Appendix N – Coastal Processes Assessment

Hunter Water Corporation

Belmont Drought Response Desalination Plant
Coastal Processes Amendment Report

June 2020

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Terms and definitions

Term/acronym	Definition
ADCP	Acoustic Doppler Current Profiler
Aeolian	Wind-driven
Almost Certain Line	There is a high possibility the event will occur as there is a history of frequent occurrence
ARI	Average Recurrence Interval – the average number of years between the occurrence of an event (e.g. coastal flooding, storm waves) as big as or larger than the selected occurrence
CM Act	*Coastal Management Act 2016*
CMP	Coastal Management Program
CZMP	Coastal Zone Management Plan
EIS	Environmental Impact Statement
H_S	Significant wave height – the mean wave height of the highest one-third of waves
km	Kilometre
NSW	New South Wales
PSD	Particle Size Distribution
Rare Line	It is highly unlikely that the event will occur, except in extreme/ exceptional circumstances, which have not been recorded historically
SEARS	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
Storm surge	Increase in water level from a reduction in barometric pressure
Unlikely Line	There is a low possibility that the event will occur, however, there is a history of infrequent or isolated occurrence
Wave runup	Uprush of water from a breaking wave
Wave setup	Raised water levels as a result of broken waves, approximately 15% of offshore wave height
Wind setup	Increase in water level on the leeward side of a body of water caused by wind stresses on the surface of the water
WWTW	Wastewater treatment works

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1. Introduction

1.1 Background

Hunter Water Corporation (Hunter Water) is seeking approval to construct and operate a drought response desalination plant (the 'Project'), adjacent to the Belmont Wastewater Treatment Works (WWTW) in Belmont South, a suburb of Lake Macquarie Local Government Area (LGA) of New South Wales (NSW) (the 'Project area'); (see Figure 1-1).

Like much of NSW, the Lower Hunter region continues to experience ongoing drought conditions. In response to the drought, Hunter Water is rolling out a program of drought response measures as outlined in the 2014 Lower Hunter Water Plan (LHWP). Measures include the staged introduction of water restrictions, implementation of a broad range of water conservation and water loss initiatives as well as various operational measures. The 2014 LHWP identified the implementation of emergency desalination as a measure of last resort in response to a severe drought, and would only be implemented if water storage levels reached a critical point and all other measures have been implemented.

GHD Pty Ltd (GHD) were engaged by Hunter Water to prepare an Environmental Impact Statement (EIS) (GHD, 2019a) to support a development application for the Project as State Significant Infrastructure (SSI) under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The EIS was prepared in accordance with the provisions of the EP&A Act and the EP&A Regulation and addresses the Secretary's Environmental Assessment Requirements (SEARs) issued by the Department of Planning, Industry and Environment (DPIE) for the Project on 12 December 2017 and revised on 24 January 2018. The EIS was publicly exhibited by DPIE for 28 days from 21 November 2019 to 19 December 2019.

The Project described in the EIS included the construction and operation of a desalination plant, designed to produce up to 15 megalitres per day (ML/day) of potable water, with two sub-surface intake structures.

Since commencing this Project, Hunter Water has begun a major review of the 2014 LHWP, now referred to as the Lower Hunter Water Security Plan (LHWSP). The LHWSP seeks to determine the preferred portfolio of supply and demand side options to ensure a sustainable and resilient supply for the region, over the long term as well as during drought. This work indicates that a drought response portfolio including a desalination plant at Belmont with a nominal production capacity of up to 30 ML/day would provide the best balance of meeting the community's needs should a severe drought occur, while still providing value for money.

In addition to the proposed increase in plant capacity, further design development and assessment following completion of the EIS has identified that a direct ocean intake would perform considerably better than a sub-surface option across key criteria including, reliability, efficiency and scalability.

1.2 Purpose and structure of this report

This Report has been prepared as a supporting document to the Amendment Report and addresses the requirements for the SEARs in considering the revised impacts of the amended Project. The purpose of this report is to compare the change in coastal processes related impacts from a seawater intake (Amended design) rather than a sub-surface seawater intake structure (EIS design).

This report should be read in conjunction with GHD reports titled: Belmont Drought Response Desalination Plant – Environmental Impact Statement (GHD, 2019a) and Belmont Drought Response Desalination Plant – Coastal Processes Assessment (GHD, 2019b).

This report draws upon the information and outcomes, and should be read in conjunction with, a number of other specialist studies have been undertaken as part of the broader EIS, including:

- Geotechnical investigation report
- Brine discharge modelling report
- Marine environment assessment
- Biodiversity development assessment report (and the marine environment chapter within the EIS)

All specialist reports are provided as separate attachments to the EIS and subsequent Amendment Report.

1.3 Limitations and assumptions

This report is based on the concept design for the project and the level of information available at the time of preparation. The concept design purpose is to provide a basis for environmental assessment and future design and construct stages.

This report: has been prepared by GHD for Hunter Water Corporation and may only be used and relied on by Hunter Water Corporation for the purpose agreed between GHD and the Hunter Water Corporation as set out in Section 1.2 of this report.

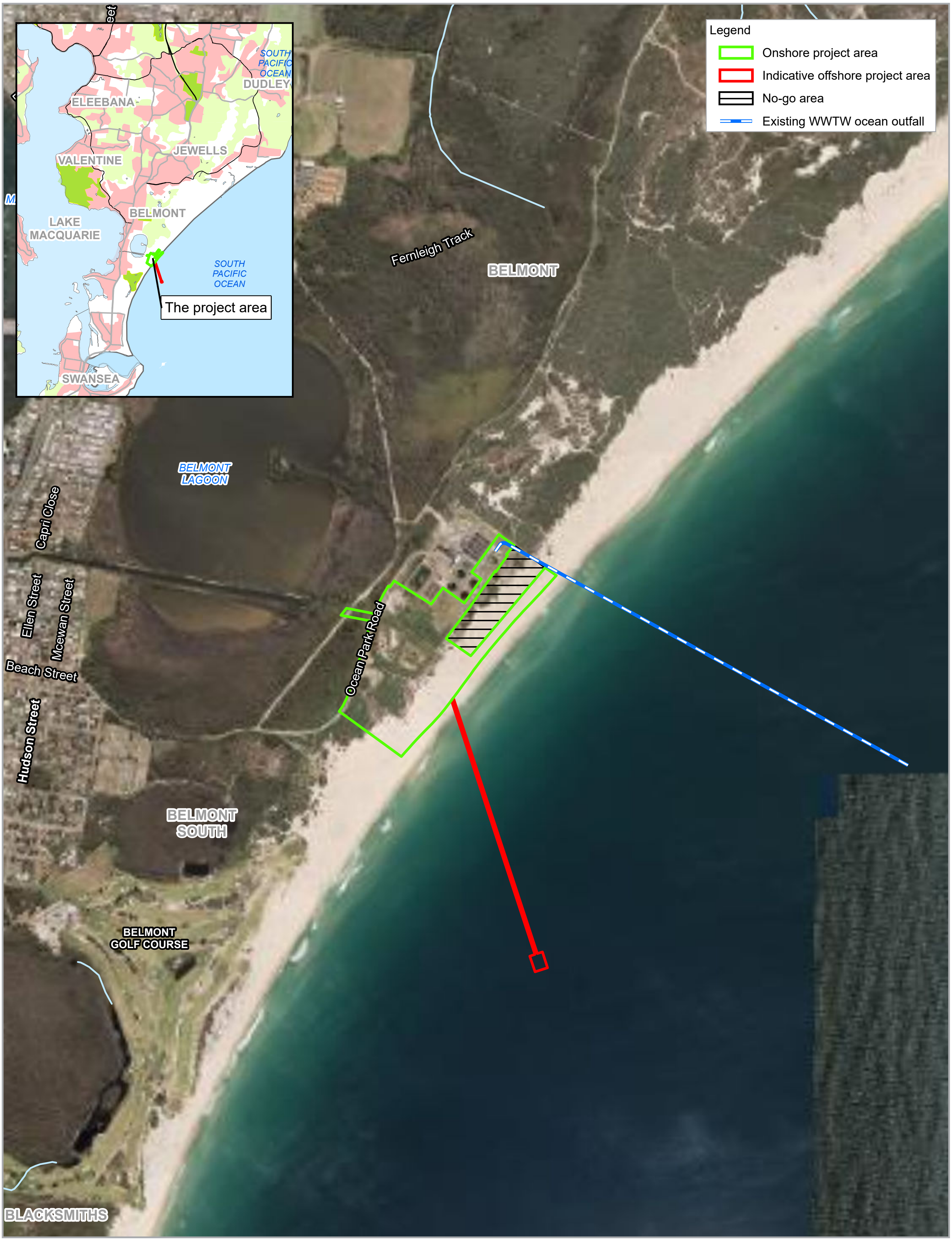
GHD otherwise disclaims responsibility to any person other than Hunter Water Corporation arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Hunter Water Corporation and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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GHD

