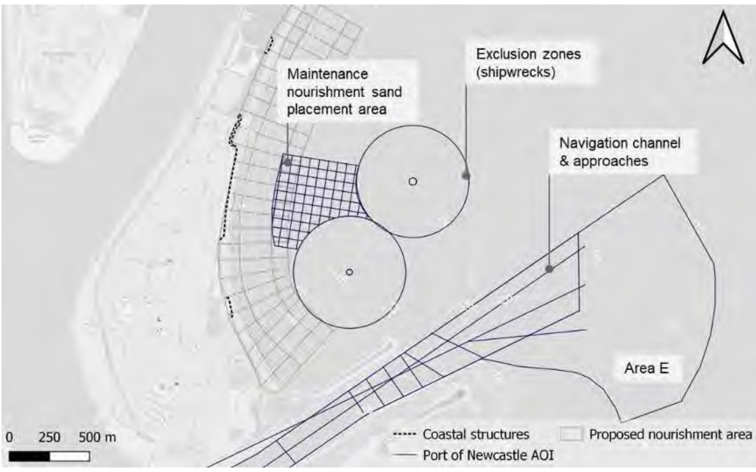
<table>
<tr><th>Constraint category</th><th>Constraint</th><th>Description</th></tr>
<tr><td></td><td>Cultural heritage</td><td>Cultural heritage sites and places of significance throughout the Stockton Bight need to be considered. Not all sites or places of significance are mapped in registers such as AHIMS highlighting the need for partnering with traditional owners. Known Aboriginal heritage sites are mapped in Figure 12. In addition, Pipis found within Stockton Bight are an important cultural heritage item to the Worimi.</td></tr>
<tr><td>Environmental</td><td>Sensitivity receptors</td><td>No sensitive habitat is shown on State Environmental Planning Policy (SEPP) mapping. However, some sightings of vulnerable and endangered species are listed for the project area, as shown on below map produced for the CMP 2021.

</td></tr>
<tr><td></td><td>Maritime heritage objects/ shipwrecks</td><td>Several shipwrecks and maritime objects such as tank traps and military vehicles are found in the nearshore of the project area (see Figure 12).

Heritage items cannot be damaged, disturbed or destroyed without a permit. Not all heritage sites are known (e.g., shipwrecks) and unexpected finds covered in Heritage Act, result in stop work orders.

As part of preparing the concept sand placement designs, consultation was undertaken with NSW Maritime Heritage. Advice received included:
• provided there is no intention to damage, move or destroy a relic then a permit or approval is not required
• reburial by natural sand movements or increasing the frequency of burial exposure is not considered to be a disturbance
• a reasonable operational buffer to avoid disturbance was considered appropriate for concept sand placement engineering considerations.

Based on consultation with dredging contractors, a 50m buffer was nominated as suitable for small to medium TSHD's. While this buffer is considered suitable for concept sand placement designs it is noted that the safe operation of a in a particular set of circumstances is a</td></tr>
</table>

Constraint category	Constraint	Description
		decision for the Master of the Vessel and may need further refinement once more is known on the executing vessel.
	Water quality	High quantities of fines contained in the source material can cause turbidity during placement and are socially and environmentally undesirable. However, it is important to recognise that during major rainfall events NSW rivers discharge large volumes of silt to the coast (see below example photograph showing Hunter River in 2021; source: Ron Boyd and Nearmaps aerial from June 2011 showing Hunter River fine sediment plume). This material naturally settles out on the continental shelf in depths typically exceeding 70m and contributes to the important ecological environment of the mid-shelf zone. Water quality implications specific to the source material need to be assessed as per Stockton Beach Sand Management Guideline (RHDHV, 2020).  
Physical	Plant and access	Beach access for land-based machinery is possible at Pirate Point at the base of the northern breakwater as well at Griffith Avenue north of Mitchell Street seawall, as shown on below aerial images.

Constraint category	Constraint	Description
		The southern section of Stockton Beach is relatively shallow restricting the access of deeper draft vessels. Land-based infrastructure required for pumping ashore options (e.g., pipelines/ slurry booster pumps) have a visual impact (and noise for boosters) that require consideration. Pipework can be buried where beach/dune area is sufficient.  
	Port of Newcastle operation	Exisiting port operations may provide constraints and opportunities for dredging, transport and placement of sand for beach nourishment at Stockton Beach. An overview of the key Areas of Interest in relation to this project's nourishment footprint is shown below. 
	Material compatibility	Ideally, source sand for beach nourishment should be similar in grain size (or slightly coarser) and similar in colour to native beach material. Grading curves based on sand samples from Stockton collected in 2011 are presented below (data source: WorleyParsons, 2012). However, usually source material will not exactly match the native beach grain size. Source material compatibility needs to be assessed as per the current and relevant sand management guideline. At the time of writing, Stockton Beach Sand Management Guideline (RHDHV, 2020) is the applicable guideline to assess compatibility.

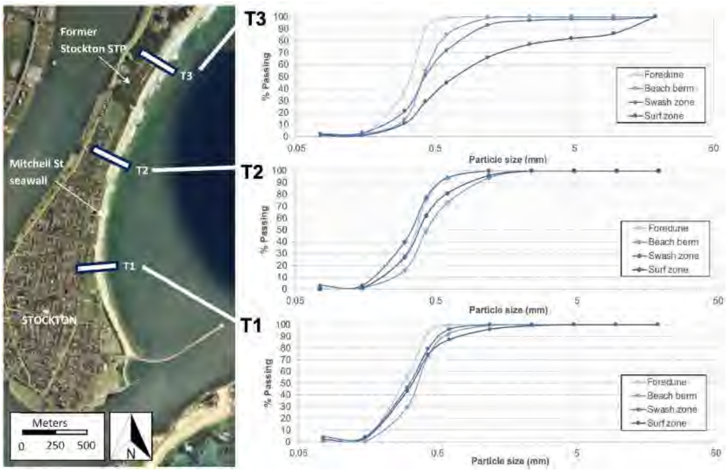
Constraint category	Constraint	Description
		
	Coastal processes	To avoid adverse impacts on coastal processes the beach nourishment should aim to maintain the beach morphology within the historic envelope of observed beach conditions at Stockton Beach (as documented in the Sand Movement Study; Bluecoast, 2020a).

Figure 10: Stockton Beach land management and areas of contamination.

Figure 11: Stockton Beach private and public assets.

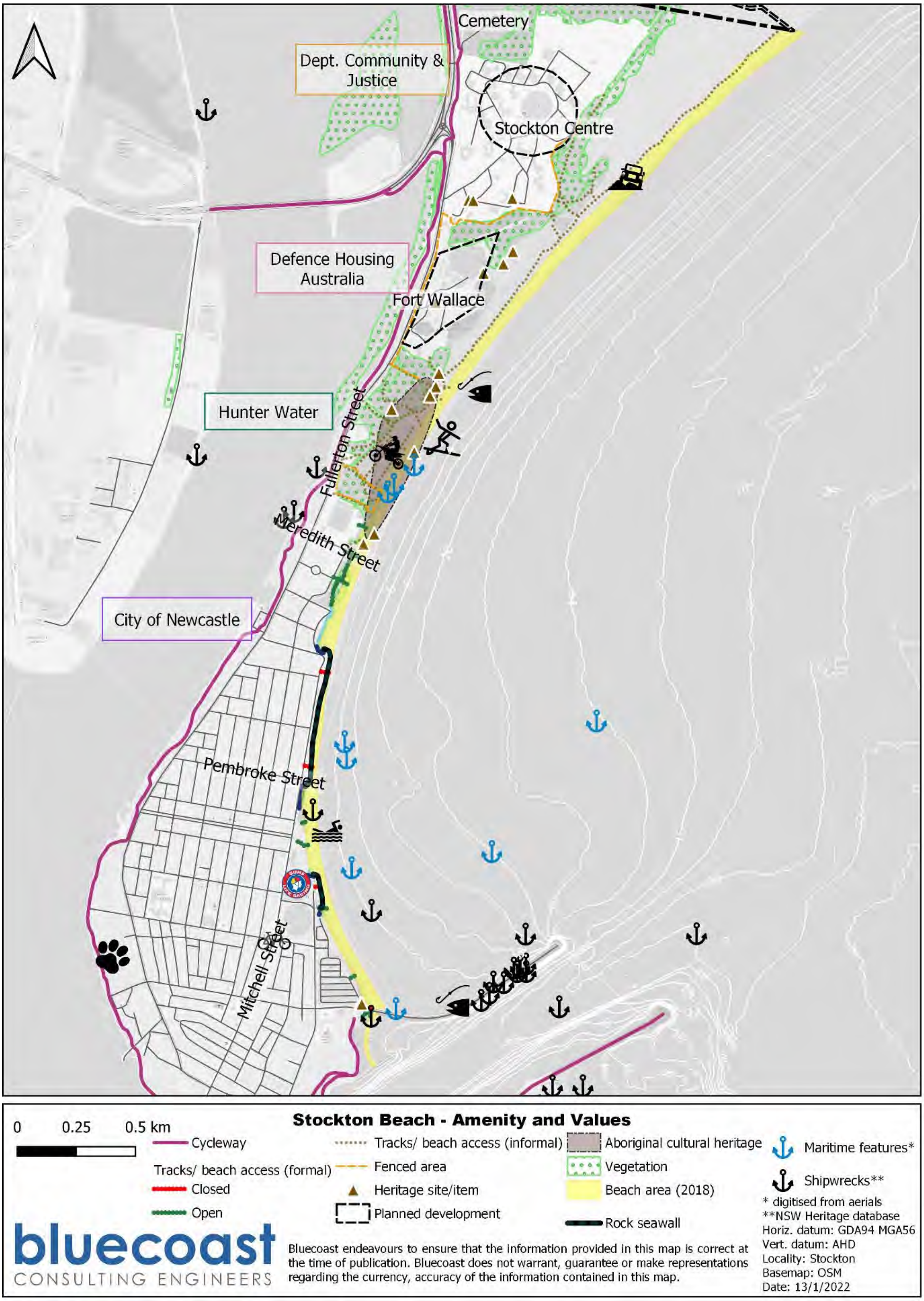


Figure 12: Stockton Beach community values and recreational use of the beach/ foreshore area.

2.6 Approval pathways

The following outlines the likely approval pathway, timeframes and key stakeholders and interested parties for beach nourishment at Stockton:

- Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act), with City of Newcastle as the proponent and consent authority. Additional permits and licenses will be required under *Crown Lands Management Act 2016* (DPI is consent authority). An Environment Protection Licence (EPL) under the Protection of the Environment Operations Act 1997 (POEO Act) will not be required as beach nourishment activities are not a scheduled activity under the POEO Act but a water quality management plan will be required. Key stakeholders will be Department of Planning and Environment (DPE), DPI Fisheries and Crown Lands (within DPE).
- Beach nourishment using suitable source material is unlikely to significantly affect the environment. As such, the placement activity is not expected to trigger the need for an Environmental Impact Statement (EIS). Environmental assessment would therefore require the preparation of a review of environmental factors (REF) involving:
    - Review of source material and material production
    - Baseline monitoring and modelling
    - Engineering design of placements
    - Assessment of environmental impacts (at receival site(s))
    - Community and agencies consultation

Approval pathways will be confirmed as part of the environmental assessment work to follow on from the concept designs. Regardless of the approval pathways, significant planning with a focus on ensuring that the proposed sand placement does not negatively impact coastal environmental values or natural coastal processes. If a Part 5 pathway is followed, determination of all approvals is expected to be completed within a 9- to 12-month period.

Furthermore, it is understood that CN have sort specific advice regarding the likely approval pathways for sand placements at Stockton as well as borrow areas. Advice has been sort from regulators, planning experts and planning lawyers. Once that advice is finalised, it should guide the environmental assessment work.

2.7 External funding sources

The State Government provides technical and financial assistance to local government to help manage the coastal zone. State Government funding is available to councils through the Coastal and Estuary Grants Program for preparing and implementing Coastal Management Programs. This grant program aims to manage risks from coastal hazards, restore and maintain coastal habitats and improve the health of estuaries, wetlands and coastal rainforests in NSW.

The NSW Coast and Estuary Grants Program is considered a possible funding source to support renourishment of Stockton Beach. Under this program, local councils are eligible to receive $2 for every $1 provided by the applicant (2:1 ratio). Grant applications must be in accordance with guidelines and applications are assessed through a competitive process.

Other external funding sources are potentially available with CN investigated these sources.

3. Engineering feasibility

3.1 Dredge vessels

A review of dredging equipment was undertaken to inform the sand placement concept designs. The potential sand sources available for beach nourishment at Stockton would either involve dredging within Newcastle Harbour, other areas within Hunter River estuary (e.g., North Arm), the entrance area or offshore. Depending on the source material depth and location the following type of dredge vessel may be suitable:

Trailer Suction Hopper Dredge (TSHD)

- suitable for dredging and transporting material (within hopper)
- suitable for placement via pipeline, bottom dumping or rainbowing
- requires water depth greater than >6-8m for dredging operation
- relatively high mobilisation cost (if suitable local dredge not available)
- relatively low unit rate for dredging/placement
- can operating in conjunction with other vessel traffic without overly affecting each other


Source: Tweed Sand Bypassing

Cutter Suction Dredge (CSD)

- requires relatively sheltered location for operation
- requires the installation of a pipeline to transport and place material at destination (potentially across navigation channel)
- relatively low unit rate for dredging/placement
- is a stationary dredger and can cause delays to for vessel traffic when dredging in a shipping channel


Source: City of Gold Coast

Backhoe Dredge (BHD)

- dredging depth is typically limited to 20 to 30m
- requires relatively sheltered location for operation
- typically requires support barges for transport of material
- relatively high unit rate for dredging/placement
- is a stationary dredger which can cause delays for vessel traffic when dredging in a shipping channel


Source: Napier Port

The most likely and cost-effective method for dredging and transporting sand to Stockton from any wave exposed areas (e.g., offshore on harbour entrance areas) is by employing a small to medium size TSHD. TSHD's are often used in beach nourishment projects as they can dredge in varying offshore wave climates and can discharge the sand in multiple ways (bottom dumping, rainbowing or through a bow connection and a floating pipeline (i.e., pump ashore)).

Alternative dredging equipment or a combination of the vessel types listed above could be used to effectively dredge and transport material to Stockton from upriver locations. For example, CSD's could be effectively work in the North Arm or South Arm of the Hunter River. BHD's and associated split hopper barges could also effectively work in these locations. The beach nourishment concept design presented herein allows for use of a variety of equipment based on availability at the time and/or contractor preference.

There are around 50 small TSHD (1,000 to 3,750m^3 hopper capacity) and 22 medium TSHD (3,750 to 6,000m^3) that have been identified for this project. Selection of an appropriate TSHD requires consideration of factors like maximum dredging depth, geographic location and work commitments and competitive advantages (e.g., loading efficiency). An overview of potentially suitable TSHDs is presented in Table 2.

Table 2: Overview of potentially suitable Trailer Suction Hopper Dredges (TSHD) for sand placements at Stockton.

Vessel	Draught (loaded)	Hopper capacity	Length	Dredging depth (extended)	Sand placement	Photo
David Allan TSHD	3.0m (4.4m)	1,000m^3	71.5m	TBC	Split hopper	
Modi R TSHD	1.5m (3.8m)	1,393m^3	67.1m	20m (24m)	Split hopper/ rainbow 50m	
Trud R TSHD	2.0m (3.8m)	1,570m^3	75.5m	28m (40m)	Split hopper/ rainbow 50m	
Albatross TSHD	1.85m (3.8m)	1,860m^3	75.0m	30m	Hopper doors/ rainbow 50m	
Brisbane TSHD	3.0m (6.25m)	2,900m^3	84.1m	25m	Hopper doors	
Balder R TSHD	3.8m (7.0m)	6,000m^3	111.3m	35m (65m)	Split hopper/ rainbow 120m	

3.2 Placement methods

Table 3 provides a summary of the ways sand may be placed for beach nourishment and the typical work methods used to place material in each area of the coastal profile at Stockton Beach. Figure 13 provides a graphical conceptual overview. To achieve nourishment of the full coastal profile at Stockton a combination of the described placement methods is required.

Table 3: Placement options for beach nourishment with excavated material.

Placement option	Example
Pumping ashore to nourish the visible beach (see ‘C’ in Figure 13) Pumping sand ashore onto the visible beach aims to broaden the existing beach and the existing dune systems (if present/accessible). The process would involve also pumping sand into the surf zone using floating pipe outlets. For this project, a typical approach may consist of: • pump sand slurry directly from dredge moving pipe outlets progressively along the beach up to approximately 1.5km. Sand could be pumped from either a TSHD or CSD across the northern breakwater at southern Stockton and/or across the peninsula at northern Stockton and distributed with land-based machinery • require additional equipment (e.g., pipeline, earth moving equipment on the beach, floating pipe outlet, slurry booster pumps for pumping beyond 1.5km) – some sections of pipeline may be buried and kept in place for future nourishment campaigns • sand placement in surf zone via floating pipe outlets to enhance post-nourishment profile for improved (perceived) longevity and swim/ surfing amenity • may cause disruption on beach usage during operations • may have potential visual impact as pumping onto subaerial beach is less effective in washing out fines from source material. Limitation on fines content for subaerial placement**s** are set out in Stockton Beach Sand Management Guideline (RHDHV, 2020b).	  Pump ashore operations for large scale beach nourishment in the USA.
Rainbowing to nourish the surf zone (see ‘A’ and ‘B’ in Figure 13) Some TSHD’s have ‘rainbow’ capabilities. This involves a sand slurry being jetted from the bow with the vessel positioned bow-in as close to the shore as possible. The objective is to widen the visible beach by moving the wave breaking zone seaward. The “losses” occur slowly and in a manner more consistent with a natural beach. For Stockton, a typical approach may: • require TSHD’s to transport material to the site and rainbow • smaller TSHD’s with reduced draft rainbowing directly onto subaerial beach	 A medium sized TSHD rainbowing on the Gold Coast (source: City of Gold Coast).

Placement option	Example
• rainbowing to the surf zone provides some washing out of fines/ mixing with native sediment prior to arriving on the visible beach	
Bottom dumping to nourish the nearshore (see 'A' and 'B' in Figure 11) Bottom dumping of nourishment material is suitable in the outer surf zone and nearshore area depending on vessel draft. After the dredge (or barge) has filled its hopper**,** it sails to the sand placement area it either opens hopper doors located at the bottom of the vessel or splits its hull (split-hopper). Split hopper is generally preferred as it allows for shallower placements. Nearshore placement aims to emulate a natural storm bar formation. If a storm arrives soon after beach nourishment, wave breaking may be triggered and thereby help protect the coast. However, if no storm arrives, the waves will redistribute the sand onshore. For Stockton, a typical approach may consider: • the method provides cost-efficient placement and cycle times • smaller TSHD with reduced drafts can place material in outer surf zone • placed material would be 'washed' and efficiently sorted by the natural coastal processes with source material mixing with native material and likely to be virtually undetectable at the visible beach • where this technique has been used in other NSW locations the beach response has been positive and there are additional recreational benefits if pattern placement is used	 Split hopper TSHD, the David Allan, placing material at Stockton Beach in August 2018 (RHDHV, 2020; photo: Peter Cousins).

Figure 13: Conceptual diagram of feasible placement methods for beach nourishment at Stockton Beach.

3.3 Operability

3.3.1 Limiting wave conditions

Due to the high cost of the equipment involved in beach nourishment operation using TSHD's typically take place seven days a week, 24 hours per day. However, there are limits on the workable sea-state conditions for which dredging, and placement operations can be safely carried out. Should unfavourable swell conditions be encountered during the execution period there is a risk that the dredgers cannot work, and sand delivery is compromised.

Limiting wave conditions for TSHD are vessel and operation specific. Wave direction, wave period, wind direction, currents and a combination of these will influence the limiting sea states significantly. Whether a vessel can work in a particular set of conditions is a decision for the Master of the Vessel. For the purposes of this exercise the following parameters, modified from Pro Dredging (2013) and Van Ord (2012) after consultation with the dredging industry, have been selected as limiting factors across various placement operations for all TSHD sizes considered:

- Dredging: Hs <=1.5m
- Dumping: Hs <= 2.0m
- Rainbowing: Hs <= 1.5m
- Pumping ashore: Hs <= 1.5m

Application of these limiting wave heights can be considered as a general guide to operability of sand placements at Stockton.

3.3.2 Downtime due to limiting wave heights

To provide guidance on the expected downtime for various sand placement operations estimates of operability were calculated. This involved:

- A 11-year (2009 to 2020) record of waves measured by the Port Authority of NSW at the entrance to Newcastle Harbour in 22m water depth was transformed to the three inshore locations shown in Figure 14. The inshore wave transformation was based on a limited number of wave conditions simulated with a detailed SWASH wave model.

- Using the transformed inshore wave climate, wave height exceedance curves were plotted for each site (see Figure 15). From these the annual percentage of expected downtime for each site/operation was determined as presented in Table 4.

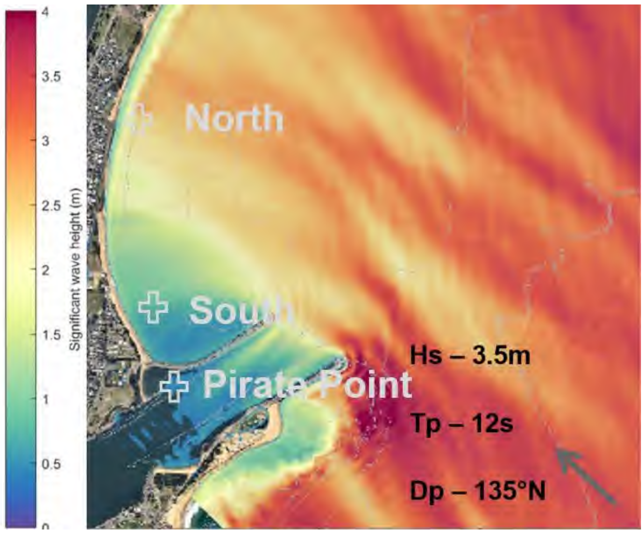


Figure 14: SWASH nearshore wave height map for moderate (Hs = 3.5m) offshore swell waves and three inshore extraction locations.

Southern Stockton Beach and Pirate Point are relatively sheltered from swell waves due to the harbour infrastructure. Based on the preliminary operability assessment it is expected that downtime is minimal for all sand placement operations in this area. North of Mitchell Street seawall, less sheltering is afforded and downtime due to sea state is in the order of 3% and 10% for bottom dumping and rainbowing/ pumping ashore, respectively. Depending on the sand source and associated dredging location, downtime due to sea state must also be considered for dredging operations. At the harbour entrance, wave heights may exceed the limit for safe dredging operations up to around 30% of the time based on the Newcastle Waverider Buoy (WRB) (for an assumed limiting significant wave height of 1.5m).

The downtime assessment completed is preliminary in nature. It is based on assumed limits and available site conditions. It does not consider all the factors that can influence workability.

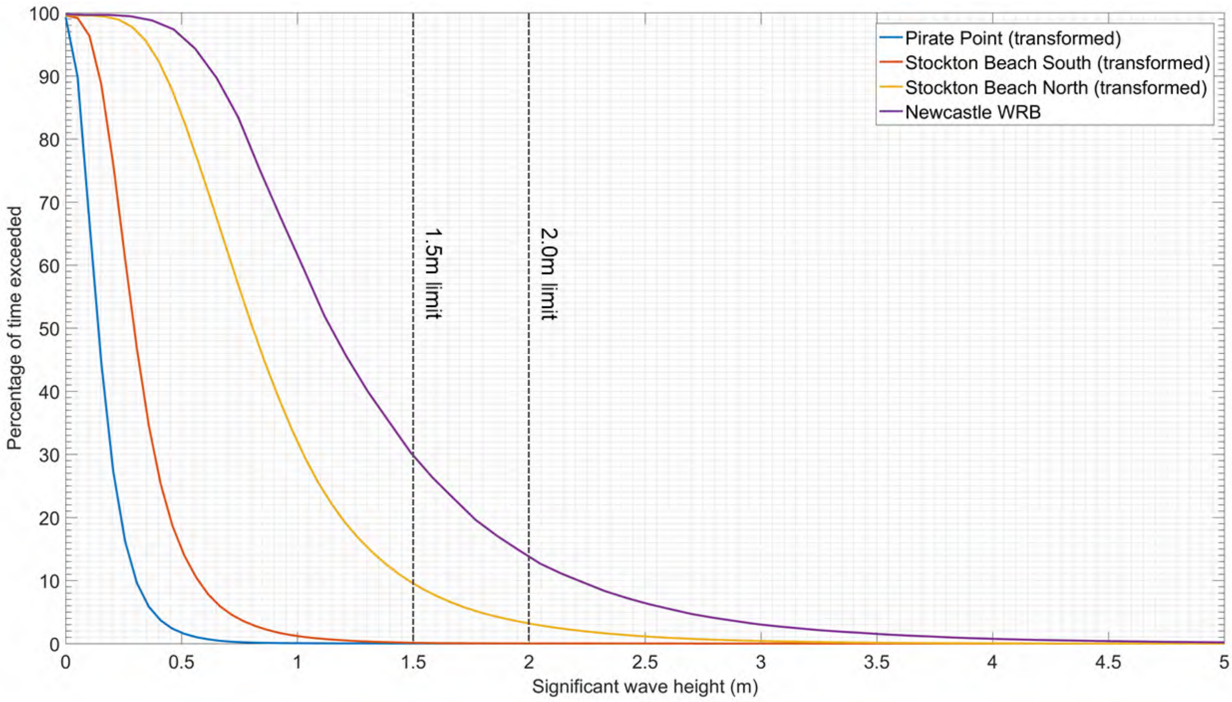


Figure 15: Wave height exceedance curves for Newcastle WRB and transformed inshore locations.

Table 4: Typical annual average downtime expected for beach nourishment operations.

Operation	Assumed wave height limit (m)	Downtime due to limiting wave heights (%)			
		Pirate Point	Stockton Beach (South)	Stockton Beach (North)	Area E (WRB)
Dredging	1.5	*NA*	*NA*	*NA*	30%
Bottom dumping	2.0	<1%	<1%	3.1%	*NA*
Rainbowing	1.5	<1%	<1%	9.7%	*NA*
Pumping ashore	1.5	<1%	<1%	9.7%	*NA*

3.3.3 Preferred execution period

Figure 16 presents monthly averages of wave heights for the Newcastle WRB and associated operability at the four inshore locations for a 1.5m Hs working limit (using the transformed inshore wave heights). It is apparent that the period from November till January provides the most favourable sea-state conditions with average significant wave heights for the three months in the order of Hs = 1.3m and average peak periods of around Tp = 9 to 10s. This is below the limiting sea-state conditions for the dredging and sand placement operations. It is noted that the operability is calculated based on average monthly wave conditions and that these may vary year to year.

The period from November to January would be the most opportune period for executing the beach nourishment works, as it is less likely for the project to be interrupted by unworkable sea-state conditions.

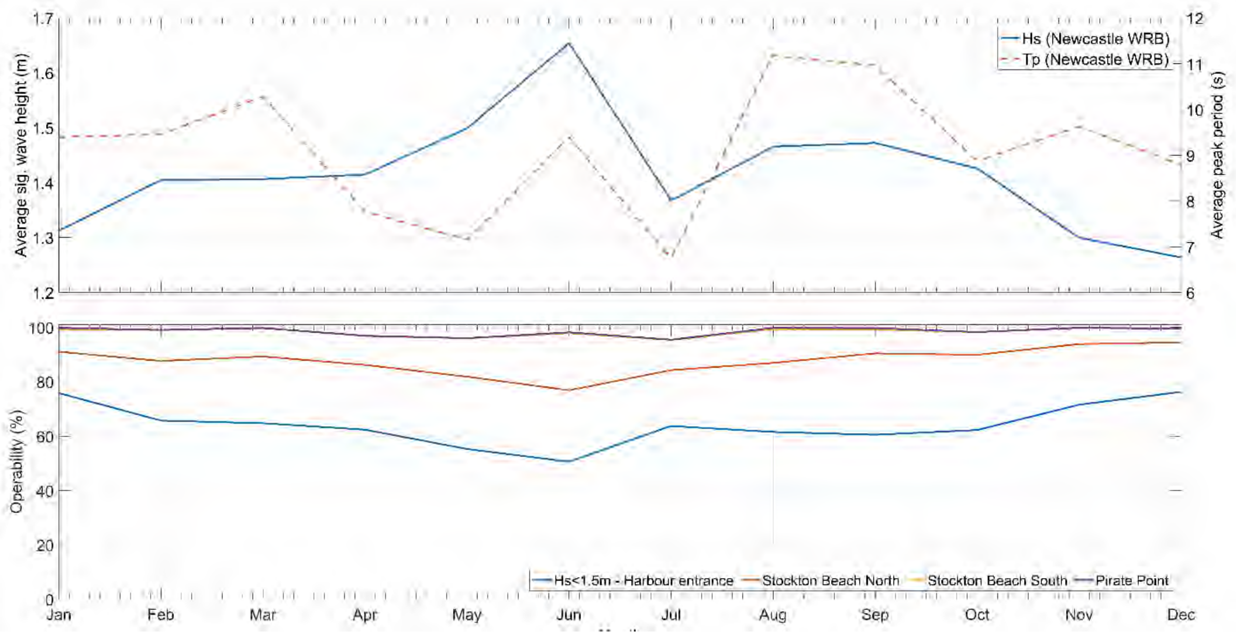


Figure 16: (top) Average monthly wave heights and periods derived from Newcastle WRB and (bottom) associated average operability at inshore locations (1.5m limiting wave height).

3.3.4 Other delays

Other non-weather related factors may effect the efficency of the sand placements. Other factors effecting workability include:

- Newcastle Harbour is a busy coal export terminals. Bulk carriers reguarly passing through the navigation channels. Dredging operations will be required to stop and clear the area when large commercial ships are passing the dredging area.
- Equipment breakdown, refueling and other operational delays, which are normally carried by the dredging contractor.

4. Concept sand placement designs

4.1 Preamble

The nourishment concept designs presented herein seeks to identify a target morphology which addresses the key objectives and constraints of the beach nourishment works. The nourishment designs allow CN to progress a Review of Environmental Factors (REF) for beach nourishment (and gain subsequent approval) at Stockton Beach.

The final material properties, placement volumes, sequencing, and execution depends on the available sand source, approval conditions and proposed method by the executing contractor. A placement schedule would then be developed and managed throughout the nourishment campaign considering a range of variables including sea-state (including forecast) and the morphology/ coastal profile in the lead up and during the work period as well as contractor operations and minimising impacts on beach users.

4.2 Nourishment objectives

To fully appreciate the dynamics of the beach system a ‘sand movement study’ of the entire Stockton Bight sediment compartment was completed in accordance with the NSW *Coastal Management Act 2016* (Bluecoast, 2020a). The sand movement study estimated that about 146,000m^3 of sand is lost from Stockton Beach each year[3]. The main causal mechanism of the long-term erosion observed at Stockton Beach[4] is explained by:

1. The blockage of natural sand supply from the Hunter River entrance and further south due to the impact of the deep-water shipping channel (formed by the entrance training breakwater and artificially deepened channel) which represents a physical barrier to natural sand bypassing. The on-going dredging activities required to maintain the channel depths result in the cumulative extraction of large quantities of marine sand from the coastal sediment compartment; and
2. The natural net northward movement of sand that, under the action of waves, acts to move sand out of the southern embayment.

As a result, the coastal erosion at Stockton has proceeded beyond an acceptable natural sandy buffer (i.e., the buffer does not provide an acceptable level of coastal protection or beach amenity).

The preferred coastal management strategy emerging from the Extended Stockton CMP is ‘Scheme 1: Mass nourishment on-going sand top-ups’. This scheme adopts a ‘keep sand moving’ approach to restore the natural supply of sand to the Stockton, addressing causal mechanism number 1. Under this preferred coastal management strategy, the objectives of beach nourishment at Stockton are to:

1. Restore the sandy buffer to provide an acceptable level of coastal protection and beach amenity.
2. Maintain the acceptable sandy buffer by restoring the natural sand supply.

Objective 1 is planned to be achieved by the delivery of mass nourishment while the regular and on-going sand top-ups maintain the buffer to achieve objective 2. Nourishment sand is to be sourced from outside the active coastal profile in the Stockton Bight sediment compartment.

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[3] On average sand, sourced from the port dredging activities, has been placed at a rate of 34,000m^3/yr, resulting in a net sand loss rate of 112,000m^3/yr (Bluecoast, 2020a).

[4] Here Stockton Beach is taken to mean southern embayment from breakwater to Fort Wallace and across the full coastal profile from the crest of the dune down to the closure depth for wave driven sand movements.

In recognition that delivery of mass nourishment has significant implementation challenges and long lead times (see Figure 17), the Stockton CMP 2020 proposed an initial $4m nourishment campaign to enhance beach amenity in the short-term. This is referred to herein as 'amenity nourishment'.

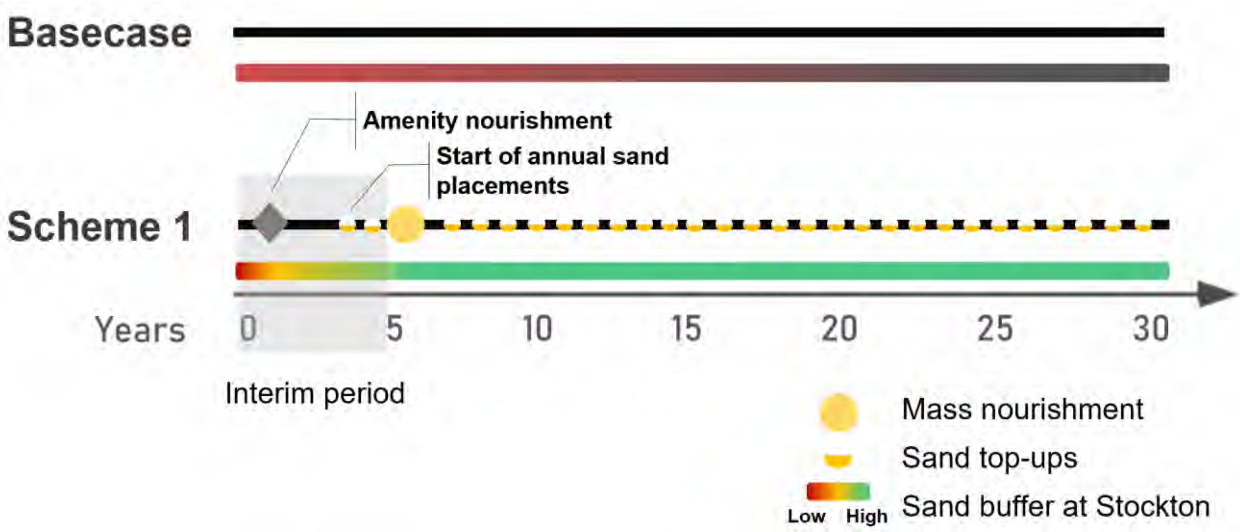

Figure 17: Indicative timing of works and sandy buffer performance over a 30-year period for beach nourishment.

Note: The coloured bar indicates the state of the sand buffer along Stockton Beach. The base case consists of business as usual, with continuation of Port sand placements at the current rate but no new beach nourishment.

The concept sand placement designs presented here are focused on the amenity and mass nourishment exercises. However, consideration is given to ongoing sand placements.

On-going sand placements should be delivered in an integrated manner with a strong preference for the use of local resources and sustainable coastal management. Given the proximity to Newcastle Harbour and its requirement for on-going maintenance dredging, a strategic alliance with the Port of Newcastle (PON) would significantly offset costs (RHDHV, 2020). Port of Newcastle currently place some 25,000 to 34,000m^3 of sand from maintenance dredging in 'Area E' as beach nourishment. These annual placements only partially outset the impacts of the deep-water shipping channel. The residual annual sand placements requirement is approximately 112,000m^3/year.

Action # CH13 of the Stockton CMP 2020 requires PON to continue its current sand placements from maintenance dredging activities offshore of Stockton Beach. PON are supportive of this action and committed to work collaboratively with CN.

4.3 Placement design

4.3.1 Conceptual approach

To allow a variety of possible sand sources and associated source material volumes be used, the concept designs are generic in nature, they do not use absolute sand volumes. To illustrate how they can be applied two nourishment schedules (one for amenity and one for mass) with assumed volumes are provided in Section 4.4.

Subsequent detailed design of individual beach nourishment exercises is recommended and would incorporate absolute placement volumes (once known) and refined in line with further site constraints and approval conditions (once known). A discussion on possible alternative design considerations is provided in Section 4.5.

4.3.2 Nourishment grid

A nourishment grid was developed based on the nourishment strategy, the feasible placement methods described in Section 3.2 and the local bathymetry and beach contours (2018 Coastal LiDAR survey). The nourishment grid defines a total of 100 placement boxes. These are arranged as 25 alongshore columns each with four cross-shore rows (see Figure 18):

- Beach boxes – this placement area extends from the dune/ upper beach to the -2m AHD depth contour. Sand placements can be achieved from land or from sea/river by pumping ashore directly onto the subaerial beach or the inner surf zone as well as rainbowing with a small TSHD.
- Bar boxes – this placement area extends from the -2m to -3.5m AHD depth contour. Sand placement is possible via bottom dumping with a small TSHD, rainbowing from a medium TSHD and pumping from the river via beach using a floating pipe outlet.
- Nearshore boxes – this placement area extends from the -3.5m AHD depth contour to 200m seaward. Sand placement would likely be undertaken using bottom dumping with a small or medium TSHD.
- Offshore boxes – this placement area extends from the seaward end of the nearshore boxes to 100m further seaward. Sand placement could be undertaken with any sized TSHD via bottom dumping.

The boxes are numbered sequentially from beach to offshore (first digit) and from south to north in alongshore direction (last three digits).

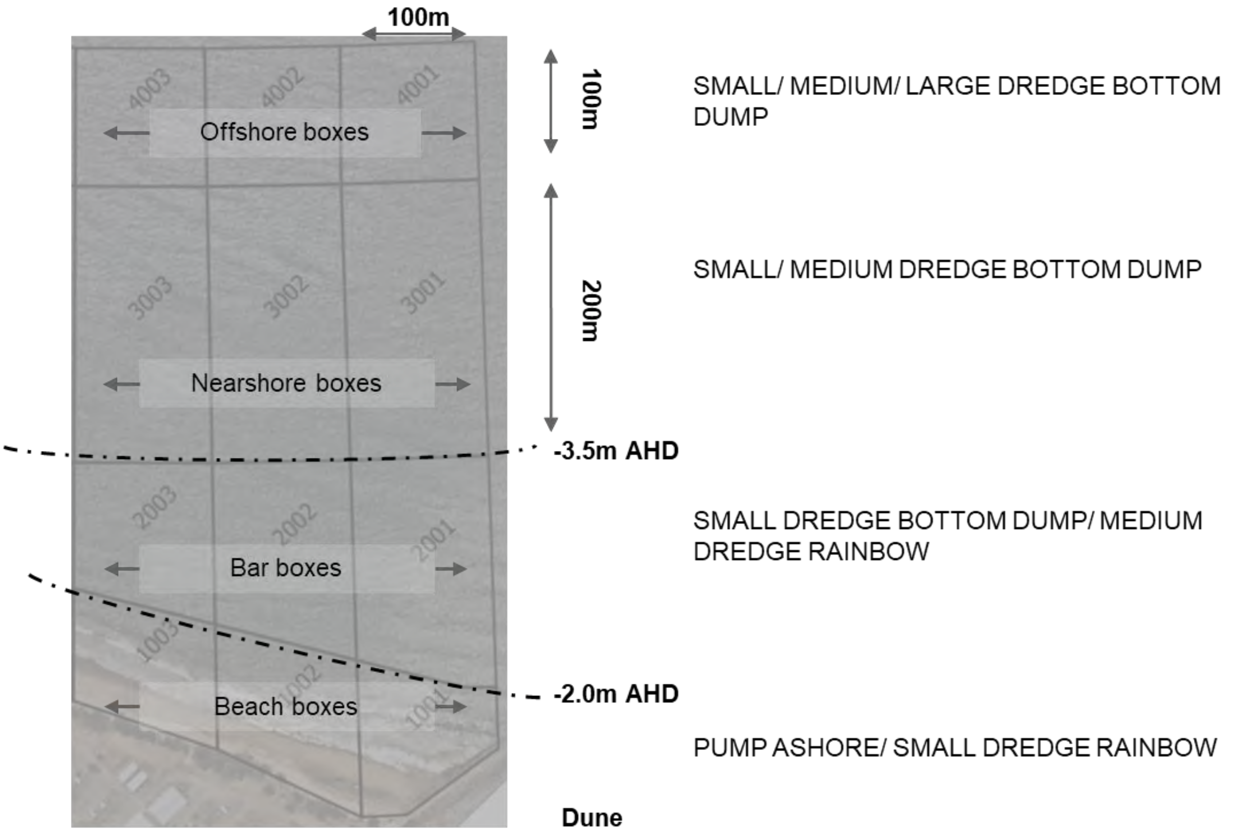

Figure 18: Cross-shore definition of the nourishment grid and suitable placement methods.

4.3.3 Amenity nourishment

Amenity nourishment placements are configured to enhances the recreational amenity of the beach and nearshore area (surf zone) and provide a level of protective buffer against storm erosion in the short-term. A plan view of the concept sand placements for amenity nourishment are shown in Figure 19. More details are provided in the drawings and a description of the key design placements is provided in Table 5.

Table 5: Key design parameters for amenity nourishment concept sand placements.

Design parameter	Description
Placement strategy	This exercise is directly related to Stockton CMP 2020 Action # CH12, which is the delivery of an initial $4m nourishment campaign targeted at the Holiday Park and Dalby Oval shorelines. Shortly following the completion of beach nourishment works the nourished profile would be expected to readjust to an equilibrium shape with additional sand volume mostly in the sub-aqueous profile.
Alongshore extent	Approximately 1,100m stretch of beach between the northern breakwater and the southern end of Mitchell Street seawall. As presented in Section 2.5, this area was identified as most popular section for beach users at Stockton and therefore provides the highest beach amenity benefit. Sand placements along the southern end of Stockton are also expected to have greater longevity over the northern area as described in Section 5.
Cross shore extent	Sand placements are proposed within the beach boxes and bar boxes of the nourishment grid (i.e., placements down to approximately -4m AHD). Extending the amenity nourishment into surf zone will improve the profile shape, improving safety, beach/swim amenity and the longevity of the placements. The nourished profile slope should not exceed 1:15.
Placement methods	The placement methods would depend on the volumes, sand source and the executing contractor work method. For volumes in the range up to 500,000m^3 a small TSHD may be a suitable selection (see Section 3.1). Likely approaches would be pump ashore, or a combination of pump ashore and rainbowing, as described in Section 3.2. This could involve: • Pump ashore from a mooring at Pirate Point with a bow coupling and floating pipeline to Little Beach. A land-based pipeline (temporary or semi-permanent) would be needed to cross the breakwater and then route either through the seaward edge of the Holiday Park, vegetated strip or the back beach area. Sand would be discharged to beach directly or via a Y-piece for spreading. Land based earth moving equipment would be needed if a design profile is specified. • Rainbowing to the beach and bar boxes and potentially some bottom dumping to the bar or nearshore boxes.

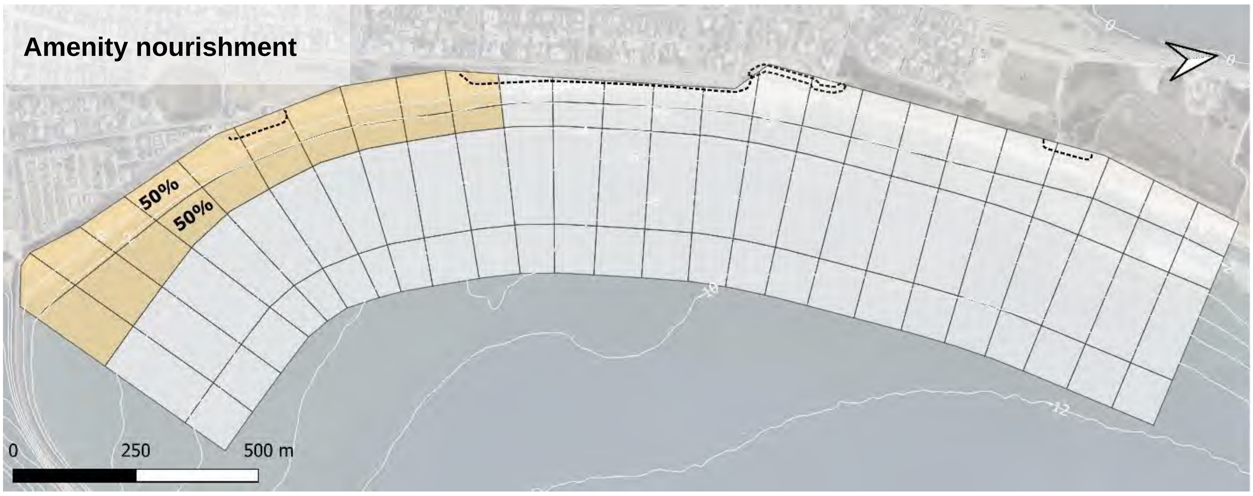

Figure 19: Extent and cross-shore distribution of sand placements for amenity nourishment.

4.3.4 Mass nourishment

Mass nourishment provides a nourishment volume that, in addition to the amenity benefits, provides an adequate level of coastal protection for vulnerable sections of Stockton Beach. A plan view of the sand placements for mass nourishment is shown in Figure 22. More details are provided in the drawings and a description of the key design placements is provided in Table 5.

Table 6: Key design parameters for amenity nourishment concept sand placements.

Design parameter	Description
Placement strategy	Restore acceptable sandy buffer by increasing the volume of sand in the active coastal profile. In line with the Stockton CMP, the target morphology for mass nourishment sand placements is guided by nature in that it is based on the coastal profile observed at Stockton in the 1990s, when the southern compartment had a greater volume of sand. The CMP states that in consideration of the average annual rate of sand loss (i.e., 146,000m^3/year), placement of 2.4M m^3 of sand to the southern compartment will revert the coastal profile back in time around 22-years. If 2020 is selected as the pre-nourishment beach, then around 1998 is representative of a post-nourishment beach. Suitable surveyed coastal profile data was available for 1995 which has been adopted as the target nourishment morphology for mass nourishment at Stockton Beach. A comparison of the 1995 and 2018 coastal profile morphology is shown in Figure 20 and Figure 21. The post-nourishment profile has a 35m wider surf zone[5] and a milder slope of 1V:29H compared to the steeper 1V:24V slope in the pre-nourishment profile. The storm response of the post-nourishment (1995) profile is therefore expected to be more resilient, particularly in the case of successive storms, resulting in reduced erosion at the beach when compared to the pre-nourishment (2018) profile.
Alongshore extent	Sand placement over a 2,800m stretch of beach from the northern breakwater and up to a point 800m north of Meredith Street. The CMP identified this area as being most vulnerable to coastal hazards. The highest cumulative sand loss since 1990s has been observed in the northern area, however sand placements are spread evenly along the 2,800m nourishment extent to enhance the longevity (see Section 5).

[5] The surf zone has been assumed to be between 0m AHD and -5m AHD.

Design parameter	Description
Cross shore extent	Full active coastal profile down to the depth of sand movements in moderate storm events, i.e., approximately -10m below AHD. Like the nourishment on the upper beach, the additional sand on the lower profile would provide a protective buffer against storm erosion. The cross-shore distribution of the sand placements is defined as a percentage of the total placement volume (see Figure 19) across all four nourishment boxes to approximate the 1995 target profile shape.
Placement methods	Mass nourishment requires the delivery of large volume of material and favours full 'profile nourishment'. This requires a combination of methods include, as a minimum, bottom dumping and rainbowing.

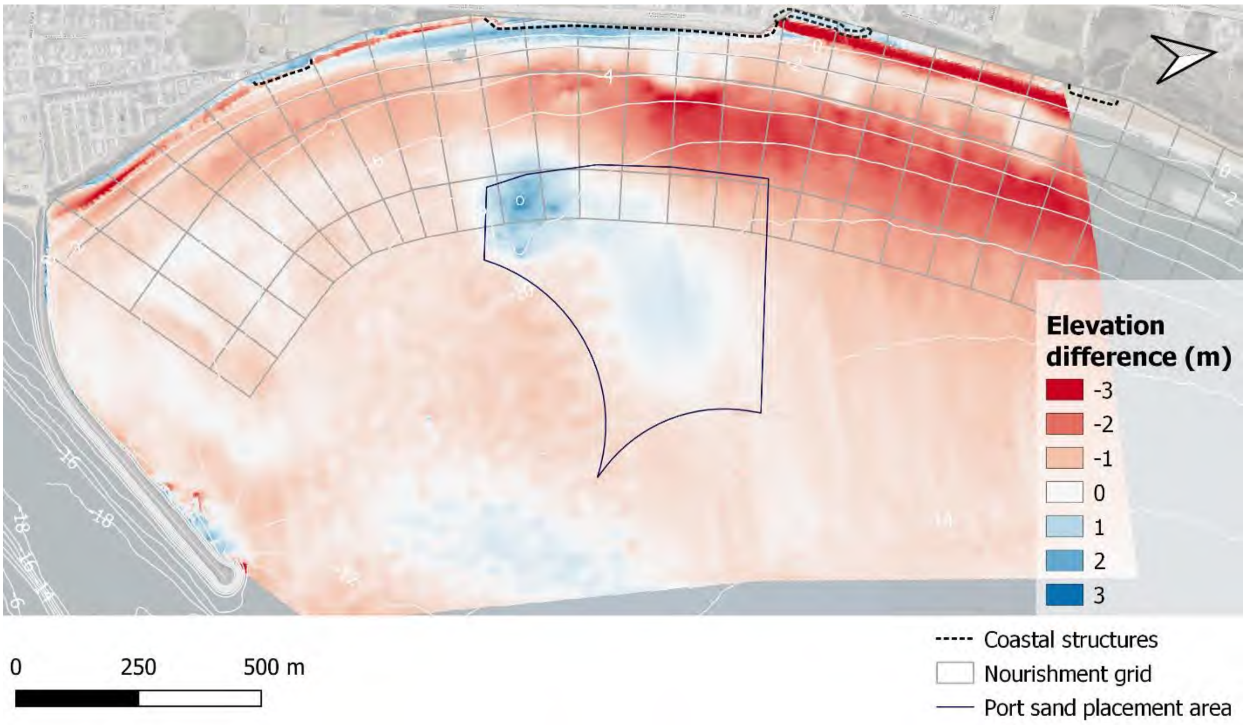

Figure 20: Elevation difference between 2018 and 1995 topography and bathymetry surveys.

Note: Red shaded areas represent erosion and blue shaded areas represent accretion since 1995.

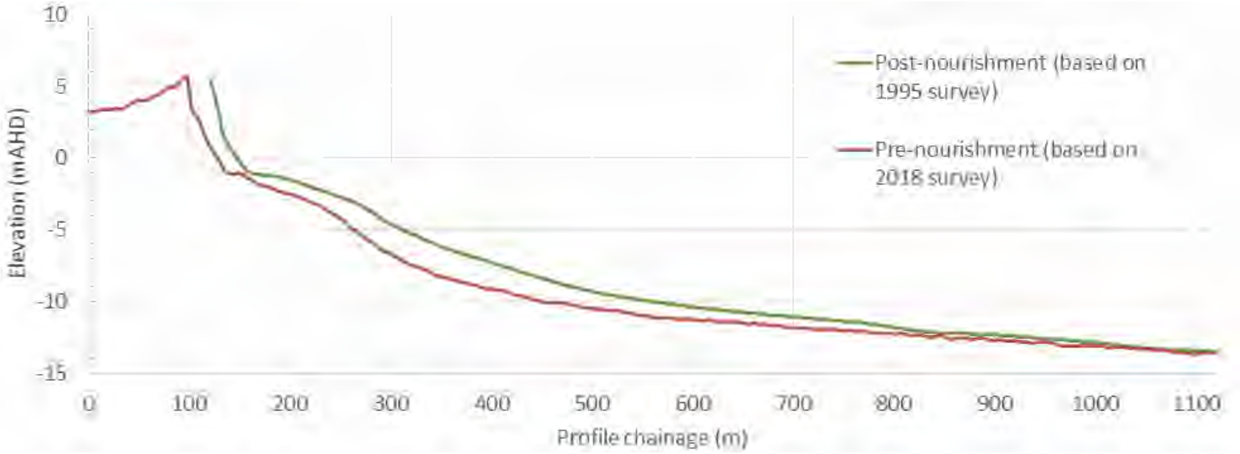

Figure 21: Adopted pre- and post-nourishment coastal profile for Stockton Beach.

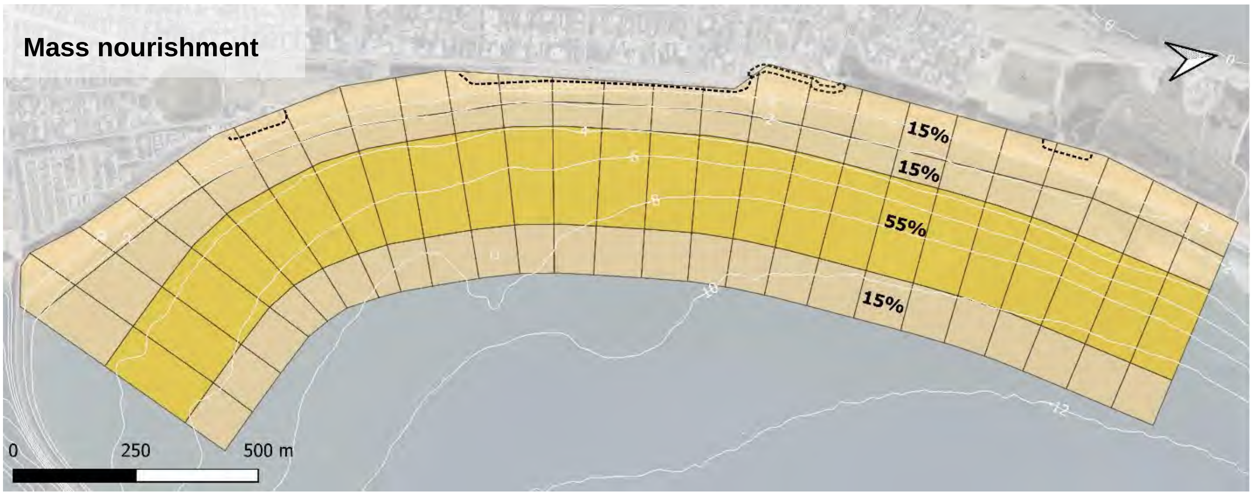

Figure 22: Extents and cross-shore distribution of sand placements for mass nourishment.

Sand placement capacity

To inform the upper limiting volumes of mass nourishment, a review of the maximum theoretical nourishment capacity of the Stockton Beach compartment was undertaken. Consideration was given to three key limiting factors identified in the constraints analysis in Section 2.5. The key limiting factors and associated theoretical maximum sand placement volumes along the 2,800m nourishment area are described in Table 7.

Based on these limiting factors, the maximum nourishment capacity for the Stockton compartment is governed by maintaining an amenable beach width less than 80m with a theoretical sand placement limit at Stockton Beach of around 4Mm^3. While having an extra wide beach is considered unfavourable for amenity reasons it should be recognised that the sand will disperse over time returning the beach widths. Therefore, if an opportunity became available to receive quantities of sand more than the 4Mm^3 amenable beach width limit at a low cost this should be considered on its merits. For example, the maximum developable dredging footprint for a large port development in the South Arm could generate up to 5Mm^3.

Table 7: Maximum theoretical sand placement volumes.

Limiting factor	Description	Maximum placement volume (m^3)
Existing coastal processes	Observed envelope of beach compartment volume compared to current sand volume	8,000,000[6]
Amenable beach width	Beach width less than 80m [7]	4,000,000
Infilling of navigation channel	Acceptable rate of southward sand bypassing around northern breakwater from overfilled Stockton Beach	>8,000,000[8]

[6] Based on additional sand volume in early 1900's in southern Stockton embayment compared to 2018 survey

[7] Assumed pre-nourishment beach width is 15m from base of dune to high water mark based on November 2021 aerial imagery

[8] The end of the breakwater is approximately 750m seaward of the current high-water mark which would accommodate a nourishment volume much greater than the maximum volumes for the first two limiting factors. If required, defining this maximum volume would need detailed assessment at later design phases.

4.4 Placement schedules

Example placement schedules are provided for:

- Amenity nourishment campaign with an assumed total placement volume of 350,000m^3 of suitable sand along the southern 1,100m stretch of Stockton Beach (see Table 8)
- Mass nourishment campaign with an assumed total placement volume of 2,400,000m^3 of suitable sand along the 2,800m stretch along Stockton Beach (see Table 9)

Concept design drawings (including plan views and typical sections) for the two example nourishment campaigns are provided in **Appendix A**.

Table 8: Example sand placement schedule for amenity nourishment campaign.

Box ID	Amenity nourishment placement volumes (m^3)				Profile total (m^3)
	Beach (1)	Bar (2)	Nearshore (3)	Offshore (4)	
001	17,500	17,500	0	0	35,000
002	17,500	17,500	0	0	35,000
003	17,500	17,500	0	0	35,000
004	17,500	17,500	0	0	35,000
005	17,500	17,500	0	0	35,000
006	17,500	17,500	0	0	35,000
007	17,500	17,500	0	0	35,000
008	17,500	17,500	0	0	35,000
009	17,500	17,500	0	0	35,000
010	17,500	17,500	0	0	35,000
%	**50%**	**50%**	**0%**	**0%**	**100%**
Total	**175,000**	**175,000**	**-**	**-**	**350,000**

Table 9: Example sand placement schedule for mass nourishment campaign.

Box ID	Mass nourishment placement volumes (m³) Beach (1)	Bar (2)	Nearshore (3)	Offshore (4)	Profile total (m³)
001	14,400	14,400	52,800	14,400	96,000
002	14,400	14,400	52,800	14,400	96,000
003	14,400	14,400	52,800	14,400	96,000
004	14,400	14,400	52,800	14,400	96,000
005	14,400	14,400	52,800	14,400	96,000
006	14,400	14,400	52,800	14,400	96,000
007	14,400	14,400	52,800	14,400	96,000
008	14,400	14,400	52,800	14,400	96,000
009	14,400	14,400	52,800	14,400	96,000
010	14,400	14,400	52,800	14,400	96,000
011	14,400	14,400	52,800	14,400	96,000
012	14,400	14,400	52,800	14,400	96,000
013	14,400	14,400	52,800	14,400	96,000
014	14,400	14,400	52,800	14,400	96,000
016	14,400	14,400	52,800	14,400	96,000
017	14,400	14,400	52,800	14,400	96,000
018	14,400	14,400	52,800	14,400	96,000
019	14,400	14,400	52,800	14,400	96,000
020	14,400	14,400	52,800	14,400	96,000
021	14,400	14,400	52,800	14,400	96,000
022	14,400	14,400	52,800	14,400	96,000
023	14,400	14,400	52,800	14,400	96,000
024	14,400	14,400	52,800	14,400	96,000
025	14,400	14,400	52,800	14,400	96,000
%	**15%**	**15%**	**55%**	**15%**	**100%**
Total	**360,000**	**360,000**	**1,320,000**	**360,000**	**2,400,000**

4.5 Special placements

4.5.1 Pattern placement

The bar morphology along Stockton is in a constant state of flux responding to changes in the incoming waves (i.e., low/high energy conditions from different wave directions), tides and the supply of sand. Sand bar and beach morphology is known to have an impact on the formation of rip currents and swimmer safety as well as quality of surf waves and surf amenity.

The concept for pattern placement of sand for the Stockton mass nourishment is to replicate as closely as practically possible a rhythmic bar morphology. By adopting this patterned placement, it is expected that a straight alongshore bar formed by sand placements in the bar boxes and nearshore boxes would be avoided and that the patterned placement has the potential to create a more 'natural' morphology in this area. The recurring, rhythmic bar plan forms create numerous opportunities for peeling waves that provide surf amenity but is also expected to reduce alongshore currents due to formation of regular rip currents more representative of a natural beach morphology..

A pattern placement can be designed to avoid nourishment boxes containing shipwrecks or other maritime heritage items (see Section 2.5). For example, minimal or no sand placement would be specified within a bar or nearshore nourishment box where a shipwreck is present while the two adjacent alongshore boxes would be 'overfilled' (see Figure 23).

Dependent on the adopted placement method and plant, the patterned placed sand bars may generally be located further offshore than natural bar systems. The placed sand would be expected to respond relatively rapidly once placed and start migrating onshore (under typical wave conditions). It should be noted that the effects of the patterned placement may be short-lived; particularly if there is a large wave event/series of wave events following the placement of sand. Patterned placement to replicate a rhythmic bar and beach bar morphology is expected to have some impact on the upper beach morphological response. For example, this could be expressed as longshore in the amount of beach widening in response to nourishment (i.e., greater widening in the lee of 'overfilled' boxes). However, again it is noted that this will largely depend on the metocean conditions following sand placement.

An example alongshore pattern of sand placement in the bar boxes would be according to:

- 150% filling of two adjacent alongshore boxes, followed by
- 50% filling of the next two most adjacent boxes.

Figure 23: Pattern placement around shipwreck and maritime heritage item exclusion buffers (50m).

The City of Gold Coast had adopted pattern placement for their 2017 mass nourishment campaign involving rainbowing and bottom dumping 3Mm^3 of sand with a medium sized TSHD. The sand was placed designed to mimic the natural occurring beach morphologies: rhythmic bar and beach and transverse bar and rip formations, known to promote good surfing conditions (see Figure 24).

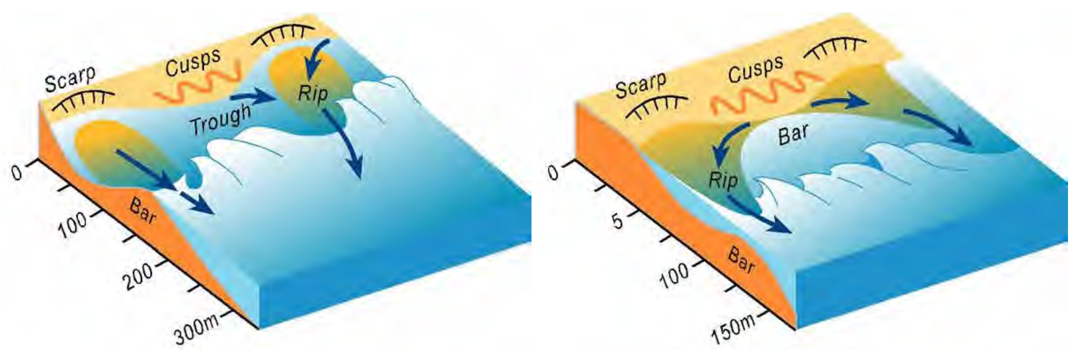

Figure 24: Schematic of rhythmic bar and beach and transverse bar and rip beach formations (source: ozcoasts.org.au).

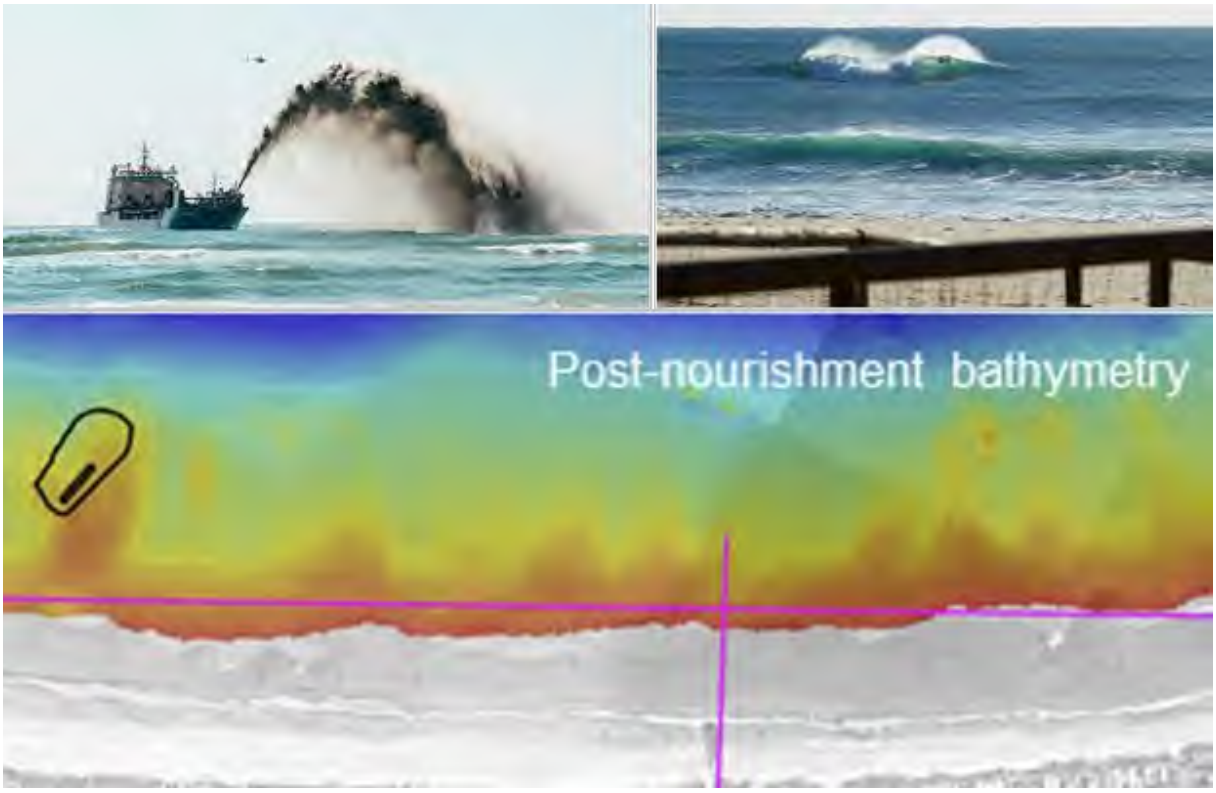

Figure 25: Example photographs during and after the 2017 pattern placement nourishment at the Gold Coast and (bottom) post-nourishment morphology for one section of beach at Palm Beach, QLD.

Note: Pattern placement evident as red shaded ‘cusps’ seen in bathymetry survey in bottom panel.

4.5.2 Beneficial reuse of mixed sediments

Large annual quantities of sediment are dredged from Newcastle Harbour’s navigational channels as part of the Port of Newcastle’s maintenance dredging program. Depending on the area from which the material is dredged and the antecedent conditions (e.g., recent floods/drought periods) a significant proportion of sand can be present, however, the sand is mixed with finer silts.

5. Performance

5.1 Physical processes

Following sand placement, the nourished coastal profile will be subject to the following key physical processes:

- Cross-shore adjustment: this is an initial adjustment that occurs because the placed sand seeks a more natural profile under the action of wind, waves, tides and currents. This initial adjustment is expected to occur rapidly depending on where within the profile sand is placed. Importantly, there is no significant net loss. The sand is simply redistributed in a cross-shore direction across the full coastal profile.
- Alongshore adjustment: beach nourishment represents a perturbation where the nourished beach extends seaward of the adjacent natural beach. Under wave action this perturbation will spread out along the shoreline governed by the gross sand transport and is a separate process from background net sand losses described below.

- Alongshore losses: over the longer-term, the nourishment sand is subject to the net sand loss observed within the southern embayment of Stockton Beach. The average rate of sand loss is expected to be like the observed historic net northward sand transport rates. The net sand loss rate varies considerably from year to year largely because of climatic cycles (e.g., El Niño Southern Oscillation).
- Storm erosion: large waves and high-water levels attributed to coastal storms causes the sand placed on the upper beach to be eroded with the sand moving offshore to be deposited in nearshore storm bars. Following the storm conditions, sand moves onshore and the upper beach recovers. That is beach erosion is related to cross shore movements of sand without significant loss of sand from the full coastal profile.

5.2 Alongshore transport

Over the longer-term, the placed sand volumes are expected to reduce at a rate equivalent to the average rate of net sand loss in line with the net northward longshore sand movement pathways determined in the Sand Movement Study (Bluecoast, 2020a). For the southern Stockton embayment, it was found that:

- a gradient in longshore transport rates exists with a maximum rate around Fort Wallace with lower rates in the south due to the wave sheltering provided by the port's breakwaters and in the north due to a much-reduced wave obliquity
- there is no evidence of sand bypassing to Stockton from the south in the contemporary setting.

