

# Supporting Documentation D.

Options Evaluation (RHDHV, 2020a)



# REPORT

## **Stockton Coastal Management Program**

Options Evaluation – Supporting Document D

Client: City of Newcastle

Reference: PA2395-RHDHV-CN-SDD-0008

Status: S1/P01

Date: 17/06/2020

**HASKONING AUSTRALIA PTY LTD.**

Level 14  
56 Berry Street  
NSW 2060 North Sydney  
Water  
Trade register number: ACN153656252  
  
+61 2 8854 5000 **T**  
+61 2 9929 0960 **F**  
project.admin.australia@rhdhv.com **E**  
royalhaskoningdhv.com **W**

Document title: Stockton Coastal Management Program

Document short title: Supporting Document D  
Reference: PA2395-RHDHV-CN-SDD-0008  
Status: P01/S1  
Date: 17/06/2020  
Project name: Stockton Coastal Management Program  
Project number: PA2395  
Author(s): N Patterson

Drafted by: N Patterson

Checked by: D Messiter

Date / initials: DM 16/6/2020

Approved by: D Messiter

Date / initials: DM 16/6/2020

Classification

Open



## Disclaimer

*No part of these specifications/printed matter may be reproduced and/or published by print, photocopy, microfilm or by any other means, without the prior written permission of Haskoning Australia PTY Ltd.; nor may they be used, without such permission, for any purposes other than that for which they were produced. Haskoning Australia PTY Ltd. accepts no responsibility or liability for these specifications/printed matter to any party other than the persons by whom it was commissioned and as concluded under that Appointment. The integrated QHSE management system of Haskoning Australia PTY Ltd. has been certified in accordance with ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018.*

## Table of Contents

<b>1</b>	<b>Introduction</b>	<b>4</b>
<b>2</b>	<b>Previous Studies</b>	<b>5</b>
2.1	Introduction	5
<b>3</b>	<b>Stockton Coastline Management Study (DHI, 2009)</b>	<b>6</b>
3.1	Options Considered	6
3.1.1	Options Assessment Results	7
<b>4</b>	<b>Newcastle Coastal Zone Management Study (BMT WBM, 2014)</b>	<b>8</b>
4.1	Options Considered	8
4.1.1	Options Assessment Results and Recommendations	8
<b>5</b>	<b>Newcastle Coastal Zone Management Plan (BMT WBM, 2016)</b>	<b>12</b>
<b>6</b>	<b>Stockton Coastal Zone Management Plan (2018)</b>	<b>14</b>
6.1	Introduction	14
<b>7</b>	<b>Coastal Management Actions</b>	<b>16</b>
<b>8</b>	<b>Stockton CMP Options Evaluation</b>	<b>21</b>
8.1	Background	21
8.2	Coarse Filter Assessment	22
<b>9</b>	<b>Options Consideration by Zone</b>	<b>25</b>
9.1	Zone 1 – Breakwater to Surf Life Saving Club (SLSC) revetment	25
9.1.1	Zone 2 – SLSC to Mitchell Street revetment	25
9.1.2	Zone 3 – Mitchell Street revetment	28
9.1.3	Zone 4 – Barrie Crescent and Eames Avenue frontage (Stone Street to Meredith Street)	28
9.1.4	Zones 5, 6 and 7	30
<b>10</b>	<b>Selection of CM Options for CBA</b>	<b>31</b>
10.1	Sand Source Constraints and Opportunities	32
<b>11</b>	<b>Reference list</b>	<b>35</b>

## Table of Tables

Table 1 Options eliminated via the initial screening process in 2009 Study	6
Table 2 Coarse Filtering of Management Options (BMT WBM, 2014)	9
Table 3 Coastal Hazards Management Actions from the 2016 CZMP	17
Table 4: Coastal Environment Management Actions from the 2018 CZMP	19
Table 5: Beach Access Management Actions from the 2018 CZMP	19
Table 6: Beach Amenity Management Actions from the 2018 CZMP	19
Table 7: Recreational Use Management Actions from the 2018 CZMP	20
Table 8: Culture and Heritage Management Actions from the 2018 CZMP	20
Table 9: Coarse Filter Assessment Criteria	23
Table 10: Traffic light coarse filtering of Options – general overview for whole Stockton CMP frontage	24
Table 11: Zone 1 – Coarse Filter Assessment of Options	26
Table 12: Zone 2 – Coarse Filter Assessment of Options	27
Table 13: Zone 4 – Coarse Filter Assessment of Options	29
Table 14: Summary of Options and sub-options assessed in CBA	34

## Table of Figures

Figure 1: Proposed Zones for Stockton Coastal Management Strategy	15
---	----

## 1 Introduction

This Supporting Document to the Stockton Coastal Management Plan (CMP) developed for CN provides the following:

- review and discussion of the alternative coastal engineering and management options that have been considered during the CMP process;
- comparative 'coarse filter' evaluation of the options and the reasons for either; selection of options for further consideration and development, or rejection or not progressing options further; and
- brief description of the options short listed for further development and economic assessment in a Cost Benefit Analysis (CBA) in line with the *Coastal Management Act 2016* and the NSW Coastal Management Manual Part A (the Manual).
- reasoning and justification as to what options have been considered and the basis of how the proposed preferred management regime was developed.

This report draws upon numerous reports and studies that have been undertaken previously considering the management options that are available to address coastal hazards in Stockton. The reader is referred to the main Stockton CMP report for further detail on the proposed preferred option.

This document will further inform the development of the Newcastle CMP.

## 2 Previous Studies

### 2.1 Introduction

A number of previous studies and reports have been undertaken to investigate coastal processes and the potential management options to be used along the Stockton frontage. These reports include:

- Newcastle Coastal Zone Hazards Study (WBM, 1998)
- Shifting Sands at Stockton Beach (Umwelt, 2002)
- Newcastle Coastal Zone Management Plan (Umwelt, 2003)
- Stockton Beach Coastal Processes Study (DHI, 2006)
- Stockton Coastline Management Study Report (DHI, 2009)
- Stockton Beach Coastal Processes Study Addendum – Revised Coastal Erosion Hazard Lines 2011 (DHI, 2011)
- Stockton Beach Sand Scoping and Funding Feasibility Study (Worley Parsons, 2012)
- Newcastle Coastal Zone Hazards Study (BMT WBM, 2014)
- Newcastle Coastal Zone Management Study (BMT WBM, 2014)
- Newcastle Coastal Zone Management Plan (BMT WBM, 2016)

This section briefly summarises the previous coastal management recommendations that were made in the three Management Study/Plan documents from the above list (DHI, 2009; BMT WBM 2014; BMT WBM, 2016), which drew on information from the other investigations. This summary provides context as to how options have been identified, considered and selected in the past. The next three sections then build on this by providing detail on how this information has been utilised by CN and its consultants to consider, evaluate and select options for coastal management.

### 3 Stockton Coastline Management Study (DHI, 2009)

#### 3.1 Options Considered

The Stage 2 Coastal Zone Management Study undertaken by DHI in 2009 assessed the following options:

1. Planned retreat (coupled with voluntary purchase)
2. Beach nourishment (onshore placement for capital nourishment)
3. Seawall (rubble mound construction)
4. Offshore breakwater (emergent, straight, shore parallel)
5. Offshore breakwater (multi-functional artificial reef)
6. Groynes (emergent)
7. Artificial headland
8. Seawall (rubble mound construction) with nourishment
9. Offshore breakwater (emergent, straight, shore parallel) with beach nourishment
10. Offshore breakwater (artificial surf reef) with beach nourishment
11. Groynes (emergent) with beach nourishment
12. Artificial headland with beach nourishment

**Table 1** summarises the options that were eliminated (and the reasons for elimination) following initial screening on the basis of reliability, practicality, and community acceptance.

*Table 1 Options eliminated via the initial screening process in 2009 Study*

Option Description	Reasons for elimination
Do Nothing	Loss of residential and roadway assets. Lack of community support.
Development Control Conditions	Would limit damage to new development and redevelopment but would not address ongoing erosion problems and would therefore fail the reliability test. May be implemented as secondary measures.
Dune Management	Insufficient to protect beach from further erosion, particularly during storm events. To be used in conjunction with another management option.
Sand bypassing across channel from Nobbys Beach lobe	Lack of community support to potentially impact Nobbys Beach as it is highest utilised beach in Newcastle area (Umwelt, 2003b). Available quantities likely to only be suitable for maintenance nourishment not capital nourishment and cost of bypassing system therefore not justified.
Configuration Dredging	Not practical on an open coastline particularly in view of complex wave patterns.
Beach Drainage	Not considered a reliable option due to unproven nature of these schemes.

Following further analysis, the following five options were short listed and assessed in greater detail:

1. Beach nourishment
2. Seawall with beach nourishment
3. Artificial headland with beach nourishment
4. Offshore breakwater with beach nourishment
5. Multi-function artificial reef with beach nourishment



### 3.1.1 Options Assessment Results

Computational modelling was used to predict the performance of the proposed options.

For Option 1, the beach nourishment was predicted to have a small effect on sediment transport processes and, as such, the ongoing recession would continue. This meant that periodic maintenance nourishment would be required to replace the sand that would be lost.

The modelling predicted that the seawall in Option 2 would only act as a passive coastal protection measure because the width of the beach provided by the nourishment scheme was sufficient to account for both long term recession and short-term erosion. This meant that the structure would remain covered, provided maintenance nourishment as for Option 1 was undertaken to maintain the beach.