Hunter Water Corporation
Belmont Drought Response Desalination Plant
Coastal Processes Amendment Report

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Project Location

Figure 1-1

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Print date: 29 Jun 2020 - 07:50

Data source: LPI: DTDB / DCDB, 2017; public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

2. Project changes

2.1 Overview

In addition to the proposed increase in plant capacity, the amended Project includes the following design changes:

- Seawater intake: Further design development and liaison with Hunter Water's construction partners following completion of the EIS identified reliability and construction risks with the proposed horizontal sub-surface intake system as described in the EIS. An assessment of the horizontal sub-surface intake system was undertaken against alternative intake options. This assessment found that a direct ocean intake would perform considerably better than a sub-surface option across key criteria including reliability, efficiency and scalability (see Section 2.2).
- Power supply: The EIS proposed to meet power requirements for the Project via a minor upgrade to the existing 11 kV power supply network in the vicinity of Hudson and Marriot Street. The amendment to the capacity of the water treatment process plant means this is now unfeasible, due to inability to meet energy requirements. Instead, the Project will connect to Ausgrid's 33 kV network in the vicinity of the Project (see Figure 2-1).

2.2 Key features of the amended Project

The amended Project for the construction and operation of a drought response desalination plant, designed to produce up to 30 ML/day of potable water, includes the following key components (as shown in Figure 2-1):

- **Direct ocean intake** – To ensure provision of sufficient quantities of raw feed water for the water treatment process plant, a direct ocean intake is proposed as part of the amended Project, as follows:
  - *Sea Water Pump Station (On-shore), including a central well, screening and pump housing*, proposed to be a concrete structure (referred to as a wet well) of approximately nine to 11 m diameter, installed to a depth up to 20 m below existing surface levels.
  - *Intake pipeline,* the indicative pipeline alignment is approximately 1000 m in length, extending outwards from the central housing to the off-shore intake structure. Construction of the intake pipeline would be determined during detailed design; however, the following construction methodologies/considered and assessed included Construction method 1 (CM1) Horizontal directional drilling (HDD) and (CM2) Pipejacking/micro-tunnelling.
  - *Intake structure (Off-shore)*, the intake structure would be in the form of a horizontal intake with a velocity cap structure and low through-screen velocity to minimise impacts on marine species and habitat. The intake structure would be 5 m in diameter, have a minimum of 5 m clearance from the seabed and a depth of approximately 18 m of water.

- **Water treatment process plant** – The water treatment process plant would not significantly change from that described in the EIS. The inclusion of buildings to house equipment rather than the installation of containerised equipment is the primary change. The buildings would be placed above ground level and located to allow incremental installation, if required. Services to and from the process equipment (e.g. power, communications, and raw feed water (seawater)) would comprise a mix of buried and overhead methods. The general components of the water treatment process would comprise:
  - *Pre-treatment:* a pre-treatment system is required to remove micro-organisms, sediment, and organic material from the raw feed water.
  - *Desalination:* a reverse osmosis (RO) desalination system made up of pressurising pumps and membranes. These would be comprised of modular components. In addition, a number of tanks and internal pipework would be required.
  - *Post treatment:* desalinated water would be treated to drinking water standards and stored prior to pumping to the potable water supply network.
- **Brine disposal system** – The desalination process would produce up to 56 ML/d of wastewater, comprising predominantly brine, as well as a small amount of pre-treatment and RO membrane cleaning waste. The waste brine from the desalination process would be transferred via a pipeline to a brine pump station at the Belmont WWTW for disposal via the existing ocean outfall pipe.
- **Power supply** – Power requirements of the amended water treatment process plant would require connection to Ausgrid's 33 kV line to the north-west of the water treatment process plant site, with new private power line connecting to a substation within the plant site.
- **Ancillary facilities** – including a tank farm, equipment housing buildings, chemical storage and dosing, hardstand areas, stormwater and cross drainage, access roads, parking areas, and fencing, signage and lighting.

Each of these elements are described further in Appendix C of the Amendment Report.

The desalination plant would be connected to Hunter Water's potable water network via a potable water pipeline proposed to be constructed to augment the existing water network. The pipeline does not form part of the Project and would be part of a separate design and approvals process.

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Hunter Water Corporation
Belmont Drought Response Desalination Plant
Coastal Processes Amendment Report

Project No. 22-19573
Revision No. 0
Date 29/06/2020

The Amended Project

Figure 2-1

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Print date: 29 Jun 2020 - 07:50

Data source: HWC: Aerial Imagery, Existing outfall: 2019; LPI: DTDB / DCDB, 2017; public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

3. Methodology

3.1 Baseline conditions and legislative framework

A review of available literature and legislation related to the project was conducted to assess the existing conditions of the project site and surrounds, specifically in relation to the general setting and the coastal processes and hazards. Key resources reviewed to inform the baseline conditions include:

- Survey data from the project site:
  - Acoustic Doppler Current Profiler (ADCP) data from 14 February to 24 March 2018 provided by Hunter Water, in particular current velocities (magnitude and direction), measured offshore of Belmont Beach.
  - Site geotechnical and geophysical survey data by GHD in August 2018.
  - Nearshore water depths from satellite derived bathymetry provider EOMAP, and offshore water depths from the MIKE global bathymetric database.
  - Site topographic data undertaken by RPS in April and July, 2019.