To assess the alongshore loss of sand placed within the proposed nourishment extent, the longshore transport rates identified in the Sand Movement Study (Bluecoast, 2020a; also see Section 2.3) were further refined. A high-resolution SWASH wave and current numerical model was applied to further assess the gradients in wave exposure and longshore currents in the southern Stockton embayment (see Figure 26 and further detail in Bluecoast, 2020a). Based on the conceptual sand movement model in Bluecoast (2020a) and the SWASH modelling, a linear gradient in the calculated transport rates across the southern embayment was assumed (see Figure 27). Hence, it is expected that:

- sand placed between the northern breakwater and the southern end of Mitchell Street seawall is subject to a net sand loss from the full coastal profile in order of 57,000m^3/year
- sand placed over the full extent of the nourishment area is subject to a net sand loss from the full coastal profile in order of 146,000m^3/year

To enhance the longevity of the amenity and mass nourishment it is proposed to place a higher percentage of the total nourishment volume within the southern extent of the nourishment area. Sand placed here will be subject to the lower net longshore transport rates as it gradually moves through the project area. As the sand moves along Stockton Beach, it then provides a supply of sand to maintain the sandy buffer north of the sand placements.

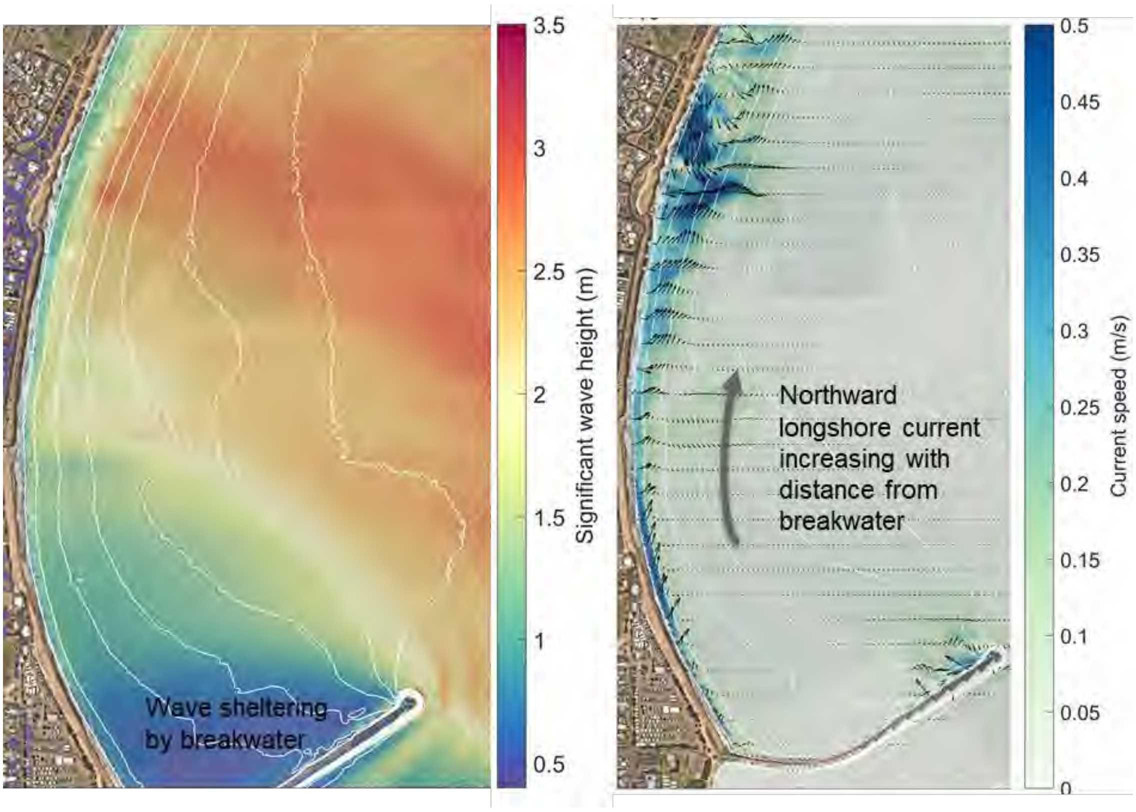

Figure 26: SWASH wave and current modelling results showing gradient in (left) significant wave heights and (right) longshore littoral currents.

Note: SWASH results show south-east wave event - significant wave height 3.5m, peak period 12s.

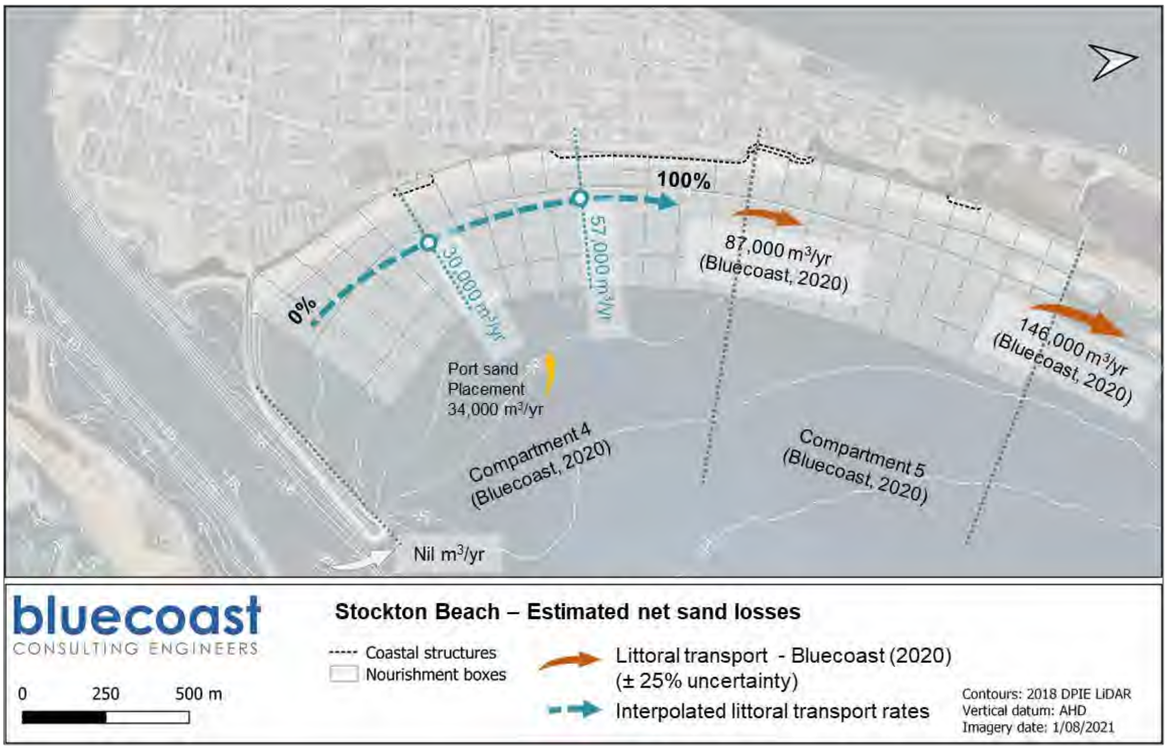

Figure 27: Refined conceptual coastal processes model (after Bluecoast, 2020a) showing alongshore variation in sand movement processes at Stockton.

Planform re-alignment of the sand placements at the southern nourishment limit is constrained by the presence of the northern breakwater. At the northern taper of the nourishment area this planform re-alignment will seek a more natural shoreline position and nourished sand is expected to move north and south along Stockton Beach with gross sand transport (Dean, 2005). Sand moving north in the direction of the net sand transport at Stockton will result in a net reduction of the sandy buffer within the nourishment extent. To account for planform re-alignment, the following allowances for reduction of the initial nourishment volume were considered in the performance assessment (see Table 10):

- Mass nourishment:
  - 20% of the long-term average net sand loss rate observed along the full extent of the nourishment area, i.e., ~29,000m^3/year
  - gradually decreasing to 10% of the long-term average net sand loss rate by year 3, i.e., ~14,500m^3/year
- Amenity nourishment:
  - 20% of the long-term average net sand loss rate observed along the southern end of Stockton, i.e., ~11,500m^3/year
  - gradually decreasing to 10% of the long-term average net sand loss rate by year 3, i.e., ~6,000m^3/year

In consideration of the sand losses described above, examples of the estimated additional sandy buffer for two beach nourishment exercises for amenity (initial quantity of 350,000m^3) and mass nourishment (initial quantity of 2.4Mm^3) are presented in Table 10. The sandy buffer estimates only assess the initial nourishment volume and do not include ongoing maintenance sand placements.

Table 10: Estimated additional sandy buffer provided by two example nourishment exercises.

Year	Additional sandy buffer (m^3)	
	Amenity nourishment (alongshore length 1,100m)	Mass nourishment (alongshore length 2,800m)
0	350,000	2,400,000
1	280,533	2,278,384
2	214,405	2,165,320
3	150,638	2,058,304
4	86,871	1,951,288
5	28,804	1,844,272
6	0	1,737,256
10	-	1,309,192
15	-	774,112
20	-	239,032
23	-	0

5.3 Beach widths

Sand placed directly onto the beach as well as placements onto lower parts of the coastal profile are expected to increase the average dry beach width between the dune scarp (or coastal structures) down to the high-water mark. It is noted that this increase is concerned with the longer-term average beach width and following initial cross-shore adjustment of the nourished profile. The actual beach width varies with seasonal and longer terms climatic conditions as well as occurrence of storm events. As an example, photographs showing Miami Beach on the Gold Coast before and two years after a mass nourishment campaign in 2017 using nearshore (rainbowing and bottom dumping) placements only are provided in Figure 28.

The average increase in beach width over the alongshore extent of the proposed Stockton mass and amenity nourishment exercises was estimated. Seaward translation of the coastal profile was calculated based on the initial nourishment volumes for an average profile slope within the nourishment extents. A summary of the estimated average increase in beach widths above the baseline is presented in Table 11. As per the storm erosion longevity calculations described in Section 5.3, the future reduction in beach width following sand placements due to net sand losses and sea level rise recession was estimated and is also presented in Table 11.

Figure 28: Photographs showing beach (top) immediately before Gold Coast mass nourishment on 17 February 2017 and (bottom) two years after mass nourishment on 14 October 2019 (source: City of Gold Coast).

Table 11: Estimated average increase in beach width along the proposed nourishment extents.

Initial nourishment volume (m^3)	Average increase in beach width (m) above baseline			
	Year 1	Year 2	Year 5	Year 10
Mass nourishment (alongshore length 2,800m)				
5,000,000	81	77	70	59
2,400,000	38	35	28	16
2,000,000	32	28	21	10
1,500,000	23	20	13	2
1,000,000	15	12	5	0
Amenity nourishment (alongshore length 1,100m)				
500,000	55	45	26	6
350,000	38	28	8	0
100,000	8	0	0	0

5.4 Storm erosion buffer

Storm erosion volumes for Stockton have been estimated in Bluecoast (2020b). A summary of the storm erosion volumes for a series of Average Recurrence Intervals (ARI) along Stockton is provided in Table 12[9].

For this project, the additional storm erosion buffer achieved by beach nourishment was calculated for a series of sand placement volumes. A summary of the calculated effective storm erosion buffer immediately after the sand placements[10] in terms of their return intervals (ARIs) are presented Table 13 and Table 14 for mass and amenity nourishment, respectively.

The longevity of the beach nourishment in terms of providing a storm erosion buffer were estimated into the future based on the sand loss described in Section 5.2. For this, the estimated combined long-term sand loss and an allowance for sea level rise recession (Bluecoast, 2020b) were applied to the nourished sand buffer volumes. These estimates do not consider ongoing maintenance nourishment. The calculated future performance (or longevity) of the initial mass and amenity nourishment in providing an increase in storm erosion buffer along Stockton Beach is also presented Table 13 and Table 14.

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[9] Storm erosion volumes for different ARI levels for each area are based on curve-fitting to the commonly used distribution of storm demands in NSW by Gordon (1987) (see Bluecoast, 2020b).
[10] This is based on the typical proportion of 33% of the total nourishment volume being the effective volume above AHD (Carley and Cox, 2017).

Table 12: Adopted storm erosion volumes for Stockton Beach (Bluecoast, 2020b).

ARI (years)	Storm erosion volume (m^3/m)		
	Breakwater to SLSC	SLSC to Barrie Cr	Barrie Cr to Hunter Water
1	16	24	30
10	53	79	99
20	65	97	122
50	80	120	150
100	91	137	172
200	101	152	190
500	118	177	221
1000	129	193	242

Table 13: Additional storm buffer provided by initial <u>mass</u> nourishment (without ongoing maintenance).

Initial mass nourishment volume (m^3)	Additional ARI storm buffer (years)[11]		
	Breakwater to SLSC	SLSC to Barrie Cr	Barrie Cr to Hunter Water
Year 1			
5,000,000	>1,000	>1,000	>1,000
2,400,000	>1,000	>1,000	>1,000
2,000,000	>1,000	>1,000	>1,000
1,500,000	>1,000	500	100
1,000,000	500	50	20
Year 2			
5,000,000	>1,000	>1,000	>1,000

[11] This is the additional sub-aerial sandy buffer provided by the beach nourishment works. The existing sub-aerial beach, in unprotected areas of the shoreline, would also provide some coastal protection function.

Initial mass nourishment volume (m^3)	Additional ARI storm buffer (years)[11]		
	Breakwater to SLSC	SLSC to Barrie Cr	Barrie Cr to Hunter Water
2,400,000	>1,000	>1,000	>1,000
2,000,000	>1,000	>1,000	500
1,500,000	>1,000	200	50
1,000,000	100	20	10
Year 5			
5,000,000	>1,000	>1,000	>1,000
2,400,000	>1,000	>1,000	500
2,000,000	>1,000	200	100
1,500,000	200	20	<1
1,000,000	5	<1	<1
Year 10			
5,000,000	>1,000	>1,000	>1,000
2,400,000	>1,000	50	20
2,000,000	50	10	5
1,500,000	<1	<1	<1
1,000,000	<1	<1	<1

Table 14: Additional storm buffer provided by initial amenity nourishment (without ongoing maintenance).

Initial amenity nourishment volume (m^3)	Additional ARI storm buffer (years)[12]	
	Breakwater to SLSC	SLSC to Pembroke St
Year 1		
500,000	>1,000	100
350,000	100	20

[12] This is the additional sub-aerial sandy buffer provided by the beach nourishment works. The existing sub-aerial beach, in unprotected areas of the shoreline, would also provide some coastal protection function.

Initial amenity nourishment volume (m^3)	Additional ARI storm buffer (years)[12]	
	Breakwater to SLSC	SLSC to Pembroke St
100,000	<1	<1
Year 2		
500,000	>1,000	50
350,000	50	10
100,000	<1	<1
Year 5		
500,000	20	5
350,000	<1	<1
100,000	<1	<1

6. Sand placement costs and durations

6.1 Preamble

This section provides estimates of sand placement costs for an assumed set of potential beach nourishment sand sources using a small or medium TSHD. As described above TSHDs are the most likely delivery method for sand from offshore sources and harbour entrance areas (i.e., Area E) and could also be used for South Arm or other sand sources within Newcastle Harbour. Costs have been estimated based on the assumptions outlined below and in consultation with dredging contractors who provided budgetary estimates.

6.2 Production rates and project duration

6.2.1 Cycle times

The dredging and sand placement cycles for the beach nourishment works with TSHDs typically consist of four consecutive operations as outlined in Table 15.

Table 15: Beach nourishment cycle times in minutes for Stockton Beach.

Nourishment operation	Small TSHD			Medium TSHD		
	Bottom dumping	Rainbowing	Pump ashore	Bottom dumping	Rainbowing	Pump ashore
Loading	24	24	24	60	60	60
Sailing full	25	25	25	100	100	100
Placing	10	31	56	10	77	102
Sailing empty	19	19	19	19	19	19
TOTAL PER CYCLE (MINS)	**78**	**99**	**124**	**189**	**256**	**281**

6.2.2 Operational hours and weekly production figures

Available dredging hours per week have been calculated after deduction for sea-state delays and other delays (see Section 3.3). These are listed in Table 16.

Table 16: Operational hours per week.

Working hours calculation	Small TSHD			Medium TSHD		
	BD	RB	PA	BD	RB	PA
Working hour per week (24/7 @ 90% efficiency)	151	151	151	151	151	151
Sea state delay (loading)	-45.4	-45.4	-45.4	-45.4	-45.4	-45.4

Working hours calculation	Small TSHD			Medium TSHD		
	BD	RB	PA	BD	RB	PA
Sea state delay (rainbowing at Stockton)	0.0	-0.3	-0.4	0.0	-2.3	-0.3
Sea state delay (pump ashore)	0.0	0.0	-0.4	0.0	0.0	-0.3
Shipping delays	-4.7	-3.7	-3.0	-1.9	-1.4	-1.3
Operational hours per week	**101**	**102**	**102**	**104**	**102**	**104**

Note: BD = bottom dumping, RD = rainbowing and PA = pump ashore.

Estimated weekly production figures for each of the representative TSHDs is provided in Table 17.

Table 17: Sand placement production (in hopper) per week.

Nourishment operation	Small TSHD			Medium TSHD		
	BD	RB	PA	BD	RB	PA
Production in hopper/week	139,860	111,060	88,740	197,400	143,400	132,600

Note: BD = bottom dumping, RD = rainbowing and PA = pump ashore.

6.2.3 Project durations

Using the calculation presented above the duration (in weeks) of nourishment works for the two example TSHDs for a range of nourishment volumes is presented in Table 18. The project durations are presented for each of the placement modes assuming these would occur for the entire works. If a combination of placement modes is used (i.e., ‘profile nourishment’), the duration would also be a combination of those presented in Table 17 (see below for examples).

Table 18: Estimated duration of beach nourishment works in weeks.

Delivery quantity	Small TSHD			Medium TSHD		
	BD	RB	PA	BD	RB	PA
Amenity/sand top-up volumes						
100,000	0.7	0.9	1.1	0.5	0.7	0.8
350,000	2.5	3.2	3.9	1.8	2.4	2.6
500,000	3.6	4.5	5.6	2.5	3.5	3.8
Mass nourishment volumes						
1,000,000	7.2	9.0	11.3	5.1	7.0	7.5

Delivery quantity	Small TSHD			Medium TSHD		
	BD	RB	PA	BD	RB	PA
1,500,000	10.7	13.5	16.9	7.6	10.5	11.3
2,000,000	14.3	18.0	22.5	10.1	13.9	15.1
2,400,000	17.2	21.6	27.0	12.2	16.7	18.1
4,000,000	28.6	36.0	45.1	20.3	27.9	30.2

Note: BD = bottom dumping, RB = rainbowing and PA = pump ashore.

6.2.4 Assumptions

The assumptions used to inform nourishment cycles are:

- The small TSHD has a hopper capacity of 1,800m^3, while the medium TSHD has a capacity of 6,000m^3.
- The small TSHD is assumed to deliver amenity nourishment from Area E with a sailing distance of 1.25NM and dredging depths less than 28m.
- The medium TSHD is assumed to deliver mass nourishment from within 5NM of Stockton Beach, which could be either offshore or South Arm. Dredging depths of less than 35m are assumed.
- Shipping delays when dredging within the navigations channel as assumed to be 10% and 4% when dredging offshore.
- Production rates are all expressed in cubic meters measured in the hopper well.
- Native Stockton Beach sand is D_{50} = 0.35 to 0.40mm. Source material is clean compatible sand with no overburden of other borrow site costs or risks.
- Production calculations have been based on the average annual sea state. If it is possible to schedule the works to be carried out during the period from November to January (see Section 3.3.3) sea state delays would be expected to be less.
- Do not include GST, are in 2021-dollar rates

6.3 Cost comparisons

Using the inputs from above Table 19 presents estimated cost ranges for mobilisation and unit rates for beach nourishment works at Stockton for the two selected TSHDs.

Table 19: Estimated cost comparisons between small and medium TSHDs for beach nourishment works at Stockton.

Component	Item	Small TSHD	Medium TSHD
Mobilisation	Range	$300,000 to $600,000*	$2,000,000 to $5,000,000**
	Adopted	$500,000^	$4,000,000

Component	Item	Small TSHD	Medium TSHD
	Pipelines for pump ashore***	$350,000^	$900,000
Unit rates ($/m^3)	Range	$6 to $13/m^3	$6 to $15/m^3
	Adopted (bottom dumping)	$7.50^	$6.50
	Adopted (rainbowing)	$8.70^	$7.50
	Adopted (pump ashore)	$13.20^	$12.00^

Note: * Mobilisation from Australia or New Zealand. The lower end of the range would require cost sharing with another concurrent project on the NSW coast. ** Mobilisation from Singapore. The lower end of the range would require cost sharing with another concurrent project on the Australian eastern seaboard. *** Mobilisation from Cairns or Townsville includes 300m or floating pipeline and 1,200m of land pipeline. ^ In the case that mass nourishment volumes were strategically delivered over a series of smaller campaigns mobilisation maybe be lower and unit rates around $1 less.

For South Arm sand sources, dredging utilising a CSD becomes a feasible option. However, such dredging would likely be undertaken by a third-party as part of a major port development project and the costs of the dredging works (mobilisation and dredging costs) would be defrayed. Previous cost estimates indicate that mobilisation costs would be in the order of $14-18M with unit rates from around $16.00 to 21.50/m^3 (Royal Haskoning, 2020). Given the nature of the works, these CSD cost estimates are not comparable to the TSHD's beach nourishment costs estimated herein.

6.4 Budget scenarios

6.4.1 Amenity nourishment

The initial nourishment campaign to enhance beach amenity in the short-term has a budget of $4 million (CN, 2020). Given the likely cost of mobilising a medium TSHD, only the smaller TSHD would be economically viable for this exercise. Based on the use of a small TSHD and the $4 million budget, Table 20 provides estimated delivery quantities for a range of sand placement combinations for this exercise.

Table 20: Amenity nourishment budget scenario for small TSHD executing $4M beach nourishment works at Stockton.

Assumed combination of sand placement modes	Estimated delivery quantity (approx.) cubic metre in hopper	Estimated project duration (weeks)
50% rainbowing, 50% bottom dumping	420,000	3.4
100% rainbowing	390,000	3.5
50% rainbowing, 50% pump ashore	290,000	2.9

6.4.2 Mass nourishment

Mass nourishment of Stockton Beach is not a committed project and there is no nominated budget. As stated in Section 4.2, the objective of mass nourishment is to restore a sandy buffer to provide an acceptable level of coastal protection and beach amenity. The Stockton CMP 2020 adopted a quantity of 2.4Mm^3 of compatible sand as a preliminary estimate of this quantity. This is considered a reasonable estimate and in the absence of more detailed investigations to confirm this quantity has been optimised it has been adopted in the budgetary scenarios examined below.

Two delivery methods are considered in Table 21, once off mass nourishment completed with a medium TSHD or delivery of a series of smaller volumes over a short period (say 3-5 years) with a small TSHD. Based on the estimates developed herein the delivery approaches are similar in cost, with the series of three smaller campaigns more economical if reduced mobilisation and unit rates can be negotiated with a dredging contractor.

Table 21: Mass nourishment budget scenario for beach nourishment works at Stockton.

Assumed combination of sand placement modes	Estimated delivery cost (approx.)	Estimated project duration (weeks)
Once off mass nourishment works with medium TSHD		
70% bottom dumping and 30% rainbowing	$21.5 million	14.7
50% bottom dumping, 35% rainbowing and 15% pump ashore	$24.5 million	13.5
Delivery of mass nourishment volumes through a series of smaller campaigns		
Three campaigns each of 800,000m^3 50% bottom dumping, 35% rainbowing and 15% pump ashore (Assumes reduction of $100,000/campaign across mobilisation of TSHD and pipework and $1/m^3 off all unit rates)	$7.1 million/campaign $21.3 million in total	6.7 weeks/ campaign
Three campaigns each of 800,000m^3 50% bottom dumping, 35% rainbowing and 15% pump ashore (Assumes no discounts)	$8.1 million/campaign $24.3 million in total	6.7 weeks/ campaign

7. Summary and recommendations

7.1 Summary and conclusion

A concept sand placement design to renourish sand lost from Stockton Beach was completed. Key elements of the assessment were:

- assessment of the engineering feasibility at the placement site
- development of a concept design that is generic in nature to provide the basis for realisation of beach nourishment from a range of material sources and quantities
- performance assessment for a range of sand placement volumes as well as two specific example nourishment exercises

- estimates of sand placement costs for an assumed set of potential beach nourishment sand source and equipment.

Key findings of the study are:

- The most likely and cost-effective method for dredging and transporting sand to Stockton from any wave exposed areas (e.g., offshore on harbour entrance areas) is by employing a small to medium size Trailer Suction Hopper Dredger (TSHD).
- To achieve nourishment of the full coastal profile at Stockton a combination of placement methods is required.
- A nourishment grid was developed defining a total of 100 placement boxes. These are arranged as 25 alongshore columns each with four cross-shore rows.
- An amenity nourishment concept design is configured along an approximately 1,100m stretch of beach between the northern breakwater and the southern end of Mitchell Street seawall. The objective of this design is to enhance the recreational amenity of the beach and nearshore area (surf zone) and provide a level of protective buffer against storm erosion in the short-term.
- A mass nourishment design that, in addition to the amenity benefits, provides an adequate level of coastal protection over a 2,800m stretch of beach from the northern breakwater and up to a point 800m north of Meredith Street.

The nourishment concept designs presented herein adopted a target morphology which addresses the key objectives and constraints of the beach nourishment works. The nourishment designs allow CN to progress a Review of Environmental Factors (REF) for beach nourishment (and assist in gaining subsequent approval) at Stockton Beach. The final material properties, placement volumes, sequencing, and execution depends on the available sand source, approval conditions and proposed method by the executing contractor.

7.2 Monitoring recommendations

Monitoring activities will be required to account for the actual quantities of sand delivered, meet environmental approval conditions and/or to determine the performance of the beach nourishment against the project objectives. In general, both baseline (pre-project) monitoring and post-project monitoring will be required to allow a suitable evaluation of the project outcomes. It is envisaged that the project's monitoring requirements would make use of existing monitoring activities, supplementing these where required.

Monitoring activities specific to the sand placement periods shall be addressed in an Environmental Management and Monitoring Plan (EMP), developed with respect to any conditions of approval. As part of this concept design, minimum monitoring activities associated with accounting for nourishment quantities delivered and nourishment performance are recommended below:

- Hydrographic and beach surveys including:
    - regular coastal (subaerial beach and subaqueous) transects along predefined shore normal profiles surveys over the full coastal profile every three months initially decreasing to six monthly thereafter. This should be complimented by additional multibeam, marine and terrestrial LiDAR or other modern survey techniques that can provide a more comprehensive coverage and resolution (e.g., drone based topographic surveys currently being undertaken by CN)
    - multibeam surveys before and after each nourishment campaign

   - the survey specification (e.g., extents, frequency, resolution (survey line spacing) and accuracy) should be determined based on the actual placement schedule.
- Assessment of beach compartment volumes prior to and after nourishment works by a targeted analysis of the survey data.
- Annual reporting and evaluation of survey analysis results against project objectives in consideration of prevailing environmental conditions.
- Sediment sampling and analysis (primarily grain size) as required to further explain post-nourishment changes and assess changes in the nourishment/native beach material over time.

On-going coastal monitoring should seek collaboration with the Port of Newcastle or other material generator seeking to place material at Stockton as beach nourishment.

7.3 Next steps

The information in this report is to be used to inform environmental assessments which will be used to seek environmental approval for Stockton to be able to legally receive suitable nourishment material. This a universally important next step as it enables mass, amenity or on-going ‘top-ups’ nourishment to be placed in a more flexible manner with better prospects of realising future opportunistic nourishment opportunities.

In relation to the delivery of mass nourishment the following additional next steps are recommended for the entity who will deliver the works:

- Confirm approval pathways for mass nourishment from offshore sources.
- Seek funding commitments for the delivery of mass nourishment subject to project approvals and final investment decision.
- Identification of offshore borrow areas suitable for economically efficient delivery of mass nourishment quantities of suitable material, including the dredging methods to extract and transport the sand to the placement areas.
- Prepare detailed sand placement designs based on refined quantities and properties of borrow material. As part of the detailed design (or environmental assessment) investigations, it is recommended more detailed shoreline response and nourishment longevity assessments be completed.
- Undertake environmental assessments of borrow areas and seek approvals (including any licences and permits) to dredge the seabed and use the sand for use as beach nourishment.
- Prepare tender documents, tender and execute the works with associated pre- and post-nourishment monitoring.
- Advocate for policy position on the beneficial reuse of any dredged sand from Newcastle Harbour to be prioritised for Stockton Beach.

8. References

Bluecoast Consulting Engineers [Bluecoast], 2020a. *Stockton Bight Sand Movement Study.* Report prepared for City of Newcastle.

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Dean, R. G., 2005. *Beach Nourishment Theory and Practice*. World Scientific Publishing Co., Hackensak, NJ.

Gordon, A.D., 1987. *Beach Fluctuations and Shoreline Change – NSW*. Eighth Australasian Conference on Coastal and Ocean Engineering, 1987: Preprints of Papers. Barton, A.C.T.: Institution of Engineers, Australia, 1987: [104]-[108].

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Short, A. D., 2012. *Coastal Processes and Beaches*. Nature Education Knowledge 3(10):15.

Appendix A: Sand Placement Concept Drawings

STOCKTON BEACH NOURISHMENT CONCEPT DESIGN

FOR

GENERAL	PLAN No	Rev	DESCRIPTION
P19130-BC-00	001	A	COVER SHEET AND DRAWING LIST
	002	A	LOCALITY PLAN
	003	A	SITE SURVEY PLAN
	004	A	SITE CONSTRAINTS PLAN
MASS NOURISHMENT			
P19130-BC-01	010	A	MASS NOURISHMENT MASTER PLAN
	011	A	MASS NOURISHMENT GENERAL ARRANGEMENT PLAN
	012	A	MASS NOURISHMENT SITE SECTIONS SHEET 1
	013	A	MASS NOURISHMENT SITE SECTIONS SHEET 2
AMENITY NOURISHMENT			
P19130-BC-02	020	A	AMENITY NOURISHMENT GENERAL ARRANGEMENT PLAN
	021	A	AMENITY NOURISHMENT SITE SECTIONS SHEET 1

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

DESIGNED BY	HL
DRAWN BY	MC
CHECKED BY	-
APPROVED	EW
APPROVED (CLIENT)	

REFERENCES

SURVEY PROVIDED BY	DPIE
HORIZONTAL DATUM	MGA 56
VERTICAL DATUM	AHD

PLANS PREPARED FOR:

Hunter & Central Coast Development Corporation

PLANS PREPARED BY:

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New South Wales, 2300
Ph +61 (0) 477 477 232
www.bluecoastconsulting.com.au

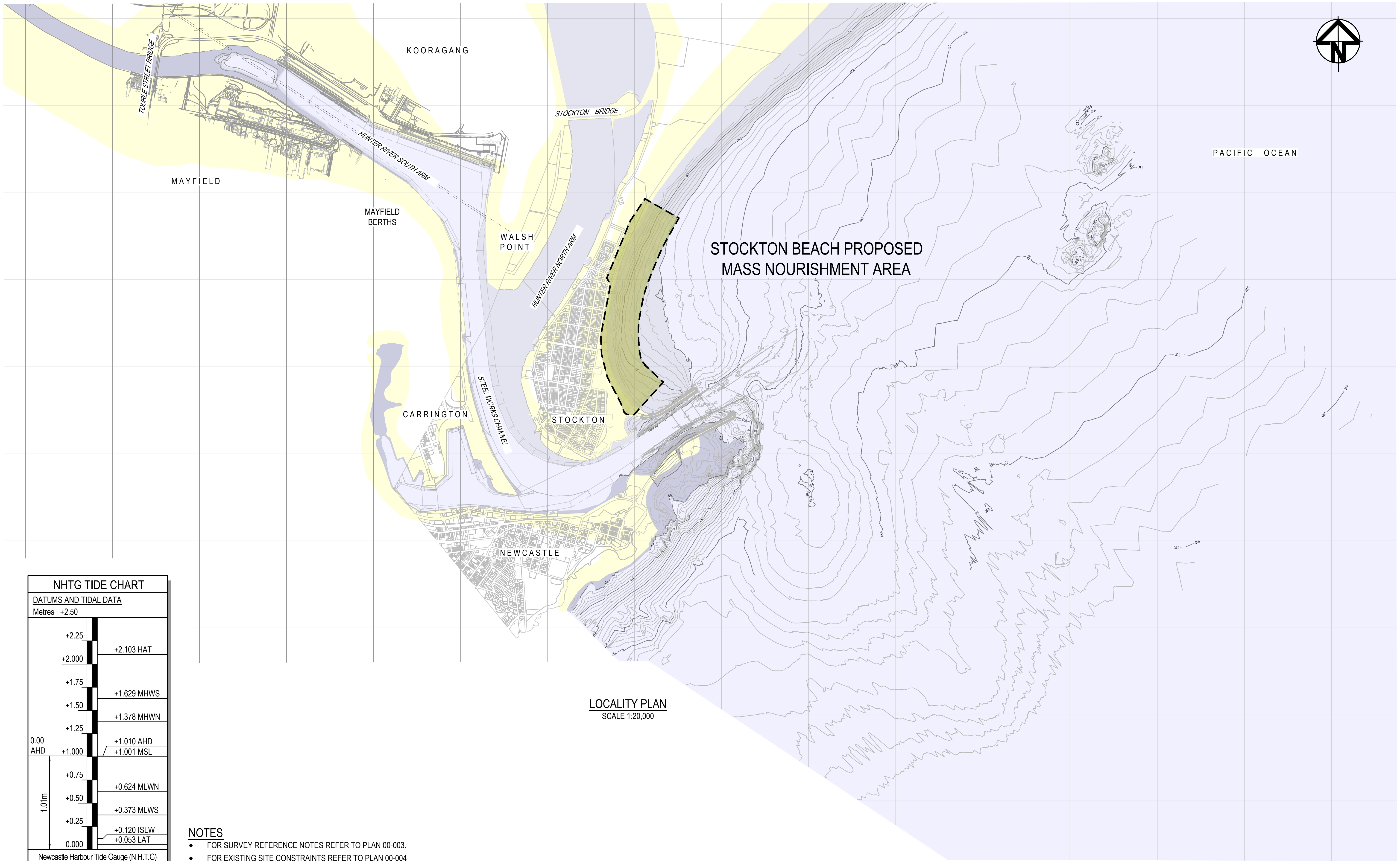
PROJECT
STOCKTON BEACH NOURISHMENT CONCEPT DESIGN

DRAWING TITLE
COVER SHEET AND DRAWING LIST

PROJECT NUMBER
P19130

DRG NO.
P19130-BC-00-001

REV.
A



LOCALITY PLAN
SCALE 1:20,000

NHTG TIDE CHART
DATUMS AND TIDAL DATA
Metres +2.50
+2.25
+2.000
+2.103 HAT
+1.75
+1.629 MHWS
+1.50
+1.378 MHWN
+1.25
0.00 AHD
+1.000
+1.010 AHD
+1.001 MSL
+0.75
+0.624 MLWN
1.01m
+0.50
+0.373 MLWS
+0.25
+0.120 ISLW
0.000
+0.053 LAT
Newcastle Harbour Tide Gauge (N.H.T.G)
ALL LEVELS N.H.T.G
A.H.D. = AUSTRALIAN HEIGHT DATUM

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 200 400 600 800 1000m
SCALE 1:20,000 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

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PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
LOCALITY PLAN

DRG NO.
P19130-BC-00-002

REV.
A

SURVEY LEVELS (m AHD)

9.0	to	10.0
8.0	to	9.0
7.0	to	8.0
6.0	to	7.0
5.0	to	6.0
4.0	to	5.0
3.0	to	4.0
2.0	to	3.0
1.0	to	2.0
0.0	to	1.0
-1.0	to	0.0
-2.0	to	-1.0
-3.0	to	-2.0
-4.0	to	-3.0
-5.0	to	-4.0
-6.0	to	-5.0
-7.0	to	-6.0
-8.0	to	-7.0
-9.0	to	-8.0
-10.0	to	-9.0
-11.0	to	-10.0
-12.0	to	-11.0
-13.0	to	-12.0
-14.0	to	-13.0
-15.0	to	-14.0
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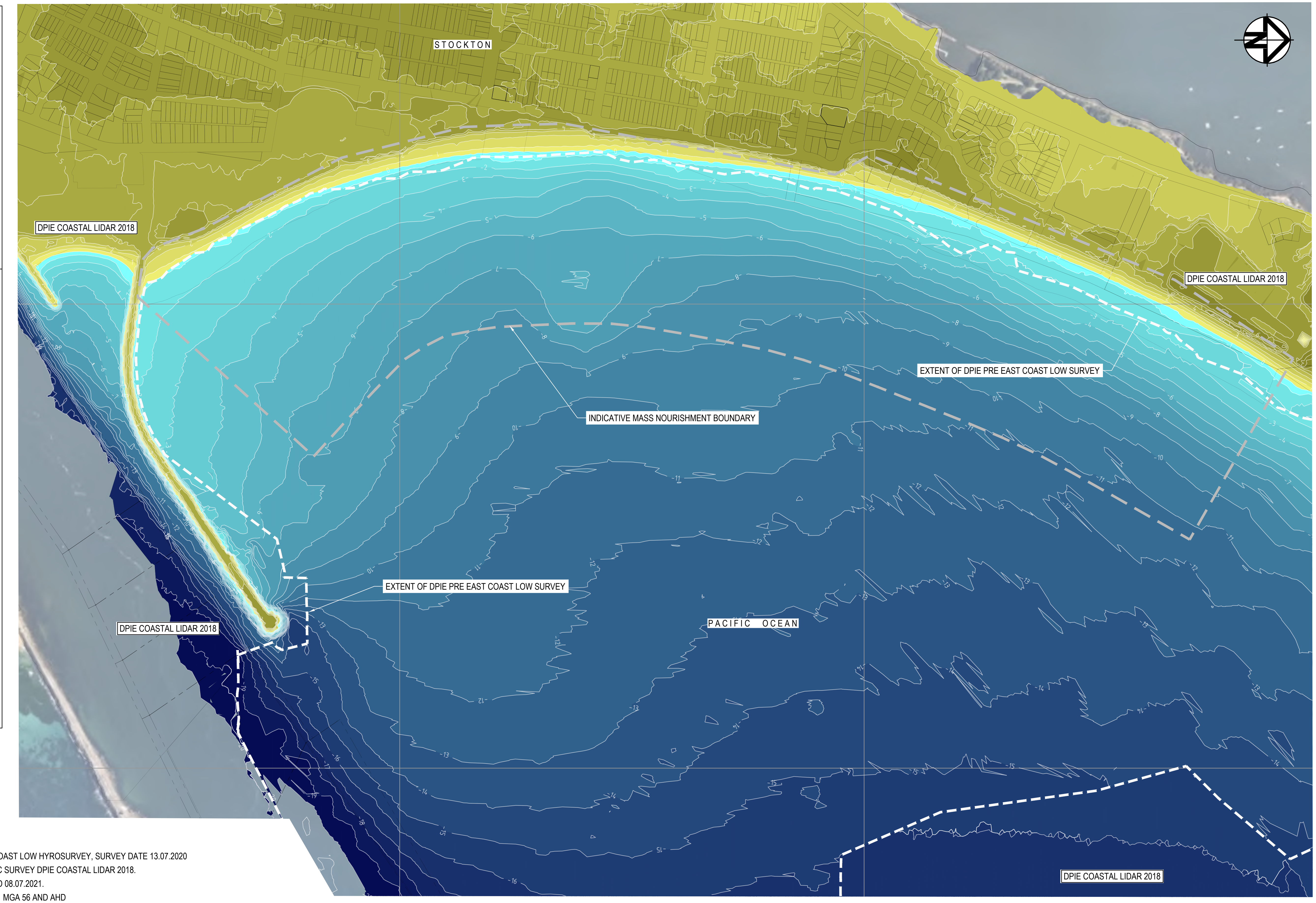
-20.0	to	-19.0



NOTES

- BASE SURVEY DPIE PRE EAST COAST LOW HYROSURVEY, SURVEY DATE 13.07.2020
- SUPPLEMENTARY TOPOGRAPHIC SURVEY DPIE COASTAL LIDAR 2018.
- AERIAL IMAGE PROVIDED, DATED 08.07.2021.
- ALL LEVELS ARE WITH RESPECT MGA 56 AND AHD
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

SURVEY PLAN
SCALE 1:4,000

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 40 80 120 160 200m
SCALE 1:4,000 AT ORIGINAL SIZE

DESIGNED BY	HL
DRAWN BY	MC
CHECKED BY	-
APPROVED	EW
APPROVED (CLIENT)	

REFERENCES

SURVEY PROVIDED BY	DPIE
HORIZONTAL DATUM	MGA 56
VERTICAL DATUM	AHD

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PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
SURVEY PLAN

DRG NO.
P19130-BC-00-003

REV.
A

CONSTRAINTS PLAN
SCALE 1:4,000

EXAMPLE VESSELS

Vessel	Draught (loaded)	Hopper capacity	Length	Sand placement
David Allan TSHD	3.0m (4.4m)	1,000m³	71.5m	Split hopper
Modi R TSHD	1.5m (3.8m)	1,393m³	67.05m	Split hopper/ rainbow 50m
Albatross TSHD	1.85m (3.8m)	1,860m³	75.0m	Hopper doors/ rainbow 50m
Brisbane TSHD	3.0m (6.25m)	2,900m³	84.1m	Hopper doors
Balder R TSHD	3.8m (7.0m)	6,000m³	111.30m	Split hopper/ rainbow 120m

LEGEND

- MARTIME FEATURES (#)
- SHIPWRECKS (*)
- STRUCTURES
- ABORIGINAL HERITAGE
- MASS NOURISHMENT AREA

(#) DIGITISED FROM AERIAL IMAGERY AND CHARTS

(*) DATA DERIVED FROM NSW MARITIME HERITAGE DATABASE

LEGEND

LADEN VESSEL DRAFT

- MODI R (3.8m)
- ALBATROSS (3.8m)
- DAVID ALLEN (4.4m)
- BRISBANE (6.25m)
- BALDER R (7.0m)

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.
- BASIS FOR VESSEL DRAFT IS RL 0.0 AHD

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

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SCALE 1:4,000 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

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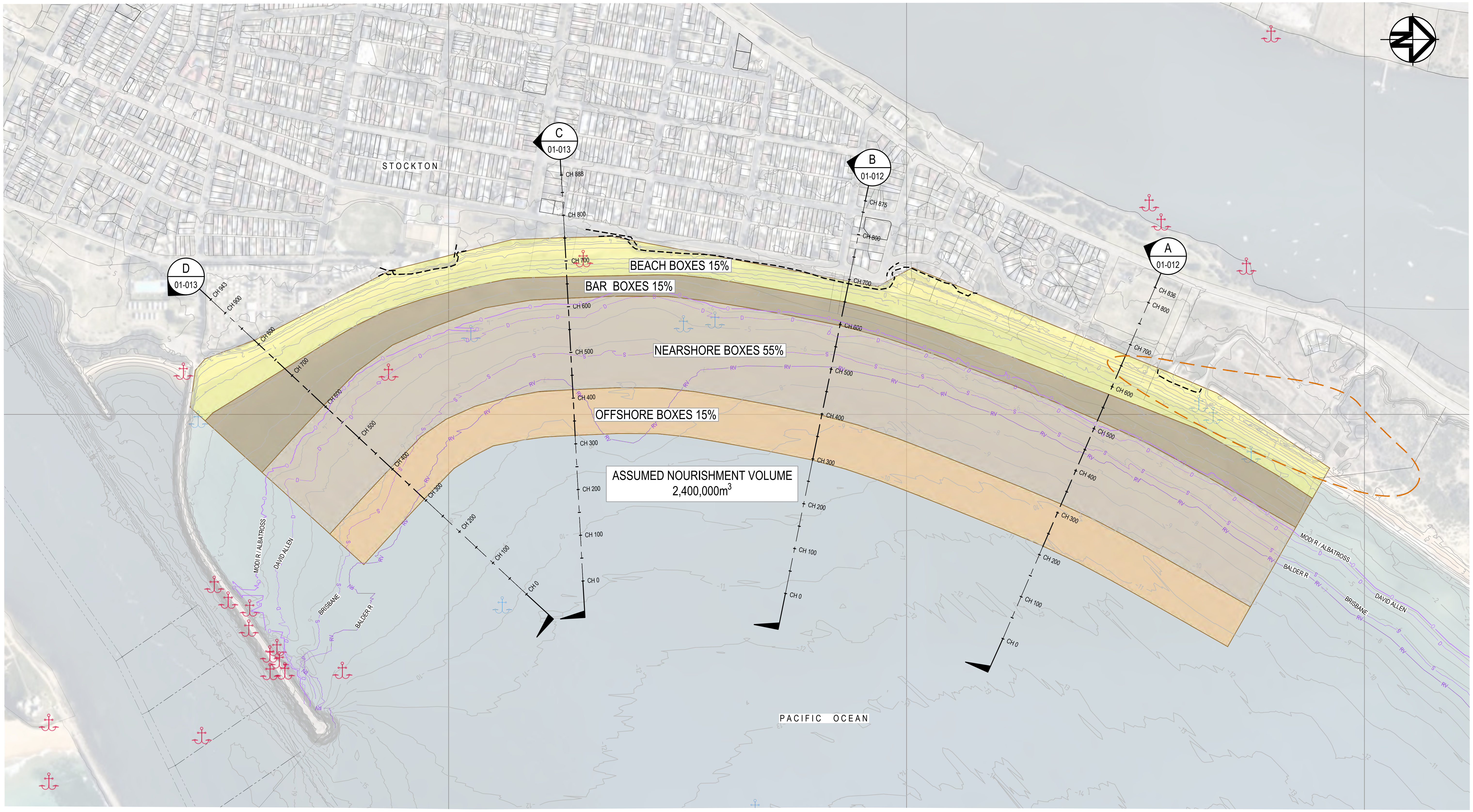
PROJECT
STOCKTON BEACH NOURISHMENT CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
SITE CONSTRAINTS PLAN

DRG NO.
P19130-BC-00-004

REV.
A



MASS NOURISHMENT PLAN

SCALE 1: 4,000

LEGEND

- MARTIME FEATURES (#)
- SHIPWRECKS (*)
- STRUCTURES
- ABORIGINAL HERITAGE

(#) DIGITISED FROM AERIAL IMAGERY AND CHARTS

(*) DATA DERIVED FROM NSW MARITIME HERITAGE DATABASE

LEGEND

LADEN VESSEL DRAFT

- O — MODI R (3.8m)
- O — ALBATROSS (3.8m)
- D — DAVID ALLEN (4.4m)
- S — BRISBANE (6.25m)
- RV — BALDER R (7.0m)

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

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SCALE 1:4,000 AT ORIGINAL SIZE

DESIGNED BY	HL
DRAWN BY	MC
CHECKED BY	-
APPROVED	EW
APPROVED (CLIENT)	

REFERENCES

SURVEY PROVIDED BY	DPIE
HORIZONTAL DATUM	MGA 56
VERTICAL DATUM	AHD

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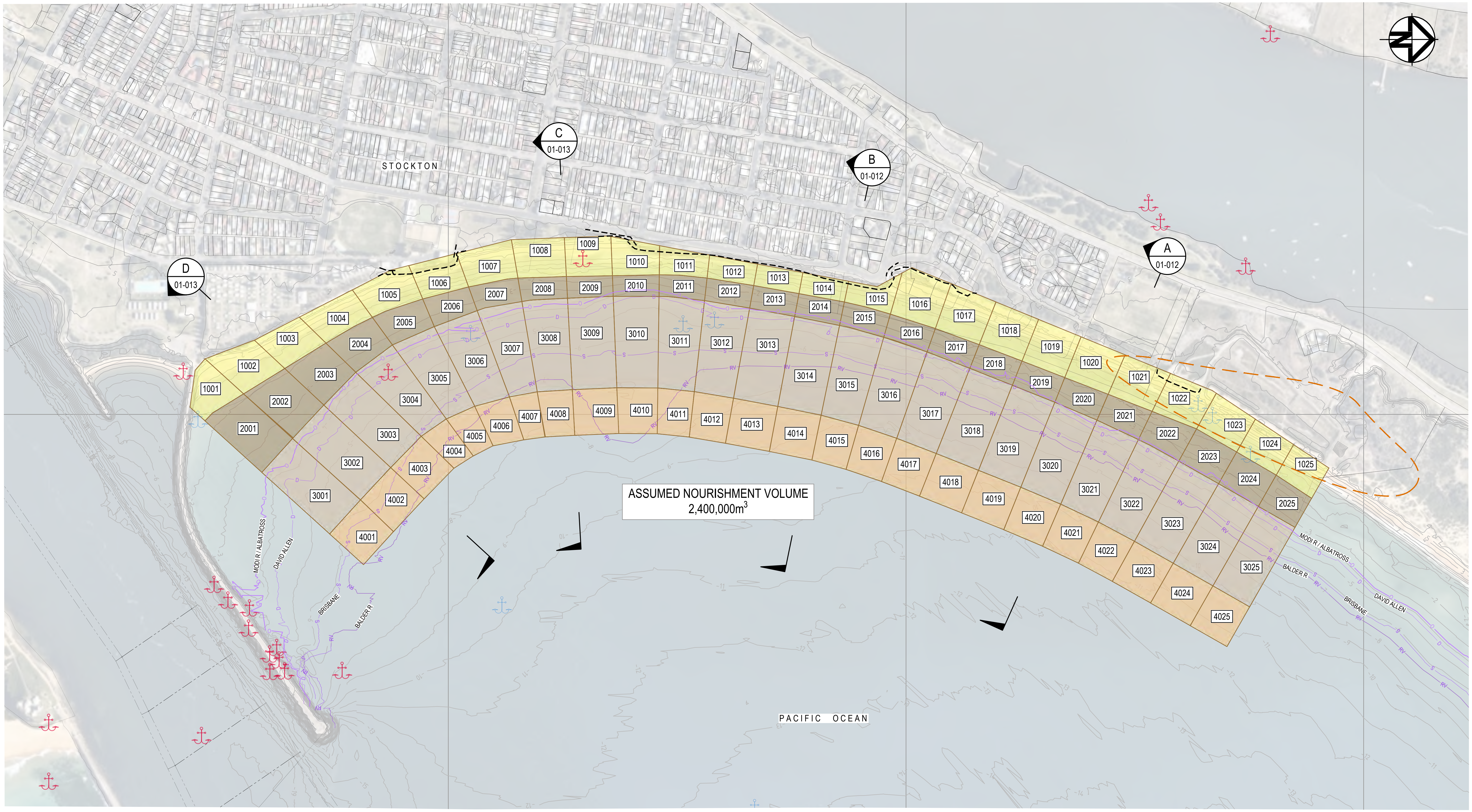
PROJECT: STOCKTON BEACH NOURISHMENT CONCEPT DESIGN

DRAWING TITLE: MASS NOURISHMENT MASTER PLAN

PROJECT NUMBER: P19130

DRG NO.: P19130-BC-01-010

REV.: A



LEGEND

- MARTIME FEATURES (#)
- SHIPWRECKS (*)
- STRUCTURES
- ABORIGINAL HERITAGE
- 2001 NOURISHMENT GRID

(#) DIGITISED FROM AERIAL IMAGERY AND CHARTS

(*) DATA DERIVED FROM NSW MARITIME HERITAGE DATABASE

LEGEND

LADEN VESSEL DRAFT

- MODI R (3.8m)
- ALBATROSS (3.8m)
- DAVID ALLEN (4.4m)
- BRISBANE (6.25m)
- BALDER R (7.0m)

GENERAL ARRANGEMENT PLAN

SCALE 1: 4,000

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 40 80 120 160 200m

SCALE 1:4,000 AT ORIGINAL SIZE

DESIGNED BY	HL
DRAWN BY	MC
CHECKED BY	-
APPROVED	EW
APPROVED (CLIENT)	

REFERENCES

SURVEY PROVIDED BY	DPIE
HORIZONTAL DATUM	MGA 56
VERTICAL DATUM	AHD

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PROJECT

STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER

P19130

DRAWING TITLE

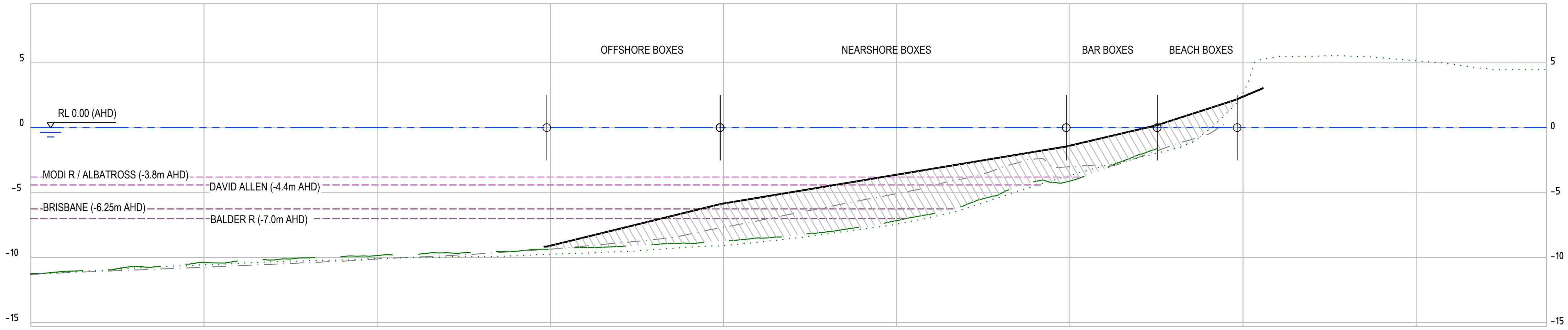
MASS NOURISHMENT
GENERAL ARRANGEMENT PLAN

DRG NO.

P19130-BC-01-011

REV.

A

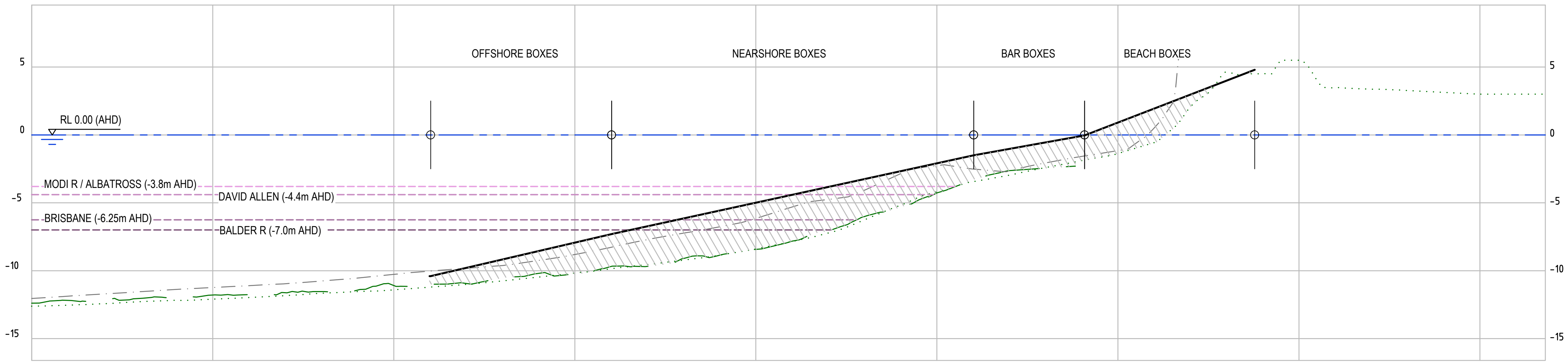


DATUM R.L. -16

DESIGN FINISHED LEVEL							-9.09	-7.45	-5.84	-4.73	-3.62	-2.51	-1.39	0.18	2.41				
EXISTING SURFACE	-11.23	-10.85	-10.35	-10.10	-9.84	-9.63	-9.37	-9.06	-8.70	-8.15	-7.16	-5.46	-4.11	-1.62	2.67	5.55	5.16	4.50	4.50
CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	875

SITE SECTION B

SCALE 1: 1500H
1:200V



DATUM R.L. -18

DESIGN FINISHED LEVEL						-9.48	-7.93	-6.44	-4.99	-3.54	-2.09	-0.79	0.91	3.48				
EXISTING SURFACE	-12.39	-12.17	-11.79	-11.51	-11.09	-10.80	-10.24	-9.51	-8.43	-6.62	-4.27	-2.54	-1.37	3.11	5.50	3.34	3.00	3.00
CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	836

SITE SECTION A

SCALE 1: 1500H
1:200V

RL 0.00m (AHD)
SURVEY LEVELS 'STAX' 1995
LIDAR SURVEY 2018
DETAILED BATHYMETRY 2020
PROPOSED FILLING / NOURISHMENT

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE

0 15 30 45 60 75m
SCALE 1:1500 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

PLANS PREPARED FOR:
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PLANS PREPARED BY:
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New South Wales, 2300
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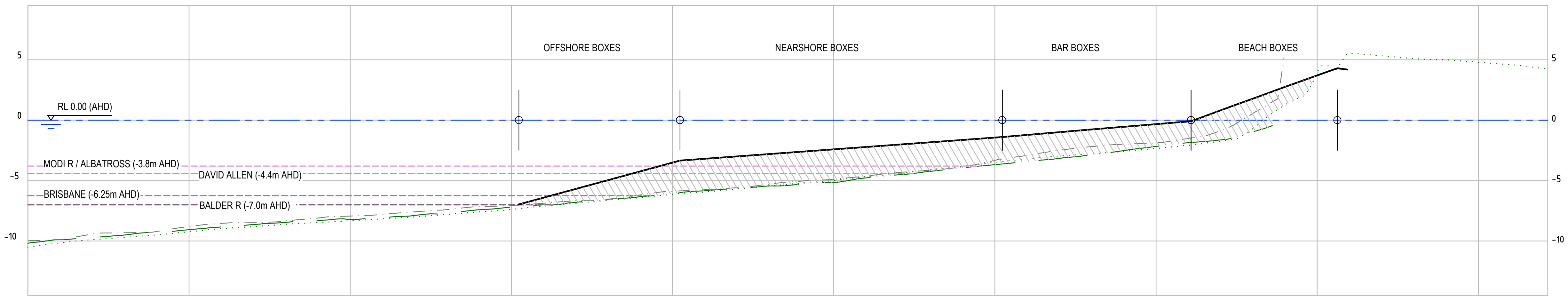
PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
MASS NOURISHMENT
SITE SECTIONS SHEET 1

DRG NO.
P19130-BC-01-012

REV.
A

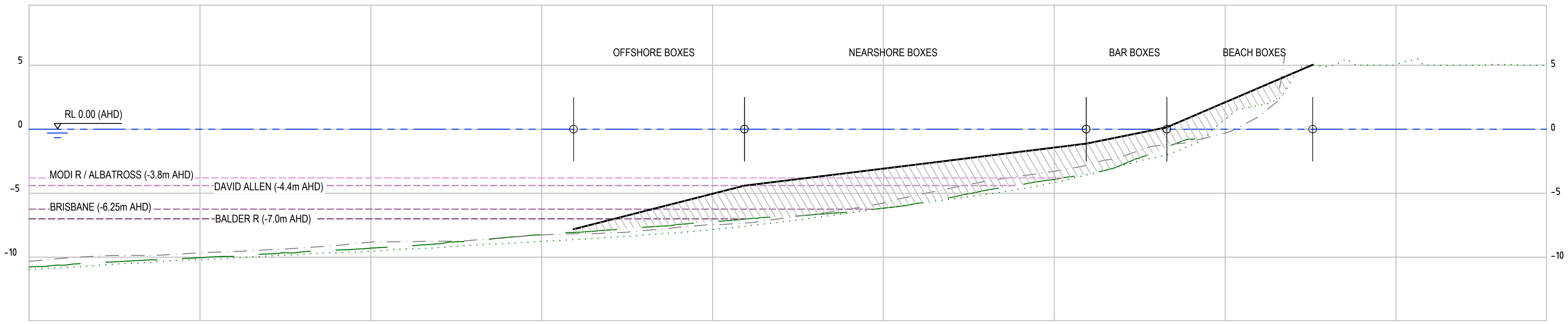


DATUM R.L. -16

CHAINAGE	DESIGN FINISHED LEVEL	EXISTING SURFACE
0		-10.18
50		-9.61
100		-9.06
150		-8.54
200		-8.23
250		-7.75
300		-7.19
350	-5.32	-6.66
400	-3.51	-6.07
450	-2.90	-5.55
500	-2.41	-5.17
550	-1.92	-4.40
600	-1.44	-3.68
650	-0.88	-3.02
700	-0.33	-2.17
750	1.30	-1.36
800	3.70	4.02
850		5.21
900		4.79
943		4.23

SITE SECTION D

SCALE 1: 1500H
1:200V



DATUM R.L. -16

CHAINAGE	DESIGN FINISHED LEVEL	EXISTING SURFACE
0		-10.76
50		-10.37
100		-10.04
150		-9.65
200		-9.29
250		-8.80
300		-8.24
350	-6.75	-7.76
400	-5.05	-7.22
450	-3.90	-6.77
500	-3.08	-6.17
550	-2.26	-5.05
600	-1.43	-3.92
650	-0.28	-2.24
700	2.10	0.77
750	4.96	5.00
800		5.07
850		5.02
888		5.00

SITE SECTION C

SCALE 1: 1500H
1:200V

RL 0.00m (AHD)
SURVEY LEVELS 'STAX' 1995
LIDAR SURVEY 2018
DETAILED BATHYMETRY 2020
PROPOSED FILLING / NOURISHMENT

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE
0 15 30 45 60 75m
SCALE 1:1500 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

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PLANS PREPARED BY:

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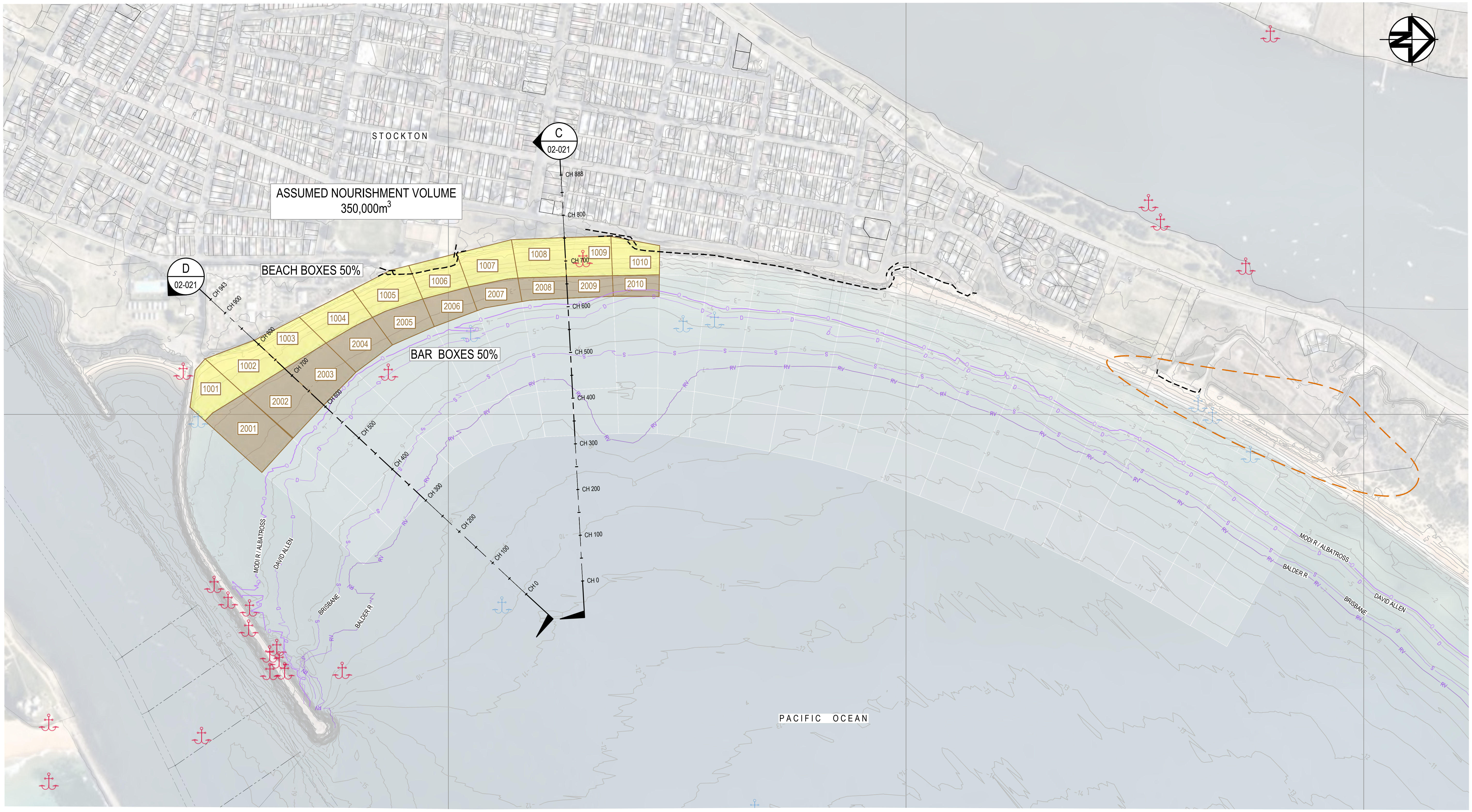
PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
MASS NOURISHMENT
SITE SECTIONS SHEET 2

DRG NO.
P19130-BC-01-013

REV.
A



LEGEND

	MARTIME FEATURES (#)	(#) DIGITISED FROM AERIAL IMAGERY AND CHARTS
	SHIPWRECKS (*)	
	STRUCTURES	(*) DATA DERIVED FROM NSW MARITIME HERITAGE DATABASE
	ABORIGINAL HERITAGE	
2001	NOURISHMENT GRID	

LEGEND

LADEN VESSEL DRAFT

- MODI R (3.8m)
- ALBATROSS (3.8m)
- DAVID ALLEN (4.4m)
- BRISBANE (6.25m)
- BALDER R (7.0m)

AMENITY GENERAL ARRANGEMENT PLAN

SCALE 1: 4,000

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 40 80 120 160 200m

SCALE 1:4,000 AT ORIGINAL SIZE

DESIGNED BY	HL
DRAWN BY	MC
CHECKED BY	-
APPROVED	EW
APPROVED (CLIENT)	

REFERENCES

SURVEY PROVIDED BY	DPIE
HORIZONTAL DATUM	MGA 56
VERTICAL DATUM	AHD

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PLANS PREPARED FOR:

Hunter & Central Coast Development Corporation

PLANS PREPARED BY:

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www.bluecoastconsulting.com.au

PROJECT

STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER

P19130

DRAWING TITLE

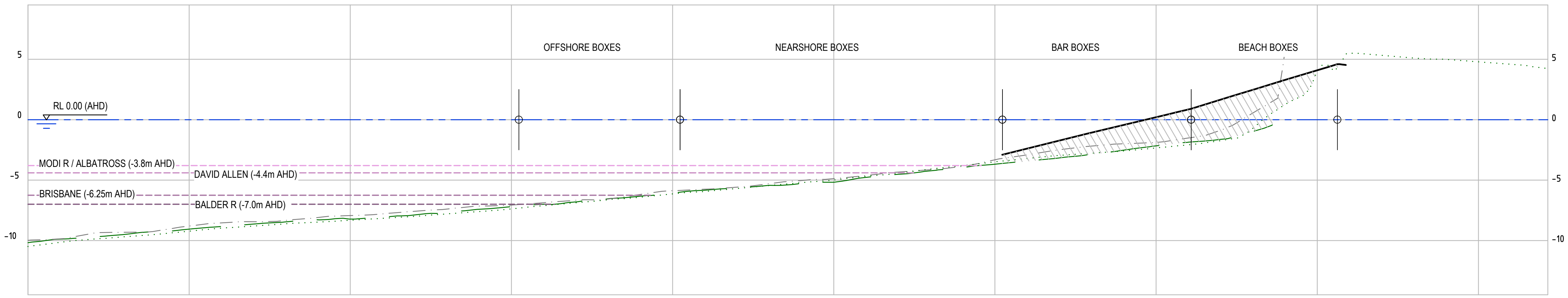
AMENITY NOURISHMENT
GENERAL ARRANGEMENT PLAN

DRG NO.

