Supporting Documentation E.

Potential Nourishment Sand Sources (RHDHV, 2020b)

City of Newcastle

REPORT

Stockton Coastal Management Program

Potential Nourishment Sand Sources
Supporting Document E

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1 Introduction

It is evident that one of the key drivers of the coastal risk at Stockton Beach is a long-term net sediment deficit (underlying recession). In addition, future shoreline recession is predicted to occur as a result of climate change sea level rise.

Beach nourishment has been considered in detail as a potential coastal management strategy to address the recession hazard. A wide range of potential sand sources have been considered as part of the Stockton CMP process, including:

- Terrestrial sources, including:
  - local quarries;
  - Sydney tunnelling spoil opportunities;
  - sand backpassing from Stockton Bight using beach scraping;
  - sand backpassing from Stockton Bight with Sand Shifter;
  - beach scraping within the Stockton CMP Area; and,
  - Swansea Channel dredged material;

- Marine sources, including:
  - offshore sand sources;
  - Port of Newcastle – Area E; and,
  - sand bypassing from Nobbys Beach;

- Hunter River sources, including:
  - South Arm; and,
  - North Arm.

An overview of each of the above potential sand sources is provided in **Sections 2, 3 & 4** below, including assessment of the feasibility, opportunities and constraints for each source. Details regarding a potential concept approval for the placement of nourishment material at Stockton Beach are provided in **Section 5** A 'traffic light' assessment of each sand source is provided in **Section 6.** References are provided in **Section 7.**

It should be noted that further details regarding potential sand sources will be provided in the Sand Management Guidelines (SMG), which is identified as an action within the Stockton CMP. The SMG will provide a summary document of information regarding sand for future beach nourishment at Stockton.

2 Terrestrial Sources

2.1 Local Quarries

Material Properties

Consultation with several local sand quarries was undertaken to assess the suitability of available products against material acceptance criteria. Sand products from the following local quarries were assessed:

- Macka's Sand and Soil Supplies;
- Boral Stockton Sand Quarry;
- Redisands (Salt Ash);
- Newcastle Sand (Williamtown); and
- Sibelco Sand Quarry in Salt Ash (Note: Sibelco only carry a maximum of 2,500 tonnes of their 3060 product at any one time, and orders greater than this will incur longer lead times).

Material data sheets relating to available products were provided by each of the quarries and assessed by RHDHV engineers.

Considering that all locally sourced terrestrial sands are quarried from the windblown dunes of Stockton Bight and are further processed (i.e. washed and screened), it is unlikely that these terrestrial sands would contain any contaminants, organic matter, excessive fines or excessive coarse material, or significant colour incompatibilities following placement. Therefore, the key criterion determining the compatibility of these quarried sands is the Particle Size Distribution (PSD) of the available sand products.

PSD curves for a range of sand products available from local quarries are plotted in **Figure 1**. It is evident that the majority of these products are characterised by a median grain size (D_{50}) ranging between around 0.30 and 0.40 mm, while two of the products comprise relatively fine sand with D_{50} values below 0.25 mm.

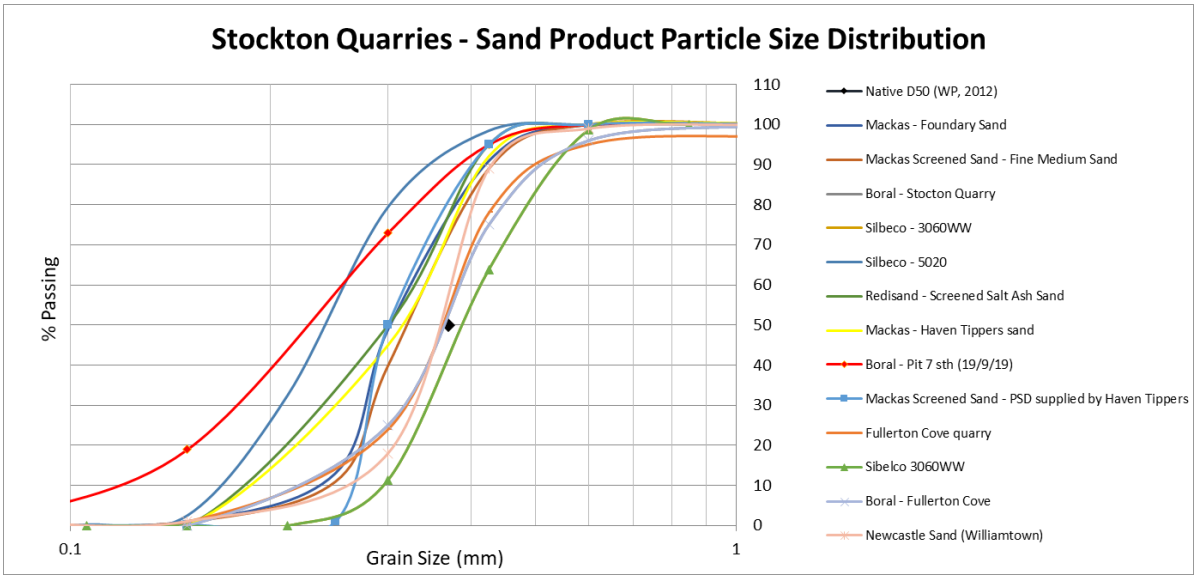

Figure 1: Stockton quarries - sand product PSDs

In April 2011, WorleyParsons (2012) collected several samples of native beach sand along three transect profiles at Stockton Beach, with the transects located 900 m, 1700 m and 2500 m north of the Northern Breakwater of the Hunter River entrance (the Breakwater). Median grain sizes (D_{50}) ranged from 0.27 to 0.47 mm, with finer sand generally found at the southern end. The average grain size (D_{50}) from these samples was 0.37 mm (excluding a gravelly sample collected in the nearshore zone at the northernmost transect), as shown in **Figure 1**.

The beach and nearshore sands extending to a depth of approximately 15 m at the southern end of Stockton Beach were described by Roy and Crawford (1980) as well to very well sorted fine to medium grained sands with grain sizes ranging from 0.18 to 0.35 mm. A uniform mean grain size of 0.25 mm was determined for beach and nearshore sands at the southern end of Stockton Beach (Roy & Crawford 1980). This grain size was used as a constant in the most recent coastal processes modelling undertaken by DHI (2006). MHL (1977) similarly found finer sands in the southern few kilometres closest to the Breakwater, with many samples finer than 0.3 mm.

Based on the above information, it is considered that a compatible source sand for Stockton Beach should have a median grain size between 0.30 and 0.40 mm. This criterion accounts for the range of grain sizes found along the length of the beach, with progressively coarser material occurring with distance north of the Breakwater. This criterion also has regard to the Coastal Engineering Manual (CERC 2006) which notes that the D_{50} of the borrow material should be within plus or minus 0.02 mm of the native sand D_{50}.

Using this criterion, it is evident that the majority of sand products available from local quarries would likely be compatible for nourishment purposes at Stockton Beach (refer **Figure 1**).

Overfill Factors

The Overfill Factor or Overfill Ratio (R_A) is the ratio of fill (nourishment) material required from a given borrow site compared to that required using the existing (native) beach sediments (CERC 2006). The Overfill Factor is based on differences in the mean grain size and sorting characteristics of both the native and nourishment (borrowed) sands.

Whilst the Overfill Factors provide an indication of compatibility between borrow and native sediment, more detailed assessment of the compatibility is recommended to inform detailed project design. For example, CERC (2006) notes that:

- Recent research and beach nourishment experiences have questioned the continued use of grain-size based factors, such as R_A and the renourishment factor (R_J), to estimate beach-fill performance (Dean 2000).
- Present guidance recommends that design be based on equilibrium beach profile concepts, an assessment of storm-induced erosion, and an assessment of wave-driven longshore transport losses; and that these methods be used to replace or complement the overfill and renourishment factor approaches (National Research Council (NRC) 1995).

Nevertheless, the Overfill Factor can be used to provide a useful indication of sand volume requirements for a nourishment project, particularly in the early stages of project design. As such, this approach has been adopted for the purpose of undertaking a high-level assessment of sand volume requirements associated with the placement of local quarry sand sources at Stockton Beach.

CERC (2006) recommends that for a sand nourishment project, ideally a nourishment (borrow) sand should have an overfill ratio of 1 to 1.05 relative to the native sand. However, CERC (2006) also notes

that this may not always be possible and as a rule of thumb if the median grain size of the borrow sand is within 0.02 mm of the native sand median grain size it is considered compatible.

Overfill Factors were calculated for several of the potential quarry sand sources using methods outlined in the Shore Protection Manual (CERC 1984). The WorleyParsons (2012) grain size data was used to characterise the native beach sands for these calculations (mean grain size, D_{50} = 0.37 mm or 1.43 phi units). Overfill Factors typically ranged from 1.8 to 5 for quarries carrying larger quantities of sand (suitable for a nourishment campaign at Stockton). This indicates that the median grain size of quarry sand sources is generally finer than the native sand requiring 1.8 to 5 times as much sand to retain each 1 m^3 on the beach. It should be noted that some products were in the unstable range (R_A > 10).

Based on the above, an Overfill Factor of approximately 2.5 has been adopted in the CMP for the purpose of assessing terrestrial sand nourishment at Stockton Beach using quarry sand sources. However, it should be noted that sensitivity testing was carried out in the CBA using an Overfill Factor of 1. The Overfill Factor would need to be reviewed on a case by case basis during any future nourishment works in consideration of the material properties of proposed sand nourishment material and the detailed project design.

Licensed Extractive Capacity

The extractive capacity of local quarries is stipulated in the Environment Protection Licence (EPL) issued to each facility. For example, EPL 10132 for Boral Quarries Stockton (Fullerton Cove) authorises an annual sand extraction of 100,000 to 500,000 tonnes. The current annual extractive capacities licensed for each of the local quarries considered herein are listed in **Table 1**.