Both Options 3 and 4 were predicted to effectively mitigate the long-term recession and lead to the formation of a stable beach planform. This meant that the maintenance nourishment requirements for each option would be minimal. Both options required additional capital maintenance nourishment volumes to provide sufficient sand for the predicted beach re-orientation. For Option 4, further sand was provided to allow for early sand bypassing of the end of the headland and to minimise downdrift erosion of the beach in this area. The modelling predicted that the generation of eddies in the vicinity of the offshore breakwaters in Option 3 could form rip currents, while the current profile along the beach for Option 4 was predicted to be uniform.

The Multi-Functional Artificial Reef (MFAR) in Option 5 was predicted to have a small effect on the overall wave and current patterns on the beach and would have a limited effect on littoral transport. The current patterns in the vicinity of the reef were predicted to be extremely complex, with the possibility of offshore sand transport on one side of the reef. Overall, the MFAR option did not mitigate the ongoing recession and it was expected that maintenance nourishment would be required.

The selection of the preferred option was based on the qualitative weighing up of the following considerations:

- performance as a coastal protection measure;
- environmental effects;
- social factors; and
- economic factors.

The assessment resulted in the selection of Option 3 – Artificial Headland with Beach Nourishment, as the preferred option for the following reasons:

- effectively mitigated the ongoing long-term recession of Stockton Beach and it was predicted there would be minimal maintenance nourishment requirements - unlike Options 1, 2 and 5 where there was predicted to be ongoing recession;
- did not cause adverse current effects, which was the case for Option 4;
- received broad support at the community workshop, which was not the case for Option 4;
- provided opportunity for increased amenity value, and
- although the capital costs would be high at an estimated cost of \$31.2 M (only Option 2 was higher), the increased coastal protection, reduced maintenance costs, increased amenity value and broad community support were considered sufficient to justify the additional cost.

## **4 Newcastle Coastal Zone Management Study (BMT WBM, 2014)**

### **4.1 Options Considered**

Options considered within the 2014 Coastal Zone Management Study included the following:

- Sand Borrowing
- Dune Rehabilitation
- Seawalls
- Beach Nourishment
- Artificial Breakwaters
- Groynes
- Artificial Headlands
- Sacrifice Land or Assets
- Relocate Assets
- Acquisition
- Buy Back / Lease Back
- Redesign or Retrofit
- LEP Clauses and Rezoning
- Coastal Hazard Development Controls
- Integration of Coastal Zone Management Planning within Council
- Asset Management Planning
- Audit of Existing Assets
- Infrastructure Design Elements
- Public Safety Policy
- Monitoring
- Community Education

#### **4.1.1 Options Assessment Results and Recommendations**

A 'coarse' filter was initially applied to the above options. The results are reproduced below in **Table 2**.

Table 2 Coarse Filtering of Management Options (BMT WBM, 2014)

Option	Treats Erosion	Treats Recession	Treats Wave Overtopping	Capital Cost	Recurrent Costs	Environmental or Social Impact	Likely Community Acceptability	Reversible / Adaptable in Future	Effectiveness over time	Legal / Approval Risk	Ease of Implementation	Score (G = 1, SI = 0, St = -1)	Overall Analysis	Comments
Sand Borrowing	✓		✓	GO	GO	GO	GO	GO	STOP	GO	GO	6	GO	
Dune Rehabilitation	✓	✓	✓	GO	GO	GO	GO	GO	STOP	GO	GO	6	GO	
Seawalls	✓	✓	✓	STOP	SLOW	STOP	SLOW	SLOW	SLOW	SLOW	SLOW	-2	SLOW	
Beach Nourishment	✓	✓	✓	STOP	STOP	GO	GO	GO	SLOW	SLOW	STOP	0	SLOW	
Artificial Breakwaters	✓		✓	STOP	SLOW	SLOW	STOP	STOP	SLOW	STOP	STOP	-5	STOP	
Groynes	✓			STOP	SLOW	STOP	SLOW	STOP	STOP	STOP	STOP	-6	STOP	
Artificial Headlands				STOP	SLOW	SLOW	GO	STOP	STOP	SLOW	STOP	-3	STOP	Noting that the preferred version of this option in DHI (2009) involved nourishment.
Sacrifice Land or Assets	✓	✓	✓	GO	GO	GO	SLOW	STOP	GO	SLOW	GO	4	SLOW	Costs not based on lost land because beach is retained = higher value
Relocate Assets	✓	✓	✓	STOP	GO	GO	SLOW	GO	GO	GO	SLOW	4	SLOW	
Acquisition	✓	✓	✓	STOP	GO	GO	SLOW	SLOW	GO	GO	SLOW	3	SLOW	
Buy Back / Lease Back	✓	✓	✓	SLOW	SLOW	GO	SLOW	GO	GO	SLOW	STOP	2	SLOW	
Redesign or Retrofit	✓	✓	✓	SLOW	SLOW	SLOW	GO	GO	SLOW	GO	SLOW	3	SLOW	
LEP Clauses and Rezoning				GO	GO	GO	SLOW	GO	GO	GO	GO	7	GO	
Coastal Hazard Development Controls	✓	✓	✓	GO	GO	GO	SLOW	GO	GO	GO	GO	7	GO	
Integration of CZM Planning Within CoN	✓	✓	✓	GO	GO	GO	GO	GO	GO	GO	GO	8	GO	
Asset Management Planning	✓	✓	✓	GO	GO	GO	GO	GO	GO	GO	GO	8	GO	
Audit of Existing CoN Assets	✓	✓	✓	GO	GO	GO	GO	GO	GO	GO	GO	8	GO	
Infrastructure Design Elements	✓	✓	✓	GO	GO	GO	GO	GO	GO	GO	GO	8	GO	
Public Safety Policy			✓	GO	GO	GO	GO	GO	SLOW	GO	GO	7	GO	
Monitoring	✓	✓	✓	GO	GO	GO	GO	GO	GO	GO	GO	8	GO	
Community Education	✓	✓	✓	GO	GO	GO	GO	GO	SLOW	GO	GO	7	GO	

For the purpose of determining management options, Stockton Beach was separated into three areas:

- Southern Stockton Beach, south of the Mitchell Street Seawall;
- Mitchell Street Seawall at Stockton Beach, and
- Northern Stockton Beach, north of Mitchell Street Seawall to Fern Bay.

The recommended management options for each of the three areas are described below.

### Stockton Beach South of Mitchell Street Seawall

The recommended approach for the southern part of Stockton Beach was to maintain the current shoreline where possible over the short to medium term through management and opportunistic supplements (nourishment) to sand reserves. Over the long-term, the approach would be to facilitate beach retreat that would preserve the sandy beach amenity, by relocating public assets further landward (onto adjacent public lands). Specific recommended management options made in the 2014 report are outlined below.

- **Sand Borrowing and Dune Rehabilitation** were recommended when there are good sand reserves on the beach to prolong the retention of sand within this section of beach.
- **Formal Agreement for use of dredge material from Newcastle Harbour as beach nourishment material** - it was recommended that CN be added to an existing agreement between the Port of Newcastle (PoN) and the (then) Office of Environmental and Heritage (OEH) to strengthen the commitment for this arrangement to continue on a regular basis.
- **Opportunistic beach nourishment** – to use sand from any large scale capital dredging projects as part of port expansion developments planned within the PoN as beach nourishment.
- **Planned retreat** - Over the long term, retreat involving both a relocation of assets and sacrifice of land immediately behind the beach was recommended as it was considered to offer the most financially and technically feasible option for retaining the sandy beach amenity. The majority of land behind southern Stockton Beach is public land. The consequences to the general public from loss of public open space were considered to be less than the consequences from loss of beach amenity in this location. Public land is in government control and typically does not demand the same compensation; therefore, retreat was considered more easily implemented.
- **Beach nourishment** - Given the planned retreat intent for this section of Stockton Beach, an ongoing nourishment program was proposed to assist in prolonging the current state requiring approximately 30,000m<sup>3</sup>/year<sup>1</sup> to replicate the stated natural sediment supply (DHI, 2009). The primary focus area for targeted nourishment would be Stockton Beach (i.e. south of the seawall) as this was the major focus area for recreation. In addition, the beach to the north of the seawall would be targeted in years when the southern beach had accreted and built up. The ideal sediment source would be dredged material from the channel entrance with funding contribution made by State Government and/or PoN. Alternatively, large scale beach scraping along the beach to the north of the Fort Wallace Royal Australian Navy (RAN) facility was suggested for consideration.

### Mitchell Street Seawall at Stockton Beach

The key recommendation was to undertake the minor maintenance works identified within the BMT WBM (2014) seawall condition assessment, including repairing the rusted gabion baskets used to bed the concrete lined stormwater drainage pipe in the seawall.

---

<sup>1</sup> This volume has been recalculated as approximately 112,000m<sup>3</sup>/yr in preparation of the Stockton CMP 2020 (Bluecoast 2020)

Stockton Beach North of Mitchell Street Seawall

The recommended management option involved facilitation of an agreement between key landholders and governing bodies regarding the future management intent for Stockton Beach. A preliminary management approach for Stockton Early Learning Centre was also developed.

There were two option suites that were recommended:

- Options Suite 1: construct protection works along current and future beach alignments
- Options Suite 2: construct protection works along future beach alignment combined with relocation of the childcare centre and setbacks for future development.

## 5 Newcastle Coastal Zone Management Plan (BMT WBM, 2016)

In 2016, the Newcastle Coastal Zone Management Plan (CZMP) was produced by BMT WBM. This, however, was not certified by the NSW State Government and, as such, was never gazetted.

