Port Beach Sand Nourishment via Dredging – Environmental Management Plan

Reference: R-10807-6
Date: December 2021

Document Control Sheet

BMT Commercial Australia Pty Ltd
Level 4, 20 Parkland Road
Osborne WA 6017
Australia
PO Box 2305, Churchlands, WA 6918

Tel: +61 8 6163 4900

ABN 54 010 830 421

www.bmt.org

Document:	R-10807-6
Title:	Port Beach Sand Nourishment via Dredging – Environmental Management Plan
Project Manager:	Melissa Capill Adam Gartner
Author:	M Capill
Client:	City of Fremantle
Client Contact:	Katrina Sachse Ryan Abbott
Client Reference:	RfQ 364/21

REVISION/CHECKING HISTORY

Revision Number	Date Issued	Checked by		Issued by	
A – Technical review	16/09/21	A Gartner		A Gartner (on behalf of M Capill)	
B- Project Working Team Review	17/09/21	J Costin			
0 – Submission to EPA	17/12/2021	A Gartner			

DISTRIBUTION

Destination	Revision										
	A	B	0	1	2	3	4	5	6	7	8
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Acronyms

Acronyms	
BCH	Benthic Communities and Habitats
CD	Chart Datum
CEMP	Construction Environmental Management Plan
CRFHPA	Cottesloe Reef Fish Habitat Protection Area
CHRMAP	Coastal Hazard Risk Management and Adaptation Plan
CoF	City of Fremantle
DEMP	Dredging Environmental Management Plan
DWC	Deep Water Channel
DPIRD	Department of Water and Environmental Regulation
DWER	Department of Water and Environmental Regulation
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EQG	Environmental Quality Guideline
ERD	Environmental Review Document
GPS	Global Positioning System
IMS	Invasive Marine Species
LAC	Light Attenuation Coefficient
LAU	Local Assessment Unit
MCA	Multicriteria analysis
RIFA	Red Imported Fire Ants
RIU	Remote Imagery Unit
TNTM	Temporary Notice to Mariners
TSS	Total Suspended Solids
WA	Western Australia

Summary

Project name	Port Beach Sand Nourishment via Dredging
Proponent name	City of Fremantle and Fremantle Ports
Ministerial Statement number	Not applicable. This Dredging Environmental Management Plan (DEMP) precedes the setting of Ministerial Conditions; it is submitted to support the referral of the Project to the Western Australian Environmental Protection Authority under Section 38 of the *Environmental Protection Act 1986*.
Purpose of the Plan	This DEMP outlines the approach to monitoring and/or management of potential environmental impacts associated with the implementation of the Project on EPA's environmental factors. The potential environmental impacts requiring monitoring and/or management were identified in the Project's Environmental Review Document (BMT 2021a). Following the implementation of this DEMP it is expected that the EPA's objective for the environmental factor of Coastal Processes will be met.
Environmental factors	The following key environmental factors that may be affected by potential environmental impacts associated with the Project have been assigned outcome-based conditions: • marine environmental quality • benthic communities and habitats • social surroundings. In addition, the following 'other factors' have outcome based provisions (monitoring and management actions and targets) assigned to provide further mitigation against impacts • marine fauna • flora and vegetation • terrestrial fauna.
Project commencement timing	The scheduled timing for Project commencement is in March 2022
Plan required prior to Project commencement?	Yes. The DEMP includes monitoring that is required prior to Project commencement.

1 Context, Scope and Rational

1.1 Background

Port Beach has undergone substantial changes since late 1800's with significant impacts from urban development altering the coastline, including the more recent Rous Head extension and realignment of Port Beach Road. These historical uses and developments have resulted in hard infrastructure surrounding the beach. Major coastal erosion events have occurred intermittently at Port Beach; the most recent in 2018, 2019 and 2020 caused significant damage with the receding shoreline compromising the Port Beach carpark and buildings. In 2020, Fremantle Council accepted a State government WA Recovery Grant of $3.25 million to implement a large-scale sand nourishment project at Port Beach. The conditions of the grant confirms the partnership between adjacent asset owners/land managers of the agreed risk mitigation approach to address coastal erosion risk to assets of both parties and requires the completion and requires the completion of a capital sand nourishment project by 30 June 2022.

1.2 Purpose of this document

This Dredging Environmental Management Plan (DEMP) outlines the approach to monitoring and/or management of potential environmental impacts on the relevant environmental factors (marine environmental quality, benthic communities and habitats, social surroundings, marine fauna, flora and vegetation, terrestrial fauna) associated with the implementation of the Project. This DEMP has been prepared in accordance with EPA (2021a).