Table 1: Local Quarry Licensed Extractive Capacity

Quarry Sand Source	EPL Number	Annual Extractive Capacity (tonnes)[1]	Annual Extractive Capacity (m^3)[1]
Boral Stockton (Fullerton Cove)	10132	500,000	300,000
Macka's Sand and Soil (Salt Ash)	12108	50,000	30,000
Sibelco (Oyster Cove)	11633	150,000	90,000
Newcastle Sand (Williamtown)	21264	500,000	300,000
Redisand (Salt Ash)	13406	500,000	300,000
TOTAL	**-**	**1.7 M tonnes**	**1,020,000 (sourced) 408,000 (effective)[2]**
Assumed availability for nourishment of Stockton Beach	**20% of total licensed quantities**	**340,000 tonnes**	**200,000 (sourced) 80,000 (effective)[2]**

[1] Maximum quantity that can be extracted, processed or stored annually.
[2] Effective in situ volume of quarry sand following placement at Stockton Beach, based on an adopted Overfill Factor of 2.5.

Based on preliminary enquiries made with Boral Stockton (Fullerton Cove), it is understood that annual extractive operations are typically within around 15,000 tonnes of the upper licensed limit of 500,000 tonnes. For the purpose of the assessment undertaken herein, it has been assumed that up to around 20% of the current annual combined extractive capacity of 1.7 million tonnes could be secured for

terrestrial sand nourishment at Stockton Beach (refer **Table 1**). This would require detailed negotiations with each quarry to secure such a substantial portion of their licensed quantities, confirmation that suitable products can be made available, and (potentially) modifications to the existing EPLs.

Therefore, it has been assumed that local quarry sources are currently capable of supplying 340,000 tonnes annually for the purpose of nourishing Stockton Beach, which is equivalent to a supplied volume of around 200,000 m^3. Based on the adopted Overfill Factor of 2.5, the effective quantity of nourishment sand that could be placed on Stockton Beach is around 80,000 m^3 per year.

Costs

The cost to supply and place around 3,500 m^3 of quarry sand at Stockton Beach in December 2019 was around \$100/m^3. However, it is expected that lower cost rates would be available for large-scale nourishment campaigns due to economies of scale and competitive tendering. Therefore, for the purpose of costing in the CBA, a 20% reduction was applied to the December 2019 costs. That is, a cost rate of \$80/m3 was adopted in the CBA for the supply and placement of quarry sands using land-based plant.

Sensitivity testing was carried out in the CBA using a lower bound cost rate of \$50/m^3, which incorporates a 50% reduction on the December 2019 project costs. This lower bound is to account for potentially even lower cost rates being available from local sand suppliers, depending on the scale of the project and a range of commercial factors.

2.2 Sydney Tunnelling Spoil Opportunities

Background

There is a potential to source tunnel spoil from the Western Harbour Tunnel (WHT) and other Sydney tunnel spoil projects for the purpose of beach nourishment.

It should be noted that sea disposal of terrestrially generated material is not common in Australia, with most material disposal occurring to land. Where this has involved material that is potentially suitable for beach nourishment purposes, such as Sydney Sandstone and Hawkesbury Sandstone, this could be considered as a series of missed opportunities. For example, future Sydney Metro and Cross-Harbour Tunnel projects are expected to generate several million m^3 of such material. While re-use of this material for nourishment purposes was briefly considered, it was not pursued further, likely due to the absence of a clearly defined, approved, alternative disposal pathway.

Concerns were raised in 2017 by the Sydney Coordination Office (SCO) regarding the cumulative impacts of proposed developments in and around White Bay and the Rozelle precinct, which included several tunnelling projects (WHT, Sydney Metro West and WestConnex Stage 3b). A Cumulative Traffic Working Group (CTWG) was established to jointly discuss management of all Sydney tunnel spoil, mostly around traffic implications related to land-based disposal of tunnel spoil. The working group comprised members of the following organisations:

- Transport for NSW;
- Urban Growth;
- Sydney Coordination Office;
- RMS (Network Sydney);
- RMS (Western Harbour Tunnel Project);
- RMS (WestConnex Stage 3b – Rozelle Interchange Project);
- Sydney Metro (Metro West); and,
- Port Authority of NSW.

The CTWG developed a shortlist of several potential mitigation options for the traffic implications, which included offshore disposal of terrestrially generated material.

Upcoming/Current Potential Opportunities

Some upcoming major tunnelling projects with the potential to generate significant quantities of material that would be suitable for nourishment at Stockton Beach include:

- Sydney Metro (Metro West), noting:
    - Tendering for construction of the 24 km Sydney Metro West metro line was launched on April 7 2020.
    - One of the tunnelling contracts associated with the tender is from Sydney Olympic Park to The Bays, with the ability to load tunnel boring machine (TBM) material at White Bay.
    - It is anticipated that tunnelling operations will commence around the end of 2022.
    - It is understood that the tunnelling works will generate around 2 million m^3 of Hawkesbury Sandstone.
    - The extra-over cost to transport this material to Newcastle is likely to be in the order of up to around $10 per m^3, subject to commercial negotiations.

- Western Harbour Tunnel (WHT), noting:
    - Tunnel spoil from the WHT project is mostly going to land.
    - Following the work of the CTWG as outlined above, a sea dumping permit was obtained from the Commonwealth for the unconfined sea disposal of sandstone material from two of the WHT waterside construction sites, Yurulbin Point and Berrys Bay (**Figure 2**), from which material would already be on a barge.
    - A total of 600,000 m^3 of sandstone material requires removal from these sites.
    - The material would be disposed at Sydney Dredged Material Ground (DMG), similar to the method adopted for disposal of sandstone for approaches to the existing Sydney Harbour Tunnel in the late 1980s.

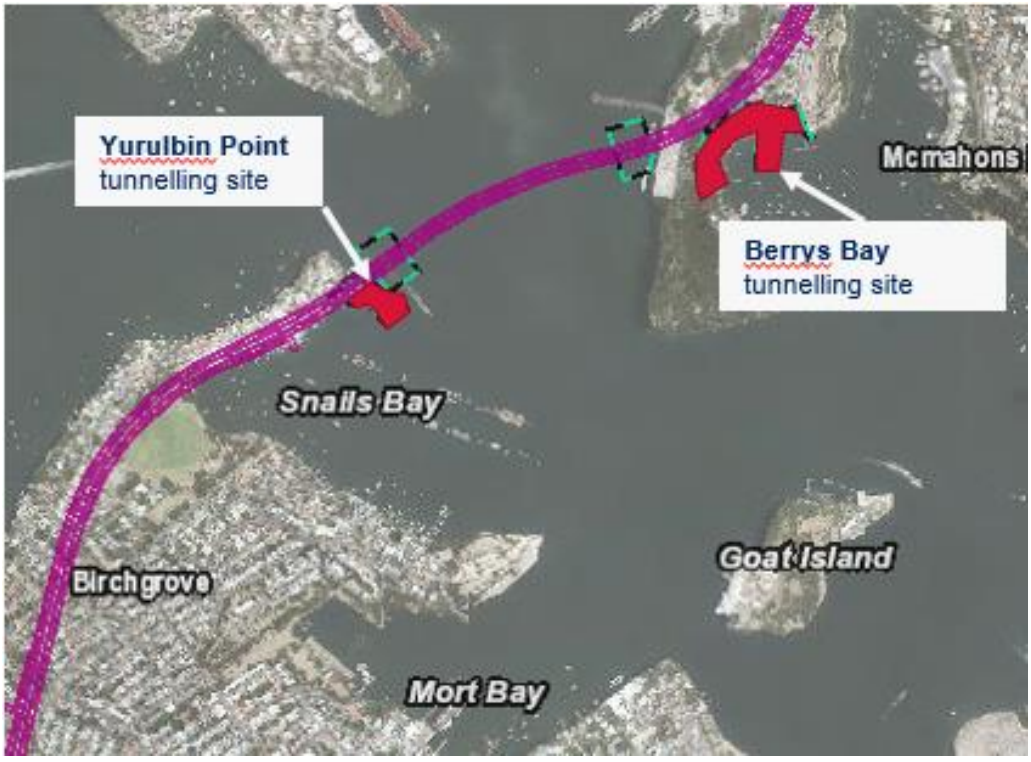

Figure 2: WHT tunneling sites nominated for unconfined sea disposal of terrestrial tunnel spoil

- WestConnex Stage 3b – Rozelle Interchange Project, noting:
    - tunnelling works commenced in early 2020;
    - the Rozelle Interchange tunnels are located mainly in Hawkesbury sandstone; and,
    - tunnelling is being largely carried out by roadheader machines that use a rotating head to slowly excavate the rock.

Tunnelling material is generated by either roadheader or TBM. Typically, TBM material is characterised by a narrower and 'finer' grading curve than roadheader material and may be generally better suited to beach nourishment applications. Furthermore, it is understood that tunnelling Contractors have the ability to adjust their machines to alter grading curves, which could enable tunnelling operations to be potentially optimised to generate the most suitable material for beach nourishment. However, Contractors would ideally be informed of this requirement prior to Tender because it can influence the types of machines used for the project and overall costs.

In general, while further investigation would be necessary, it is considered that tunnel spoil would be suitable for nourishment of Stockton Beach provided it is placed in the nearshore, regardless of whether the material is generated by TBM or roadheader methods. Based on assessment of grading curves for roadheader material associated with Sydney tunnelling projects, typical roadheader material comprises around 10% fines (material less than 75 microns, i.e. silts and clays) and up to cobble size and greater. While this grading is not directly compatible with native material at Stockton Beach, it would not be financially justifiable to wash and screen the tunnel spoil prior to placement. In any case, this is not considered to be essential since if roadheader material, for example, was placed in the nearshore:

- fines would be transported out of the active coastal zone into deeper water, as they are not compatible with coastal processes (wave and current energy) in the nearshore;
- sand sized material would remain within the active coastal zone as required to satisfy nourishment objectives;
- larger fractions including cobbles would be expected to remain in the vicinity of the placement area over the medium to longer-term, noting that this material:
    - may provide some beneficial rocky reef function;
    - cannot become a navigation hazard (an issue for trawling) or significantly modify wave transformation unless by design;
    - would likely break down over time to form additional sand sized material.

Approvals Pathway

It must be noted that the proponents of these tunnelling projects, for certainty, have pursued other means of tunnel spoil disposal that are currently approvable. It is likely that the proponents would be generally open to the idea of the beneficial reuse of tunnel spoil for nourishment but only if it did not delay their project or incur additional cost.

It is likely the best opportunity for existing projects (such as WHT and WestConnex) may now lie with Contractors, but Contractors are unlikely to take on the risk of obtaining an approval for reuse of the material for beach nourishment.