Since the preparation of the EIS, the following additional investigations have been undertaken:

- Sub-bottom profiling geophysical investigations carried out by GBG at Blacksmiths Beach Belmont in October 2019.
- Underwater Remotely Operated Vehicle (ROV) survey of the proposed ocean intake area on 12 and 13 December 2019.
- Literature review:
  - NSW legislation identified in Section 4.
  - Lake Macquarie Coastal Zone Management Plan 2015-2023 (CZMP) (Umwelt, 2015) and associated studies, including a Coastal Zone Hazard and Risk Assessment and Coastal Hazard Study report (BMT WBM, 2015a, 2015b), both commissioned by LMCC as part of the Lake Macquarie CZMP.
  - NSW Sea Level Rise Policy Statement.

3.2 Impact assessment

An assessment of potential impacts of the amended Project components was undertaken via a qualitative assessment against previously endorsed plans. Previous plans include a Coastal Zone Hazard and Risk Assessment and Coastal Hazard Study report, both commissioned by Lake Macquarie City Council as part of the Lake Macquarie CZMP (BMT WBM, 2015a, b). These assessments included numerical modelling to assess the risk of present day and future coastal hazards including coastal erosion and coastal inundation. Given that modelling has been conducted for the Project area relatively recently, there was no requirement to conduct additional modelling.

The impact assessment therefore builds upon available information and incorporates:

- Potential impacts during the construction of the amended Project components including undertaking construction activities on sandy soils and sand dunes.
- Potential impacts during the operation of the amended Project components, including potential impacts to infrastructure from storm surges and erosion events.

- An assessment of the potential impacts of coastal hazards on the amended Project components factoring in the potential amplification of impacts as a result of sea level rise associated with climate change.

Coastal hazards are defined within the Lake Macquarie CZMP as rare, unlikely and almost certain. The definitions for these hazards for coastal erosion and coastal inundation are provided in Table 3-1 and Table 3-2, respectively.

For critical utilities, including water infrastructure, the recommended hazard line to use is the 2100 line, with the following hazard areas defined:

- High hazard area – Seaward of Unlikely line
- Medium hazard area – Unlikely to Rare line
- Low hazard area – Landward of Rare line

Table 3-1 Likelihood definitions for erosion recession hazards

Likelihood	Immediate timeframe (2010)	Future (2050 and 2100)
Almost certain	Average beach erosion, as measured over the last four decades	Immediate average beach erosion for both periods, plus structural impacts (such as Swansea breakwaters) for 2100.
Likely	N/A	Immediate average beach erosion, plus recession due to sea level rise (0.4 m above 1990 by 2050 and 0.9 m above 1990 by 2100, as set by the NSW Government Policy Statement), plus structural impacts.
Unlikely	Maximum beach erosion (as measured over the last four decades, and approximately equivalent to a 1 in 100 year event)	Immediate maximum beach erosion, plus recession due to sea level rise (0.4 m above 1990 by 2050 and 0.9 m above 1990 by 2100, as set by the NSW Government Policy Statement) and allowing for structural controls such as breakwaters and headlands.
Rare	Extreme beach erosion calculated as maximum beach erosion plus average beach erosion, with sea walls removed	Immediate maximum beach erosion, plus an allowance for higher than projected recession due to sea level rise, (using 0.7 m above 1990 level by 2050 and 1.4 m above 1990 levels by 2100) or Immediate extreme beach erosion plus recession associated with sea level rise (0.4 m above 1990 levels by 2050 and 0.9 m above 1990 levels by 2100), or Immediate maximum beach erosion, plus changes to the angle of wave approach and/or structural impacts.

Table 3-2 Likelihood definitions for coastal inundation hazard

<table>
<tr><th rowspan="2">Likelihood</th><th rowspan="2">Storm surge and wave set up</th><th colspan="3">Sea level rise</th></tr>
<tr><th>2010</th><th>2050</th><th>2100</th></tr>
<tr><td>Almost certain</td><td>1 in 20 year</td><td rowspan="3">0 m</td><td rowspan="3">0.4 m</td><td rowspan="3">0.9 m</td></tr>
<tr><td>Unlikely</td><td>1 in 100 year</td></tr>
<tr><td>Rare</td><td>1 in 100 year with an extreme climatic event (such as a tropical cyclone or extreme east coast low)</td></tr>
</table>

The impact assessment has been undertaken for the amended Project components described in Section 2.2.

The impact assessment relies upon inputs from the GHD concept design (April 2020) including:

- Concept design of the direct ocean intake, Sea Water Pump Station, intake pipeline and intake structure (WSP 2020)
- Proposed construction methodology including plant, equipment, duration and project footprint
- Geotechnical information including particle size distribution of dune sands

4. Legislative setting

4.1 Introduction

The NSW Government has established a coastal management framework to manage the open coast and estuaries. The key components of the coastal management framework comprise:

- Coastal Management Act 2016
- State Environmental Planning Policy (Coastal Management) 2018
- NSW Coastal Management Manual

Under the framework, local Councils will prepare Coastal Management Programs (CMPs) that set the long-term strategy for the coordinated management of the coast, consistent with the objectives of the *Coastal Management Act 2016* (CM Act). These CMPs replace the current CZMPs, which will remain in force until 31 December 2021.

A CZMP was prepared and certified for the Lake Macquarie Local Government Area (LGA) in 2015, prior to endorsement of the CM Act. While all local councils will be required to prepare a CMP under the CM Act, the Act does allow for transitional provisions such that councils have until 2021 to be fully compliant with the new Act and Manual. As such, the Lake Macquarie CZMP will remain in effect until 31 December 2021.

The existing CZMP is considered to be an appropriate tool for the determination of coastal processes and associated risks for the coastline of relevance to this project. A qualitative assessment of the proposed project against the previously endorsed CZMP is considered appropriate to meet the requirements of this assessment.

Full details of the relevant legislation and associated manuals and management plans are described in the EIS and are not repeated in this report.

5. Existing and future conditions

5.1 Existing setting

The water treatment process plant would be located in the coastal dunes behind Nine Mile Beach, located within 170 metres of the shoreline (Figure 2-1). The immediate surrounds of the Project area consists of coastal bushland and wetland environments to the west, including Belmont Lagoon to the north-west, and Belmont Wetlands State Park to the north. Land to the east includes the coastal environment of Nine Mile Beach. Immediately north is the Belmont WWTW while to the south, the coastal dune drops significantly in elevation. Excluding the Belmont Golf Course (600 m south) and the WWTW, the central portion of Nine Mile Beach is relatively undeveloped, forming part of Belmont Wetlands State Park.

Within the CM Act, the NSW coastline is separated into coastal sediment compartments, defined by sediment flows and landforms. The Project area is located within Newcastle Coast sediment compartment, which extends from Nobbys Head to Norah Head and is made up of sandstone, siltstone and conglomerate headlands, embayed beaches, pocket beaches, transgressive dunes, backbarrier swamps and a large coastal lake (Lake Macquarie).