The potential environmental impacts requiring monitoring and/or management in this DEMP were identified in the Project's Environmental Review Document (ERD; BMT 2021). Following the implementation of this DEMP, it is expected that the WA Environmental Protection Authority (EPA) objectives for the relevant environmental factors will be met.

1.3 Proponent details

The Proponent for the Proposal is a shared arrangement between City of Fremantle and Fremantle Ports. The Proponents details for this Proposal are provided in Table 1-1. It is noted that Fremantle Ports (Dain Osbourne) is the primary point of contact for this DEMP.

Table 1-1 Proponent details for the Port Beach Sand Nourishment via Dredging Project

Detail	Proponent 1	Proponent 2
Proponent name	City of Fremantle	Fremantle Ports
Proponent address	70 Parry Street, Fremantle WA 6160	1 Cliff Street, Fremantle WA 6160
Australian Business Number	74 680 272 485	78 187 229 472
Key contact name	Katrina Sachse	Dain Osborne

Detail	Proponent 1	Proponent 2
Key contact details	Phone: (08) 9432 9814 Email: katrinas@fremantle.wa.gov.au	Phone: (08) 9430 3457 Email: dain.osborne@fremantleports.com.au

1.4 Project description

1.4.1 Dredging and sand placement

The target volume of sand to effectively nourish Port Beach is ~150,000 m^3. Sand for the Project will be sourced via dredging to deepen the bend area of Fremantle Ports' Deep existing Water Channel (DWC) (hereafter, the dredging area; Figure 1-1) to -18.5 m Chart Datum (CD) and placed within a defined nearshore area at Port Beach (hereafter, the placement area; Figure 1-1 and Figure 1-2). The proposed dredging depth is ~0.5 m below the previously approved dredging depth for the bend area of the DWC (-18 m Low Water Mark (LWM) for Fremantle; Ministerial Statement 801). Only unconsolidated sediments (i.e. no rock material) will be targeted as part of the dredging, to source suitable material for beach nourishment. Design drawings for the dredging and placement area are provided in Appendix A.

In addition to the dredge, various work boats will be required as part of the Project operations for dredge equipment management, crew transfers and environmental monitoring etc. The proposed method for sand placement is yet to be confirmed but is anticipated to involve rainbowing into the nearshore, pumping onshore through temporary pipework or bottom dumping by a split hopper. Various land-based equipment will be used onshore to undertake beach building and profiling, as required. Examples of the likely types of land-based equipment that may be present on site during the Project include light vehicle(s), land-based excavator(s) and/or front-end loader(s). The beach building and profiling works will also involve re-construction of eroded dunes to provide additional coastal protection. The re-constructed eroded dunes will be re-vegetated as part of the Project to stabilise the features, while also providing the additional benefit of enhancing the natural environment in the area. Placement activities including beach building and profiling works will be staged along the placement area during the Project, thereby limiting the impact of restricted access to Port Beach to sections at a time rather than the entire area.

The dredging and sand placement activities are proposed to occur over seven days per week between 0700 and 1900 for a duration of ~8 weeks (this duration assumes of full availability of the dredge during the operational period and does not account for potential standby from weather or mechanical breakdown etc. The scheduled timing for commencement is in March 2022, targeted to (i) ensure works are completed prior to the winter period when there is an increased risk of high energy weather events and further coastal erosion; (ii) avoid the summer period when there is peak social use of Port Beach, and (iii) avoid the peak seagrass growing seasons.

A summary of the Project is provided in Table 1-2 and the key characteristics of the Project are provided in Table 1-3.

Table 1-2 Summary of the Port Beach Sand Nourishment via Dredging Project

Project title	Port Beach sand nourishment via dredging
Proponent name	City of Fremantle and Fremantle Ports
Short description	The Project is for dredging to remove 150,000 m^3 of sand from deepening Fremantle Ports' DWC (bend area only) to -18.5 m Chart Datum within a footprint of 53.21 ha and placement to Port Beach for sand nourishment within a footprint of 7.06 ha

Table 1-3 Key elements of the Port Beach Sand Nourishment via Dredging Project

Element	Location	Proposed extent
Physical elements		
Not applicable	Not applicable	There are no new physical elements associated with the Proposal
Construction elements		
Dredging	Fremantle Ports' DWC (Figure 1-1)	Removal of 150,000 m^3 of sand from deepening the bend area of Fremantle Ports' DWC to -18.5 m LWM for Fremantle within a footprint of ~53.21 ha
Placement	Port Beach (Figure 1-1 and Figure 1-2)	Placement of 150,000 m^3 of sand to Port Beach within a footprint of 7.06 ha
Operational elements		
Not applicable	Not applicable	There are no operational elements associated with the Proposal