It is considered that the most feasible and effective approvals pathway would involve a government agency obtaining a ‘concept approval’ for the placement of nourishment material at Stockton Beach. The following is noted:

- The concept approval would include a range of criteria that must be met for the nourishment project to proceed (e.g. properties of the proposed nourishment material).
- The concept approval would ideally apply to any future significant sand sourcing opportunities, including tunnelling projects, Hunter River dredging, Newcastle redevelopment sites, and any other potential sources.
- The Beach Nourishment Concept Approval Pathway is discussed further in **Section 5**.
- Having a concept approval for placement of suitable nourishment material at Stockton Beach is considered to be essential to ensure current and future opportunities to beneficially re-use tunnelling material or materials from other sources are not missed. Accordingly, it is recommended that the obtaining of a concept approval should be pursued as an immediate action. This could be progressed by any suitably resourced, tasked and funded Public Authority.

2.3 Sand backpassing from Stockton Bight using Beach Scraping

Overview

RHDHV, building on previous work by WorleyParsons (2012), have assessed the option of sand backpassing from the northern end of Stockton Bight using beach scraping techniques. WorleyParsons (2012) considered the use of sand from within the Newcastle LGA as well as sand from further north within the Port Stephens LGA. For beach scraping to be contained within the Newcastle LGA, the length of beach suitable for scraping is limited to approximately 1 km. This 1 km stretch of beach extending south from the LGA boundary (including part of Stockton Centre frontage) has been identified as the optimum location for beach scraping for the following reasons:

- the long-term beach behaviour in this area is stable to slightly prograding;
- the distance to transport the material is minimised therefore lowering costs;
- negotiations and approvals are minimised as the activities are contained within the Newcastle LGA; and,
- the wide dunes in this area mean that recession of the dune face due to scraping would not be expected to significantly impact the natural and built environments, with the narrowest dune width currently approximately 250 m (to the closest built assets within Stockton Centre) at the southern end of the 1km stretch of beach.

Further north, within the Port Stephens LGA, the beach and dune system of Stockton Bight is some 30 km long with a bare sand beach-dune width of around 600 m and dune elevations of 20 m. This area includes the Worimi Conservation Lands and National Park and Wildlife Service (NPWS) land, with further consultation required to negotiate use of this resource. The approvals process would be critical to the feasibility of this sand source. Relevant consents and approvals would need to be obtained to borrow sand from this area. This is discussed further below.

It is noted that the sand in the back dunes is likely to be less compatible due to the fineness of the sand as this is generally aeolian transported material. The proposed sand extraction is limited to scraping from within the tidal/wave runup zone which should be more compatible. This would likely lead to a level of recession of the dune face at the extraction site.

Methodology

The option involves land-based beach scraping equipment (Wheel Tractor Scrapers) excavating material from Stockton Bight and transporting it along the beach to the southern areas requiring nourishment. The Wheel Tractor Scrapers are self-loading machines with on-board storage (17 to 26 m^3 capacity).

The beach scraping could be undertaken with say four 17.5 m^3 tractors operating, for a round trip of approximately 1 km and 10 mins/trip.

Typically, scraping depth is limited to 0.2 to 0.3 m to minimise environmental impacts. Beach levels also need to recover before additional scraping can be undertaken. With a typical beach width of say 30 m (of trafficable sand between low water and the extent of wave runup) and a beach length of 600 m (i.e. CN managed land contained within the Newcastle LGA north of Mitchell Street revetment) the area would need to be scraped 10 times (to a depth of 0.2 m) to achieve 36,000 m^3. That is, each scraping exercise could yield 3,600 m^3 of sand.

Permissibility

There are a range of land zoning and other regulatory considerations that would need to be addressed to facilitate the use of sand from Stockton Bight for beach nourishment purposes. Preliminary consultation has been undertaken with several stakeholders including DPIE – Crown Lands, Port Stephens Council and NPWS, as outlined below:

Feedback from DPIE - Crown Lands regarding coastal management/protection works:

The information is specific to Crown land in zones 1, 2, 3 and 4 of the Stockton CMP and seaward of the 2025 coastal hazard line (as provided by CN, email dated 16 April 2020).

- CN is required to undertake development on Crown reserves and Crown land in accordance with the relevant planning legislation.
- Public foreshore land immediately seaward of the 2025 hazard line at Stockton, zones 1, 2, 3 and 4, is Crown land under the management of CN - being Crown Reserve 79066, gazetted 9 Nov 1956. The reserve purpose is for: public recreation, additional purpose 'port facilities and services'.
- Under the *Crown Land Management Act 2016* (CLM Act) CN has authority to manage the Crown reserve in accordance with the reserve purpose or any purpose incidental or ancillary to the reserve purpose, or for a purpose specified in a plan of management for the reserve. Where these conditions are satisfied, CN does not generally need to seek additional approvals under the CLM Act for works undertaken by CN on the reserve.
- Under new arrangements under the CLM Act, refer Division 3.4, CN is authorised to manage its dedicated or reserved Crown land as if it were public land under the *Local Government Act 1993* (LG Act). Noting there are transitional arrangements in place until 30 June 2021 and more information is provided in the attached 'Transition guide for Crown land managers- local councils'. Under these new arrangements, CN is to prepare and adopt a plan of management (PoM) for the reserve by 20 June 2021. After the adoption of the PoM, CN will be directly responsible for the care, control and management of the reserve as carried out in accordance with the PoM prepared under the LG Act.
- Where works are to occur on Crown land not under the management of CN, for example beach nourishment or beach scraping works that are located on submerged Crown land below mean high water mark and outside of reserve 79066, then a form of tenure under the CLM Act will be required before the works can be carried out. Further details will need to be provided to determine the tenure that is appropriate to the works. Beach scraping works have generally required a Crown land licence at other locations, refer attached 'Licensing of Crown land—guidelines' for more information.
- The *Native Title Act 1993 (Cth)* needs to be considered by CN in the preparation of the PoM and any subsequent development on reserve 79066.
- The bed and banks of waterways below mean high water mark (MHWM) are typically Crown Waterway across much of the state (there are exceptions, for example those waterways managed under the *Ports and Maritime Administration Act 1995* e.g. Newcastle Port). Where actions are considered or proposed in, on or adjacent to Crown land, boundaries may need to be identified/verified by survey. Works and proposals should not rely on retaining structures or fencing as evidence of land boundaries.

Aboriginal Land Rights Act 1983 (ALR Act)

- DPIE - Crown Lands advised CN (letter dated 17 November 2017), that there are incomplete Aboriginal land claims (ALCs) made under the ALR Act on Crown land in the Stockton CMP area. This advice was specific to Crown land in the vicinity of Barrie Crescent, refer Table 1 below. There are three other incomplete ALCs in the southern zones of the Stockton CMP area, refer Table 2.
- DPIE - Crown Lands' ALC Unit has completed the investigation of ALC 5720/1933/19564. The investigation indicates these ALCs are not claimable as the land was likely to be needed for an essential public purpose. Crown Lands anticipate these ALCs should be determined by 30 June 2020. CN have not undertaken any investigation of ALC 6602/19468/19579 at this stage, but will commence an investigation of 19468 and 19579 shortly. In terms of ALC 6602, it is very likely the land will not be claimable as it is a waterway. As a result, it would not be unreasonable to proceed with planning for any works in this area, pending determination at some future point.

Feedback from Port Stephens Council regarding sand extraction within the Port Stephens LGA:

- The DPI land as well as Worimi Conservation Lands (WCL) are zoned as E1 National Parks and Nature Reserves.
- The Defence Housing Australia (DHA) land at Rifle Range is classified as E2 Environmental Conservation.
- Under the provisions of Port Stephens LEP2013, extractive industries are not permissible within E1 and E2 zones and the sourcing of sand is therefore not permissible.
- Furthermore, Clause 7(3) of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* states that extractive industries may be carried out with consent on land where development for the purposes of agriculture or industry can be undertaken with consent, or on land that is part of a waterway, estuary in the coastal zone or coastal waters that are not within an environmental conservation zone. As the E1 and E2 zones do not permit agriculture or industrial development, and the land is zoned for environmental conservation, sand extraction would not be permissible in these areas.
- Under the provisions of Port Stephens LEP2013, extractive industries are permissible in RU1 Primary Production and RU2 Rural Landscape zones. Several commercial sand mines are currently operating along the foreshore areas that could potentially provide the sand required for the proposed rehabilitation activities (refer **Section 2.1** for discussion of local quarries as a potential sand source).

Feedback from DPIE regarding Worimi Conservation Lands:

- The WCL covers 4029 hectares, comprising 1812 hectares of national park, 881 hectares of state conservation area and 1336 hectares of regional park (**Figure 3**).
- Throughout 2005 and 2006, Worimi Local Aboriginal Land Council (LALC) representatives and an Aboriginal Negotiating Panel of Worimi Traditional Owners negotiated the Lease Agreement for the WCL with the Minister for the Environment. Once the Lease was agreed and entered into, the land was granted to the Worimi LALC under the *Aboriginal Land Rights Act 1983* and gazetted in 2007 under the *National Parks and Wildlife Act 1974* (NPW Act) as Worimi National Park, Worimi State Conservation Area and Worimi Regional Park.
- The intertidal zone extending to the mean low water mark was gazetted as part of Worimi Regional Park under Part 4 of the NPW Act, and therefore not returned to Aboriginal ownership. The Lease Agreement commits NPWS to managing the intertidal zone as part of the WCL

- Sand extraction in all these classifications of reserve is prohibited either under the NPW Act and Regulations, or is contrary to the objectives and provisions of the existing statutory Plan of Management.