Of relevance to this Appendix, it had the following coastal management plan for the Stockton area:

*“Council's preferred option for protection works is to construct an artificial headland/groyne with beach nourishment. This option has the benefit of stopping the northerly drift of sand, which means that the sand would become trapped between the northern breakwater and the artificial headland/groyne (and would protect the southern end of Stockton), and is the communities preferred option.*

*The DHI (2009) report indicated that an artificial headland with beach nourishment would cost in the order of \$31.2M, \$13.7M to construct the structure and \$17.5M for beach nourishment. The NSW Government has previously indicated that this amount of funding would not be made available for the headland. However, it is possible that the structure could be redesigned to reduce costs. As Council does not have the capacity to fund this option on its own, it is proposing to advocate the NSW Government and other stakeholders to fund the preferred management option.*

*In the absence of funding being made available for the artificial headland/groyne, Council is proposing to investigate and construct a rock seawall with beach nourishment to protect public assets. The benefit of this option is that Council can afford to stage the construction over a number of years, and is therefore able to fund the project. Construction of a 165m section of the rock seawall between the Surf Life Saving Club (SLSC) and Lexies Café will commence in 2016. Council is also currently preparing a beach scraping program to ensure the rock seawall remains buried by sand (except during storm events), and has committed ongoing annual funding for beach scraping activities. Council held a community presentation and drop in session in August 2016 to discuss the proposed seawall. The community highlighted the importance of maintaining a sandy beach, that is why Council has committed to annual beach scraping.*

*Further potential stages of the seawall are under investigation, with future stages of the seawall being subject to the findings from the investigations, funding and resource availability. Council will monitor the seawall and undertake maintenance works as required. End effects will be managed through the annual beach scraping/ nourishment program.*

*Council will also continue to investigate other beach nourishment options including a sand bypassing system and offshore dredging. Offshore dredging for the purposes of beach nourishment is currently prohibited, and Council will advocate the NSW Government to allow offshore dredging for beach nourishment. Council will also advocate for the NSW Government to purchase (or contract) an offshore dredge, which could provide beach nourishment activities up and down the NSW coastline.”*

The preferred option of the artificial headland was rejected by the Coastal Panel on the basis of a lack of detail concerning:

- availability of material to facilitate the strategy;
- details of its proposed location or impacts;
- Cost-Benefit Analysis to justify the extent of financial investment proposed, and
- any feasible or identified funding source.

The Coastal Panel also noted that there was a lack of evidence of consultation with affected landowners, including and notably Crown Lands.

## **6 Stockton Coastal Zone Management Plan (2018)**

### **6.1 Introduction**

The Newcastle Coastal Zone Management Plan including Part A - Stockton, was submitted to the Minister for Environment for certification under the savings provisions of the Coastal Protection Act 1979 (now repealed) to address coastal management actions for the short (1-2 year) and medium (1-5 years) term. Certification under the Coastal Protection Act 1979 was required to be undertaken by 3 October 2018 due to legislative reform. Under provisions of the Coastal Management Act 2016, this plan will cease on 31 December 2021.

CN's elected Council adopted the Newcastle Coastal Zone Management Plan 2018 on the 24th July 2018 and the plan was certified by the Minister for the Environment on 24 August 2018. The Newcastle CZMP 2018 provides the current management framework for the Newcastle coastline and guides actions and projects to be undertaken by CN and other stakeholders. Management actions relate to coastal hazards along with recreational and environmental issues.

The 2018 CZMP was limited to short to medium-term coastal management actions, given that updated coastal processes investigations had not yet been completed to inform a longer term coastal management strategy. It is worth noting though that the 2018 CZMP recognised that the Stockton Community Liaison Group (CLG) has identified that the preferred long-term solution was sand replenishment or nourishment.

Under the CZMP, 7 coastal zones were introduced in order that coastal management options could be considered both holistically (e.g. beach nourishment, offshore breakwaters etc.) and site-specifically (i.e. options considered only appropriate to certain sections of the coastline).

- Zone 1 – Breakwater to Surf Life Saving Club (SLSC) revetment
- Zone 2 – SLSC to Mitchell Street revetment
- Zone 3 – Mitchell Street revetment
- Zone 4 – Barrie Crescent and Eames Avenue frontage (Stone Street to Meredith Street)
- Zone 5 – Griffiths Avenue to Corroba Oval (northern boundary)
- Zone 6 – Hunter Water
- Zone 7 – Hunter Water (northern boundary) to LGA boundary





Figure 1: Proposed Zones for Stockton Coastal Management Strategy

## 7 Coastal Management Actions

The CZMP developed a number of management actions for the seven zones with regard to coastal hazards. These are outlined below in **Table 3** as short (1-2 year) and medium (1-5 year) actions. The management actions are listed in priority order. Long-term management actions were identified as being part of a future Coastal Management Program submitted under the Coastal Management Act 2016. The 2018 CZMP also identified a series of short and medium-term management actions for a number of other aspects of the Stockton Coastline as identified below in **Table 3**.

Table 3 Coastal Hazards Management Actions from the 2016 CZMP

#	Approach	Zone	Management Action	Primary responsibility	Supporting partners <sup>1</sup>	Cost estimate (Funding source)	Evaluation method	Timeframe
CH1	Risk assessment	4	Lease for the operation of a childcare centre at the former North Stockton Surf Life Saving Club not to be renewed once expired.	Mission Australia	Council	Minimal	Operation of childcare centre in building ceases.	Short-medium
CH2	On-ground works	4	Former North Stockton Surf Life Saving Club building demolished.	Council		\$50,000 (Council)	Demolition of building.	Medium
CH3	Planning, on-ground works	6	Appropriate temporary coastal protection works undertaken at former landfill at 310 Fullerton Street (Lot 202 DP 1150470). Temporary coastal protection works will include geofabric container wall/structure designed by appropriately qualified coastal engineer with duration of 5-7 years.	Hunter Water Corporation	Department of Industry - Lands and Water (Crown Lands) Council	\$1,500,000 (To be determined)	Temporary coastal protection works completed.	Short-medium
CH4	Planning, on-ground works	6	Investigate the extent of the former landfill to the south of 310 Fullerton Street (Lot 202 DP 1150470) on to part of Crown reserve 79066 Appropriate works on the Crown reserve will be subject to further negotiation between Department of Industry - Lands and Water (Crown Lands), Council and Hunter Water Corporation	Department of Industry - Lands and Water (Crown Lands) Council	Hunter Water Corporation	To be determined based on extent of landfill	Extent of former landfill on Crown reserve identified. Identified agreed works implemented	Short
CH5	Planning	3,4	Identify appropriate coastal protection works or repairs at northern end of Mitchell Street seawall. Planning to include how works will connect with future coastal protection works to the north.	Council	Department of Industry - Lands and Water (Crown Lands)	\$40,000 (Council)	Appropriate design/repairs for northern end of Mitchell Street seawall completed.	Short
CH6	On-ground works	3,4	Identified coastal protection works or repairs at northern end of Mitchell Street constructed.	Council	Department of Industry - Lands and Water (Crown Lands)	\$200,000 - \$700,000 \$20,000-\$70,000/ annum maintenance (Council, State Government)	Identified works/repairs to northern end of Mitchell Street seawall completed.	Short-medium
CH7	On-ground works		Port of Newcastle to place suitable sand from maintenance dredging activities from harbour entrance offshore of Stockton Beach in accordance with concurrence issued by Office of Environment and Heritage.	Port of Newcastle	Office of Environment and Heritage Roads and Maritime Services Department of Industry - Lands and Water (Crown Lands)	Minimal. Maintenance dredging for navigational safety currently conducted by Port of Newcastle.	Placement of sand after dredging campaigns.	Short, medium
CH8	Planning		Coastal Management Program process for certification under the <i>Coastal Management Act 2016</i> commenced. Scoping study under Coastal Management Program process will include actions contained in Part A - Stockton.	Council	Office of Environment and Heritage	Minimal	Coastal Management Program process commenced.	Short
CH9	Planning	1-7	Undertake detailed investigations and other required studies, including scoping study and assessment of sand replenishment sources, to be undertaken to facilitate certification of a Coastal Management Program under the <i>Coastal Management Act 2016</i> .	Council		\$250,000 (Council, State Government)	Detailed studies completed and Coastal Management Program prepared and certified.	Short -medium
CH10	Planning		Establish a working group to identify required investigations or studies, including potential studies to progress sand replenishment option, for development of Coastal Management Program. Working group will include Councils, key government stakeholders, community and interest groups.	Council		Minimal	Working group established	Short
CH11	Planning	1-7	Assess potential options for long-term management of coastal hazards in the Stockton study area through the development of a Coastal Management Program in accordance with the <i>Coastal Management Act 2016</i> and the NSW Coastal Management Manual.	Council		\$100 000 (Council, State Government)	Coastal Management Program prepared and certified.	Medium
CH12	Monitoring		Monitor opportunities under grant programs and ensure grant applications are best positioned to deliver funding for Stockton study area projects.	Council		Internal Council resources	Funding applications submitted.	Short-medium
CH13	Monitoring		Alternative funding methods to be investigated and considered for Stockton study area projects. Funding methods to be advocated for in consultation with key stakeholders.	Council		Minimal	Alternative funding sources investigated and advocated for.	Short, medium
CH14	Monitoring	3	Undertake condition assessment/scope of works for maintenance to Mitchell Street seawall.	Council		\$10,000 (Council)	Condition assessment/scope of works completed.	Short-medium
CH15	On-ground works	3	Undertake maintenance to Mitchell Street seawall identified in condition assessment report	Council	Department of Industry - Lands and Water (Crown Lands)	\$2,750,000 capital. \$200 000 per annum maintenance. (Council, State Government)	Identified repairs to Mitchell Street seawall completed.	Short-medium
CH16	On-ground works	1,2	Conduct beach management works, such as beach scraping and beach grooming, in areas south of the Mitchell Street seawall to increase dune volume. Required approvals for beach scraping will be obtained.	Council	Department of Industry - Lands and Water (Crown Lands)	\$50,000 per annum (Council, State Government)	Identified beach scraping activities completed as conditions permit.	Short, medium
CH17	On-ground works	4,5	Conduct beach management works, such as beach scraping and beach grooming, in areas north of the Mitchell Street seawall to increase dune volume. Required approvals for beach scraping will be obtained.	Council	Department of Industry - Lands and Water (Crown Lands)	\$75,000 per annum (Council, State Government)	Identified beach scraping activities completed as conditions permit.	Short, medium