P19130-BC-02-020

REV.

A



DATUM R.L. -16

DESIGN FINISHED LEVEL														-1.40	0.21	2.07	4.09			
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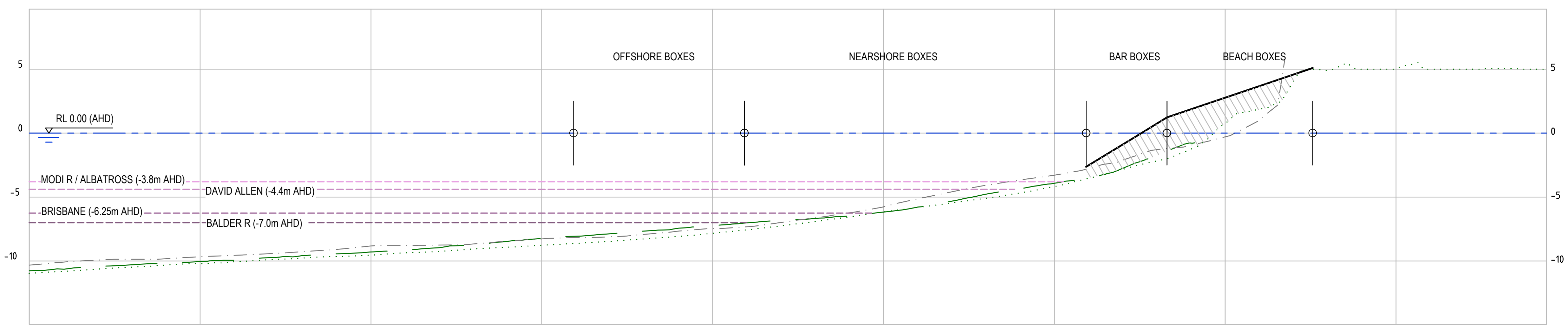
CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	943

AMENITY SITE SECTION D

SCALE 1: 1500H
1:200V



DATUM R.L. -16

DESIGN FINISHED LEVEL														-0.08	2.77	5.04			
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CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	888

AMENITY SITE SECTION C

SCALE 1: 1500H
1:200V

RL 0.00m (AHD)
SURVEY LEVELS 'STAX' 1995
LIDAR SURVEY 2018
DETAILED BATHYMETRY 2020
PROPOSED FILLING / NOURISHMENT

NOTES
- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE
0 15 30 45 60 75m
SCALE 1:1500 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

PLANS PREPARED FOR:
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PLANS PREPARED BY:
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PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
AMENITY NOURISHMENT
SITE SECTIONS SHEET 1

DRG NO.
P19130-BC-02-021

REV.
A

Appendix B: Consideration of Clause 171(2) Factors Consideration of Matters of National Environmental Significance

Clause 171(2) Checklist

Factor	Impact
Any environmental impact on a community? In the short term the community will be subject to a loss of amenity and public space whilst the works are being undertaken. The safeguards included in this REF will ensure that any potential loss of amenity is minimised. In the long term the community will have access to higher quality public infrastructure and space.	Minor short-term negative. Positive long term.
Any transformation of a locality? In the short term the works area will be subject to disruption and reduced public access. In the longer term the locality will be positively transformed into a high-quality public space.	Minor short-term negative. Major long-term positive.
Any environmental impact on the ecosystems of the locality? Although some disturbance of marine habitat is unavoidable during the works, provided that the safeguards included in this REF are implemented there are unlikely to be any long-term impacts.	Minor short-term negative. Nil long term.
Any reduction of the aesthetic, recreational, scientific, or other environmental quality or value of a locality? The amenity, quality and recreational value of the environment will be reduced whilst works are being undertaken. At completion the Proposal will significantly improve the aesthetic and recreational value of the locality.	Minor short-term negative. Major long-term positive.
Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific, or social significance or other special value for present or future generations? Provided that the safeguards included in this REF are implemented on site it is unlikely that there would be any impacts.	Nil
Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)? Although some disturbance of natural systems is unavoidable during the works, provided that the safeguards included in this REF are implemented there are unlikely to be any long-term impacts.	Minor short-term negative. Positive long term.
Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? The Proposal is unlikely to result in the endangering of any species of animal, plant or other form of life.	Nil
Any long-term effects on the environment? There are no long-term effects on the environment likely, provided that the safeguards included in this REF are implemented.	Major long-term positive.
Any degradation of the quality of the environment? The quality of the environment will be reduced whilst works are being undertaken. No long-term degradation of the environment is likely, provided that the	Minor short-term negative. Major long term positive.

Factor	Impact
safeguards included in this REF are implemented. Longer term the quality of the environment will be significantly improved.	
Any risk to the safety of the environment? Some risks to the safety of the environment are possible during sand placement. No long-term safety risks are likely, provided that the safeguards included in this REF are implemented.	Minor short-term negative. Nil long term.
Any reduction in the range of beneficial uses of the environment? In the short term the works area will be subject to disruption and reduced public access. In the longer term the range of beneficial uses of the environment will be increased due to the improvement of the beach and foreshore.	Minor short-term negative. Major long-term positive.
Any pollution of the environment? Provided that the safeguards included in this REF are implemented, it is unlikely that there would be any pollution of the environment.	Nil.
Any environmental problems associated with the disposal of waste? It is anticipated that there would be minimal waste. No contaminated waste is likely to be generated and no problems with the disposal of waste are likely.	Nil.
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? The Proposal does not rely upon the use of resources that are, or are likely to become, in short supply.	Nil.
Any cumulative environmental effect with other existing or likely future activities? No other construction works are likely to be undertaken in close proximity at the same time as the Proposal. In the longer term the Proposal will make a positive contribution to a larger effort to address coastal hazards.	Nil short-term. Major long-term positive.
Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The proposed works are for the purpose of addressing the impacts of coastal hazards on the community and the local environment.	Major long-term positive.

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on the Commonwealth land are required to be considered to assist in determining whether the Proposal should be referred to the Australian Government Department of Agriculture, Water and Environment.

Factor	Impact
Any impact on a World Heritage property? There are no World Heritage properties in close proximity to the Proposal and no indirect impacts on any World heritage property are likely.	Nil
Any impact on a National Heritage place? There are no National Heritage places in close proximity to the Proposal and no impacts on any National Heritage place are likely.	Nil
Any impact on a wetland of international importance? There are no wetlands of international importance in close proximity to the Proposal and no indirect impacts on any wetlands are likely.	Nil
Any impact on a listed threatened species or communities? There are no listed threatened species or communities likely to be impacted by the Proposal, provided that the safeguards and mitigation measures detailed in this REF are implemented.	Nil
Any impacts on listed migratory species? There are no listed migratory species likely to be impacted by the Proposal provided that the safeguards and mitigation measures detailed in this REF are implemented.	Nil
Any impact on a Commonwealth marine area? No impacts on a Commonwealth marine area are likely, provided that the safeguards and mitigation measures detailed in this REF are implemented.	Nil
Does the Proposal involve a nuclear action (including uranium mining)? The Proposal does not involve a nuclear action.	Nil
Additionally, any impact (direct or indirect) on the environment of Commonwealth land? There is no Commonwealth land in close proximity to the Proposal and no indirect impacts on any Commonwealth land is likely.	Nil

Appendix C: Cultural Heritage Assessment

APPENDIX C INTENTIONALLY LEFT BLANK
Privileged information provided to CN confidentially

Appendix D: Historic Heritage Assessment

COSMOS ARCHAEOLOGY

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Murwillumbah, NSW
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A.B.N. 83 082 211 498

Stockton Beach Renourishment Project

Desktop Maritime Archaeological Assessment

Newcastle
NSW

December 2022

Updated January 2023

Stockton Beach Renourishment
Desktop Maritime Archaeology Assessment

Prepared for:

Bluecoast Consulting Engineers

By:

Jane Mitchell

Tara Chilcott

December 2022

Updated January 2023

Cosmos Archaeology Job Number J22/06

Cover Image: The barque* Durisdeer *in 1895, wrecked on Stockton Beach. Source: Newcastle Regional Library.

Revision	Description	Date	Originator	Reviewer	Approver
V1	Draft Desktop MAA	28/09/2022	JM, TC	CC	CC
V1.1	CN comments incorporated and report finalised.	13/12/2022	JM		
V1.2	Incorporated additional location data provided by BlueCoast Jan 2023	25/01/2023	JM	CC	CC

EXECUTIVE SUMMARY

City of Newcastle are planning to combat serious erosion on Stockton Beach by utilising mass sand renourishment. Cosmos Archaeology has been commissioned by Bluecoast to undertake a desktop maritime archaeology assessment (MAA) for the Stockton Beach renourishment project.

By the mid 19th century, Newcastle had become a major shipping hub for coal, timber and salt exports, alongside shipbuilding, engineering and rail services. Stockton became particularly industrious by the mid 19th century, with enterprises such as a salt works, chemical plants, an iron foundry and a tweed mill. In 1884, the Stockton Colliery commenced production, helping to prop up the then-struggling Newcastle coal industry.

Newcastle gained a reputation of being a particularly dangerous port to enter. The Oyster Bank was a significant maritime hazard for shipping. Eventually some of the vessels wrecked on the Oyster Bank were used to create the foundations of the Stockton Breakwater.

Known maritime sites within the area include two shipwrecks – currently attributed to the *Durisdeer and Berbice* and the remains of a ventilation shaft from the Stockton Colliery.

There are potentially over 100 undocumented or unlocated shipwrecks within the study area.

Based on the available information, the study area is considered to contain high archaeological potential.

The works involve placement of sand with a proposed volume of up to 2,400,00 m^3. The seabed will not be impacted by any other methods. The potential impacts to the archaeological resource is considered to be placement of sand directly onto delicate sites and sediment accretion as the dumped sand moves with the tides and general water movement.

From the findings of this desktop MAA, the following recommendations are made:

Review of 2021 Remote sensing survey data and diver survey

The purpose of the review is to identify anomalies and known wreck sites within the study area. Identified targets should be dived on by a qualified maritime archaeologist to record each site.

Placement of buffer zones around known underwater sites within the sand placement area.

Buffer zones should be placed around exposed maritime archaeological sites to avoid have dredged material directly overhead and crushing or destabilising them. The diameter of these zones should be 50 m so as to avoid direct impacts to delicate sites.

Apply for a permit to impact underwater cultural heritage under the UCHA Act 2018.

This permit can be applied online through the Australasian Underwater Cultural Heritage Database (AUCHD) managed by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW). While the overall impact of the works is likely to be mostly positive, the exposed wrecks may still experience impacts from either accretion or erosion resulting from the works.

TABLE OF CONTENTS

Abbreviations

AAC	Australian Agricultural Company
AUCHD	Australasian Underwater Cultural Heritage Database
DAWE	Department of Agriculture, Water and the Environment
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
EPBC Regs	*Environment Protection and Biodiversity Conservation Regulations 2000* (Cwlth)
LEP	Local Environment Plan
MAA	Maritime Archaeological Assessment
MASoHI	Maritime Archaeological Statement of Heritage Impact
NC	Newcastle Council
NPC	Newcastle Port Corporation
NSW	New South Wales
NSWMHD	NSW Maritime Heritage Database
REF	Review of Environmental Factors
RNE	Register of the National Estate
ISEPP	State Environment Planning Policy (Infrastructure)
SHI	State Heritage Inventory
SHR	State Heritage Register
SoHI	Statement of Heritage Impact
TfNSW	Transport for New South Wales
TSB	Territorial Sea Baseline
UCHA 2018	*Underwater Cultural Heritage Act 2018* (Cwlth)
UNESCO	United Nations Educational, Scientific and Cultural Organisation

1 INTRODUCTION

1.1 Background

Stockton Beach is located immediately north of the Hunter River, one of NSW's largest coastal rivers. The area is highly dynamic and has experienced numerous coastal erosion events requiring the construction of a range of temporary and permanent protection measures. Historical analysis of erosion at Stockton Beach demonstrated a cyclic nature of beach erosion and recovery, in recent years the levels of erosion has progressed beyond the extents of historical cycles.

Cosmos Archaeology has been commissioned by Bluecoast to undertake a desktop maritime archaeology assessment (MAA) for the Stockton Beach renourishment project.

1.2 Project Description

The Stockton CMP presents a long-term plan for the management of the Stockton coastline. The CMP identified large scale (mass) sand nourishment as the preferred solution that sustainably meets the City of Newcastle and the community's objectives of asset protection and beach amenity over the long term.[1]

1.3 Study Area

Stockton Beach is defined as the southern end of Stockton Bight, also known as Newcastle Bight. Stockton Bight is a 32 km long beach (NSW's longest beach), extending from Birubi Point in the north to the mouth of the Hunter River in the south (Figure 1 and Figure 2).

It has the largest active dune system in Australia, one of the highest wave energy beaches in NSW and a beach that grades from highly developed in the south to natural along its central and northern sections.

[1] **City of Newcastle, 2022** Request for Quotation Environmental Assessment Stockton Beach Renourishment Project, p. 2

***Figure 1: Stockton Bight with location of study area circled in red.*[2]**

Figure 2: Stockton Beach study area in green. Sand placement area is yellow outline. Base image Google Earth.

[2] **Royal Haskoning DHV, 2020,** *Stockton Coastal Management Program*, report prepared for City of Newcastle, p.10.

1.4 Scope

The scope of this investigation covers impacts to the maritime archaeological resource within the study area.

The scope of this proposal does not cover:

- Sourcing of sand for beach nourishment
- Underwater Aboriginal heritage
- Any heritage related impacts above the Highest Astronomical Tide (HAT).

2 HERITAGE LEGISLATION AND POLICY

Cultural heritage in NSW is protected and managed under a hierarchy of legislation. There are four levels of statutory listings for historical cultural heritage sites, objects and places in NSW:

Local listing on the heritage schedule of a Council's environmental planning instrument

- State listing on the NSW State Heritage Register
- National listing on the National Heritage List
- World listing on the United Nations Educational Scientific and Cultural Organisation (UNESCO) World Heritage List.

Sites and items owned, occupied or managed by the NSW Government can also be included in the Heritage and Conservation Register of the respective agency or corporation under Section 170 of the NSW *Heritage Act 1977.*

Inclusion on such statutory heritage registers provides automatic legal protection. In NSW, protection for historical heritage sites and items is afforded by the NSW *Heritage Act 1977*, the NSW *Environmental Planning and Assessment (EPA) Act 1979*, the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* and guided by policies such as the UNESCO *Convention Concerning the Protection of the World Cultural and Natural Heritage.*

Additional protection can also be afforded to historic shipwrecks and associated relics within NSW waters under the Commonwealth *Underwater Cultural Heritage Act 2018.*

Cultural heritage sites, objects and places may also be listed on non-statutory registers, most notably the Register of the National Estate. The act of listing a place on the Register of the National Estate does not constitute automatic legal protection, however the Register is widely recognised as an authoritative compilation of the heritage significance of many of Australia's natural and cultural places and is considered by planning agencies when decisions about development and conservation are being made.

The following sections provide a summary of the relevant statutory regulations regarding the current project area.

2.1 Commonwealth Legislation

2.1.1 *Commonwealth Underwater Cultural Heritage Act 2018*

The *Underwater Cultural Heritage Act 2018* (UCHA 2018) provides for the protection of Australia's underwater cultural heritage The objectives of this Act are:

(a) to provide for the identification, protection, and conservation of Australia's underwater cultural heritage.

(b) to enable the cooperative implementation of national and international maritime heritage responsibilities.

(c) to promote public awareness, understanding, appreciation and appropriate use of Australia's underwater cultural heritage.

The *UCHA 2018* came into effect on 1 July 2019, replacing the *Historic Shipwrecks Act 1976.* Clause 16 of *UCHA 2018* provides certain articles of underwater cultural heritage are automatically protected. This includes the remains of vessels and articles associated with the vessel or remains of the vessel that have been in Australian waters for at least 75 years. This means that articles removed from the wreck at the time of sinking are not automatically protected.

The new Act also extends automatic protection to the remains of aircraft and certain associated articles that have been in Commonwealth waters for at least 75 years.

It should be noted that the 75-year rolling date protection applies to when a vessel or aircraft entered the water, for instance when it was wrecked and sank, and does not relate to its age at that time. Therefore, a 75-year-old vessel that entered the water 10 years ago does not qualify for automatic protection at that time but does once it has been in the water for 75 years.

The designation of Australian and Commonwealth waters is complex. These maritime boundaries are measured from what is defined as the Territorial Sea Baseline (TSB) (Figure 3).

The calculation of the TSB is also complex. The baseline follows the lowest astronomical tide (LAT) along the coast except where the coastline is deeply indented and cut into, or where there is a fringe of islands along the coast in its immediate vicinity, or at the entrances to rivers and bays. In these instances, straight baselines or closing lines are drawn (Figure 4).

Commonwealth waters under the Act extends from the seaward boundary of coastal waters (3 nm from the TSB) to the seaward boundary of the Exclusive Economic Zone (200 nm from the TSB) and to the edge of the continental shelf and up to the borders of Papua New Guinea, Timor - Leste and Indonesia. To re-iterate what has been stated above, within Commonwealth waters;

- Planes wrecked over 75 years ago are automatically protected.
- Younger plane wrecks, as well as other forms of underwater cultural heritage such as submerged terrestrial (Aboriginal) sites can be declared protected by the Minister.

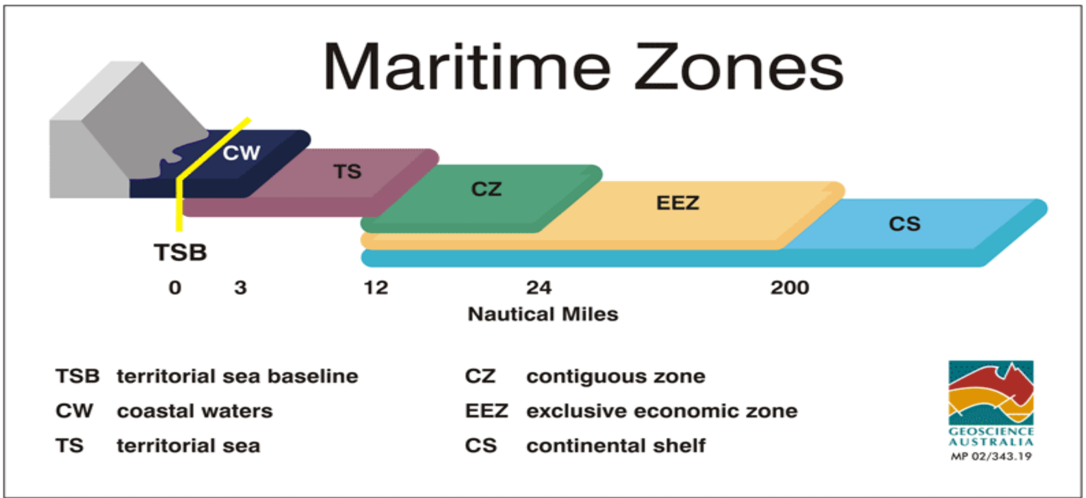

Figure 3: Maritime zone definitions.[3]

[3] Op. Cit., **Geoscience Australia** Maritime Boundary Definitions.

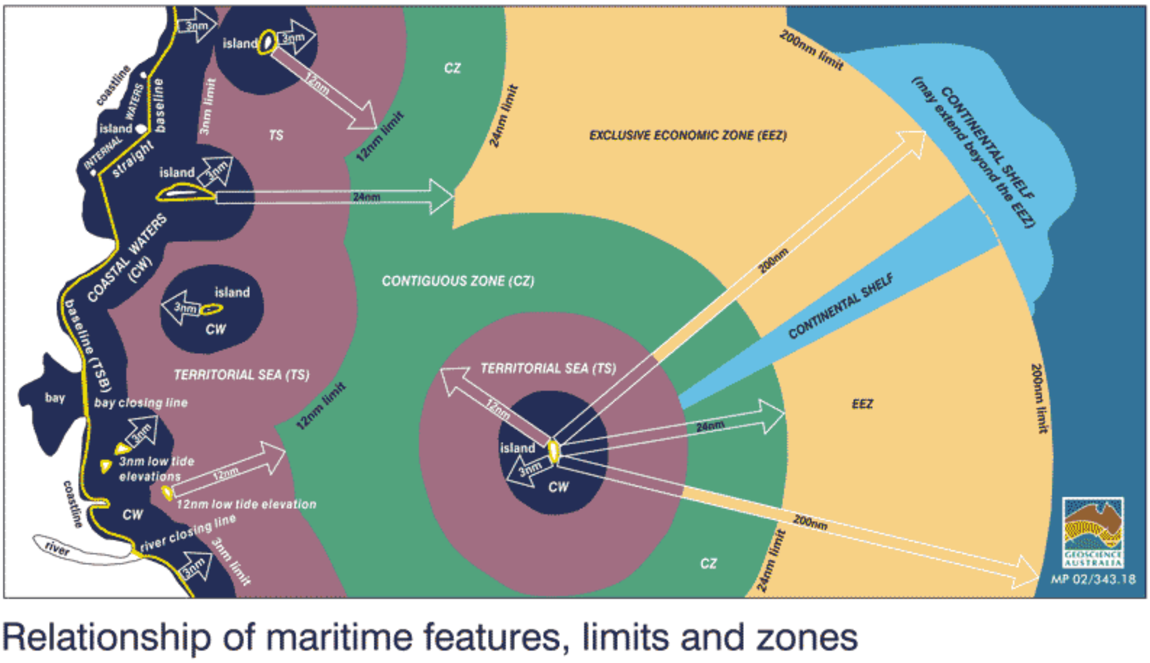

Figure 4 : Maritime features, limits and zones.[4]

The definition of 'Australian Waters' appears to be peculiar to the *UCHA 2018*. This term covers the seabed of the continental shelf (from 12 nm to 200 nm from the TSB) and the territorial sea (up to 12 nm from the TSB) and *any waters on the landward side of the territorial sea* [that is, landward of the TSB] *of Australia that are not within the limits of a State*. The seabed landward of the TSB is considered to be internal waters but this does mean the same as the *limits of the State* with respect to the *UCHA 2018.*[5] Note that the Act therefore applies to all internal waters of the Northern Territory.

There is no known border or line available that delineates the limit of a State and the seabed landward of the TSB for the purposes of administrating the *UCHA 2018*. What constitutes the limits of a State when applying the *UCHA 2018* has to do with such things as the shape of a bay where the entrance is narrower than the width and depth of the bay and/or the distance between the headlands of a bay. Bodies of water such as Port Phillip, Jervis Bay, Botany Bay and Port Jackson (Sydney Harbour) are treated as being within the limits of the State.

The applicability of the *UCHA 2018* within shallow bays or bays with large entrances and/or bodies of water bounded by offshore islands such as Kangaroo Island, Cockburn Sound or Moreton Bay is opaque. In these situations, the legal status of an underwater cultural heritage site located landward of the TSB may need to be determined by legal opinion based on the application of formulas dedicated to defining the boundary of the 'limit of State' and 'Australian waters'. Because of the cost involved in doing this for the whole of the Australian coastline, the Commonwealth assesses the legal status of an underwater cultural heritage site landward of the TSB on a case-by-case basis.

In recent years a number of Historic Bays have been proclaimed as being within the limits of the State that would otherwise be considered to be in Australian waters. These bays are Anxious Bay, Encounter Bay, Lacepede Bay and Rivoli Bay in South Australia. Gulf St

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[4] Op. Cit., **Geoscience Australia** Maritime Boundary Definitions.
[5] For more information on maritime boundaries see **Geoscience Australia** *Maritime Boundary Definitions* https://www.ga.gov.au/scientific-topics/marine/jurisdiction/maritime-boundary-definitions

Vincent and Spencer Gulf have also been proclaimed to be within the limits of the State of South Australia.

To re-iterate what has been stated above, Australian waters for the purposes of the *UCHA 2018* encompasses the seabed from the poorly defined - in places - boundary between the limits of the State landward of the TSB to a minimum distance of 200 nm from the TSB; and in these waters;

- Vessels wrecked over 75 years ago are automatically protected.
- Younger shipwrecks can be declared protected by the Minister.

Any shipwreck located seaward of the TSB is clearly governed by the *UCHA 2018* while the status of a wreck landward of the TSB may need to be adjudicated by the Commonwealth. See also Table 1 below.

Table 1 : Summary of UCH 2018 protections

UCH landward of TSB determined on case-by-case basis	TSB	3 nm	12 nm	24 nm	200 nm	Limits of shelf or international borders.

Limits of the State
Coast waters
Territorial sea
Contiguous zone
Exclusive Economic Zone
Continental Shelf
Australian Waters - Vessels wrecked over 75 years ago automatically protected with Minister empowered to protect more recent wrecks.
Commonwealth waters - Plane wrecks over 75 years automatically protected with Minister empowered to protect other forms of UCH.

Certain conduct is prohibited under the *UCHA 2018* for protected sites without a permit including:

- conduct that would or is likely to adversely impact the article
- possessing the article
- supplying, or offering to supply, the article
- importing or exporting the article.

Further, the Minister can declare an area containing protected underwater cultural heritage to be a protected zone if the area is within Australian waters and the declaration would be consistent with the objectives of the *UCHA 2018*. The declaration may regulate or prohibit the kinds of activities that can be carried out in the protected zone.

The *UCHA 2018* is aligned with the UNESCO 2001 *Convention on the Protection of the Underwater Cultural Heritage* and identifies a standard for the assessment and management of underwater cultural heritage in Australia.

2.1.1.1 Australasian Underwater Cultural Heritage Database [6]

The *Underwater Cultural Heritage Act 2018* requires the Minister to maintain a register in relation to underwater cultural heritage for items protected under the *UCHA 2018*. The Australasian Underwater Cultural Heritage Database (AUCHD) contains information about the shipwrecks, submerged aircraft and other underwater cultural heritage in the Oceania and Southeast Asian regions. It also includes information about artefacts or articles

[6] **Department of Agriculture, Water and the Environment 2021,** *Australasian Underwater Cultural Heritage Database; Advanced Search,* available at www.environment.gov.au/shipwreck/public/maps/shipwreck-map-search-load.do?source=search, Accessed 26th July 2021.

associated with specific entries. The database also contains information regarding wrecks within the limits of the State.

A search of the AUCHD for vessels lost at Stockton Beach, returned 18 entries (Table 2).

Table 2: Shipwrecks recorded as lost at Stockton Beach from the AUCHD.

AUCHD ID	Name	Year Lost	Vessel Type	Where Lost
15	*Adderly*	1897		Stockton Beach, 3 mls sth of Moma Point
70	*Alice*	1901		Newcastle, Stockton Beach
249	*Boyd*	1812		Newcastle, Stockton Beach
521	*Durisdeer*	1895		Newcastle, Stockton Beach, ashore
550	*Electra*	1909	Screw Steamer	Newcastle, Stockton Beach
585	*Emily*	1919	Launch	Newcastle, Stockton Beach
1066	*Laura*	1869		Newcastle, Stockton Beach, ashore
1126	*LVT4*	1954		Newcastle, Stockton Beach
1241	*Merksworth*	1898	Screw Steamer	Newcastle, Stockton Beach, off
1380	*Oriti*	1869		Stockton Beach
1523	*Ranger*	1891		Newcastle, Stockton Beach
1637	*Saturn*	1890		Stockton Beach, 7 mls north Newcastle
1660	*Seagull II*	1926	Screw Steamer	Stockton Beach, 12 mls north Newcastle
1760	*Sygna*	1974	Motor Vessel	Newcastle, Stockton Beach
1818	*Transport*	1888		Newcastle, Stockton Beach
1869	*Unidentified*	1835		Newcastle, Stockton Beach
1967	*Unity*	1907	Screw Steamer	Newcastle, Stockton Beach
10875	*Unidentified Stockton Beach wreckage*			Stockton Beach

2.1.2 *Environment Protection and Biodiversity Conservation Act 1999* [7]

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the principal environmental Act at a Commonwealth level. Australia is one of only a few countries worldwide that has enacted legislation to implement its obligations under the World Heritage Convention. The EPBC Act and the *Environment Protection and Biodiversity Conservation*

[7] **Department of Agriculture, Water and the Environment 2021,** *Australia's National Heritage List,* available at https://www.environment.gov.au/heritage/places/national-heritage-list, Accessed 26 May 2022; and **Department of Agriculture, Water and the Environment 2021,** *Australia's Commonwealth Heritage List*, available at https://www.environment.gov.au/heritage/places/commonwealth-heritage-list, Accessed 26 May 2022.

Regulations 2000 (EPBC Regs) focuses Government interests on the protection of matters of national environmental significance, with the states and territories having responsibility for matters of State and local significance. Matters of national environmental significance include but are not limited to flora, fauna, ecological communities and heritage places of national and international importance.

The EPBC Act requires approval from the Minister for actions with a significant impact on places included on the World Heritage List or Commonwealth Heritage List, which may include maritime and underwater heritage.

There are no sites on the World, National or Commonwealth lists within the study area.

2.2 NSW Legislation

2.2.1 *NSW Heritage Act 1977 (amended 1999)*

The NSW *Heritage Act 1977* is the primary piece of State legislation affording protection to all items of non-indigenous environmental heritage (natural and cultural) in NSW. Under the Act, "items of environmental heritage" include places, buildings, works, relics, moveable objects and precincts identified as significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. Items of heritage identified as having State significance are listed on the NSW State Heritage Register (SHR) and are afforded automatic protection against any activities that may damage the item or affect its heritage significance under the Act. It also requires government agencies to maintain a Heritage and Conservation Register.

The Act distinguishes between assets of State and local significance:

- State significance means significance to the State in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item.
- Local significance means significance to an area in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item.

State Heritage Register [8]

The State Heritage Register (SHR) identifies places and objects of importance to the whole of NSW. It can include maritime archaeology or submerged cultural heritage.

Under the Act movement, demolition, damage or alteration of an item included on the SHR or the subject of an Interim Heritage Order (IHO) requires the approval of the Heritage Council of NSW in accordance with Section 60 of the Act. Exemptions are applicable for minor work and work which would not adversely affect the significance of the item in accordance with Section 57(2) of the Act. Some exemptions may require prior notification and written endorsement (approval) from the Heritage Council of NSW.

Section 170 Heritage and Conservation Registers [9]

Under the Act, State government agencies are required to maintain a Heritage and Conservation Register listing significant assets that it owns, occupies or manages.

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[8] **NSW Government, 2021** *State Heritage Inventory*, available at https://www.hms.heritage.nsw.gov.au/App/Item/SearchHeritageItems?_ga=2.109466755.701239543.1627256983-646661626.1622069078, Accessed 26 May 2022.

[9] **NSW Heritage Office, 2021** *State Heritage Inventory*, available at https://www.hms.heritage.nsw.gov.au/App/Item/SearchHeritageItems?_ga=2.109466755.701239543.1627256983-646661626.1622069078, Accessed 26 May 2022.

Government agencies are required to notify the Heritage Council of NSW within 14 days if an item is removed from a Section 170 Heritage and Conservation Register, and in relation to transfer of ownership, occupation or management of an item included on a Section 170 Heritage and Conservation Register. Items included on a Section 170 Heritage and Conservation Register must be managed in accordance with the State-Owned Heritage Management Principles and the Heritage Council of NSW asset management document. Proposals to alter or demolish assets of State significance must be referred to the NSW Heritage Council.

The *NSW Maritime Heritage Register Report* (GML, 2010) identified and recommended registration of a large number of discrete items, which form the core of the s170 Register.[10]

Shipwrecks and the Register for Shipwrecks

Part 3C of the NSW *Heritage Act 1977* relates to the protection of shipwrecks within State waters. In NSW, a historic shipwreck means the remains of any ship that have been situated in State waters for 75 years or more, or that are the subject of a historic shipwrecks' protection order. Historic shipwrecks are protected under the *Heritage Act 1977* and a Register of Shipwrecks is kept by the Heritage Council. It is noted that items not listed on the Register are still protected under the *Heritage Act 1977* (see 'Relics').

It is possible for a shipwreck to be protected by both the *Heritage Act 1977* and *UCHA 2018* if located in Coastal Waters of NSW (see Figure 3 and Figure 4).

The protection afforded under the *Heritage Act 1977* also extends to articles associated with a shipwreck including articles that formed part of, or had been installed on, or carried in, the ship, or constructed or used by a person associated with the ship.

Part 3C of the Act applies to shipwrecks and associated articles within State waters that are not the subject of an IHO or included, or within an area included, on the SHR. Under the Act, it is an offence to "move, damage or destroy" a shipwreck in NSW unless in accordance with a permit.

The Shipwreck Register now forms part of the NSW Maritime Heritage Database (a register of a diverse range of over 2800 shipwrecks, relics and other underwater and maritime cultural heritage).[11] This database has been built up around historical accounts of the loss of vessels, mainly through the systematic examination of newspapers from the 1790s to the present day. The database has been augmented by other sources such as archival information from the Australian Hydrographic Office.

A search of the NSW Maritime Heritage Database was undertaken using the search terms: Newcastle, Stockton Beach and Nobbys Head. These search terms returned a result of 226 shipwrecks, 1 unidentified aircraft wreck and 1 maritime heritage site (See Annex A for the full list). Of the shipwrecks, 35 are listed as found, 152 are listed as wrecked and not found, 34 were refloated or salvaged and there was not enough information in the database to determine the fates of seven wrecks. There are 20 shipwrecks in the database that have location data either a range or single location but are listed as NOT found.

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[10] **Transport NSW, 2010,** *NSW Maritime Heritage Listings – Listings status*, available at https://roads-waterways.transport.nsw.gov.au/documents/about/environment/protecting-heritage/nsw-maritime-heritage-listings.pdf, Accessed 26 May 2022.
[11] **NSW Heritage Office, 2020** 'Maritime Heritage Online', NSW, available http://www.environment.nsw.gov.au/maritimeheritage/index.htm

Relics provision and protection

In addition to buildings and items listed on the State Heritage Register, various cultural heritage sites, items and archaeological features and deposits are afforded automatic statutory protection by the relics provisions of the NSW *Heritage Act 1977*. The Act defines 'relics' as any item that:

(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement; and,

(b) is of State or local heritage significance.

Sections 139 to 145 of the Act prevent the disturbance or excavation of any land if there is a reasonable cause to suspect that a relic will be discovered, exposed, moved, damaged or destroyed, unless an excavation permit has been issued by the Heritage Council of NSW. The type of permit that is required depends on whether the relic or relics have been listed on the State Heritage Register.

Excavation permits are issued by the Heritage Council of NSW, or its delegate, under Section 140 of the Heritage Act for relics outside an SHR curtilage or under Section 60 for significant archaeology within SHR curtilages. An application for an excavation permit must be supported by an Archaeological Research Design and Archaeological Assessment prepared in accordance with the NSW Heritage Division archaeological guidelines.

Government Gazette # 59 – Planning and Heritage came into force on 1st March 2022 and outlined changes to the exceptions provisions in subsections 139(1) and (2) of the Act.

The following disturbance or excavation of land does not require an excavation permit, provided that it falls within one or more of the exceptions described at clauses 2(a) to (f) below:

a. Any disturbance or excavation of land that has limited archaeological research potential, as demonstrated by a heritage management document, such as an Archaeological Assessment, completed within the last five years.

b. Any disturbance or excavation of land that constitutes minor works involving limited impact to relics of local heritage significance, in accordance with '*Relics of local heritage significance: a guide for minor works with limited impact*', published by Heritage NSW.[12]

c. Any disturbance or excavation of land that constitutes minor works involving limited impact to relics of local heritage significance as demonstrated by a heritage management document, such as an Archaeological Assessment, completed within the last five years.

d. Any disturbance or excavation of land for archaeological test excavation of relics of local heritage significance completed in accordance with the guideline '*Relics of local heritage significance: a guide for archaeological test excavation*'.[13]

e. Any disturbance or excavation of land for archaeological monitoring of relics of local heritage significance completed in accordance with the guideline '*Relics of local heritage significance: a guide for archaeological monitoring*' published by Heritage NSW.[14]

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[12] **Heritage NSW 2022** Relics of local heritage significance: a guide for minor works with limited impacts 2022.1 Information sheet. State of NSW, Department of Premier and Cabinet.

[13] **Heritage NSW 2022,** *Relics of local heritage significance: a guide for archaeological test excavation 2022.2* Information sheet. State of NSW, Department of Premier and Cabinet.

[14] **Heritage NSW 2022,** *Relics of local heritage significance: a guide for archaeological monitoring 2022.3* Information sheet. State of NSW, Department of Premier and Cabinet.

f. Any disturbance or excavation of land:
   i. for the purpose of exposing underground utility services infrastructure which occurs within an existing service trench and will not affect any other relics;
   ii. to carry out inspections or emergency maintenance or repair on underground utility services with due care taken to avoid effects on any other relics;
   iii. to maintain, repair, or replace underground utility services to buildings which will not affect any other relics;
   iv. to maintain or repair the foundations of an existing building which will not affect any associated relics; or
   v. to expose survey marks for use in conducting a land survey.

Exceptions do not apply to relics of State heritage significance or to a relic subject to an interim heritage order or a listing on the State Heritage Register. Under the general conditions, exceptions are now self-assessed by the proponent and no longer require an application to the Heritage Council.[15]

Anything done under these exceptions must be carried out by people with knowledge, skills and experience appropriate to the work. Some exceptions require suitably qualified and experienced professional advice/ work as set out in the guidelines '*Relics of local heritage significance: a guide for archaeological test excavation*' published by Heritage NSW and '*Relics of local heritage significance: a guide for archaeological monitoring*' published by Heritage NSW.

Discovery of Relics

Section 146 of the Act requires that anyone who is aware or believes that they have discovered or located a relic (regardless of whether a permit has been issued) must notify the Heritage Council of its location.

A person who is aware or believes they have discovered or located a relic, in any circumstances (including where works are carried out in reliance on an exception under section 139(4)), must notify the Heritage Council in accordance with section 146 of the *Heritage Act 1977*. Depending on the nature of the discovery, additional assessment and approval under the Heritage Act 1977 may be required prior to the recommencement of excavation in the affected area(s).

2.2.2 *Environmental Planning and Assessment Act (NSW) 1979*

The *Environmental Planning and Assessment Act 1979 (EPA Act)* establishes the framework for cultural heritage values to be formally assessed in the land use planning and development consent process. The EP&A Act requires that environmental impacts are considered prior to land development; this includes impacts on cultural heritage items and places as well as archaeological sites and deposits.

The EP&A Act also requires that local governments prepare planning instruments (LEPs and Development Control Plans [DCPs]) in accordance with the EP&A Act to provide guidance on the level of environmental assessment required. The proposal area falls within the boundaries of the City of Newcastle Council. The study area is covered by the Newcastle LEP 2012.

[15] **Heritage Council of NSW, 2021**, Government Gazette of the State of New South Wales, Number 59 – Planning and Heritage, Friday 18th February 2022.

Schedule 5 of each LEP includes a list of items/sites of heritage significance within the LGA.

Heritage items listed on the LEP are managed in accordance with the provisions of Section 5.10 Heritage Conservation of each LEP. Under Clause 5:

Objectives *The objectives of this clause are as follows—*

a) *to conserve the environmental heritage of [each shire region],*
b) *to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views,*
c) *to conserve archaeological sites,*
d) *to conserve Aboriginal objects and Aboriginal places of heritage significance.*

The relevant clauses for the requirement to obtain development consent are:

1. ***Development consent is required for any of the following—***
   a) *demolishing or moving any of the following or altering the exterior of any of the following (including, in the case of a building, making changes to its detail, fabric, finish or appearance)—*
      a. *a heritage item,*
      b. *an Aboriginal object,*
      c. *a building, work, relic or tree within a heritage conservation area,*

   (c) disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed.

There are two archaeological items listed on the Newcastle LEP 2012 adjacent to the study area:

- ID A23: Stockton Bight Landscape including Fort Wallace
- ID A12: Wreck of *Adolphe*

2.2.3 *State Environmental Planning Policy (Transport and Infrastructure) 2021*

State Environment Planning Policies (SEPPs) are plans drafted by the Department of Planning and Environment (DPE) and apply to a nominated “region,” covering broad issues such as urban growth, commercial centres, extractive industries, recreational needs, rural lands and heritage and conservation. They provide the framework for detailed local planning by councils. The local council of the area in which development is proposed to be carried out is usually the consent authority for that development for the purposes of the SEPP, unless the DPE selects to substitute the Minister or Secretary of Planning as the consent authority in respect to particular forms of development.

Generally, where there is conflict between the provisions of the SEPP and other environmental planning instruments, the SEPP prevails. The SEPP overrides the controls included in the LEPs and DCPs, and consultation with the relevant local councils is only required when development:

> *is likely to affect the heritage significance of a local heritage item, or of a heritage conservation area, that is not also a State heritage item, in a way that is more than minor or inconsequential.* [16]

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[16] **NSW Government, 2021**, *State Environment Planning Policy,* Section 2.11, available at https://legislation.nsw.gov.au/view/html/inforce/current/epi-2021-0732#sec.2.11, Accessed 13th December 2022.

When this is the case, the proponent must not carry out such development until it has:

- Had an assessment of the impact prepared
- Given written notice of the intention to carry out the development, with a copy of the assessment, to the council for the area in which the heritage item or heritage conservation area (or the relevant part of such an area) is located
- Taken into consideration any response to the notice that is received from the council within 21 days after the notice is given.

2.3 Non-statutory Listings

2.3.1 *Register of the National Estate* [17]

The Register of the National Estate (RNE) is a non-statutory listing of natural and cultural heritage places that are considered special to Australians and worth keeping for the future. The register was initiated by the Australian Heritage Commission in 1976 and now contains over 13,000 places across Australia. The RNE is now maintained by the Australian Heritage Council, however, in 2006, the *Environment Protection and Biodiversity Conservation Act 1999*, and the *Australian Heritage Council Act 2003* were amended to, among other things, stop changes to the RNE. The Australian Heritage Council can no longer add to, alter, or remove all or part of a place from an RNE listing.

Listing on the RNE was a way of identifying and providing information on Australia's heritage places and publicly confirmed their value to the community. Places on the RNE may be protected under appropriate State, Territory and Local Government heritage legislation and under an agreement between the Commonwealth and States and Territories it is intended those registered places will be considered for inclusion in appropriate Commonwealth, State / Territory heritage lists. Registered places can also be protected under the EPBC Act if they are also included in another Commonwealth statutory heritage list. However, the act of listing a place on the RNE does not constitute automatic legal protection. Notwithstanding, the RNE is widely recognised as an authoritative compilation of the heritage significance of many of Australia's natural and cultural places and is still considered by planning agencies when decisions regarding development and conservation are being determined.

2.3.2 *The Register of the National Trust of Australia (NSW)*

The RNTA is a community heritage conservation organisation acting to recognise and promote heritage conservation through publicity, lobbying and representations which are based on the identified heritage significance of a place listed on the register. The RNTA was commenced in 1946 at the request of the NSW Government and was the first register of heritage places in Australia. Although no longer a statutory register, the register continues to contain 11,600 listed places in NSW and is a valuable information and educational resource.

[17] **Department of Agriculture, Water and the Environment, 2021,** *Australian Heritage Database,* available at https://www.environment.gov.au/cgi-bin/ahdb/search.pl, accessed 26 May 2022.

2.4 Heritage Policies Relevant to Maritime Heritage

2.4.1 *UNESCO Convention on the Protection of the Underwater Cultural Heritage* [18]

The UNESCO *Convention on the Protection of the Underwater Cultural Heritage*, adopted in 2001, sets out the basic principles for the protection of underwater cultural heritage, provides a detailed cooperation system and provides widely recognised practical rules for the treatment and research of underwater cultural heritage. The main principles are:

- Obligation to preserve underwater cultural heritage
- *In situ* preservation as first option
- No commercial exploitation
- Training and information sharing.

2.4.2 *The Burra Charter* [19]

The Burra Charter 2013 provides a best practice standard for managing cultural heritage places in Australia. The Burra Charter was first adopted in 1979 and is periodically updated to reflect developing understanding of the theory and practice of cultural heritage management. The current version was adopted in 2013.

The Charter can be applied to all types of places of cultural significance including natural, Indigenous, and historic places with cultural values. The Burra Charter advocates a cautious approach to change: do as much as necessary to care for the place and to make it useable, but otherwise change it as little as possible so that its cultural significance is retained. The Charter includes 12 conservation principles which are further developed in the processes and practice sections of the Charter.

2.4.3 *Guidelines for the Management of Australia's Shipwrecks* [20]

The *Guidelines for the Management of Australia's Shipwrecks* was produced as a combined publication by the Australian Institute for Maritime Archaeology Inc. (now the Australasian Institute for Maritime Archaeology) and the Australian Cultural Development Office (now the Australian Government Department of the Environment and Energy) in 1994.

The guidelines comprise principles and practices that have been adopted by Australia's professional maritime archaeologists and serve as useful modules for other groups. The document includes a Statement of Principles governing the broad approach to be taken when dealing with historic shipwreck sites and related archaeological collections.

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[18] **UNESCO 2001,** *Convention on the Protection of the Underwater Cultural Heritage,* available at http://www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/2001-convention/, accessed 26 May 2022.
[19] **Australia ICOMOS, 2013** *The Burra Charter*, available at https://australia.icomos.org/publications/charters/, accessed 25 May 2022.
[20] **Australian Institute for Maritime Archaeology. Special Projects Advisory Committee & Australian Cultural Development Office & Australian Institute for Maritime Archaeology 1994**, *Guidelines for the management of Australia's shipwrecks*, Australian Institute for Maritime Archaeology and the Australian Cultural Development Office, Canberra.

2.4.4 *A Guide to the NSW Heritage System* [21]

The *Heritage Information Series: A guide to the Heritage System* published by the NSW Heritage Department in 2005 is an updated version of the *NSW Heritage Manual*, published in 1996 by the NSW Heritage Office and Department of Urban Affairs & Planning. This document is a comprehensive set of guidelines explaining all aspects of the NSW heritage management system. The Guide is concerned principally with how cultural heritage is defined, assessed and protected in NSW. When the manual was first published in 1996, it served as the primary reference for heritage management in NSW. The regular updates have kept the information regarding the NSW Heritage system up to date in line with legislation changes.

2.4.5 *Thematic study of NSW Shipwrecks (2020)* [22]

Heritage NSW recently completed a thematic study of NSW shipwrecks and a review of the NSW Maritime Heritage Database. This strategic project was undertaken to provide a clearer understanding of the range and significance of shipwreck site types in NSW and guidelines for management of data on the Maritime Heritage Database. It also identified sites for potential State Heritage Register listing in the future.

The aim of the thematic study of shipwrecks in New South Wales is to identify key historical themes associated with maritime shipping activities that form the basis to identify the heritage item types associated with each theme. These have been developed to identify gaps in the database, to support the assessment of heritage significance of database items and to support the identification of items for potential listing on the SHR.

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[21] **NSW Heritage Office, 2005** *Heritage Information Series: A Guide to the Heritage System,* available at https://nswheritage.files.wordpress.com/2015/07/infoheritagesystem.pdf, accessed 25 May 2022.
[22] **Comber Consultants, August 2020,** *Thematic Study: New South Wales Shipwrecks*, Report to Heritage NSW, Department of the Premier and Cabinet.

3 GENERAL HISTORICAL OVERVIEW

The area currently known as Stockton Beach is part of the Worimi Nation, which stretches from the Manning River in the north, to the Hunter River in the south. Prior to European settlement, the Worimi Nation was home to 18 clan groups, who would use the Stockton Bight to travel between the northern and southern parts of their lands. The traditional name for the Stockton Peninsula was *Burrinbingon*, and its Indigenous inhabitants were skilled hunters who utilised the deep-water and littoral zones of the coastline (Figure 5).[23] Evidence of Indigenous occupation could also be found in the huge shell middens scattered along Stockton Beach. These would later be used by early European settlers for lime production.

Figure 5: Painting depicting Indigenous people camped on the Stockton side of the Hunter River ca.1817. Nobby Island can be seen in the distance.[24]

Figure 6: First European map of the mouth of the Hunter River by Lt John Shortland in 1797. Not to scale. Approximate location of Stockton Beach shown in red circle.[25]

On May 10th 1770, Captain James Cook was the first European to make observations of the area as he passed by the rocky outcrop now known as Nobbys, however he did not venture further to explore the nearby river system.[26] Nearly 30 years later, Lieutenant John Shortland arrived in the area searching for escaped convicts, but instead became the first European to map the entrance to the Hunter River (Figure 6), which he named after the Governor of New South Wales.[27] It was during this visit that Shortland discovered a considerable quantity of coal, which was seen as a huge economic advantage for the fledgling colony. In 1801, the first coal export was shipped to Bengal, sealing the area's fate as a major coal producer.

[23] **Bottomley, B. 2022.** Car Punts of Newcastle – The Early Years. Pg. 8. Available at: https://www.billbottomley.com.au/wp-content/uploads/2015/11/ch1.pdf.
[24] **Lycett, J. 1817,** [Aborigines resting by camp fire, near the mouth of the Hunter River, Newcastle, New South Wales], viewed 3 August 2022 http://nla.gov.au/nla.obj-138500420.
[25] **Shortland, J. 1810,** An eye sketch of Hunter's River it lays N.N.E. true, 63 or 65 miles from Port Jackson: discovered this river 9th Sept'r 1797, in the Governor's whale boat. Published 29th Sept. 1810 by J. Gold, 103, Shoe Lane, London viewed 3 August 2022 http://nla.gov.au/nla.obj-230694043.
[26] **Captain Cook's voyages round the world** - pages 437-439 Living Histories, accessed 11 Jul 2022, https://livinghistories.newcastle.edu.au/nodes/view/69532.
[27] **1798.** Series 23.38: 'Extract of a Letter from Lieut. John Shortland of H.M.S. Reliance, to his Father...', 10 September 1798.

Figure 7: Engraving of the penal colony of Newcastle in 1812, with Stockton Beach situated in the centre of the two pictures. Stockton Peninsula remains undeveloped and heavily timbered. Indigenous people are depicted living on the edges of the settlement, as the penal colony rapidly expands.[28]

The labour-intensive industries of coal mining and timber getting, combined with the area's isolation made it the ideal location for a convict settlement. In 1804 the penal colony of Newcastle was established, with the population of convicts eventually swelling to more than one thousand people by 1821.[29] By the 1820s, the convict population was gradually moved further north, as development and industry in Newcastle and its surrounds gained momentum as a free settlement. In 1828, the Australian Agricultural Company took possession of the coal mines and opened the first colliery in 1831.

Across the harbour, the Stockton Peninsula was originally known as Pirate Point due to its association with a gang of runaway convicts. In 1800, 15 prisoners seized the sloop *Norfolk* as it was sailing the Hawkesbury River and tried to make an escape to the Dutch settlements of Indonesia. The *Norfolk* was significant, as it was the vessel used by Bass and Flinders to make the first circumnavigation of Tasmania. The convicts made a stop at the Hunter River but grounded their vessel on the southern tip of the Stockton Peninsula, making it the first recorded shipwreck in the Newcastle area. The *Norfolk* incident would be the first of many maritime related incidents to occur at Stockton, due to its proximity to the port of Newcastle.

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[28] **Browne, T.R. 1812**. View of Hunters River, near Newcastle, New South Wales. 1812; and Newcastle, in New South Wales, with a distant view of Point Stephen. 1812. Copper Engraving. Photographer Bruce Turnbull. Courtesy Newcastle Region Art Gallery.

[29] **Turner, J. W. 1982**, Coal Mining in Newcastle 1801-1900, pg. 19.

Figure 8: The harbour of Newcastle and Stockton in 1873, featuring sailing ships from around the world.[30]

By the mid 19th century, Newcastle had become a major shipping hub for coal, timber and salt exports, alongside shipbuilding, engineering and rail services (Figure 8). At the same time, Stockton established itself as a mining village, officially receiving its new name in 1862. Wooden shipbuilding enterprises operated at Stockton up until the 1880s, however these were located along the estuary sides of the Stockton Peninsula.[31] The first rowboat service for passengers between Newcastle and Stockton commenced in 1853, however settlers still had to travel via Fullerton Cove and use the punt at Hexham to access Newcastle and its wharves and markets with their produce, making it a long and arduous journey. Despite its location, Stockton had become particularly industrious by the mid 19th century, with enterprises such as a salt works, chemical plants, an iron foundry and a tweed mill, the latter employing around 300 people. In the following decades, shipyards, timber mills and a substantial fishing fleet were the dominating industries. In 1884, the Stockton Colliery commenced production, helping to prop up the then-struggling Newcastle coal industry. This industrial boom coincided with Stockton becoming increasingly residential, following a large sub-division project in the late 1880s.[32]

While shipping activity in and around the harbour was booming, Newcastle was quickly gaining a reputation as a notoriously dangerous port. As early as 1813, Europeans commenced a works programme to alter the river mouth, in an attempt to deepen the entrance channel and improve harbour safety. The first improvement was the construction of the Macquarie Pier, linking Nobbys to the mainland. The breakwater was completed in 1846.

On the other side of the harbour mouth, the notorious Oyster Bank proved a disastrous maritime hazard for many ships. Sailing vessels often lost wind due to the positioning of Nobby Island and would then be pushed over to the northern side of the harbour entrance, ending up on the shallows of the Oyster Bank. The sheer number of wrecks strewn across the Oyster Bank subsequently created a new maritime hazard, eventually prompting the construction of the Stockton Breakwater, which was built using shipwrecks as its foundations. A more detailed history of the breakwater and its shipwrecks is presented in Section 3.2.

It was through huge expenditure on breakwaters, dredging and infrastructure such as lighthouses, that the notorious Hunter River estuary was transformed into a port capable of

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[30] **Calvert, S. & Clint, A. 1873.** *Newcastle Harbor [sic] and Stockton, N.S.W., looking north*, Melbourne. Viewed 11 July 2022 http://nla.gov.au/nla.obj-133181270

[31] **Suters Architects 1997.** Newcastle Archaeological Management Plan Volume 1. Prepared for Newcastle City Council. Pg. 2/31.

[32] **Bottomley, B. 2022.** Car Punts of Newcastle – The Early Years. Pg. 9. Available at: https://www.billbottomley.com.au/wp-content/uploads/2015/11/ch1.pdf.

handling 4,000 ships per year by 1900.[33] Such changes ultimately altered the morphology of the Stockton Peninsula and Stockton Beach.

3.1 Shipwrecks

By the early 19th century, Newcastle already had a reputation as a notorious harbour, especially in heavy seas. Knaggs Nautical Almanac stated that:

> *Newcastle harbour should be approached with extreme caution in southerly or south-easterly gales… Land as far as Port Stephens is a dangerous lee shore on which the seas roll heavily home.*

This sentiment was echoed by Commissary John Palmer when addressing the House of Commons in 1810, stating that, “Newcastle is a very dangerous place to go to”.[34] The Oyster Bank was a well charted feature of the entrance into Newcastle Harbour (Figure 9 to Figure 12).

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[33] **Suters Architects 1997.** Newcastle Archaeological Management Plan Volume 1. Prepared for Newcastle City Council. Pg. 2/20.

[34] **Callen, T. 1986**. *Bar Dangerous: a maritime history of Newcastle*, Newcastle Region Maritime Museum in association with the Runciman Press and Varley, Newcastle. Pg. 99.

Figure 9: Excerpt from 1839 chart marking the Oyster Bank prior to any Harbour improvements.[35]

Figure 10: Excerpt from 1852 chart marking the Oyster Bank.[36]

Figure 11: Excerpt from 1888 chart marking the Oyster Bank. Approximate location of study area in red. [37]

Figure 12: Excerpt from 1968 chart marking the Oyster Bank. Approximate location of study area in red.[38]

The earliest ship to be wrecked at Stockton Beach was likely the *Francis*, which was blown onto 'north beach' in 1805. Newcastle Historian Terry Callen argues that north beach refers

[35] **Anon, 1839** *Harbour of Newcastle, 10th December 1839* [cartographic material], available https://digital.sl.nsw.gov.au/delivery/DeliveryManagerServlet?embedded=true&toolbar=false&dps_pid=IE3758080
[36] **Great Britain. Hydrographic Dept & Potter, J. D & Stokes, J. Lort & J. & C. Walker. 1852,** *Australia, East Coast, Newcastle Harbour* Published according to Act of Parliament at the Hydrographic Office of the Admiralty ; Sold by J.D. Potter, agent for the Admiralty charts, 31 Poultry, London viewed 19 August 2022 http://nla.gov.au/nla.obj-233813152
[37] **Great Britain, Hydrographic Department & Evans, F.J & Sidney, F.W & J.D. Potter. 1891** *Australia, East Coast, New South Wales, Newcastle Harbour.* Published at the Admiralty 6th Jany. 1882.

to Stockton Beach in this case.[39] This is supported by a newspaper account which states that, before wrecking, the *Francis* was seen 'in amongst the heavy breakers off the sand point, on Port Stevens Beach (sic), directly opposite Coal Island'.[40] As Stockton Beach had not been named at this time, Port Stephens beach would have been used as a general term for the area north of the Newcastle harbour entrance, while Coal Island was the colonial term sometimes used for Nobbys Island. Therefore, Stockton Beach seems the most accurate location for the *Francis* wreck. The loss of the *Francis* was a major blow for the early Novocastrians, as the vessel was carrying vital supplies, mail, and personnel.[41]

This pattern would repeat itself regularly over the 19th century. A newspaper article states that the colonial schooner *Governor King* also went ashore at Stockton Beach, not far from the *Francis*, in April 1806. *Governor King* had been on a voyage from Norfolk Island to Sydney carrying a cargo of soap and salted pork when she was driven northward by strong winds. The vessel struck the Oyster Bank and broke up within 12 hours.[42] Following the destruction of the *Francis* and *Governor King*, the *Dundee* was the next vessel to meet its fate at Stockton Beach. The wooden ship wrecked in 1808 as it embarked on a voyage to China via Fiji to transport sandalwood, killing two crew members. [43]

The engineer who would eventually be tasked with improving the port entrance believed the unusual ebb current was to blame for the treacherous conditions. Civil Engineer Edward Orpen Moriarty described a particular combination of factors as the cause for at least five wrecking events near Stockton:

> *These ships had all passed the outer bar in safety, but because of the heavy south-easter, were unable to beat up into harbour and were obliged to anchor. They all held until the ebb tide came down in force. Their anchors dragged and, one after another, all drifted onto the Oyster Bank and were lost.*[44]

A map produced in 1816 indicated three wrecks in the vicinity of the Oyster Bank, the first of approximately 50 ships to be wrecked on the shallow sandbank during the 19th and 20th centuries (Figure 13).[45]

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[38] **New South Wales. Department of Lands 1968**, *Parish of Stockton, County of Gloucester*, 10th ed, Dept. of Lands, Sydney, https://trove.nla.gov.au/work/7754872?keyword=Stockton&l-format=Map&l-availability=y&l-decade=196.
[39] *Op. Cit.* **Callen, T 1986**:101.
[40] **1911 'WRECK OF THE FRANCIS.**', *Newcastle Morning Herald and Miners' Advocate*, 5 April, p. 9, viewed 02 Aug 2022, http://nla.gov.au/nla.news-article133791389.
[41] *Op. Cit.* **Callen, T 1986**:101.
[42] **1912 'WRECK OF A VESSEL**.', *Newcastle Morning Herald and Miners' Advocate*, 26 June, p. 9, viewed 02 Aug 2022, http://nla.gov.au/nla.news-article138332873.
[43] *Op. Cit.* **Callen, T 1986**:102.
[44] *Op. Cit.* **Callen, T 1986**:101.
[45] *Op. Cit.* **Callen, T 1986**:105.

Figure 13: Hydrographic survey of the mouth of the Hunter River in March 1816, indicating the locations of three wrecks, the brig **Nautilus** ***(1816), the schooner*** **Estramina** ***(1816) and the ship*** **Dundee** ***(1812) (sic).***[46]

The notorious tides and sandbanks of Stockton Beach would contribute to one of Australia's worst maritime disasters. In July 1866, the 552-ton steamer *Cawarra* was leaving Newcastle Harbour as it travelled from Sydney to Brisbane and Rockhampton, when it was struck by huge swell. The engine fires were quickly extinguished, and the ship became unmanageable. Passengers were placed in lifeboats, however these capsized. Everyone onboard perished except for a single survivor who was plucked from a buoy while holding on to a piece of wreckage.[47] Sixty people lost their lives in the disaster and many were buried in a mass grave at the Newcastle Cathedral cemetery.[48] The wreck of the *Cawarra* would eventually be incorporated into the Stockton Breakwater, alongside other notable wrecks including the *Adolphe* and the *Eleanor Lancaster*. The history of the breakwater wrecks is discussed in more detail in Section 3.2

[46] **Jeffreys, C. 1816**. *Part of Hunter's River (or the Coal River).* Accessed July 25th 2022. Available at https://trove.nla.gov.au/work/37528448.
[47] **NSW Maritime Heritage Database 2022**. "Cawarra". Accessed Aug 2nd 2022. Available at https://www.heritage.nsw.gov.au/search-for-heritage/maritime-heritage-database/
[48] *Op. Cit.* **Callen, T 1986**:124.

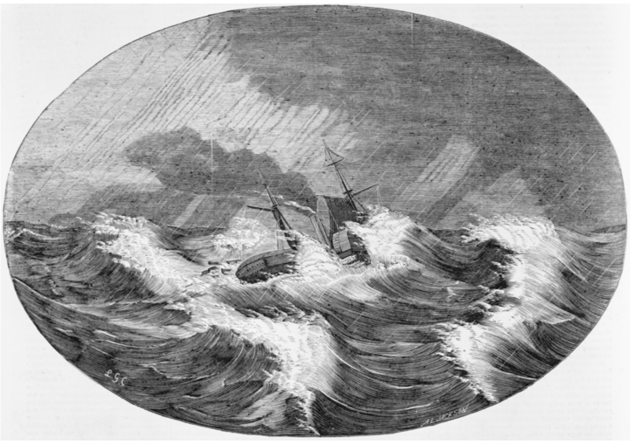
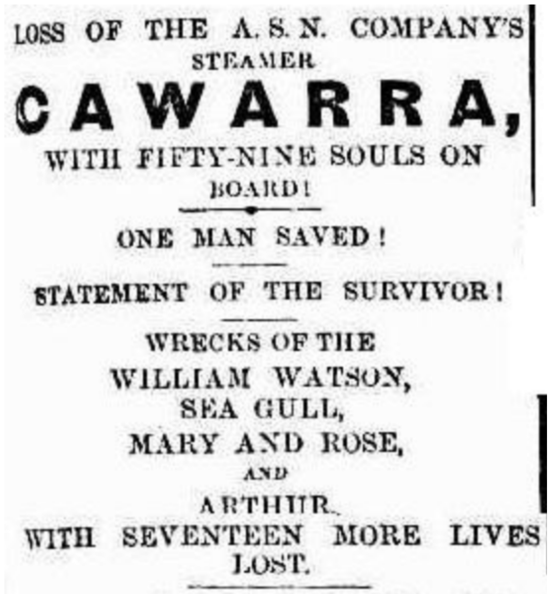


Figure 14: Illustration of the Cawarra caught in a gale before wrecking on the Oyster Bank in 1866.[49]



LOSS OF THE A. S. N. COMPANY'S STEAMER

CAWARRA,

WITH FIFTY-NINE SOULS ON BOARD!

ONE MAN SAVED!

STATEMENT OF THE SURVIVOR!

WRECKS OF THE WILLIAM WATSON, SEA GULL, MARY AND ROSE, AND ARTHUR, WITH SEVENTEEN MORE LIVES LOST.

Figure 15: Newspaper headlines announcing the tragedy in 1866.[50]

The same gale which destroyed the *Cawarra* continued to wreak havoc the following day. At dawn, the stern section of a wooden vessel washed ashore at Stockton Beach, bearing the name *Seagull.* It was from Richmond, bound for Sydney, with a cargo of timber. No surviving crew members were found.[51] A short time later, the barque *William Watson* also wrecked on Stockton Beach, with two crew members perishing during the rescue mission. On the same day, the ketch *Arthur* foundered just inside Nobby's and was gradually pushed over to the Oyster Bank, where it capsized and sank with no survivors.[52] Overall, the 'Cawarra Gale' caused 16 vessels to be wrecked or foundered at sea within the Newcastle area and claimed more than a hundred lives.[53]

By the late 1800s, Newcastle port's notoriety was well established, however some vessels still took a chance. In June 1888, the *Berbice* attempted to enter the port in the dark during poor conditions and ended up ashore on Stockton Beach (Figure 18), at the exact same site as the *Rialto* wreck of 1870, according to a contemporaneous newspaper article.[54] The wrecking event became the first major operation for the newly formed Stockton rescue brigade. The group managed to save all hands, including the 12-year-old cabin boy, in a dangerous rescue mission.[55]

The same brigade would save another 18 lives when the *Durisdeer* was wrecked on Stockton beach just before Christmas 1895 (Figure 16 and Figure 17). The 989-ton barque

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[49] **Jackson, A.L. 1866.** *The wreck of the Cawarra*, Robert Stewart, Melbourne. Available at State Library of Victoria. ID: 1651246.

[50] **1866 'FOUNDERING OF THE CAWARRA.'**, *The Herald,* 16 July, p. 2, viewed 03 Aug 2022, http://nla.gov.au/nla.news-article244421927.

[51] **1866 'THE WRECKS AT NEWCASTLE.'**, *The Age*, 21 July, p. 6, viewed 02 Aug 2022, http://nla.gov.au/nla.news-article160216038

[52] **1866 'FURIOUS GALE AND DISASTROUS WRECKS. LOSS OF SIXTEEN VESSELS AND MORE THAN A HUNDRED LIVES.'**, *The Sydney Morning Herald*, 23 July, p. 5, viewed 02 Aug 2022, http://nla.gov.au/nla.news-article13134217.

[53] *Op. Cit.* **Callen, T 1986**:125-126.

[54] **1888 'WRECK OF THE SHIP BERBICE AT NEWCASTLE.'**, *Newcastle Morning Herald and Miners' Advocate*, 6 June, p. 5, viewed 03 Aug 2022, http://nla.gov.au/nla.news-article135922106.

[55] *Op. Cit.* **Callen, T 1986**:142.

had journeyed from Simon's Town in South Africa, when it got into trouble on arrival at Newcastle. Once again, the Oyster Bank proved disastrous, and the crew had to be ferried ashore in 'breaches' fitted to a rescue line in a valiant mission.[56]

Figure 16: Children viewing the wreck of the Durisdeer on Stockton Beach, 1895. Source: Hunter Photobank, Newcastle Regional Library no. 026 000093.

Figure 17: Wreck of the barque* Durisdeer *on Stockton Beach in 1895. Source: Newcastle Regional Library no. 026 000108.

Figure 18: The Berbice wreck on Stockton Beach, 1888.[57]

Only a few years earlier, on October 10, 1891, the ketch *Jonathan* was in distress while anchored close to a lee shore. A lifeboat was towed out to the vessel and the crew was saved; however, the ship was later lost on Stockton Beach after its anchor chains parted.[58] It

[56] **NSW Maritime Heritage Database 2022**. "Durisdeer". Accessed Aug 2nd 2022. Available at https://www.heritage.nsw.gov.au/search-for-heritage/maritime-heritage-database/.
[57] *Op. Cit.* **Callen, T 1986**:141.
[58] *Op. Cit.* **Callen, T 1986**:114.

appears that the only large ship to ever be successfully salvaged from Stockton Beach was the *Adderley* in 1897.[59]

By this time, work was well underway to develop an effective breakwater which would tackle the problem of the Oyster Bank.

3.2 Newcastle Harbour Improvements and the Stockton Breakwater

Improving shipping safety in and around the port of Newcastle became a key priority for the growing colony, and in the 1850s, Chief Engineer E.O. Moriarty devised a plan to greatly improve the harbour and manage the notorious sandbanks. On the Stockton side, the works included the Pirate Point Guide wall (Northern Breakwater), which was constructed using ship ballast between 1861 and 1872. The Northern Breakwater was designed to create a funnel effect which would manipulate the tidal waters and scour out an entry channel, however it was ultimately ineffective.

In October 1898, works commenced on the Stockton Breakwater, in an attempt to address the constantly shifting sandbank that was making the harbour entrance so dangerous (Figure 19). By 1900, the breakwater had reached a length of 1,180 ft. The route of the wall was designed to incorporate several wrecks which already lay on the Oyster Bank, and more wrecks were added to the breakwater during its construction, some unintentionally (Table 3). The French barque *Adolphe* was one such ship which ended up in the breakwater involuntarily, after it was wrecked on the bar following its passage from Antwerp in 1904.