The benthic environment throughout the proposed direct ocean intake area is comprised of open homogenous sand substrate (Figure 5-1) interspersed by sand ripples characteristic of open coast beaches within the Newcastle Coast sediment compartment. Observations of survey footage indicate that sand substrate consisted primarily of coarse grained sand, interspersed with patches of shell grit/shell fragments.

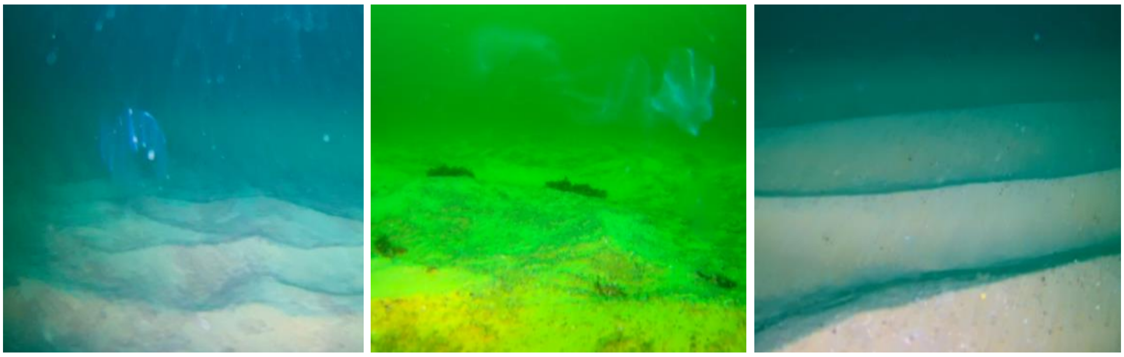


Figure 5-1 Coarse sand patches and sand ripples in the vicinity of the proposed intake structure

5.1.1 Belmont WWTW dune restoration project

The coastal dune system at Belmont WWTW currently acts as a buffer for the Project area and existing WWTW infrastructure from the dynamics of the ocean and beach environment. The dune is presently in poor condition, containing hummocks caused by vehicle tracks. There has been a progressive loss of native vegetation on the dunes and the invasive species bitou bush is present. The loss of vegetation and vehicle tracks leaves the dunes vulnerable to destabilisation and erosion. In the longer term if there is ongoing dune erosion and destabilisation this would result in the project site being more vulnerable to large and extreme storm events.

Whilst not directly part of the Project, Hunter Water is proposing a dune protection and restoration project within and adjacent to the Project area. Restoration of the dunes will assist with the future protection of the WWTW and Project area as well as providing improvements to a valuable coastal ecosystem. Whilst still under development, it is envisaged that the works proposed will involve:

- Possible dune reshaping
- Installation of dune forming fences within the fenced area to provide for sand build up
- Perimeter fencing to restrict access to a 12 ha area of dune to enable native vegetation regrowth
- Spinifex seeding
- Bitou bush removal

5.2 Existing coastal processes

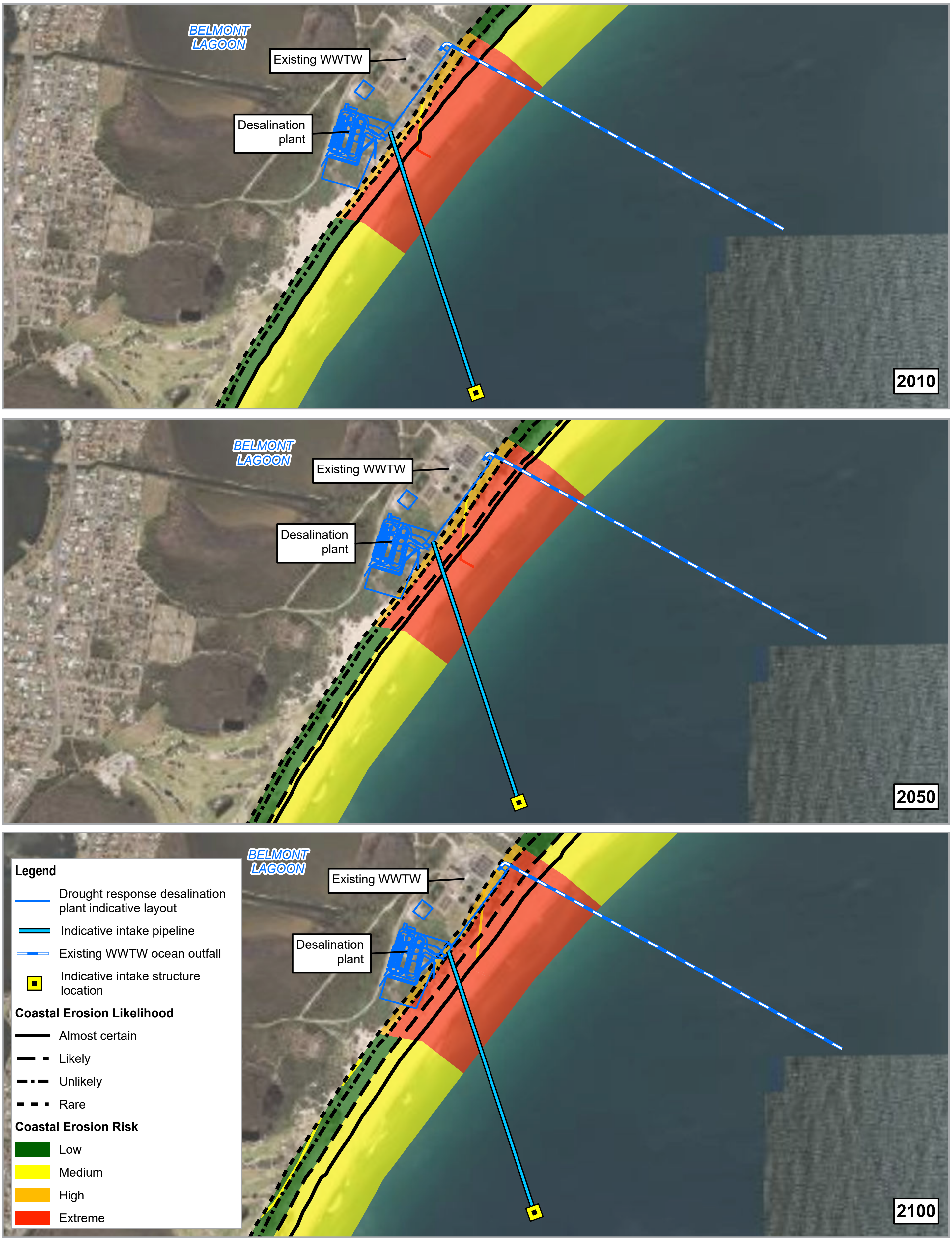
Coastal processes that influence the Project area include:

- **Bathymetry and coastal morphology** – Nine Mile Beach is characterised by a low sandy beach ridge in the south near Swansea Channel, extending to wide dunes of heights up to 15 m to the north at Redhead. At the Project area, the beach is oriented to the south-east. The narrow and steep nature of the nearshore zone and continental shelf offshore of Nine Mile Beach means there is less energy dissipation of deep water waves as they travel into the nearshore zone and onto the shoreline, accentuating the potential for wave-induced coastal erosion relative to surrounding coastal compartments. The benthic environment throughout the proposed direct ocean intake area is comprised of open homogenous sand substrate (Figure 5-1) interspersed by sand ripples characteristic of open coast beaches within the Newcastle Coast sediment compartment.
- **Geotechnical** – a number of boreholes and test pits revealed the sites subsurface typically comprises a thin layer of fill, followed by two sand layers increasing in density to 31 m depth and clay below to 41 m depth. The results of the Particle Size Distribution (PSD) testing indicate that the soils at the site are predominantly medium grained sand with small proportions of fine and coarse grained sand. Observations of recent survey footage indicate that the overlying sand substrate consists primarily of coarse grained sand, interspersed with patches of shell grit/shell fragments.
- **Wave climate** – The NSW coast is subject to a moderate wave climate predominantly from the south to southeast with an average offshore significant wave height (H_s) in the order of 1.6 m (Shand et al., 2011). Large waves can be generated year round by tropical cyclones, mid latitude cyclones and east coast lows. Given the orientation of the beach at the project site, waves from the south-east will have the most potential for cross-shore erosion.
- **Water levels** – fluctuate as they are influenced by tidal variation (semi diurnal), storm surge (from significant reduction in barometric pressure), wind setup (from onshore winds), wave setup (raised water levels as a result of broken waves, approximately 15% of offshore wave height), wave runup (uprush of water from a breaking wave).
- **Currents** – An Acoustic Doppler Current Profiler (ADCP) measured current velocities offshore of Belmont Beach from 14 February to 24 March 2018. It was noted that velocity components were greater along the north-south axis (longshore) than the east-west axis (cross shore). Also, the north-south velocity components at the surface and mid-depth were greater than at the seabed, whereas the east-west velocity components were similar for all three depths.

- **Longshore sediment transport** – there is a prevailing northerly drift of sediment due to the dominant south-south-east wave direction on the NSW east coast. The annual gross transport rates for Nine Mile Beach have been estimated up to 600,000 m^3 although net littoral drift outside of the embayment is thought to be significantly lower.
- **Cross-shore sediment transport** – typical patterns are erosion during significant wave events (increased wave heights and elevated water levels cause sand to be eroded from the upper beach/dune system and transported in an offshore direction) and accretion when wave conditions are mild (in calmer weather, sand slowly moves onshore from the nearshore bars to the beach). Typically, the cross-shore exchange of sand from the upper beach/dune area to the nearshore profile represent a net balance in the overall active beach system.
- **Aeolian sediment transport** – transport of sediment from the dry upper beach face and berm into unvegetated incipient dunes and foredunes by wind.
- **Climate change and sea level rise** – it is predicted that there would be elevated water levels associated with climate change (increase in mean sea level above 1990 levels of 0.4 m by 2050 and 0.9 m by 2100 (DECCW, 2009)) and potential for variation to storm intensity and frequency. It should be noted that the NSW Government policy on sea level rise is in the process of transition. Following a review by the NSW Chief Scientist and Engineer (April 2012) and stage one coastal management reforms, the NSW Government announced that councils would have the flexibility to determine their own sea level rise projections to suit their local conditions. The Government would no longer prescribe statewide sea level rise projections for use by councils and the 2009 NSW Sea Level Rise Policy Statement would no longer be NSW Government policy. In the 2015 Lake Macquarie CZMP, the allowances for sea level rise at 2050 and 2100 were 0.4 and 0.9 m respectively as advised by the 2009 NSW Sea Level Rise Policy Statement. The values adopted in the CZMP are considered to be appropriate until an updated CMP is prepared which complies with the CM Act and considers the latest available guidance on future climate projections.

5.3 Existing and future coastal hazards

Maps defining the present day (2010) and future (2050 and 2100) hazard lines and risk areas associated with coastal inundation, erosion and recession in the vicinity of the Project are presented in Figure 5-2 and Figure 5-3 and have been sourced from BMT WBM (2015a) (original figures provided in the EIS). Coastal hazards under existing conditions in vicinity of the Project are described in the following sub-sections. It should be noted that while they have been separated for explanation, they are intrinsically linked to one another.



Paper Size ISO A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Hunter Water Corporation
Belmont Temporary Desalination Plant
Coastal Processes Amendment Report

Coastal Erosion and Recession Risk for 2010, 2050 and 2100

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 5-2

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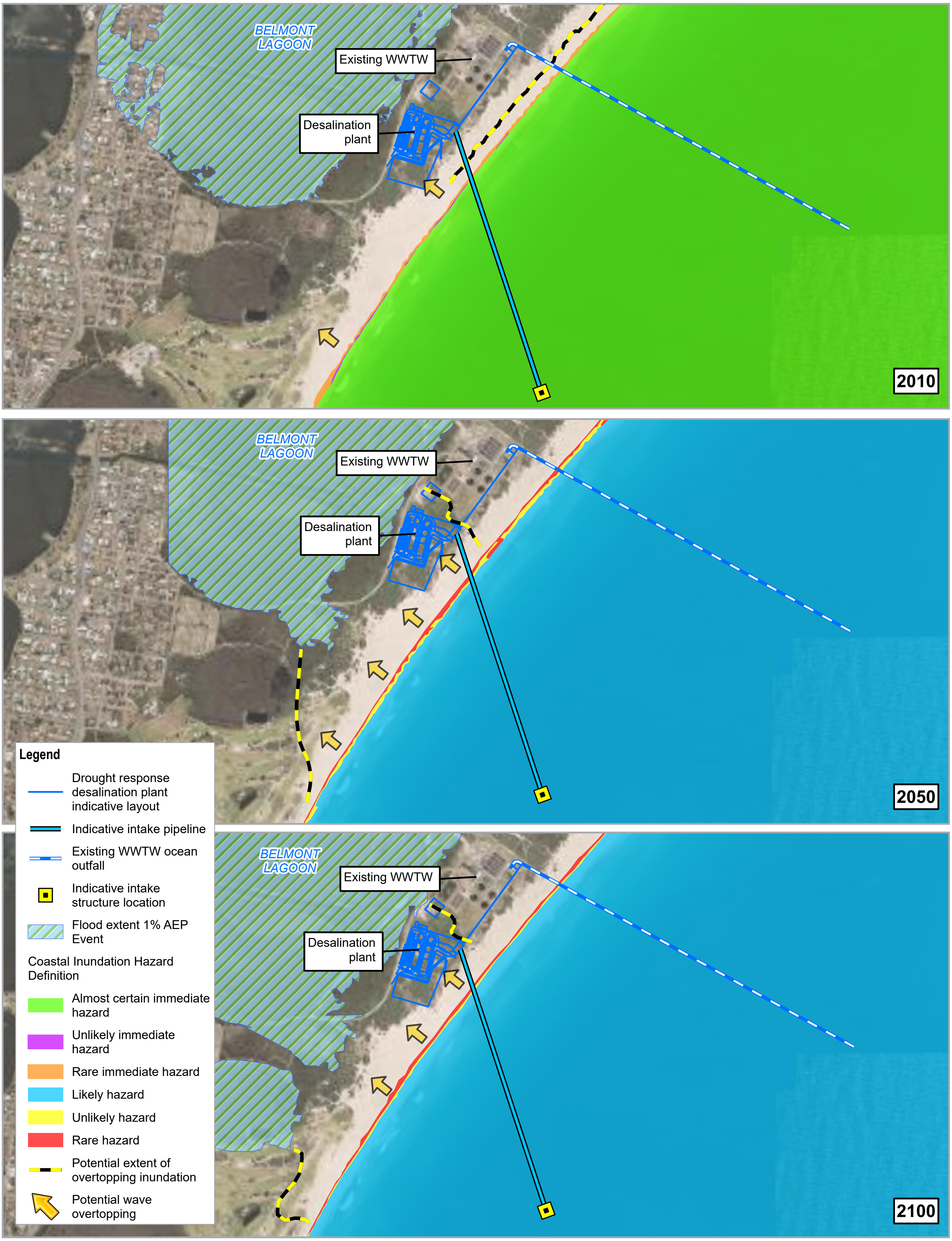
Data source: LMCC: Coastal Erosion risk, 2018; LPI: DTDB / DCDB, 2017; public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay



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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 56

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Belmont Temporary Desalination Plant
Coastal Processes Amendment Report

Coastal Inundation Hazard for 2010, 2050 and 2100

Project No. **22-19573**
Revision No. **0**
Date **29/06/2020**

Figure 5-3

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Data source: LMCC: Coastal Inundation hazards, 2018; LPI: DTDB / DCDB, 2017; public_NSW_Imagery: © Department of Customer Service 2020. Created by: fmackay

5.3.1 Existing and future coastal erosion hazards

Erosion typically occurs during storms (storm bite) or very high tides. Shoreline recession can occur under a number of situations, including:

- Sediment deficit or accretion when there is more sand migrating on to the beach
- Medium term changes to storm patterns
- Long term sea level rise

Slope instability is a by-product of coastal erosion whereby dune slopes become steeper until reaching an angle, known as the angle of repose, that the bearing capacity of the sand can no longer support itself (or any infrastructure it may be supporting) and subsequently slumps downwards. An extended erosion event can see multiple cycles of a dune being cut into by elevated waves and water levels until mass slumping occurs. This process will repeat itself provided erosive forces are able to reach the critical interface.

Erosion and recession risk maps for the Study area (BMT WBM, 2015a) show that the beach and dunes adjacent to the WWTW and Project area are subject to an extreme coastal erosion risk under all three timeframes assessed (2010, 2050, 2100). For the 2100 scenario, part of the existing WWTW infrastructure adjacent to the Project area is assessed as having a high coastal erosion risk.

To the north and south of the WWTW and Project area, the coastal erosion risk is mapped as medium for the beach area and low for the dunes under all three timeframes assessed. The erosion risk is lower to the north and south because risk is determined by assessing both likelihood and consequence. Assets such as the existing WWTW and the proposed water treatment process plant, sea water pump station, brine pump station and associated pipelines are subject to higher risk than an undeveloped coastal dune even if the likelihood is equal given that the consequence of the hazard occurring would be greater.

5.3.2 Existing and future coastal inundation hazards

Inundation occurs when coastal barriers, such as dunes and seawalls, are overtopped by oceanic waters and waves, allowing for estuary, lake or lagoon foreshores and low lying back beach areas to be inundated. Coastal inundation is characterised by two processes:

- A "quasi-static" component, which includes the effects of elevated water levels due to astronomical tide, wind setup, storm surge, wave setup and sea level rise.
- A "dynamic" component, which includes the effects of wave runup and wave overtopping.

During an unlikely storm event (defined as a 100 year Average Recurrence Interval (ARI) storm surge and 100 year ARI design wave in combination), wave runup is expected to breach the low dune barrier along the northern boundary of Belmont Golf Course to a point near the southern property boundary of the Belmont WWTW and proposed site. At the Project area, the volumes of water that do overtop the dune may be dispersed by draining toward Belmont Lagoon via Cold Tea Canal or infiltrating directly through the dune sands, depending upon the rate of overtopping. The consequences of the wave runup will likely be enhanced by storm erosion. The occurrence of wave overtopping at the Project area will be enhanced by sea level rise.

5.4 Potential impact of coastal hazards on the Project

Sections 5.4.1 and 5.4.2 provide an overview of the potential coastal erosion and inundation risks to the Project. Potential impacts to coastal processes stemming from the proposed construction and operational phases of the Project have been described in Section 6.

5.4.1 Risks of coastal erosion impacts to the Project

Present day (2010) and future (2050) scenarios

The mapping prepared under the 2015 CZMP designates that the water treatment process plant is located landward of the designated risk areas under the 2010 and 2050 scenarios and is thus deemed not to be at risk (Figure 5-2). However, adjacent infrastructure associated with the seawater intake and brine discharge systems would extend into the mapped hazard areas of the coastal zone under these scenarios (Figure 5-2).

Under the current concept design, the intake structure and associated pipeline extend into the extreme hazard area for erosion and recession risk. However, the pipeline would be drilled or microtunnelled through the active portion of the beach profile, such that the pipeline achieves a minimum installation depth of 15 m below ground levels at the time of installation.

Whilst the brine discharge pump station and pipeline connection between the water treatment process plant and the WWTW are outside the 2010 hazard area, it is within the mapped high hazard area for 2050. Accordingly, potential beach erosion could expose and directly damage this infrastructure, which is critical to the operation of the desalination plant. Further, beach erosion could expose sands to aeolian processes, with the potential to cause sand ingress into the plant leading to operational maintenance issues.

Should a storm occur during construction of the amended Project, coastal erosion could be exacerbated by the disturbed state of the system during construction. The components of the amended Project most at risk are the intake pipe and sea water pump station building which lie closest to the coastline. The construction timeframe and method would define the risk of exposure. It is expected that the construction timeframes for marine and intertidal works would be in the order of eight months for each of the options.

Long term future scenario (2100)

The water treatment process plant is predicted to be subject to low erosion risk in 2100 given it is landward of the rare hazard line. However, the pipeline structures and pump stations, including the brine pipeline connection to the WWTW, are predicted to be subject to extreme erosion risk in 2100 (Figure 5-2). Given that the water treatment process plant is not expected to be operational in 2100, the 2100 scenario is not considered to be of relevance to the project. However, should a rare 2100-equivalent event occur while the plant is in place, then beach erosion could occur resulting in shoreline recession, beach level fluctuation and storm bite leading to slope instability and disruption of dunes exposing sands to aeolian processes. These processes could have a range of impacts on the desalination plant infrastructure including equipment, materials and personnel. However, as described above, the 2100 rare scenario is unlikely to affect the amended Project given the operational timeframe and nature of the operation.