Table 3: Continued

#	Approach	Zone	Management Action	Primary responsibility	Supporting partners <sup>1</sup>	Cost estimate (Funding source)	Evaluation method	Timeframe
CH18	On-ground works	1,2	Continue dune maintenance in areas south of the Mitchell Street seawall.	Council	Department of Industry - Lands and Water (Crown Lands) Landcare	\$15,000 (Council, State Government)	Dune maintenance in identified areas undertaken.	Short, medium
CH19	On-ground works	4,5	Continue dune maintenance in areas north of the Mitchell Street seawall.	Council	Department of Industry - Lands and Water (Crown Lands) Landcare	\$15,000 (Council, State Government)	Dune maintenance in identified areas undertaken.	Short, medium
CH20	Planning	1	Undertake annual inspection of Stockton breakwall and assess potential issues from coastal hazards	Port of Newcastle	Roads and Maritime Services	As required (Port of Newcastle)	Visual inspection of rock armour, public pathway and ancillary infrastructure	Short (annual basis)
CH21	Planning, on-ground works	1-5	Continue beach and seawall monitoring program with cross section sites within the Stockton study area.	Council		\$10,000- \$15,000 per annum (Council)	Beach and seawall monitoring program, cross sections completed. Innovation in methodology undertaken.	Short-medium
CH22	Planning	7	Identify coastal hazards at Stockton Centre (342 Fullerton Street) as part of Fern Bay and North Stockton Land Use Strategy.	Council	Port Stephens Council Family and Community Services	Minimal	Coastal hazards identified as part of Fern Bay and North Stockton Land Use Strategy.	Short
CH23	Planning	7	Identify coastal hazards at Defence Housing Australia site (338 Fullerton Street) as part of Fern Bay and North Stockton Land Use Strategy and rezoning proposal.	Council	Port Stephens Council Defence Housing Australia	Minimal	Coastal hazards identified as part of Fern Bay and North Stockton Land Use Strategy.	Short
CH24	Development controls		Review planning certificates to ensure properties potentially affected by coastal hazards contain an appropriate notation and reflect ability (or not) for complying development to be carried out on the land.	Council		Minimal	Planning certificate notification reviewed.	Short
CH25	Development controls		New subdivisions or greenfield development to be located landward of coastal hazards 2100 unlikely line.	Council		Minimal	Design of subdivisions or development landward of 2100 unlikely coastal hazard line.	Short-medium
CH26	Planning	1-3	When the opportunity arises, Plans of Management, public domain plans and other master plan documents within the Stockton study area will be prepared or amended in consideration of the coastal hazards outlined in the Newcastle Coastal Zone Hazards Study (BMT WBM, 2014(a)).	Council	As required	Minimal	Coastal hazards incorporated into relevant plans	Short-medium
CH27	Planning	1-5	Consider impacts of coastal hazards when renewing or constructing public assets within the Stockton study area. The design of assets should consider the coastal hazards outlined in the Newcastle Coastal Zone Hazards Study (BMT WBM, 2014(a)). Asset life, purpose/service and location are to be considered along with the potential impacts from climate change.	Council		Varied due to project undertaken, costing within project budget (Council)	Incorporation of coastal hazards into project design documents.	Short-medium
CH28	Planning, on-ground works		Incorporation of coastal hazards into Council's service asset plans and implement service asset plans.	Council		\$20,000 (Council)	Coastal hazard analysis included in service asset plans.	Short-medium
CH29	On-ground works	1-5	Undertake emergency works, if appropriate, to manage beach erosion during storm events in accordance with the Emergency Action Subplan contained in <b>Appendix D</b> .	Council		Varied based on extent of emergency works (Council, State Government, Federal Government)	Emergency works in accordance with Subplan completed as required.	Short-medium
CH30	Planning, monitoring, on-ground works	6	Undertake a monitoring and response procedure for the former landfill at 310 Fullerton Street (Lot 202 DP 1150470) and part of Crown reserve 79066. Procedure will include management of former waste material in erosion events.	Hunter Water Corporation Council	Department of Industry - Lands and Water (Crown Lands)	Minimal	Monitoring of former landfill after erosion events completed	Short, medium
CH31	Partnerships		Continue to consult with Port of Newcastle and capital dredging proponents to request excess suitable sand from capital dredging projects is placed offshore of Stockton Beach.	Council	Port of Newcastle Roads and Maritime Services	Minimal	Excess suitable sand from capital dredging placed offshore of Stockton Beach.	Short-medium (project based)
CH32	Engagement		Conduct community engagement and education programs focusing on the Stockton study area environment and coastal processes.	Council		\$5,000 per annum for coastal education program (Council)	Education programs developed and presented to community.	Short-medium
CH33	Engagement		Update and enhance Council's website with information about coastal processes, management of the coastal environment. Provide more information about coastal activities.	Council		Minimal	Council website updated.	Short-medium
CH34	Planning, on-ground works	1-5	Prepare and implement post storm asset condition monitoring plan	Council		\$5,000 per annum (Council)	Post storm asset monitoring plan developed and implemented.	Short-medium

Table 4: Coastal Environment Management Actions from the 2018 CZMP

#	Approach	Zone	Management Action	Primary responsibility	Supporting partners <sup>1</sup>	Cost estimate (Funding source)	Evaluation method	Timeframe
CE1	Monitoring	1-5	Continue to monitor coastal habitat and implement recommendations of monitoring program.	Council	Department of Industry - Lands and Water (Crown Lands)	\$5,000 (Council)	Monitoring program undertaken.	Short, medium
CE2	On-ground works	1-5	Undertake coastal revegetation works as outlined in Coast and Estuary Vegetation Management Plan (Umwelt, 2014). Options to control Bitou Bush and other invasive plant species included in revegetation works.	Council	Department of Industry - Lands and Water (Crown Lands)	\$10,000 per annum (Council)	Coastal revegetation works completed.	Medium
CE3	Planning	1-3	Public domain works along the coastal section of the Stockton study area to include landscaping with native provenance species	Council		\$10,000 (Council)	Public domain plan completed.	Short, medium
CE4	On-ground works	1-5	Implement beach stormwater outlet maintenance program to manage dunes and remove stormwater ponding, particularly after rain events	Council		\$10 000-\$15 000 per annum (Council)	Stormwater outlet areas on beach maintained.	Short, medium
CE5	Planning	1-5	Water Sensitive Urban Design (WSUD) principles to be included in Public Domain Plans (or other masterplan documents) within the Stockton study area	Council	Department of Industry - Lands and Water (Crown Lands)	Minimal		Short, medium
CE6	On-ground works	1-7	Provide support and assistance to Landcare/volunteers when revegetation activities are undertaken in Stockton study area	Council		Minimal	Assistance to Landcare provided.	On-going
CE7	Monitoring, Partnerships		Build capacity for community volunteers to undertake citizen science environmental monitoring	Council		Minimal	Community environmental program established.	Medium

Table 5: Beach Access Management Actions from the 2018 CZMP

#	Approach	Zone	Management Action	Primary responsibility	Supporting partners <sup>1</sup>	Cost estimate (Funding source)	Evaluation method	Timeframe
BA1	Risk assessment	1-5	Undertake an audit of beach access points to assess public safety issues and erosion potential. Access point data to be available in Council GIS program.	Council	Department of Industry - Lands and Water (Crown Lands)	\$5,000 (Council)	Audit undertaken.	Short
BA2	Monitoring	1-5	Identify beach access points for closure and/or replacement in consultation relevant stakeholders and the community.	Council	Department of Industry - Lands and Water (Crown Lands)	Minimal	Access points identified for closure and/or replacement.	Short
BA3	Planning	1-5	Design of new fencing and beach access points are undertaken in accordance with the Coastal Dune Management Manual (Department of Land and Water Conservation, 2001). Design will need to include maintenance plan for beach access points.	Council	Department of Industry - Lands and Water (Crown Lands)	\$10,000 (Council)	Design drawings completed with reference to Coastal Dune Management Manual.	Short, medium

Table 6: Beach Amenity Management Actions from the 2018 CZMP

#	Approach	Zone	Management Action	Primary responsibility	Supporting partners <sup>1</sup>	Cost estimate (Funding source)	Evaluation method	Timeframe
B1	Planning	1-3	Investigate opportunities for landscaping within the Stockton study area as part of public domain plans.	Council	Department of Industry - Lands and Water (Crown Lands)	Minimal	Appropriate landscaping included within public domain plan.	Medium
B2	On-ground works	1-5	Undertake beach maintenance program and continue dune rehabilitation works. This includes dune fencing, access controls, invasive species control and replanting native colonising species.	Council	Department of Industry - Lands and Water (Crown Lands)	\$150,000 per annum (Council)	Beach maintenance program undertaken.	Short
B3	Planning, risk assessment	1-5	Undertake audit of stormwater discharge points onto Stockton coastline and assess water quality and erosion potential	Council	Department of Industry - Lands and Water (Crown Lands)	Minimal	Stormwater audit undertaken.	Short-medium
B4	On-ground works	1-5	Undertake beach maintenance at stormwater discharge points on Stockton coastline after storm events to prevent additional erosion.	Council		\$5,000 per annum (Council)	Beach maintenance at stormwater discharge points undertaken where required.	Short-medium