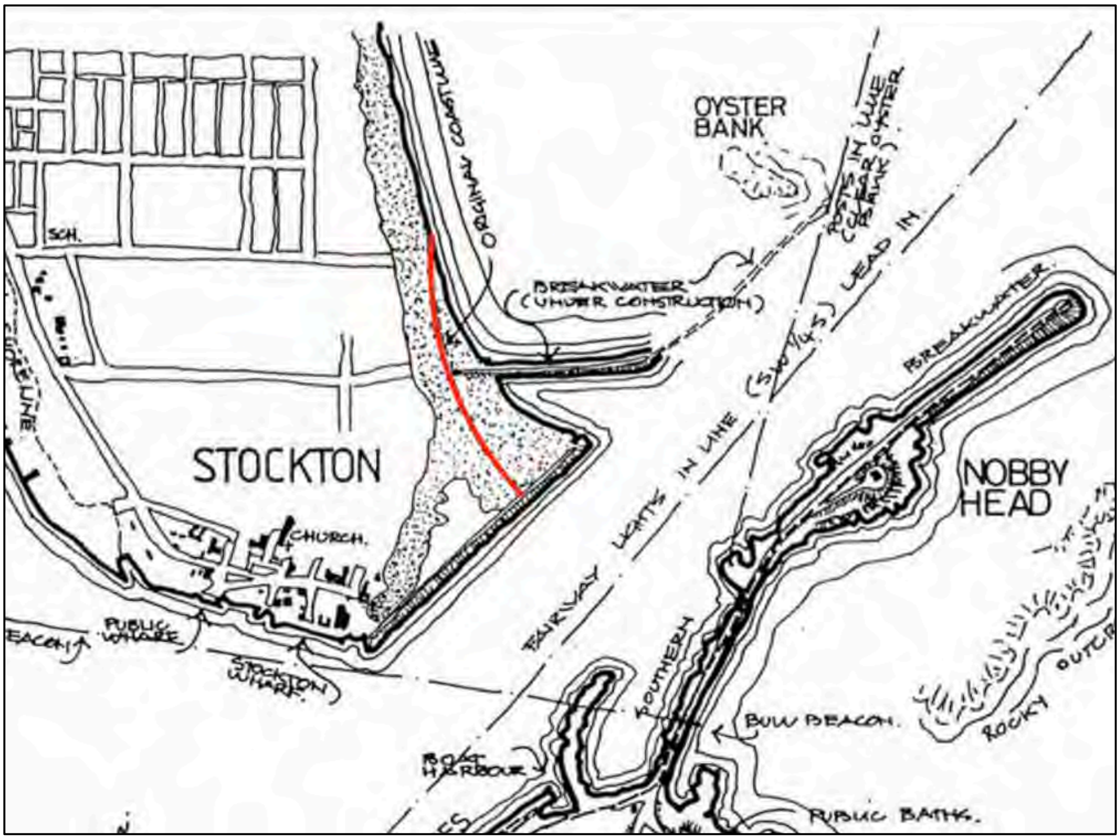

Figure 19: Plan of the Port of Newcastle in 1902, showing the early stages of the Stockton Breakwater. The line highlighted red indicates the original coastline. Not to scale.

The following year two passenger steamers (*Elamang* and *Katoomba*) were scuttled at the wall between *Adolphe* and *Regent Murray* to fill in the gaps, while smaller punts were added

[59] *Op. Cit.* **Callen, T 1986**:147.

to further solidify the breakwater (Figure 21). By 1905, a total of nine wrecks lay within or against the breakwater.

Stone for the breakwater was quarried at Platts Hill and brought to the site by punt, then via a tramway across Stockton Peninsula. The significant infrastructure project culminated in 1912, with the breakwater having a final length of 3,400 ft. A concrete top was laid in 1913.

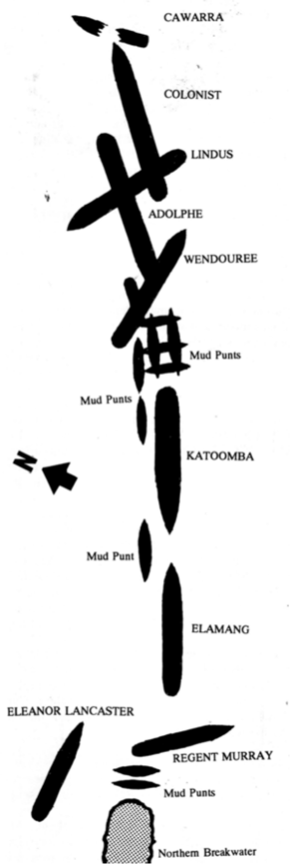

Figure 20: Diagram showing the approximate locations of wrecks incorporated into the Stockton Breakwater. Not to scale. Source: Ross and Pat Craig Collection, University of Newcastle (Australia).

Figure 21: From left,* Adolphe *on the Oyster Bank with the hulks* Katoomba *and* Elamang *to the right. Date unknown. Source: Newcastle Herald.

Figure 22: The* Adolphe *incorporated into the Stockton Breakwater. Date Unknown.[60]

[60] **n.d. Barque Adolphe.** Wrecked Stockton Breakwater, Newcastle. State Library of Western Australia. Viewed 03 Aug 2022. Available at https://trove.nla.gov.au/work/189729443?keyword=Barque%20Adolphe%20wrecked.

Figure 23: Stockton Breakwater wrecks, from left to right, Regent Murray, Wendouree and Lindus. Passing tug in the foreground. Date Unknown.[61]

Table 3: Known Shipwrecks Incorporated into the Stockton Breakwater[62]

Name	NSW Maritime Heritage Database Site ID	Year Wrecked	Wrecking Event
Adolphe	#36	1904	The iron barquentine, built in 1902 in Dunkirk France, was wrecked on the Oyster Bank while in ballast from Antwerp to Newcastle in 1904. The incident occurred after the tug's tow parted in bad weather and the Adolphe came to rest on top of the wrecks of the Lindus and Wendouree. The French crew of 32 men were rescued. Today, the ship's bow is visible above the breakwater and is a prominent feature of the Newcastle skyline. The wreck holds local significance under the Newcastle Local Environement Plan (ID: A12).
Cawarra	#1928	1866	The loss of the paddle steamer Cawarra in July 1866 is considered one of Australia's worst maritime disasters. The 552-ton steamer was on a voyage from Sydney to Queensland when it attempted to re-enter Newcastle harbour to shelter from a storm. Large seas battered the vessel, extinguishing its fires and making it unmanageable. Lifeboats were deployed for female passengers but were overwhelmed and sank. Of the 61 people aboard Cawarra, only one crew member survived.
Colonist	#1633	1894	Colonist was an 819-ton screw steamer employed in the coastal cargo trade. As the vessel was departing Newcastle for Adelaide laden with coal, careless navigation caused her to wreck against the northern breakwater. The Colonist's 19 crew members were all rescued.
Eleanor Lancaster	#1621	1856	Eleanor Lancaster was a wooden ship built in 1839 and registered for the coastal cargo trade. During a voyage from Newcastle to Melbourne, the ship, which was laden with 640 tons of coal, was lifted onto the Oyster Bank during a wild gale. The NSW database has no coordinates listed for the wreck.
Elamang	#1618	1905	Elamang was one of two hulks purchased by the Public Works Department to scuttle as part of the construction of the Stockton Breakwater. Elamang

[61] *Op. Cit.* **Callen, T 1986**:181.
[62] **Heritage NSW**, Maritime Heritage Database. Available at: https://www.heritage.nsw.gov.au/search-for-heritage/maritime-heritage-database/.

Name	NSW Maritime Heritage Database Site ID	Year Wrecked	Wrecking Event
			was an iron screw steamer built in 1876 in Scotland and had been operated by the Australian Steam Navigation Company.
Katoomba	#1082	1905	The second hulk to be scuttled in 1905 was Katoomba, a 1,006-ton iron screw steamer built in Glasgow, Scotland.
Lindus	#991	1899	Lindus was a 1,678-ton screw steamer carrying cargo from Newcastle to Adelaide when it was hit by a gale in June 1899. The crew was saved by a passing vessel; however Lindus sank and was later found straddling the wreck of the Colonist.
Regent Murray	#604	1899	Regent Murray was driven ashore during a squall as it tried to enter the port of Newcastle from Adelaide under tow in April 1899. The iron barquentine ended up beached on the Oyster Bank.
Wendouree	#207	1898	In July 1898, Wendouree was carrying 1,850 tons of coal destined for Adelaide when she grounded on the Oyster Bar. The screw steamer was a 1,640-ton vessel built in Scotland and operated the coastal cargo routes.

3.2.1 *Erosion controls*

More recently several seawalls have been constructed along Stockton Beach to protect infrastructure and provide some erosion control. In 1989, a rock revetment was constructed at Mitchell Street protecting assets for approximately 600 m along the beach front. In 1996, a geotextile sandbag wall was built in front of the Stockton surf lifesaving club, this was replaced in 2016 with a rock revetment. In 2019, a 100 m seawall was built to protect Hunter Water Land from coastal erosion (.) [63]

[63] **Bluecoast, 2020** *Part A – Stockton Bight Study_R.4.00* Report prepared for City of Newcastle, p.12-13.

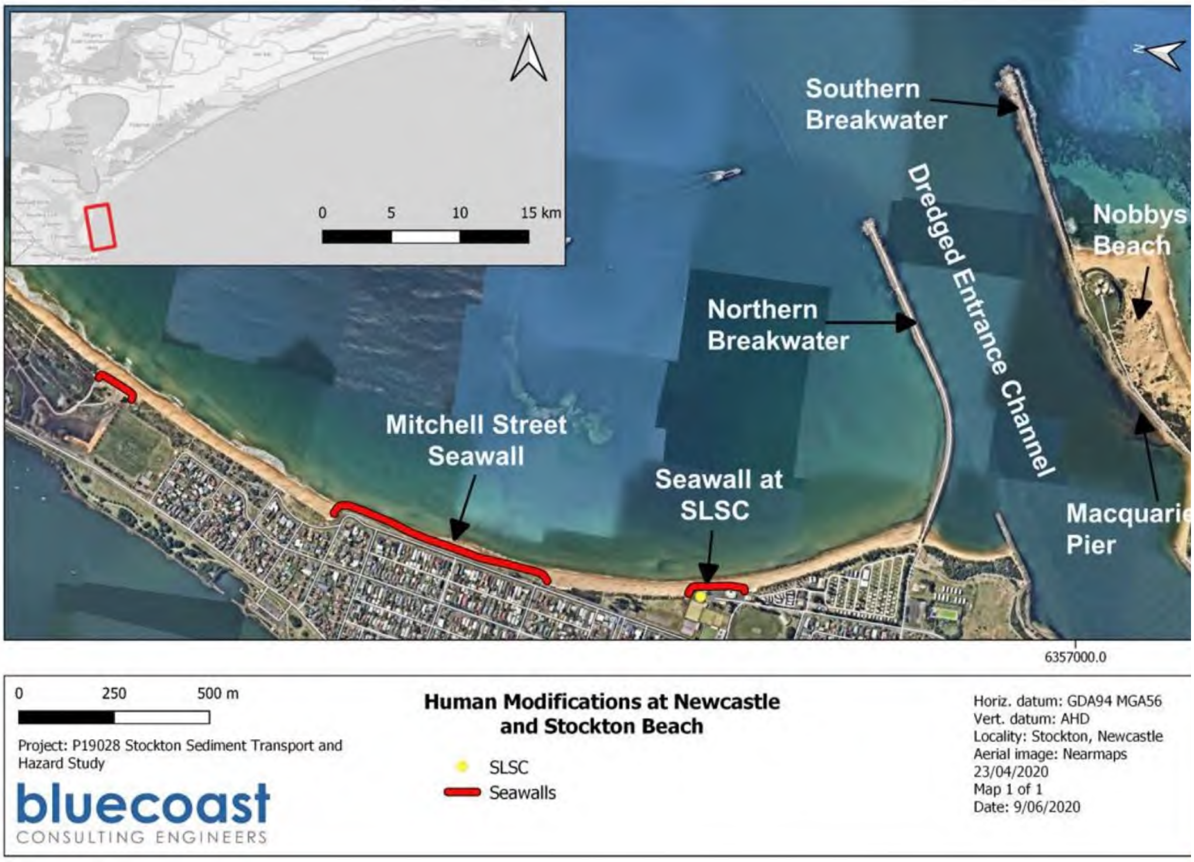

Figure 24: Map of seawall structures erected along the Stockton beachfront. Image: Bluecoast.[64]

3.3 Dredging

Stockton Beach and the entrance to the Hunter River have been continuously modified since the arrival of Europeans. A brief list of major dredging activities is contained in the table below:[65]

Date	Dredging Activity
1859	Continuous dredging of the Newcastle Harbour Entrance began using ladder dredges.
1914	Dredging depth at the entrance to Newcastle Harbour is increased to 7.5 metres.
1952	A Dutch dredge carried out contract dredging of approximately 2.3 million cubic metres.
1955	3,500,00 tons of sand and silt were removed from Newcastle Harbour and the lower reaches of the Hunter River.
1962 - 1966	Approximately 450,000 cubic metres of rock and 620,000 cubic metres of soft sediment were dredged. Some of the dredged sand was placed on Stockton Beach via a pipeline.
1977 - 1983	Harbour approaches were deepened to 17.7 m and harbour channels to 15.2 m. This involved the removal of approximately 2 million cubic metres of rock and over 8 million cubic metres of sand and clay were dredged from the main entrance. All dredged material was dumped offshore.

[64] *Op. Cit.*, **Bluecoast, 2020** p. 13.
[65] *Op. Cit.*, **Bluecoast, 2020** p.7-12.

Date	Dredging Activity
2005	Maintenance dredging of 153,000 cubic metres of sand from the harbour entrance with the material dumped offshore.

In 2009, an REF was undertaken by Worley Parsons for maintenance dredging and placement of dredged materials off Stockton Beach. As a result, Newcastle Port Corporation (NPC) were granted approvals to conduct routine dredging to maintain the navigation channel. Under the permit, at the discretion of the dredge master, material suitable for beach nourishment (sand dredged from offshore of the breakwaters and on the channel slopes) could be placed in the nearshore location of Stockton Beach (Figure 25). A condition of the permit placed a 350 m diameter around two shipwrecks – PS *Yarra Yarra* and SS *Davenport.*[66]

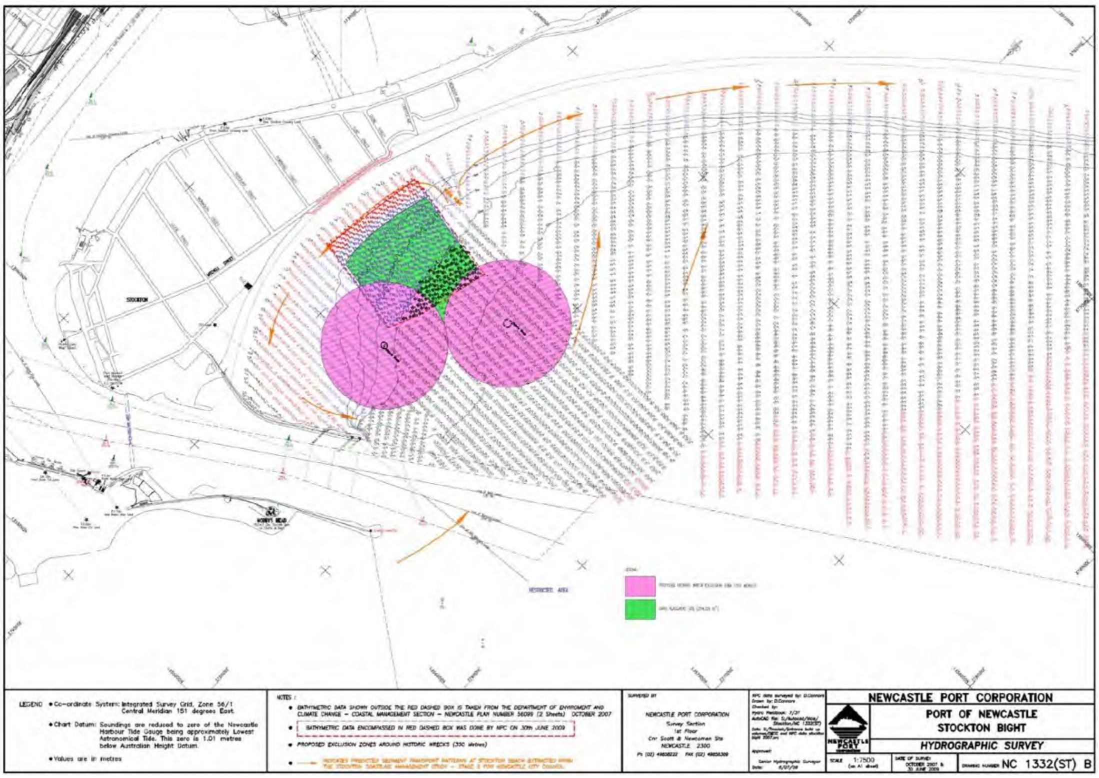

Figure 25: Dredged sand placement in the nearshore area of Stockton Beach (green). Areas in pink are the exclusion zones around PS *Yarra Yarra* and SS *Davenport.*

3.4 Stockton Colliery

By the 1880s, Stockton's commercial importance and population had increased significantly. The key industry at the time was the Patent Slip and Shipbuilding Yards of T. O'Sullivan and Co, however by 1885, these works were being eclipsed by the newly formed Stockton Colliery. According to the Newcastle City & Country Almanac of 1885:

[66] **Port of Newcastle, 2022** Proposed Stockton Beach Renourishment Project (pers. comms.)

> *Where there was only a dreary waste of sand now has risen a complete colliery plant with powerful machinery of the newest and best description.*[67]

By January 1885, the Stockton Coal Company had reached the first coal seam, about 4 ft thick, and miners were eagerly working towards the renowned Stockton seam, about 16 ft thick.[68] Business boomed and by 1889, 400 men and boys were employed at the Stockton colliery. The initial Stockton mine had two main shafts at the southern end of Stockton. However, a third shaft was needed for better ventilation and to act as an emergency exit, as the colliery's proximity to the ocean meant a sudden inrush of water was a constant threat. It took three years to construct the third shaft at the northern end of the mine, with the project reaching completion in 1895.[69] Sinking a shaft in saturated soft sediments was challenging, and the successful technique used to construct Stockton No. 3 was presented in a report to the Institute of Mining Engineers in London in 1902.[70]

The importance of an extra emergency exit had been demonstrated a few years prior in 1893 when part of the roof collapsed in the lower seam area, leading to lengthy disputes about the general safety of the mine.[71] Only a year after the third shaft was built, the mine would temporarily cease operations again after 11 men were killed in the Stockton Colliery Disaster.[72] In late 1907, the decision was made to close the colliery permanently due to dwindling coal quantities.

At the end of the 20th century, significant beach erosion uncovered what appeared to be the Stockton Colliery No. 3 shaft site, in the intertidal zone near the end of Stone Street. Photos taken in 2017 show a vertical iron tube, believed to be a ventilation pipe, which has subsequently washed away. The iron tube was located not far from the remains of the main shaft, which measures approximately 3 m in diameter and includes remnants of a metal ladder.[73] This feature can be seen during erosion events and at extreme low tides. The Stockton Colliery Ventilation Pipe is listed on the NSW Maritime Heritage Database (**ID: 3925**), however its protection status is recorded as 'unknown'.

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[67] **Anon. 1885.** *The Newcastle city and country almanac & directory: with farm and garden calendar* R.C. Knaggs & Co, Newcastle. p. 37. viewed 5 August 2022 http://nla.gov.au/nla.obj-2968155965.
[68] *Op. Cit.* **Anon, 1885**:37.
[69] **Rigby, R. 2017**. *Stockton Colliery No. 3 Shaft*. Hunter Living Histories – University of Newcastle. Viewed 5 August 2022 https://hunterlivinghistories.com/2017/09/12/stockton-colliery-3-shaft/.
[70] *Op. Cit.* Rigby, R. 2017.
[71] *Op. Cit.* Rigby, R. 2017.
[72] **1896 'STOCKTON COLLIERY DISASTER.',** *The Sydney Morning Herald*, 14 December, p. 4, viewed 05 Aug 2022, http://nla.gov.au/nla.news-article14079681
[73] *Op. Cit.* Rigby, R. 2017.

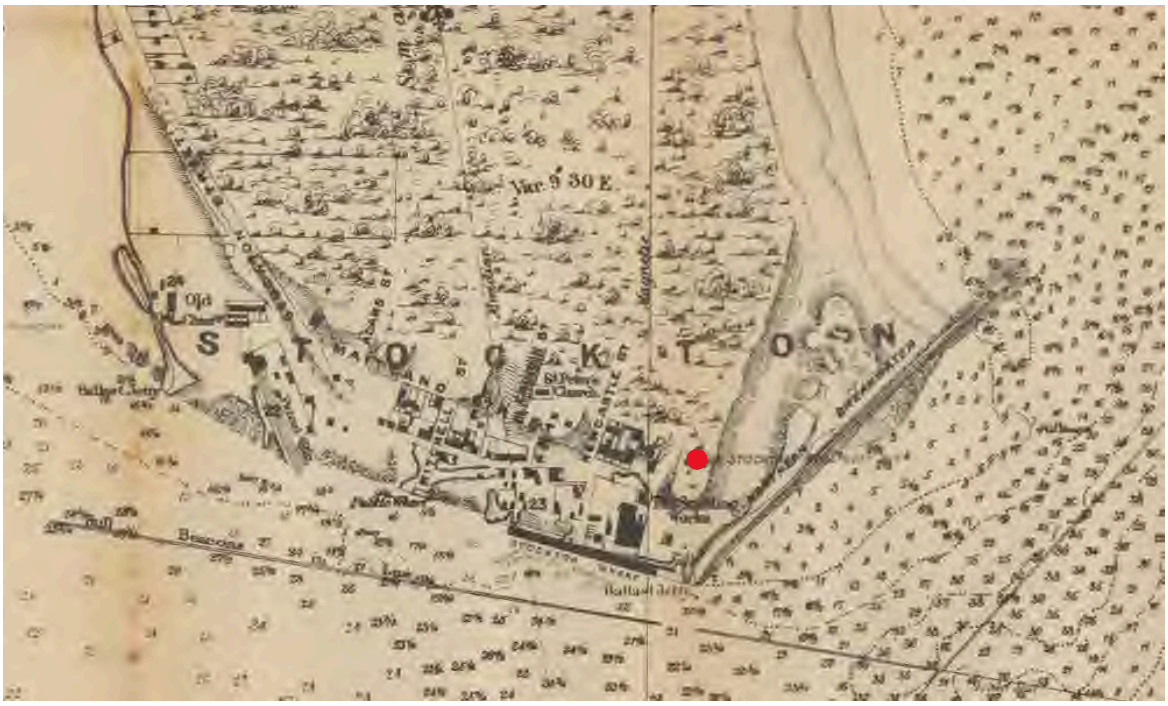

Figure 26: Map of Stockton produced in 1887, showing the location of the Stockton Colliery, as indicated by the red dot.[74]

[74] **1887.** Plan of the Port of Newcastle: reduced from recent surveys by officers of the Harbours & Rivers Department; outer soundings by Captn. F.W. Sidney, R.N. Digitised from The Newcastle nautical almanac. Newcastle, N.S.W: R.C. Knaggs & Co. Cultural Collections, University of Newcastle (Australia).

Figure 27: View of Stockton Colliery looking southeast, 1897. The breakwater and Nobby's Head can be seen in the distance. [75]

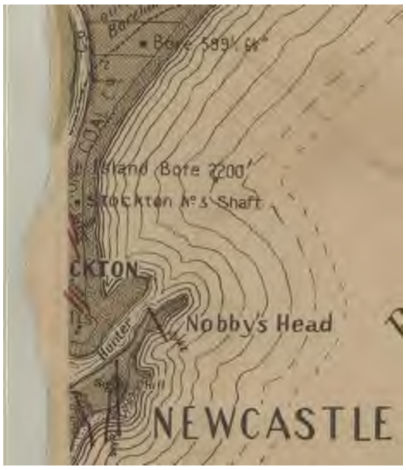

Figure 28: Excerpt from a 1940s geological formations map, showing the Stockton No. 3 Shaft at centre.[76]

Figure 29: Stockton Colliery looking south towards Newcastle over the harbour, date unknown. Note the sailing ships docked at the Stockton wharves.[77]

Figure 30: Stockton No. 3 Shaft exposed at 0.35m low tide in September 2017. The shaft has a diameter of approximately 3m. Remains of ladder can be seen on right. Photographer: Russell Rigby. Source: Hunter Living Histories.

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[75] **University of Newcastle Cultural Collections 2022**, *Stockton Colliery, Stockton, NSW, June 1897.* Accessed Aug 15 2022. Viewed at https://trove.nla.gov.au/work/192177924.
[76] **New South Wales. Department of Lands [194-?],** *[The geological formations and principal collieries in the Newcastle region]* [Division of Reconstruction and Development, Premier's Department?], [Sydney, N.S.W.?] viewed 15 August 2022 http://nla.gov.au/nla.obj-2926607398.
[77] **University of Newcastle Ross and Pat Craig Collection, 2016**. *Stockton Colliery n.d.* Accessed Aug 15 2022. Viewed at https://www.flickr.com.

3.6 Stockton Beach Defences during World War II

During WWII, Newcastle and the surrounding area played a crucial role in the war effort. The city was home to Australia's largest steel-making facilities, had an invaluable deep harbour, ship building docks and coal mines. Protecting such important manufacturers and resources became crucial, and the military operation to defend the area was known as 'Fortress Newcastle' – the largest of its type in Australian defence history.[78]

Fortress Newcastle comprised four fixed coastal defence forts, two air bases and four army training camps, and stretched from Port Stephens in the north to the Tuggerah Lakes in the south.[79] Stockton Bight Beach was one of the key areas to be reinforced. The beach defences at Stockton included machine gun emplacements, searchlights, barbed wire and 2,650 cement anti-tank traps (Figure 31). These defences were supported by two anti-aircraft batteries situated at Fort Wallace (Stockton's fixed defence fort).[80]

Figure 31: Anti-tank traps along Stockton Beach in the 1940s. Source: Newcastle Regional Library.

Recent beach erosion events have exposed extant anti-tank traps in various sections along the Stockton coastline. During 1945 some anti-tank traps were removed from the beach to repair the northern breakwater at the Newcastle Harbour entrance.[81] In 1947, the Newcastle Morning Herald reported that *a big percentage of the 6000 tank traps on the beach had been removed by the contractor.*[82]

In 2020, a long line of the traps, also known as tetrahedrons, could be seen along Stockton Beach following large swells (Figure 32). The anti-tank traps are made of concrete and feature sharp, protruding metal poles. In October 2020, Hunter Water removed 185 of

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[78] **Newcastle Industrial Heritage Association, 2021**. *The Fortress Newcastle Project*. Hunter Living Histories – University of Newcastle. Viewed 5 August 2022 https://hunterlivinghistories.com/2020/06/12/fortress-newcastle-project/.
[79] *Op. Cit.* Newcastle Industrial Heritage Association, 2021.
[80] **N.d.** "*Australia Remembers – World War Two*" plaque at Norm Bassan M.B.E. Park, Stockton. Inscription available at www.monumentaustralia.org.au/themes/conflict/ww2/display/23072-australia-remembers-world-war-two/photo/2.
[81] **Anon 1945** 'Tank Traps Repair Breakwater', *Newcastle Morning Herald and Miners' Advocate (NSW : 1876 - 1954)*, 27 March, p. 2. , viewed 18 Aug 2022, http://nla.gov.au/nla.news-article135020270
[82] **Anon 1947** 'Stockton Beach Nearly Clear Of Tank Traps', *Newcastle Morning Herald and Miners' Advocate (NSW : 1876 - 1954)*, 31 October, p. 4. , viewed 18 Aug 2022, http://nla.gov.au/nla.news-article134229044

approximately 200 tank traps that had become exposed due to safety reasons (Figure 33 and Figure 34).[83]

Figure 32: A photo taken of Stockton Beach in 2020 near Fort Wallace, showing a long line of anti-tank traps exposed after large swell. Photographer: Symon James. Source: Newcastle Herald.

Figure 33: Removal of a tank trap from Stockton beach. Image: Hunter Water.

Figure 34: Concrete tank traps removed by Hunter Water. Image: Hunter Water.

While structures relating to Fort Wallace are listed on the Newcastle LEP (Item nos. **1696 – 1700**), there is no reference made to anti-tank traps. Further north, tank traps on Stockton Beach are protected under the Port Stephens LEP 2013 (Item no. **I34**), however this is outside the study area.

Another military-related maritime archaeological site is the wreck of an amphibious assault vehicle, located in approximately 30 m of water, at the mid-way point of Stockton Beach (Figure 37). In March 1954, a convoy of LVTs (Landing Vehicle Tracked) set out from Wave Trap Beach for a training exercise but encountered severe weather shortly after (Figure 35). Five LVT4As, one LVT4 and two DUKWs were lost, killing three personnel in what was a significant peacetime loss event.[84] While one LVT4A has been located on the seabed, the

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[83] **Hunter Water October 2020** *World War II Tank trap removal.* Available at https://www.hunterwater.com.au/haveyoursay/project-news/world-war-ii-tank-trap-removal
[84] **NSW Maritime Heritage Database 2022**. "*Landing Vehicle Tracked*". Accessed Aug 2nd 2022. Available at https://www.heritage.nsw.gov.au/search-for-heritage/maritime-heritage-database/.

remaining vehicles have not been found (Figure 36). The wreck is listed on the NSW Maritime Heritage Database (**ID: 1155**).

Figure 35: LVTs entering the water at Stockton. Source: Port Stephens Historical Society Inc.

Figure 36: Driving wheel and tail-shaft of a DUKW found by fishermen trawling in Stockton Bight. Date unknown. Source: Port Stephens Historical Society Inc.

Figure 37: Wreck of LVT4A off Stockton Beach. Source: Grey Nurse Dive Charters Newcastle.

3.7 Previous Maritime Studies

3.7.1 *Review of Environmental Factors: Maintenance Dredging and placing of Dredged materials off Stockton Beach. Worley Parsons 2009.*

In terms of maritime heritage, the REF identified two shipwrecks within the vicinity of the dredge and placement area for Stockton Beach:

- SS *Davenport (1943)*
- PS *Yarra Yarra (1877)*

The Heritage Branch of the NSW Department of Planning (now the Department of Planning and the Environment) advised that dredged material should not be placed within a 350 m radius exclusion zone around these two wrecks.

The reasoning behind this decision is quoted below:

> *Marine sediments generally act to preserve Historic Shipwrecks by providing support to fragile archaeological structures, creating an anaerobic environment that reduces the environmental effects of natural materials degradation, act to retain archaeological relics associated with an Historic Shipwreck site, and reduce the impacts of mechanical damage to fragile sites through boat anchor damage, commercial fishing net contacts, diver abrasion, and natural swell scouring of sites.*
>
> *However, Historic Shipwrecks, prone to sediment shifts, also act as fragile and unique marine ecosystems when partly exposed above the seabed. The scientific study of shipwrecks as artificial reefs and their effect on species consolidation, breeding cycles etc is not well documented. Hence, the accidental or purposeful burial or partial burial of exposed shipwreck structures could have a negative impact on their associated natural values.*[85]

The Heritage Office recommended an inspection of the shipwreck sites to document their state at the end of the sand placement operation.

[85] **Worley Parsons, 2009**, Area E Maintenance Dredging and Placement of Dredged Material off Stockton: Review of Environmental Factors, p. 22.

4 KNOWN AND POTENTIAL MARITIME ARCHAEOLOGICAL SITES

The following discussion of known archaeological sites is based on database research and the analysis of historical maps. Consideration should be given to the difficulties in relating plans and maps of differing scales and levels of accuracy. An error margin of around +/- 20 m should be factored in when attempting to ascertain what underwater archaeological remains may be located within the study area. This study has identified the following known maritime archaeological sites within the footprint of the current study area:

- *Berbice* shipwreck
- SV *Durisdeer* shipwreck
- Stockton Colliery ventilation pipe and shaft

4.1 Shipwrecks in the Sand Placement Area

4.1.1 *Berbice*

The *Berbice* was wrecked on Stockton Beach on 5th June 1888 and its crew were rescued by the Stockton Rocket Brigade. The vessel was built in Scotland in 1868 and was a 760-tonne composite cargo ship, 53 m in length.

A wreck site was exposed in 2018 and sits in approximately five metres of water off shore of the Surf Life Saving Club. Hunter Living Histories has attributed this site to the *Berbice.*[86] The NSW maritime database has a different location attributed to the *Berbice*. Both wreck locations are displayed in Figure 38.

Since the wreck site was discovered, a large rudder washed ashore not far from the possible site of the *Berbice*. The vessel it came from is yet to be identified. The rudder is currently under conservation at the Newcastle Regional Museum.

NSW Maritime Heritage Database **Site ID: 1821**.

[86] **Hunter Living Histories, August 2018,** *The wreck of the* Berbice*, Stockton Beach 1888,* available https://hunterlivinghistories.com/2018/08/03/wreck-berbice/

***Figure 38: Locations attributed to possible wreck site of* Berbice.** Green mark location provided by BlueCoast and white mark taken from NSW Maritime Database. Sand placement area in yellow.

Figure 39: Wreck of* Berbice *on Stockton Beach 1888. [87]

Figure 40: The possible wreck site of* Berbice *in front of the Stockton Surf Life Saving Club in February 2021. [88]

4.1.2 *SV Durisdeer*

The 21-year-old vessel, SV *Durisdeer* was wrecked in 1895 after getting caught in a strong gale. The 989-ton three masted barque was built in Glasgow in 1864 and wrecked on the

[87] **Anon, 1885**, *The 'Berbice' after being wrecked*. Available at https://trove.nla.gov.au/work/208522444?keyword=Berbice%20wreck.
[88] **Chesworth, J. February 2021** Berbice *shipwreck, just off Surf Club, February 2021*, available at https://hunterlivinghistories.com/2018/08/03/wreck-berbice/

Oyster Bank at the end of a voyage from South Africa. *Durisdeer* was under ballast at the time of the incident.

There is a wreck site attributed to SV *Durisdeer* lying in approximately 5 m of water, resting on its port side just off Stockton Beach.[89] The NSW maritime database has a different location attributed to the *SV* Durisdeer. Both wreck locations are displayed in Figure 41.

While shifting sands can affect how much of the wreck is visible, its large iron masts are a prominent feature, pointing out to sea.

NSW Maritime Heritage Database **Site ID: 1594**.

Figure 41: Location of shipwreck SV Durisdeer. Green mark location provided by BlueCoast and white mark taken from NSW Maritime Database. Sand placement area in yellow outline.

[89] **Hunter Living Histories, August 2018,** *The wreck of the* Berbice*, Stockton Beach 1888,* available https://hunterlivinghistories.com/2018/08/03/wreck-berbice/

Figure 42: Wreck of the barque Durisdeer on Stockton Beach in 1895. Source: Newcastle Regional Library no. 026 000108.

Figure 43: The possible wreck site of* SV Durisdeer *February 2021.[90]

A piece of wreckage was located in the intertidal zone close by to the wreck site location in the NSW Maritime Database attributed to *Durisdeer* in 2013 (Figure 44). It consisted of an approximately 3 m length of timber with regularly spaced clench bolts. The NSW maritime database does not specify the current location of the item ie whether this wreckage is still *in situ* or was removed.

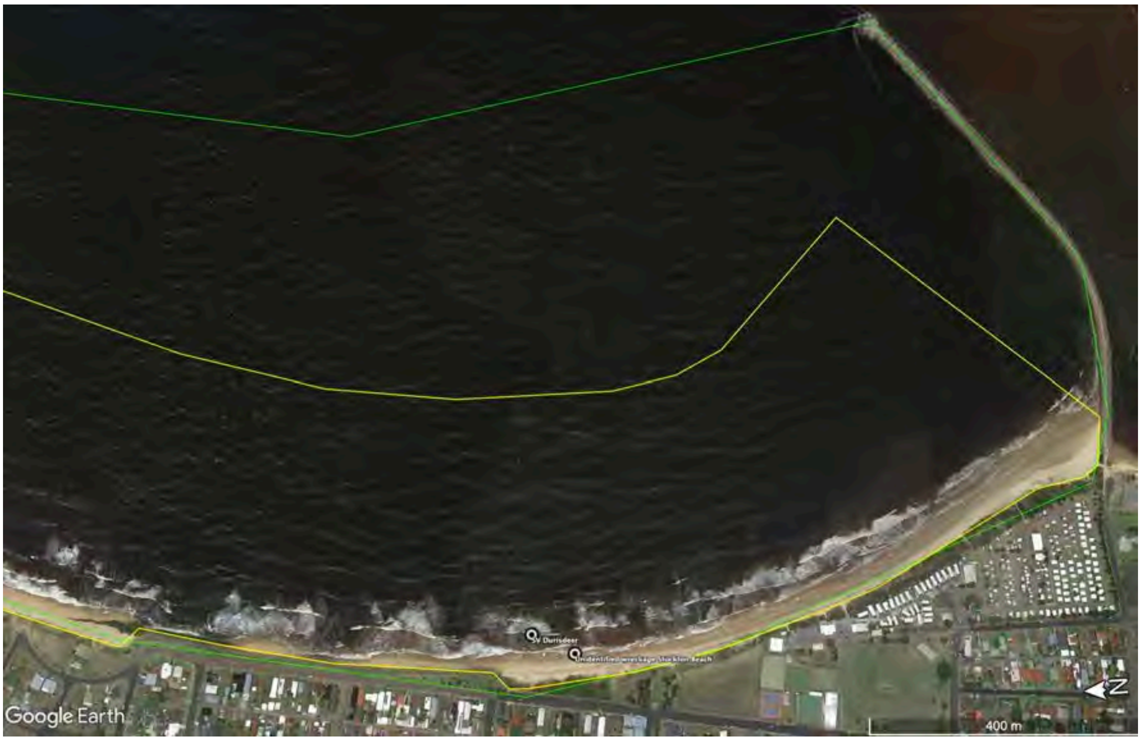


***Figure 44: Location of unidentified wreckage in relation to the wreck of SV* Durisdeer.** Sand placement area in yellow outline, study area in green. Locations from NSW Maritime Database.

[90] **Chesworth, J. February 2021** Durisdeer *February 2021*, available at https://hunterlivinghistories.com/2018/08/03/wreck-berbice/

4.2 Maritime Sites in the Study Area

4.2.1 *Stockton Colliery Ventilation Pipe and No. 3 Shaft*

The ventilation pipe is listed in the NSW Maritime Heritage Database as **ID: 3925**. This section of iron or steel segmented pipe was exposed from sand dunes on Stockton Bight Beach after a period of intense storm activity in 2017.

The pipe consisted of three bolted sections (approximately 750 mm diameter) with a square base. The pipe was previously completely buried in the sand dune but has now collapsed after it was left freestanding in the intertidal zone (Figure 46).[91]

The remaining shaft is approximately 3 m in diameter and features a metal protrusion which appears to be an iron ladder (Figure 47).

Figure 45: Location of potential items relating to the Stockton Colliery. Location of ventilation pipe (in blue) taken from NSW Maritime Heritage Database. Note the pipe is no longer in situ. Colliery Shaft (in green) location taken from Hunter Living Histories. Yellow outline is sand placement area.

[91] **Heritage NSW, 2022** *Stockton Colliery Ventilation Pipe,* available https://www.heritage.nsw.gov.au/search-for-heritage/maritime-heritage-database/.

Figure 46: Potential Stockton Colliery ventilation pipe which has since washed away. [92]

Figure 47: Potential Stockton Colliery shaft. [93]

4.3 Shipwrecks adjacent to the sand placement area

There are two known shipwrecks immediately adjacent to the study area – *SS Davenport* and PS *Yarra Yarra* as well as the wrecks incorporated into the Stockton Breakwater. While these wrecks do not lie directly in the study area footprint, their significance and archaeological potential should be taken into consideration. SS Davenport

The 911-ton screw steamer *Davenport* caught fire while on the Oyster Bank in 1943. Because it was carrying munitions for the war effort, the fire onboard posed a serious threat, hence the vessel was towed out of Newcastle Harbour. It drifted to Stockton and sank in approximately 12 m of water, in front of the Stockton Surf Club. The wreck is now a local dive site, with the wreck showing interesting evidence of the significant fire damage caused before the vessel sank.

The 60.9 m long vessel was built in Oregon, USA in 1912 and was powered by a triple expansion engine.

NSW Maritime Heritage Database **Site ID: 1556**.

[92] **Kite, J., 2017** *No.3 Shaft 6 Sep 2017 at 0.35m low tide – 3m diameter shaft- ladder-way on right, timber balk on left,* available at https://hunterlivinghistories.com/2017/09/12/stockton-colliery-3-shaft/
[93] **Jones, S 2017** *No.3 Shaft – top of ladder-way in shaft in surf on left, 2 Sep,* available at https://hunterlivinghistories.com/2017/09/12/stockton-colliery-3-shaft/

Figure 48: Location of shipwreck* SS Davenport*. Study area in green outline. Sand Placement area is in yellow.

Figure 49: SS Davenport wreck site. Image courtesy of Grey Nurse Dive Charters.

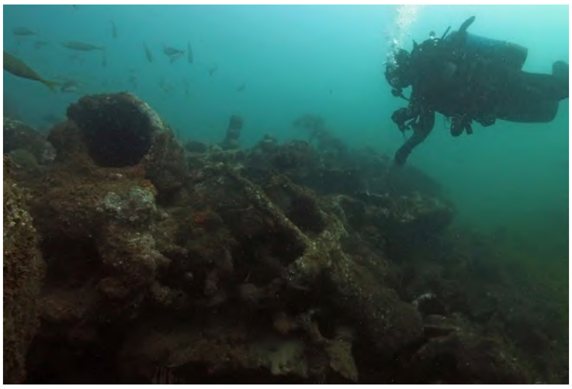


Figure 50: SS Davenport wreck site. Image courtesy of Grey Nurse Dive Charters.

4.3.1 *Stockton Breakwater wrecks*

An overview of the Stockton Breakwater wrecks can be found in Table 4 and their location as recorded in the NSW Maritime Heritage database is indicated in Figure 51.

Table 4: Overview of Stockton Breakwater wrecks.

Name	NSW Maritime Heritage Database Site ID	Year Wrecked	Wrecking Event
Adolphe	#36	1904	The iron barquentine, built in 1902 in Dunkirk France, was wrecked on the Oyster Bank while in ballast from Antwerp to Newcastle in 1904. The incident occurred after the tug's tow parted in bad weather and the Adolphe came to rest on top of the wrecks of the Lindus and Wendouree. The French crew of 32 men were rescued. Today, the ship's bow is visible above the breakwater and is a prominent feature of the Newcastle skyline. The wreck holds local significance under the Newcastle Local Environement Plan (ID: A12).
Cawarra	#1928	1866	The loss of the paddle steamer Cawarra in July 1866 is considered one of Australia's worst maritime disasters. The 552-ton steamer was on a voyage from Sydney to Queensland when it attempted to re-enter Newcastle harbour to shelter from a storm. Large seas battered the vessel, extinguishing its fires and making it unmanageable. Lifeboats were deployed for female passengers but were overwhelmed and sank. Of the 61 people aboard Cawarra, only one crew member survived.
Colonist	#1633	1894	Colonist was an 819-ton screw steamer employed in the coastal cargo trade. As the vessel was departing Newcastle for Adelaide laden with coal, careless navigation caused her to wreck against the northern breakwater. The Colonist's 19 crew members were all rescued.
Eleanor Lancaster	#1621	1856	Eleanor Lancaster was a wooden ship built in 1839 and registered for the coastal cargo trade. During a voyage from Newcastle to Melbourne, the ship, which was laden with 640 tons of coal, was lifted onto the Oyster Bank during a wild gale. The NSW database has no coordinates listed for the wreck.
Elamang	#1618	1905	Elamang was one of two hulks purchased by the Public Works Department to scuttle as part of the construction of the Stockton Breakwater. Elamang was an iron screw steamer built in 1876 in Scotland and had been operated by the Australian Steam Navigation Company.
Katoomba	#1082	1905	The second hulk to be scuttled in 1905 was Katoomba, a 1,006-ton iron screw steamer built in Glasgow, Scotland.
Lindus	#991	1899	Lindus was a 1,678-ton screw steamer carrying cargo from Newcastle to Adelaide when it was hit by a gale in June 1899. The crew was saved by a passing vessel; however Lindus sank and was later found straddling the wreck of the Colonist.
Regent Murray	#604	1899	Regent Murray was driven ashore during a squall as it tried to enter the port of Newcastle from Adelaide under tow in April 1899. The iron barquentine ended up beached on the Oyster Bank.
Wendouree	#207	1898	In July 1898, Wendouree was carrying 1,850 tons of coal destined for Adelaide when she grounded on the Oyster Bar. The screw steamer was a 1,640-ton vessel built in Scotland and operated the coastal cargo routes

Figure 51: Location of breakwater shipwrecks as listed in the NSW Maritime Heritage database. Study area in green outline. Sand Placement area is in yellow.

4.4 Potential Maritime Archaeological Sites

Based on historical information, as summarised in Section 3, the following cultural activities have occurred on or in the vicinity of Stockton Beach:

- Regular shipwreck events dating from 1805 (*Francis* – wreck not found). Stockton beach was also the site of numerous rescue missions using a range of new lifesaving technologies throughout the 19th century.
- The development of the Stockton Breakwater in 1898, including the incorporation of Oyster Bank wrecks.
- The construction of colliery-related infrastructure in the late 1800s, including a ventilation shaft.
- Military fortification processes including anti-tank traps and training exercises relating to ‘Fortress Newcastle’ during WWII.

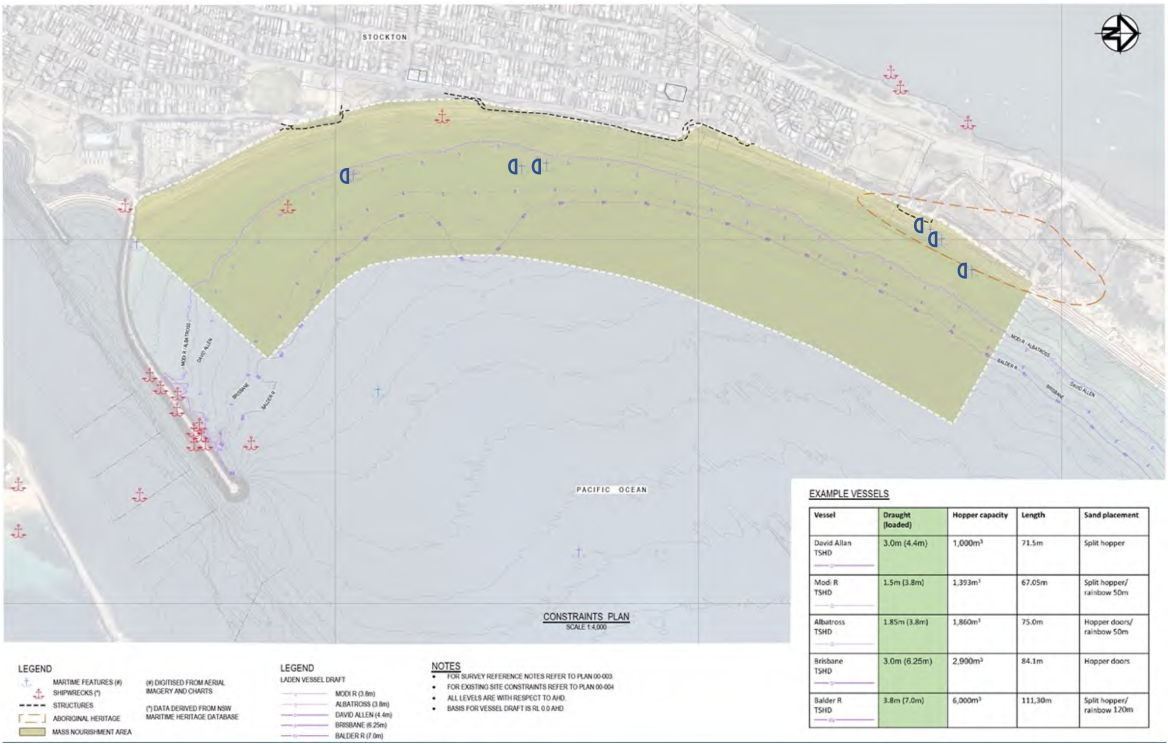
Based on the above and the known sites within the study area, the following types of maritime heritage sites and items may also be present:

- Undocumented or unlocated Australian built vessels pre-1840.
- Undocumented or unlocated shipwrecks – particularly those involved in the NSW coastal trade and colliers.
- Parts or wreckage from undocumented or unlocated shipwrecks.

- Discard from vessels – accidental and/or deliberate discard of items such as personal objects, food and drink containers, ship fittings and equipment as well as fishing and boating equipment.
- Wreckage or artefacts relating to the missing LVTs (amphibious military vehicles).

4.4.1 *Potential maritime sites*

Within the sand placement area, Bluecoast has mapped 6 potential maritime sites identified from aerial imagery and charts (Figure 52). These sites are not listed in the NSW Maritime Heritage Database. Further investigation is required to determine a potential identification and significance.



Vessel	Draught (loaded)	Hopper capacity	Length	Sand placement
David Allan TSHD	3.0m (4.4m)	1,000m³	71.5m	Split hopper
Modi R TSHD	1.5m (3.8m)	1,393m³	67.05m	Split hopper/ rainbow 50m
Albatross TSHD	1.85m (3.8m)	1,860m³	75.0m	Hopper doors/ rainbow 50m
Brisbane TSHD	3.0m (6.25m)	2,900m³	84.1m	Hopper doors
Balder R TSHD	3.8m (7.0m)	6,000m³	111,30m	Split hopper/ rainbow 120m

Figure 52: Constraints Plan displaying shipwrecks and maritime features. Blue circles are maritime features not listed in the NSW Maritime Heritage Database.

4.5 Summary

Based on the findings of archival research using maps, databases and primary sources such as newspapers, the following table and map outline the archaeological potential within the sand placement area (Table 5and Figure 53).

The entire sand placement area has been assessed as being of high archaeological potential due to the location of the Oyster Bank and the historical records indicating a significant amount of shipwrecks not found within the area.

Table 5: Archaeological potential within the study area.

Potential remains	Maritime Archaeological potential
Potential remains of undocumented or unlocated Australian-built vessels pre-1840.	High
Potential remains of undocumented or unlocated shipwrecks – particularly those involved in the NSW coastal trade and colliers	High
Discard from vessels – accidental or deliberate	High

Figure 53: Archaeological potential within the sand placement area.

5 SIGNIFICANCE ASSESSMENT

5.1 Significance Criteria

An assessment of cultural significance or heritage significance seeks to understand and establish the importance or value that a place, site or item may have to select communities and the general community. The Australian ICOMOS *Charter for the Conservation of Places of Cultural Significance*[94] (the *Burra Charter 1979,* most recently revised in 1999) is the standard adopted by most heritage practitioners in Australia when assessing significance. It defines cultural significance as "aesthetic, historic, scientific or social value for past, present or future generations".

This value may be contained in the fabric of the item, its setting and relationship to other items, the response that the item stimulates in those who value it now, or the meaning of that item to contemporary society.

Accurate assessment of the cultural significance of sites, places and items is an essential component of the NSW heritage assessment and planning process. A clear determination of a site's significance allows informed planning decisions to be made for place, in addition to ensuring that their heritage values are maintained, enhanced, or at least minimally affected by development.

Assessments of significance are made by applying the following standard evaluation criteria provided by the NSW Office of Environment and Heritage[95] in order to establish a statement of significance:

- **a.** An item is important in the **course or pattern** of NSW's **cultural or natural history** (or the cultural or natural history of the local area);
- **b.** An item has strong or special **associations with** the life or works of **a person, or group of persons, of importance in NSW' cultural or natural history** (or the cultural or natural history of the local area);
- **c.** An item is important in demonstrating **aesthetic characteristics** and/or a high degree of **creative or technical achievement** in NSW (or the local area);
- **d.** An item has strong or special **associations with a particular community or cultural group** in NSW (or the local area) for **social, cultural or spiritual reasons**;
- **e.** An item has **potential to yield information** that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);
- **f.** An item possesses **uncommon, rare or endangered** aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);
- **g.** An item is important in **demonstrating the principal characteristics of a class of NSW's cultural or natural places**; or cultural and natural environments.

[94] **The Australia ICOMOS, 1999,** Charter for the conservation of places of cultural significance.
[95] **NSW Heritage Office, 2001,** Assessing Heritage Significance.

5.2 Berbice

The following significance assessment applies to the wreck of *Berbice*.

a) An item is important in the course or pattern of NSW's cultural or natural history (or the cultural or natural history of the local area)

While Stockton Beach saw many shipwrecks, the *Berbice* was significant as it would be the first major opportunity for the newly formed Stockton Rocket Brigade to undertake a rescue using new life-saving technology. The brigade used 'Illuminating Long Life Lights' for the first time during the *Berbice* mission and managed to save all hands by firing a rescue line onto the sinking vessel. Therefore, the *Berbice* wreck is associated with successful 19th century attempts at improving shipping safety and reducing fatalities at the notorious Oyster Bank.

The remains of *Berbice* are considered to be of **local significance** under this criterion.

b) An item has strong or special associations with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)

Berbice is strongly associated with the Stockton Rocket Brigade and their first major successful rescue mission. Techniques and equipment used by the brigade on the *Berbice* would continue to be used on future wrecks, as the rescue group played a crucial role at Stockton until the late 1920s.

The remains of *Berbice* are considered to be of **local significance** under this criterion.

c) An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);

Due to salvage activity and the wreck's position buried in the seabed, the extent of *Berbice*'s structural remains is unknown. It is unlikely that the wreck site would meet the threshold for this criterion.

The remains of *Berbice* are not considered to meet the requirements of this criterion.

d) An item has strong or special associations with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;

Berbice has a social connection to the Stockton community as a well-known and documented wreck that represents the area's treacherous maritime past and coal mining links. Since its re-discovery in 2018, the wreck site has become popular with divers and is a tourist attraction with historical qualities.

Furthermore, the wreck has a social and cultural connection to the Stockton residents who pioneered lifesaving procedures and techniques as a response to the often-lethal Oyster Bank.

The remains of *Berbice* are considered to be of **local significance** under this criterion.

e) An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);

While the intactness of *Berbice* is currently unknown, the wreck site has the potential to yield information relating to NSW coastal trade in the late 19th century. Depending on how extensively the wreck was salvaged, *Berbice* could potentially offer insight into British ship construction in the 1860s, NSW coastal cargo and the personal belongings of those who worked on the ship.

The remains of *Berbice* are considered to be of **local significance** under this criterion.

f) An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);

Wrecking events were common in the Newcastle area during the second half of the 19th century, especially involving coastal traders, therefore it is unlikely that *Berbice* would present as a rare or uncommon archaeological site. While the rescue mission relating to the *Berbice* was an uncommon and new initiative for Stockton at the time, it is unlikely that any relics relating to the rescue remain.

The remains of *Berbice* are not considered to meet the requirements of this criterion.

g) An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural and natural environments.

Due to the wreck being easily accessible from the beach, parts of the ship were salvaged during the initial years following the wrecking event. *Berbice* is characteristic of a coastal cargo trader and collier from the mid 19th century, however salvage of the wreck site has the effect of reducing the archaeological potential to moderate.

The remains of *Berbice* are not considered to meet the requirements of this criterion.

Statement of Significance

The *Berbice* was a coastal cargo trader built in England in 1868. Like many ships before it, *Berbice* was wrecked while trying to sail into Newcastle Harbour at night-time and in poor weather. During the wrecking event, the newly formed Stockton Rocket Brigade were deployed for their first major rescue mission using new technologies such as long-life lights and a breeches buoy attached to the rescue line. The rescue mission was a success and marked a new era in lifesaving technologies and responsibilities on the Stockton peninsula. The integrity of the wreck site is unknown due to salvage activities soon after the disaster occurred, however the parts of the vessel which remain under the seabed are likely well preserved. *Berbice* has the potential to yield information relating to ship construction and the contents of cargo ships plying the NSW coastal trade route in the 1880s. The wreck is assessed as being an item of **local significance**.

5.3 SV *Durisdeer*

The following significance assessment applies to the wreck of SV *Durisdeer*.

a) An item is important in the **course or pattern** of NSW's **cultural or natural history** (or the cultural or natural history of the local area)

The *Durisdeer* wreck is associated with successful 19th century attempts at improving shipping safety and reducing fatalities at the notorious Oyster Bank. The wreck is also an example of a 19th century international trading vessel involved incorporating NSW in its trading routes.

The remains of SV *Durisdeer* are considered to be of **local significance** under this criterion.

b) An item has strong or special associations with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)

Durisdeer is strongly associated with the Stockton Rocket Brigade. Techniques and equipment used by the brigade saved all on board SV *Durisdeer* and the rescue group played a crucial role at Stockton until the late 1920s.

The remains of SV *Dursideer* are considered to be of **local significance** under this criterion.

c) An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);

Due to salvage activity and the wreck's position buried in the seabed, the extent of *Dursideer*'s structural remains is unknown. It is unlikely that the wreck site would meet the threshold for this criterion.

The remains of SV *Durisdeer* are not considered to meet the requirements of this criterion.

d) An item has strong or special associations with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;

SV *Durisdeer* has a social connection to the Stockton community as a well-known and documented wreck that represents the area's treacherous maritime past and coal mining links. The wreck site has become popular with divers and is a tourist attraction with historical qualities.

Furthermore, the wreck has a social and cultural connection to the Stockton residents who pioneered lifesaving procedures and techniques as a response to the often-lethal Oyster Bank.

The remains of SV *Durisdeer* are considered to be of **local significance** under this criterion.

e) An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);

While the intactness of SV *Durisdeer* is currently unknown, the wreck site has the potential to yield information relating to international trade with Australia in the late 19th century. Depending on how extensively the wreck was salvaged, SV *Durisdeer* could potentially offer insight into British ship construction in the 1860s, NSW coastal cargo and the personal belongings of those who worked on the ship.

The remains of SV *Durisdeer* are considered to be of **local significance** under this criterion.

f) An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);

Wrecking events were common in the Newcastle area during the second half of the 19th century, especially involving coastal traders, therefore it is unlikely that SV *Durisdeer* would present as a rare or uncommon archaeological site. While the rescue mission relating to the *Durisdeer* was difficult and treacherous, it is unlikely that any relics relating to the rescue remain.

The remains of SV *Durisdeer* are not considered to meet the requirements of this criterion.

g) An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places, or cultural and natural environments.

Due to the wreck being easily accessible from the beach, parts of the ship were salvaged during the initial years following the wrecking event. SV *Durisdeer* is characteristic of an international cargo trader and collier from the mid 19th century, however salvage of the wreck site has the effect of reducing the archaeological potential to moderate.

The remains of SV *Durisdeer* are not considered to meet the requirements of this criterion.

Statement of Significance

SV *Dursideer* was an international cargo trader built in Glasgow in 1864. The 3 masted barquentine had arrived off the Newcastle Coast from South Africa on charter to load coal destined for South America when it sank off Stockton Beach in 1895. All on board were rescued by the Stockton Rocket Brigade but the wreck keeled over and became a complete wreck.

The integrity of the wreck site is unknown due to salvage activities soon after the disaster occurred, however the parts of the vessel which remain under the seabed are likely well preserved. SV *Durisdeer* has the potential to yield information relating to ship construction and the contents of cargo ships plying the international trade route in the 1880s. The wreck site is also a local dive site. The wreck is assessed as being an item of **local significance**.

5.4 Stockton Colliery No. 3 Shaft

a) An item is important in the course or pattern of NSW's cultural or natural history (or the cultural or natural history of the local area)

The No. 3 Shaft is one of the very few structures to remain from the Stockton Colliery. Apart from coal-related street names and memorial plaques, there is virtually no visible remains of the colliery, which was once a key industry and employer in Stockton. The mine was one of the two largest Delta collieries and was a major contributor to Newcastle's coal exports during its operating years from 1885 to 1908.

The remains of the No. 3 Shaft are considered to be of **local significance** under this criterion.

b) An item has strong or special associations with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)

The No. 3 Shaft is not known to have any special associations with a person or group of persons of importance in NSW's cultural or natural history.

The remains of the No. 3 Shaft are not considered to meet the requirements of this criterion.

c) An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);

The Stockton colliery operated in a challenging, harbourside environment which required the development of specialist technology to mitigate the risk of flooding. The Stockton Colliery mined the highly regarded Borehole seam which existed under the harbour, seabed and low-lying areas of Stockton. Therefore, Stockton No. 3 Shaft was constructed as a response to these high-risk conditions. The shaft not only provided ventilation, but an emergency exit in the event of flooding. The methods used for sinking No. 3 Shaft were presented to the Institute of Mining Engineers in London in 1902 and was also featured in a book about Australian collieries. It was seen as a leading example of how to sink a shaft in water-logged soft sediments.

The remains of the No. 3 Shaft are considered to be of **local significance** under this criterion.

d) An item has strong or special associations with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;

The No. 3 Shaft represents an industry which played an important role in the cultural and social fabric of Stockton in the late 19th century. The colliery has a special association with the Stockton community, as demonstrated by the memorial plaques and street signs throughout the town. As one of the last remaining visible structures from the colliery, the No. 3 Shaft would be meaningful to the Stockton community.

The remains of the No. 3 Shaft are considered to be of **local significance** under this criterion.

e) An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);

For its era, the shaft was an example of industry-leading engineering and was used as a guide for other collieries facing similar environmental challenges. The No. 3 Shaft could demonstrate technical information about how mine shafts were constructed and sunk in this unique environment, where flooding was a constant threat.

The remains of the No. 3 Shaft are considered to be of **local significance** under this criterion.

f) An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);

There are numerous mining shafts listed on the NSW State Heritage Inventory, therefore it is unlikely that the No. 3 Shaft demonstrates rare or endangered aspects of NSW's cultural history. However, the shaft was a successful engineering response to an unusual environmental challenge, therefore the shaft may demonstrate uncommon structural or technical features as part of its design.

The remains of the No. 3 Shaft are considered to be of **local significance** under this criterion.

g) An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural and natural environments.

The No. 3 Shaft would be a good representative example of its class, however its condition is unknown due to its position within the seabed. A better understanding of the shaft's condition and intactness is needed before determining whether the No. 3 Shaft would meet this criterion.

The remains of the No. 3 Shaft are not considered to meet the requirements of this criterion.

Statement of Significance

The Stockton Colliery No. 3 Shaft is one of the very few remaining visible structures from Stockton's coal mining industry, which was a major employer from 1885 to 1908. In particular, the shaft was a successful engineering response to the difficulties of mining the 'Borehole Seam' which ran under the low-lying land, harbour and ocean bed of the Newcastle area. The shaft took 3 years to construct (completed in 1895) and provided ventilation and an emergency exit for miners who worked under the ever-present risk of flooding at the Stockton Colliery. While the shaft's intactness is unknown due to its position in the seabed, its special design suited for wet, soft sediments makes it an interesting example of late 19th century colliery engineering. Extant structures from the Stockton colliery are meaningful to the local community, who recognise the economic role that coal mining played in the town, as well as the many lives lost in mining disasters. The No. 3 Shaft is assessed as being an item of **local significance**.

5.5 Significance of shipwrecks adjacent to sand placement area

5.5.1 *SS Davenport*

The following significance assessment applies to the wreck of SV *Davenport*.

a) An item is important in the course or pattern of NSW's cultural or natural history (or the cultural or natural history of the local area)

The American steamer, SS *Davenport* was loaded with munitions for the war effort when it caught fire in Newcastle Harbour in 1943. Newcastle (nicknamed 'Fortress Newcastle' during the war) was critical for steel, coal and munition supplies. The wreck of *Davenport* is significant as a cog in the machine keeping supplies moving to the front line and the role that Newcastle played in the war effort.

The remains of SS *Davenport* are considered to be of **local significance** under this criterion.

b) An item has strong or special associations with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)

SS *Davenport* is not known to have any special associations with a person or group of persons of importance in NSW's cultural or natural history.

The remains of SS *Davenport* are not considered to meet the requirements of this criterion.

c) An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);

The wreck of SS *Davenport* is spread over a wide area and was heavily damaged by fire before it sank.

The remains of SS *Davenport* are not considered to meet the requirements of this criterion.

d) An item has strong or special associations with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;

SS *Davenport* has a social connection to the Stockton community as a well-known and documented wreck that represents the area's links to the war effort during the second world war. The wreck site has become a local dive site and is a tourist attraction with historical qualities.

The remains of SS *Davenport* are considered to be of **local significance** under this criterion.

e) An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);

The wreck of SS *Davenport* is spread over a wide area and was heavily damaged by fire before it sank. While the boilers and winches can be identified, it is unlikely that the wreck remains will yield information contributing to this criterion.

The remains of SS *Davenport* are not considered to meet the requirements of this criterion.

f) An item possesses **uncommon, rare or endangered** aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);

No other vessels are reported as being sunk in the Newcastle area while being resupplied for the war effort. However due to contemporary salvage and fire damage, it is unlikely that SS *Davenport* would present as a rare or uncommon archaeological site.

The remains of Ss *Davenport* are not considered to meet the requirements of this criterion.

g) An item is important in **demonstrating the principal characteristics of a class of NSW's cultural or natural places**; or cultural and natural environments.

SS *Davenport* is representative of a class of vessels tasked with supplying the front lines during WWII and is associated with the role that Newcastle played in that capacity.

The remains of SS *Davenport* are considered to be of **local significance** under this criterion.

Statement of Significance

SS *Davenport* was built in the USA in 1912. Very little is known about the vessel until SS *Davenport* was loaded with munitions in Newcastle Harbour for the war effort in 1943 when a fire took hold. For safety, the vessel was towed out of Newcastle Harbour before the cable broke and the vessel sank off Stockton Beach.

The wreck of SS *Davenport* has a social connection to the Stockton community as a well-known and documented wreck that represents the area's links to the war effort during the second world war. The wreck site has become a local dive site and is a tourist attraction with historical qualities.

The wreck is assessed as being an item of **local significance**.

5.5.2 *Breakwater shipwrecks*

The following significance assessment applies to the Stockton Breakwater and its shipwrecks.

a) An item is important in the course or pattern of NSW's cultural or natural history (or the cultural or natural history of the local area)

Construction of the Stockton Breakwater commenced in 1898 in an attempt to outflank the notorious Oyster Bank while also straightening the current over the bar to prevent silting. At this time, Newcastle was a key port for coal exports and the need to improve the hazardous harbour entry had become critical. The Stockton Breakwater was an innovative and resourceful engineering response to a significant maritime safety problem.

Additionally, the breakwater contains shipwrecks which are culturally significant to the Stockton community, especially the *Cawarra,* which was one of Australia's worst peacetime maritime disasters. Together, the wrecks and the breakwater represent the often-treacherous consequences of NSW coastal shipping in the 19^{th} and early 20^{th} centuries.

The Stockton Breakwater is considered to be of **local significance** under this criterion.

b) An item has strong or special associations with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)

The construction of the Stockton Breakwater was carried out under the supervision of H. D. Walsh, who was the Resident Engineer for Harbours and Rivers at Newcastle at the time. Walsh was responsible for all public works programmes undertaken between the Queensland border and Lake Macquarie and this included the reclamation of Walsh Island and the development of a new harbour basin at Newcastle. Walsh would eventually become the Commissioner of the Sydney Harbour Trust and was responsible for the rat-proofing and general transformation of the south shore of Sydney Harbour. Walsh's legacy included many significant public works projects, including the Stockton breakwater.

The Stockton Breakwater is considered to be of **local significance** under this criterion.

c) An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);

The inclusion of shipwrecks into the Stockton Breakwater lends a considerable aesthetic component to the structure. In particular, the *Adolphe's* profile against the Newcastle skyline has become symbolic, representing Stockton's significant maritime history and long association with shipwrecks.

The Stockton Breakwater is considered to be of **local significance** under this criterion.

d) An item has strong or special associations with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;

The breakwater is an iconic and unique part of the Stockton landscape, with strong social and cultural connections for the local community. The structure is a social meeting place and is a popular location for sightseeing, exercise and engaging with the aesthetics of the Stockton waterfront. Divers also enjoy exploring the breakwater wrecks.

The breakwater has a significant spiritual connection to the local community, which is evident through a series of handmade memorials located along the breakwall. A significant number of large rocks have been painted, decorated or had plaques attached in memoriam to local residents. The practice has been described as a local funerary folk custom and is a way of recording and honouring the memory of community members.