5.4.2 Risks of coastal inundation to the Project

The mapping prepared under the 2015 CZMP shows that all infrastructure within the desalination plant location is predicted to be landward of the designated inundation risk areas (Figure 5-3) and thus deemed not to be at risk of coastal inundation. However, indicative locations of wave overtopping during a storm event for the future 2050 and 2100 scenarios suggests that overtopping risk could increase near the proposed location of the sea water pump station (Figure 5-3). While this would likely be dispersed by draining and infiltration, there could be an impact to the sea water pump station as a result of the ocean water impacting the site, which would need to be considered during detailed design.

6. Impact assessment

Section 6 provides an overview of the potential impacts to coastal processes stemming from the proposed construction and operational phases of the project. Coastal erosion and inundation risks to the proposed Project have been described in Sections 5.4.1 and 5.4.2.

6.1 Construction phase – impact assessment

6.1.1 Coastal processes impacts during construction

The potential changes to impacts on coastal erosion during the construction phase of the amended Project relate to the water treatment process plant and the direct ocean intake as described in Table 6-1 and Table 6-2 respectively. Mitigation measures have been developed to minimise these potential impacts and are described in Section 7.

Table 6-1 Potential impacts of the water treatment process plant on coastal processes

Impact	Infrastructure	Existing conditions	Process
Exposing sands to aeolian processes, which may increase the mobility of dunal sands leading to increased rates of erosion	Sea water pump station, water treatment process plant, brine pump station and connecting pipeline	The geotechnical investigation revealed near surface sediments are of loose to medium density and are thus susceptible to erosion	Disruption to dune vegetation systems, aeolian processes and associated dune stability during construction as a result of heavy vehicle movement and earthworks

Comparison of the potential impacts associated with the amended water treatment process plant against those described in the EIS indicates that there would be no significant differences in potential impacts to coastal processes between the amended and EIS development proposals.

Table 6-2 Potential impacts of the ocean intake on coastal processes

Impact	Infrastructure	Existing conditions	Process
Temporary offshore structures, excavated offshore receival pit and underwater stockpile may modify nearshore wave transformation behaviours, potentially leading to localised focusing or dissipation of wave energy.	HDD and microtunnelling (CM1 and CM2).	The benthic environment throughout the proposed ocean intake area is comprised of open homogenous sand substrate interspersed by small scale sand ripples.	Drilling and boring machines require offshore receival infrastructure. A tunnel boring machine would also require excavation of a receival pit and stockpiling of sediments on the seafloor. Waves approaching the shoreline may “feel” the modified seabed contours which would result in modified nearshore wave transformation behaviours, potentially leading to localised focusing or dissipation of wave energy.

Comparison of the potential impacts associated with the amended ocean intake and associated pipeline against those described in the EIS indicates that the amended Project could be expected to create a minor increase in potential impacts to coastal processes due to the temporary offshore receival infrastructure and associated excavation/stockpiling activities.

6.1.2 Coastal inundation impacts during construction

There are no perceivable impacts on coastal inundation that could be caused by the Project. This is because the footprint and methodology for construction would have no significant influence on the processes that effect coastal inundation.

6.2 Operations phase – impact assessment

6.2.1 Coastal processes impacts during operations

The potential changes to impacts on coastal erosion during the operations phase of the amended Project relate to the water treatment process plant and the direct ocean intake as described in Table 6-3 and Table 6-4 respectively. Mitigation measures have been developed to minimise these potential impacts and are described in Section 7.

Table 6-3 Potential impacts of the process plant on coastal erosion

Impact	Infrastructure	Existing conditions	Process
Exposing sands to aeolian processes, which may increase the mobility of dunal sands leading to increased rates of erosion	Sea water pump station, water treatment process plant and brine pump station	The geotechnical investigation revealed near surface sediments are of loose to medium density and are thus susceptible to erosion.	Disruption to dune vegetation systems, aeolian processes and associated dune stability during operations due to hardstand runoff and other plant activities.
Consolidating or 'locking up' of coastal dunes, removing the buffer for coastal erosion and increasing the risk of inland erosion	Sea water pump station, water treatment process plant, brine pump station and connecting pipeline	Coastal processes are typically in equilibrium and rely on the availability of dunal sands during periods of erosion.	Establishment of built infrastructure is likely to lock up these sands such that they are no longer available to the natural system of coastal processes. The water treatment process plant would be constructed behind the foredunes, which are proposed to be restored as part of a separate project by Hunter Water, which reduces the likelihood of this impact. This project is described in detail in Section 5.1.1. The intake structure and associated pipeline extend into the extreme hazard area for erosion and recession risk. However, with the exception of the pump stations, the remainder of the infrastructure would be at a minimum depth of 15 metres below existing surface levels. Consequently, the risk of the pipeline interacting with sediment transport is considered low.

Comparison of the potential impacts associated with the amended water treatment process plant against those described in the EIS indicates that there would be no significant differences in potential impacts to coastal erosion between the amended and EIS development proposals.

Table 6-4 Potential impacts of the ocean intake on coastal erosion

Impact	Infrastructure	Existing conditions	Process
Localised scour and modified nearshore wave transformation behaviour due to seabed infrastructure	Intake structure	The benthic environment throughout the proposed ocean intake area is comprised of open homogenous sand substrate interspersed by small scale sand ripples.	The proposed intake structure would measure 5 m in diameter and would rise from the seabed at approximately -17 m AHD to a height of 5 m above the existing seabed (to a level of approximately -12 m AHD). Given the relative size of the intake structure, no significant impacts to nearshore wave transformation are expected. Nevertheless, localised eddies and currents around the structure may lead to scour of the seabed in the immediate vicinity of the intake. These scour impacts are not expected to result in a significant impact to broader coastal processes.

Comparison of the potential impacts associated with the intake structure itself with the subsurface intake described in the EIS indicates that there would be impacts to longshore transport that would not have been associated with the sub-surface intake structure.

The amended project proposal could be expected to create a minor increase in potential impacts to coastal processes due to the presence of the intake structure.

6.2.2 Coastal inundation

There are no perceivable impacts on coastal inundation that could be caused by the Project. This is because the footprint and operation would have zero influence on the processes that effect coastal inundation.

6.3 Decommissioning phase

When desalination operations cease, there are two options for decommissioning: retaining the intake pipe and intake structure in place or partially removing the intake structure from the seabed.

If the intake pipe and intake structure is kept in place, there is no further disturbance impact expected on coastal processes as it would already have been present in the environment for a period of time.

If the intake structure is to be removed, the impacts to coastal processes would be considered similar to the impacts of installation. This would relate to the presence of temporary offshore structures, excavation of sediments and underwater stockpiling which may modify nearshore wave transformation behaviours, potentially leading to localised focusing or dissipation of wave energy.

Any future decommissioning review would take into account potential risks at the time of the proposed action adopting leading industry practices and identify measures/strategies for any proposed action that have the lowest practical environmental impact risk.