Table 7: Recreational Use Management Actions from the 2018 CZMP

#	Approach	Zone	Management Action	Primary responsibility	Supporting partners <sup>1</sup>	Cost estimate (Funding source)	Evaluation method	Timeframe
RU1	Planning	1-3	Prepare public domain plan for the Stockton coastal zone study area in consultation with relevant land managers and stakeholders. Public domain plan will build upon the adopted Newcastle Revitalisation Strategy Master Plan.	Council	Department of Industry - Lands and Water (Crown Lands)	Minimal	Public domain plan prepared.	Medium
RU2	Planning	1-5	Enhance opportunities for recreational fishing and identify areas for facilities such as fish cleaning tables.	Council	NSW Fisheries	TBA (Council, State Government)	Opportunities identified in public domain plan.	Medium
RU3	Planning	1-5	Public domain plan for Stockton coastal zone study area will consider footpath/cycleway along Mitchell Street.	Council		Minimal	Footpath/cycleway investigated in public domain plan.	Medium

Table 8: Culture and Heritage Management Actions from the 2018 CZMP

#	Approach	Zone	Management Action	Primary responsibility	Supporting partners <sup>1</sup>	Cost estimate (Funding source)	Evaluation method	Timeframe
H1	Planning	1-5	Incorporate Aboriginal cultural information into Council projects and works within the Stockton study area.	Council	Guraki Committee Worimi Aboriginal Land Council	Minimal	Aboriginal cultural information incorporated into Council projects	Short, medium
H2	Planning		Implement dual naming of sites within the Stockton study area where appropriate	Council	Guraki Committee Worimi Aboriginal Land Council	Minimal	Dual naming sites determined	Short, medium
H3	Planning	1-5	Ensure high quality interpretive treatments of heritage items or places that increase understanding of the heritage significance of these items or places in Council projects and works within the Stockton study area.	Council		Cost to be determined as part of individual project	Heritage treatment incorporated into Council projects	Short, medium
H4	Planning		Prepare Aboriginal Heritage Management Strategy to ensure due diligence processes are followed for Council projects and assessment of development applications	Council	Guraki Committee Worimi Aboriginal Land Council	\$30 000 (Council)	Aboriginal Heritage Management Strategy completed	Medium
H5	Planning	1-3	Interpretation of the history and heritage within the Stockton area is to be integrated into Public Domain Plans.	Council		Minimal	Heritage considerations included in Public Domain Plan.	Medium
H6	Planning	1-7	Investigate protection of heritage listed items on public lands from coastal hazards	Council		Minimal		Short, medium

## 8 Stockton CMP Options Evaluation

### 8.1 Background

Since the 2016 Newcastle CZMP CN have undertaken consultation with the local Stockton community through the Stockton CLG and other general community meetings. This has provided CN with a good understanding of the community's values and desires for their coastline.

Since 2016 CN have also been in consultation with DPIE who have provided technical and financial advice to assist in the development of the CMP for this coastline.

On 3 April 2018, the Coastal Protection Act 1979 was replaced by the Coastal Management Act 2016. The Coastal Management Act 2016 includes the requirement for local councils to prepare a Coastal Management Program in accordance with the NSW Coastal Management Manual (2019) to address long-term management of the coastal zone. With erosion continuing at Stockton and growing community concern and interest the NSW Government issued CN a directive under section 13 of the *Coastal Management Act 2016*, to complete the CMP for Stockton Beach by 30 June 2020. The Stockton CMP would build on the short and medium term coastal management actions outlined in the 2016 CZMP, developing a long term coastal management strategy for the Stockton coastline.

Investigation and assessment of long-term coastal management actions to address coastal hazards within the Stockton CMP area has been undertaken in accordance with the NSW Coastal Management Manual to facilitate the preparation of a Coastal Management Program. Investigation of the feasibility of management actions such as sand nourishment or engineered structures to address beach erosion and shoreline recession has been conducted.

The Stockton CLG has identified sand replenishment or nourishment as a preferred long-term option to address coastal hazards and improve beach amenity. It is understood that the recently established NSW State Government Deputy Premier's Task Force will be investigating all options for sand nourishment sources, including offshore dredging which is currently not permissible under NSW legislation. The Stockton CMP has been prepared to include consideration of offshore dredging (or other potential sand sources) coming on-line in the future via a sensitivity analysis in the Cost Benefit Analysis (CBA) (Bluecoast, 2020a).

In developing the shortlisted options for appraisal in the Stockton CMP, the above factors have all been considered. Due to the extremely tight time frame available to develop and prepare the 2020 Stockton CMP, CN in consultation with DPIE, elected to limit the spatial extent of the Stockton CMP to the frontage from the Breakwater to Meredith St. This allowed efforts to be focussed on the southern portion of Stockton that could realistically be completed, allowing for the more complex stakeholder consultation required for the coastal area north of Meredith St to be undertaken at a later date under less time pressure. The remainder of the Stockton coastline (within the Newcastle LGA) will be addressed in the full Newcastle CMP to be completed in 2021.

In making this decision it was understood that any actions proposed in the south need to consider the potential impacts on stakeholders to the north and ensure that these are acceptable.

## 8.2 Coarse Filter Assessment

A coarse filter for the overall frontage was initially applied to rule out options deemed not feasible. The filter identified feasible options ('Go' options), options suitable to specific sites but which required further assessment ('Slow' options) and non-feasible options ('Stop' options). The Go, Slow, Stop assessment was also used to assess whether each option addressed short-term storm erosion, long term recession and beach amenity.

The assessment criteria used in the filter are summarised in **Table 9** outlines the coarse filter for the options relevant to the whole Stockton CMP area.

Only options with a Go or Slow assessment were considered further in the development of the Stockton CMP. **Table 10, Table 11, Table 12 and Table 13** outline more specifically the coarse filter for options for Zones 1, 2, 3 and 4, respectively (which constitute the spatial extent of the Stockton CMP).



Table 9: Coarse Filter Assessment Criteria

	Addresses Storm Erosion	Addresses Long Term Recession	Addresses Beach Amenity	Capital Costs	Recurrent Costs	Environmental or Social Impact	Likely Community Acceptability	Reversible / Adaptable in Future	Effectiveness over time	Legal / Approval Risk	Ease of implementation
<b>STOP</b>	Does not provide protection to assets in short term i.e.. can not accommodate design storm demand	Does not accommodate long term recession i.e.. Shoreline position moves landward	Does not provide a sandy beach i.e.. beach amenity is lost	Very Expensive (> \$8 million)	Very Expensive (300K to millions)	Will impact negatively on environment, community or beach amenity	Unlikely to be acceptable to community and politically unpalatable. Extensive community education, endorsement by Minister (s) and Council required	Option is irreversible once implemented; option limits alternative options in future	Option does not provide a solution over the period of time required.	Will require an EIS to implement and / or new Government Program to implement. There is a residual risk that approval will not be able to be obtained for the proposed work/strategy	Requires Substantial engineering investigations and capabilities; financial finding mechanisms etc. to be implemented.
<b>SLOW</b>	Provides protection to some assets in short term i.e.. can accommodate design storm demand in short term	Does not accommodate long term recession in all areas i.e.. Shoreline position moves landward and some assets at risk	Provides a sandy beach part of the time or in the medium term	Moderately expensive (e.g. \$1 million - \$8 million)	Moderately expensive (e.g. \$30 000 - \$300,000)	No net impact	Would be palatable to some, not to others (50/0 response) Briefing by Councillors, GM and community education required	Option is reversible or adaptable but at considerable cost / effort	Option is only a short term solution but has other benefits or option required further resources /changes to be effective over the long term	Will require government approvals to be implemented, or require assistance through an existing government program. Generally these approvals /assistance are likely to be granted assuming requirements are met	Requires further engineering designs, financial assistance (which is likely to be available ) etc. to be implemented.
<b>GO</b>	Provides protection to all assets in short term i.e.. can accommodate design storm demand	Accommodates long term recession i.e.. Shoreline position stable and assets protected	Maintains a sandy beach in the long term	Low cost (< \$1 million)	Little to no cost (< \$30 000)	Will benefit environment community or beach amenity (e.g. improve beach access, recreation, habitats etc.)	Is very politically palatable to community. Minimal education required.	Option can be easily adapted for future circumstances or should impacts not occur, option would not negatively impact future generations.	Option provides a long term solutions	No or minimal government approvals required to implement.	Requires little to no further investigations and / or funding assistance to be implemented.