The Stockton Breakwater also holds a significant cultural association with the *Cawarra* wreck, which was a notable maritime disaster. The breakwater provides a tangible link to the many vessels wrecked on the Oyster Bank throughout the 19th century. The shipwreck memorial plaques erected along the breakwall are testament to this sense of connection felt by the public.

The Stockton Breakwater is considered to be of **local significance** under this criterion.

e) An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);

The Stockton Breakwater was a successful engineering response to the notorious Oyster Bank problem, a maritime hazard which blighted the port of Newcastle for more than a century. The wall itself would offer insight into breakwater technology and construction at the turn of the 20th century, and how engineers at that time approached issues such as harbour design and maritime safety.

The broad range of wrecks contained within the wall also have the potential to yield significant information about different vessel types, including their construction and cargo. In particular, the *Adolphe* - which was the largest and final ship to be wrecked on the Oyster Bank in 1904 - is an interesting example of a French four-masted barque. The main, visible breakwater wrecks are *Cawarra*, *Colonist*, *Wendouree*, *Lindus*, *Adolphe* and *Regent Murray*. However, the construction processes used to incorporate the shipwrecks into the breakwall, in conjunction with salvage activity, may have negatively impacted the archaeological integrity of the wreck sites.

The Stockton Breakwater is considered to be of **local significance** under this criterion.

f) An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);

While breakwaters are a common feature at many river mouths in NSW, the incorporation of shipwrecks into the Stockton Breakwater makes it relatively unique. The NSW maritime heritage database lists a number of breakwater structures built at the end of the 19th century, including at the Clarence and Tweed Rivers, however these do not include shipwrecks as part of the structural composition.

Deliberately scuttled ships have been used to make breakwaters in the past, such as the Tangalooma wrecks and the Bulwer wrecks at Moreton Island, Queensland. However, Stockton's breakwater is distinctive, as the wrecks have been consolidated with stone and topped with a cement walkway.

The Stockton Breakwater is considered to be of **local significance** under this criterion.

g) An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural and natural environments.

The breakwater demonstrates the principal characteristics of breakwall construction at the turn of the 20th century, as engineers strived to improve maritime safety in key export hubs such as Newcastle. The addition of shipwrecks to the structure gives it unusual feature characteristics, making the Stockton Breakwater an important and rare representative example of its class.

The Stockton Breakwater is considered to be of **local significance** under this criterion.

Statement of Significance

The Stockton Breakwater was a response to the treacherous Oyster Bank, which blighted the entry to Newcastle Harbour throughout the 19th Century. Several vessels which were wrecked on the bank were eventually incorporated into the breakwater, effectively encapsulating Stockton's long and often tragic association with shipwrecks. The breakwall functions as a memorial to the many ships lost on the Oyster Bank, especially in the case of the *Cawarra*, which saw more than 60 lives lost. The local community has demonstrated a strong social, cultural and spiritual connection to the breakwater. Furthermore, the structure holds strong aesthetic merit and is an iconic part of the Stockton waterfront. Research potential exists relating to the breakwater's construction and design, as well as the individual wrecks within the wall. The breakwater is assessed as being an item of **local significance**.

5.6 Maritime themes relating to NSW shipwrecks

The aim of the thematic study of shipwrecks in New South Wales is to identify key historical themes associated with maritime shipping activities that form the basis to identify the heritage item types associated with each theme. Table 6 outlines the maritime themes relevant to the shipwrecks within the sand placement area.

Table 6: Maritime themes related to the shipwrecks within the sand placement area

Name of shipwreck	Year lost	Maritime Theme / Sub-Themes
Berbice	1888	Commerce and Industry - *the transport of goods and services*
Durisdeer	1895	Commerce and Industry – *the transport of goods and services*
SS Davenport	1943	Defence and War in Coastal Waters
Stockton Breakwater shipwrecks*	1856 - 1905	Creating a Maritime Cultural Landscape

*These wrecks are the wrecks listed in the NSW Maritime Heritage Database. There may be others not listed.

Table 7: Significance by potential maritime site types

Site Types	Criterion A (Historical)	Criterion B (Person)	Criterion C (Aesthetic/technical)	Criterion D (Social)	Criterion E (Research)	Criterion F (Rarity)	Criterion G (Representativeness)	Significance Level
Shipwrecks: Pre-1840 Australian built vessels Such as: - *Francis* (1805) - *Surprise* (1805) - *Boyd* (1812)	Shipwrecks within the study area would reflect the changes from the earliest Australian shipbuilding and trading activities highlighting the development of NSW maritime trade. **State.**	Early Australian-built vessels may have association with some well-known local / Australian shipbuilders but would need to be assessed on a site-by-a site basis. **Local to State.**	Any shipwrecks present within the study area would be of low relief and mostly buried giving them little aesthetic appeal. There is, however, the possibility of the remains of a well-made and technically superior hand-crafted timber boat representative of the Australian shipbuilding industry being present in the area **State.**	Early Australian-built vessels were integral to the coastal trade of NSW. Any social significance would need to be assessed on a site-by-site basis. **Nil - Local.**	Some of the potential shipwrecks lost at or near Stockton Beach are early Australian-built vessels. Little is known from documentary sources about one of the nation's first industries. **State.**	There is a limited number of shipwrecks recorded in NSW and locally built vessels from the early 19th century, particularly inshore craft like fishing or recreational boats or even work punts and barges, are under-reported. **State**	The seabed within the study area consists of sand, which is conducive to the preservation of wrecks; however, erosion/beach scraping/dredging could have a destructive impact on a wreck site. This criterion can only be addressed on a site-by-site basis. **Local to State**	**State**
Shipwrecks: others	Shipwrecks within the study area highlight the historical significance of Newcastle as a trading port along the NSW coast. **Local.**	There may potentially be shipwrecks associated with a significant figure in Newcastle but this can only be assessed on a case-by-case basis. **Nil - Local**	Any shipwrecks present within the study area would be of low relief and mostly buried giving them little aesthetic appeal. **Nil - Local**	Shipping and associated wrecks were commonplace in Newcastle from the 19th century onwards. Any social significance would need to be assessed on a site-by-site basis. **Nil - Local.**	Some of the shipwrecks lost at Stockton beach may have research significance in site formation processes. **Nil – Local.**	Due to the number of shipwrecks potentially wrecked at or near Stockton Beach this criterion can only be assessed on a site-by-site basis. **Nil – Local.**	The seabed within the study area consists of sand, which is conducive to the preservation of wrecks; however, erosion/beach scraping/dredging could have a destructive impact on a wreck site. This criterion can only be addressed on a site-by-site basis. **Nil – Local.**	**Local**

Site Types	Criterion A (Historical)	Criterion B (Person)	Criterion C (Aesthetic/technical)	Criterion D (Social)	Criterion E (Research)	Criterion F (Rarity)	Criterion G (Representativeness)	Significance Level
Discard from vessels	Discard from vessels would reflect the changing habits and material culture of those engaged in waterborne activities in and around the Stockton Beach area. **Nil to local**	No known association with well-known person(s). **Nil**	Discard from vessels within the study area would not reach the threshold for Local significance in this area. **Nil**	No known association with a particular community. **Nil.**	Discard from vessels would generally be of no cultural significance. The exception would be unusual items (in character or date of manufacture), which could provide some new understanding of the cultural development of the project area that is not readily available in the historical record. **Nil to Local.**	The presence of cultural material on the seabed would be ubiquitous and forms ambient background 'noise' in the underwater landscape.	Discard from vessels within the study area would not be a good representative example of its class. **Nil.**	**Potentially Local**

6 POTENTIAL IMPACTS AND MITIGATION

6.1 Proposed Works

The proposed works involve mass renourishment at the southern end of Stockton Beach. The assumed renourishment amount is 2,400,000 m^3 (Figure 54 to Figure 56).

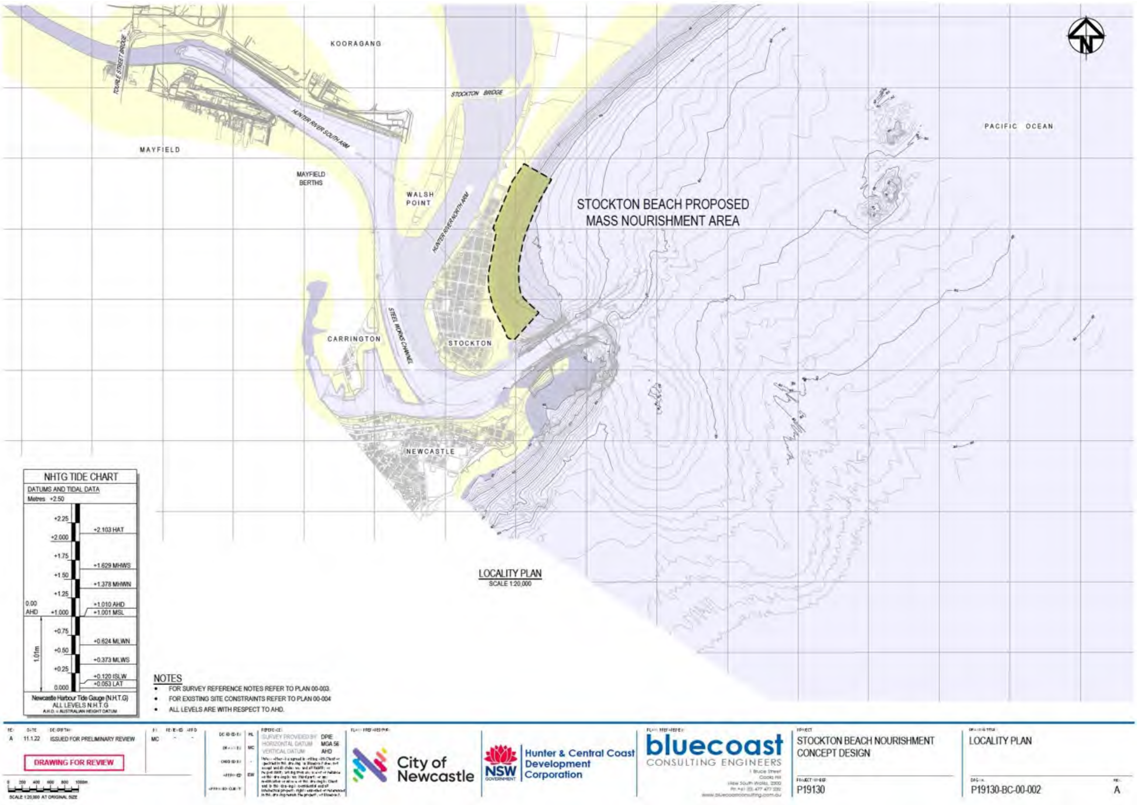


Figure 54: Sand placement area for the beach renourishment works.[96]

[96] **BlueCoast Consulting Engineers,** *Stockton Beach Renourishment Concept Design 50%*, Drawing number P19130-BC-00-002.

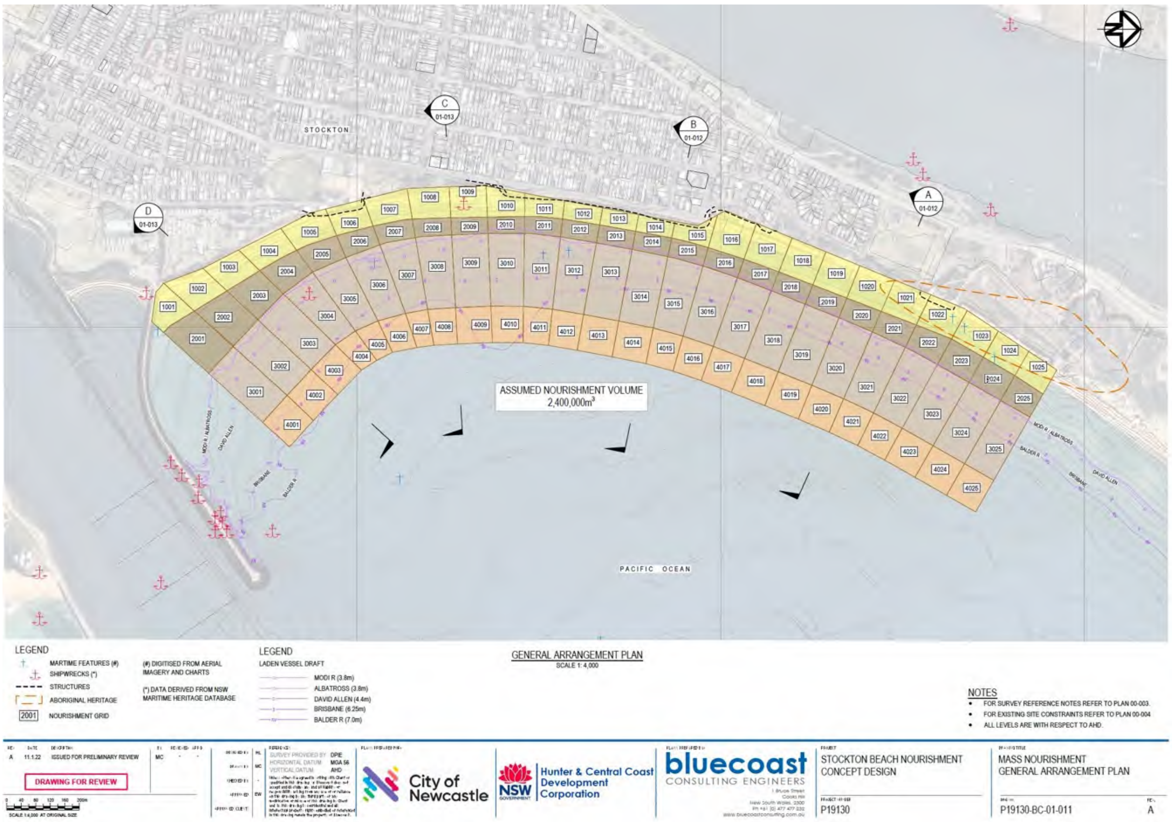


Figure 55: Stockton Beach renourishment general arrangement plan.[97]

[97] **BlueCoast Consulting Engineers,** *Stockton Beach Renourishment Concept Design 50%*, Drawing number P19130-BC-01-011.

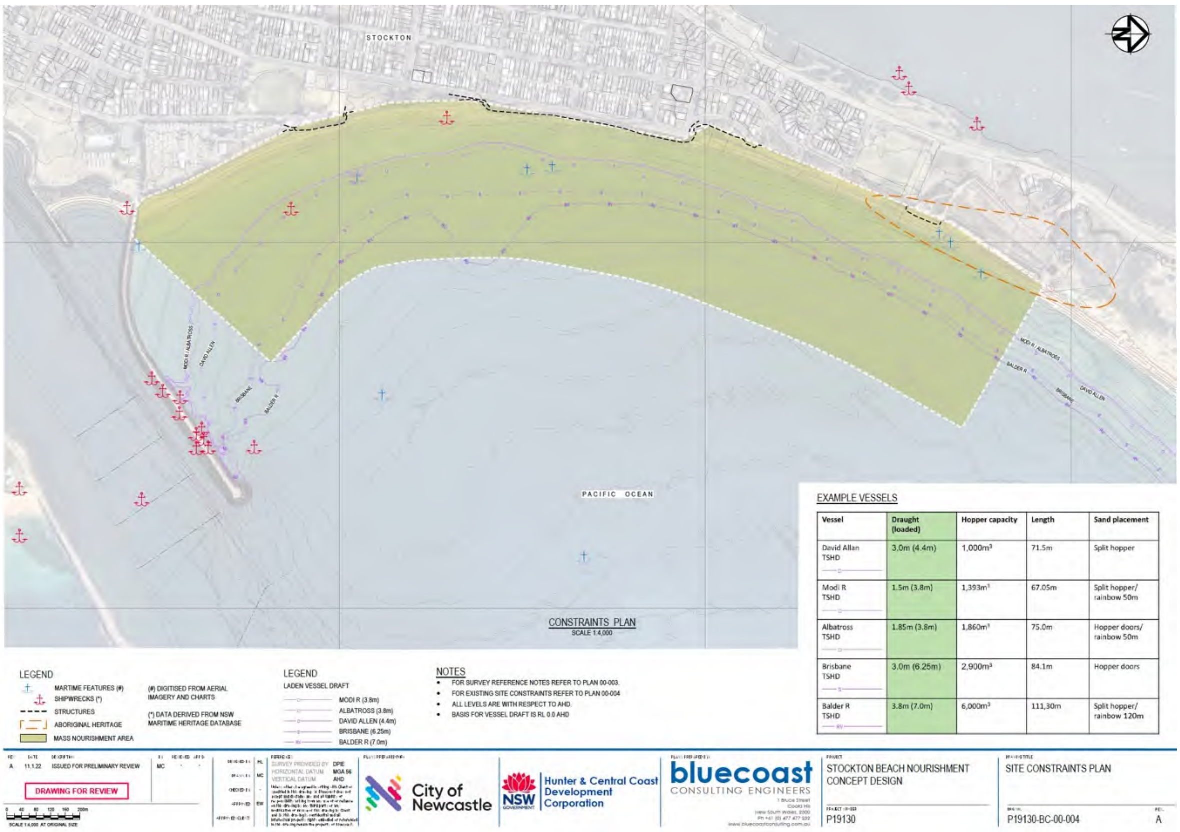


Figure 56: Stockton Beach Renourishment Site Constraints plan.[98]

The method of sand placement is still to be determined.

6.2 Potential Impacts

Cultural heritage sites can be damaged as a result of direct and indirect impacts by a variety of processes. Damage is categorised as *mechanical*, *chemical* or *biological*:

- *Mechanical* damage is where the physical integrity of the site is affected by the impacts of wave, surge, current, sand abrasion as well as cultural behaviour such as dredging, dragging anchors or vessels running aground. Increases in mechanical damage to a site can result from increases in tidal flows and increased exposure of sites to sediment erosion.
- *Chemical* damage relates primarily to the corrosion of the metal components of a site. Changes in pH levels, salinity, light levels (heat) and water movement can dramatically increase electrochemical (corrosion) activity for metal components immersed in seawater.
- *Biological* damage occurs where organic materials, such as wreck or wharf timbers, are exposed to biological organisms such as marine borers and bacteria, and in some cases vegetation. In relation to marine heritage sites, increased biological damage

[98] **BlueCoast Consulting Engineers,** *Stockton Beach Renourishment Concept Design 50%*, Drawing number P19130-BC-00-004.

will occur if hitherto buried sites, or partially exposed sites, are further exposed, due to sediment erosion.

If a marine heritage site suffers from one or more of the above categories of damage it will become further ‘scrambled’. The term ‘scrambled’ refers to alterations made to a site that make it more difficult to interpret/understand – that is, it results in the loss of information whether it be the loss/deterioration of physical fabric or loss of context (the relationship between artefacts). The term ‘transformation’ is used to describe alteration of material (such as breaking/pulverising, corrosion or marine borer damage) and the term ‘translation’ is used to describe the displacement (removal and/or dispersal) of material. [99]

The scrambling of a marine heritage site reduces its overall cultural heritage significance. The degree of the reduction of cultural significance for a particular heritage site is related to the scale and extent of damage.

6.2.1 *Relocation of dredged material*

If heavy sediments are deposited at a fast rate over buried or exposed structures, destabilisation and/or crushing of those sites could occur. Water turbulence created by large volumes of sediment falling in a single event can cause waterlogged timbers to temporarily float and move from their original position.

6.2.2 *Sediment accretion*

The accretion of sediments around and over heritage sites is generally seen as a positive impact. The accumulation of sediment over a site, whether from changed environmental conditions or placement of dredged material will, in effect, protect the site from marine borers and will also protect sites from intrusion, disturbance and removal. Mechanical and chemical damage will also be reduced. Sediment accretion is also generally favourable for coastal/littoral sites.

However, such accretion can also have a negative aspect by resulting in the covering of sites which renders them invisible, hence more susceptible to accidental damage.

6.3 Proposed Mitigation Measures

Overall, the impacts to the maritime archaeological resource can be considered in a positive light. However, due to the uncertainty surrounding currently exposed sites, the following mitigation measures are recommended.

6.3.1 *Review of 2021 Remote sensing data and diver survey*

The purpose of the review is to identify anomalies and known wreck sites within the study area. Identified targets should be dived on by a qualified maritime archaeologist to record each site. Such recording would include:

a) Development of a site plan to provide a baseline for comparison in the future.
b) High definition video and photography to record the current condition of the site and any identifying features to assist in identification if required.

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[99] **Ward, I., P. Larcombe and P. Veth 1999** “A New Process-based Model for site formation” Journal of Archaeological Science Volume 26 p.561.

If the anomaly is determined to be a shipwreck then a wreck report will be developed including scantlings and other identifying features to potentially attribute a site to a vessel.

6.3.2 *Placement of buffer zones around known underwater sites within the sand placement area.*

Buffer zones should be placed around exposed maritime archaeological sites to avoid have dredged material directly overhead and crushing or destabilising them. These sites include *Durisdeer* and *Berbice*. Other maritime sites within the sand placement area may require the same buffer as determined by the remote sensing and diver survey. The diameter of these zones should be 50 m so as to avoid direct impacts to delicate sites.

6.3.3 *Apply for a permit to impact underwater cultural heritage under the UCHA Act 2018.*

This permit can be applied online through the Australasian Underwater Cultural Heritage Database (AUCHD) managed by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

While the overall impact of the works is likely to not be negative, the exposed wrecks may still experience impacts from either accretion or erosion resulting from the works.

7 CONCLUSION AND SUMMARY OF RECOMMENDATIONS

The key findings of this MAA are as follows:

- City of Newcastle are planning to combat serious erosion on Stockton Beach by utilising mass sand renourishment.
- Cosmos Archaeology has been commissioned by Bluecoast to undertake a desktop maritime archaeology assessment (MAA) for the Stockton Beach renourishment project.
- By the mid 19th century, Newcastle had become a major shipping hub for coal, timber and salt exports, alongside shipbuilding, engineering and rail services.
- Stockton became particularly industrious by the mid 19th century, with enterprises such as a salt works, chemical plants, an iron foundry and a tweed mill.
- In 1884, the Stockton Colliery commenced production, helping to prop up the then-struggling Newcastle coal industry.
- Newcastle gained a reputation of being a particularly dangerous port to enter. The Oyster Bank was a significant maritime hazard for shipping.
- Eventually some of the vessels wrecked on the Oyster Bank were used to create the foundation s of the Stockton Breakwater.
- Known maritime sites within the area include two shipwrecks – currently attributed to the *Durisdeer and Berbice* (although the locations are still to be confirmed)– and the remains of a ventilation shaft from the Stockton Colliery.
- There are potentially over 100 undocumented and/or unlocated shipwrecks within the study area.
- Based on the available information, the study area is considered to contain high archaeological potential.
- The works involve placement of dredged sand with a proposed volume of up to 2,400,00 m^3.
- The potential impacts to the archaeological resource is considered to be dumping of dredged material directly onto delicate sites and sediment accretion as the dumped sand moves with the tides and general water movement.

7.1 Recommendations

Based on the above findings it is recommended that the following steps be undertaken:

7.1.1 *Review of 2021 Remote sensing data and diver survey*

At the time of finalising the report, the data for the 2021 remote sensing and hydrographic surveys was not available to contribute to this desktop assessment. The purpose of the review is to identify anomalies and known wreck sites within the study area. Identified targets should be dived on by a qualified maritime archaeologist to record each site. Such recording would include:

c) Development of a site plan to provide a baseline for comparison in the future.

d) High definition video and photography to record the current condition of the site and any identifying features to assist in identification if required.

If the anomaly is determined to be a shipwreck then a wreck report will be developed including scantlings and other identifying features to potentially attribute a site to a vessel.

Placement of buffer zones around known underwater sites within the sand placement area.

Buffer zones should be placed around exposed maritime archaeological sites to avoid have dredged material directly overhead and crushing or destabilising them. These sites include *Durisdeer* and *Berbice*. Other maritime sites within the sand placement area may require the same buffer as determined by the remote sensing and diver survey. The diameter of these zones should be 50 m so as to avoid direct impacts to delicate sites.

Apply for a permit to impact underwater cultural heritage under the UCHA Act 2018.

This permit can be applied online through the Australasian Underwater Cultural Heritage Database (AUCHD) managed by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

While the overall impact of the works is likely to not be negative, the exposed wrecks may still experience impacts from either accretion or erosion resulting from the works.

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ANNEX A – NSW MARITIME HERITAGE DATABASE: SHIPWRECKS

NSWMHD ID	Name	Year Lost	Vessel Type	Where Lost	Status
96	*Alice*	1836	Brig	Newcastle sandspit	Refloated
97	*Alice*	1861	Schooner	Newcastle, Nobbys Head	Wrecked, not found
99	*Alice*	1901	Schooner	Newcastle, Stockton Beach	Wrecked, not found
101	*Alice*	1927	Iron hulk	Morna Point	Found
18	*Active*	1852	Wooden ketch	Hunter River Entrance	Wrecked, not found
19	*Active*	1898	Wooden ketch	Newcastle, near Colonist	Wrecked, not found
11	*Ada*	1897	Wooden ketch	Newcastle, Oyster Bank	Wrecked, not found
22	*Adderley*	1897	Barquentine	Stockton, south of Morna Point	Refloated?
33	*Adeline*	1898	Steamer	Newcastle Harbour, South Side	Collision, refloated
36	*Adolphe*	1904	Barquentine	Newcastle, Oyster Bank	Found
39	*Advance*	1908	Tug	Off Catherine Hill Bay	Found
54	*Afghan*	1889	Steamer	Dyke, Newcastle Harbour	Refloated
55	*Age*	1899	Steamer	Near Catherine Hill Bay	Refloated
56	*Agnes*	1860	Cutter	Newcastle Bight	Wrecked, not found
66	*Ajax*	1928	Steamer	Walsh island	Abandoned, found
83	*Alexander and John*	1849	Schooner	Newcastle, Nobbys Head	Wrecked, potentially dismantled
95	*Alhambra*	1888	Steamer	Newcastle, near Nobbys Head	Wrecked, not found
1726	*Ann*	1856	Schooner	Newcastle, Oyster Bank	Wrecked, not found
1732	*Anna Maria*	1851	Schooner	Newcastle Bight	Wrecked, not found
1750	*Architect*	1859	Schooner	Disappeared off Newcastle	Wrecked, not found
1756	*Arthur*	1866	Ketch	Newcastle Bight	Wrecked, not found
1803	*Bell Bird*	1897	Ketch	Cape Hawke, bar	Wrecked, not found
-	*Bell Flower*	1904	Ketch	Breakwater	Refloated
1815	*Ben*	1881	Ketch	Disappeared of Newcastle	Wrecked, not found
1819	*Bengal*	1872	Barquentine	Off Newcastle	Wrecked, not found
1821	*Berbice*	1888	Ship	Stockton Beach	Wrecked, found
1827	*Bessie Maud*	1898	Schooner	Newcastle Harbour	Refloated
1840	*Blue Bell*	1934	Ferry steamer	Newcastle	Refloated

NSWMHD ID	Name	Year Lost	Vessel Type	Where Lost	Status
1841	*Blue Gum*	?	?	?	MSB list of vessels
1843	*Boatman*	1901	Lighter	Newcastle Harbour, near Crane Number 12	Wrecked, not found
1846	*Bonnie Dundee*	1879	Steamer	Swansea Heads, Newcastle	Wrecked, found
1854	*Boyd*	1812	Schooner	Stockton Beach	Wrecked, not found
1864	*Britannia*	1869	Schooner	Morna Point	Wrecked, not found
1877	*Bungaree*	1866	Paddle steamer	Stoney Point	Refloated
1881	*Burnett*	1869	Brig	One mile off Newcastle	Wrecked, not found
1900	*Canmore*	1854	Schooner/brig	Nobbys Head Newcastle	Wrecked, not found
1915	*Carrington*	1835	Schooner	Wreckage found at Port Stephens but could have wrecked at Nobbys Head	Wrecked, not found
1928	*Cawarra*	1866	Steamer Paddle	Newcastle, Oyster Bank	Wrecked, found
1936	*Ceylon*	1834		Beached near Newcastle	Wrecked, not found
1940	*Champion*	1877	Lighter	Hunter River Entrance	Wrecked, not found
1946	*Chance*	1857	Ketch	Newcastle, Oyster Bank	Wrecked, not found
1952	*Charlotte*	1827	Sloop	6 miles north of Newcastle	Wrecked, not found
1449	*Fitzroy*	1897	Steamer	Morna Point	Wrecked, found
1165	*Irresistible*	1931	Steamer	6 miles NE Newcastle	Scuttled
67	*Charlotte*	1833	Unknown	Off the coast of Newcastle	Wrecked, not found
1964	*Cific*	1923	Steamer	Off the coast of Newcastle	Wrecked, not found
1973	*Clara*	1874	Unknown	On reef south of Nobbys	Wrecked, not found
1993	*Colleen Bawn*	1877	Ketch	Between Sydney and Port Stephens	Wrecked, not found
1633	*Colonist*	1889	Steamer	Northern breakwater Newcastle	Wrecked, found
1639	*Comet*	1866	Schooner	Newcastle Bight	Wrecked, not found
1642	*Commodore*	1931	Paddle steamer	3 miles east Nobbys Head	scuttled
1646	*Concord*	1867	Ketch	Morna Point	Wrecked, not found
1648	*Condong*	1896	Schooner	Morna Point	Wrecked, not found
1652	*Coolebar*	1949	Steamer	North Stockton	Removed 1954-1958
1667	*Cumberland*	1862	Schooner	Newcastle, 2 miles off	Wrecked, not found
1698	*Darius*	1908	Steamer	Newcastle Pinnacle Rocks	Refloated

NSWMHD ID	Name	Year Lost	Vessel Type	Where Lost	Status
****	*Davenport*	1943	Steamer	Oyster Bank towed out to sea	Wrecked, not found
1558	*Day Spring*	1871	Barquentine	70 miles east of Newcastle	Wrecked, not found
1562	*Delight*	1838	Cutter	Hunter River Entrance	Wrecked, not found
1579	*Doorebang*	1873	Steamer	Between Stony Point and Nobbys Head	Wrecked, not found
1591	*Dundee*	1808	ship	Newcastle, Oyster Bank	Wrecked, not found*
1594	*SV Durisdeer*	1895	Barque	Newcastle, Stockton Beach	Wrecked, found
3888	*Edith*	1893	Water tank	Newcastle Harbour	Refloated and repaired
1617	*Elaine*	1914	Steamer	Stockton Riverbank	Decayed, not found
1618	*Elamang*	1905	Hulk	Northern breakwater	Scuttled
1621	*Eleanor Lancaster*	1856	ship	Newcastle, Oyster Bank	Wrecked, not found
1622	*Electra*	1909	Steamer	Stockton beach	Grounded, refloated
1480	*Eliza Appleton*	1853	Brig	Newcastle, Oyster Bank	Wrecked, not found
1478	*Eliza Harriet Simpson*	1856	Ketch	Newcastle, Red Bank	Wrecked, not found
	Elizabeth Henrietta	1825	Brig	Newcastle, Nobbys Head	Wrecked, not found
1525	*Emily*	1919	Launch	Newcastle, Stockton Beach	Wrecked, not found
1510	*Emily & Mary*	1892	Ketch	Newcastle, Nobbys Head	Wrecked, not found
1530	*Ena*	1933	Schooner	Newcastle, North Stockton	Wrecked, not found/refloated?
1532	*Endeavour*	1817	Schooner	Newcastle, Nobbys Point	Wrecked, not found*
1546	*Esperanza*	1868	Brig	Newcastle, Bird Island	Wrecked, not found
1550	*Estramina*	1816	Schooner	Newcastle, Oyster Bank	Wrecked, not found*
1362	*Fanny*	1853	Brig	Newcastle, Oyster Bank	Wrecked, not found
1439	*Fido*	1898	Barquentine	Newcastle, Red Head	Wrecked, not found
1449	*Fitzroy*	1897	Steamer	Newcastle, Morna Point	Wrecked, found
1471	*Fox*	1864	Schooner	Newcastle, north shore	Wrecked, not found
1472	*Francis*	1805	Schooner	Newcastle, north of 1805 entrance	Wrecked, not found*
1328	*Frederick*	1854	Schooner	Newcastle, Oyster Bank	Wrecked, salvaged
1331	*Frederick Griffiths*	1860	Schooner	Newcastle, Nobbys Head	Wrecked, not found

NSWMHD ID	Name	Year Lost	Vessel Type	Where Lost	Status
1347	*Gazelle*	1860	Schooner	Newcastle, ashore near lighthouse	Wrecked, not found
1360	*Gilbert Jamieson*	1859	Brigantine	Newcastle, Nobbys Head	Wrecked, not found
1380	*Goolwa*	1919	Paddle Steamer	Hunter River, south arm entrance	Wrecked, found
1384	*Governor Arthur*	1829	Cutter	Newcastle, Nobbys Head	Wrecked, not found*
1388	*Governor King*	1806	Cutter/Schooner?	Newcastle, near wreck of *Francis*	Wrecked, not found*
1249	*Harriet*	1844	Schooner	Some distance off Newcastle	Wrecked, not found
139	*Heather Bell*	1972	Barque	Hunter River	Decayed, found
1264	*Hebe*	1893	Brig	Newcastle Bight, 4miles west of Morna Point	Wrecked, not found
1271	*Helen S Page*	1868	Barque	North Shore Beach, Newcastle	Wrecked, not found
1283	*Herculean*	1863	Schooner	Newcastle, Nobbys Head	Wrecked, not found
1309	*Hunter*	1856	Schooner	Newcastle, north beach	Wrecked, not found
1209	*Ino*	1870	Ketch	Newcastle, north shore beach	Refloated
1241	*Islander*	1870	Sloop	Newcastle	Wrecked, not found
92	*Jean*	1855	Brig	Newcastle Harbour	Possibly refloated
1197	*Jessie*	1869	Schooner	Newcastle, Oyster Bank	Wrecked, not found
1215	*Jonathan*	1891	Ketch	Newcastle, Oyster Bank	Wrecked, not found*
1216	*Jones Brothers*	1905	Schooner	Newcastle Harbour Entrance – near Adolphe	Wrecked, not found
1217	*Joseph Weller*	1837	Schooner	Newcastle, north beach near entrance	Wrecked, not found
1221	*Josephine*	1943	Yacht	Morna Point	Wrecked, not found
1222	*Joyron*	1937	Launch	South of Newcastle	Wrecked, not found
1074	*Karuah*	1909	Steamer	Stockton Beach	Refloated
1079	*Kate Tatham*	1907	Schooner	North Stockton	Stranded
1082	*Katoomba*	1905	Steamer	Newcastle, north breakwater	Wrecked, found
1095	*King William IV*	1839	Paddle Steamer	Newcastle, Nobbys Island	Wrecked, not found
1108	*Kuring Gai*	1930s	Steamer	Hexham Newcastle	Abandoned
1155	*LTV MK4*	1954	Amphibious Landing Vehicle	Newcastle, Stockton Beach	Wrecked, found
1132	*Laura*	1869	Ketch	Stockton Beach Newcastle	Wrecked, not found

NSWMHD ID	Name	Year Lost	Vessel Type	Where Lost	Status
1145	*LF71*	1937	Motor Launch	Newcastle Nobbys Head	Wrecked, not found
1154	*Lillian*	1878	Ketch	Stony Point	Refloated
988	*Lilly*	1885	Steamer	Morna Point	Wrecked, not found
991	*Lindus*	1899	Steamer	Newcastle, Oyster Bank on top of *Colonist*	Wrecked, found
992	*Lion*	1857	Schooner	Nobbys Head	Refloated
995	*Lismore*	1866	Brigantine	Newcastle, Oyster Bank	Refloated?
1017	*Lovet Peacock*	1879	Schooner	Newcastle, North Shore Beach	Wrecked, not found
1020	*Lubra*	1920	Steamer	Catherine Hill Bay	Wrecked, found
1013	*Lydia M Child*	1943	Liberty Ship	145 m eat of Newcastle	Torpedoed, not found
1046	*Maianbar*	1940	Steamer	Newcastle, Nobbys Head	Wrecked, found
1059	*Manhegan*	1882	Barquentine	Newcastle Harbour	Refloated
1065	*Mareeba*	1908	Steamer	Stockton Beach	Wrecked, found
1068	*Margaret*	1860	Schooner	Newcastle, Oyster Bank	Wrecked, not found
1072	*Margaret Chessel*	1879	Schooner	Newcastle, north beach ashore	Wrecked, not found
912	*Maria Theresa*	1856	Schooner	Somewhere north of Newcastle	Wrecked, not found
919	*Mars*	1826	Sloop	Newcastle, 5 miles north of harbour	Wrecked, not found*
926	*Mary*	1873	Schooner	Newcastle, 10-12 mls SE	Wrecked, not found
945	*Mary Grant*	1878	Brig	Newcastle, 10-14 mls north	Wrecked, not found
949	*Mary Lloyd*	1874	Cutter	Newcastle, Nobbys Head	Wrecked, not found
961	*May*	1887	Ketch	Newcastle Harbour, near no. 2 crane	Wrecked, not found
971	*Merksworth*	1898	Steamer	Newcastle, off Stockton Beach	Wrecked, not found
967	*Meeinderry*	1922	Steamer	Beached near the breakwater	Refloated?
972	*Merlin*	1898	Ketch	Morna Point	Refloated
975	*Merry Days*	1912	Launch	Near Newcastle	Wrecked, not found
977	*Messenger*	1869	Schooner	Newcastle, Nobbys Head	Wrecked, not found
839	*Monitor*	1834	Cutter	Newcastle, near ashore	Wrecked, not found
44	*Mud Barge*			Newcastle, off	Scuttled, found*
877	*Nancy*	1869	Schooner	Newcastle, north beach	Wrecked, not found

NSWMHD ID	Name	Year Lost	Vessel Type	Where Lost	Status
886	*Nautilus*	1816	Brig	Newcastle, Oyster Bank	Wrecked, not found*
887	*Nautilus*	1866	Barquentine	Newcastle, Nobbys Head	Wrecked, not found
892	*Nereid*	1825	Cutter	Newcastle, 100 mls north?	Wrecked not found*
904	*Norfolk*	1800	Sloop	Newcastle, Stockton Beach	Wrecked, salvaged
749	*Numba*	1878	Ketch	Morna Point 1.5 miles off	Wrecked, not found
765	*Oimara*	1903	Barquentine	Morna Point	Wrecked, Found
775	*Orient*	1866	Schooner	Newcastle, North Beach	Wrecked, not found
776	*Oriti*	1869	Schooner	Newcastle, Stockton Beach	Wrecked, not found
782	*Osprey*	1931	Steamer	Newcastle, 5 mls east	Wrecked/scuttled, not found
783	*Otago*	1867	Schooner	Newcastle	Wrecked, not found
2695	*Pasha Bulker*	2007	Bulk Carrier	Nobbys Head	Wrecked, refloated
3865	*Paterson*	1901	Steam punt	Nelson Bay	Wrecked, refloated
802	*Paterson Packet*	1859	Cutter	Newcastle, Nobbys Head	Wrecked, not found
670	*Phantom*	1860	Brig	Newcastle, Oyster Bank	Wrecked, not found
674	*Phoebe Dunbar*	1864	ship	Newcastle, Stockton	Wrecked, not found
680	*Pilot*	1849	Schooner	Newcastle, Nobbys Head	Wrecked, refloated?
723	*Priscilla*	1837	Cutter	Newcastle, Oyster Bank	Wrecked, refloated?
724	*Prospector*	1884	Barquentine	Newcastle Harbour	Wrecked, not found
589	*Ranger*	1891	Schooner	Newcastle, Stockton Beach	Wrecked, not found
602	*Recovery*	1816	Sloop	Near Port Stephens	Wrecked, not found*
999	*Redpole*	1834		Newcastle, off River entrance	Wrecked, not found
604	*Regent Murray*	1899	Barquentine	Newcastle, Oyster Bank	Wrecked, found
615	*Resource*	1814	Schooner	Off Newcastle	Wrecked, not found*
2799	*Rho*	1924	Lighter	Newcastle Harbour	Wrecked, not found*
622	*Rialto*	1870	Barquentine	Newcastle, North Beach	Wrecked, not found
625	*Richmond*	1934	Dredge	Off Newcastle	Scuttled, not found*
633	*Rob Roy*	1838	Schooner	Newcastle, Nobbys Head	Wrecked, not found
638	*Roderick Dhu*	1866	Schooner	Newcastle Bight	Wrecked, not found
655	*Rover*	1856	Schooner	Newcastle, Oyster Bank	Wrecked, not found
658	*Ruby*	1894	Schooner	Newcastle Bight	Wrecked, not found

NSWMHD ID	Name	Year Lost	Vessel Type	Where Lost	Status
660	*Runette*	1947	Launch	Newcastle	Wrecked, not found
3946	*Sam Pan*	1936	Yacht	Big Ben Reef Newcastle	Wrecked, not found*
45	*Santa Cruz*	1883	Ketch	Newcastle Breakwater	Wrecked, refloated
525	*Sarah Wilson*	1848	Brigantine	Newcastle Nobbys Head	Wrecked, not found
528	*Saturn*	1890	Ketch	Newcastle, Stockton Beach	Wrecked, not found
531	*School Boy*	1881	Barquentine	One mile beach	Wrecked, not found
540	*Sea Gull*	1876	Ketch	Newcastle Nobbys Head	Wrecked, not found
541	*Sea Gull*	1866	Schooner	Off Newcastle lighthouse	Wrecked, not found
544	*Sea Nymph*	1856	Brig	Newcastle, 7 mls north	Wrecked, not found
	Seagull II	1926	Steamer	Newcastle, Stockton Beach	
553	*Shamrock*	1889	Ketch	Port Stephens 13 mls south	Wrecked, not found
555	*Shamrock*	1861	Schooner	Newcastle, Oyster Bank	Wrecked, not found
559	*Sir David Ogilby*	1840	Schooner	Newcastle, north spit	Wrecked, not found
572	*Sophia*	1826	Schooner	Newcastle, Oyster Bank	Wrecked, not found*
576	*Southland*	1876	Paddle Steamer	Newcastle, offshore	Wrecked, found
582	*Speculant*	1859	Schooner	Newcastle Bight	Wrecked, not found
439	*Star of Peace*	1864	Schooner	Newcastle, north beach	Wrecked, not found
187	*Storm Cock*	1930	Steamer	Off Newcastle	Wrecked, not found
455	*Surprise*	1874	Schooner	Newcastle, Oyster Bank	Wrecked, not found
458	*Surprise*	1805	Sloop	Newcastle, 2 mls north	Wrecked, not found*
463	*Susan Gilmore*	1884	ship	Newcastle, Susan Gilmore Beach	Wrecked, found/not found
467	*Sussane Godeffroy*	1880	ship	North of Newcastle	Wrecked, not found
468	*Susie*	1891	Schooner	South of Port Stephens	Wrecked, not found
475	*Swansea*	1916	Ketch	Newcastle Harbour	Wrecked, not found
481	*Sygna*	1974	Bulk Carrier	Newcastle Stockton Beach	Wrecked, Found
484	*Sylvan*	1924	Steamer	Newcastle, near Stockton Hospital	Wrecked, Found
2754	*Tamboi Queen*	1976	Cruiser	Newcastle, Nelson Bay	Wrecked, refloated
373	*Tory*	1853	Barquentine	Newcastle, 18 miles north of	Wrecked, refloated
376	*Transport*	1888	Brig	Newcastle, Stockton Beach	Wrecked, not found
385	*Trimmer*	1805	Sloop	Near Newcastle	Wrecked, not found*

NSWMHD ID	Name	Year Lost	Vessel Type	Where Lost	Status
2496	*Triumph*	1854	Schooner	Hunter River, coal channel	Sunk, refloated
129	*Unidentified*	1890	Barge	½ mile off Nobbys Head	Noted in newspaper
264	*Unidentified*	1835		Newcastle, Stockton Beach	Noted in newspaper
2732			Fixed wing aircraft	Newcastle, Stockton Beach	No source, no info
2707	*Unidentified – Hunter River Hexham 1*			Hunter River Newcastle	Wrecked, found`
2708	*Unidentified – Hunter River Hexham 2*			Hunter River Newcastle	Wrecked, found`
2748	*Unidentified - Stockton Beach Trawler*	2015	Fishing Trawler	Newcastle Breakwall	Wrecked, found
2544	*Unidentified – Birubi Beach Anna Bay Stockton Bight*			Birubu Beach Stockton Bight	Wrecked, found
3844	*Unidentified – Hunter River North Arm 2*			Hunter River	Wrecked, not found*
2485	*Unidentified – Hunter River North Arm 5*			Stockton off Fullerton St	Wrecked, found`
2517	*Unidentified Stockton Beach Wreckage*				Wrecked, found
290	*Unit*	1938		Newcastle	Wrecked, not found
291	*Unity*	1907	Steamer	Newcastle, Stockton Beach	Wrecked, not found
292	*Unity*	1862	Ketch	Newcastle, Nobbys Head	Wrecked, not found
293	*Unamed silt punt*	1890	Lighter	Newcastle, Nobbys Head	Wrecked, not found
294	*Uralla*	1928	Steamer	Newcastle, Stockton	Wrecked, found
313	*Victor*	1866	Brig	Newcastle, Nobbys Head	Wrecked, not found
329	*Vixen*	1858	Brigantine	Newcastle, Nobbys Head	Wrecked, not found
332	*Vulcan*	1837	Sloop	Newcastle, entrance to Hunter River	Wrecked, not found
341	*Wallamba*	1923	Steamer	Point Stephens near Burubu Point	Wrecked, found
342	*Wallarah*	1914	Steamer	Catherine Hill Bay	Wrecked, found

NSWMHD ID	Name	Year Lost	Vessel Type	Where Lost	Status
196	*Waratah*	1864	Schooner	Newcastle, off	Wrecked, not found
200	*Waterwitch*	1854	Brig	Newcastle, Oyster Bank	Wrecked, not found
202	*Wave*	1850	Schooner	Newcastle Bight	Wrecked, not found
207	*Wendouree*	1898	Steamer	Newcastle, Oyster Bank	Wrecked, found
210	*Western Star*	1904	Brig	Off Newcastle	Wrecked, not found
214	*White Bay*	1928	Steamer	Stockton Bight	Wrecked, not found
233	*William Watson*	1866	Barquentine	Newcastle, north shore	Wrecked, not found
235	*Williams*	1922	Steamer	Stockton Bight	Wrecked, not found
238	*Windhover*	1874	Brig	Off Newcastle	Wrecked, not found
	WST1	1945	Motor vessel	Susan Gilmore Beach	
257	*Yarra*	1874	Schooner	Newcastle, North Beach	Wrecked, not found
260	*Yarra Yarra*	1877	Paddle Steamer	Newcastle, Stockton Bight	Wrecked, found
261	*Young Budgaree*	1885	Steamer	Newcastle	Wrecked, not found
	Yua Wha	1947	Motor vessel	Newcastle, 8 miles south	
115	*Zone*	115	Brigantine	Newcastle Bight	Wrecked, not found

- * Denotes a wreck site that has not been found but has location data in the database
- ` Denotes a wreck site that has been identified using Google Earth

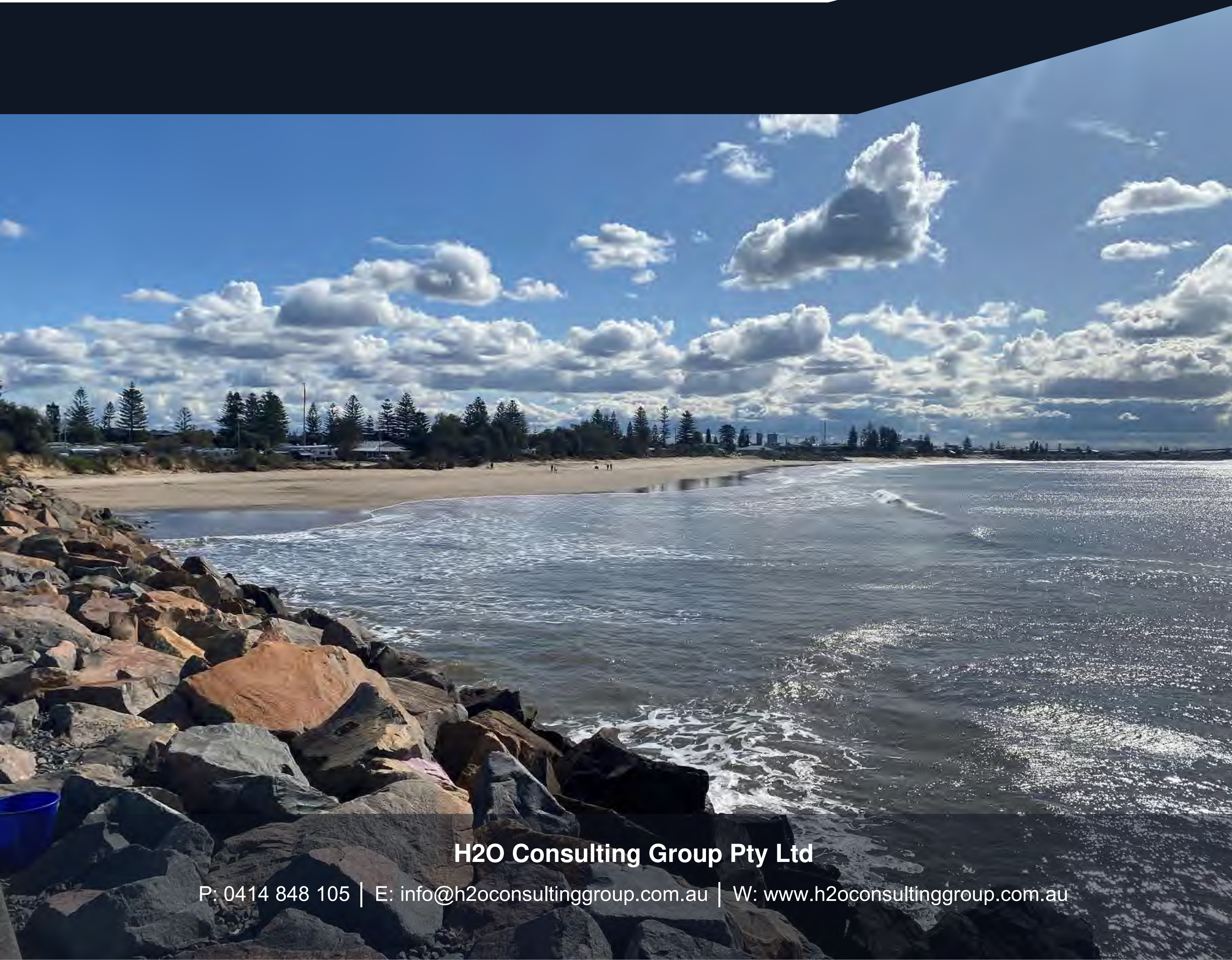
Appendix E: Biodiversity Assessment

Aquatic Ecology Assessment

Stockton Beach Nourishment

Prepared For: Bluecoast Consulting Engineers

Report Date: 15 December 2022



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Cover Photo: Stockton Beach, Newcastle, NSW.

Executive Summary

H2O Consulting Group has been engaged by Bluecoast Consulting Engineers, on behalf of the City of Newcastle, to prepare an Aquatic Ecology Assessment for a Stockton Beach Nourishment Program (the project) at the southern end of Stockton Beach. Stockton Beach is located on the Hunter Coast of NSW, at the southern end of Stockton Bight. At the southern end of Stockton Beach shoreline erosion has progressed beyond the extents of historical cycles, with erosion now having considerable impacts on beach amenity and coastal assets.

The adopted coastal management strategy emerging from the Extended Stockton program involves mass nourishment to restore the sandy buffer and regular and on-going sand top-ups to maintain the buffer. This approach seeks to restore the natural supply of sand to the Stockton sediment compartment. It is expected an initial mass nourishment of Stockton Beach of 2,400,000 m^3 will be required over a 2,800m stretch of beach from the northern breakwater and up to a point 800m north of Meredith Street.

Nourishment processes have the potential to result in a number of environmental impacts in aquatic environments, including physical (changes to wave refraction, beach impacts and burial of shipwrecks and reefs), and ecological (e.g. burial of reefs, disturbance of habitats, smothering of species, change to native biota) impacts. Disturbances associated with nourishment works generally have the largest biological impact on infauna and macroinvertebrates that live amongst the sand grains. The surf zone and nearshore areas also provide habitat for various marine fishes, sharks and rays as well as marine reptiles, mammals and birds, some of which may include threatened and migratory species.

As part of this assessment desktop works included threatened species searches and review of existing ecological mapping. Site investigations included sampling of sediments along the shoreline for infauna and macroinvertebrates and descriptions of shoreline, intertidal and subtidal habitats to determine their ecological significance and potential habitat value for threatened and migratory species, which may occur in the locality.

Desktop searches identified that 93 shorebirds and marine birds, ten marine mammals, five marine reptiles, nine sharks and rays, and four fish listed as threatened or migratory that may occur in the locality, which will require consideration as part of this assessment. In addition, these searches identified one threatened ecological community to occur nearby. The review of existing mapping identified that the Project Area is also in close proximity to the Hunter Estuary RAMSAR wetland. Site investigations that included sampling for infauna and macroinvertebrates found the sediments along the shoreline within the Project Area to be deprived of almost all fauna. The seawall also provided some intertidal hard substrata habitat for colonisation by algae and various common marine invertebrates. In deep subtidal parts of the Project Area, site observations and review of various data sources indicated that the majority of subtidal habitat was limited to marine sands, with some scattered occurrences of hard substrata habitat provided by isolated debris fields that appear associated with maritime archaeological sites.

The impact assessment identified that the direct impacts from this proposal will include disturbance of soft sediment intertidal and subtidal areas that provide habitat for small invertebrates that live amongst the sediment, which will likely be smothered or buried. Given that the intertidal and shallow subtidal sediments appear to be very deprived of fauna as a result of the ongoing erosion, these impacts will be greatest in deeper subtidal areas of the Project Area. Impacts on hard substrata habitats are expected to be minimal and confined to isolated occurrences within the Project Area. The Project Area does not provide any critical habitat for any threatened or migratory marine species or shorebirds. Impacts on marine species and shorebirds will likely be minimal and confined to disturbances to marginal foraging habitat during

nourishment works, which may include, additional vessel operations, some construction noise, reduced water quality and potential alterations in prey/food source regimes. Other potential impacts include risks associated with habitat change, or alteration as a result of changes to the natural sediment size composition of these soft sediment habitats, and the sourcing of sediments with elevated risks of contaminants, debris and potential for introduced marine pest species. The preferential use of clean offshore sources of sand for the nourishment works would minimise many of these risks that may be elevated with use of some onshore and/or estuarine sources of sediment.

To manage the potential risks that this proposal may pose to marine habitat, flora and fauna, a series of recommendations have been provided. These recommendations should be adopted into the CEMP for construction works for this proposal. With adoption of these recommendations, the proposal is considered unlikely to have a significant impact on State and/or Commonwealth listed threatened aquatic biodiversity. As such, referral to the Department of the Environment under the EPBC Act is not required. Similarly, the preparation of a Species Impact Statement (SIS) based on the provisions of the BC and FM Act should not be required

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1 Background

1.1 Overview

H2O Consulting Group has been engaged by Bluecoast Consulting Engineers, on behalf of the City of Newcastle (CN), to prepare an Aquatic Ecology Assessment (AEA) for a Stockton Beach Nourishment Program (the project) at the southern end of Stockton Beach. Historical analysis at Stockton suggests a cyclic nature of beach erosion and recovery. In recent years, however, erosion has progressed beyond the extents of historical cycles, with erosion now having considerable impacts on beach amenity and coastal assets. The Stockton CMP (Royal Haskoning DHV, 2020), identifies large scale (mass) sand nourishment as the only technically feasible solution that sustainably meets Council's and the community's objectives of asset protection and beach amenity over the long term. Mass nourishment, with a 10 yearly renourishment period, would likely provide adequate coastal protection to eliminate the need for coastal protection structures beyond the immediate term (Bluecoast Consulting Engineers 2022).

This report provides supporting information for the Review of Environmental Factors (REF) that is being prepared to assess the potential for environmental impacts from the proposed beach nourishment works at Stockton Beach. Under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), CN is required to undertake an REF to identify and consider the likely environmental impacts of the proposed beach nourishment activities and to consider the appropriate level of environmental assessment required. For the purposes of the proposal, City of Newcastle (CN) is the proponent and the determining authority under Division 5.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The AEA forms part of a larger REF being prepared by Bluecoast Consulting Engineers for the project.

1.2 Locality and Site

Stockton Beach is located on the Hunter Coast of NSW, within the Local Government Area of the City of Newcastle (Figure 1). The beach is defined as the southern end of Stockton Bight, also known as Newcastle Bight. Stockton Beach is the longest beach in NSW, extending approximately 32 km in length and is bounded by Birubi Point to the north, and the mouth of the Hunter River Estuary to the south. The lower reaches of the Hunter River Estuary form the entrance channel to the Port of Newcastle and is protected by both a northern and southern breakwater. The channel provides an important means of passage to the Port of Newcastle, which is recognised as a major economic centre for both the Hunter Region and NSW (Worley Parsons, 2009). Stockton Beach is located directly north of the entrance channel, adjacent to the northern breakwater of the harbour channel.

1.3 Description of the Proposal

CN's adopted coastal management strategy emerging from the Extended Stockton program involves mass nourishment to restore the sandy buffer and regular and on-going sand top-ups to maintain the buffer. This approach seeks to restore the natural supply of sand to the Stockton sediment compartment (Bluecoast Consulting Engineers 2022).

The sand placements would act to restore and maintain the volume of sand in the active coastal profile observed in the early 1990's. Given historical sand movements are reasonably well understood, there would be a high degree of confidence in the fate and longevity of the nourishment material. There would likely be some initial period of enhanced sand loss as the system adjusts to the mass nourishment. After which and assuming no material change in the wave climate, sand placed in the south would be expected to move northward at the natural transport rate, providing ongoing supply of sand to the northern CMP.

The key design features of the concept design are provided in Table 1 and the concept design drawings are provided in Appendix 1.

Table 1: Key design parameters for amenity nourishment concept sand placements

Design parameter	Description
Mass nourishment volume	An initial mass nourishment of Stockton Beach of 2,400,000m^3 within the footprint shown in Figure 1. In line with the Stockton CMP, the target morphology for mass nourishment sand placements is guided by nature in that it is based on the coastal profile observed at Stockton in the 1990s, when the southern compartment had a greater volume of sand. The CMP states that in consideration of the average annual rate of sand loss (i.e., 146,000m^3/year), placement of 2.4M m^3 of sand to the southern compartment will revert the coastal profile back in time around 22-years. If 2020 is selected as the pre-nourishment beach, then around 1998 is representative of a post-nourishment beach.
Annual maintenance volume	Sand top-ups at a rate equivalent to the long-term sand loss rate at Stockton (estimated to be 112,000 m^3) following the initial mass nourishment. Sand placements to top up the sand buffer would be undertaken on an approximately annual basis and in perpetuity (or until an alternative strategy is implemented).
Alongshore extent	Sand placement over a 2,800m stretch of beach from the northern breakwater and up to a point 800m north of Meredith Street. The CMP identified this area as being most vulnerable to coastal hazards.
Cross shore extent	Full active coastal profile down to the depth of sand movements in moderate storm events, i.e., approximately -10m below AHD. Like the nourishment on the upper beach, the additional sand on the lower profile would provide a protective buffer against storm erosion.
Sediments	Clean marine sand is to be selected for beach nourishment. Sediments should be similar in grain size (or slightly coarser) and similar in colour to native beach material. The source material compatibility (i.e. contamination level and proportion of fines) needs to be assessed as per the current and relevant sand management guideline. Stockton Beach Sand Management Guideline (RHDHV, 2020) is the applicable guideline to assess compatibility.
Sources of sediments	Provided compliance with the Sand Management Guidelines (RHDHV, 2020), nourishment sand could come from a range of possible sources including: offshore, Hunter River or other opportunistic sources. Please refer to section Terrestrial sand supply is excluded on cost and acceptability basis.
Placement methods	Placement of sand would essentially be undertaken by marine means, with exception temporary land-based structures/ machinery on the beach. The placement methods would depend on the volumes, sand source and the executing contractor work method. Mass nourishment requires the delivery of large volumes of material and favours full 'profile nourishment'. Placement methods may typically include one or several of the following methods: • Pumping ashore to nourish the visible beach • Rainbowing to nourish the surf zone • Bottom dumping to nourish the nearshore Placement by trucks is excluded on cost and acceptability basis.

Source: Bluecoast Consulting Engineers 2022

1.4 Background Information

Stockton Beach has the largest active dune system in Australia, one of the highest wave energy beaches in NSW and a beach that transitions from highly developed in the south, to natural along its central and northern sections (Bluecoast Consulting Engineers, 2020). It is a beach that is impacted by naturally occurring coastal processes, including waves, tides, river flows and wind, as well as human induced modifications, all of which result in a complex and dynamic system, with considerable sand movement (Bluecoast Consulting Engineers, 2020).

There is a well-documented history of erosion and sand loss at Stockton Beach, with historical analysis indicating a cyclic nature of beach erosion and recovery, typically triggered by storms. In more recent times, however, erosion has progressed beyond the extents of historical cycles, with the underlying cause of erosion attributed to a persistent net loss of sand from southern Stockton Beach (Bluecoast Consulting Engineers, 2020). This continual erosion is now impacting on beach amenity and coastal assets, resulting in the declaration of Stockton Beach as a 'Significant Open Coast Location' or coastal erosion 'hot spot' by the NSW Government (Bluecoast Consulting Engineers, 2020).

Volumetric analysis of historical topographic and bathymetric surveys identified the rate of sand loss from the full coastal profile within the southern embayment of Stockton Beach, to be an estimated 146,000 m^3 /year (25%) with a nett sand loss rate of 112, 000 – 121, 000 m^3/ year (Bluecoast Consulting Engineers, 2020). This rate is far greater than that previously estimated, with significant implications for the ongoing management of the coastal erosion and potential further loss of assets, if left unmitigated. Large scale (mass) sand nourishment has been identified as the preferred solution that sustainably meets Newcastle Council and the community's objectives of asset protection and beach amenity over the long term (Royal Haskoning DHV, 2020), with the project designed to return amenity and access to the Stockton coastal zone, while also establishing a sand protection buffer between the ocean and public assets, avoiding the need to build a structure line of defence.

The volumes of nourishment required to achieve coastal protection at Stockton are estimated in the range of 1.8 million to 4.5 million m^3, depending on source and nourishment period (Royal Haskoning DHV, 2020). Regular (ongoing) beach nourishment activities, as part of the Port of Newcastle's navigation channel maintenance dredging program have been occurring within the Study Area since 2009, with an annual average of 34, 000m^3 of sand placed within shallow (~ -8m) nearshore habitat in front of the Mitchell Street seawall (Bluecoast Consulting Engineers, 2022). Models suggest the sand placement site is dispersive in nature, with the bulk of the transport occurring onshore, and the remainder of sediments moving alongshore, in a net northerly movement, depending on the prevailing wind conditions at the time of placement. An additional pilot campaign, undertaken in December 2019, placed 3,500m^3 of sand from terrestrial quarries onto the subaerial beach in front of the Holiday Park (Royal Haskoning DHV, 2020). Post-nourishing monitoring, however, suggested that most of the placed material was lost from the subaerial beach within a six week period. Grain size from terrestrial sources was also found to be less compatible than those of marine sands.

Nourishment processes have the potential to result in a number of environmental impacts in aquatic environments, including physical (changes to wave refraction, beach impacts and burial of shipwrecks and reefs), and ecological (e.g. burial of reefs, disturbance of habitats, smothering of species, change to native biota) impacts. Few studies, specific to the NSW coast and it's unique ecology exist, however, with much of the available literature relating to impacts, consisting of a generic or international nature (Carley and Cox, 2017).

Short-term ecological impacts may include factors such as the direct burial or smothering of biota, lethal or damaging doses of turbidity, and direct damages to habitat and/or species as a result of equipment used during the nourishment process. Whilst long-term impacts may include changes to the natural state of a beach including profile and gradient, prolonged periods of turbidity affecting light penetration; and altered sediment composition, which may affect the native biota that occur within an area (Carley and Cox, 2017).

Beach nourishment generally has the largest biological impact on infauna and macroinvertebrates that live amongst the sand grains, where at the nourishment site this group of fauna is buried and crushed by the replacement sand and machinery used to spread and shape the sand along the beach. Changes in sand particle size has potential to influence critical habitat properties for this group of fauna (Marks 2017) and result in a functionally degraded habitat through the nourishment process (Peterson and Bishop 2005). Research indicates that these impacts are intensified with the use of coarser sediments for nourishment and/or where the sediments used do not resemble the pre-nourished conditions of the site (Vanden Eede et al. 2014).

The surf zone and nearshore areas provide habitat for various marine fishes, sharks and rays as well as marine reptiles, mammals and birds. Many of these species are likely to be transient visitors or confined to use of habitat associated with the isolated structures such as shipwrecks and the breakwater at the southern end of Stockton Beach, however some of these species may include both threatened and/or migratory species of fishes, sharks, marine reptiles, mammals and birds. In addition, the proposed nourishment site is located in close proximity to the Hunter Estuary (~1 km to the north-west), which is a RAMSAR wetland and important site for various species of both threatened and migratory shorebirds, which at times may utilise habitat associated with the open coastline.

1.5 Relevant Legislation and Policies

The following legislation and policies have been considered in this ecological assessment:

- NSW *Environmental Planning and Assessment Ac*t 1979
- NSW *Fisheries Management Act 1994*
- NSW *Biodiversity Conservation Act 2016*
- NSW *Coastal Management Act 2016*
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
- NSW *Protection of the Environment Operations Act 1997*

The legislative context for the assessment is outlined in the following sections.

1.5.1 Fisheries Management Act 1994

The objectives of the *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations, and in particular to:

- conserve fish stocks and key fish habitats;
- conserve threatened species, populations and ecological communities of fish and marine vegetation;
- promote ecologically sustainable development, including the conservation of biological diversity, consistently with these objectives;
- promote viable commercial fishing and aquaculture industries;
- promote quality recreational fishing opportunities;
- appropriately share fisheries resources among the users of those resources;
- provide social and economic benefits for the wider community of NSW; and
- recognise the spiritual, social and customary significance of fisheries resources to Aboriginal persons, and to protect and promote the continuation of Aboriginal cultural fishing.

To meet the primary objectives, Part 7 of the FM Act deals with the protection of aquatic habitats, with Part 7A addressing the conservation of threatened species. Part 7 commonly applies to dredging and reclamation works, protection of marine vegetation including mangroves and seagrass, protection of spawning of certain fish, and noxious fish and marine vegetation.

If a public authority (including a local council or state agency) is a determining authority under Part 5 of the EP&A Act, they may still be required to obtain the following approvals or undertake consultation under the following provisions:

- Section 199 – Under s199 of the FM Act, the Minister for Primary Industries is required to be consulted over any dredging or reclamation works carried out, or proposed to be authorised, by a public authority (other than a local government authority) (i.e. any excavation within, or filling or draining of, water land or the removal of woody debris, snags, rocks or freshwater native aquatic vegetation or the removal of any other material from water land that disturbs, moves or harms these in-stream habitats).
- Section 200 – A permit is required for dredging or reclamation work carried out by a local government authority, unless these works are authorised by a relevant public authority (other than NSW DPI) or under the Crown Lands Act 1989.
- Section 205 – A permit to harm (cut, remove, damage, destroy, shade etc) marine vegetation (saltmarshes, mangroves, seagrass and seaweeds).
- Section 219 – A permit to obstruct the free passage of fish.

Listings of threatened species, populations and ecological communities gazetted under the FM Act are relevant to this assessment. Threatened biota impacted by this construction proposal must be assessed under best practise.

Key fish habitat policy

NSW DPI recognises that certain types of activities have varying degrees of impact on key fish habitats and, as such, require different levels of control and regulation. As a general principle, NSW DPI requires that proponents should, as a first priority, aim to avoid impacts upon key fish habitats. Where avoidance is impossible or impractical, proponents should then aim to minimise impacts. For any unavoidable remaining impacts consideration is to be given to establishment of suitable offsets or compensation.

Where key fish habitat is impacted by this construction proposal, suitable offsets or compensation may be required to be negotiated with NSW DPI Fisheries.