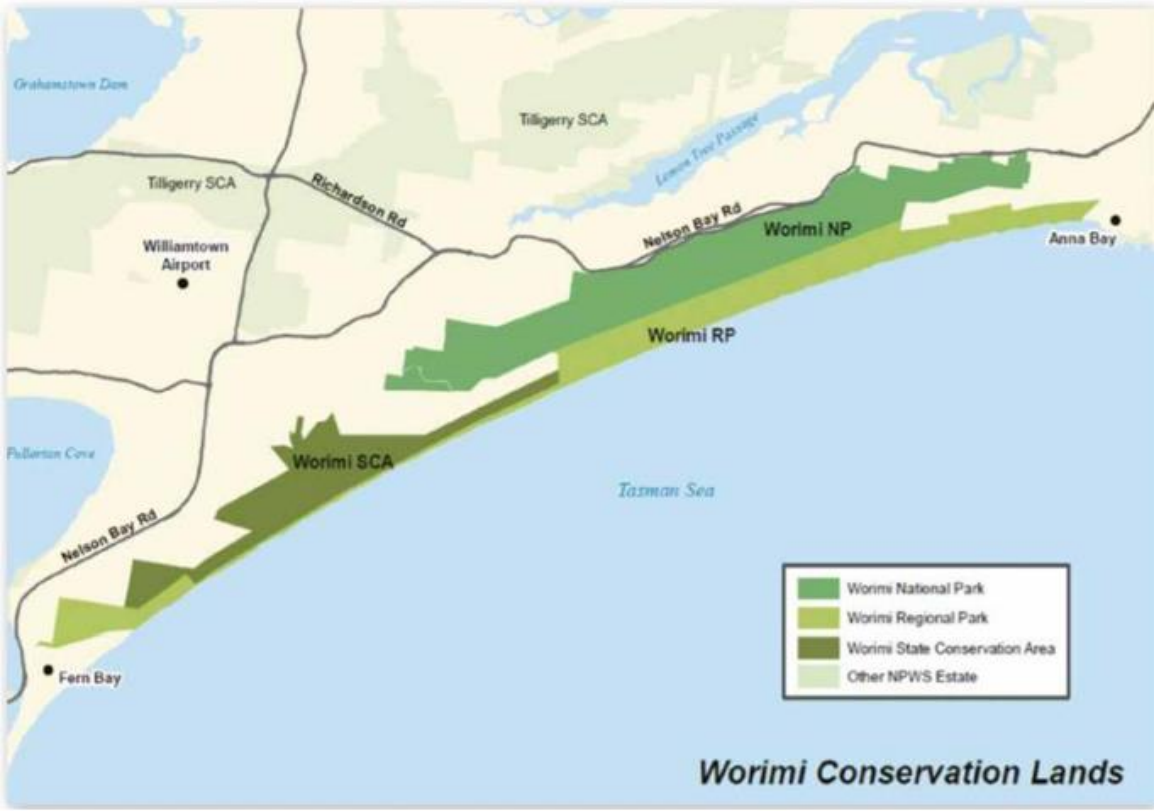

Figure 3: Reserves comprising the Worimi Conservation Lands

The following land zoning applies for parts of Stockton Bight located within the Newcastle LGA:

- DHA land at Fort Wallace is classified as E2 Environmental Conservation;
- the Hunter Water site is classified as SP2 Sewerage systems; and,
- Stockton Centre is classified as SP2 Health Services Facility.

For each of these zonings, extractive industries are prohibited under Newcastle LEP 2012. For this reason, the beach scraping activities and quantities described were limited to the 600 m frontage north of the Mitchell Street revetment up to the Hunter Water boundary. This constraint would need to be addressed by CN to enable beach scraping to occur further north.

Cost

A unit cost rate of around $20/m^3 is estimated for this backpassing option.

Summary

For the purpose of the present assessment to inform the Stockton CMP, it has been assumed that a maximum of two to three scraping exercises could be undertaken each year, based on allowing four to six months between scraping exercises for the borrow area to recover. This equates to an annual maximum

supply of 20,000 m^3 to 30,000 m^3 from this source. This is likely to fall well short of the volume requirements under the various management options.

A unit cost rate of \$20/m^3 could be adopted for this backpassing option.

Furthermore, it should be noted that the existing narrow beach widths would limit beach access for machinery at certain locations. Some areas may only be trafficable at very low tides with calm seas (e.g. Mitchell Street revetment frontage). This would effectively increase the down time for machinery, extend project timeframes and increase costs. Road access may therefore be necessary to transport the material to the southern side of Mitchell Street revetment. This limitation may make this option only feasible for transporting sand to the areas north of Mitchell Street revetment.

Overall, it is considered that the feasibility of this backpassing option is constrained by:

- the maximum quantity of material that can be regularly sourced from the borrow area;
- existing land zoning and regulatory provisions, particularly within the Port Stephens LGA; and,
- machinery access south of Mitchell Street.

2.4 Sand backpassing from Stockton Bight with Sand Shifter

RHDHV have assessed the option of backpassing sand from north of the Stockton township frontage using a submerged sand shifter system (refer **Figure 4**). Similar systems are currently operated at Noosa, Lakes Entrance Victoria, Mooloolaba and Bribie Island.

This sand backpassing option involves collection of sand using a submerged sand extraction unit buried under the sea floor with shore based pumping equipment at the northern end of the Newcastle LGA (prograding area) and pumping the material southwards, through approximately 3 km of land-based, buried HDPE pipeline with outlets onto the beach to the north of Mitchell Street revetment and terminating at the southern end of Mitchell Street revetment (refer **Figure 5**).

Figure 4: Example submerged sand extraction unit

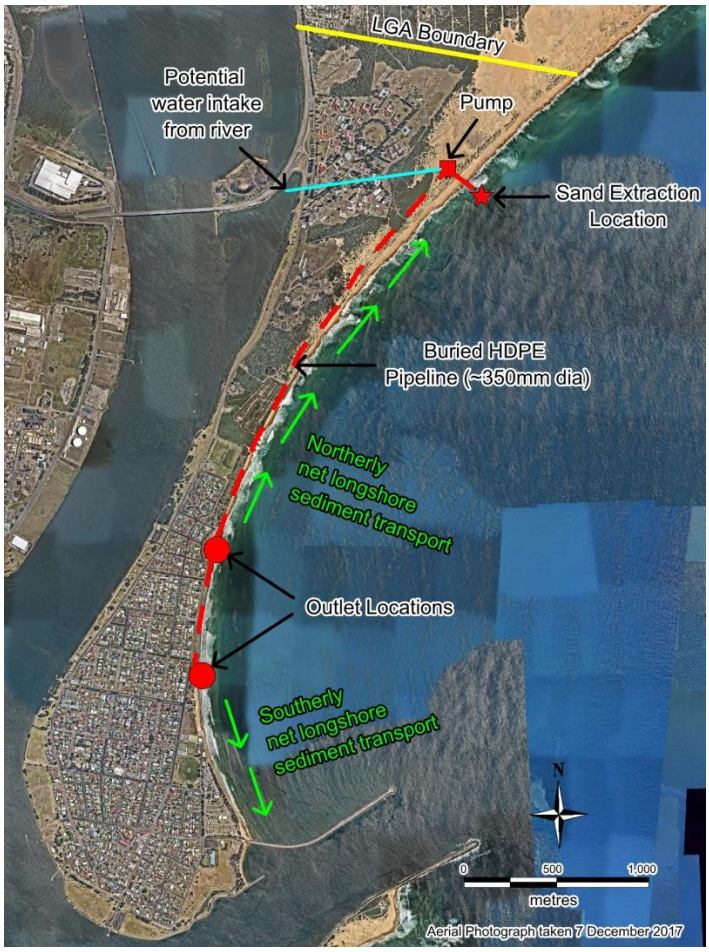

Figure 5: Sand backpassing schematic for Sand Shifter

Water supply for these systems is generally via a directionally drilled water intake line extending from the beach to 100 m offshore, or from a river source if feasible. At Stockton the most cost-effective option may be to source the water from the Hunter River rather than an offshore intake.

The temporary sand backpassing system was priced by RHDHV on the basis of a 100,000 m^3/year system to achieve a total nourishment of 500,000 m^3 over its 5-year life, followed by the installation of a permanent system (NB: a 85,000 m^3/year system was allowed for, although larger systems may be necessary based on the latest understanding of recession rates; Bluecoast (2020) estimated an annual nourishment volume requirement of up to 112,000 m^3/year).

These significant sand extraction volumes would inevitably lead to adverse impacts at the borrow site. Monitoring of the performance of the nourishment provided by the temporary system would enable further refinement of the permanent system capacity and design.

Based on the current understanding of sediment transport processes at Stockton Beach, the sand discharged to the south of Mitchell Street revetment, would be expected to move southward nourishing Zone 1 and 2 of the Stockton frontage via the net southerly sediment transport regime (refer **Figure 5**). Conversely, sand discharged to the north of Mitchell St revetment, would be expected to move northward nourishing Zone 4 to 7 of the Stockton frontage via the net northerly sediment transport regime. Sand could also be pumped onto beaches at intermediate locations on an as needs basis. The sand is assumed to initially be evenly distributed with 50,000 m^3/year to each of the southern and northern ends of

Mitchell Street revetment. This breakdown can be monitored and adjusted as required within this flexible system.

Backpassing would likely be regarded initially on a trial basis, with monitoring and flexibility to modify the strategy to achieve optimum outcomes. Comprehensive monitoring of any backpassing together with flexible reactive response in terms of the back-passing location, rate and method are essential.

Costs

The estimated costs are set out below for this backpassing option.

For a trial diesel system (100,000 m^3/year capacity over a 5-year contract):

Capital Cost:

Mobilisation	$ 1.6M
Demobilisation	$ 0.35M
Total	**$ 1.95M**

Recurring Costs

Operating costs	$390,000/year ($32,500/month)
Unit rate for sand	$750,000/year ($7.5/m^3 for 100,000 m^3/year)
Power	$220,000 ($2.2/m^3)
Total	**$1.36M**/year for 5 years

For a permanent electrical system (85,000 m^3/year capacity):

Capital Cost:	**$4.5M**
Recurring Costs:	**$8/$m^3$** (operating costs including maintenance, power and unit rate for sand)

Summary

For the purpose of the present assessment to inform the Stockton CMP, it has been assumed that a trial diesel system (100,000 m^3/year capacity over a 5-year contract) would initially operate as per the details set out above. This would deliver 500,000 m^3 of nourishment over the first five years at an average cost rate of around $17.50/$m^3$.

A permanent system with an appropriate pumping capacity would then be installed, based on annual pumping requirements. A capital cost of around $4.5 million plus an ongoing rate of around $8/$m^3$ would apply for this option. However, further investigations would be required to assess the feasibility of pumping systems able to keep pace with the Bluecoast (2020) high estimated recession rates of 112,000 m^3/year.

These volumes would inevitably lead to adverse impacts at the borrow site, which would require further investigations.