Table 10: Traffic light coarse filtering of Options – general overview for whole Stockton CMP frontage

Option	Addresses Storm Erosion	Addresses Long Term Recession	Addresses Beach Amenity	Capital Cost	Recurring Costs	Environmental or Social Impact	Likely Community Acceptability	Adaptable into Future	Long Term Effectiveness	Approval Risk	Ease of Implementation	Score (G = 1, SI = 0, St = -1)	Overall Analysis	Comments
<b>Nourishment Options</b>														
Beach Nourishment (Sand Backpassing from north)	SLOW	SLOW	GO	SLOW	SLOW	GO	GO	GO	GO	STOP	GO	5	STOP	A semi-permanent piped backpassing system or wheeled tractor scraper transport from Stockton Bight to Mitchell St could be investigated in the Newcastle CMP however this is outside of the spatial extent of the Stockton CMP.
Beach Scraping	STOP	STOP	SLOW	GO	GO	GO	GO	GO	STOP	GO	GO	4	STOP	Dependent on beach condition so sand may not be available when needed. Does not add any sand to the system, just redistributes it therefore beach scraping is not a coastal protection strategy and is therefore not considered further in the assessment, though it is recommended as a beach management tool where appropriate (refer previous report on beach scraping (RHDHV, 2016)).
Beach Nourishment (from dredging)	SLOW	SLOW	GO	SLOW	SLOW	GO	GO	GO	GO	SLOW	SLOW	5	GO	New offshore sand extraction is currently restricted by legislation in NSW, therefore only potentially feasible source is capital dredging for PoN or other developments. Costs could be low if aligned with capital dredging operations, however timing of sand availability is unknown and therefore not a reliable source. Concept based approval to be sought from NSW Gov. that provides an opportunity for any beneficial reuse of dredged material at Stockton should dredged material become available.
Beach nourishment from terrestrial sources	SLOW	SLOW	SLOW	STOP	STOP	SLOW	GO	GO	SLOW	SLOW	SLOW	0	SLOW	Sand sourced from local quarries and trucked to site and placed with trucks/dozers on sub aerial beach. Constrained by sand quantities available, logistics of placement and community acceptance of trucking movements, beach disruption, noise and traffic impacts. Would be limited to 5 days/week for 6 mths of the year. Also dependent on beach, weather and surf conditions.
Beach Nourishment (bypassing from Nobbys beach)	SLOW	SLOW	GO	STOP	STOP	SLOW	SLOW	SLOW	GO	STOP	STOP	-2	STOP	Cost prohibitive and unacceptable level of risk. High cost and high risk construction methodology to lay pipe beneath fully operational shipping channel. Risk of impacts to Port operations. Risk of damage to pipeline infrastructure in channel due to regular maintenance dredging.
<b>Structural Solutions (all require beach nourishment to maintain beach amenity)</b>														
Seawalls	GO	GO	SLOW	SLOW	GO	SLOW	SLOW	GO	GO	GO	GO	7	GO	Roadway and building assets are currently at immediate risk from storm erosion and seawalls are the only way to provide terminal protection to these assets. Appropriate alignment (as far landward as possible) required to ensure long term effectiveness and reduce likelihood of loss of beach amenity. Without nourishment will result in eventual loss of beach amenity. Recent quarry assessment indicates that sourcing local rock for extensive revetment structures would be very difficult. Alternative structure type therefore recommended.
Artificial Reef Breakwaters	SLOW	SLOW	SLOW	STOP	SLOW	SLOW	GO	GO	SLOW	STOP	STOP	-1	STOP	Cost prohibitive and technical performance unreliable (DHI, 2009). Would potentially reduce risk of storm erosion and long term recession but would not provide terminal protection to assets.
Groyne Field	STOP	STOP	STOP	STOP	SLOW	STOP	STOP	GO	SLOW	SLOW	SLOW	-4	STOP	High cost due to construction in high wave energy environment making cost prohibitive. Would potentially reduce risk of storm erosion and long term recession but would not provide terminal protection to assets. Lack of community acceptance due to intrusive nature as noted in (DHI, 2009).
Large Single Artificial Headland	SLOW	SLOW	GO	STOP	STOP	STOP	GO	SLOW	SLOW	STOP	STOP	-3	STOP	The Coastal Panel noted that this option was cost prohibitive with no funding mechanism, as reasons for not certifying the 2016 CZMP. Would potentially improve retention of beach nourishment sand, reduce risk of storm erosion and long term recession but would not provide terminal protection to assets. Not suitable within the 2020 Stockton CMP area as the downdrift erosion impacts would affect Hunter Water significantly. Potentially viable further north and should be investigated as part of broader Newcastle CMP.
Multiple Small(er) Artificial Headlands	SLOW	SLOW	GO	SLOW	SLOW	SLOW	SLOW	GO	GO	SLOW	SLOW	3	GO	May be feasible option north of Mitchell St revetment. Would potentially improve retention of beach nourishment thereby improving beach amenity, reduce risk of storm erosion and long term recession but would not provide terminal protection to assets.
<b>Planned Retreat</b>														
Relocate Assets	SLOW	GO	GO	SLOW	GO	GO	STOP	GO	GO	GO	GO	7	GO	Relocation of public assets is a feasible option in some zones. e.g Holiday Park
Land Acquisition	SLOW	SLOW	GO	SLOW	SLOW	SLOW	SLOW	GO	SLOW	SLOW	SLOW	2	SLOW	Potentially possible on a small scale in targeted locations.
Buy back/Lease scheme	STOP	GO	GO	STOP	SLOW	STOP	STOP	GO	SLOW	SLOW	SLOW	-1	STOP	Cost prohibitive, lack of community acceptance.
Sacrifice Land/Assets	GO	GO	GO	GO	GO	STOP	STOP	STOP	GO	SLOW	GO	4	GO	More appropriate in some zones where there is public land and limited assets.

Note: it is assumed that typical planning mechanisms such as LEP and DCP controls would also be adopted in combination with above options.

## 9 Options Consideration by Zone

The zones previously developed for the CZMP (2018), will be used to consider the options and evaluate feasible options more specifically for that area.

### 9.1 Zone 1 – Breakwater to Surf Life Saving Club (SLSC) revetment

Zone 1 is approximately 660m long and comprises the Stockton Holiday Park frontage, Lexie's Café, formalised carparking, SLSC amenities and storage facility, and the main SLSC building. Zone 1 is all CN owned land. Zone 1 is the most heavily utilised portion of Stockton Beach for recreation. Accordingly, beach amenity and access in this zone are highly valued.

Assets at immediate risk from storm erosion include (refer 2020 1% AEP hazard line):

- Lexie's café;
- northern end of Pitt St, and
- approx. 20-30m of Holiday Park frontage including amenities block.

A more specific coarse filter of options for Zone 1 was undertaken as shown in **Table 11**.

#### 9.1.1 Zone 2 – SLSC to Mitchell Street revetment

Zone 2, extending approximately 400m from the SLSC revetment to the Mitchell Street revetment, is backed by predominantly public land including an informal grassed area and a pine tree lined loop road accessing the Memorial Monument at the end of Hereford Street.

Assets at immediate risk from storm erosion include (refer 2020 1% AEP hazard line):

- Mitchell St roadway at northern end of zone;
- Residential properties on Mitchell Street:
- Part of the Monument carpark:
- Tennis court behind SLSC: and
- SLSC building.

A more specific coarse filter of options for Zone 2 was undertaken as shown in **Table 12**.

Table 11: Zone 1 – Coarse Filter Assessment of Options

Option	Addresses Storm Erosion	Addresses Long Term Recession	Addresses Beach Amenity	Capital Cost	Recurring Costs	Environmental or Social Impact	Likely Community Acceptability	Adaptable into Future	Long Term Effectiveness	Approval Risk	Ease of Implementation	Score (G = 1, SI = 0, St = -1)	Overall Analysis	Comments
<b>Nourishment Options</b>														
Beach Nourishment (from dredging)	SLOW	SLOW	GO	SLOW	SLOW	GO	GO	GO	GO	SLOW	SLOW	4	GO	New offshore sand extraction is currently restricted by legislation in NSW, therefore only potentially feasible source is capital dredging from PoN. Costs could be low if aligned with PoN capital dredging operation, however timing of sand availability is unknown and therefore not a reliable source. Concept based approval to be sought from NSW Gov. that provides an opportunity for any beneficial reuse of dredged material should it become available.
Beach nourishment from terrestrial sources	SLOW	SLOW	SLOW	STOP	STOP	SLOW	GO	GO	SLOW	SLOW	SLOW	0	SLOW	Sand sourced from local quarries and trucked to site and placed with trucks/dozers on sub aerial beach. Constrained by sand quantities available, logistics of placement and community acceptance of trucking movements, beach disruption, noise and traffic impacts. Would be limited to 5 days/week for 6 mths of the year. Also dependent on beach, weather and surf conditions.
<b>Structural Solutions (all require beach nourishment)</b>														
Seawalls	GO	GO	SLOW	SLOW	GO	SLOW	SLOW	SLOW	GO	SLOW	GO	5	GO	Roadway and building assets are currently at immediate risk from storm erosion and seawalls are the only way to provide protection to these assets. Would provide terminal protection to assets at risk. Appropriate alignment (as far landward as possible) required to ensure long term effectiveness and reduce likelihood of loss of beach amenity. Without nourishment will result in eventual loss of beach amenity.
Multiple Small(er) Artificial Headlands	STOP	STOP	STOP	SLOW	SLOW	STOP	STOP	GO	STOP	SLOW	SLOW	-5	STOP	Due to complex sediment transport processes in this zone with both north and south movement of sediment it is not considered a technically suitable option to capture and retain sand transported alongshore. Loss of continuous alongshore beach access in this location is not likely to be acceptable to the community.
<b>Planned Retreat</b>														
Relocate Assets	SLOW	GO	GO	SLOW	GO	GO	SLOW	GO	GO	GO	GO	8	GO	Relocation of built assets (such as amenities in Holiday Park) further landward is a feasible option, with at-risk foreshore zone used for adaptive recreational and environmental land uses such as camp sites. Relocation of the SLSC revetment and assets behind it have not been considered as CN are committed to holding the line and protecting this area for as long as possible.
Sacrifice Land/Assets	GO	GO	GO	GO	GO	SLOW	SLOW	SLOW	GO	SLOW	GO	7	GO	Appropriate as there are limited non-relocatable assets .
Note: it is assumed that typical planning mechanisms such as LEP and DCP controls would also be adopted in combination with above options.														