1.5.2 Biodiversity Conservation Act 2016

The Biodiversity Conservation Act 2016 (BC Act) provides for legal protections of biodiversity and threatened species in NSW. Specifically, it provides for the following:

- A process for declaring and protecting areas of outstanding biodiversity value.
- The listing of threatened species, populations and ecological communities, with critically endangered, endangered and vulnerable species under Schedule 1.
- The listing of critically endangered, endangered and vulnerable ecological communities under Schedule 2.
- The listing of extinct species, species extinct in the wild and collapsed ecological communities of animals and plants under Schedule 3.
- Requirements for the preparation of a species impact statement (SIS).
- Determining where the Biodiversity Offset Scheme (BOS) applies to proposals.

The BC Act sets the criteria for determining whether a proposal is likely to have a significant impact on threatened biodiversity listed under the BC Act. If significant impacts are identified, it would necessitate the preparation of a SIS.

To identify areas with outstanding biodiversity value the Biodiversity Values (BV) Map has been prepared under Part 7 of the BC Act to protected land sensitive to impacts from development and clearing. The map forms part of the Biodiversity Offsets Scheme Threshold, which is one of the triggers for determining whether the Biodiversity Offset Scheme (BOS) applies to a clearing or development proposal. Types of land the Environment Agency Head can include on the BV Map include the following:

- Coastal wetlands and littoral rainforest mapped under the State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP).
- Core koala habitat identified in a plan of management under State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44).
- Declared Ramsar wetlands defined by the Environment Protection and Biodiversity Conservation Act 1999.
- Land containing threatened species or threatened ecological communities identified as having potential for serious and irreversible impacts (SAII) under section 6.5 of the BC Act.
- Protected riparian land.
- High conservation-value grasslands or groundcover.
- Old growth forest identified in mapping developed under the National Forests Policy Statement but excluding areas not meeting the criteria published jointly by the Minister for the Environment and the Minister for Primary Industries.
- Rainforest identified in mapping developed under the National Forests Policy Statement but excluding areas not meeting the criteria published jointly by the Minister for the Environment and the Minister for Primary Industries.
- Declared areas of outstanding biodiversity value.
- Council-nominated areas with connectivity or threatened species habitat that the Minister for the Environment considers will conserve biodiversity at bioregional or state scale.
- Land that, in the opinion of the Environment Agency Head, is of sufficient biodiversity value to be included.

Listed items of threatened biodiversity under the BC Act with potential to be impacted by this construction proposal will require further consideration. In addition, direct or indirect impacts to any adjacent areas identified as having outstanding biodiversity values may trigger the requirement for determination under the BOS.

1.5.3 Environmental Planning and Assessments Act 1979

Development in NSW falls under the provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and subordinate legislation. Under Section 5.1 of the EP&A Act, there is a duty for determining authority to consider the environmental impacts of proposed activities. The specific aspects of these environmental considerations are detailed in Clause 171 of the Environmental Planning and Assessment Regulations 2021. Under section 5.1of this Act, determining authorities are required to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity. These include items of biodiversity listed under the BC and FM Acts.

1.5.4 Coastal Management Act 2016

The objectives of the *Coastal Management Act 2016* (CM Act) are to manage the coastal environment of NSW in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic wellbeing of the people of the State.

The CM Act defines the coastal zone, comprising four coastal management areas:

- Coastal wetlands and littoral rainforests area;
- Coastal vulnerability area;
- Coastal environment area; and
- Coastal use area.

Part 2 of the CM Act establishes management objectives specific to each of these management areas, reflecting their different values to coastal communities.

The CM Act, along with the State Environmental Planning Policy (Coastal Management) 2018, forms part of the Coastal management framework.

State Environmental Planning Policy (Coastal Management) 2018

The State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) aims to promote an integrated and coordinated approach to land use planning in the coastal zone in a manner consistent with the objectives of the Coastal Management Act 2016. The CM SEPP provides maps of the coastal zone management areas and identifies development controls for consent authorities to apply to each coastal management area to achieve the objectives of the CM Act.

Consideration of the relevant coastal management areas and identified development controls will require consideration as part of this proposal.

1.5.5 Environmental Protection and Biodiversity Conservation Act 1999

The purpose of the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) is to ensure that actions likely to cause a significant impact on matters of national environmental significance undergo an assessment and approval process. Under the EPBC Act, an action includes a project, undertaking, development or activity. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a controlled action and may not be undertaken without prior approval from the Commonwealth Minister for the Department of Environment (DoE).

The EPBC Act identifies and categorises matters of national environmental significance (MNES) as the following:

- World heritage properties
- National heritage places
- Wetlands of international importance (Ramsar wetlands)
- Threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- Nuclear actions (including uranium mining)
- The Great Barrier Reef Marine Park
- A water resource, in relation to coal seam gas development and large coal mining development.

Listings of MNES deemed relevant to this construction proposal will require further considered under the guidance provided by the EPBC Act.

1.5.6 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is the key piece of environment protection legislation administered by the NSW Environmental Protection Authority (EPA). The POEO Act relates to noise, air and water pollution and waste management. There is a broad allocation of responsibilities under the Act between the EPA, local councils and other public authorities. The EPA is made the regulatory authority for:

- activities listed in Schedule 1 to the Act and the premises where they are carried out;
- activities carried out by a State or public authority; and
- other activities in relation to which a licence regulating water pollution is issued.

The POEO Act provides for the provision of and conditioning of activities requiring environmental protection licensing. Scheduled activities as listed under Schedule 1 of the Act require an Environmental Protection License (EPL) from the EPA, unless clauses in Schedule 1 specify otherwise.

1.6 Assessment Objectives

The objectives of this assessment are to:

- Identify any potential impacts from the proposed works on threatened biodiversity, MNES, water quality, fish habitat, marine vegetation and fauna, and areas of outstanding biodiversity value; and
- Provide recommendations regarding adoption of environmental controls and mitigation measures into the Construction Environmental Management Plan (CEMP) and identify any additional permitting and approval requirements under the FM Act, including any requirements for an SIS.

Figure 1: Location of the Subject Site (Project Area)

2 Methodology and Approach

2.1 Desktop Review

2.1.1 Threatened Species Searches

Relevant databases were searched during July 2022, applying a 5 km radius around the Project Area at Stockton Beach (Locality) to identify threatened biodiversity, migratory species and MNES that may potentially occur at the locality. The following databases and information sources were searched:

- Bionet, Atlas of NSW Wildlife
- NSW DPI Fisheries Threatened species lists
- EPBC Act Protected Matters Report tool

2.1.2 Existing Mapping and Imagery

Mapping of existing ecological features important to this assessment was reviewed using the following online tools:

- Fisheries NSW Spatial Data Portal – Mapping of Estuarine Macrophytes, Aquaculture, Marine Protected Areas, and Coastal Management SEPP layers.
- Biodiversity Values and Threshold Tool – Biodiversity values.
- High resolution aerial imagery from Nearmap that has been captured since 2018
- Sea floor bathymetry (topography) mapping provided by the Seabed NSW Program

A review of the potential environmental constraints identified via these maps was undertaken.

2.2 Site Investigations

Site investigations completed within the Study Area (Figure 1) as part of this assessment included:

- Inspection and description of general habitat within and adjacent to the proposal footprint;
- Description of intertidal flora and fauna present by experienced marine ecologists at low tide;
- Description of subtidal flora and fauna present using an ROV (Plate 1) and some limited in water inspections via snorkelling;
- Opportunistic records of any marine birds, mammals and reptiles or shorebirds;
- Sampling of intertidal sediments for macrofauna e.g. bivalves and gastropods using a 40 x 40cm box quadrat (Plate 1) at three sites (Figure 2). Five replicate samples were collected at both the mid-intertidal and low-intertidal areas.
- Collection and analysis of sediment core samples from three sites (Figure 2) along the waters edge of Stockton Beach within the Study Area. At each site a mid-intertidal, low-intertidal and shallow subtidal (approx. -0.5 m depth) composite sample was obtained from 3 haphazardly collected 100 mm diameter sediment cores at each tidal position. Samples were sieved down through a 1mm sieve and the remaining material was retained for analysis. Samples were preserved in 95% ethanol and analysed in the laboratory for benthic infauna.

2.3 Mapping

2.3.1 Habitat

Habitat maps were verified and created based on consideration of the following data sources:

- *In situ* estuarine mapping data
- Aerial imagery

- Bathymetry data

Aerial imagery captured through Nearmap were collated and reviewed across five consecutive years within the Study Area. Imagery was captured between 2018 and 2022 and reviewed for changes in subtidal structure throughs time.

Bathymetry and seabed data were reviewed and verified for habitat types using the Seabed mapping program (DPE 2022) undertaken as part of the Seabed NSW Program.

2.4 Threatened Species Assessment

The threatened species assessment was undertaken by desktop review of 'sightings', assessment of the habitat in the Study Area, and determining the likelihood of occurrence of each species using the criteria outlines in Table 2. Species considered further were those in the 'Known', 'High' and 'Moderate' categories and where impacts on the species from the proposed works are considered to possibly or likely occur.

Table 2: Likelihood of occurrence criteria

Likelihood of occurrence	Criteria
Known	The species was observed within the Study Area. The species is known to inhabit the Study Area.
High	The species has frequently been recorded previously in the Study Area or similar habitats in the locality. The species is known or likely to maintain resident populations surrounding the Study Area. It is likely that the species utilises habitat or resources that are abundant or in good condition within the Study Area. The species is known or likely to visit the Study Area during regular seasonal movements or migrations.
Moderate	The species has infrequently been recorded previously in the Study Area or similar habitats in the locality. The Study Area contains potential marginal and/or modified habitat and resources for the species, which it may occasionally utilise. The species is unlikely to maintain sedentary populations but may seasonally use resources within the Study Area opportunistically or during migrations.
Low	The species has not been recorded previously in the Study Area or similar habitats in the locality. The Study Area is beyond the current distribution range of the species. If present in the Study Area the species would likely be a transient visitor. The Study Area contains only very marginal habitat for the species, which would not be relied upon for its on-going local existence.
Unlikely	The species is highly restricted to certain geographical areas not including the Study Area. The habitat within the Study Area is unsuitable for the species.

2.5 Limitations

Fauna surveys were limited to the assessment of habitat values and other opportunistic observations. Habitat assessments are conservative, defaulting to assume presence where there is insufficient knowledge to determine otherwise.

Numerous threatened species of fauna are seasonal in geographical distribution and/or may be transient in nature. For instance, some migratory bird species may be seen only at certain times of the year as they migrate to more significant nearby sites, while other fauna are only present during certain seasons (e.g. migration patterns or seasons).

Mapping is limited to broad-scale mapping guided by *In situ* field observations taken with ROV camera output and verified against existing aerial imagery and bathymetry data.

Due to swell coinciding with a suitable spring low tide, box cores at the low-intertidal and shallow subtidal core samples were not obtainable at Soft Sediment Site 1 (most northerly site).

Subtidal survey was limited due to lack of suitable in water conditions of low swell and clear water with 5m or greater visibility. As a result, in water survey targeted permanent structures along the southern seawall and perimeter of the Study Area, which were typically more protected, however, during these periods water visibility was still found to be very poor (1-2m)

Figure 2: Study Area and survey sites

3 Results and Findings

3.1 Desktop Review

3.1.1 Threatened Biodiversity and Protected Matters

Searches of the Bionet database identified sightings data for 72 items listings under the BC Act within a 5km radius of the Project Area (Figure 3, Appendix 2). These included:

- 65 Threatened or Migratory marine birds and/or shorebirds;
- Four Threatened or Migratory marine mammals; and
- Three Threatened or Migratory marine reptiles.

In addition, six shark and fish species listed under the FM Act may also occur within the 5 km of the Project Area.

The EPBC Protected Matters Report Search identified the following MNES relevant to this study (i.e. marine/estuarine species or those that use marine/estuarine habitat) within 5 km radius of the Project Area (Appendix 2):

- 86 Listed Threatened species;
- 78 Listed Migratory species;
- Six Threatened Ecological Communities (TEC);
- One Wetland of International Importance (RAMSAR).

In addition to the above, the EPBC Protected Matters Report Search identified 108 protected marine species that include certain species of fish, along with some marine birds, reptiles and mammals. While 13 marine mammals were identified as part of protected listings for cetaceans (Appendix 2).

Of the Commonwealth listed threatened and/or migratory species, the following were identified for consideration as part of this assessment:

- 86 shorebirds or marine birds;
- Eight marine mammals;
- Five marine turtles;
- 13 sharks, rays and fish; and
- One TEC.

A summary of all threatened and migratory species considered as part of this assessment, along with consideration of their likelihood of occurrence within the Study Area and potential to be impacted, is provided in Table 3.

Table 3: Threatened and migratory species identified from searches that have been considered further as part of this assessment.

Scientific Name	Common Name	BC/FM Acts	EPBC Acts	Sightings Bionet	Likelihood of Occurrence	Possibility of Impact
Marine Birds and Shorebirds						
Actitis hypoleucos	Common Sandpiper	P	C,J,K	91	Moderate	Unlikely
Anous stolidus	Common Noddy	P	C,J	8	Low	Unlikely
Apus pacificus	Fork-tailed Swift	P	C,J,K	8	Low	Unlikely

Scientific Name	Common Name	BC/FM Acts	EPBC Acts	Sightings Bionet	Likelihood of Occurrence	Possibility of Impact
Ardenna carneipes	Flesh-footed Shearwater	V,P	J,K	5	Low	Unlikely
Ardenna grisea	Sooty Shearwater	P	J	4	Moderate	Unlikely
Ardenna pacifica	Wedge-tailed Shearwater	P	J	189	High	Unlikely
Ardenna tenuirostris	Short-tailed Shearwater	P	C,J,K	78	High	Unlikely
Arenaria interpres	Ruddy Turnstone	P	C,J,K	276	Moderate	Unlikely
Botaurus poiciloptilus	Australasian Bittern	E,P	E	1	Low	Unlikely
Burhinus grallarius	Bush Stone-curlew	E,P		4	Moderate	Unlikely
Calidris acuminata	Sharp-tailed Sandpiper	P	C,J,K	1111	Low	Unlikely
Calidris canutus	Red Knot	P	E,C,J,K, B	497	Low	Unlikely
Calidris ferruginea	Curlew Sandpiper	E,P	CE,C,J,K ,B	2275	Low	Unlikely
Calidris melanotos	Pectoral Sandpiper	P	J,K	12	Low	Unlikely
Calidris ruficollis	Red-necked Stint	P	C,J,K	873	Low	Unlikely
Calidris subminuta	Long-toed Stint	P	C,J,K	1	Low	Unlikely
Calidris tenuirostris	Great Knot	V, P	CE,C,J,K ,B	198	Low	Unlikely
Calonectris leucomelas	Streaked Shearwater	P	C,J,K	1	Low	Unlikely
Charadrius bicinctus	Double-banded Plover	P	B		Low	Unlikely
Charadrius leschenaultii	**Greater Sand Plover**	**P**	**V,B,C,J, K**	**15**	**Moderate**	**Possible**
Charadrius mongolus	**Lesser Sand-plover**	**V,P**	**E,B,C,J. K**	**204**	**Moderate**	**Possible**
Charadrius veredus	Oriental Plover	P	C,J,K	1	Low	Unlikely
Chlidonias leucopterus	White-winged Black Tern	P	C,J,K	18	Low	Unlikely
Circus assimilis	Spotted Harrier	V,P		1	Low	Unlikely
Diomedea antipodensis	Antipodean Albatross	V,P	V,B		Low	Unlikely
Diomedea antipodensis gibsoni	Gibson's Albatross	V,P	V		Low	Unlikely
Diomedea epomophora	Southern Royal Albatross	P	V,B		Low	Unlikely
Diomedea exulans	Wandering Albatross	E,P	E	3	Moderate	Unlikely
Diomedea sanfordi	Northern Royal Albatross	P	E,B		Low	Unlikely
Erythrotriorchis radiatus	Red Goshawk	CE,P	V		Low	Unlikely
Esacus magnirostris	Beach Stone-curlew	CE,P		2	Low	Possible
Falco hypoleucos	Grey Falcon	E,P	V		Low	Unlikely
Fregata ariel	Lesser Frigatebird	P	C,J,K	1	Low	Unlikely
Fregata minor	Great Frigatebird, Greater Frigatebird	P	C,J		Low	Unlikely
Fregetta grallaria grallaria	White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian)	P	V		Low	Unlikely
Gallinago hardwickii	Latham's Snipe	P	B,J,K	40	Low	Unlikely
Gallinago megala	Swinhoe's Snipe	P	C,J,K,B		Low	Unlikely
Gallinago stenura	Pin-tailed Snipe	P	C,J,K,B		Low	Unlikely
Gelochelidon nilotica	Gull-billed Tern	P	C	38	Low	Unlikely
Haematopus longirostris	**Pied Oystercatcher**	**E,P**		**605**	**High**	**Possible**

Scientific Name	Common Name	BC/FM Acts	EPBC Acts	Sightings Bionet	Likelihood of Occurrence	Possibility of Impact
Haliaeetus leucogaster	White-bellied Sea-Eagle	V,P		393	High	Unlikely
Hieraaetus morphnoides	Little Eagle	V,P		8	Moderate	Unlikely
Hirundapus caudacutus	White-throated Needletail	P	V,C,J,K	15	Moderate	Unlikely
Hydroprogne caspia	Caspian Tern	P	J	527	Low	Unlikely
Lathamus discolor	Swift Parrot	E,P	CE		Low	Unlikely
Limicola falcinellus	Broad-billed Sandpiper	V,P	C,J,K	45	Low	Unlikely
Limnodromus semipalmatus	Asian Dowitcher	P	C,J,K,B	6	Low	Unlikely
Limosa lapponica	**Bar-tailed Godwit**	**P**	**V**	**1558**	**Moderate**	**Possible**
Limosa lapponica baueri	Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	P	V		Low	Unlikely
Limosa limosa	**Black-tailed Godwit**	**V,P**	**B,C,J,K**	**661**	**Moderate**	**Possible**
Lophoictinia isura	Square-tailed Kite	V,P		2	Low	Unlikely
Macronectes giganteus	Southern Giant Petrel	E,P	E	3	Low	Unlikely
Macronectes halli	Northern Giant Petrel	V,P	V,B		Low	Unlikely
Numenius madagascariensis	**Eastern Curlew**	**P**	**CE,B,C,J ,K**	**234**	**Moderate**	**Possible**
Numenius minutus	Little Curlew	P	C,J,K	1	Low	Unlikely
Numenius phaeopus	Whimbrel	P	C,J,K	528	Moderate	Unlikely
Onychoprion fuscata	Sooty Tern	V,P		3	Low	Unlikely
Pachyptila turtur subantarctica	Fairy Prion (southern)	P	V		Low	Unlikely
Pandion cristatus	Eastern Osprey	V,P		97	Known	Unlikely
Phaethon lepturus	White-tailed Tropicbird	P	C,J		Low	Unlikely
Philomachus pugnax	Ruff	P	C,J,K	2	Low	Unlikely
Pluvialis fulva	**Pacific Golden Plover**	**P**	**C,J,K**	**773**	**Moderate**	**Possible**
Pluvialis squatarola	Grey Plover	P	B,C,J,K	13	Low	Unlikely
Pterodroma leucoptera leucoptera	Gould's Petrel	V,P	E	1	Low	Low
Pterodroma neglecta neglecta	Kermadec Petrel (western)	V,P	V		Low	Low
Pterodroma solandri	Providence Petrel	V,P		2	Low	Unlikely
Rhipidura rufifrons	Rufous Fantail	P	B		Low	Unlikely
Rostratula australis	Australian Painted Snipe	E,P	E		Low	Unlikely
Stercorarius longicaudus	Long-tailed Jaeger	P	C,J	1	Low	Unlikely
Stercorarius parasiticus	Arctic Jaeger	P	C,J,K	9	Low	Unlikely
Stercorarius pomarinus	Pomarine Jaeger	P	C,J,K	26	Low	Unlikely
Sterna hirundo	**Common Tern**	**P**	**C,J,K**	**383**	**Known**	**Possible**
Sternula albifrons	**Little Tern**	**E,P**	**B,C,J,K**	**540**	**Moderate**	**Possible**
Sternula nereis nereis	Australian Fairy Tern	P	V		Low	Unlikely
Sula dactylatra	Masked Booby	V,P	J,K	1	Low	Unlikely
Thalassarche bulleri	Buller's Albatross, Pacific Albatross	P	V,B		Low	Unlikely

Scientific Name	Common Name	BC/FM Acts	EPBC Acts	Sightings Bionet	Likelihood of Occurrence	Possibility of Impact
Thalassarche bulleri platei	Northern Buller's Albatross, Pacific Albatross	P	V		Low	Unlikely
Thalassarche carteri	Indian Yellow-nosed Albatross	P	V,C,J,K, B		Low	Unlikely
Thalassarche cauta	Shy Albatross	V,P	V	1	Low	Unlikely
Thalassarche eremita	Chatham Albatross	P	E,B		Low	Unlikely
Thalassarche impavida	Campbell Albatross, Campbell Black-browed Albatross	P	V,B		Low	Unlikely
Thalassarche melanophris	Black-browed Albatross	V,P	V,B	10	Moderate	Unlikely
Thalassarche salvini	Salvin's Albatross	V,P	V,B		Low	Unlikely
Thalassarche steadi	White-capped Albatross	P	V,B		Low	Unlikely
Thalasseus bergii	Crested Tern	P	J	908	Known	Possible
Tringa brevipes	Grey-tailed Tattler	P	B,C,J,K	521	Known	Possible
Tringa glareola	Wood Sandpiper	P	C,J,K	2	Low	Unlikely
Tringa incana	Wandering Tattler	P	J	1	Low	Unlikely
Tringa nebularia	Common Greenshank	P	C,J,K	516	Known	Unlikely
Tringa stagnatilis	Marsh Sandpiper	P	C,J,K	436	Low	Unlikely
Xenus cinereus	Terek Sandpiper	V,P	C,J,K	616	Low	Unlikely
Marine Mammals						
Arctocephalus forsteri	New Zealand Fur-seal	V,P		1	Unlikely	Possible
Arctocephalus pusillus doriferus	**Australian Fur-seal**	**V,P**		**2**	**Known**	**Possible**
Balaenoptera edeni	Bryde's Whale	P	**B**		Low	Unlikely
Balaenoptera musculus	Blue Whale	E,P	E,B		Low	Unlikely
Caperea marginata	Pygmy Right Whale	P	B		Low	Unlikely
Dugong dugon	Dugong	E,P	B	2	Low	Unlikely
Eubalaena australis	Southern Right Whale	E,P	E,B		Low	Unlikely
Megaptera novaeangliae	Humpback Whale	V,P	V,B	4	Moderate	Unlikely
Orcinus orca	Killer Whale, Orca	P	B		Low	Unlikely
Sousa sahulensis	Australian Humpback Dolphin	P	B		Low	Unlikely
Marine Reptiles						
Caretta caretta	Loggerhead Turtle	E,P	E,B	4	Moderate	Unlikely
Chelonia mydas	Green Turtle	V,P	V	3	Known	Unlikely
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	E,P	E,B		Moderate	Unlikely
Eretmochelys imbricata	Hawksbill Turtle	V,P	V,B	2	Low	Unlikely
Natator depressus	Flatback Turtle	P	V, B		Low	Unlikely
Sharks, Rays and Fish						
Carcharhinus longimanus	Oceanic Whitetip Shark	P	B		Low	Unlikely
Carcharias taurus (east coast population)	Grey Nurse Shark (east coast population)	CE,P	CE		Possible	Possible
Carcharodon carcharias	White Shark, Great White Shark	V,P	V,B		Known	Unlikely
Epinephelus daemelii	Black Rockcod, Black Cod, Saddled Rockcod	V,P	V		Possible	Possible
Galeorhinus galeus	School Shark, Eastern School Shark, Snapper		CD		Known	Unlikely

Scientific Name	Common Name	BC/FM Acts	EPBC Acts	Sightings Bionet	Likelihood of Occurrence	Possibility of Impact
	Shark, Tope, Soupfin Shark					
Hippocampus whitei	White's Seahorse, Crowned Seahorse, Sydney Seahorse	E,P	E		Unlikely	Unlikely
Lamna nasus	Porbeagle, Mackerel Shark		B		Low	Unlikely
Mobula alfredi	Reef Manta Ray, Coastal Manta Ray		B		Low	Unlikely
Mobula birostris	Giant Manta Ray		B		Low	Unlikely
Rhincodon typus	Whale Shark	P	V,B		Low	Unlikely
Seriolella brama	Blue Warehou		CD		Low	Unlikely
Sphyrna lewini	Scalloped Hammerhead	E	CD		Possible	Unlikely
Thunnus maccoyii	Southern Bluefin Tuna	E	CD		Low	Unlikely
Threatened Ecological Communities (TEC)						
Subtropical and Temperate Coastal Saltmarsh	Coastal Saltmarsh	E	V		Unlikely	Unlikley

CD = Conservation Dependent, P = Protected, V = Vulnerable, E Endangered, CE = Critically Endangered, C = Migratory listed species under CAMBA, J = Migratory species under JAMBA, K = Migratory species under ROKAMBA, B = Migratory species under Bonn Agreement, M = Marine Species, CT = Cetacean.

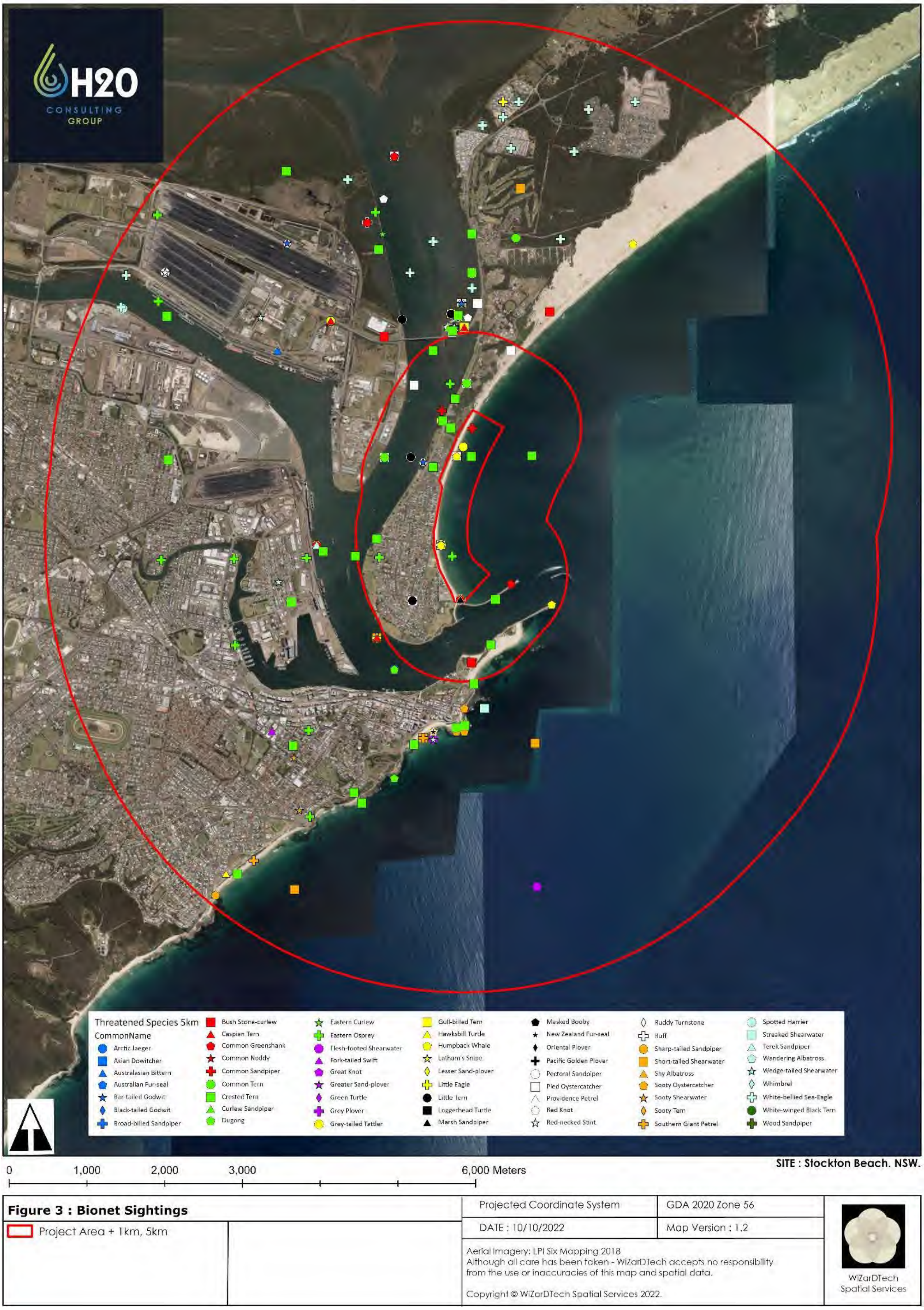

Figure 3: Map showing threatened and migratory species sightings from Bionet.

3.1.2 Existing Ecological Mapping

Mapping of estuarine macrophytes by NSW DPI Fisheries indicate that no species of seagrasses, mangroves, or saltmarsh (including the Coastal Saltmarsh TEC) occur within the Study Area. Large areas of mangrove and saltmarsh communities were identified outside within the Hunter River Estuary nearby, particularly around Fullerton Cove, Smiths Island and Kooragang Island, as well as the upper reaches of the northern and southern arm channels of the Hunter River (DPI, 2022, Appendix 3).

The nearest Marine Protected Area (MPA) to the Study Area is the Port Stephens Great Lakes Marine Park, which encompasses an area of approximately 98, 000 hectares and extends from Birubi Beach at the northern end of Stockton Beach, to Cape Hawke near Forster in the north (Appendix 3). The Marine Park commences ~20 km north of the Study Area and well outside the Project Area. Additionally, the Hunter River Estuary, occurs in the vicinity of the Study Area and contains a number of significant conservation sites, including the Hunter Wetlands National Park, Kooragang Wetlands and the Hunter Wetland Centre, each of which are protected under the RAMSAR Convention as a wetland of international importance, which commences ~1 km north-west of the Project Area (Appendix 3). The wetlands are home to numerous migratory and shorebird species, including a number of threatened species.

Commercial fisheries, limited to coastal waters may occur within the Project Area at times, these are likely to include Ocean Prawn Trawl Fishery, Ocean Trap and Line Fishery, Lobster Fishery, Ocean Haul Fishery and Pipi Fishery, while no aquaculture leases or designated Aquaculture Strategy Areas were identified within the vicinity of the Project Area (DPI 2022). Mapping as part of the Coastal Management SEPP identifies the shoreline and adjacent waters of Stockton Beach to be part of the Coastal Area but do not include any Coastal Wetland areas (Appendix 3).

The entirety of tidal areas inside the Study Area are identified as Key Fish Habitat (Appendix 3). Key Fish Habitat within the Study Area includes Type 3- Minimally sensitive key fish habitat due to unstable or unvegetated sand substrates that dominate the Project Area (Fairfull 2013).

3.2 Description of Habitat and Biota

3.2.1 Shoreline Habitat

The shoreline included various coastal assets such as roads, public walking paths, beach access stairs, car parks and commercial waterfront structures, including the NRMA Holiday Park, Stockton Surf Life Saving Club and Bowling Club. Extensive shoreline erosion has occurred along this more southern stretch of the shoreline, with extensive damage to assets occurring within this section.

The Project Area at the southern end of Stockton Beach (Plate 1) is partially protected from southerly swells by the Hunter River Breakwater, while more exposed to easterly to north-easterly swells. The shoreline features include sections of extensive recent rock armouring north of the Stockton Beach Surf Club, as well as some patchy occurrences of shoreline vegetation along the beach face and foreshore, which typically has been highly disturbed as a result of the ongoing erosion that has eroded large areas of the beach face away during recent storm events. Within the Project Area, some scattered larger trees provide some afternoon shading include Norfolk Island Pine's (*Araucaria heterophylla*) and Swamp She-oak's (*Casuarina glauca*), while shrubs and herb (*Lamandra longifolia* and *Carpobrotus virescens*) plantings that provided some stabilisation of the beach front were noted in places. These supplemented the native Acacia's (likely *Acacia longifolia*), Bitou Bush (*Chrysanthemoides monilifera)* shrubs and mixture of native and exotic grasses that are mostly confined to the shoreline that is lesser developed and impacted by erosion, typically to the north of the Project Area.

The shoreline within the Study Area provides only very marginal roosting habitat for shorebirds. This may include the higher sections of rock armouring associated with the seawall and breakwater, and some very limited areas where shoreline vegetation remains, which are typically highly disturbed by development, erosion and human activity. The presence of unvegetated sandy beach faces and foredunes, which provides the preferred habitat for many shorebirds to roost, was typically absent due to the erosion, which has removed sands on the beach face back to, and beyond the shoreline vegetation in places.

A list of shorebirds and marine birds observed during the site survey is provided in Table 4.

3.2.2 Intertidal habitat

Intertidal habitat within and adjacent to the Study Area consists of a sandy shoreline (Plate 2) and artificial habitat provided by rocks associated with the seawalls and breakwater (Plate 3), as well as the remains of a shipwreck, located seaward of the sandy shoreline, along the breakwater. The sandy shoreline is typically comprised of marine sands, with associated infauna assemblages in lower tidal areas that are likely to include some small polychaetes, bivalves and crustaceans. However, sampling of intertidal sediments found sediments to be highly deprived of any infauna and macrofauna within both the mid and lower intertidal areas and areas across all sites assessed within the Study Area, with only one Common Pipi (*Plebidonax deltoides*) sampled (Table 5). Intertidal sections of the rock armouring associated with the breakwater, was sparsely covered with common intertidal invertebrate species. Higher areas were dominated by Blue Periwinkles (*Austrolittorina unifasciata*), whilst in mid to lower areas, Barnacles, including Honeycomb (*Chaemosipho tasmanica*) and Rose-Coloured Barnacles (*Tesseropora rosea*), Limpets, including Variegated (*Cellana tramoserica*), Oyster (*Patelloida mimuli*) and False Limpet (*Siphonaria denticulate*) species, as well as Tubeworms (*Galeolaria caespitosa*) and the mobile invertebrate, Red Bait Crab (*Plagusia chabrus*) were commonly observed. Sydney Rock Oysters (*Saccostrea glomerata*), Cunjevoi (*Pyura stolonifera*) and Cartrut Shells (*Dicathais orbita*) were observed in lower intertidal areas only. Common species of intertidal vegetation were observed in areas associated with the rock walls. Species including Coraline Algae (*Amphiroa anceps* and *Corallina officinalis*), Gulfweed (*Sargassum sp*.), fine green turfing algae, and Sea Lettuce (*Ulva sp*.), were commonly observed in lower intertidal areas within the Project Area.

Intertidal sections of the breakwater may provide additional habitat for pinniped species at times, including Australian Fur Seals (*Arctocephalus pusillus doriferus*), which were seen basking along lower sections of the breakwater at the time of the survey.

Substantial deposits of marine debris and wrack were recorded on the shoreline at the southern end of the beach at the time of surveying. These included various sponges, kelp fronds (*Ecklonia radiata*), Port Jackson shark egg casings, and the common green seaweed species, Bootstrap Caulerpa (*Caulerpa filiformis*).

3.2.3 Subtidal habitat

Subtidal habitat within the Study Area was predominantly unvegetated marine sands with accumulations of seaweed and wrack in places (Plate 4). Bathymetry indicates that the seabed is gradually sloping to -7 m in the south and -11 m in the north, of the Project Area (Appendix 1). Soft sediment habitat is likely used by various demersal and benthic fish species that rest on the sea floor or partially bury themselves in the sediment to ambush prey, such as various species of rays, and flathead. The demersal fish species such as Whiting and Bream may use these areas to forage amongst the soft sediments for invertebrate prey. While surveys indicate that invertebrate items (infauna) are very deprived in shallow areas, they are likely to be more abundant in deeper areas behind the surf zone where erosional processes are likely to be less intense and frequent.

Hard substrata subtidal habitat is limited within the Study Area and predominantly artificial as a result of the breakwater and adjacent shipwrecks (Plate 4) which are outside the Project Area (Figure 4). However, seabed mapping and aerial imagery indicate that some small outcrops of substrate occur within the Project Area (Figure 4), which are likely maritime archaeological sites and shipwrecks. Aerial imagery indicates that these structures may be periodically covered by sand, indicating that sand movement resulting in smothering and erosion, is likely a regular process in these areas (Figure 5). In turn, this is expected to result in reduced marine growth and provision of only short-term refuge habitat for marine species that utilise hard substrata benthic habitats in the locality.

Rocky reef habitat that supported live macroalgae assemblages is likely limited to the breakwater, which is outside the Project Area. These macroalgae stands (Plate 5) included dense kelp beds (*Ecklonia radiata*), with moderate levels of growth of some brown macroalgae species including Forkweed (*Dictyota dichotoma*) and Gulfweed (*Sargassum sp*.). A number of ascidian species and some small encrusting sponges were also recorded within this area. The rocky reef habitat associated with the breakwater (Figure 4) transitioned into large boulders around the toe, with a dense covering of Bootstrap Caulerpa (*C. filiformis*) and intermittent patches of brown turfing algae associated with this habitat. The breakwater, boulders and shipwreck occurring along the breakwater, form complex habitats supporting a wide diversity of less cryptic fish, as well as Yellow-fin Bream (*Acanthopagrus australis*), Luderick (*Girella tricuspidata*) and Smooth Toadfish (*Tetractenos glaber)*. At times threatened fishes such as the Vulnerable Black Rockcod (*Epinephelus daemelii)* may take refuge in habitat amongst these wrecks along the breakwater or the area may be used for foraging by a range of larger more predatory fish, sharks and rays.

Table 4: List of species observed during the site survey.

Name	Species	Habitat	Within Project Area
Invertebrates*			
Blue Periwinkle	*Austrolittorina unifasciata*	High intertidal sections of the seawall and breakwater	√
Variegated Limpet	*Cellana tramoserica*	Mid-intertidal sections of the seawall and breakwater	√
Honeycomb Barnacle	*Chamaesipho tasmanica*	Mid-intertidal sections of the seawall and breakwater	√
Cartrut Shell	*Dicathais orbita*	Low intertidal sections of the breakwater	√
False Limpet	*Siphonaria denticulata*	Mid-intertidal sections of the breakwater	√
Tubeworm	*Galeolaria caespitosa*	Mid-low intertidal sections of the seawall and breakwater	√
Oyster Limpet	*Patelloida mimula*	Mid-low intertidal sections of the seawall and breakwater	√
Black Nerita	*Nerita atramentosa*	Mid-intertidal sections of the seawall	√
Sand Anemone	Oulactis muscosa	Mid-intertidal sections of the seawall	√
Native Oyster	Ostrea angasi	Mid-intertidal sections of the seawall	√
Red Bait Crab	*Plagusia chabrus*	Intertidal sections of the seawall and breakwater	√
Cunjevoi	*Pyura stolonifera*	Low intertidal sections of the breakwater	√
Sydney Rock Oyster	*Saccostrea glomerata*	Mid-low intertidal sections of the seawall and breakwater	√
Rose Barnacle	*Tesseropora rosea*	Mid -low intertidal sections of the seawall and breakwater	√
Macroalgae			
Coraline Algae	*Amphiroa anceps*	Low intertidal and subtidal sections of the breakwater	√
Bootstrap Caulerpa	*Caulerpa filiformis*	Beach wrack	√
Red Alga	*Champia viridis*	Low intertidal and subtidal sections of the breakwater	√

Coraline Algae	*Corallina officinalis*	Low intertidal and subtidal sections of the breakwater	√
Forkweed	*Dictyota dichotoma*	Low intertidal and subtidal sections of the breakwater	√
Kelp	*Ecklonia radiata*	Subtidal sections of the breakwater and beach wrack	√
Gulfweed	*Sargassum* sp.	Low intertidal and subtidal sections of the breakwater	√
Sea Lettuce	*Ulva sp.*	Low intertidal sections of the breakwater	√
Birds			
Silver Gull	*Chroicocephalus novaehollandiae*	Adjacent Shoreline	√
Little Pied Cormorant	*Microcarbo melanoleucos*	Shipwreck adjacent to the rock wall	√
Australian Pelican	*Pelecanus conspicillatus*	Adjacent Shoreline and waterfront structures	√
Little Black Cormorant	*Phalacrocorax sulcirostris*	Rock Wall and Shipwreck	√
Great Cormorant	*Phalacrocorax carbo*	Intertidal and subtidal sections of the rock walls	√
Common Tern	*Sterna hinundo*	Intertidal and subtidal sections of the rock walls	√
Fish			
Yellowfin Bream	*Acanthopagrus australis*	All subtidal areas	√
Luderick	*Girella tricuspidata*	All subtidal areas	√
Smooth Toadfish	*Tetractenos glaber*	All subtidal areas	√
Marine Mammals			
Australian Fur-seal	*Arctocephalus forsteri*	All subtidal areas and intertidal sections of the breakwater	√
Bottlenose Dolphin	*Tursiops truncatus*	All subtidal areas	√
Reptiles			
Green Turtle	*Chelonia mydas*	All subtidal areas	√

**Excludes infauna and macroinvertebrates associated with soft sediment sampling*

Table 5: List of invertebrate infauna and macrofauna sampled in intertidal and subtidal sediments during the site survey.

Intertidal and subtidal invertebrate's – Soft Sediment				
Site	Infauna Taxa	Infauna Abundance	Macrofauna Taxa	Macrofauna Abundance
IS01-M	No fauna	0	No macrofauna	0
IS01-L	No fauna	0	Not Sampled	0
IS02-M	No fauna	0	Pipi - *Plebidonax deltoides*	1
IS02-L	No fauna	0	No macrofauna	0
IS03-M	No fauna	0	No macrofauna	0
IS03-L	No fauna	0	No macrofauna	0
SS02	No fauna	0	Not Sampled	0
SS03	No fauna	0	Not Sampled	0

Figure 4: Habitat map of the Study Area, showing no seagrass within the proposed nourishment area.

Figure 5: Nearmap imagery timeseries for the Study Area occurring between 208 and 2022.

4 Impact Assessment

The Guidelines for Aquatic Ecology in Environmental Impact Assessment identifies that environmental disturbances to aquatic ecology can be categorised in terms of potential physical, chemical and biological effects, which allows for the nature of impacts and their likely magnitude to be assessed (Lincoln Smith 2003). More recently, research on impacts to marine fauna has had increased focus on behavioural impacts as a result of additional sources of disturbance such as underwater noise (Erbe 2012) and light (Tidau 2021). To recognise this, behavioural effects have been added as a fourth category of impacts summarised in Table 5.

Table 6: Identification of potential impacts from the proposal.

Impact	Likelihood	Description
Physical		
Physical disturbance or smothering of marine fauna and flora	Known	The proposal is likely to result in some physical disturbance and potential smothering of marine fauna, particularly infauna associated with soft sediments located where nourishment activities occur. Additional species, likely to be impacted include some species of marine and shorebird species, which may experience some temporary disturbances to shoreline and intertidal foraging or roosting habitat because of nourishment works.
Modification or alteration of habitat	Known	The proposal will result in smothering and changes to gradient and potential composition of sediments associated with the nourishment area. These changes have potential to have impacts on infauna which are an important food source to other species occurring within the area.
Sedimentation of adjacent habitat.	Possible	It is likely that there will be some movement of nourishment sediments within the locality, given the dynamic processes and movements of sediments associated with the location. Nearby hard substrata-based habitats may be impacted temporarily during placement of sediments; however it is likely that this will be minimal and very short-term. No sensitive habitat types, including seagrasses or extensive reef systems, occur within the Study Area.
Potential for increased risk of vessel strike for marine fauna	Unlikely	Any increase in vessel movements within the Study Area is likely to be short-term and confined to repositioning of larger slow-moving vessels, which pose minimal risk of ship strike.
Introduction or spread of a marine pest species	Possible	Sediments used for nourishment are a potential vector for introduction or spread of introduced marine species. The potential risk will be dependent of the source of sediment used for nourishments
Potential for spread of microplastic and marine Debris	Possible	Given the extensive distribution of microplastics, their spread is likely unavoidable. Spread of marine debris is considered a much lower risk as it is assumed clean marine sands will be used.
Chemical		
Changes in water quality	Likely	The proposal will result in changes to water quality as a result of increased turbidity and sedimentation during nourishment works. These changes are likely to be short term and temporary, with increased turbidity expected to dissipate within normal tidal regimes. The Study Area also regularly experiences naturally occurring, increased levels of turbidity during high levels of rainfall, due to its close proximity to the Hunter Estuary.
Exposure to Acid Sulfate Soils (ASS)	Unlikely	It assumed that clean marine sands with minimal to no ASS risk will be used.
Mobilisation of contaminants	Unlikely	It assumed that clean marine sands with minimal contamination risk will be used.
Nutrification	Unlikely	It assumed that clean marine sands with minimal nutrient enrichment risk will be used.
Biological		
Invasion or spread of non-native or invasive species	Possible	Sediments used in nourishment or equipment brought to site during construction works has potential to introduce non-native or invasive species to the site from other areas.
Introduction of disease or pathogens	Unlikely	No known diseases or pathogens have been identified as an environmental issue for marine fauna and flora in this locality, while no aquaculture occurs in the vicinity of the Project Area.
Behavioural		

Attraction of fauna to area during nourishment	Possible	It is likely that some behavioural changes to species will occur during placement of sediments in the proposed nourishment area. These changes will be short term and limited to the direct time of impact, with no long- term impacts of ecological significance expected to occur for species within the Study Areas. Natural movements, utilisation of habitat and behaviours of species are likely to return to normal, post nourishment works.
Artificial lighting during construction works	Unlikely	It is assumed construction works will be undertaken during daytime hours.
Generation of construction noise with potential to impact on fauna behaviour	Possible	Some construction noise as a result of booster pumps and machinery use on the beach may be required at times.
Generation of underwater noise with potential to impact on fauna behaviour	Unlikely	Under water noise will be restricted to vessel noise, which is frequent in this locality with the regular shipping to and from the Hunter River.

4.1 Estuarine Fauna

4.1.1 Marine Birds and Shorebirds

Marine birds and shorebirds may regularly use resources within the Project Area. This may include shoreline habitats associated with the breakwater or open beach to forage, rest or roost and potentially nest at times. Such species are known to include gulls, terns and cormorants, which are common in coastal areas along the NSW Coast. In addition to these common species, various threatened and migratory species may at times utilise habitat within the Project Area, which is in very close proximity to the Hunter Estuary, a RAMSAR wetland. Impacts on these birds may also include short term disturbances to habit quality relating to reduced water quality and potentially lower prey abundances. Although, given the large areas these birds forage across and the very small and localised habitat that will be disturbed as a result of nourishment, which is very deprived of intertidal invertebrates from the erosion, these impacts on foraging habitat quality are not expected to be of ecological significance to shorebirds including wading species that utilise shoreline habitat. For the majority of these species breeding does not occur locally nor on the Australian mainland. For the few (shorebirds) that do breed locally such as the Pied Oystercatcher (*H*aematopus *longirostrisi*) and Little Tern (*Sternula albifrons*), the Study Area only provides very marginal potential breeding habitat and is not considered a breeding/nesting area. However, some of these species, such as some Sand Plovers and Godwits, may at times potentially roost along the higher shoreline of the open beach within the Project Area. While the habitat is marginal for roosting at best and currently in a very degraded state due to shoreline erosion, the proposed nourishment works could potentially attract additional birds to feed on amongst deposited sands, which may encourage roosting in these areas that are typically not preferred by these species. Given this, the following shorebird species were considered further through a 7-Part test and /or Assessment of Significance (Appendix 4):

- Greater Sand Plover
- Lesser Sand-plover
- Sooty Oystercatcher
- Pied Oystercatcher
- Bar-tailed Godwit
- Black-tailed Godwit
- Eastern Curlew
- Pacific Golden Plover
- Common Tern
- Little Tern

These assessments concluded that disturbances from nourishment works on shorebirds will be confined to foraging habitat along the shoreline and very marginal and highly degraded potential roosting habitat for some threatened shorebird species. These works are not expected to have an ecologically significant impact on these threatened shorebird species, and may improve both foraging and roosting habitat along the shoreline. The proposed action is unlikely to have a significant impact on any threatened or migratory shorebirds (Appendix 4).

A wide diversity of other marine birds that forage along the coastline are likely to forage in waters within the Study Area at times. These species may include various albatross, shearwater and petrel species, which spend the majority of their time in coastal areas foraging aerially over very large areas of water along the coastline and at sea (SEWPAC 2012). In addition to these marine birds, several birds of prey, such as the White-bellied Sea Eagle (*Haliaeetus leucogaster*) are likely to be common aerial visitors to the Project Area. These birds, especially the marine birds, typically forage over the water and rely on detecting prey aerially from above (Billerman et al. 2020; DAWE 2020; DPIE 2020). Potential impacts on water quality in foraging habitats has potential to affect foraging habitat quality for these species. This may be through reduced prey detection success from waters with elevated levels of turbidity (Lunt and Smee 2015), or due to a reduction in prey abundance. Given that these birds forage over very large areas of the coastline, impacts of water quality on foraging habitat quality as a result of nourishment processes, which are likely to be temporary and localised, given fine content will be less than (RHDHV, 2020), are not expected to be of ecological significance for marine birds given that regular elevations of turbidity are already occurring within the Project Area as a result of regular spoil disposal as part of the Maintenance Dredging within the Newcastle Harbour, and the constant tidal exchange of more turbid waters from the Hunter River.

4.1.2 Marine Mammals

The proposal is limited to shallow water, in close proximity to the shoreline. Use of these waters by any of the larger marine mammals, including cetaceans, is likely to be rare and only as part of transient movements through the locality. Smaller marine mammals, such as dolphins and fur-seals, are however, likely to occur on occasions as part of transient movements in and out of the locality to opportunistically feed or for refuge. Given these species forage over very large areas, when considered against the size of the Study Area, the potential for ecologically significant impacts on these species as a result on the proposed nourishment works is minimal. Use of rocky habitat associated with the breakwater by Australian Fur-seals is known within the locality. The sandy shoreline, adjacent to the proposed nourishment site, however, has a high level of existing human activity and is unlikely to be a permanent and/or significant resting location for the local Australian Fur-seal population. The breakwater is, however, likely to provide preferential foraging opportunities for Fur-Seals at times. Short-term disturbances and reductions in habitat quality associated with the nourishment processes, have the potential to induce behavioural changes for this species, including a temporary shift or expansion of foraging grounds, which may increase predation risk for this species. Potential to impact on Fur-Seals was considered further through a 5-Part Test (Appendix 4). This assessment found that Australian Fur-seals that may potentially utilise habitat in the vicinity of the proposal are unlikely to be significantly affected by the proposed activity. Habitat use in the vicinity of the Project Area is likely to be very occasional, and likely restricted to occasional individual visits during foraging activities and transient movement along the coast (Appendix 4).

The proposal is not expected to generate any ecologically significant levels of underwater noise with potential for detrimental physiological or behavioural responses. Any noise that is generated is not expected to be any greater in occurrence to existing shipping movements that occur in and out of the Hunter River or from existing spoil placement nearby from the maintenance Hopper Dredge operated by Ports.

4.1.3 Marine Reptiles

Some marine reptiles may be transient visitors to the site at times. These include the Green Turtle (*Chelonia mydas*), Loggerhead Turtle (*Caretta caretta*) and Hawksbill Turtle (*Eretmochelys imbricata*). While some Green Turtles have been found to nest as far south as the mid North Coast, most of the Marine Turtle nesting occurs in more tropical waters of northern Australia, while no nesting of Green Turtles has been recorded as far south as Stockton Beach.

Increased vessel interactions and potential ship strikes are key threats to marine turtles. Some additional vessel operations, typically large vessels, will be required during nourishment works, although vessel movements in association with construction works are expected to be minimal in comparison to existing vessel movements that occur in the area. Another major threat to marine turtles is entanglement in or ingestion of marine debris. It is assumed that a source of clean marine sands will be selected for nourishment and that no elevated potential for marine debris, and potential consumption by marine turtles would result from the proposed action, which is greater than inherent risks that marine debris within the existing environment pose.

Habitat associated with the Study Area is largely confined to large areas of unvegetated, clean marine sands, with isolated hard substrata and additional subtidal habitat provided by the breakwater. There is potential that disturbances to water quality will result in reduced habitat quality for marine turtles during construction works, however this disturbance is expected to be very localised. The hard substrata habitats, may provide some foraging potential for marine turtles, however, are likely restricted to areas along the breakwater and unlikely to be a significant foraging ground for these species. Any small-scale habitat changes within the Project Area during or following nourishment works (including short term potential for smothering of isolated areas of hard substrata), are therefore considered of minimal ecological significance to foraging prospects for this group of species.

Based on the current project description the potential for nourishment works to impact on marine turtles that may occur in the Project Area at times is considered minimal and does not require further assessment.

4.1.4 Fish, Sharks and Rays.

The proposal is limited to shallow water, in close proximity to the shoreline. Given this, direct impacts on any pelagic or benthic fish, sharks or rays are considered unlikely, with most benthic species that occupy soft sediment habitats, capable if disturbed by placement of sediment, to quickly move out of the way and to a nearby similar habitat, which are plentiful. The placement of sands may, however, attract fish and smaller shark and ray species that feed on small invertebrates, with the nourishment providing for opportunistic feeding by some of these species, should it include potential food/prey items. Reef dwelling species may include highly motile species that move between various reefs and resources throughout the much wider locality, or the more cryptic species that may occupy complex structure created amongst large rocks along the breakwater toe or wrecks, for protection and/or shelter. With the later potentially including the Vulnerable Black Rockcod (*Epinephelus daemelii*) which may at times utilise habitat associated with the breakwater and potentially any permanent structure provided by the shipwrecks in the Study Area. The natural habitat of the Black Rockcod includes deeper shoreline areas along rocky drop-offs where ledges, overhangs and caves occur (NSW DPI 2012b). Although it was not observed during the survey during which water visibility conditions were generally poor, the potential for its use of habitat in the Study Area cannot be dismissed. It is likely that only a very small proportion of the local population, if any, and/or intermittent use of habitat resources within the Study Area occurs. The proposed nourishment works have potential to disturb any Black Rock Cod that occur in the Project Area and reduce habitat quality. Cryptic species such as protected Syngnathidae fishes may occur in the Study Area but are most likely associated with macroalgal stands associated with the breakwater and any shipwrecks that provide permanent habitat. No potential habitat for the Endangered White's Seahorse occurs in the Study Area.

Various other endangered and/or migratory larger predatory fish, sharks and rays, may occur at times in the waters of the Study Area. The waters of the Stockton Bight are known to provide habitat for threatened species such as the White Shark (*Carcharodon carcharias*). In NSW, the Stockton Beach/Hawks Nest area has been identified as a primary residency region for juvenile White Shark (DPI, 2022). Given no direct impacts of the project are expected to occur on this species, the large spatial area utilised by juveniles within this locality, and the transient nature of and wide range of resources used by this shark species, the potential impact on the White Shark is considered minimal. The Critically Endangered Grey Nurse Shark does occur in the locality, while no aggregation sites are present within or nearby, it is likely that some individuals forage within the Study Area (mostly at night) or could potentially seek daytime refuge amongst any habitat provided by the wrecks along the breakwater or in deeper areas behind the surf zone. Likewise with the Black Rockcod, the proposed nourishment works may have potential to disturb any Grey Nurse Sharks that occur in the Project Area and reduce habitat quality. Potential to impact on Black Rockcod and Grey Nurse Sharks was considered further through a 7-Part Test and Assessment of Significance. This assessment found the viability of the Grey Nurse Shark and Black Rockcod population that may utilise habitat in the vicinity of the proposal is unlikely to be significantly affected by the proposed activity. Potential Grey Nurse Shark and Black Rockcod habitat inside the Study Area is marginal habitat only and is not expected to be significant to the local population. Impacts from the proposal are restricted to some potential disturbances during construction works that may have some localised and short-term influence on habitat quality if they are present in the Study Area at this time. Any disturbance of Grey Nurse Sharks or Black Rockcod will be dependent on their occurrence at the time of nourishment works. The proposed action is unlikely to have a significant impact on any Grey Nurse Shark or Black Rockcod (Appendix 4).

4.1.5 Invertebrates

Direct disturbances of the invertebrate community will be confined to soft sediment habitats. This may include infauna and macroinvertebrates that live amongst intertidal and subtidal soft sediments. These small animals, which live amongst the sand grains are a key component of marine food webs that provide a food source for fish and birds. They are also a key component of the benthic ecosystem within soft sediment communities and can be good indicators of environmental quality (Marks 2017).

Based on surveys done for this report the infauna assemblage (greater than 1mm in size) is highly deprived and in most part likely absent in the intertidal and shallow subtidal areas following erosion events. Given the amount of sand that has been lost over recent months from Stockton Beach and use of primarily the top 100 mm of soft sediment by infauna (Morrisey *et al.* 1998), this finding is not surprising. Other larger, intertidal invertebrates such as the Common Pipi (*P. deltoides*) were also found to be very rare. Historically, Stockton Beach has been a significant site for both recreational and commercial harvest of this species on the NSW Coast (Murray-Jones 1999). This finding coincides with previous general surveys, which noted that few Pipis occurred on beaches with erosion and resulting steep swash zones (McKenzie & Montgomery 2012). In subtidal areas further from shore within the Project Area, soft sediment invertebrates such as infauna are likely to be less disturbed by the erosional processes occurring on the beach, especially in areas beyond the surf zone. In these areas various polychaetes, gastropods and bivalve species are likely still to be present and abundant in places.

The proposed nourishment will result in smothering and burying of any remaining infauna, which will be one of the largest biological impacts of this proposal (Marks 2017). These impacts will likely be greatest in areas beyond the Surf Zone where the infauna and macroinvertebrate community is not as deprived as intertidal and shallow subtidal areas, where significant shoreline erosion has occurred. This community of animals is of importance to ecological function and higher order consumers such as shorebirds and fish. The proposal also has potential to have longer-term impacts on the habitat for this group of fauna by changing the critical habitat requirements in regard to sediment particle size distribution (Marks 2017). These impacts can be reduced by selecting sediments for nourishment that are similar in composition to the pre-nourished state of the site (Vanden Eede *et al.* 2014), which will also likely aid recovery on infauna and macroinvertebrates in nourished areas. The research and information regarding the recovery by infauna and macroinvertebrates following nourishment works remains very limited (Marks 2017). However, it is predicted that recovery will occur more quickly in subtidal habitats, with those more stable sediments in deeper water likely to recover quicker then shallow areas, where greater disturbance from wave energy occurs. While the recovery of intertidal sediments is likely to be slower, lower intertidal areas have been previously found to recover more quickly in comparison with higher areas (Marks 2017). Typically, early stages of recovery may be detectable from weeks to months after sand placement but will depend on seeding potential for these communities, patchiness and volume of nourishment, other disturbances of sediments and the physical properties of the sediment used.

Other larger soft sediment invertebrates such as larger gastropods and crustaceans, sea cucumbers, sand and tube anemones, sea pens and other cnidarians may sporadically occur in the Project Area, and slow moving and solitary species would likely be smothered by this proposal. The Endangered Cauliflower Soft Coral (*Dendronephthya australis*) typically confined to estuarine environments (NSW DPI 2021) and is unlikely to occur in the Project Area, due to constant sand movements and exposure to regular and large swells.

Invertebrate communities associated with hard substrata are primarily intertidal within the project Area and associated with the seawall. These communities consist of common molluscs, gastropods, and bivalves. More diverse subtidal communities may be found on the scattered areas of hard substrata and the nearby breakwater. Some smothering and burial of these communities may also occur along the toe of the seawall and on any scattered hard substrata structures within the Project Area. Given the very small areas likely to be impacted and rapid ability to recolonise hard substrata by these species, impacts on these communities from this project are considered to be of minimal ecological significance

4.1.6 Macroalgae

Macroalgae within the Study Area is typically confined to areas along the breakwater and adjacent shipwrecks. Minimal macroalgae occurs within the Project Area, with occurrences limited to the toe of the seawall, where the common brown macroalgae Gulfweed (*Sargassum* sp.) was observed. Some macroalgae may also occur on the scattered substrates within subtidal sections of the Project Area. However, given the exposure to swell, and likely regular sand scouring and burial, any occurrence establishment on these structures is likely to be rare. Given this, direct impacts from this proposal on the macroalgae community are considered minimal. However, indirect impacts on the larger and more established assemblages associated with the nearby breakwater and adjacent shipwrecks may occur as a result of reduced water quality and sedimentation. Macroalgae, is typically less sensitive to reduced water quality and sedimentation then other macrophytes, however sedimentation can be a driver of change of these communities, with loss of large canopy forming species and favourable conditions for turfing and opportunistic species (Airoldi 2003), especially wear prolonged disturbances occur that coincide with other events and disturbances, such as removal of large canopy forming macroalgae as a result of ocean swells. Given that this site is regularly influenced by large ocean swells, and elevated sediment loads from the adjacent Hunter River, impacts from short-term disturbances to water quality on nearby macroalgae assemblages are expected to be minimal as a result of this proposal. However, potential impacts can be further reduced by the selection of clean marine sands and avoidance of sediments with high fines that take longer to settle and are more likely to cause larger and more widespread sediment plumes.

4.2 Key Threatening Processes

4.2.1 Debris and Harmful Substances

Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris is considered a Key Threatening Process under both the FM and EPBC Acts. The planned or unplanned disposal of any wastes, petroleum-based products and other debris has potential to have direct and indirect impacts on marine fauna in the proposal area. For example, petroleum products destroy the insulating ability of fur-bearing mammals such as seals and the water repellence of bird feathers, while they can also have an effect on the health, fitness, condition, growth rates, and larval survival of fish and invertebrates (Clarke 2011). During construction works uncontained debris and contaminants from unplanned spills can enter the waterways. The implementation of management measures to manage wastes and minimise the likelihood of unplanned spills will be required to minimise this risk.

In addition, sediments for nourishment may potentially introduce additional debris and harmful substances to the area, which in turn could be ingested by or become entangled on wildlife. Thus, selection of clean marine sands, with minimal to no debris will be of importance in minimising environmental impact for this project.

4.2.2 Non-native and Invasive Species

The introduction of non-indigenous fish and marine vegetation to the coastal waters of NSW is considered a Key Threatening Process under the FM Act. Introduced fish and marine vegetation, or noxious (invasive or toxic) species, that may occur and be transferred from place to place on construction equipment can pose a risk in terms of introduction of a non-native or invasive species. Attachment to vessel hulls and transport amongst ballast water are considered the major vectors for dispersal of these species.

Various introduced marine species occur in NSW waters, with the majority causing no apparent harm to the marine environment, and instead simply become additional species in the local environment. However, for a minority of species, they become pests with potential for disease in native species and humans, interfere with fisheries and aquaculture, fouling of industrial equipment, and disturbance and alteration of local ecosystems (Wallentinus and Nyberg 2007). The nourishment works have potential to act as a vector to transport and spread marine pest species, should they be present within or on sediments from the source. This may include vegetative material of an invasive alga, an introduced fouling or sedimentary invertebrate or toxic dinoflagellates. These species are more likely to be present within harbours with international shipping, such as nearby Newcastle Harbour. The selection of clean marine sands from sources outside of commercial harbours would significantly reduce this risk. Additional investigations to determine the risk of spread of introduced marine species will need to be undertaken should any sediments be sourced from areas such as harbours with elevated risk potential for introduced marine species.

5 Recommendations and Conclusions

5.1 Recommendations

This section details how the proposal would, in the first instance, avoid ecological impacts on the marine environment, then apply mitigation measures where avoidance is not possible.

5.1.1 Avoid

The following recommendations should be implemented to avoid impacts to marine flora, fauna, infauna and their habitats:

- Avoid placement of sands on habitat provided by the breakwater and adjacent shipwrecks to the south of the proposed Project Area
- Avoid nourishment of the beach areas if any shorebirds are found to be nesting within or adjacent (within 100m) of the Project Area).
- All vessel operations and nourishment works (including rainbowing) should maintain suitable approach distances for any marine mammals or reptiles. This should include:
  - 100m from any whale including 300m in front and behind the animal.
  - 50m from any dolphin or dugong and 150m if they have calves.
  - 50m from any seal or turtle.
  - 100m from any shorebirds found to be nesting, roosting or feeding along the shore.
- Avoid storing hydrocarbon-based products on site.
- Avoid use of sediments for nourishment, which are substantially different in particle size distribution to the pre-nourishment site and where from sources with an elevated risk of:
  - Contaminants, nutrients and ASS.
  - Marine debris, plastics and microplastics.
  - Potential; for introduced marine species.

5.1.2 Minimise / mitigate

The following recommendations should be implemented to minimise impacts to marine flora, fauna, infauna and their habitats:

- An assessment for the potential for introduced marine species should be undertaken for any sediment source sites from within estuarine environments. For high risk localities such as harbours this may require survey and sampling for species of concern.
- Inspections of the shoreline for nesting shorebirds should be undertaken within the 10 days prior to commencement of works and Pre- nourishment works by an experienced ecologist.
- Adequate erosion and sediment control measures should be implemented to minimise mobilisation of any shoreline sediments directly from the source into the water or into adjacent stormwater drains, in accordance with the 'Blue Book' (Landcom 2004), where shoreline works above the High Water mark are required.
- Sediment should be placed and spread in a manner that minimises changes to the natural beach and seabed profiles.
- During nourishment works, operations should be paused when the above approach distances cannot be maintained due to animals moving into the area. Should the nourishment works be found to be attracting the animals in and the approach distance cannot be maintained, a fauna ecologist will need to need visit site and prepare a suitable management plan to control any risks to marine and avian fauna.

- All machinery should be routinely checked for leaks, with an emergency spill kit to be kept on site at all times. All staff are to be made aware of the location of the spill kit and trained in its use.

5.1.3 Offsetting

NSW DPI enforces a ‘no net loss’ habitat policy as a permit condition or condition of consent. This may require proponents to conduct habitat rehabilitation and/or provide environmental compensation. Given no seagrasses or macroalgae stands are expected to be directly impacted, it is unlikely the current proposal will trigger offsetting requirements under the current NSW DPI Policy (Fairfull 2013).

5.1.4 Permits

The project is not expected to result in any harm to marine vegetation. As such, a Section 205 - permit to harm (cut, remove, damage, destroy, shade etc.) marine vegetation (saltmarshes, mangroves, seagrass and seaweeds) under the FM Act will likely not be required.

5.1.5 Ecological Monitoring

The major ecological impact from nourishment works is expected to be the smothering and burial of infauna and macroinvertebrates from the nourishment works. The development and implementation of a suitable monitoring program is encouraged for this project. The monitoring program should include sampling of soft sediment infauna within low intertidal and deeper subtidal areas behind the surf zone and be developed following the Before-After Control-Impact (BACI) framework (Underwood 1994). The monitoring program should include:

- Multiple sites within Control and Impact locations;
- Replicate infauna samples (minimum 5) collected with a 0.5 mm sieve;
- Minimum of two baseline (Before) surveys within 12 months prior to nourishment.
- Minimum of two post nourishment (After) surveys within 18 months of completion of nourishment works.

5.2 Conclusions

Direct impacts from this proposal will include disturbance of soft sediment intertidal and subtidal areas that provide habitat for small invertebrates that live amongst the sediment, which will likely be smothered or buried. Given that the intertidal and shallow subtidal sediments appear to be very deprived of fauna as a result of the ongoing erosion, these impacts will be greatest in deeper subtidal areas of the Project Area. Impacts on hard substrata habitats are expected to be minimal and confined to isolated occurrences within the Project Area. The Project Area does not provide any critical habitat for any threatened or migratory marine species or shorebirds. Impacts on marine species and shorebirds will likely be minimal and confined to disturbances to marginal foraging habitat during nourishment works, which may include, additional vessel operations, some construction noise, reduced water quality and potential alterations in prey/food source regimes. Other potential impacts include risks associated with habitat change, or alteration as a result of changes to the natural sediment size composition of these soft sediment habitats, and the sourcing of sediments with elevated risks of contaminants, debris and potential for introduced marine pest species. The preferential use of clean offshore sources of sand for the nourishment works would minimise many of these risks that may be elevated with use of some onshore and/or estuarine sources of sediment.

To manage the potential risks that this proposal may pose to marine habitat, flora and fauna, a series of recommendations have been provided. These recommendations should be adopted into the CEMP for construction works for this proposal. With adoption of these recommendations, the proposal is considered unlikely to have a significant impact on State and/or Commonwealth listed threatened aquatic biodiversity.

As such, referral to the Department of the Environment under the EPBC Act is not required. Similarly, the preparation of a Species Impact Statement (SIS) based on the provisions of the BC and FM Act should not be required.