As such, it is considered that this backpassing option may be constrained by:

- the maximum quantity of material that can be sourced from the borrow area without yielding adverse impacts;

- existing land zoning and regulatory provisions, although noting that sand would be sourced within the Newcastle LGA which would be expected to simplify the approvals process; and,
- pumping capacity of the permanent system, which may struggle to achieve maximum required rates of 112,000 m^3/year, subject to further investigations.

2.5 Beach Scraping within the Stockton CMP Area

Overview

Beach scraping involves the movement of small to medium quantities of sand from the lower part of the littoral beach zone to the dune system using mechanical means. Beach scraping is undertaken to augment the natural processes of building the subaerial portion of the beach profile. Beach scraping activities are undertaken on a periodic basis at numerous beaches along the NSW coast with successful outcomes being observed.

Periodic beach scraping practices aim to increase the volume of sand in the subaerial portion of the beach profile at locations which are vulnerable to episodic erosion. This measure is primarily to enhance coastal protection through building the upper profile and dune system while at the same time improving beach amenity. It is not a nourishment activity as it does not introduce additional sand into the beach profile, rather it is a redistribution of existing material within the profile.

Beach scraping is undertaken as a maintenance activity when sand is available in the intertidal zone. It must be noted that beach scraping does not address long-term recession or sand loss from the beach profile.

Beach Scraping at Stockton

Beach scraping is included as a management action in the Newcastle CZMP. CN have developed a scraping strategy for Stockton Beach that utilises material from within the Stockton CMP Area, i.e. from the Breakwater in the south to Corroba Oval in the north.

RHDHV (2018) estimated that a total sand volume of around 14,000 m^3 could be scraped from the lower profile to the upper dune face for a single project within the Stockton CMP Area, based on a scraping depth of 0.2 m.

The timing of beach scraping activities needs to account for a number of factors, including:

- seasonal variation in coastal processes and resulting beach profile fluctuations;
- potential threats to resident beach fauna (i.e. nesting birds and intertidal species);
- seasonality in beach usage and access; and,
- favourable conditions for dune vegetation planting.

The rate at which sand can be transferred for the rebuilding of the foredune is naturally limited by the rate of onshore movement of sand into the swash zone, i.e. availability of borrow material. The duration of scraping exercises is also highly dependent on the number and type of machinery used to undertake the works.

RHDHV (2018) noted that beach scraping at Stockton Beach would be best performed during Spring; when the probability of significant erosion events is lower, to avoid peak tourist or residential recreational periods over summer, and to maximise the period of natural rebuilding following the beach scraping before

the following autumn and winter (when there is a greater probability of storm events). It is estimated that at least two scraping campaigns could be undertaken across all proposed areas during Spring.

Costs

Based on data provided by CN, it is understood that a cost of $7.20 was incurred for a 2017 beach scraping campaign at Stockton associated with the SLSC revetment works.

Carley (2010) noted that due to competitive tendering and depending on the degree of difficulty, beach scraping rates could potentially range from $6.20 to $12.50/$m^3$ (adjusted to 2020 prices). For budgeting purposes, an average rate of $9.30 could be adopted for beach scraping works.

Approvals Pathway

State Environmental Planning Policy (SEPP) (Infrastructure) 2007 and the recently introduced SEPP (Coastal Management) 2018 both have provisions for activities such as beach scraping to be undertaken by a public authority without development consent. The works are therefore classified as an activity under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

In accordance with Subdivision 1 under Part 5 of the EP&A Act, CN has been defined as the determining authority as the activity is to be carried out on behalf of CN. As the works are considered to have a greater than minimal but not significant impact, a Review of Environmental Factors (REF) was required to ensure compliance with Part 5 of the EP&A Act. The REF is detailed in RHDHV (2018).

CN has previously consulted with the DPIE – Crown Lands to determine the necessary approvals for beach scraping as it would occur within Crown land. CN was advised that the site is within Crown Reserve R79066 for Public Recreation and Other Purposes: Port Facilities and Services and CN is the Trust Manager of the Reserve. As such, DPIE's formal approval for NCC to undertake beach scraping works in this locality is not required. DPIE – Crown Lands advised that CN's modification of its planning assessment would suffice, enabling CN to undertake and maintain urgent coastal protection works at Stockton Beach, under their LEP.

Summary

Beach scraping using material sourced from within the Stockton CMP Area is a permitted activity for the ongoing coastal management of Stockton Beach. Beach scraping is a relatively low cost activity (around $9.30/$m^3$) that can be implemented with success to enhance coastal protection through building the upper profile and dune system. Short-term beach amenity benefits may also be realised.

However, it must be noted that beach scraping does not address long-term recession or sand loss from the beach profile. As such, it is not an adequate standalone measure for addressing the long-term sediment budget deficit at Stockton Beach.

Furthermore, a constraint of beach scraping is that the timing of this activity is limited to fair-weather periods when sand is available in the intertidal zone. Spring months are considered to be most feasible for this purpose.

2.6 Swansea Channel Dredged Material

Dredging in Swansea Channel is regularly undertaken by DPIE – Crown Lands to maintain navigability of the channel. Investigations were made into the possibility of utilising material from previous Swansea Channel dredging campaigns, which is currently stored at the Belmont Sand Stockpile site (Pelican). DPIE – Crown Lands have provided sediment testing results and analysis of the sand from the channel.

The mean particle size of the stockpiled sand ranged between 0.209 to 0.411 mm depending where it has been dredged from in the channel. Review of the analysis indicates that approximately 70% of the 25 samples have physical properties within the technical specification criterion relating to median grain size for the nourishment material. Generally, the other samples had a finer median grain size (<0.35mm) meaning that the sand would be more readily mobilised either by wave action or aeolian transport. Accordingly, the nourishment sand would be more rapidly moved from the nourishment area than the native sediment.

The degree of compatibility is considered acceptable if the material is coarser than the technical specification criterion relating to median grain size of the nourishment material. It is noted that an inspection of the material undertaken by a potential contractor observed that there was a large amount of shell in the sand. This matter is a potential issue in terms of beach amenity and not the technical performance of the material.

An overfill factor of 2.0 was determined for dredged material from Swansea Channel, which is at the lower end of the typical range of overfill factors determined for quarry sands (1.8 to 5, refer **Section 2.1)**. However, it is noted that the high shell content may have skewed this result. Overall, based on the particle size distribution and overfill ratios, dredged material from Pelican is considered to be slightly more compatible than quarry sands.

However, dredged material from Pelican is not considered to be a financially viable option for nourishment of Stockton Beach due to the transport involved with costs exceeding $\$100/m^3$ for sand supplied to site.

3 Marine Sources

3.1 Dredging of Offshore Sand Sources

General Information

While noting that offshore marine sand sources are not currently available due to regulatory constraints, there may be opportunities to access these sources in the future. For the purpose of the Stockton CMP, it has been assumed that the offshore marine source could be accessed by a Trailing Suction Hopper Dredger (TSHD) method.

A TSHD is a self-propelled ship which is mainly used for dredging loose and soft soils such as sand, gravel, silt or clay. TSHDs have a hull in the shape of a conventional ship and are both highly seaworthy and able to operate without any form of mooring or spud. They are equipped with either single or twin (one on each side) trailing suction pipes. A pump system sucks up a mixture of sand or soil and water and discharges it into the 'hopper' or hold of the vessel.

The hopper can be emptied in a nearshore location by opening the doors or valves in the hopper bottom ("bottom dumping"), by using the dredging pump to deliver material to shore through a floating pipeline, or by projecting material towards the shore using a special bow jet. This latter method of placement is commonly referred to as "rainbowing", whereby sand is sprayed in a high arc towards the deposition location, resembling a sand-coloured rainbow.

The above full suite of placement methods would ideally be used to create the desired beach profile. This is termed 'profile nourishment' and seeks to create the natural beach profile from the outset so as to minimise cross-shore redistribution of the placed sand.

The measure of size of a TSHD is the hopper capacity, which may range from a few hundred cubic metres to over 40,000 m^3.

Further details regarding TSHD methodologies, plant and costs are provided in RHDHV (2020).

Key Assumptions for TSHD

For the purpose of nourishing Stockton Beach, it is assumed that adequate and appropriate offshore sand sources (borrow areas):

- are available within a 7.5 nautical mile sailing distance of the site[1];
- comprise areas where no rock or wrecks are shown on Admiralty Charts; and,
- contain minimal amounts of fines[2] (<2%), noting that grain size at the borrow area would need to be established by sampling.

[1] *It should be noted that the costings adopted for mass nourishment options in the CBA assumed a 5 nautical mile limit with an allowance to dredge to depths of 28 m (Bluecoast, 2020).*

[2] *Fines is the collective term given to particle sizes less than 0.075mm (75 microns) and comprise silts and clays.*

Review of potential marine sand resources for nourishment of Stockton Beach

Mining, Exploration and Geoscience (MEG) in Regional NSW recently carried out a desktop study to identify marine sand bodies that may be suitable for beach nourishment at Stockton Beach (GSNSW 2020). The main findings of this study included:

- Sand suitable for the nourishment of Stockton Beach is likely to occur on the inner shelf plain, the lobe and possibly the dredge spoil dumps in Stockton Bight (refer **Figure 6**).
- The available data indicates that the medium-grained, quartzose sands of the Newcastle inner shelf sand sheet (ISSS) that are lying on the inner shelf plain[3] appear to be suitable for beach nourishment and represent the largest potential sand resource in Stockton Bight.
- The lobe and spoil dumps off Nobbys Head also contain sand that may be suitable. However, some data suggest the variability of the sand in these areas may not be as uniform as that on the inner shelf plain to the northeast.
- A comprehensive offshore sampling program is required to confirm the extent, thickness and continuity of the sand sheet and to identify the most suitable areas to source sand for nourishment.
- MEG should continue with its attempts to locate and compile existing data that may be useful in the assessment of offshore marine sand sources, including previous sediment sampling and seismic data.

In consideration of current legislation, MEG recommends that CN should seek to source sand from State waters (i.e. within 3 nautical miles of the NSW coast) in the first instance. The boundary of State waters in the vicinity of the study area is shown on **Figure 6**. It is evident that extensive areas of the ISSS at appropriate dredging depths (approximately 30 m) lie within State waters and inside the 7.5 nautical mile limit . It is considered that adequate sand reserves are available in these areas to meet the volume requirements for mass nourishment at Stockton Beach.