Table 12: Zone 2 – Coarse Filter Assessment of Options

Option	Addresses Storm Erosion	Addresses Long Term Recession	Addresses Beach Amenity	Capital Cost	Recurring Costs	Environmental or Social Impact	Likely Community Acceptability	Adaptable into Future	Long Term Effectiveness	Approval Risk	Ease of Implementation	Score (G = 1, S = 0, St = -1)	Overall Analysis	Comments
<b>Nourishment Options</b>														
Beach Nourishment (from dredging)	SLOW	SLOW	GO	SLOW	SLOW	GO	GO	GO	GO	SLOW	SLOW	4	GO	New offshore sand extraction is currently restricted by legislation in NSW, therefore only potentially feasible source is capital dredging from PoN. Costs could be low if aligned with PoN capital dredging operation, however timing of sand availability is unknown and therefore not a reliable source. Concept based approval to be sought from NSW Gov. that provides an opportunity for any beneficial reuse of dredged material should it become available.
Beach nourishment from terrestrial sources	SLOW	SLOW	SLOW	STOP	STOP	SLOW	GO	GO	SLOW	SLOW	SLOW	0	SLOW	Sand sourced from local quarries and trucked to site and placed with trucks/dozers on sub aerial beach. Constrained by sand quantities available, logistics of placement and community acceptance of trucking movements, beach disruption, noise and traffic impacts. Would be limited to 5 days/week for 6 mths of the year. Also dependent on beach, weather and surf conditions.
<b>Structural Solutions (all require beach nourishment)</b>														
Seawalls	GO	GO	SLOW	SLOW	GO	SLOW	SLOW	SLOW	GO	SLOW	GO	5	GO	Roadway assets are currently at immediate risk from storm erosion and seawalls are the only way to provide protection to these assets. Appropriate alignment (as far landward as possible) required to ensure long term effectiveness and reduce likelihood of loss of beach amenity. Without nourishment will result in eventual loss of beach amenity. Minimal assets threatened in this zone, just road at northern end.
Multiple Small(er) Artificial Headlands	STOP	STOP	STOP	SLOW	SLOW	STOP	STOP	GO	STOP	SLOW	SLOW	-5	STOP	Due to complex sediment transport processes in this zone with both north and south movement of sediment it is not considered a technically suitable option in this zone to capture and retain sand transported alongshore.
<b>Planned Retreat</b>														
Relocate Assets	SLOW	GO	GO	SLOW	GO	GO	SLOW	GO	GO	GO	GO	8	GO	Relocation of the Memorial and carparking along Mitchell St are feasible.
Sacrifice Land/Assets	GO	GO	GO	GO	GO	SLOW	SLOW	SLOW	GO	SLOW	GO	7	GO	Appropriate as there are limited non-relocatable assets .
Note: it is assumed that typical planning mechanisms such as LEP and DCP controls would also be adopted in combination with above options.														

### 9.1.2 Zone 3 – Mitchell Street revetment

Zone 3 comprises the entire Mitchell Street seawall (rock revetment) extends 550 m along Stockton Beach from Pembroke Street in the south to Stone Street in the north.

There are currently no assets at risk in Zone 3 assuming the Mitchell Street revetment continues to be maintained. The southern and northern flanks of the revetment have been considered with Zones 2 and 4, respectively. It is therefore proposed that the current CZMP action to maintain the Mitchell Street revetment structure be adopted as a long term action in the Stockton CMP, understanding that any beach nourishment adopted for the wider area will consider beach amenity value in this zone.

### 9.1.3 Zone 4 – Barrie Crescent and Eames Avenue frontage (Stone Street to Meredith Street)

Zone 4 is comprised of 200m fronting Barrie Crescent (between Stone Street and Griffiths Avenue) and 270m fronting Eames Avenue (between Griffiths Avenue and Meredith Street).

The assets at immediate risk in this zone (refer 2020 1% AEP hazard line) are:

- Barrie Cres roadway (north and south ends);
- residential dwellings on Stone Street and Griffiths Ave corners of Barrie Cres); and
- Griffiths Ave roadway.

The coarse filter of options 4 is summarised below in **Table 13**.

.

Table 13: Zone 4 – Coarse Filter Assessment of Options

Option	Addresses Storm Erosion/ protects assets	Addresses Long Term Recession	Addresses Beach Amenity	Capital Cost	Recurring Costs	Environmental or Social Impact	Likely Community Acceptability	Adaptable into Future	Long Term Effectiveness	Approval Risk	Ease of Implementation	Score (G = 1, SI = 0, St = -1)	Overall Analysis	Comments
<b>Nourishment Options</b>														
Beach Nourishment (from dredging)	SLOW	SLOW	GO	SLOW	SLOW	GO	GO	GO	GO	SLOW	SLOW	4	SLOW	NSW, therefore only potentially feasible source is capital dredging from PoN. Costs could be low if aligned with PoN capital dredging operation, however timing of sand availability is unknown and
Beach nourishment from terrestrial sources	SLOW	SLOW	SLOW	STOP	STOP	SLOW	GO	GO	SLOW	SLOW	SLOW	0	SLOW	Within the spatial extent of the Stockton CMP, trucking of sand from quarries is the only permissible option for nourishment. Other backpassing options from further north along Stockton Bight could be considered in the broader Newcastle CMP at a later date.
<b>Structural Solutions (all require beach nourishment)</b>														
Seawalls	GO	GO	SLOW	SLOW	GO	SLOW	SLOW	SLOW	GO	SLOW	GO	5	GO	Roadway assets are currently at immediate risk from storm erosion and seawalls are the only way to provide protection to these assets. Buried terminal seawall structure to protect roads and houses at risk by 2025
Multiple Small(er) Artificial Headlands	SLOW	SLOW	GO	SLOW	SLOW	SLOW	SLOW	GO	GO	SLOW	SLOW	3	GO	More predictably northerly net sediment transport in this zone therefore more suited to this type of structure than southerly zones. Would reduce alongshore losses and assist in retaining sand on beach. Small headland structures could be considered to the north of the Stockton CMP area in Newcastle CMP in consultation with stakeholders such as Hunter Water.
<b>Planned Retreat</b>														
Relocate Assets	SLOW	SLOW	SLOW	SLOW	GO	SLOW	STOP	SLOW	SLOW	GO	STOP	0	SLOW	Reconfiguration of Barrie Cres and Griffiths Ave roadways e.g one way system to provide additional natural buffer (sand volume) for storm demand to assist in maintaining beach amenity and reducing coastal inundation/overtopping.
Sacrifice Land/Assets	STOP	STOP	GO	STOP	SLOW	STOP	STOP	STOP	GO	SLOW	GO	-3	STOP	Numerous private residences would eventually need to be sacrificed as recession would continue. Likely to be cost prohibitive.
Land Acquisition	SLOW	SLOW	GO	SLOW	SLOW	SLOW	SLOW	GO	SLOW	SLOW	SLOW	2	SLOW	Potentially possible on a small scale in targeted locations where significant benefit can be gained from optimising beach platform.

Note: it is assumed that typical planning mechanisms such as LEP and DCP controls would also be adopted in combination with above options.

#### 9.1.4 Zones 5, 6 and 7

Whilst Zone 4 represents the northern most section of this Stockton CMP, the zones to the north have been considered in general terms to ensure a holistic view of the coastline and coastal processes in making decisions regarding the southern portion of the embayment.

The Zone 5 frontage extends from Meredith Street to the Hunter Water land and is approximately 200m long. It is comprised of vegetated dune fronting Corroba Oval. There are no built assets at risk in this zone, and it is considered likely that there would be no rationale to protect Zone 5 with engineered structures.

The Zone 6 Hunter Water frontage extends approximately 400m north from Corroba Oval. In 2019 a temporary coastal protection structure (5-7 year design life) in the form of geotextile container seawall was constructed in this zone. This structure's primary purpose is to temporarily contain the solid components of a legacy landfill waste located in the dune system and reduce the impact of oceanic storm conditions further exposing the waste, whilst a longer-term strategy is developed. Though not its original design purpose, this seawall will also function as a hard point controlling the beach planform of Zone 5 for the life of this temporary structure. The strategy for this zone needs to consider the outcomes of the assessment of long term options to treat/manage the landfill.

Zone 7 is approximately 2.3km long and extends from Hunter Water in the south to the Local Government Authority (LGA) boundary in the north. This coastline is generally undeveloped with most assets a minimum of 100m behind the beach. The back beach land use along the northern section of Stockton Beach from south to north comprises:

- Fort Wallace RAN Facility, owned by Defence Housing Australia (DHA);
- Stockton Centre, a major institutional heritage complex dating back to 1900, owned and managed by the State Government; and
- Fern Bay Rifle Range, considered to be outside of the scope of the Strategy.

This zone is relatively stable compared to the southern portion of the beach, with long term recession rates of 1m/year erosion at the southern end to approx. 1m/ year accretion at the northern end. There are currently no assets at risk in the short to medium term.



## 10 Selection of CM Options for CBA

In line with the Coastal Management Act 2016 and the NSW Coastal Management Manual Part A (the Manual), a Cost Benefit Analysis (CBA) for Stockton Beach is to be undertaken to provide an economic analysis of coastal management options (refer to **Supporting Document G** for CBA).