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Plates

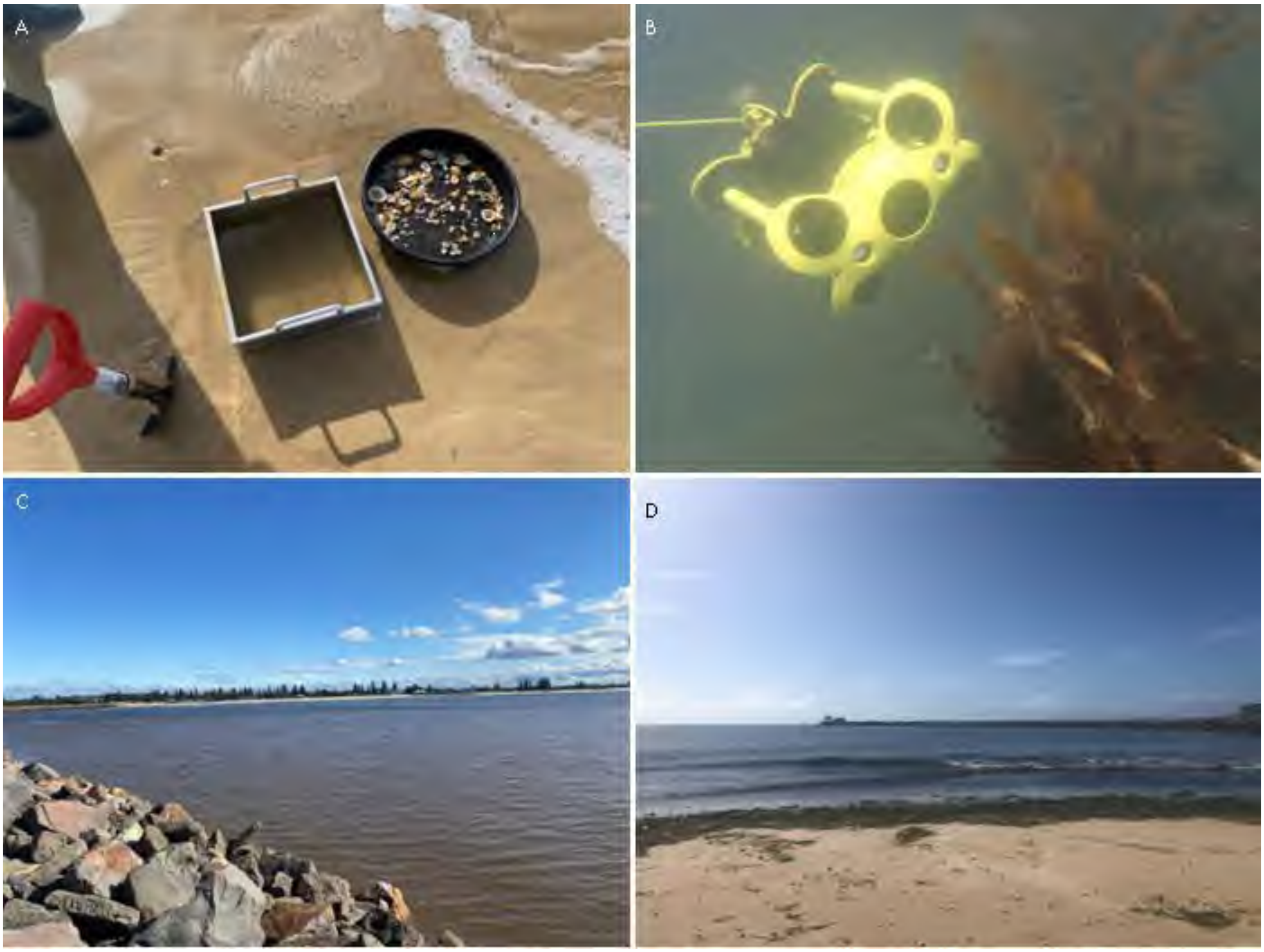


Plate 1: Survey photos and the southern end of Stockton Beach

A: Box quadrat sampling
B: ROV (Underwater drone) on the breakwater
C: Stockton Beach from the Breakwater
D: Southern end of Stockton Beach

Plate 2: Sandy intertidal habits within the Study Area

A: Open sections of the southern end of Stockton Beach looking north.
B: Open sections of the southern end of Stockton Beach looking south.
C: Beach at low tide below the Mitchell Street Seawall looking north
D: Beach at low tide below the Mitchell Street Seawall looking south

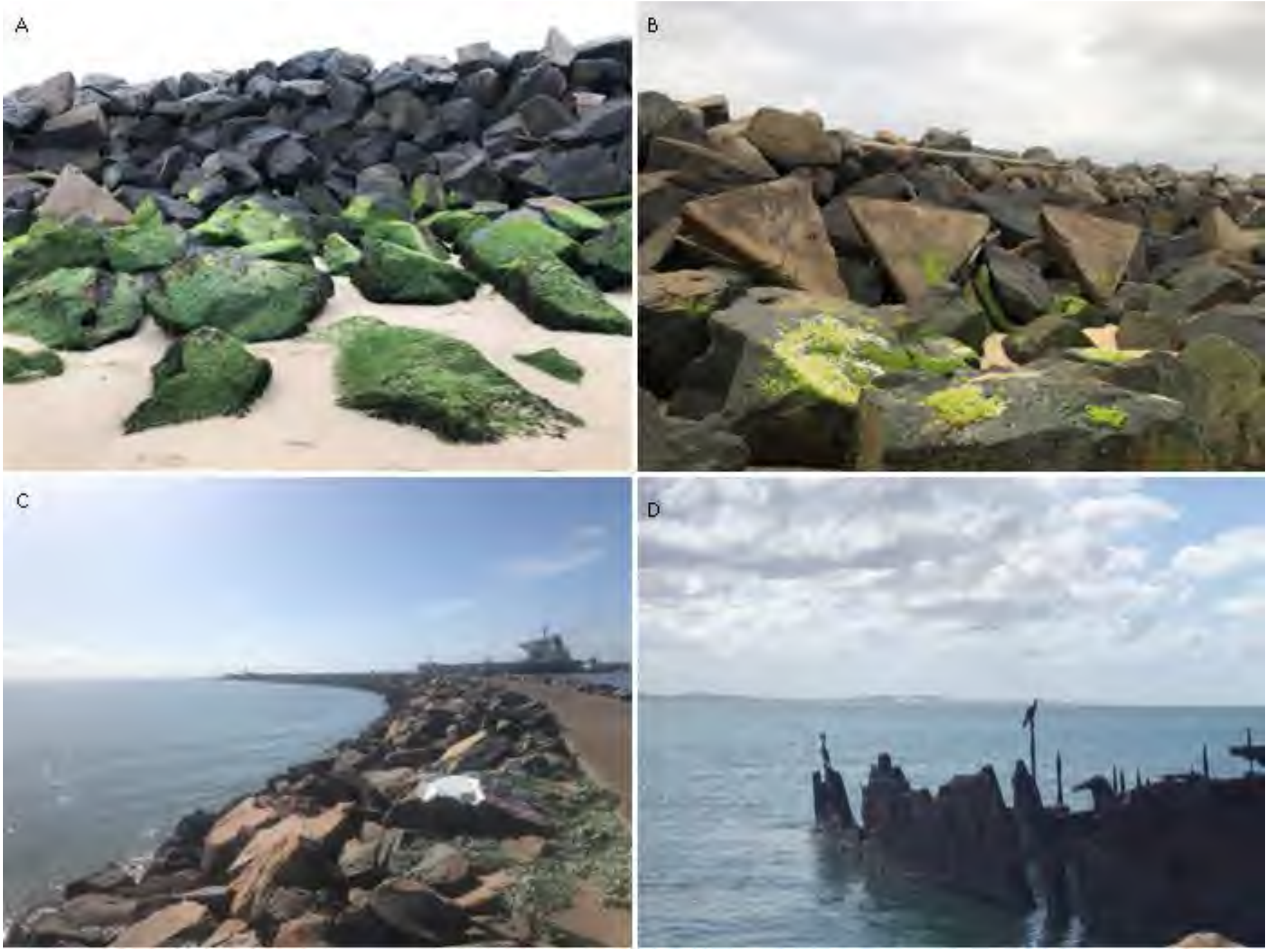


Plate 3: Survey photos and the southern end of Stockton Beach

A: Algae covered rocks on the lower section of the Mitchell Street Seawall
B: Intertidal rocks on the Mitchell Street Seawall.
C: The Stockton Breakwater
D: Shipwrecks adjacent to the Stockton Breakwater

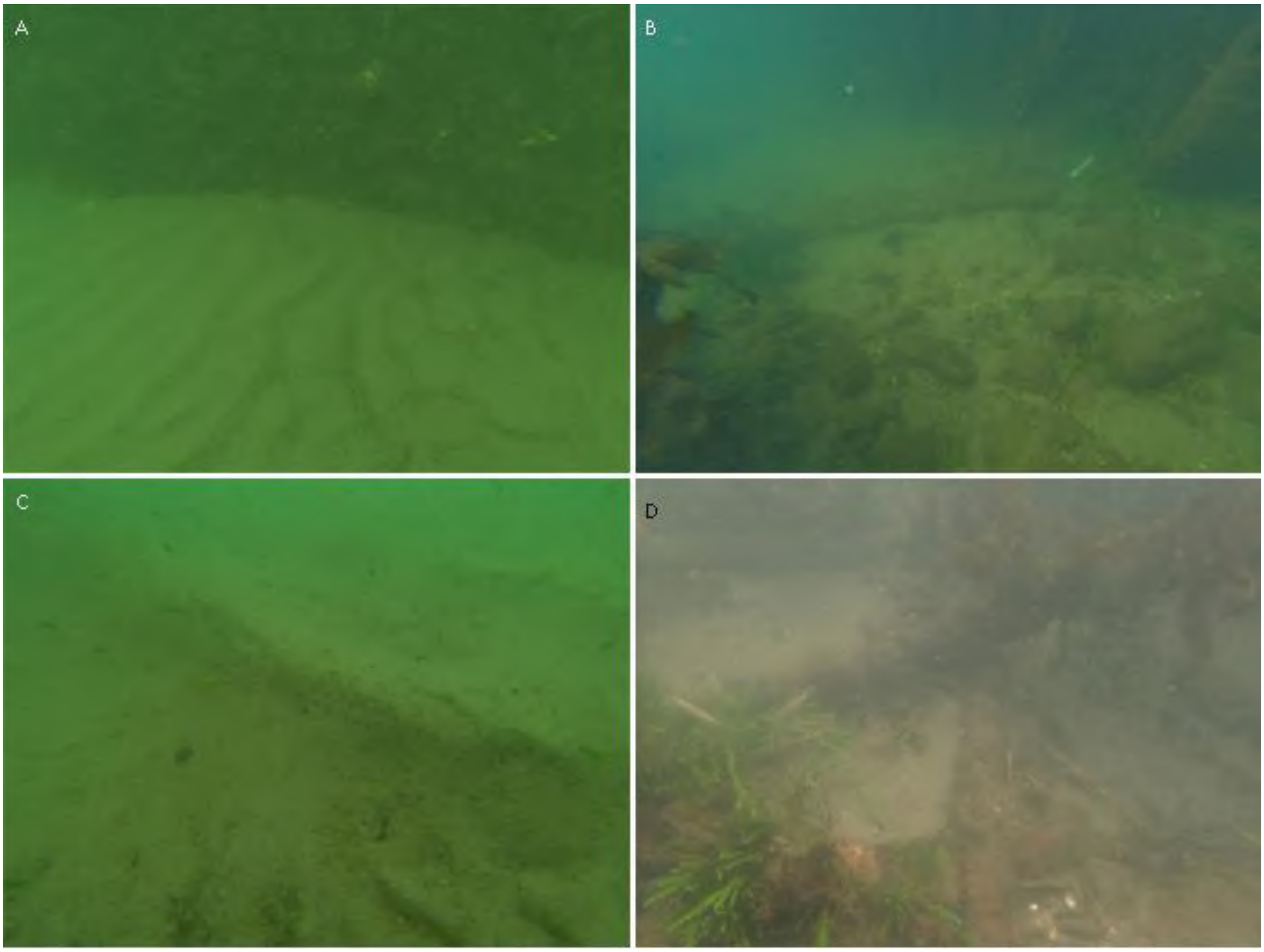


Plate 4: Subtidal habitat within the Study Area

A: Clean marine sands adjacent to the Breakwater
B: Rubble and debris associated with the shipwrecks adjacent to the breakwater.
C: Clean marine sands typical of subtidal habitat within the Project Area
D: Debris associated with the shipwrecks and *Caulerpa filiformis* wrack

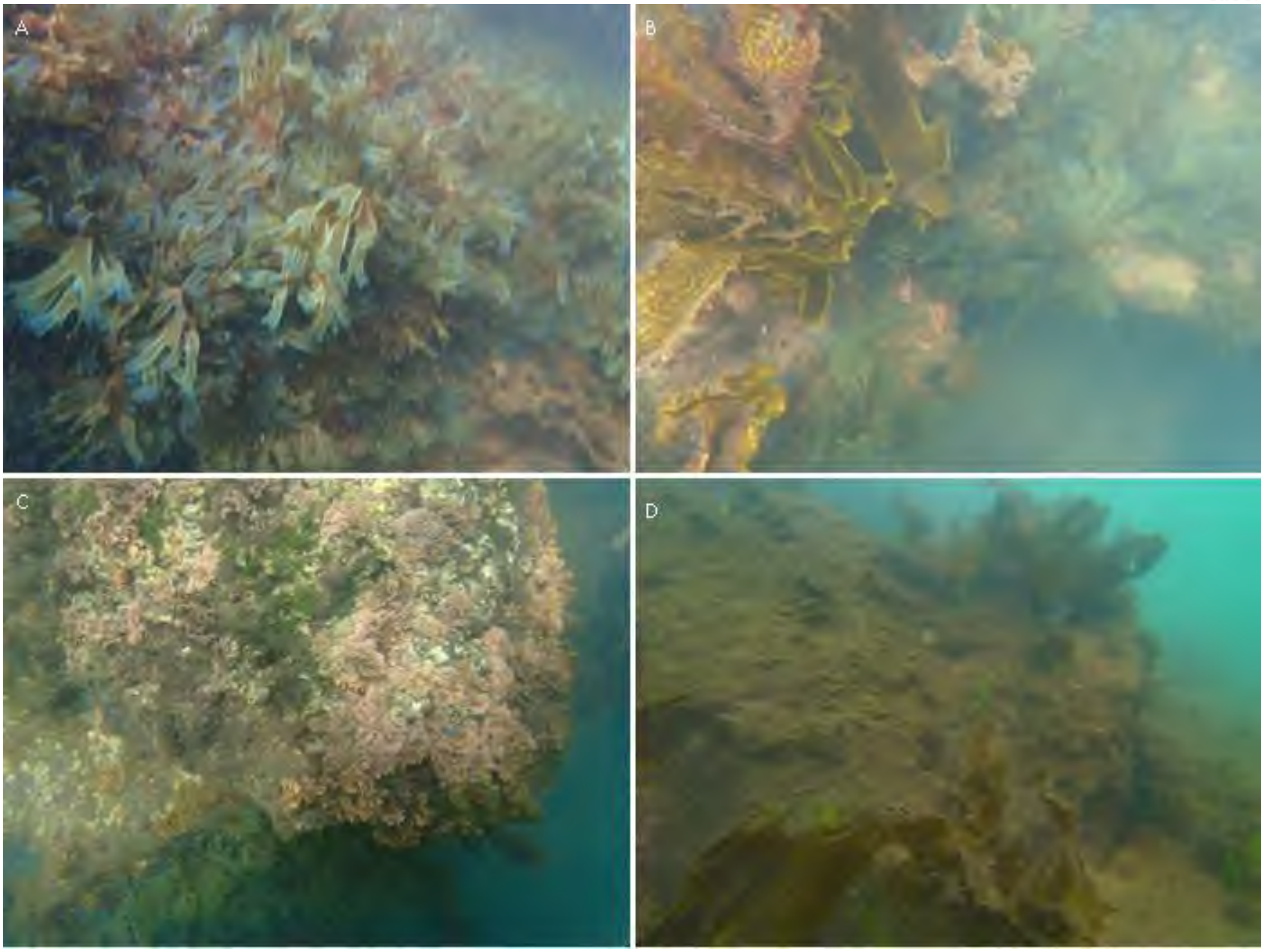
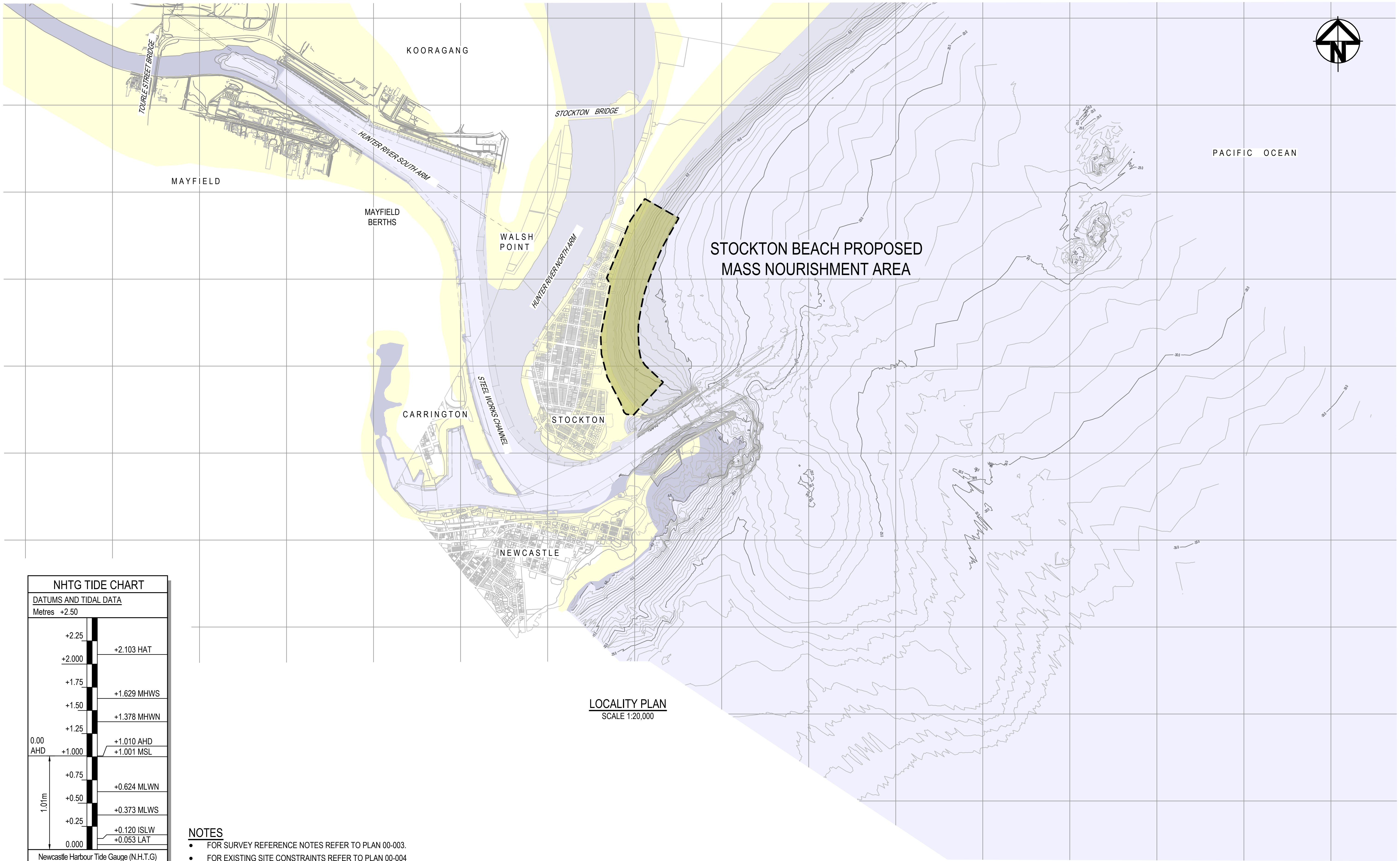


Plate 5: Subtidal algae assemblages associated with the Stockton Breakwater

A: *Dictyota dichotoma*
B: Kelp (*Ecklonia* radiata) with *D. dichotoma*.
C: Encrusting Coralline algae *Corallina officinalis*
D: Kelp and turfing algae

Appendix 1: Concept Design Drawings

Prepared by Blue coast Consulting Engineers



LOCALITY PLAN
SCALE 1:20,000

NHTG TIDE CHART

DATUMS AND TIDAL DATA

Metres +2.50

Metres	
+2.25	
+2.000	+2.103 HAT
+1.75	
+1.50	+1.629 MHWS
+1.25	+1.378 MHWN
+1.000 (0.00 AHD)	+1.010 AHD
	+1.001 MSL
+0.75	
+0.50	+0.624 MLWN
+0.25	+0.373 MLWS
0.000	+0.120 ISLW
	+0.053 LAT

1.01m

Newcastle Harbour Tide Gauge (N.H.T.G)
ALL LEVELS N.H.T.G
A.H.D. = AUSTRALIAN HEIGHT DATUM

NOTES
- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 200 400 600 800 1000m
SCALE 1:20,000 AT ORIGINAL SIZE

DESIGNED BY	HL
DRAWN BY	MC
CHECKED BY	-
APPROVED	EW
APPROVED (CLIENT)	

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

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New South Wales, 2300
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PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

DRAWING TITLE
LOCALITY PLAN

PROJECT NUMBER
P19130

DRG NO.
P19130-BC-00-002

REV.
A

SURVEY LEVELS (m AHD)

9.0	to	10.0
8.0	to	9.0
7.0	to	8.0
6.0	to	7.0
5.0	to	6.0
4.0	to	5.0
3.0	to	4.0
2.0	to	3.0
1.0	to	2.0
0.0	to	1.0
-1.0	to	0.0
-2.0	to	-1.0
-3.0	to	-2.0
-4.0	to	-3.0
-5.0	to	-4.0
-6.0	to	-5.0
-7.0	to	-6.0
-8.0	to	-7.0
-9.0	to	-8.0
-10.0	to	-9.0
-11.0	to	-10.0
-12.0	to	-11.0
-13.0	to	-12.0
-14.0	to	-13.0
-15.0	to	-14.0
-16.0	to	-15.0
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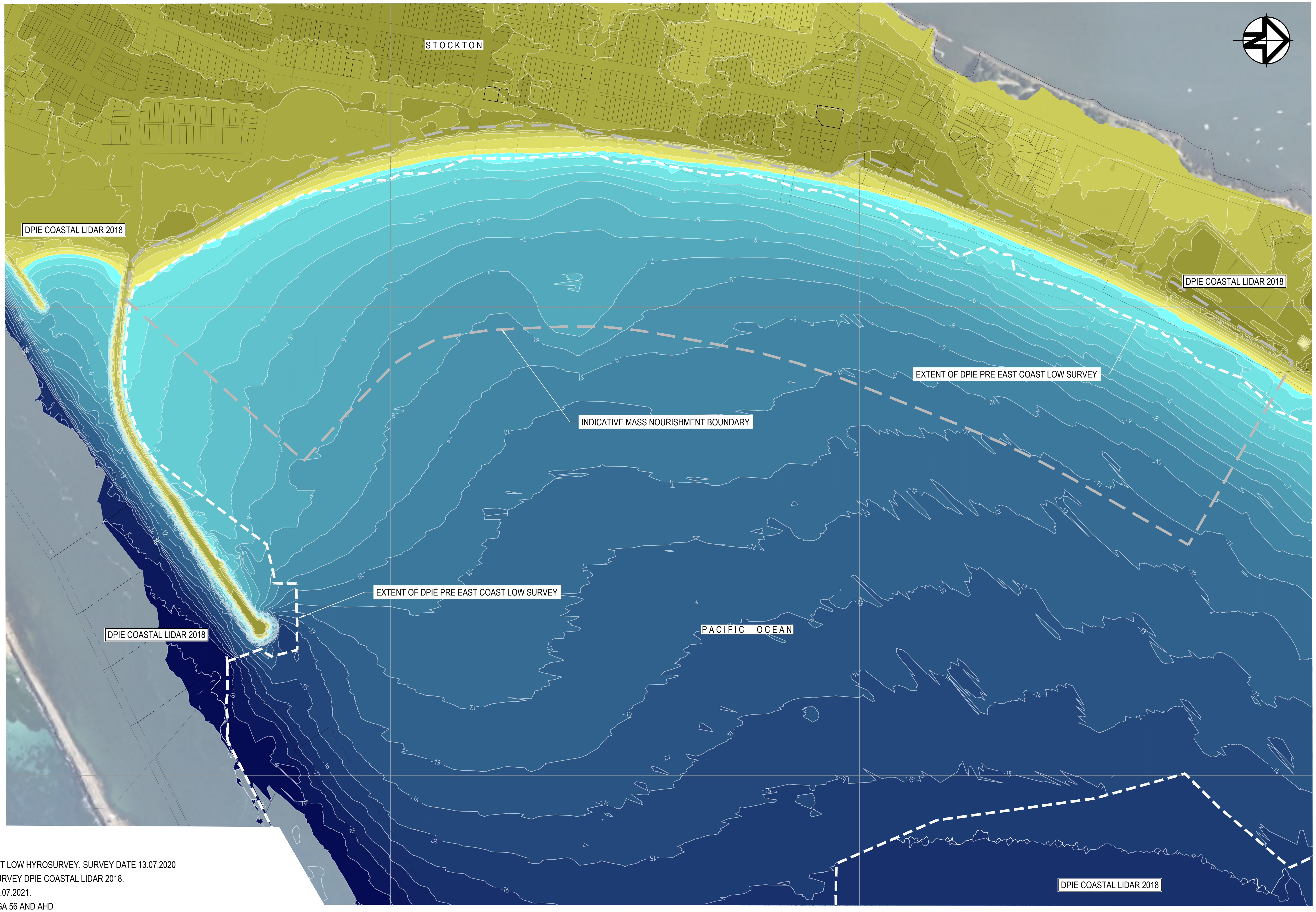
-20.0	to	-19.0



SURVEY PLAN
SCALE 1:4,000

NOTES

- BASE SURVEY DPIE PRE EAST COAST LOW HYROSURVEY, SURVEY DATE 13.07.2020
- SUPPLEMENTARY TOPOGRAPHIC SURVEY DPIE COASTAL LIDAR 2018.
- AERIAL IMAGE PROVIDED, DATED 08.07.2021.
- ALL LEVELS ARE WITH RESPECT MGA 56 AND AHD
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 40 80 120 160 200m
SCALE 1:4,000 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

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PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

DRAWING TITLE
SURVEY PLAN

PROJECT NUMBER
P19130

DRG NO.
P19130-BC-00-003

REV.
A

EXAMPLE VESSELS

Vessel	Draught (loaded)	Hopper capacity	Length	Sand placement
David Allan TSHD	3.0m (4.4m)	1,000m³	71.5m	Split hopper
Modi R TSHD	1.5m (3.8m)	1,393m³	67.05m	Split hopper/ rainbow 50m
Albatross TSHD	1.85m (3.8m)	1,860m³	75.0m	Hopper doors/ rainbow 50m
Brisbane TSHD	3.0m (6.25m)	2,900m³	84.1m	Hopper doors
Balder R TSHD	3.8m (7.0m)	6,000m³	111,30m	Split hopper/ rainbow 120m

LEGEND

- MARTIME FEATURES (#)
- SHIPWRECKS (*)
- STRUCTURES
- ABORIGINAL HERITAGE
- MASS NOURISHMENT AREA

(#) DIGITISED FROM AERIAL IMAGERY AND CHARTS

(*) DATA DERIVED FROM NSW MARITIME HERITAGE DATABASE

LEGEND

LADEN VESSEL DRAFT

- MODI R (3.8m)
- ALBATROSS (3.8m)
- DAVID ALLEN (4.4m)
- BRISBANE (6.25m)
- BALDER R (7.0m)

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.
- BASIS FOR VESSEL DRAFT IS RL 0.0 AHD

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 40 80 120 160 200m

SCALE 1:4,000 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

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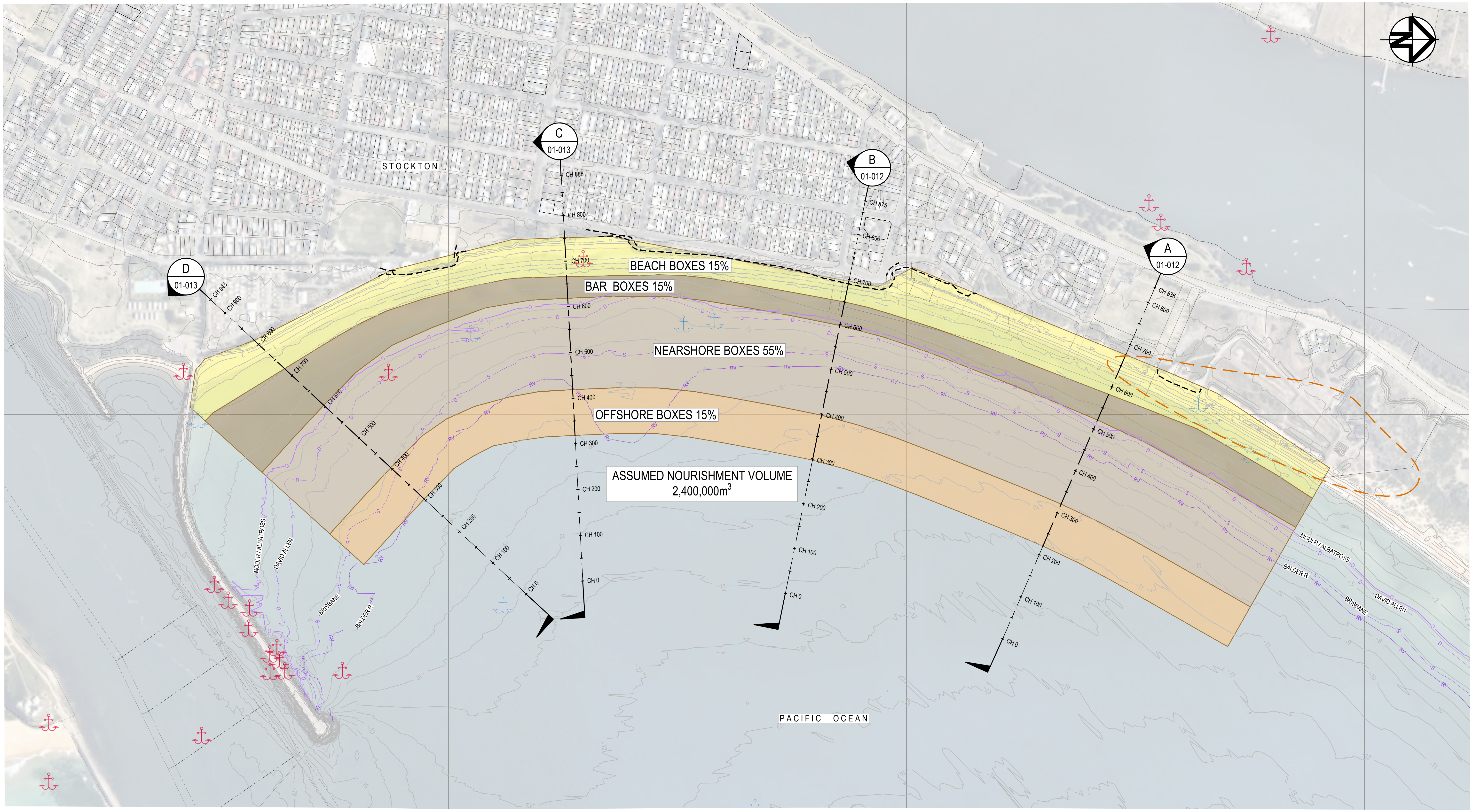
PROJECT
STOCKTON BEACH NOURISHMENT CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
SITE CONSTRAINTS PLAN

DRG NO.
P19130-BC-00-004

REV.
A



LEGEND

	MARTIME FEATURES (#)	(#) DIGITISED FROM AERIAL IMAGERY AND CHARTS
	SHIPWRECKS (*)	
	STRUCTURES	(*) DATA DERIVED FROM NSW MARITIME HERITAGE DATABASE
	ABORIGINAL HERITAGE	

LEGEND

LADEN VESSEL DRAFT

- MODI R (3.8m)
- ALBATROSS (3.8m)
- DAVID ALLEN (4.4m)
- BRISBANE (6.25m)
- BALDER R (7.0m)

MASS NOURISHMENT PLAN

SCALE 1: 4,000

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 40 80 120 160 200m

SCALE 1:4,000 AT ORIGINAL SIZE

DESIGNED BY	HL
DRAWN BY	MC
CHECKED BY	-
APPROVED	EW
APPROVED (CLIENT)	

REFERENCES

SURVEY PROVIDED BY	DPIE
HORIZONTAL DATUM	MGA 56
VERTICAL DATUM	AHD

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PROJECT

STOCKTON BEACH NOURISHMENT CONCEPT DESIGN

PROJECT NUMBER

P19130

DRAWING TITLE

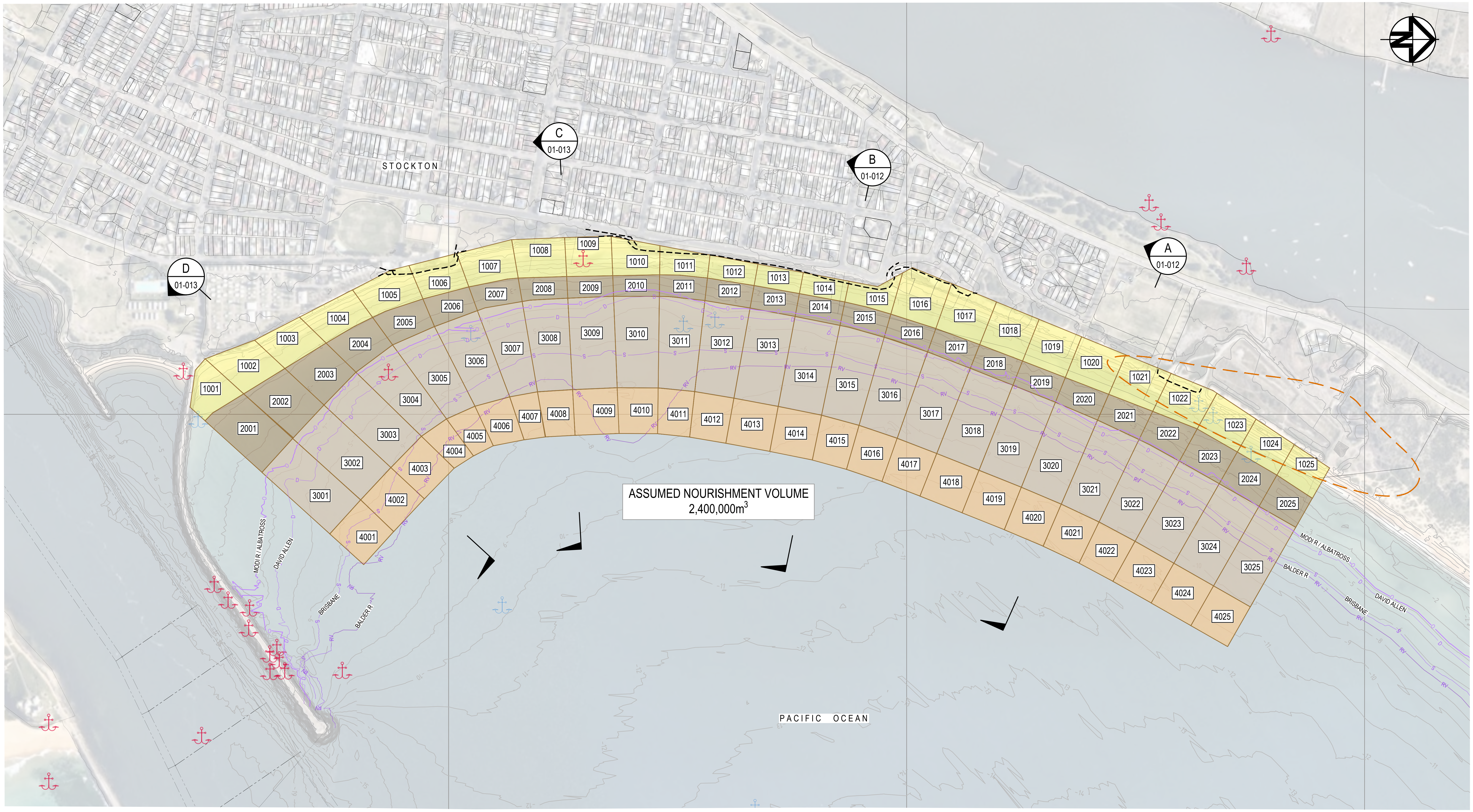
MASS NOURISHMENT MASTER PLAN

DRG NO.

P19130-BC-01-010

REV.

A



LEGEND

- MARTIME FEATURES (#)
- SHIPWRECKS (*)
- STRUCTURES
- ABORIGINAL HERITAGE
- 2001 NOURISHMENT GRID

(#) DIGITISED FROM AERIAL IMAGERY AND CHARTS

(*) DATA DERIVED FROM NSW MARITIME HERITAGE DATABASE

LEGEND

LADEN VESSEL DRAFT

- MODI R (3.8m)
- ALBATROSS (3.8m)
- DAVID ALLEN (4.4m)
- BRISBANE (6.25m)
- BALDER R (7.0m)

GENERAL ARRANGEMENT PLAN

SCALE 1: 4,000

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

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SCALE 1:4,000 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

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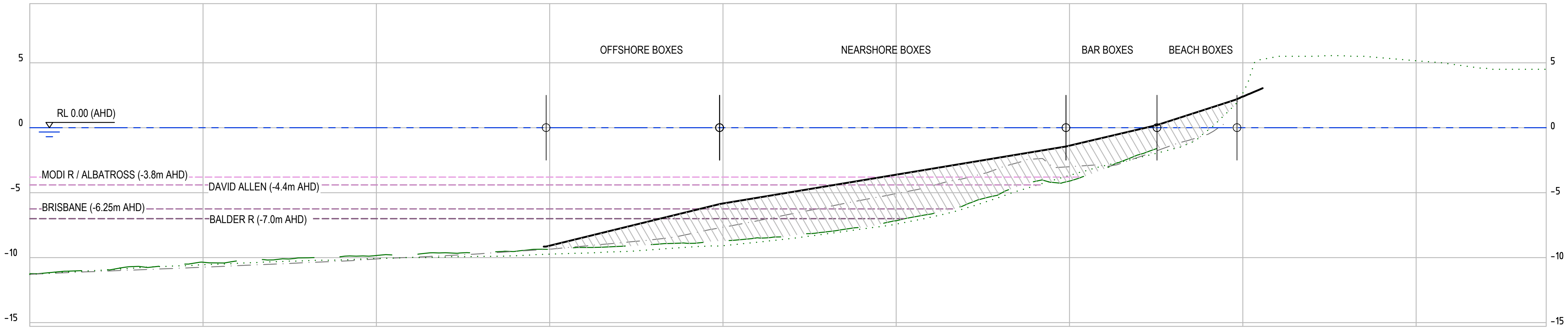
PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
MASS NOURISHMENT
GENERAL ARRANGEMENT PLAN

DRG NO.
P19130-BC-01-011

REV.
A



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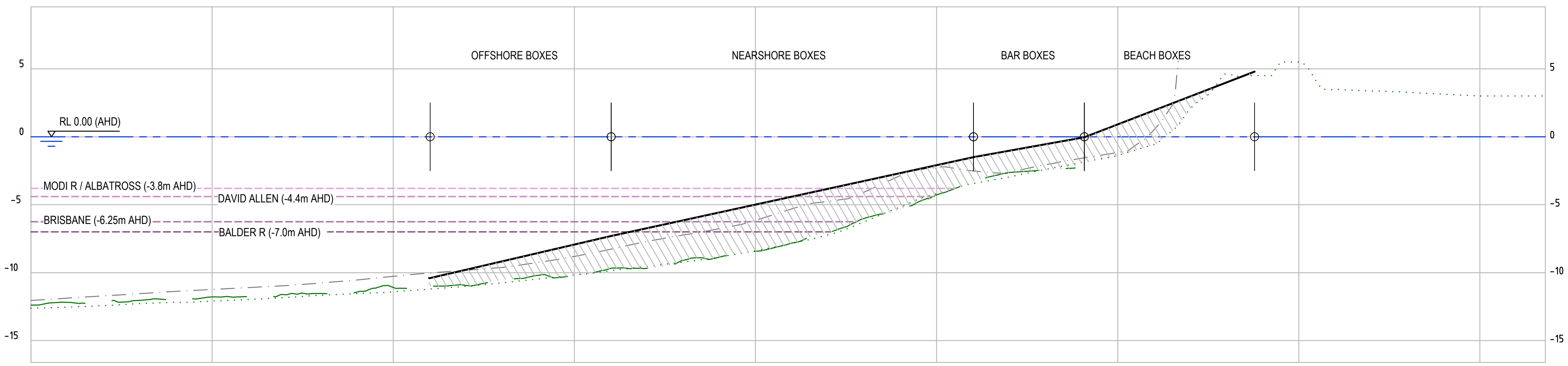
EXISTING SURFACE	-11.23	-10.85	-10.35	-10.10	-9.84	-9.63	-9.37	-9.06	-8.70	-8.15	-7.16	-5.46	-4.11	-1.62	2.67	5.55	5.16	4.50	4.50
CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	875

SITE SECTION B

SCALE 1: 1500H
1:200V



DESIGN FINISHED LEVEL						-9.48	-7.93	-6.44	-4.99	-3.54	-2.09	-0.79	0.91	3.48				
EXISTING SURFACE	-12.39	-12.17	-11.79	-11.51	-11.09	-10.80	-10.24	-9.51	-8.43	-6.62	-4.27	-2.54	-1.37	3.11	5.50	3.34	3.00	3.00
CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	836

SITE SECTION A

SCALE 1: 1500H
1:200V

RL 0.00m (AHD)
SURVEY LEVELS 'STAX' 1995
LIDAR SURVEY 2018
DETAILED BATHYMETRY 2020
PROPOSED FILLING / NOURISHMENT

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE
0 15 30 45 60 75m
SCALE 1:1500 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

PLANS PREPARED FOR:
City of Newcastle
NSW GOVERNMENT
Hunter & Central Coast Development Corporation

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New South Wales, 2300
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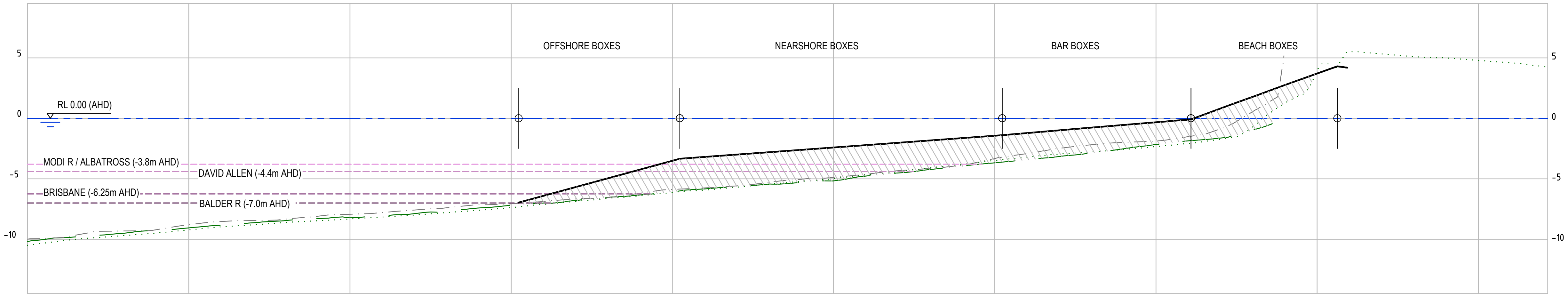
PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
MASS NOURISHMENT
SITE SECTIONS SHEET 1

DRG NO. P19130-BC-01-012
REV. A

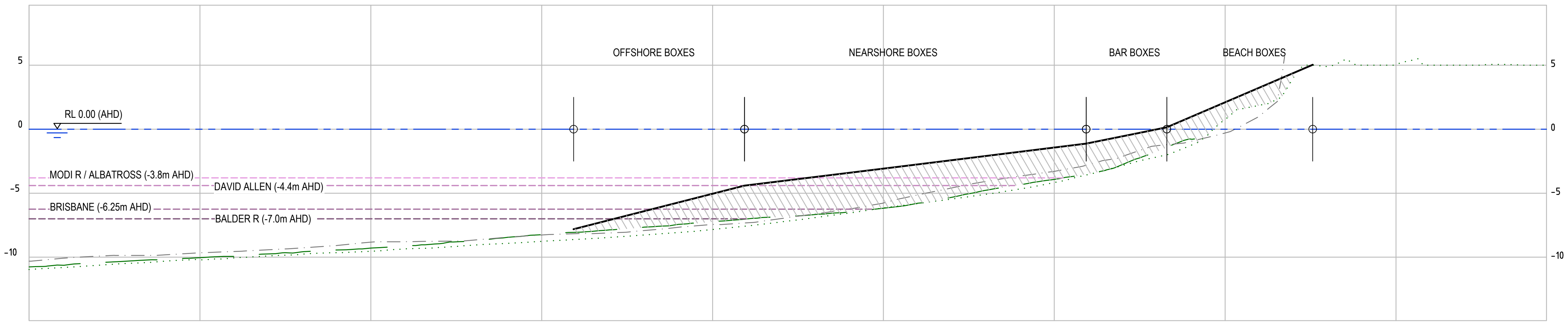


DATUM R.L. -16

DESIGN FINISHED LEVEL								-5.32	-3.51	-2.90	-2.41	-1.92	-1.44	-0.88	-0.33	1.30	3.70			
EXISTING SURFACE	-10.18	-9.61	-9.06	-8.54	-8.23	-7.75	-7.19	-6.66	-6.07	-5.55	-5.17	-4.40	-3.68	-3.02	-2.17	-1.36	4.02	5.21	4.79	4.23
CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	943

SITE SECTION D

SCALE 1: 1500H
1:200V



DATUM R.L. -16

DESIGN FINISHED LEVEL								-6.75	-5.05	-3.90	-3.08	-2.26	-1.43	-0.28	2.10	4.96			
EXISTING SURFACE	-10.76	-10.37	-10.04	-9.65	-9.29	-8.80	-8.24	-7.76	-7.22	-6.77	-6.17	-5.05	-3.92	-2.24	0.77	5.00	5.07	5.02	5.00
CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	888

SITE SECTION C

SCALE 1: 1500H
1:200V

RL 0.00m (AHD)
SURVEY LEVELS 'STAX' 1995
LIDAR SURVEY 2018
DETAILED BATHYMETRY 2020
PROPOSED FILLING / NOURISHMENT

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE

0 15 30 45 60 75m
SCALE 1:1500 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

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Hunter & Central Coast Development Corporation

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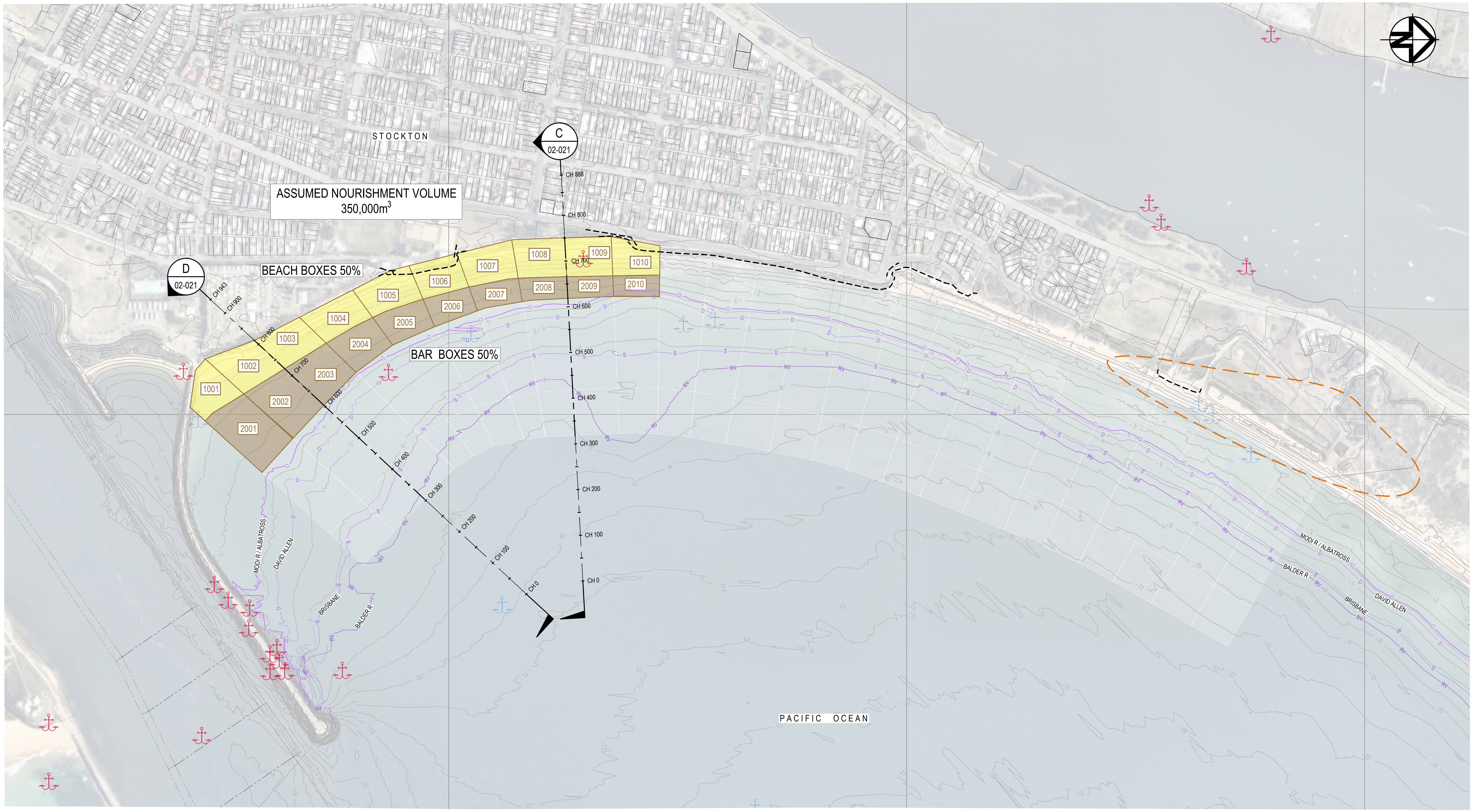
PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
MASS NOURISHMENT
SITE SECTIONS SHEET 2

DRG NO.
P19130-BC-01-013

REV.
A



LEGEND

MARTIME FEATURES (#)

SHIPWRECKS (*)

STRUCTURES

ABORIGINAL HERITAGE

2001 NOURISHMENT GRID

(#) DIGITISED FROM AERIAL IMAGERY AND CHARTS

(*) DATA DERIVED FROM NSW MARITIME HERITAGE DATABASE

LEGEND

LADEN VESSEL DRAFT

MODI R (3.8m)

ALBATROSS (3.8m)

DAVID ALLEN (4.4m)

BRISBANE (6.25m)

BALDER R (7.0m)

AMENITY GENERAL ARRANGEMENT PLAN

SCALE 1: 4,000

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 40 80 120 160 200m

SCALE 1:4,000 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

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PLANS PREPARED FOR:

City of Newcastle

NSW GOVERNMENT Hunter & Central Coast Development Corporation

PLANS PREPARED BY:

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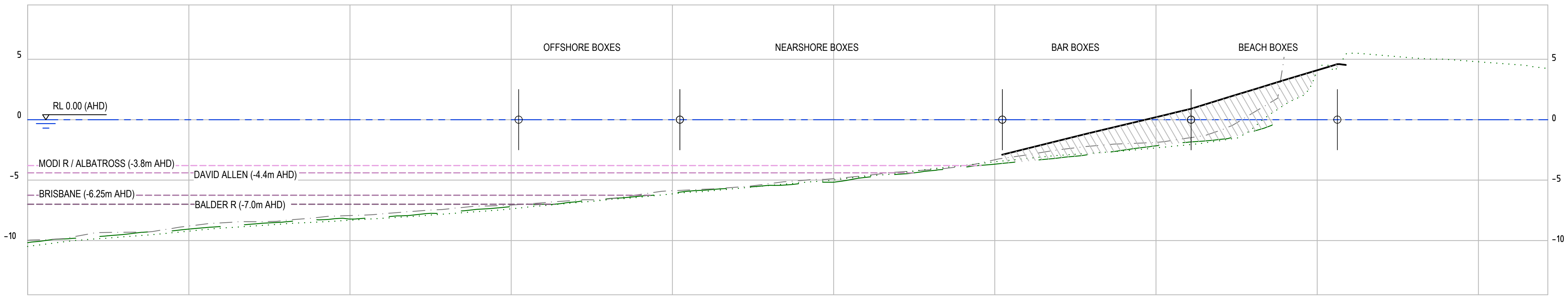
PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
AMENITY NOURISHMENT
GENERAL ARRANGEMENT PLAN

DRG NO.
P19130-BC-02-020

REV.
A

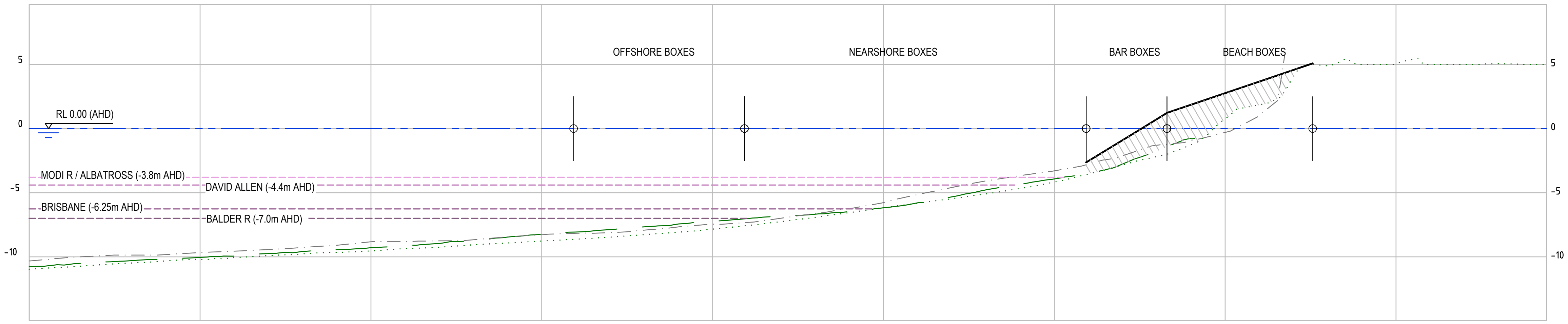


DATUM R.L. -16

DESIGN FINISHED LEVEL														-1.40	0.21	2.07	4.09			
EXISTING SURFACE	-10.18	-9.61	-9.06	-8.54	-8.23	-7.75	-7.19	-6.66	-6.07	-5.55	-5.17	-4.40	-3.68	-3.02	-2.17	-1.36	4.02	5.21	4.79	4.23
CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	943

AMENITY SITE SECTION D

SCALE 1: 1500H
1:200V



DATUM R.L. -16

DESIGN FINISHED LEVEL														-0.08	2.77	5.04			
EXISTING SURFACE	-10.76	-10.37	-10.04	-9.65	-9.29	-8.80	-8.24	-7.76	-7.22	-6.77	-6.17	-5.05	-3.92	-2.24	0.77	5.00	5.07	5.02	5.00
CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	888

AMENITY SITE SECTION C

SCALE 1: 1500H
1:200V

RL 0.00m (AHD)
SURVEY LEVELS 'STAX' 1995
LIDAR SURVEY 2018
DETAILED BATHYMETRY 2020
PROPOSED FILLING / NOURISHMENT

NOTES

- FOR SURVEY REFERENCE NOTES REFER TO PLAN 00-003.
- FOR EXISTING SITE CONSTRAINTS REFER TO PLAN 00-004
- ALL LEVELS ARE WITH RESPECT TO AHD.

REV	DATE	DESCRIPTION	BY	REVIEWED	APP'D
A	11.1.22	ISSUED FOR PRELIMINARY REVIEW	MC	-	-

DRAWING FOR REVIEW

0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE

0 15 30 45 60 75m
SCALE 1:1500 AT ORIGINAL SIZE

DESIGNED BY HL
DRAWN BY MC
CHECKED BY -
APPROVED EW
APPROVED (CLIENT)

REFERENCES
SURVEY PROVIDED BY DPIE
HORIZONTAL DATUM MGA 56
VERTICAL DATUM AHD

PLANS PREPARED FOR:
City of Newcastle
NSW GOVERNMENT
Hunter & Central Coast Development Corporation

PLANS PREPARED BY:
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PROJECT
STOCKTON BEACH NOURISHMENT
CONCEPT DESIGN

PROJECT NUMBER
P19130

DRAWING TITLE
AMENITY NOURISHMENT
SITE SECTIONS SHEET 1

DRG NO.
P19130-BC-02-021

REV.
A

Appendix 2: Threatened Species Searches

Results of Bionet Search (Marine species only within 5km)

Data from the BioNet Atlas website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1°C; ^^ rounded to 0.01°C. Copyright the State of NSW through the Department of Planning, Industry and Environment. Search criteria : Licensed Report of all Valid Records of Threatened (listed on BC Act 2016) ,Commonwealth listed ,CAMBA listed ,JAMBA listed or ROKAMBA listed Entities in selected area [North: -32.86 West: 151.75 East: 151.85 South: -32.96] returned a total of 16,076 records of 107 species.

Report generated on 12/07/2022 3:07 PM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records	Info
Animalia	Amphibia	Myobatrachidae	3137	*Crinia tinnula*		Wallum Froglet	V,P		1	
Animalia	Amphibia	Myobatrachidae	3932	*Uperoleia mahonyi*		Mahony's Toadlet	E1,P		1	
Animalia	Amphibia	Hylidae	3166	*Litoria aurea*		Green and Golden Bell Frog	E1,P	V	17	
Animalia	Reptilia	Cheloniidae	2004	*Caretta caretta*		Loggerhead Turtle	E1,P	E	4	
Animalia	Reptilia	Cheloniidae	2007	*Chelonia mydas*		Green Turtle	V,P	V	3	
Animalia	Reptilia	Cheloniidae	2008	*Eretmochelys imbricata*		Hawksbill Turtle	P	V	2	
Animalia	Aves	Anseranatidae	0199	*Anseranas semipalmata*		Magpie Goose	V,P		1	
Animalia	Aves	Columbidae	0025	*Ptilinopus magnificus*		Wompoo Fruit-Dove	V,P		1	
Animalia	Aves	Columbidae	0023	*Ptilinopus superbus*		Superb Fruit-Dove	V,P		1	
Animalia	Aves	Apodidae	0335	*Apus pacificus*		Fork-tailed Swift	P	C,J,K	8	
Animalia	Aves	Apodidae	0334	*Hirundapus caudacutus*		White-throated Needletail	P	V,C,J,K	15	
Animalia	Aves	Diomedeidae	0086	*Diomedea exulans*		Wandering Albatross	E1,P	E	3	
Animalia	Aves	Diomedeidae	0091	*Thalassarche cauta*		Shy Albatross	V,P	V	1	
Animalia	Aves	Diomedeidae	0088	*Thalassarche melanophris*		Black-browed Albatross	V,P	V	10	
Animalia	Aves	Procellariidae	0072	*Ardenna carneipes*		Flesh-footed Shearwater	V,P	J,K	5	
Animalia	Aves	Procellariidae	0070	*Ardenna grisea*		Sooty Shearwater	P	J	4	
Animalia	Aves	Procellariidae	0069	*Ardenna pacifica*		Wedge-tailed Shearwater	P	J	189	
Animalia	Aves	Procellariidae	0071	*Ardenna tenuirostris*		Short-tailed Shearwater	P	C,J,K	78	
Animalia	Aves	Procellariidae	0853	*Calonectris leucomelas*		Streaked Shearwater	P	C,J,K	1	
Animalia	Aves	Procellariidae	0929	*Macronectes giganteus*		Southern Giant Petrel	E1,P	E	3	
Animalia	Aves	Procellariidae	8684	*Pterodroma leucoptera leucoptera*		Gould's Petrel	V,P	E	1	
Animalia	Aves	Procellariidae	0971	*Pterodroma solandri*		Providence Petrel	V,P		2	
Animalia	Aves	Fregatidae	0095	*Fregata ariel*		Lesser Frigatebird	P	C,J,K	1	
Animalia	Aves	Sulidae	0105	*Sula dactylatra*		Masked Booby	V,P	J,K	1	
Animalia	Aves	Ardeidae	0197	*Botaurus poiciloptilus*		Australasian Bittern	E1,P	E	1	
Animalia	Aves	Accipitridae	0218	*Circus assimilis*		Spotted Harrier	V,P		1	

Animalia	Aves	Accipitridae	0226	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V,P		393
Animalia	Aves	Accipitridae	0225	*Hieraaetus morphnoides*	Little Eagle	V,P		8
Animalia	Aves	Accipitridae	0230	*Lophoictinia isura*	Square-tailed Kite	V,P,3		2
Animalia	Aves	Accipitridae	8739	*Pandion cristatus*	Eastern Osprey	V,P,3		97
Animalia	Aves	Falconidae	0238	*Falco subniger*	Black Falcon	V,P		1
Animalia	Aves	Burhinidae	0174	*Burhinus grallarius*	Bush Stone-curlew	E1,P		4
Animalia	Aves	Burhinidae	0175	*Esacus magnirostris*	Beach Stone-curlew	E4A,P		2
Animalia	Aves	Haematopodidae	0131	*Haematopus fuliginosus*	Sooty Oystercatcher	V,P		369
Animalia	Aves	Haematopodidae	0130	*Haematopus longirostris*	Pied Oystercatcher	E1,P		605
Animalia	Aves	Charadriidae	0141	*Charadrius leschenaultii*	Greater Sand-plover	V,P	V,C,J,K	15
Animalia	Aves	Charadriidae	0139	*Charadrius mongolus*	Lesser Sand-plover	V,P	E,C,J,K	204
Animalia	Aves	Charadriidae	0142	*Charadrius veredus*	Oriental Plover	P	C,J,K	1
Animalia	Aves	Charadriidae	8006	*Pluvialis fulva*	Pacific Golden Plover	P	C,J,K	773
Animalia	Aves	Charadriidae	0136	*Pluvialis squatarola*	Grey Plover	P	C,J,K	13
Animalia	Aves	Scolopacidae	0157	*Actitis hypoleucos*	Common Sandpiper	P	C,J,K	91
Animalia	Aves	Scolopacidae	0129	*Arenaria interpres*	Ruddy Turnstone	P	C,J,K	276
Animalia	Aves	Scolopacidae	0163	*Calidris acuminata*	Sharp-tailed Sandpiper	P	C,J,K	1111
Animalia	Aves	Scolopacidae	0164	*Calidris canutus*	Red Knot	P	E,C,J,K	497
Animalia	Aves	Scolopacidae	0161	*Calidris ferruginea*	Curlew Sandpiper	E1,P	CE,C,J,K	2275
Animalia	Aves	Scolopacidae	0978	*Calidris melanotos*	Pectoral Sandpiper	P	J,K	12
Animalia	Aves	Scolopacidae	0162	*Calidris ruficollis*	Red-necked Stint	P	C,J,K	873
Animalia	Aves	Scolopacidae	0965	*Calidris subminuta*	Long-toed Stint	P	C,J,K	1
Animalia	Aves	Scolopacidae	0165	*Calidris tenuirostris*	Great Knot	V,P	CE,C,J,K	198
Animalia	Aves	Scolopacidae	0168	*Gallinago hardwickii*	Latham's Snipe	P	J,K	40
Animalia	Aves	Scolopacidae	0167	*Limicola falcinellus*	Broad-billed Sandpiper	V,P	C,J,K	45
Animalia	Aves	Scolopacidae	0939	*Limnodromus semipalmatus*	Asian Dowitcher	P	C,J,K	6
Animalia	Aves	Scolopacidae	0153	*Limosa lapponica*	Bar-tailed Godwit	P	C,J,K	1558
Animalia	Aves	Scolopacidae	0152	*Limosa limosa*	Black-tailed Godwit	V,P	C,J,K	661
Animalia	Aves	Scolopacidae	0149	*Numenius madagascariensis*	Eastern Curlew	P	CE,C,J,K	234
Animalia	Aves	Scolopacidae	0151	*Numenius minutus*	Little Curlew	P	C,J,K	1
Animalia	Aves	Scolopacidae	0150	*Numenius phaeopus*	Whimbrel	P	C,J,K	528
Animalia	Aves	Scolopacidae	0934	*Philomachus pugnax*	Ruff	P	C,J,K	2
Animalia	Aves	Scolopacidae	0155	*Tringa brevipes*	Grey-tailed Tattler	P	C,J,K	521
Animalia	Aves	Scolopacidae	0154	*Tringa glareola*	Wood Sandpiper	P	C,J,K	2
Animalia	Aves	Scolopacidae	0156	*Tringa incana*	Wandering Tattler	P	J	1
Animalia	Aves	Scolopacidae	0158	*Tringa nebularia*	Common Greenshank	P	C,J,K	516
Animalia	Aves	Scolopacidae	0159	*Tringa stagnatilis*	Marsh Sandpiper	P	C,J,K	436
Animalia	Aves	Scolopacidae	0160	*Xenus cinereus*	Terek Sandpiper	V,P	C,J,K	616

Animalia	Aves	Stercorariidae	0933	*Stercorarius longicaudus*	Long-tailed Jaeger	P	C,J	1
Animalia	Aves	Stercorariidae	0128	*Stercorarius parasiticus*	Arctic Jaeger	P	C,J,K	9
Animalia	Aves	Stercorariidae	0945	*Stercorarius pomarinus*	Pomarine Jaeger	P	C,J,K	26
Animalia	Aves	Laridae	0122	*Anous stolidus*	Common Noddy	P	C,J	8
Animalia	Aves	Laridae	0109	*Chlidonias leucopterus*	White-winged Black Tern	P	C,J,K	18
Animalia	Aves	Laridae	0111	*Gelochelidon nilotica*	Gull-billed Tern	P	C	38
Animalia	Aves	Laridae	0112	*Hydroprogne caspia*	Caspian Tern	P	J	527
Animalia	Aves	Laridae	0120	*Onychoprion fuscata*	Sooty Tern	V,P		3
Animalia	Aves	Laridae	0953	*Sterna hirundo*	Common Tern	P	C,J,K	383
Animalia	Aves	Laridae	0117	*Sternula albifrons*	Little Tern	E1,P	C,J,K	540
Animalia	Aves	Laridae	0115	*Thalasseus bergii*	Crested Tern	P	J	908
Animalia	Aves	Psittacidae	0260	*Glossopsitta pusilla*	Little Lorikeet	V,P		3
Animalia	Aves	Psittacidae	0309	*Lathamus discolor*	Swift Parrot	E1,P,3	CE	2
Animalia	Aves	Psittacidae	0302	*Neophema pulchella*	Turquoise Parrot	V,P,3		2
Animalia	Aves	Strigidae	0248	*Ninox strenua*	Powerful Owl	V,P,3		8
Animalia	Aves	Tytonidae	0252	*Tyto longimembris*	Eastern Grass Owl	V,P,3		2
Animalia	Aves	Tytonidae	0250	*Tyto novaehollandiae*	Masked Owl	V,P,3		1
Animalia	Aves	Meliphagidae	0448	*Epthianura albifrons*	White-fronted Chat	V,P		74
Animalia	Aves	Pomatostomidae	8388	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V,P		3
Animalia	Aves	Neosittidae	0549	*Daphoenositta chrysoptera*	Varied Sittella	V,P		1
Animalia	Aves	Petroicidae	0380	*Petroica boodang*	Scarlet Robin	V,P		1
Animalia	Aves	Estrildidae	0652	*Stagonopleura guttata*	Diamond Firetail	V,P		1
Animalia	Mammalia	Phascolarctidae	1162	*Phascolarctos cinereus*	Koala	E1,P	E	10
Animalia	Mammalia	Burramyidae	1150	*Cercartetus nanus*	Eastern Pygmy-possum	V,P		1
Animalia	Mammalia	Petauridae	1137	*Petaurus norfolcensis*	Squirrel Glider	V,P		7
Animalia	Mammalia	Pteropodidae	1280	*Pteropus poliocephalus*	Grey-headed Flying-fox	V,P	V	108
Animalia	Mammalia	Emballonuridae	1321	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V,P		2
Animalia	Mammalia	Molossidae	1329	*Micronomus norfolkensis*	Eastern Coastal Free-tailed Bat	V,P		6
Animalia	Mammalia	Vespertilionidae	1372	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V,P		1
Animalia	Mammalia	Vespertilionidae	1357	*Myotis macropus*	Southern Myotis	V,P		3
Animalia	Mammalia	Vespertilionidae	1361	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V,P		2
Animalia	Mammalia	Miniopteridae	1346	*Miniopterus australis*	Little Bent-winged Bat	V,P		8
Animalia	Mammalia	Miniopteridae	3330	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	V,P		5