[3] *The inner shelf plain is a seaward-sloping surface occurring between 20–65 m depth, between 1.5 km and 11 km wide with an average gradient of 0.05–0.42° (Boyd et al. 2004).*

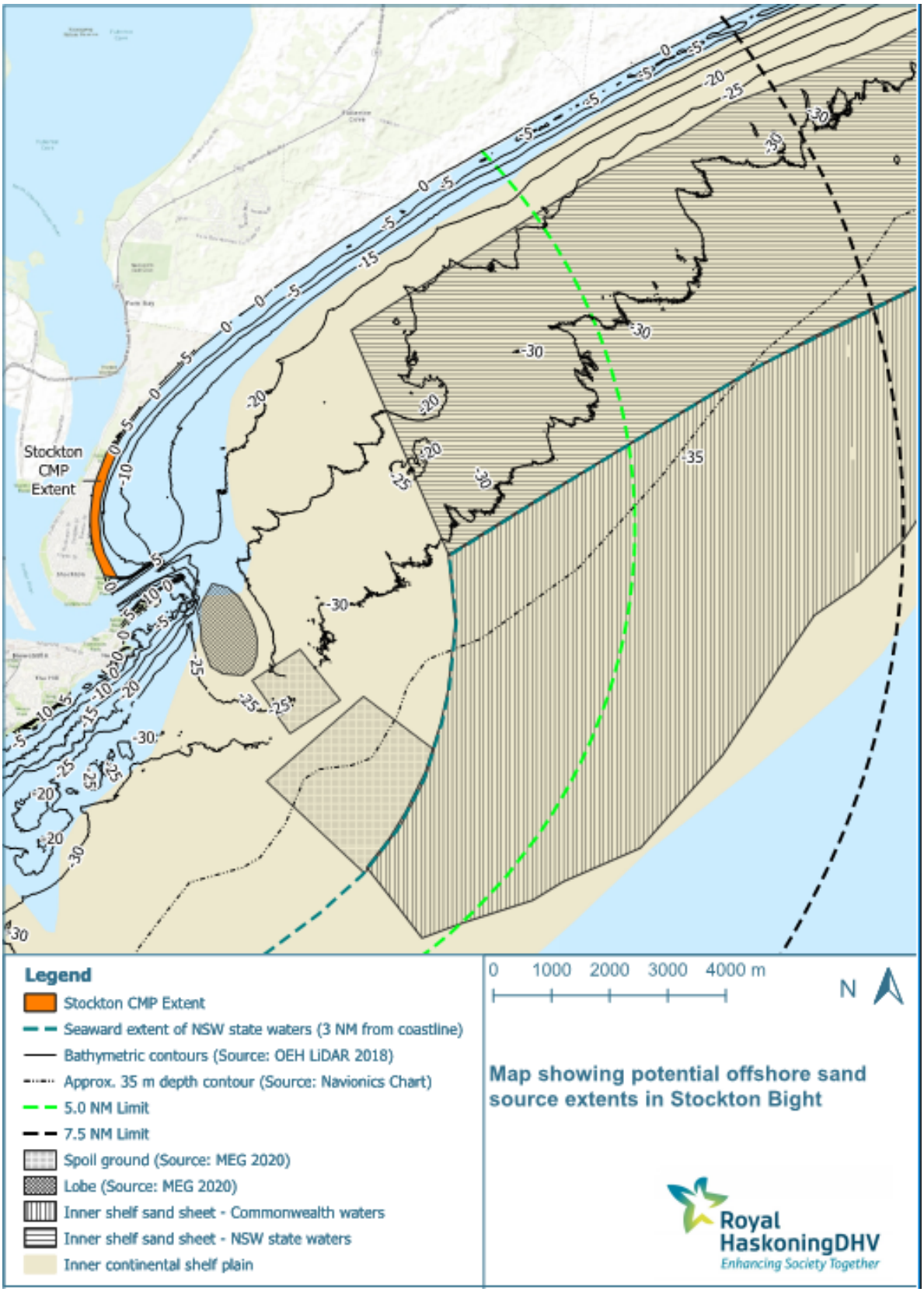

Figure 6: Map showing potential offshore sand source extents in Stockton Bight

Cost Estimates for TSHD

Cost rates for TSHD vary depending on a wide range of factors including (but not limited to):

- plant and equipment used (e.g. size of dredger);
- method of placement (e.g. bottom dumping, rainbowing, pumping);
- scale of project; and,
- mobilisation/demobilisation costs.

Detailed cost estimates for offshore sand sources at Stockton Beach are provided in RHDHV (2020). Cost rates (including mobilisation/demobilisation) determined for mass nourishment options in RHDHV (2020) range between around $\$17/m^3$ and $\$19/m^3$ for 1.8 million m^3 using a Trailing Suction Hopper Dredge (TSHD) within a 7.5 nautical mile limit to a depth of 40m and a combination of bottom dumping, rainbowing and pumping ashore

Cost rates (including mobilisation/demobilisation of TSHD) adopted for a 2.4 million m^3 mass nourishment campaign in the CBA (Bluecoast 2020) range between $\$6/m^3$ and $\$8/m^3$. It should be noted that these costings assumed a 5 nautical mile limit with an allowance to dredge in water depths up to 28 m, utilising a combination of bottom dumping and rainbowing (Bluecoast, 2020).

It should also be noted that economic efficiencies may be available if maintenance nourishment activities were undertaken on a regular basis (say, annually) by smaller vessels that undertake similar scale operations at other locations in Australia. In particular, there may be opportunities to secure low mobilisation and demobilisation costs if the maintenance nourishment campaigns could be coupled with other dredging operations.

Regulatory Constraints

Permissibility issues require resolution in relation to offshore marine sources. When considering extraction in NSW coastal waters (within 3 nautical miles of the NSW coast), the relevant NSW legislation is the *Offshore Minerals Act 1999*, which is supported by the *Offshore Minerals Regulation 2013*. Under the *Offshore Minerals Act 1999*, sand extraction is not permissible in NSW coastal waters without being authorised by a mining licence. An applicant cannot apply for a mining licence without the NSW Minister responsible for Resources (currently the Deputy Premier) first inviting applications. This is because NSW offshore waters have been reserved.

The *Offshore Minerals Act 1994* is the relevant Federal legislation and applies to Commonwealth waters (all Australian territorial waters more than 3 nautical miles from the coast). The Federal legislation is supported by the *Offshore Minerals Regulation 2018*. Commonwealth waters are managed by the Joint Authority, comprising the NSW and Federal Ministers responsible for resources. There is no current reservation of Commonwealth waters.

The NSW Deputy Premier has announced the formation of a Taskforce of government agencies, CN and community representatives, to work together to address Stockton's erosion issues, and to consider options to fund long-term solutions. CN is committed to working with the Deputy Premier's Taskforce and the NSW Government to explore all opportunities to source sand for beach nourishment that is affordable and suitable.

Furthermore, should offshore sand extraction become a viable option, then the role of DPIE - Crown Lands and any requirement to issue a licence under the *Crown Land Management Act 2016* would need

to be further investigated. It could be expected that a license would be required under the *Crown Land Management Act 2016*.

Any offshore sand extraction would also need to be discussed directly with the Harbour Master as it relates to the creation of potential navigational hazards, with consideration of the *Ports and Maritime Administration Regulation 2012*.

Furthermore, an assessment of environmental impact would need to be undertaken in accordance with the EP&A Act and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

3.2 Port of Newcastle – Area E

Background

In 2014, the NSW Government granted a 98-year lease to Port of Newcastle (PoN) which included the management of 792 hectares of land within Newcastle Port, the right to manage the commercial use of the shipping channel and the obligation to maintain the shipping channel and navigational infrastructure, including the breakwaters, for the benefit of commercial shipping. The State retains ownership of Newcastle Port including all land, the channel and breakwaters.

As a result of the obligation to maintain channel depths for the safe navigation of commercial vessels, PoN dispose of sand material dredged from Area E (the port entrance) at the location described in the *Coastal Protection Regulation 2011 Notification of Concurrence for 'Dredging of Area E and disposal offshore at Stockton Beach*', issued by the (then) NSW Office of Environment and Heritage. The nourishment placement area is directly in front of the Mitchell Street revetment as indicated in **Figure 7**. Channel infilling in Area E comprises sand transported from outside the entrance under wave action and flood tide.

Figure 7: PoN dredge sand placement area and Stockton Beach CMP area (Source : Bluecoast 2020)

Current Dredging Operations

Dredging at Newcastle Port is undertaken by a TSHD, the *David Allan*, which has a hopper capacity of 1,100 m^3. The dredger operates 12 hours per day, seven days per week. Material placement occurs via bottom dumping only.

PoN currently place up to 30,000 m^3 of sand from Area E at Stockton Beach each year. PoN have indicated that they will continue to support nourishment efforts with suitable sand dredged from Area E.

However, it should be noted that the frequency and amount of dredge material placement that occurs at Stockton Beach varies depending on harbour works requirements; maintaining navigable depths in the shipping channel for vessel safety is the main priority of the *David Allan*. For example, it is understood that it can take several months to clear the harbour channels following a major flood event, which would potentially delay any planned nourishment activities at Stockton.

Future Sand Placement Area

There would likely be a benefit in relocating the existing nourishment placement area (refer **Figure 7**) to a more inshore location, if feasible. This would be expected to lead to an increased rate of onshore sand movement from the placement area to the subaerial portion of Stockton Beach, resulting in a reduction of the erosion hazard and improved beach amenity.

The following is noted:

- PoN has indicated that relocation of the current nourishment placement area could potentially be accommodated. Hhowever, safety and efficiency considerations would need to be discussed with PoN.
- The existing nourishment placement area was previously nominated under a Part 5 Approval at a time when PoN was operating as Newcastle Port Corporation (NPC) and able to issue such approvals. A Review of Environmental Factors (REF) was also prepared. The existing approval and REF would need to be revisited and modified if the nourishment placement area was to change.
- Any changes to the nourishment placement area would need to consider the latest understanding of sediment transport processes, to ensure that the material placement will allow onshore movement of sand to nourish high priority areas.