Due to the compressed Stockton CMP timeframe, a shortlist of potentially feasible management action options were selected for assessment in the CBA based on the 'Course Filter' Options Evaluation outlined in the previous sections. Three options were selected that are to be robustly examined in the CBA on the basis of the sometimes-competing considerations of:

- community values e.g. beach access and recreational amenity, coastal culture and environment;
- protection of assets from coastal hazards;
- cost and economic viability; and
- legal feasibility.

The options will be assessed relative to a Base Case of 'business as usual'. The base case and the three Options are outlined briefly below.

### Base Case – Business as Usual

General Description – The Base Case involves continued delivery of the actions within the Newcastle Coastal Zone Management Plan (CZMP) 2018 Part A including ongoing retreat and relocation of assets e.g. the old SLSC building or Childcare Centre at Barrie Crescent. This certified CZMP provides a planning and approvals pathway to undertake a range of management actions and investigations, which are eligible to receive grant funding.

### Option 1 - Mass sand nourishment for protection + amenity, limited coastal protection works

General Description - Mass sand nourishment to a level that provides coastal protection to existing assets and the construction of buried coastal protection structures to protect assets at risk within the next 5 years (in accordance with established 2025 hazard lines<sup>2</sup>).

### Option 2 - Sand nourishment for improved beach amenity + staged buried terminal protection

General Description - Beach amenity sand nourishment to provide improved recreational access and use. The beach amenity objective is a minimum annual average beach width of 5m at the narrowest point. This option also includes construction of buried terminal protection structures, constructed in two stages, to address the current and future risk of potentially high consequence, low probability events that may affect the area (mandatory requirement 13, Coastal Management Manual Part A). Sub-options also include an additional nourishment volume to accommodate a 1 year ARI storm. Any future buried terminal protection structures would be set back from the current shoreline and construction of these structures would only be triggered if the foreshore reaches a threshold width. Built assets within the at-risk foreshore zone (such as amenities in Holiday Park) would be relocated further landward and at-risk foreshore zone used for adaptive recreational and environmental land uses.

### Option 3 – Sand nourishment to maintain beach amenity + staged buried terminal protection

General Description - Beach amenity sand nourishment of a volume logistically feasible using available terrestrial sources of sand. This volume is likely to be able to maintain current beach widths, recreational access and use. As in **Option 2**, this also includes construction of buried terminal protection structures, constructed in two stages, to address the current and future risk of potentially high consequence, low

<sup>2</sup> This approach allows a 5 years' time period for sufficient nourishment to be in place to provide ongoing protection to coastal assets further landward.

probability events that may affect the area (mandatory requirement 13, Coastal Management Manual Part A). Any future buried terminal protection structures would be set back from the current shoreline and construction of these structures would only be triggered if the foreshore reaches a threshold width. As noted in Option 2, built assets within the at-risk foreshore zone (such as amenities in Holiday Park) would be relocated further landward and at-risk foreshore zone used for adaptive recreational and environmental land uses.

A sub-option (Option 3b) with optimised Stage 1 works, reduced nourishment volume and subsequent planned retreat and relocation of assets, was also assessed as described further below.

## 10.1 Sand Source Constraints and Opportunities

Noting that terrestrial sand is currently the only readily available source, all Options have been developed for the CBA using this supply source, with the relevant methodology and cost estimates. Existing extraction limits from licensed local sand quarries and practical limitations associated with transporting and placing sand on Stockton Beach using trucks and earth moving equipment have been acknowledged. Accordingly, it is understood that these actions are neither permissible (Carley & Cox 2017) nor technically feasible for the volumes of sand required for **Options 1 and 2** (refer **Supporting Document E** for a more detailed discussion of the constraints of availability and placement of terrestrially sourced sand). CN have advised that despite these not constituting certifiable actions within the Stockton CMP, they were to be assessed in the CBA due to the community preference for beach nourishment.

While acknowledging that marine sand sources are currently either; restricted by legislation, or not available, there are potential future opportunities to access these sources. Accordingly, marine sand sources have been included in a sensitivity analysis in the CBA to assess the benefit cost ratios of potential future use of offshore marine sand (**Option 1b**) and Hunter River marine sand (**Option 1c**). Details of potential marine sources, methodology and costs are provided in **Supporting Document F**.

As noted previously, **Option 3** was developed on the basis of a logistically feasible annual nourishment volume from terrestrial sources (200,000m<sup>3</sup>/year) whilst providing terminal protection structures for any assets at risk by 2025 (seaward of ZRFC for 1% AEP storm) and future setback terminal protection (Stage 2) when trigger foreshore widths were reached. However, once developed to greater level of detail than the course filter assessment (**Section 8.2**), cost estimates for nourishment from terrestrial sources for the volumes required, indicated that Option 3 was not economically feasible (with nourishment costs from terrestrial sources at \$16 million every year).

To reduce capital cost, a variant of Option 3 was developed (**Option 3b**), with a more affordable nourishment quantity and some of the initial buried terminal protection works delayed. Nourishment would be 50,000m<sup>3</sup>/year which would reduce (but not prevent) future beach erosion and recession (as it is approx. 45% of the current annual volume of sand loss from this section of the coastline). The optimized initial buried terminal protection works would provide protection to assets seaward of the 2025 Zone of Slope Adjustment for a 5% AEP storm i.e. a higher risk profile than other options. This option would be viable in the medium term (2 to 5 years) but in the longer term it would result in significant loss of beach width and amenity within the Stockton CMP area and impact downdrift beaches to the north.

Furthermore, **Option 1d** was developed as a hybrid of **Option 1b** and **Option 3b** to provide an economic assessment of a practical path forward given current legislative and availability constraints on marine sand sources. **Option 1d** involves **Option 3b** for the first year i.e. nominal sand nourishment from terrestrial sources with optimized initial terminal protection structures, followed by **Option 1b** with a mass sand nourishment campaign in year 2 from offshore marine sources and ongoing maintenance

nourishment campaigns every 10 years. The need for the Stage 2 structural works would be eliminated by the protection afforded by the mass sand nourishment.

A summary of all of the options and associated parameters assessed in the CBA are outlined in **Table 14**.

Table 14: Summary of Options and sub-options assessed in CBA

Option	Sub-option	Description	Sand Source	Initial nourishment vol (m3)	Maintenance nourishment vol (m3)**	Maintenance nourishment frequency (years)	Buried terminal Protection Structures (m)	
							Stage 1	Stage 2
1	1a	Mass nourishment for protection + amenity, stage 1 coastal protection works	Terrestrial	4.5 million*	2.5 million*	5 years	458	0
	1b		Marine (offshore)	2.4 million**	1.12 million**	10 years		
	1c		Marine (Hunter River)	1.8 million	560,000	5 years		
	1d	Option 3b adopted for first year, then mass nourishment as per Option 1b, with optimised stage 1 coastal protection work	Terrestrial Marine (offshore)	50,000 2.4 million**	1.12 million**	10 years	225	0
2	2a	Sand nourishment for improved beach amenity + staged buried terminal protection	Terrestrial	525,000*	280,000*	5 years	458	995
	2b	Sand nourishment for improved beach amenity + 1 year ARI storm each year + staged buried terminal protection	Marine (offshore)	610,000*	560,000	5 years	458	995
	2c	Sand nourishment for improved beach amenity + 1 year ARI storm each year + staged buried terminal protection	Marine (Hunter River)	610,000*	560,000	5 years	458	995
3	3a	Sand nourishment to maintain beach amenity (logistically feasible terrestrial volume) + staged buried terminal protection	Terrestrial	200,000	200,000	annual	458	995
	3b	Reduced sand nourishment (economically feasible terrestrial volume) + optimised stage 1 and 2 buried terminal protection	Terrestrial	50,000	50,000	annual	225	1186

\* exceeds volume from terrestrial sources that can feasibly be placed on the subaerial beach. Volumes include an overfill ratio of 2.5 though sensitivity analysis is also recommended to be undertaken for overfill ratio of 1.

\*\* volumes determined by Bluecoast (2020) on basis of Stage 2 Sediment Transport Study findings

Nourishment volumes have been estimated by RHDHV for input into the CBA, with refinements made by Bluecoast based on models and outcomes of the Stage 2 Sediment Transport Study.

Further detail of the development, rationale and risks of each of the Options and sub-options is provided in **Appendix C** of the CBA report (refer **Supporting Document F**).

## 11 Reference list

Bluecoast (2020), Sediment Transport Study within Stockton Bight – Part A, Technical Note, prepared for City of Newcastle, 10 June 2020.

Bluecoast (2020a), Cost benefit analysis for Stockton Beach coastal management program, prepared for City of Newcastle. 23 April 2020.



Royal HaskoningDHV is an independent, international engineering and project management consultancy with over 138 years of experience. Our professionals deliver services in the fields of aviation, buildings, energy, industry, infrastructure, maritime, mining, transport, urban and rural development and water.

Backed by expertise and experience of 6,000 colleagues across the world, we work for public and private clients in over 140 countries. We understand the local context and deliver appropriate local solutions.

We focus on delivering added value for our clients while at the same time addressing the challenges that societies are facing. These include the growing world population and the consequences for towns and cities; the demand for clean drinking water, water security and water safety; pressures on traffic and transport; resource availability and demand for energy and waste issues facing industry.

We aim to minimise our impact on the environment by leading by example in our projects, our own business operations and by the role we see in “giving back” to society. By showing leadership in sustainable development and innovation, together with our clients, we are working to become part of the solution to a more sustainable society now and into the future.

Our head office is in the Netherlands, other principal offices are in the United Kingdom, South Africa and Indonesia. We also have established offices in Thailand, India and the Americas; and we have a long standing presence in Africa and the Middle East.



[royalhaskoningdhv.com](http://royalhaskoningdhv.com)