Animalia	Mammalia	Muridae	1455	*Pseudomys novaehollandiae*	New Holland Mouse	P	V	1
Animalia	Mammalia	Dugongidae	1558	*Dugong dugon*	Dugong	E1,P		2
Animalia	Mammalia	Otariidae	1543	*Arctocephalus forsteri*	New Zealand Fur-seal	V,P		1
Animalia	Mammalia	Otariidae	1882	*Arctocephalus pusillus doriferus*	Australian Fur-seal	V,P		2
Animalia	Mammalia	Balaenopteridae	1575	*Megaptera novaeangliae*	Humpback Whale	V,P	V	4
Plantae	Flora	Asteraceae	1643	*Rutidosis heterogama*	Heath Wrinklewort	V	V	1
Plantae	Flora	Elaeocarpaceae	6206	*Tetratheca juncea*	Black-eyed Susan	V	V	2
Plantae	Flora	Fabaceae (Faboideae)	11644	*Pultenaea maritima*	Coast Headland Pea	V		1
Plantae	Flora	Myrtaceae	9163	*Eucalyptus parramattensis subsp. decadens*		V	V	5
Plantae	Flora	Zannichelliaceae	6339	*Zannichellia palustris*		E1		2

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 12-Jul-2022

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	86
Listed Migratory Species:	78

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	38
Commonwealth Heritage Places:	2
Listed Marine Species:	101
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	4
Regional Forest Agreements:	1
Nationally Important Wetlands:	1
EPBC Act Referrals:	38
Key Ecological Features (Marine):	None
Biologically Important Areas:	10
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity	Buffer Status
Hunter estuary wetlands	Within Ramsar site	In feature area

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
EEZ and Territorial Sea	In buffer area only

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Central Hunter Valley eucalypt forest and woodland	Critically Endangered	Community may occur within area	In feature area
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area	In feature area
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	Community likely to occur within area	In buffer area only
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area	In buffer area only
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community likely to occur within area	In feature area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area	In feature area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat likely to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In feature area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area	In feature area
Pycnoptilus floccosus Pilotbird [525]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In feature area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
FISH			
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]	Endangered	Species or species habitat likely to occur within area	In feature area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
FROG			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Litoria aurea			
Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area	In feature area
Mixophyes balbus			
Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat may occur within area	In feature area
Uperoleia mahonyi			
Mahony's Toadlet [89189]	Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			
Balaenoptera musculus			
Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area
Chalinolobus dwyeri			
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population)			
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area	In feature area
Eubalaena australis			
Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area	In feature area
Petauroides volans			
Greater Glider (southern and central) [254]	Endangered	Species or species habitat likely to occur within area	In feature area
Petaurus australis australis			
Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)			
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area	In feature area
Potorous tridactylus tridactylus			
Long-nosed Potoroo (northern) [66645]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area	In feature area
PLANT			
Angophora inopina Charmhaven Apple [64832]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Commersonia prostrata Dwarf Kerrawang [87152]	Endangered	Species or species habitat likely to occur within area	In feature area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area	In feature area
Diuris praecox Newcastle Doubletail [55086]	Vulnerable	Species or species habitat known to occur within area	In feature area
Eucalyptus camfieldii Camfield's Stringybark [15460]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Eucalyptus parramattensis subsp. decadens Earp's Gum, Earp's Dirty Gum [56148]	Vulnerable	Species or species habitat known to occur within area	In feature area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Grevillea shiressii [19186]	Vulnerable	Species or species habitat known to occur within area	In feature area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area	In feature area
Rhizanthella slateri Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area	In feature area
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Rhodomyrtus psidioides Native Guava [19162]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Tetratheca juncea Black-eyed Susan [21407]	Vulnerable	Species or species habitat known to occur within area	In feature area
REPTILE			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
SHARK			
Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Sphyrna lewini Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat likely to occur within area	In feature area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Fregata minor](#) Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area	In feature area
[Macronectes giganteus](#) Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
[Macronectes halli](#) Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
[Phaethon lepturus](#) White-tailed Tropicbird [1014]		Species or species habitat known to occur within area	In feature area
[Phoebetria fusca](#) Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In feature area
[Sternula albifrons](#) Little Tern [82849]		Breeding may occur within area	In feature area
[Thalassarche bulleri](#) Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area	In feature area
[Thalassarche carteri](#) Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Thalassarche cauta](#) Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
[Thalassarche eremita](#) Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
[Thalassarche impavida](#) Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
Migratory Marine Species			
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area	In feature area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
Dugong dugon			
Dugong [28]		Species or species habitat may occur within area	In feature area
Eretmochelys imbricata			
Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis			
Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area	In feature area
Lamna nasus			
Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae			
Humpback Whale [38]		Species or species habitat known to occur within area	In feature area
Mobula alfredi as Manta alfredi			
Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat may occur within area	In feature area
Mobula birostris as Manta birostris			
Giant Manta Ray [90034]		Species or species habitat may occur within area	In feature area
Natator depressus			
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Orcinus orca			
Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Rhincodon typus			
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Sousa sahulensis as Sousa chinensis			
Australian Humpback Dolphin [87942]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Cuculus optatus			
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Hirundapus caudacutus			
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Monarcha melanopsis			
Black-faced Monarch [609]		Species or species habitat known to occur within area	In feature area
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat known to occur within area	In feature area
Myiagra cyanoleuca			
Satin Flycatcher [612]		Species or species habitat known to occur within area	In feature area
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat known to occur within area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus			
Spectacled Monarch [83946]		Species or species habitat likely to occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Arenaria interpres			
Ruddy Turnstone [872]		Roosting known to occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]		Roosting known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area	In feature area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area	In feature area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area	In feature area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area	In feature area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area	In feature area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area	In feature area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In feature area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area	In feature area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In feature area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area	In feature area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area	In feature area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area	In feature area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area	In feature area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Commonwealth Bank of Australia		
Commonwealth Land - Commonwealth Bank of Australia [11596]	NSW	In buffer area only
Commonwealth Trading Bank of Australia		
Commonwealth Land - Commonwealth Trading Bank of Australia [11685]	NSW	In buffer area only
Commonwealth Land - Commonwealth Trading Bank of Australia [11703]	NSW	In buffer area only
Commonwealth Land - Commonwealth Trading Bank of Australia [11591]	NSW	In buffer area only
Communications, Information Technology and the Arts - Australian Broadcasting Corporation		
Commonwealth Land - Australian Broadcasting Corporation [11595]	NSW	In buffer area only
Communications, Information Technology and the Arts - Australian Postal Corporation		
Commonwealth Land - Australian Postal Commission [11680]	NSW	In buffer area only
Commonwealth Land - Australian Postal Commission [11687]	NSW	In buffer area only
Commonwealth Land - Australian Postal Commission [11594]	NSW	In buffer area only
Commonwealth Land - Australian Postal Commission [11593]	NSW	In buffer area only
Commonwealth Land - Australian Postal Commission [11592]	NSW	In feature area
Communications, Information Technology and the Arts - Telstra Corporation Limited		
Commonwealth Land - Australian & Overseas Telecommunications Corporation [11686]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [11681]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [11600]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [11702]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [11597]	NSW	In buffer area only
Defence		
Commonwealth Land - Defence Service Homes Corporation [11524]	NSW	In buffer area only
Commonwealth Land - Defence Service Homes Corporation [11705]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Defence Service Homes Corporation [11679]	NSW	In buffer area only
Commonwealth Land - Defence Service Homes Corporation [11598]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11229]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11225]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11228]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11219]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11220]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11223]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11226]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11221]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11222]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11227]	NSW	In buffer area only
Defence - ADF CAREERS REFERENCE CENTRE [11224]	NSW	In buffer area only
Defence - OFFICES [11195]	NSW	In buffer area only
Defence - STOCKTON RIFLE RANGE [10057]	NSW	In buffer area only
Defence - TS TOBRUK [10053]	NSW	In buffer area only
Defence - Defence Housing Authority		
Commonwealth Land - Defence Housing Authority [11688]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [11683]	NSW	In buffer area only
Commonwealth Land - Director of War Service Homes [11704]	NSW	In buffer area only
Unknown		
Commonwealth Land - [11684]	NSW	In buffer area only
Commonwealth Land - [11599]	NSW	In feature area

Commonwealth Heritage Places

[Resource Information]

Name	State	Status	Buffer Status
Historic			
Fort Wallace	NSW	Listed place	In feature area
Nobbys Lighthouse	NSW	Listed place	In feature area

Listed Marine Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]		Species or species habitat likely to occur within area	In feature area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Breeding likely to occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area	In feature area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area overfly marine area	In feature area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area	In feature area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In feature area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea antipodensis gibsoni as Diomedea gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area	In feature area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area overfly marine area	In feature area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area	In feature area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area overfly marine area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area overfly marine area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Neophema chrysostoma Blue-winged Parrot [726]		Species or species habitat may occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area	In feature area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In feature area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In feature area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat known to occur within area	In feature area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area overfly marine area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In feature area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In feature area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Recurvirostra novaehollandiae			
Red-necked Avocet [871]		Roosting known to occur within area overfly marine area	In feature area
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Stercorarius skua as Catharacta skua			
Great Skua [823]		Species or species habitat may occur within area	In buffer area only
Sternula albifrons as Sterna albifrons			
Little Tern [82849]		Breeding may occur within area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus			
Spectacled Monarch [83946]		Species or species habitat likely to occur within area overfly marine area	In feature area
Thalassarche bulleri			
Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche bulleri platei as Thalassarche sp. nov.			
Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche carteri			
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta			
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
Tringa brevipes as Heteroscelus brevipes Grey-tailed Tattler [851]		Roosting known to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area overfly marine area	In feature area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area	In feature area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area overfly marine area	In feature area
Fish			
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area	In feature area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area	In feature area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area	In feature area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]	Endangered	Species or species habitat likely to occur within area	In feature area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area	In feature area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area	In feature area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Mammal			
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Dugong dugon			
Dugong [28]		Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
Eretmochelys imbricata			
Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Natator depressus			
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Pelamis platurus			
Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area	In feature area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata			
Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera edeni			
Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
Balaenoptera musculus			
Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Sousa sahulensis as Sousa chinensis Australian Humpback Dolphin [87942]		Species or species habitat likely to occur within area	In feature area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Glenrock	State Conservation Area	NSW	In buffer area only
Hunter Wetlands	National Park	NSW	In buffer area only
Worimi	State Conservation Area	NSW	In buffer area only
Worimi	Regional Park	NSW	In buffer area only

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

RFA Name	State	Buffer Status
North East NSW RFA	New South Wales	In feature area

Nationally Important Wetlands [Resource Information]

Wetland Name	State	Buffer Status
Kooragang Nature Reserve	NSW	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Former Rifle Range Residential Development, Popplewell Road, Fern Bay, NSW	2017/7993	Controlled Action	Proposed Decision	In buffer area only
Gas Transmission Pipeline	2011/5917	Controlled Action	Completed	In buffer area only
Hunter River Port and Transport Corridor	2001/419	Controlled Action	Completed	In buffer area only
Hunter River south arm dredging	2003/950	Controlled Action	Post-Approval	In buffer area only
Kooragang Wetland Rehabilitation Project	2007/3220	Controlled Action	Post-Approval	In buffer area only
Newcastle LNG export facility	2011/5915	Controlled Action	Completed	In feature area
Nobby's Lighthouse redevelopment	2006/3179	Controlled Action	Completed	In feature area
Port Site and Materials Handling Development	2001/242	Controlled Action	Completed	In feature area
Protech Cold Mill Facility	2001/274	Controlled Action	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Queensland Hunter Gas Pipeline, approximately 825 km in length	2008/4483	Controlled Action	Completed	In feature area
Remediation Works, Kooragang island waste facility emplacement facility NSW	2011/5920	Controlled Action	Completed	In buffer area only
River Dredging Operations	2001/249	Controlled Action	Completed	In feature area
Rutile and Zircon Mining on Stockton Rifle Range	2000/8	Controlled Action	Post-Approval	In buffer area only
Steel Mill	2001/231	Controlled Action	Completed	In buffer area only
Terminal 4 Coal Export Terminal Project, Kooragang Island	2011/6029	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
Demolition of Ablutions Block, Snapper Island, NSW	2018/8303	Not Controlled Action	Completed	In buffer area only
Expansion to Kooragang Coal Terminal	2007/3352	Not Controlled Action	Completed	In buffer area only
Fort Scratchley refurbishment works	2005/2283	Not Controlled Action	Completed	In feature area
Fort Scratchley site remediation	2005/2075	Not Controlled Action	Completed	In feature area
Geological exploration and historical research of convict coal mines beneath For	2004/1421	Not Controlled Action	Completed	In feature area
Green & Golden Bell Frog Habitat Enhancement Project	2004/1795	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Kooragang Coal Terminal Arrival Roads Stage 2 Upgrade, Newcastle, NSW	2014/7229	Not Controlled Action	Completed	In buffer area only
Nelson Bay Rd and Seaside Blvd intersection development, Nelson Bay, NSW	2019/8433	Not Controlled Action	Completed	In buffer area only
Nobbys Headland Redevelopment	2008/4672	Not Controlled Action	Completed	In feature area
sale of property located at 96, Hunter Street	2003/1097	Not Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Sandgate Rail Grade Separation	2005/1948	Not Controlled Action	Completed	In buffer area only
Shorebird and wader habitat rehabilitation	2001/457	Not Controlled Action	Completed	In buffer area only
Stockpiling of lump coal up to 40,000 tonnes	2003/1304	Not Controlled Action	Completed	In buffer area only
Tomago to Tomaree Electricity Supply Upgrade	2003/1023	Not Controlled Action	Completed	In feature area
Tomago Wetland Rehabilitation Project	2011/5894	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
2D marine seismic survey in PEP-11 permit area, NSW	2002/879	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Fort Wallace Residential Development Proposal, north of Newcastle, NSW	2017/7951	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Kooragang Island coal export terminal	2006/2987	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Kooragang Island Waste Emplacement Facility Closure Works	2012/6464	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Rehabilitation of Hexham Swamp	2003/1244	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
TransGrid 132kV Power Transmission Line	2002/794	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Referral decision				
Breeding program for Grey Nurse Sharks	2007/3245	Referral Decision	Completed	In feature area

Biologically Important Areas

Scientific Name	Behaviour	Presence	Buffer Status
Dolphins			

Scientific Name	Behaviour	Presence	Buffer Status
Tursiops aduncus Indo-Pacific/Spotted Bottlenose Dolphin [68418]	Breeding	Likely to occur	In buffer area only
Tursiops aduncus Indo-Pacific/Spotted Bottlenose Dolphin [68418]	Foraging	Known to occur	In feature area
Seabirds			
Ardenna carneipes Flesh-footed Shearwater [82404]	Foraging	Known to occur	In buffer area only
Ardenna grisea Sooty Shearwater [82651]	Foraging	Likely to occur	In feature area
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Likely to occur	In feature area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In buffer area only
Procellaria parkinsoni Black Petrel [1048]	Foraging	Likely to occur	In buffer area only
Sharks			
Carcharias taurus Grey Nurse Shark [64469]	Foraging	Known to occur	In feature area
Whales			
Megaptera novaeangliae Humpback Whale [38]	Foraging	Known to occur	In feature area

Bioregional Assessments

SubRegion	BioRegion	Website	Buffer Status
Hunter	Northern Sydney Basin	BA website	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix 3: Existing Mapping

NSW Estuarine Macrophytes

NSW Marine Protected Areas

RAMSAR Wetland Map

NSW Coastal Management SEPP

NSW KFH Map

NSW GOVERNMENT Department of Primary Industries

Legend

NSW Estuarine Macrophytes

- Posidonia
- Posidonia - Sparse
- Posidonia/Zostera
- Posidonia/Zostera/Halophila
- Posidonia/Halophila
- Posidonia/Halophila/Ruppia
- Posidonia/Ruppia
- Zostera
- Zostera - Sparse
- Zostera/Halophila
- Zostera/Halophila/Ruppia
- Zostera/Ruppia
- Halophila
- Halophila/Ruppia
- Ruppia
- Mangrove
- Mangrove/Saltmarsh
- Saltmarsh

Notes

3.7 0 1.83 3.7 Kilometers

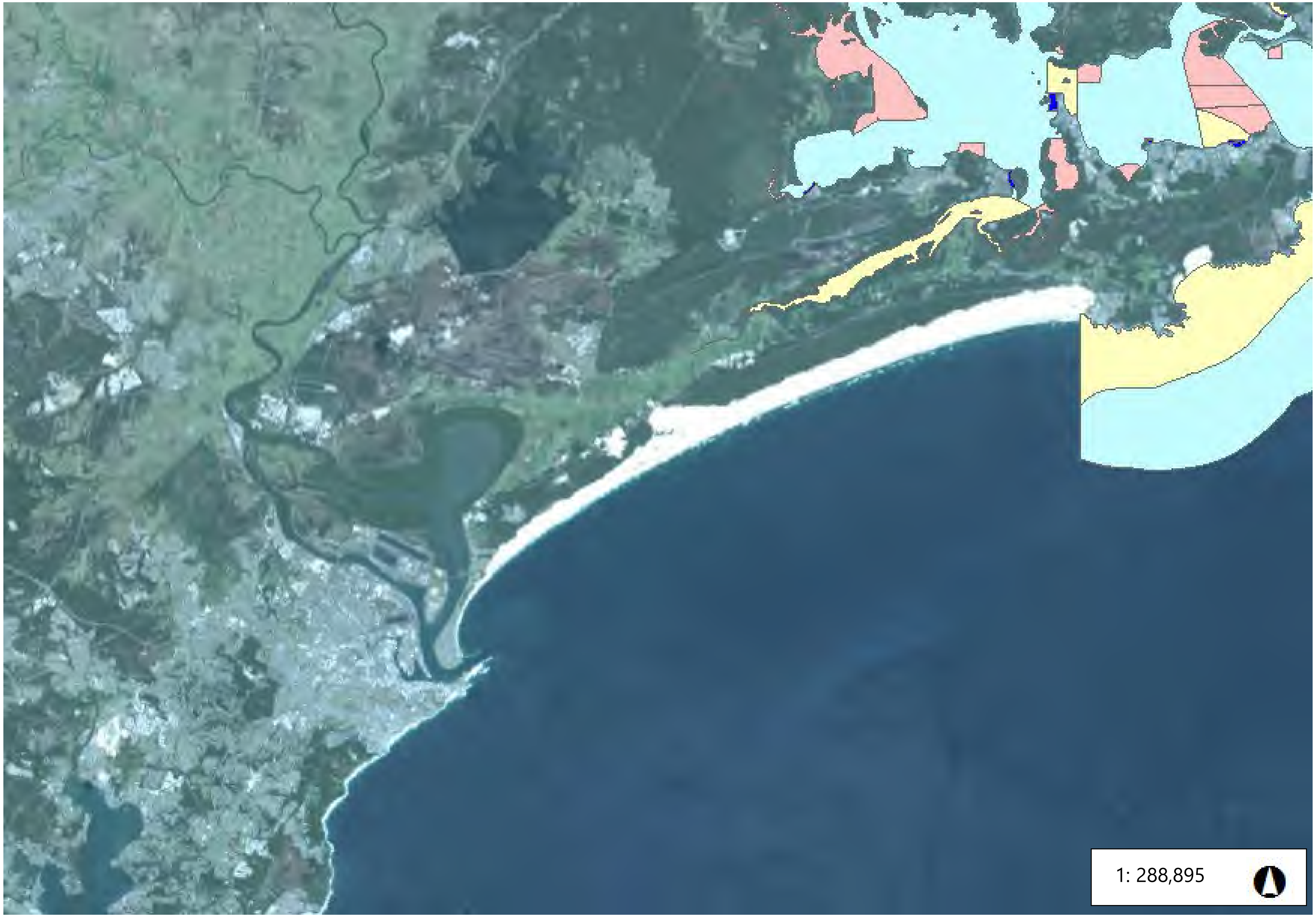
WGS_1984_Web_Mercator_Auxiliary_Sphere

20-Oct-2022

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Department of Primary Industries



Legend

NSW Marine Protected Areas

- Aquatic Reserve (IUCN IV)
- Aquatic Reserve (Sanctuary) (IUCN
- General Use Zone (IUCN VI)
- Habitat Protection Zone (IUCN IV)
- Habitat Protection Zone (Restrictior
- Sanctuary Zone (IUCN II)
- Special Purpose Zone (IUCN VI)

1: 288,895

14.7 0 7.34 14.7 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

20-Oct-2022

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Notes

SEED | Sharing and Enabling Environmental Data SEED Map

7.2 0 3.61 7.2 Kilometers

Scale 1: 144,447.64

WGS_1984_Web_Mercator_Auxiliary_Sphere

Generated from SEED web map. Created 3:45 PM 6/10/2022

Department of Primary Industries

Legend

- Coastal Wetlands
- Proximity Area for Coastal Wet
- Littoral Rainforests
- Proximity Area for Littoral Rain
- Coastal Vulnerability Area Map this time
- Coastal Environment Area Map
- Coastal Use Area Map
- Land Application Map

1: 72,224

Notes

3.7 0 1.83 3.7 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

20-Oct-2022

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Department of Primary Industries

Legend

Key Fish Habitat - Central Rive

1: 72,224

3.7 0 1.83 3.7 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

20-Oct-2022

Notes

Appendix 4: Threatened Species Assessments

Shorebirds

Review of Species

Common Name	Species	Status BC Act	Status EPBC Act
Charadrius leschenaultii	Greater Sand Plover	P	V,B,C,J,K
Charadrius mongolus	Lesser Sand-plover	V,P	E,B,C,J.K
Haematopus fuliginosus	Sooty Oystercatcher	V,P	
Haematopus longirostris	Pied Oystercatcher	E,P	
Limosa lapponica	Bar-tailed Godwit	P	B,C,J,K
Limosa limosa	Black-tailed Godwit	V,P	B,C,J,K
Numenius madagascariensis	Eastern Curlew	P	CE,B,C,J,K
Pluvialis fulva	Pacific Golden Plover	P	B,C,J,K
Sterna hirundo	Common Tern	P	C,J,K
Sternula albifrons	Little Tern	E,P	B,C,J,K

Species	Distribution	Habitat	Breeding and Prey
C. leschenaultii	Within Australia occurs in coastal areas in all states, though the greatest numbers occur in northern Australia, especially the north-west. It is also abundant in south-eastern parts of the Gulf of Carpentaria in Queensland, and is widespread from the Torres Strait, along the eastern coast, into the Northern Rivers region of northern NSW, with occasional records south to about Shoalhaven Heads.	In the non-breeding grounds in Australasia, the species is almost entirely coastal, inhabiting littoral and estuarine habitats. They mainly occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons. They usually roost on sand-spits and banks on beaches or in tidal lagoons, and occasionally on rocky or in adjacent areas of saltmarsh. They tend to roost further up the beach than other waders, sometimes well above high-tide mark.	Breeding occurs outside of Australia where they lay their eggs in April and May. Mostly eat molluscs, worms, crustaceans (especially small crabs and sometimes shrimps) and insects (including adults and larvae of termites, beetles, weevils, earwigs and ants)
C. mongolus	Widespread in coastal regions within Australia. Has been recorded in all states. Mainly occurs in northern and eastern Australia, in south-eastern parts of the Gulf of Carpentaria, western Cape York Peninsula and islands in Torres Strait, and along the entire east coast, though it occasionally also occurs inland. Most numerous in Queensland and NSW	This species usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. They roost near foraging areas, on beaches, banks, spits and banks of sand or shells and occasionally on rocky spits, islets or reefs They rarely roost in mangroves	The species does not breed in Australia. The species feeds mostly on extensive, freshly-exposed areas of intertidal sandflats and mudflats in estuaries or beaches, or in shallow ponds in saltworks. Prey includes molluscs (especially bivalves), worms, crustaceans (especially crabs) and insects
H. fuliginosus	Found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Small numbers of the species are evenly distributed along the NSW coast.	Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries.	Breeds in spring and summer amongst pebbles and shells on rocky shores or cliffs located almost exclusively on offshore islands, but occasionally on isolated promontories. They forage on intertidal invertebrates such as limpets and mussels.

Species	Distribution	Habitat	Breeding and Prey
H. longirostris	Distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria. In NSW the species is thinly scattered along the entire coast.	Favours intertidal flats of inlets and bays, open beaches and sandbanks.	Nests between August and January, mostly on coastal or estuarine beaches, although occasionally they use saltmarsh or grassy areas. Forages on exposed sand, mud and rock at low tide for molluscs, worms, crabs and small fish.
L. lapponica	Birds arrive in New South Wales between August and October and then leave between February and April, with a small number of individuals remaining over winter	Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platform. Usually roosts on sandy beaches, sandbars, spits and also in near-coastal saltmarsh.	Non-breeding migrant in Australia and New Zealand. Forages at low to mid tide in shallow water or along the water's edge on sandy substrates on intertidal flats, banks and beaches or on soft mud substrates. Its diet consists of worms, molluscs, crustaceans, insects and some plant material.
L. limosa	First arrives in north-west Australia from late August Some move to east and south Australia in November–December. Small numbers move down the east coast September–November as far south as the estuary of the Hunter River.	In Australia the species is commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit; occasionally recorded on rocky coasts or coral islets. It is also found in shallow and sparsely vegetated, near-coastal, wetlands; such as saltmarsh, salt flats, river pools, swamps, lagoons and floodplains. They roost and loaf on low banks of mud, sand or shell, bars, islets and beaches in sheltered areas; also on saltflats behind mangroves.	Does not breed in Australia. Breeds in the Northern Hemisphere summer, with laying from April to mid-Jun Forages on wide intertidal mudflats or sandflats, in soft mud or shallow water and occasionally in shallow estuaries.
N. madagascariensis	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. In NSW the species occurs across the entire coast but is mainly found in estuaries such as the Hunter River, Port Stephens, Clarence River, Richmond River and ICOLLs of the south coast.	Generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets.	Breeds in Russia and north-eastern China. Within Australia, immature birds, which do not migrate, move northward in winter. Carnivorous mainly eating crustaceans (including crabs, shrimps and prawns), small molluscs, as well as some insects. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed.
P. fulva	The species is present at in Australia mostly between September and May. Widespread in coastal regions within Australia, though there are also a number of inland records (in all states). Most Pacific Golden Plovers occur along the east coast, and are especially widespread along the Queensland and NSW coastlines.	In Australia this species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. Usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh in sheltered areas including harbours, estuaries and lagoons. Usually roost near foraging areas, on sandy beaches and spits or rocky points, islets or exposed reefs, occasionally among or beneath vegetation including mangroves or low saltmarsh, or among beachcast seaweed.	Does not breed in Australia, breeds in the northern hemisphere. Forages on sandy or muddy shores (including mudflats and sandflats) or margins of sheltered areas such as estuaries and lagoons, though it also feeds on rocky shores, islands or reefs.
S. hirundo	Non-breeding migrant to Australia, where it is widespread and common on	Uses marine, pelagic and coastal marine zones, including near-coastal waters, ocean beaches, rock platforms	Breeds in the northern hemisphere between May and September.

Species	Distribution	Habitat	Breeding and Prey
	the east coast (including the NSW north coast), extending south to eastern Victoria. Arrives in NSW from late September to October.	and headlands, and in sheltered waters, such as bays, harbours and estuaries with muddy, sandy or rocky shores., before returning to land to roost at night. Roost on unvegetated, intertidal sandy ocean beaches, sandy islands, shores of estuaries or lagoons, and sandbars, as well as on rocky shores, rock platforms or rocks protruding above the surface of the water.	Typically forage opportunistically at sea in the day on small fish, crustaceans or insects, and occasionally squid
S. albifrons	Migrates from eastern Asia, and is found on the north, east and south-east Australian coasts. In NSW, they arrive from September to November, occurring mainly north of Sydney with most departing by May.	Almost exclusively coastal, preferring sheltered environments; however, may occur several kilometres from the sea in harbours, inlets and rivers. Feeds on small fish, crustaceans, insects, worms and molluscs, typically by diving while aerially foraging. Usually roost or loaf on sand-spits, banks and bars within sheltered estuarine or coastal environments, or on the sandy shores of lakes and ocean beaches.	Nests in small, scattered colonies in low dunes or on sandy beaches (especially sand spits along the NSW coast), just above high tide mark near estuary mouths or adjacent to coastal lakes and islands. Breeds in spring and summer.

Sources: DCCEEW 2022, DPIE 2022.

5-Part Test – BC Act

Threatened Shorebirds – BC Act ***Charadrius mongolus, Haematopus fuliginosus, H. longirostris, Limosa limosa*** **and** ***Sternula albifrons.***
(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Shorebirds that utilise habitat within the Project Area are expected to be confined to the shoreline habitat along Stockton Beach, which is an open coastal beach, with the majority of the shoreline with moderate to high development and very significant erosion that has resulted in the loss of the beach face and any foredune habitat in most parts of the Project Area. Habitat within the Project Area is not known to be of significance for breeding and/or nesting of any shorebirds listed as threatened in NSW under the BC Act. Any use of the habitat by threatened shorebirds is likely restricted to foraging at low tides, during periods of calm weather and low levels of human disturbance. There is potential that some species may choose to roost near these foraging grounds in the more disturbed areas of the shoreline that fringe the project Area, however given the significant beach erosion that has occurred, this is considered to be of low likelihood at present. The proposed action to nourish the beach will result in some disturbance of threatened shorebirds should they be present and foraging during the works. This may deter the shorebirds to use another stretch of the beach to forage or it could potentially attract them as a result of any potential food source that has been deposited on to the beach amongst sands during beach nourishment. Irrespective of the effect nourishment works have on any foraging activity by threatened shorebirds, the action is not considered likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Not Applicable
(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality

I. The nourishment works will result in modification of shoreline foraging habitat within the Project Area for threatened shorebirds through the placement of additional sands on the eroded sections of the lower beach. In addition, sands placed on the higher sections of the beach may also modify some very marginal roosting habitat for some threatened shorebird species as a result of the sands reducing the erosion scar along the beach face. II. No habitat is expected to become fragmented or isolated from other areas as a result of the proposed nourishment works. If anything, the proposed works will improve connectivity between the foraging habitat on the lower beach and potential roosting habitat within any adjacent foredune areas. III. Foraging habitat to be modified is likely of minimal ecological significance to the long-term survival of threatened shorebirds that forage in the locality as: a. It represents only a very small area of potential foraging area in the locality and along Stockton Beach; and b. Sediments have been found to be very deprived on macroinvertebrates and infauna that provide food sources for these bords, which is likely a result of the ongoing erosion. In addition to the above the nourishment works may improve forging habitat should: a. The deposited sands include potential prey items during the activity; and b. May reduce erosion and improve long-term prey availability along the beach within the Project Area.	
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).	
No	
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process	
NSW KTPs with potential to be exacerbated by the proposed development do not have potential to impact on these shorebirds	
Conclusion	Disturbances from nourishment works on shorebirds will be confined to foraging habitat along the shoreline and very marginal and highly degraded potential roosting habitat for some threatened shorebird species. These works are not expected to have an ecologically significant impact on these threatened shorebird species, while may improve both foraging and roosting habitat along the shoreline.

Significant Impact Criteria: Shorebirds

Significant Impact Criteria: Migratory Marine Birds (EPBC Act) ***Charadrius leschenaultia* – Vulnerable and Migratory** **C. mongolus - Endangered and Migratory** ***Limosa lapponica, limosa, Pluvialis fulva, Sterna hirundo, Sternula albifrons* – Migratory** ***Numenius madagascariensis* – Critically Endangered and Migratory**	**Likelihood of Impact**
An action is likely to have a significant impact on a threatened or migratory species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population of a Critically Endangered or Endangered species or an important population of a Vulnerable species.	
During beach nourishment works some short-term disturbances to a very small area of foraging habitat along the Stockton Beach shoreline and very marginal potential roosting habitat that is in a very degraded state from erosion may occur. The nourishment works themselves are expected, if anything, to improve foraging and roosting habitat for threatened shorebirds over the longer term.	Unlikely
Reduce the area of occupancy of a Critically Endangered or Endangered species or an important population of a Vulnerable species.	
Use of habitat along Stockton Beach is likely restricted to only occasional foraging, with the beach face and foredunes providing only very marginal habitat for any roosting by threatened shorebirds. In its current condition permanent presence or occupancy for a number of days of any threatened shorebirds within the project Area is very unlikely.	Unlikely
Fragment an existing population of a Critically Endangered or Endangered species or an important population of a Vulnerable species into two or more populations.	
No habitat is expected to become fragmented or isolated from other areas as a result of the proposed nourishment works. If anything, the proposed works will improve connectivity between the foraging habitat on the lower beach and potential roosting habitat within any adjacent foredune areas.	Unlikely
Adversely affect habitat critical to the survival of a threatened species.	
Habitat within the Project Area along Stockton Beach is not considered to be critical to the survival of any threatened shorebirds that utilise resources within the locality.	Unlikely
Disrupt the breeding cycle of a population of a threatened species or seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	
Within the Project Area along Stockton Beach breeding by any threatened or migratory shorebirds that occur in the area is considered unlikely. The beach however may at times be used by some species to feed or roost, however any disturbance is unlikely to seriously disrupt the lifecycle of any threatened or migratory shorebirds.	Unlikely
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species or remove for a threatened species.	
The nourishment works will result in modification of shoreline foraging habitat within the Project Area for threatened shorebirds through the placement of additional sands on the eroded sections of the lower beach. In addition, sands placed on the higher sections of the beach may also modify some very marginal roosting habitat for some threatened shorebird species as a result of the sands reducing the erosion scar along the beach face. These modifications to habitat are, if at all, expected to improve foraging and roosting habitat for threatened and migratory shorebirds.	Unlikely
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory or threatened species, or	
No known invasive species harmful to migratory or threatened shorebirds are at risk to be released or have their populations enhanced as a result of this proposal.	Unlikely
interfere with the recovery of a threatened species.	
The nourishment works are not expected to interfere with the recovery of any threatened shorebird species in the locality.	Unlikely
Conclusion	
Disturbances from nourishment works on threatened or migratory shorebirds will be confined to foraging habitat along the shoreline and very marginal and highly degraded potential roosting habitat for some threatened shorebird species. The proposed action is unlikely to have a significant impact on any threatened or migratory shorebirds.	

Australian Fur Seals

Species Review

Species	Name /	Status BC Act	Status EPBC Act
Australian Fur-seal	*Arctocephalus pusillus doriferus*	Vulnerable	

Species	Distribution	Habitat and Prey	Breeding
Arctocephalus pusillus doriferus	The majority of the population is around the islands of Bass Strait, parts of Tasmania and southern Victoria. They are regularly seen hauling out in southern NSW, such as at Montague Island, while on occasions as far north as the Queensland border.	Often seen in the water near the coast or around offshore islands where they may haul out. Prefers rocky parts of islands with flat, open terrain. May also haul out inside harbours and on protected areas of the coastline. Skilful hunters that prey on bony fish, squid and octopus.	Typically breeds at colonies in southern Australia. Reported to have bred at Seal Rocks, near Port Stephens, and Montague Island in southern NSW. Pups are typically born between October and December.

Sources: DPIE (2020) and Australian Museum (2020).

5-Part Test – BC Act

Threatened Australian Fur-seal – BC Act
(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
The Australian Fur-seal may enter the Stockton Bight for opportunistic foraging in subtidal habitats within and adjacent to the Study Area. Intertidal rocky habitat associated with the breakwater, provides refuge and resting habitat for this species, with Fur-Seals utilising the breakwater to haul out and rest at times. The Australian Fur -Seal does not breed in this area. Given the above, any potential for disturbances of foraging habitat or resting in intertidal areas during construction is unlikely to adversely impact the lifecycle of the individuals of the species that may occur within the locality.
(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Not Applicable
(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
I. The proposed footprint for spoil disposal is largely limited to areas of habitat away from the breakwater and over unvegetated, clean marine sands and some smaller, intermittent rocky reefs. The rocky intertidal habitat and associated subtidal areas utilised by this species for resting and foraging are unlikely to be directly impacted by nourishment works. Any modifications to foraging habitat will be restricted to a small amount of foraging habitat only. Other disturbances will be restricted to some potential short- term impacts on habitat quality as a result of reduced water quality. II. No habitat is expected to become fragmented or isolated as a result of the proposal. III. Modifications to the existing habitat are unlikely to result in any ecologically significant changes to this species. Nourishment works are largely targeted at increasing the sand deposits within habitat associated with unvegetated, clean marine sands, that may provide foraging habitat for this species. While Fur-Seals may utilise these areas transiently, it is not considered core habitat for this species. Consequently, there is minimal potential to impact the long-term survival of any Australian Fur-seals that may at times utilise habitat within or adjacent to the Project Area.
(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).
No
(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

NSW KTPs with potential to be exacerbated by the proposed development do not have potential to impact on the Australian Fur-seal.	
Conclusion	Australian Fur-seals that may potentially utilise habitat in the vicinity of the proposal are unlikely to be significantly affected by the proposed activity. Habitat use in the vicinity of the Project Area is likely to be very occasional, and likely restricted to occasional individual visits during foraging activities and transient movement along the coast.

Sharks and Fish

Species Review

Species	Name /	Status FM Act	Status EPBC Act
Carcharius taurus	Grey Nurse Shark	Critically Endangered	Critically Endangered
Epinephelus daemelii	Black Rockcod	Vulnerable	Vulnerable

Species	Distribution	Habitat and Prey	Breeding
C. taurus	The Grey Nurse Shark has been regularly reported from southern Queensland and around south-east Australia, although the species is uncommon in Victorian, South Australian and Tasmanian waters, and has not been found in the Great Australian Bight. In NSW, aggregations of Grey Nurse Sharks can be found at reefs off the following locations: Byron Bay, Brooms Head, Solitary Islands, South West Rocks, Laurieton, Forster, Seal Rocks, Port Stephens, Sydney, Bateman's Bay, Narooma and Montague Island.	Grey Nurse Sharks are found primarily in warm temperate (from subtropical to cool temperate) inshore waters around rocky reefs and islands, in or near deep sandy-bottomed gutters, or rocky caves, and occasionally in the surf zone and shallow bays. They are often observed hovering motionless just above the seabed. They have been recorded at varying depths down to 230m on the continental shelf but are most commonly found between 15-40m.	The diet of the adult Grey Nurse Shark consists of a wide range of fish, other sharks and rays, squids, crabs and lobsters
E. daemelii	Black Rockcod is now mostly found from southern Queensland to eastern Victoria, with the NSW coastline forming its main range. Adults are territorial and often occupy a particular cave for life.	Adult Black Rockcod are usually found in caves, gutters and beneath bommies on rocky reefs, from nearshore environments to depths of at least 50m. Small juveniles are often found in coastal rock pools, and larger juveniles around rocky shores in estuaries. Black Rockcod are opportunistic carnivores, eating mainly other fish and crustaceans.	The Black Rockcod is a protogynous hermaphrodite, first developing as a sexually mature female and then changing into a male later in life at a length of approximately 100–110cm.

Source: NSW DPI 2013, 2015.

7-Part Test – FM Act

Threatened Sharks and Fish –FM Act *Carcharius taurus* and *Epinephelus daemelii*
(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
The Grey Nurse Shark does occur in the locality, while no aggregation sites are present within or nearby, it is likely that some individuals forage within the Study Area (mostly at night) or could potentially reside amongst any habitat provided by the wrecks in deeper areas behind the surf zone. No Grey Nurse Sharks were sighted during the survey and their use of this area, if any, is likely to be temporally variable and by a very small part of the population. Given this, the proposal is unlikely to have an ecologically significant adverse effect on the life cycle of the Grey Nurse Shark. The Black Rockcod is known to be common on coastal reefs along the northern NSW coast. Juveniles are also known to occur amongst rocks and cracks along the edges of break walls inside estuaries and harbours. Adults will typical frequent caves and overhangs on coastal reefs. The breakwater and shipwreck in the Study Area may provide potential Black Rockcod habitat, while juveniles could use cracks and crevices associated with the breakwater. Inspection of these areas during the survey did not find any Black Rockcod, and their use of these areas, if any, is unlikely to be permanent in nature. Furthermore, any use would only be by a very small part of the local population. Given this, the proposal is unlikely to have an adverse effect on the life cycle of the Black Rockcod such that a viable local population of the species is likely to be placed at risk of extinction.
(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
Not applicable

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Not applicable
(d) in relation to the habitat of a threatened species, population or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality
I. The unvegetated, soft sandy sediments which will be disturbed as a result of this proposal are not preferred habitats for either of these species and provide only a very small amount of foraging habitat within the locality for any Grey Nurse Shark or Black Rockcod. Some minor, short-term and localised changes to habitat quality may occur as a result of changes to water quality associated with nourishment works at the time of placement, however, these changes will not result in any long-term net habitat loss for either of these species. II. No habitat is expected to become fragmented or isolated as a result of the proposal. III. The habitat within the Project Area that will be modified represents only a very small area of marginal Black Grey Nurse Shark and Rockcod habitat. Use, if any, would likely be occasional, and only by a very small part of the local population of the Grey Nurse Shark or Black Rockcod, while the habitat is unlikely to be significance to the long-term survival of the species in the locality.
(e) Whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly)
This question is only applicable to the Grey Nurse Shark. The nearest critical habitat for the Grey Nurse Shark is at Little Broughton Island, which is within the Port Stephens, Great Lakes Marine Park and is not expected to be impacted by this proposal.
(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.
A Grey Nurse Shark Recovery Plan has been prepared by the NSW DPI Fisheries (DCCEEW, 2014). The objectives or actions of the recovery plan are: • Develop and apply quantitative monitoring of the population status (distribution and abundance) and potential recovery of the Grey Nurse Shark in Australian waters. • Quantify and reduce the impact of commercial fishing on the Grey Nurse Shark through incidental (accidental and/or illegal) take, throughout its range. • Quantify and reduce the impact of recreational fishing on the Grey Nurse Shark through incidental (accidental and/or illegal) take, throughout its range. • Where practical, minimise the impact of shark control activities on the Grey Nurse Shark. • Investigate and manage the impact of ecotourism on the grey nurse shark • Manage the impact of aquarium collection on the Grey Nurse Shark. • Improve understanding of the threat of pollution and disease to the Grey Nurse Shark • Continue to identify and protect habitat critical to the survival of the Grey Nurse Shark and reduce the impact of threatening processes within these areas. • Continue to develop and implement research programs to support the conservation of the Grey Nurse Shark • Promote community education and awareness in relation to Grey Nurse Shark conservation. A Black Rockcod Recovery Plan has been prepared by the NSW DPI Fisheries (DPI, 2012). The objectives or actions of the recovery plan are: • Determine the distribution and abundance of Black Rockcod in NSW. • Initiate and support research into the biology and ecology of Black Rockcod. • Initiate and support research into the impacts of high and moderate risks to Black Rockcod. • Identify important areas of Black Rockcod habitat and implement appropriate actions to recover Black Rockcod. • Improve the collection of data on interactions between Black Rockcod and fishers. • Increase community awareness and support for Black Rockcod issues and recovery actions. • Ensure that management authorities carry out appropriate planning and impact assessment and make management decisions which minimise impacts on Black Rockcod habitats. • Mitigate the impacts of water pollution on Black Rockcod. The proposed nourishment works are broadly consistent with the objectives and actions of the recovery plans for the Grey Nurse Shark and Black Rockcod.
(g) Whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
KTPs with potential to be exacerbated by the proposed development do not have potential to impact on Grey Nurse Sharks or Black Rockcod.

Conclusion	The viability of the Grey Nurse Shark and Black Rockcod population that may utilise habitat in the vicinity of the proposal is unlikely to be significantly affected by the proposed activity. Potential Grey Nurse Shark and Black Rockcod habitat inside the Study Area is marginal habitat only and is not expected to be significant to the local population. Impacts from the proposal are restricted to some potential disturbances during construction works that may have some localised and short-term influence on habitat quality if they are present in the Study Area at this time.

Significant Impact Criteria: Black Rockcod

Significant Impact Criteria: (EPBC Act) ***Carcharius taurus* – Critically Endangered** ***Epinephelus daemelii* - Vulnerable**	**Likelihood of Impact**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population of a Critically Endangered or Endangered species or an important population of a Vulnerable species.	
During beach nourishment works some short-term disturbances to a very small area of foraging habitat that may at times be used by threatened sharks and fish may occur. These areas represent only a very small amount of the foraging grounds that these species likely utilise within the locality. The hard substrata habitats that occur within the Project Area provides only very marginal and likely temporary refuge habitat for these species, which if at all, is only likely to be occasionally used by few individuals of the local population.	Unlikely
Reduce the area of occupancy of a Critically Endangered or Endangered species or an important population of a Vulnerable species.	
The proposal is not expected to reduce any area of occupancy important to the Grey Nurse Shark or Black Rockcod population in the locality. Any occupancy of these species in the Study Area is likely to be occasional and part of transient movements between aggregation sites along the coast.	Unlikely
Fragment an existing population of a Critically Endangered or Endangered species or an important population of a Vulnerable species into two or more populations.	
The proposal is not expected to result in any habitat that the Grey Nurse Shark or Black Rockcod may use to become fragmented or isolated from other areas of habitat.	Unlikely
Adversely affect habitat critical to the survival of a threatened species	
The Study Area includes only a very small amount of marginal habitat that may be used by the Grey Nurse Shark and Black Rockcod at times. This habitat is unlikely to be critical to the survival of the species in the locality, while any disturbances will be minimal and short-term.	Unlikely
Disrupt the breeding cycle of a population	
Habitat within the Study Area provides only marginal habitat for the Grey Nurse Shark and Black Rockcod. This habitat is likely to be only utilised infrequently for short-term refuge and foraging. It is not recognised as an aggregation location or expected to be of any elevated importance to breeding of any local population.	Unlikely
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	
Modification of potential habitat will be typically confined to soft sediment areas. These areas may include some very marginal refuge habitat and a small amount of foraging habitat, which are unlikely to be of ecological significance to the Grey Nurse Shark or Black Rockcod in the locality.	Unlikely
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable, endangered, or critically endangered habitat or habitat for migratory species'	
No known invasive species harmful to Grey Nurse Sharks or Black Rockcod are likely to be released or have their populations enhanced as a result of this proposal.	Unlikely
introduce disease that may cause the species to decline, or	
The proposed action is unlikely to result in the introduction of disease that may cause a decline in the local Grey Nurse Sharks or Black Rockcod populations.	Unlikely
interfere substantially with the recovery of the species.	
The proposed action is unlikely to substantially interfere with the recovery of Black Rockcod.	Unlikely
Conclusion	
Habitat in the Study Area is not considered significant habitat for the Grey Nurse Shark or Black Rockcod or likely to be utilised by a significant part of the local population. Any disturbance of Grey Nurse Sharks or Black Rockcod will be dependent on their occurrence at the time of nourishment works and, if the species is present, will typically be confined to short-term disturbances to habitat quality during periods of reduced water quality or placement of sediments. The proposed action is unlikely to have a significant impact on any Grey Nurse Shark or Black Rockcod.	

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Appendix F: Agency and Authority Consultation

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
	The REF must demonstrate how the activity is considered consistent with the objects and principles of the Crown Land Management Act 2016 (sections 1.3 & 1.4 CLM Act)	The activity is consistent with the objects and principles of the Crown Land Management Act 2016 (sections 1.3 & 1.4 CLM Act). This is addressed in Part 4 of this REF.
Crown Lands	The REF must provide detail on how the proposed activity will be authorised under the CLM Act 2016. Should CoN wish to have the proposed activity authorised by way of licence outside of reserves where CoN is the appointed manager then the following considerations will apply: A licence application will be required and supported by the planning approval under the EP&A Act. A review of the planning approval and environmental assessment (REF) would inform the licence application assessment. The licence application will require concurrence from NSW Fisheries under the Fisheries Management Act 1994 and should be accompanied by any relevant supporting material. Crown Lands may request additional information if required to support the assessment of the REF. As outlined in your letter, the Stockton CMP (2020), identifies mass sand nourishment and maintenance nourishment as the preferred methodology to address beach erosion with regular follow up sand nourishment campaigns of around 146,000m^3/yr for 10 years. Given it is intended to undertake regular maintenance nourishment and/or the installation of permanent infrastructure/plant, Division 5.6 of the Crown Land Management Act 2016 will apply and a licence with a specified term and an annual rent will be required. If the management approach, licenced activity, or licence area needed to change / adapt for any reason, then a new environmental assessment / planning approval may be required, and/or a new licence may need to be issued.	CN preferred approach is to be granted a license for sand placements on Crown Land. CN aims for a 'in perpetuity' license with any review/audit process aligned with CMP renewals and/or Port's maintenance dredging sea dumping permit. An 'in perpetuity' approval aligns will the preferred CMP scheme which is amass nourishment with permanent sand top-ups (i.e., on-going). Regular monitoring would be undertaken and reported to Crown Lands to support an 'in perpetuity' licence.
	As an alternative option to a Licence, CoN may become appointed as the Crown Land Manager (CLM) for proposed nourishment locations outside of reserves where CoN is already the appointed manager.	CN's preferred approach is to be granted a license for sand placements on Crown Land.

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
	Consideration needs to be given to the Native Title Act prior to the issue of a Crown Lands licence.	There is no Native Title Claim over the study area.
	Under the Aboriginal Land Rights Act 1983 the following (undetermined) claims were made by Worimi LALC on 18 July 2001: The intertidal zone is subject to ALC 6602 ALC 6603 covers an area of 32,079ha on the seaward side of the low water mark extending to 3 nautical mile limit. Early consultation with the LALC is recommended.	The LALC have been consulted as part of the Cultural Heritage Assessment in Appendix C.
Department of Communities and Justice	No comments to provide.	Noted.
	No objections to the proposed sand nourishment works.	Noted.
	Council requires a Section 200 permit for reclamation	A Crown Land licence will be sought for the works; therefore a Section 200 permit is not required for the Proposal as Crown Lands will consult with DPI Fisheries prior to issuing its licence.
Department of Primary Industries - Fisheries	With regards to future dredging, potential environmental impacts will need to be assessed and a Section 200 permit will be required. All relevant issues raised in *Working paper to inform environmental assessment guidelines: offshore sand extraction for beach nourishment* (Department of Planning, Industry & Environment) (Umwelt Australia Pty. Ltd., 2020) will need to be addressed. Cultural fishing considerations, commercial fishing activities, recreational fishing activities and impacts on marine biodiversity and habitats will need to be considered.	The impacts of dredging will be considered separately for dredging Proposals. No dredging is proposed for this REF. The working paper nominated by DPI has not been provided nor is it publicly available.
Hunter and Central Coast Development Corporation	Shipwreck data provided.	n/a
Environment Protection Authority	Dredge spoil can have adverse impacts on water quality. This has been observed at The Entrance	The potential for water quality impacts has been addressed in Chapter 6 of this REF. This

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
	due to inadequate treatment prior to disposing of dredge spoil direct to waters.	Proposal does not intend to 'dispose' of any material, rather material placed will be for the purpose of beach nourishment (i.e., it will be placement for a purpose).
	The EPA is aware of several potential sources of material that could be sourced locally, that are: potentially contaminated, have a high fines content; have a high organic content; or are potential acid sulphate soils. The source of the material for nourishment will need to be tested and be carefully considered, as this will determine if it is suitable and will determine the level of environmental controls that will be necessary at the deposition site or elsewhere. Such investigations will be necessary to prevent adverse impacts to marine life and protect beach amenity.	This REF covers placement of sand only, not souring. The placed sand must conform with the *Stockton Sand Management Guidelines*, for which testing will be required to ensure that compliance. Testing of source sediments prior to placement will be handled as part of the Project Environmental Management Plan and specifically the Sediment Quality Management Plan. Measures to ensure that the risk of contamination is minimised have been addressed in Chapter 6 of this REF.
	The REF should state the ambient Water Quality Objectives for the receiving waters. These refer to the community's agreed environmental values and human uses endorsed by the Government as goals for the ambient waters. These environmental values are published on the website: http://www.environment.nsw.gov.au/ieo/index.htm.	The REF adopts the ambient Water Quality Objectives for the receiving waters as stated in the Marine Water Quality Objectives for NSW Ocean Waters – Hunter and Central Coast published in 2005 by the Department of Environment and Conservation (NSW). Chapter 6.3 of this REF addresses water quality aspects.
	The proposed environmental controls need to be stipulated in the REF. The REF will need to predict likely water quality impacts from the Proposal and demonstrate whether these are acceptable in terms of achieving protection of the Water Quality Objectives.	Chapter 6 of this REF stipulates the environmental controls that will apply to the Proposal. The likely water quality impacts are also addressed in Chapter 6.
	The potential for odours from dredge spoil placement and handling needs to be considered to protect the amenity of the local area.	Chapter 6 of this REF addresses potential odours from dredge spoil.
	Noise impacts from fixed and mobile plant has the potential to affect the amenity of residents and needs to be appropriately considered within the REF in accord with the guidance provided.	Chapter 6 of this REF addresses the potential noise impacts of the Proposal.

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
	Based on the information provided, we do not anticipate the Proposal described (just beach nourishment), will be required to hold an environment protection licence. The REF needs to explore the necessity, or desirability, of holding an environment protection licence under the provisions of the *Protection of the Environment Operations Act 1997*.	It is understood that an EPL is not required. The necessity, or desirability, of holding an environment protection licence under the PoEO Act is addressed in Chapter 4 of this REF.
Heritage NSW	Previous correspondence considered in relation to historic shipwrecks near the proposed nourishment site.	The previous correspondence from Heritage NSW has been addressed in the maritime Heritage Assessment in Appendix D
Port of Newcastle (PON)	The maintenance dredging and disposal activities carried out by PON are governed by ensuring safe navigation and disposing of dredge material in accordance with relevant permits and approvals to the highest environmental standards. Under PON's current Commonwealth Sea Dumping Permit dredged spoil is placed offshore in a dedicated placement area.	Noted.
	PON has previously placed suitable dredged spoil off Stockton Beach within an approved placement area under an OEH approval issued on 7 July 2017. Under the OEH Approval, PON was permitted to dispose of suitable dredged material that comprised at least 90% sand off Stockton Beach within a designated disposal area. As identified in the OEH Approval the area that contains suitable material for beach nourishment works is in "Area E" and the area in which PON was permitted to place suitable dredged material off Stockton Beach is within the proposed placement area. PON enclosed a copy of the OEH Approval and a copy of the approved placement area.	Noted.
	PON requests consultation when the REF is periodically reviewed.	Noted
	PON expects that the REF will allow parties placing spoil to comply with other approvals applicable to their dredging, in PON's case, its' applicable Commonwealth Sea Dumping Permit.	The REF does not alter any other parties' existing approvals.
	PON expects the placement ground for PON's suitable material for beach nourishment in the REF to be generally in the location of the OEH approved Placement Area. This is because	These issues have been considered in the proposed nourishment methodologies in Part 3 of this REF and will be subject to detailed

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
	PON's dredge capability and practice only allows placement at this near shore zone site to Stockton Beach. The placement procedure is via bottom discharge dredge from the David Allen, which has an operating depth range for disposal of 7 to 11m (below Chart Datum), approximately 250m offshore and one (1) kilometre north of the northern breakwater, having regard to the required under keel clearance requirements and tide. PON understands that treatment of shipwrecks under the new REF is comparable to the OEH Approval.	arrangements when suitable dredged material becomes available. The treatment of shipwrecks under this REF is addressed in the maritime Heritage Assessment in Appendix D.
	PON expects that the criteria for dredged material suitable for beach nourishment under the REF will be comparable to the OEH Approval, being at the discretion of the dredge master. PON understands that CoN's Stockton Beach Sand Management Guideline (Royal Haskoning 21 December 2020) is intended to apply to the REF. PON understands this Guideline to be comparable to the OEH approval, being about 10% mud 90% sand. PON is prepared to place maintenance dredge material containing less than 90% sand (more than 10% fines) off Stockton Beach providing this assessment continues in PON's dredge master's discretion informed by appropriate environmental safeguards including laboratory testing. PON also requests to be consulted when the Guideline is reviewed.	PON would be consulted when the Guideline is reviewed.
	PON expects the volume of suitable material to be placed by PON under the REF of approximately 25,000m^3 per annum primarily in Area E. This is an estimate only and PON is not under any obligation to place this amount as the primary purpose of its dredging is for safe navigation. Further, this volume estimate is for material sourced from maintenance dredging primarily within Area E. At the 2 August 2022 conference PON indicated that it expects to complete a few capital dredging campaigns to support developments at the Port and this may contain material suitable for beach nourishment works.	Noted.
	PON confirms that it is willing, prior to any dredging of suitable material, to notify CN. PON is willing to maintain records of dredging of	Noted.

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
	suitable material in a form like that required by its Commonwealth Sea Dumping Permit	
	PON confirms that it would be willing to provide pre and post dredging surveys on a comparable basis to that under the attached OEH Approval. This is at the termination of the approval and after major dredging projects (those with over 20,000 cubic metres within a one month period), and to provide CN with a report on the details of dredging that has occurred of suitable material. Given that the REF is intended to operate in perpetuity, it is proposed for PON hydrographic surveys to be conducted every two years. Under the OEH Approval this report included pre and post dredging surveys of the borrow and disposal sites, including an area 250 metres beyond the extent of the sites. Also, post dredging surveys were required to be carried out within 28 days of the completion of the dredging, subject to weather and sea conditions.	Noted.
	CN would obtain a Crown licence (if necessary) to permit the beach nourishment works which would allow PON to undertake placement for or on behalf of CN.	It is confirmed that CN would seek the appropriate Crown licenses for the proposed nourishment works.
Port Stephens Council	Community consultation should be undertaken with community members to the northern end of Stockton Bight, i.e., Worimi LALC and the Anna Bay community.	Worimi LALC have been consulted. Consultation with the Port Stephens community has been undertaken as part of the extended CMP consultation.
	Community consultation should be undertaken with Port Stephens community members who are in proximity to Stockton Beach and therefore, may regularly use it, i.e., Fern Bay community.	Consultation with the Port Stephens community has been undertaken as part of the extended CMP consultation.
	Unsure how sand will be transported to Stockton Beach, however; it is recommended that a traffic assessment be undertaken should sand be trucked in; and consideration is given to how this will impact on any roads within the Port Stephens LGA if applicable.	It is not proposed to transport sand to Stockton via road. All nourishment methods considered in this REF are marine based.
	Noting the intention is to nourish Stockton beach and retain sand in that location, consideration should be given to the impacts of the transportation of sand from Stockton beach to Port Stephens beaches.	The sand placement grid was designed to maintain the beach morphology within the historic envelope of beach conditions at Stockton Beach sand of similar nature than the ones

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
		presently composing Stockton Beach. Post-nourishment sediment transport patterns in Stockton Bight, including to Port Stephens beaches are expected to be similar than observed during the past.
	Consideration should be given to impacts to the White's Seahorse (*Hippocampus white*) habitat. The species is currently listed as endangered within NSW and is endemic to the east coast of Australia; known to occur in Port Stephens. The primary cause for the decline of the White's Seahorse is loss of habitat. This is largely due to the installation of boat moorings, boat anchors and inundation of habitat by sand movement. The REF should consider whether the placement of sand at Stockton Beach will result in indirect impacts to White's Seahorse key habitat.	There is no suitable habitat for this species in the study area. Refer to the Biodiversity Assessment at Appendix E.
	Port Stephens Council would like to contribute and be involved in the approval process where required.	Port Stephens Council will be invited to participate in the approval process if required.
Transport for NSW - Maritime	TfNSW Maritime requests the following conditions to be considered in preparation of the REF: 1.Any works impacting on navigation during the construction phase must seek TfNSW Maritime support. A full scope of works relating to on-water operations is to be provided 28 days prior to works commencing. 2.Any work vessels and crew associated with the project must comply with the Marine Safety (Domestic Commercial Vessels) National Law Act 2012 along with relevant NSW marine legislation.	The requirements have been included in Chapter 6 of this REF in the safeguards for Transport and Access (Maritime)
Worimi Local Aboriginal Land Council	Request your assistance in protecting a significant site/area within the Stockton Peninsula, Stockton Seabed and Waters contained or adjacent to Aboriginal Land Claim 6603 area, which has been explored for (sub-surface exploration) and relocation of Sand (Seabed) from within the designated Claimed area onto Open Crown and Public Lands. This Site is of great Cultural and Spiritual significance to the Maiingal Families and all Aboriginal People	A Cultural Heritage Assessment has been undertaken in consultation with the Worimi LALC (Appendix C). Recommendations for the protection of sites and areas are included in that assessment.

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
	of the Worimi and Hunter Area. and is associated with Oral History, Ships Logs and Non-Indigenous Records and Writings. Maiingal Families continue to visit the Site and carry out Traditional Activities and Educational facilitation for all the Communities. The replacing and destruction of existing Seabed and Water (reported in the media) if it continues, will result in the desecration of the site and will cause serious distress to the Aboriginal People of this area. I have spoken with Council (CN) previously on the 'significance' of this area and have issued to them ' guidelines' for responsible use of our Lands. To which they ignore and are not prepared to be governed (or guided) by such Ideologies. I feel they act to a Law unto themselves, as they have issued an AHIP Investigation and by utilising a Natural Disaster to benefit their Business Agenda they deem themselves untouchable. meanwhile destroying, not only Physical, Spiritual but also Intellectual Property Rights of Our Families. I request that you recommend to the Minister (or Rep) that they make an Interim Protection Order in respect of the Site under Section 91B of the National Parks and Wildlife Act 1974 and amendments (there from) which would have the effect of preventing any further development or expansion on the known 'stable' land areas until further discussions with all parties concerned can take place.	
	All remediation work should be an immediate action on the First Dune Line and Beachfront so as to halt further loss and the protection of possible Cultural Material.	Noted.
	I request that the Department recommend to the Minister (or their Rep) that he/she declare the area to be an Aboriginal Place under section 84 of the NPWS Act 1974 (amendments there from). or Native Title be granted over Claim 6603.	Waiting on Penny's report
NTS Corp	No response received.	
Port Authority of NSW	No response received.	

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
DPE Biodiversity Conservation Division	The factors in cl171(2) will apply to the Proposal and must be considered.	These factors are considered in Appendix B of this REF.
	The REF should address matters associated with the application of coastal management areas under the State Environmental Planning Policy (Resilience and Hazards) 2021 (Resilience and Hazards SEPP) as well as the relevant aspects of the certified Stockton Coastal Management Program (CMP) 2020.	Chapter 4 of this REF address the Resilience and Hazards SEPP. This REF has been prepared to respond to recommendations and outcomes from the Stockton CMP 2020.
	The REF should include a description of the likely physical and chemical properties of sediments proposed for beach nourishment purposes	The Stockton Beach Sand Management Guideline (RHDHV, 2020) is the applicable guideline to assess compatibility.
	The REF should include characterisation of existing and historical coastal processes, including: a. Sediment transport pathways and quantitative estimates of transport rates at extraction and nourishment site/s including the transport and fate of 'fine' sediment b. Chronic sediment transport deficit at the nourishment site/s c. Short-term, storm-driven, nearshore sediment demand at the nourishment site/s	A characterisation of existing and historical coastal processes was carried out as part the CMP studies. This was used to determine the potential impact on coastal processes. These aspects are addressed in Chapter 6 of this REF.
	The REF should include a description of relevant water quality objectives to protect environmental values as set out in *Marine Water Quality Objectives for NSW Ocean Waters -Hunter and Central Coast* and the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, and existing water quality at the nourishment site	The REF adopts the ambient Water Quality Objectives for the receiving waters as stated in the Marine Water Quality Objectives for NSW Ocean Waters – Hunter and Central Coast published in 2005 by the Department of Environment and Conservation (NSW). Chapter 6.2 of this REF addresses water quality aspects.
	The REF should include mapping and characterisation of coastal and marine habitat types in Stockton Bight and surrounds (especially reefs, wetlands, beaches, shoals), and a description of their sensitivity and resilience	This is included in the Biodiversity Assessment at Appendix E.
	The REF should include characterisation of the biodiversity values of the nourishment site and other areas potentially affected by beach nourishment (e.g., depositional areas), including:	This is included in the Biodiversity Assessment at Appendix E.

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
	a. An assessment of the known, likely, and possible occurrence of threatened species, populations and communities, and relevant key impacting processes, listed under the Biodiversity Conservation Act 2016 (refer to advice from the Department of Primary Industries with regard to matters under the Fisheries Management Act 1994) b. An assessment of the known, likely, and possible occurrence of species important to the maintenance of coastal ecosystems c. Mapping and description of protected areas, including but not limited to Hunter Estuary Wetlands Ramsar site, national parks, regional parks, and conservation areas	
	The REF should include direct, indirect, and cumulative impacts (beneficial and adverse) on coastal processes and hazards, especially: a. sediment grain size, roundness, and colour b. sediment transport pathways at the extraction and nourishment site/s c. profile recovery and erosion buffer at the nourishment site/s d. water quality because of extraction and nourishment activities	Chapter 6 of this REF assesses the direct, indirect, and cumulative impacts of the Proposal.
	The REF should include direct, indirect, and cumulative impacts (beneficial and adverse) of the activity on species, ecological communities and habitats. The intensity, frequency and duration of impacts and recovery timeframes should be described with reference to the existing case and historical environmental conditions. Impacts and recovery timeframes should be described, including but not limited to, the following: a. changes to the physio-chemical properties of sediments and waters, including increased turbidity from fine sediments, contaminants, and acid sulphate soils b. alterations to coastal habitat features (e.g., dunes, beaches, bars, nearshore reefs) c. burial of benthic invertebrates and its impacts on food resource availability for avifauna and fish	This is included in the Biodiversity Assessment at Appendix E.

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
	d. noise and visual disturbance to fauna e. vessel strike f. marine pests.	
	Direct, indirect, and cumulative impacts (beneficial and adverse) on: a. cultural heritage, including Aboriginal cultural heritage and site amenity, maritime historical heritage, and post-settlement cultural amenity b. coastal infrastructure, shipping, defence and other coastal uses c. social matters (e.g. access, recreational activities, fishing, visual amenity etc.) d. economic costs and benefits.	These matters are addressed in Chapter 6 of this REF.
	An environmental management framework should be developed that considers: •The approach to assessing the suitability of dredged material for beach nourishment purposes, including fines content, acid sulphate soils and contaminants. Regarding contaminants and acid sulphate soils, the assessment should consider relevant guidance in National Environment Protection (Assessment of Site Contamination) Measure, National Assessment Guidelines for Dredging and the Acid Sulphate Soils Manual. The management framework for assessing the suitability of sediments for beach nourishment purposes from a 'fines' content perspective should consider: the transport and fate of fine sediments in the short and long term; and (ii) the sensitivity of receptors (including biological and human amenity) to fine sediments. From this, it is recommended that numerical fines content 'threshold' values are developed to inform the management framework. •The monitoring and adaptive management framework used to manage potential impacts to water quality •The management of potential impacts to environmental receptors, including measures to minimise disturbance of sensitive species	The Stockton Beach Sand Management Guideline (RHDHV, 2020) is the applicable guideline to assess compatibility of nourishment material. The criteria in the Guideline will be reviewed on a regular basis. Screening test according to ASSMAC guideline which demonstrate no actual or potential presence of ASS in nourishment sand would need to be performed. These aspects will be detailed in the Project Environmental Management Plan (PEMP).

Agency / Authority	Issue raised	Response or chapter where addressed in the REF
	•The monitoring and adaptive management framework should address the potential to 'learn' from previous (and future) beneficial re-use nourishment activities to refine the fines content 'threshold' and maximise the quantities re-used beneficially. •The monitoring framework should aim to collect sufficient bathymetric and beach profile data so that impacts to sediment transport pathways can be understood, which should allow for future optimisation of Stockton Beach nourishment strategies.	
NSW National Parks and Wildlife Service	No response received.	
Department of Regional NSW	No response received.	
Defence Housing Australia	No response received.	
Hunter Water	No response received.	