Opportunities

There is the potential for CN to enter into a mutually beneficial commercial arrangement with PoN for the delivery of an annual increment of sand (e.g. in the order of 112,000 m^3/year, which was noted in Bluecoast (2020) to be the long-term volumetric rate of sand loss over the full profile within the Stockton CMP Area). This could provide significant cost savings in mobilisation costs and potentially the cost rates for material placement.

However, there may be limited scope to increase PoN's current dredging operations to a level that can meet the significant volume requirements for nourishment of Stockton Beach, while also satisfying the ongoing requirements to maintain navigable depths in the Port. Further discussions with PoN are required to investigate these possibilities, both technically and strategically. For example, it may be prudent to consider acquiring an alternative dredger with a larger capacity than the *David Allan* and also rainbowing capabilities for inshore sand placement. In addition, a larger dredger would be able to undertake Port

maintenance operations more rapidly than can occur at present. This would potentially lead to opportunities to dredge other areas within the Port and further upstream for placement at Stockton Beach, including the North Arm of the Hunter River, subject to obtaining the necessary approvals (refer **Section 4.2**).

Larger PoN capital dredging campaigns in the entrance area could also be used to nourish Stockton Beach on an opportunistic basis. For example, in 2009, PoN dredged approximately 130,000 m^3 of clean marine sand from the mouth of the Hunter River and placed the material offshore of Stockton Beach. However, this would be subject to material availability, obtaining the necessary approvals, engagement with the proponent (noting that this may not be PoN), and commercial factors.

3.3 Sand Bypassing from Nobbys Beach

Sand bypassing from Nobbys Beach was assessed in WorleyParsons (2012) and has been further investigated by RHDHV. The features of the sand bypassing system included a Slurry Systems Marine submarine sandshifter unit to recover sand (38 m^3/hour) and a transfer pipeline (160 mm OD HDPE) beneath the shipping channel and an inline booster (located near the Stockton Memorial), and five outlets across the Mitchell Street revetment frontage.

WorleyParsons (2012) noted that the pipe work required to transport sand would need to cross the main shipping channel into Newcastle Harbour would require complex infrastructure to implement the scheme without disrupting ongoing shipping activities. Furthermore, there would be a high risk of damage to and failure of such a pipeline with maintenance dredging activities undertaken in the channel by PoN.

The assessment found this option to be not viable for capital nourishment due to insufficient sand reserves and high risk. While the modest sand reserves at Nobbys Head may be able to satisfy maintenance nourishment requirements, this option was noted to be cost prohibitive and high risk.

4 Hunter River Sources

Reworked marine sand from the inner and outer sand barriers of the Stockton embayment extend 10 km upstream in the Hunter River (WorleyParsons 2012). Throughout most of the estuary, these marine sands are overlain by silts and clays, which is the primary maintenance dredge material and is not suitable for beach nourishment purposes. An exception to this is the entrance area, where maintenance dredging involves sand (i.e. Area E, refer **Section 3.2**).

In general, capital dredging in the Hunter River for port development would be expected to generate potentially significant quantities of marine sand suitable for the nourishment of Stockton Beach.

Sand sources from the South Arm and North Arm of the Hunter River are considered below.

4.1 South Arm

General Information

Sand sources in the South Arm of the Hunter River could be accessed by a Cutter Suction Dredger (CSD) method.

A CSD is a stationary dredger which makes use of a rotating cutter head at the suction inlet to loosen the material to be dredged. The dredged material is usually sucked up by a wear-resistant centrifugal pump and discharged either through a pipeline to the shore (more typical) or into barges.

A CSD operates by swinging about a central working spud using two fore side-line wires leading from the lower end of the ladder to anchors. By pulling on alternate sides the dredger clears an arc of cut, and then moves forward by pushing against the working spud using a spud carriage. A generally smooth bottom can be achieved, and accurate profiles and side slopes are able to be dredged.

The size of a CSD is measured by the diameter of the suction pipe and by the installed machinery power. Pipe diameters generally range from 100 mm to 1,500 mm, and booster stations are utilised to improve productivity over longer pumping distances. Through consideration of site conditions and industry knowledge, four pipe diameters ranging from 500 mm to 900 mm and use of between one and three boosters have been selected to undertake comparative analysis of efficiency and cost for a CSD to supply nourishment sand to Stockton Beach from the South Arm.

Further details regarding CSD methodologies, plant and costs are provided in RHDHV (2020).

Cost Estimates for CSD

Cost rates for CSD vary depending on a wide range of factors including (but not limited to):

- plant and equipment used (e.g. size of dredger, number of boosters, etc);
- scale of project; and,
- mobilisation/demobilisation costs.

Detailed cost estimates for accessing sand sources in the South Arm for nourishment at Stockton Beach are provided in RHDHV (2020). Cost rates (including mobilisation/demobilisation) determined for mass nourishment options in RHDHV (2020) range between around \$15/m^3 and \$35/m^3. Cost rates adopted for the CBA (Bluecoast 2020) range between \$25/m^3 and \$30/m^3 for capital and maintenance campaigns, respectively

However, lower cost rates could apply on an opportunistic basis, particularly if reductions in mobilisation and/or demobilisation costs are possible due to local availability of dredge plant and equipment. For example, at the time of writing this document, it is understood that an experienced dredging contractor is in a position to offer a cost rate of around $17.50/m^3 for dredging of clean sand from the South Arm and placement in the nearshore zone at Stockton Beach.

Material Availability

It is assumed that adequate and appropriate sand sources are available within the South Arm of the Hunter River below the Tourle Street Bridge for the purpose of nourishing Stockton Beach. It should be noted that the control of fines (material <75 microns) and grain size would be subject to the levels in available Soil Reports, with limited options to search for cleaner sand.

The availability of sand reserves in the South Arm would be on an opportunistic basis, dependant on activities of port developers as part of future port expansion.

Nevertheless, significant quantities of sand could be generated in one-off dredging campaigns that would be of value to Stockton Beach nourishment efforts. Furthermore, mutually beneficial commercial arrangements may be possible for CN and developers due to the close proximity of the South Arm to Stockton Beach, and complementary project objectives.

For example, it is understood that the proposed Newcastle GasDock LNG import terminal project would require capital dredging of around 4.0 million m^3 material, a substantial proportion of which is likely to be sand. The NSW Government has granted the GasDock project the status of Critical State Significant Infrastructure (CSSI), in recognition of its potential for securing the state's economic future. Subject to receiving all regulatory and planning approvals, and other commercial considerations, the project is anticipated to begin operations in the first half of 2021.

Furthermore, it should be noted that major dredging activities in the South Arm upstream of the navigable port waters would be expected to result in a range of additional benefits including:

- facilitating further development of this part of the Port; and,
- potentially acting as a sediment trap and reducing maintenance dredging requirements.

They were in a position to offer the below rates for dredging of clean sand from the already approved South Arm (T4 footprint) and placement at Stockton Beach nearshore

Regulatory Constraints

Approval for dredging of the Hunter River South Arm was granted in 2013 (DA-134-3-2003-i) for the GasDock, a proposed liquified natural gas (LNG) terminal (and previously in 2005 for the proposed T4 expansion of port coal facilities with a similar footprint). The approval covered dredging the channel and disposing of these materials at existing dumping grounds, which are about five kilometres offshore of the Port of Newcastle. This material could instead be potentially redirected to nourish Stockton beach for beneficial reuse.

As noted for the Sydney tunnelling opportunities (**Section 2.2**), it is considered to be essential to have a concept approval under Part 5 of the Coastal Management Act (2018) and State Environmental Planning Policy (Coastal Management) 2018for the placement of suitable nourishment material at Stockton Beach

using opportunistic sources, including sand reserves in the South Arm. This is discussed further in **Section 5**

A pre-existing concept approval would reduce the risk of missing out on future significant sand sourcing opportunities in the South Arm.

4.2 North Arm

Overview

There are also potentially significant sand reserves in the North Arm of the Hunter River, which have the advantage of being closer to Stockton Beach. In particular, areas along the western bank of the North Arm, from Walsh Point to Stockton Bridge, should be considered in further detail as part of the SMP.

While sand reserves are also available north of Stockton Bridge, the environmental sensitivities in this section of the river would necessitate a more rigorous environmental assessment and approvals process, particularly in regard to the Ramsar listed wetland area. The potential impacts of dredging in areas south of the bridge would also need to be assessed in detail. However, this process would likely be more straightforward due to the relatively disturbed waterway in this area.

It is understood that there have been several commercial development prospects involving dredging of the North Arm in the past. However, RHDHV is not aware of any current proposals to develop this area.

Cost Considerations

Given the close proximity of the North Arm to Stockton Beach, dredging operations would be expected to attract lower mobilisation/demobilisation and dredging costs compared to similar operations in the South Arm. Mutually beneficial commercial arrangements may be possible for CN and developers due to the close proximity of the North Arm to Stockton Beach, and complementary project objectives.

Dredging of the North Arm may also provide synergies with PoN operations (e.g. reduced maintenance dredging in the lower port). Further consultation with PoN is required to explore these possibilities further. This could involve consideration of an alternative dredger that services the complementary objectives of CN and PoN as discussed in **Section 3.2**.

Regulatory Constraints

As noted above, detailed environmental assessments would be required to obtain an approval for major dredging activities in the North Arm. However, this is not considered to be a major constraint for this sand source, particularly if dredge footprints were confined to areas south of Stockton Bridge.

As noted previously, it is considered to be essential to have a pre-existing concept approval in place for the placement of nourishment material at Stockton Beach using opportunistic sand sources, which would include sand reserves in the North Arm. Such an approval could be used to facilitate opportunistic dredging of the North Arm in collaboration with a future development proposal, as part of a mutually beneficial arrangement with PoN, and/or stand-alone project(s) carried out for the sole purpose of nourishing Stockton Beach. This is discussed further in **Section 5.**

There may also be an opportunity for PoN to expand the current Part 5 approval for Area E dredging and placement at Stockton Beach, to include other dredge areas in the estuary such as the North Arm.

5 Beach Nourishment Conceptual Part 5 Approval Pathway

In order to ensure any appropriate sand source opportunities can be taken advantage of, a concept approval for beach nourishment is proposed. This would assist in giving proponents of projects increased confidence in pursuing this option.