Potential impacts to coastal processes due to the decommissioning of intake and pipeline infrastructure are in addition to those considered in the EIS since an ocean intake was not proposed at the time of the EIS.

Potential impacts associated with the decommissioning of the water treatment process plant would be as per those assessed as part of the EIS.

7. Summary of revised mitigation measures

Mitigation measures to address coastal hazards have been considered and documented in Table 7-1. It is recommended these mitigation measures be used to inform detailed design and adhered to during the construction, operation and decommissioning phases of the water treatment process plant.

Table 7-1 Summary of mitigation measures

Impact	Mitigation measure	Timing
Disruption to dune vegetation systems, aeolian processes and associated dune stability leading to a potential increased rate of erosion	Implement a coordinated erosion monitoring and mitigation program in conjunction with the existing strategies and dune restoration project implemented for the adjacent WWTW, including: • Site profiling and revegetation following completion of civil works in accordance with the final design which is to comply with the Lake Macquarie CZMP (2015) and DLWC (2001). • Monitoring of recession and implementation of mitigation measures below as needed: - Beach management works such as beach scraping to reshape dunes and increase dune volume/recovery after storms if necessary. - Stabilisation of the frontal dune system by removing invasive species and replacing with locally indigenous dune vegetation. - Installation of sediment fences to minimise the movement of sands during construction. - Control offroad vehicle access and surface runoff. - Potential positive cumulative impact to align these works with Hunter Water's proposed dune protection and restoration project between the Belmont Golf Course and WWTW as described in Section 5.1.1. • Ensure the public are prevented from entering works areas and potential areas of impact.	Construction and Operation
Consolidating or 'locking up' of coastal dunes by built infrastructure, removing the buffer for coastal erosion and increasing the risk of inland erosion	The amended design situates the desalination plant behind the foredunes. Avoid locating the water treatment process plant and intake structures more seaward than is currently proposed in the concept design and minimise hardstand areas or structures that would consolidate the coastal dunes.	Detailed Design
Exposure of the subsurface pipelines by coastal processes including beach level fluctuation and storm bite	Ensure that infrastructure installed within the active portion of the beach profile is of sufficient depth such that it is below the limit of scour. Alternatively, modify the infrastructure design such that it can be exposed to wave action during extreme events, or ensure plant is decommissioned prior to risk levels increasing under future scenarios.	Detailed Design
	Monitor weather forecasts when working on the intake infrastructure and halt works when extreme coastal warnings are issued by the Bureau of Meteorology. Prepare and implement a Natural Event Response Plan as part of the Construction Environment Management Plan (CEMP).	Construction

Impact	Mitigation measure	Timing
Risk of coastal erosion impacting the plant and associated pipelines under long term future or rare events	Ensure that infrastructure does not extend into areas of present day erosion and recession risk without appropriate design measures and that the future risk level applied allows for the most conservative operational and decommissioning timeframes.	Detailed Design, Construction and Operation
	Conduct consistency reviews at major design milestones against the EIS, AR, approval conditions and latest available literature including the Lake Macquarie CMP. It is understood that the EIS will have a 10 year validity period if approved, and as such it is likely that updated sea level rise guidance and coastal risk maps will be available in the interval between concept design and project implementation. The review is required to ensure that the Project area remains acceptable from a coastal erosion risk perspective.	Operation
Aeolian sand ingress into the plant leading to operational maintenance issues	Implement a coordinated erosion monitoring and mitigation program and update if required.	Operation
Wave overtopping impacting the desalination plant	Design infrastructure and landscaping to minimise the likelihood and extent of wave overtopping. Minimise the impact on the plant should wave overtopping occur by maintaining appropriate drainage and designing the plant to withstand an overtopping event.	Detailed Design
Localised scour and modified nearshore wave transformation behaviour due to seabed infrastructure	Adopt pipeline and intake designs which minimise impacts to wave reflection and transformation, generation of localised eddy currents and obstructions to longshore transport.	Detailed Design

8. Conclusion

This report assesses the potential impacts to coastal processes from the water treatment process plant and the direct ocean intake south of the existing Belmont WWTW outfall and compare these impacts to those outlined in the EIS, which did not include a direct ocean intake.

8.1 Construction phase impacts

Construction of this intake pipeline and structure has the potential to alter coastal processes through activities that will disturb the seabed such as drilling, piling and trenching. Vessels will also be required to support the construction activities. The potential impacts to coastal processes from these activities are listed below and summarised in Table 7-1:

- Exposing sands to aeolian processes, which may increase the mobility of dunal sands leading to increased rates of erosion.
- Temporary offshore structures, excavated offshore receival pit and underwater stockpile may modify nearshore wave transformation behaviours, potentially leading to localised focusing or dissipation of wave energy.

Comparison of the potential impacts associated with the amended water treatment process plant against those described in the EIS indicates that there would be no significant long term differences in potential impacts to coastal processes between the amended and EIS Project designs.

Comparison of the potential impacts associated with the amended direct ocean intake and associated intake pipe against those described in the EIS indicates that the amended project proposal could be expected to create a minor and temporary increase in potential impacts to coastal processes due to the temporary offshore receival infrastructure and associated excavation/stockpiling activities.

8.2 Operations phase impacts

Operation of the amended water treatment process plant has potential to influence coastal processes. The risks to coastal processes from these operations are:

- Exposing sands to aeolian processes, which may increase the mobility of dunal sands leading to increased rates of erosion
- Consolidating or ‘locking up’ of coastal dunes, removing the buffer for coastal erosion and increasing the risk of inland erosion
- Localised scour and modified nearshore wave transformation behaviour due to seabed infrastructure

Comparison of the potential impacts associated with the amended water treatment process plant against those described in the EIS indicates that there would be no significant differences in potential impacts to coastal processes between the amended and EIS development proposals.

Comparison of the potential impacts associated with the amended direct ocean intake and associated intake pipe against those described in the EIS indicates that the amended Project could be expected to create a minor increase in potential impacts to coastal processes due to the presence of the intake structure.

8.3 Decommissioning phase impacts

Potential impacts associated with the decommissioning of the water treatment process plant would be as per those assessed as part of the EIS.

When desalination operations cease, there are two options for decommissioning: retaining the intake pipe and intake structure in place or partially removing the intake structure from the seabed.

If the intake pipe and intake structure is kept in place, there is no further disturbance impact expected on coastal processes.

If the intake structure is to be removed, the impacts to coastal processes would be considered similar to the impacts of installation. This would relate to the presence of temporary offshore structures, barges, excavation of sediments and underwater stockpiling which may modify nearshore wave transformation behaviours, potentially leading to localised focusing or dissipation of wave energy.

Potential impacts to coastal processes due to the decommissioning of intake and pipeline infrastructure are in addition to those considered in the EIS since an ocean intake was not proposed at the time of the EIS.

8.4 Concluding remarks

The management and mitigation measures detailed in the Belmont Drought Response Desalination Plant – Environmental Impact Statement (GHD, November 2019) and Belmont Drought Response Desalination Plant – Coastal Processes Assessment Report (GHD, November 2019) are still appropriate and will be implemented where reasonable and feasible.

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