CN could seek conceptual approval for the beach nourishment works under Part 5 of the EP&A Act. The approval could cover receiving material from a number of potential sources. The excavation, dredging or extraction of the source material would be covered by separate project approvals and not by CN's beach nourishment Part 5 approval. The environmental assessment to be prepared with the Part 5 approval would need to consider impacts of a defined range or upper limit volume from a variety of sources. Different source material will have different physical properties resulting in different placement methods and, or, locations on the beach. The potential impacts of these options would need to be assessed in the environmental assessment document. The Part 5 approval would also need to have a time limit which could, for example be linked to the CMP. The relevant legislation and clauses for the Part 5 approval pathway are described below.

SEPPs are drafted by the NSW State Government and apply to issues and developments of state significance. The SEPP relevant to beach nourishment works at Stockton is SEPP (Coastal Management) 2018. Under Clause 19(2) of SEPP (Coastal Management) 2018, a public authority may carry out coastal protection works without development consent if the works are:

(i) identified in the relevant certified coastal management program, or
(ii) **beach nourishment**, or
(iii) the placing of sandbags for a period of not more than 90 days, or
(iv) routine maintenance works or repairs to any existing coastal protection works

Beach nourishment at Stockton can therefore be undertaken without development consent (i.e. approval under Part 5 of the EP&A Act requiring the preparation of a REF or EIS).

Clause 19(2) of SEPP (Coastal Management) 2018 prevails over SEPP (State and Regional Development) 2011 and SEPP (Infrastructure) 2007.

In accordance with Clause 5.1 under Part 5 of the EP&A Act, a determining authority is defined as:

…a Minister or public authority and, in relation to any activity, means the Minister or public authority by or on whose behalf the activity is or is to be carried out or any Minister or public authority whose approval is required in order to enable the activity to be carried out.

CN would therefore be a determining authority for the beach nourishment as the activity is to be carried out on behalf of CN. As additional approvals will be required from other public authorities, these public authorities are also determining authorities e.g. Department of Planning, Industry and Environment (Crown Lands licence for elements of the proposed works that are below the MHWM) and Department of Primary Industries (Fisheries Permit).

Preparation of a REF or, if significant impacts are anticipated, an EIS could be prepared and approved (or "approved in principle") by the determining authorities based on an assessment of one or a number of potential sources of the material or specifying certain criteria which must be satisfied.

6 Summary of Potential Sand Sources

A traffic light assessment of each potential sand source is provided in **Table 2**, where:

- red - currently unfeasible,
- yellow - potentially feasible but dependant on individual factors / approval processes / costs; and
- green - currently feasible within existing approvals.

This assessment did not consider approvals required for material placement which are assumed to be feasible for each source.

Table 2 Traffic light assessment of potential sand sources:

Source	Estimated Costs	Potential Volumes	Constraints / Considerations
TERRESTRIAL			
Local Quarries	$80/m^3 supply and place	80,000 m^3 per year (max)	• Compatibility constraints – overfill factor generally > 2 • Licence limits for extraction • Local traffic impacts • Beach amenity impacts – machinery on beaches • Insufficient quantities to address ongoing recession
Sydney tunnelling opportunities and local building sites	Less than $10/m^3 for the extra-over cost to transport material to Newcastle	Variable but potentially significant	• Opportunistic source – subject to limited availability • Requires a pre-existing concept approval obtained by a government agency – proponents/developers generally unwilling to take on this responsibility • Mutual benefits for proponents – reduced land-based disposal • Material expected to be suitable if placed in the nearshore • Relatively low cost potential source of significant quantities of material

Sand backpassing from Stockton Bight (via scraping)	$20/m^3	20,000 to 40,000 m^3 per year (max)	• Advantages: relatively low cost, utilises material within the same coastal compartment.
			• The 1 km stretch of beach extending south from the LGA boundary (including part of Stockton Centre frontage) has been identified as the optimum location for beach scraping.
			• Key constraints:
			  ○ the maximum quantity of material that can be regularly sourced from the borrow area;
			  ○ existing land zoning and regulatory provisions, particularly within the Port Stephens LGA (see below); and,
			  ○ machinery access south of Mitchell Street.

Worimi Conservation Lands			• Zoned E1 (National Parks and Nature Reserves) - extractive industries prohibited under Port Stephens LEP 2012 • Sand extraction in all reserve classifications is prohibited either under the NPW Act and Regulations or is contrary to the objectives and provisions of the existing statutory Plan of Management.

Source	Estimated Costs	Potential Volumes	Constraints / Considerations
DHA Land (Fort Wallace, Rifle Range)			• Zoned E2 - extractive industries prohibited under Newcastle LEP 2012 (Fort Wallace) and Port Stephens LEP 2012 (Rifle Range)
Hunter Water Site			• Zoned SP2 Sewerage systems – extractive industries prohibited under Newcastle LEP 2012
Stockton Centre			• Zoned SP2 Health Services Facility - extractive industries prohibited under Newcastle LEP 2012
Sand backpassing from Stockton Bight (via sand shifter)	Initial Trial System (5 years): $17.50/m^3 Permanent System: $4.5 million capital cost plus $8/m^{3}ongoing costs	100,000 m^3/year pumping systems are common	• Advantages: ○ relatively low cost; ○ utilises material within the same coastal compartment; ○ flexible pumping rates. • Key constraints: ○ the maximum quantity of material that can be sourced from the borrow area without yielding adverse impacts; ○ existing land zoning and regulatory provisions, although noting that sand would be sourced within the Newcastle LGA which would be expected to simplify the approvals process; and, ○ pumping capacity of the permanent system, which may struggle to achieve required rates of 112,000 m^3/year, subject to further investigations.
Beach Scraping – within immediate areas	$9.30/m^3	Small – 14,000 m^3 per project	• Currently permitted activity for the ongoing coastal management of Stockton Beach. • Relatively low cost. • Can be implemented with success to enhance coastal protection through building the upper profile and dune system. • Short-term beach amenity benefits may also be realised. • Does not address long-term recession or sand loss from the beach profile – i.e. not a nourishment activity. • The timing of this activity is limited to fair-weather periods when sand is available in the intertidal zone. Spring months are considered to be most feasible for this purpose.

Source	Estimated Costs	Potential Volumes	Constraints / Considerations
Swansea Channel	>$100/m3	Variable	• Material is considered to be slightly more compatible than quarry sands. • Not considered to be a financially viable option due to the high transport costs involved.
MARINE			
Offshore Dredging	Varying between $6- $19/$m^3$ depending on campaign volume, distance, depth, vessel, mobilisation	Unknown but potentially significant	• Permissibility issues require resolution for offshore sand extraction. When considering extraction in NSW state waters (within 3 nautical miles of the NSW coast), the relevant NSW legislation is the *Offshore Minerals Act 1999*, which is supported by the *Offshore Minerals Regulation 2013*. Under the *Offshore Minerals Act 1999*, sand extraction is not permissible in NSW coastal waters (3 nautical miles from the NSW coast) without being authorised by a mining licence. An applicant cannot apply for a mining licence without the NSW Minister responsible for Resources (currently the Deputy Premier) first inviting applications. This is because NSW offshore waters have been reserved. The *Offshore Minerals Act 1994* is the relevant Federal legislation and applies to Commonwealth waters (all Australian territorial waters more than 3 nautical miles from the coast). The Federal legislation is supported by the *Offshore Minerals Regulation 2018*. Commonwealth waters are managed by the Joint Authority, comprising the NSW and Federal Ministers responsible for resources. There is no current reservation of Commonwealth waters. • The NSW Government led Taskforce has been established to investigate these opportunities and navigate the legislative hurdles for accessing these sources. • Desktop review by GSNSW of potential sources has been completed, however additional investigations/survey work has been recommended to verify the results. • Other licences and approvals required. • Assessment of environmental impact required under the EP&A Act and the EPBC Act. • Economic efficiencies may be available if maintenance nourishment activities were undertaken on a regular basis (say, annually) by smaller vessels that undertake similar scale operations at other locations in Australia.
Port of Newcastle – Area E	Low	30,000 m^3 per year (max)	• Currently undertaken on an as needs basis - up to 30,000 m^3/year from channel entrance in accordance with existing Part 5 Approval. • Opportunity to modify existing approval to:

Source	Estimated Costs	Potential Volumes	Constraints / Considerations
			○ nominate a more appropriate placement area; and, ○ include other dredge areas in the estuary such as the North Arm. • Potential for CN to enter into a mutually beneficial commercial arrangement with PoN for the delivery of an annual increment of sand (e.g. in the order of 112,000 m^3/year), noting: ○ There may be limited scope to increase PoN's current dredging operations to a level that can meet the significant volume requirements for nourishment of Stockton Beach, while also satisfying the Port maintenance requirements. ○ It may be prudent to consider an alternative dredger for the port with a larger capacity.
Sand bypassing from Nobbys Beach	>$100 million	Insufficient	• Insufficient sand reserves to meet nourishment requirements. • Offshore sand extraction currently prohibited by the *Offshore Minerals Act 1999.* • High risk/cost.
HUNTER RIVER			
South Arm	$25/$m^3$ - initial mass nourishment $30/$m^3$ – maintenance nourishment $17.50/$m^3$ – potential lower-bound rate for opportunistic prospects	Potentially significant (1 to 4 million m^3)	• Likely limited to an opportunistic basis, dependant on activities of port developers. • Significant quantities of sand could be generated in one-off dredging campaigns that would be of significant value to Stockton Beach nourishment efforts. • Mutually beneficial commercial arrangements may be possible for CN, developers and/or PoN. • Requires a pre-existing concept approval obtained by a government agency – proponents/developers generally unwilling to take on this responsibility • Lower cost rates could apply on an opportunistic basis, particularly if reductions in mobilisation and/or demobilisation costs are possible due to local availability of dredge plant and equipment.

Source	Estimated Costs	Potential Volumes	Constraints / Considerations
North Arm	Lower cost than South Arm dredging due to proximity – further investigations required	Unknown but potentially significant (likely in the order of several million m^3)	• Potentially significant sand reserves with the key advantage of being very close to Stockton Beach. • Detailed environmental assessments would be required – more feasible if dredge footprints are confined to areas south of Stockton Bridge. • Mutually beneficial commercial arrangements may be possible for CN, developers and/or PoN. • Requires a pre-existing concept approval obtained by a government agency – proponents/developers generally unwilling to take on this responsibility.

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