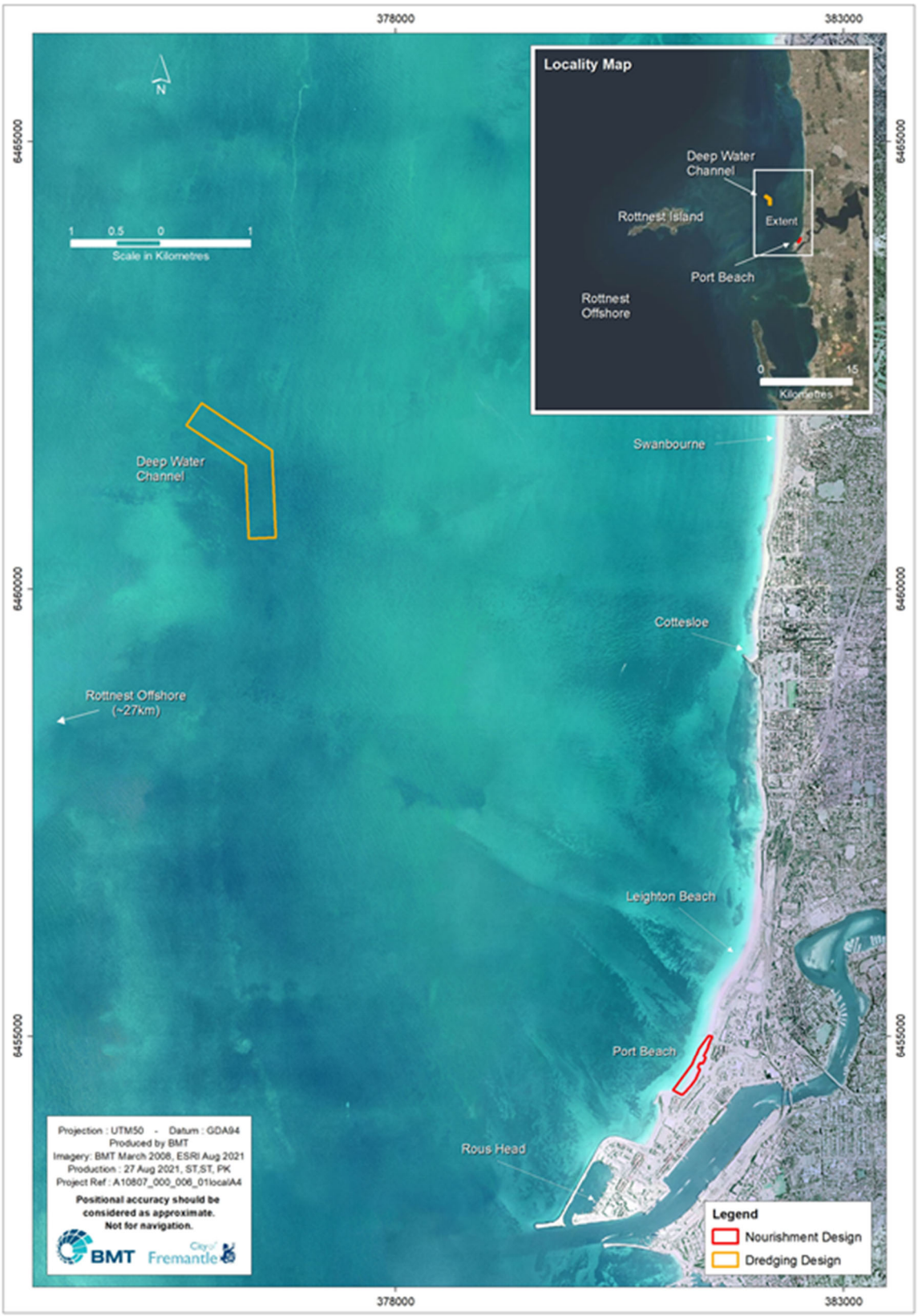


Figure 1-1 Location of the dredging area within Fremantle Ports' Deep Water Channel and placement area at Port Beach

Figure 1-2 Location of the placement area at Port Beach

1.5 Condition requirements

This DEMP precedes the setting of Ministerial Conditions; it is submitted to support the referral of the Project to the EPA under Section 38 of the *Environmental Protection Act 1986* (EP Act; Part IV). Proposed outcome-based conditions are provided in Section 2.

1.6 Relevant environmental factors

An assessment of potential environmental factors against the EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021b) was provided in the Project's ERD (BMT 2021) to identify the environmental factors that are relevant to the Project. Based on the assessment of the potential environmental impacts, the following environmental factors were identified as requiring monitoring and/or management and are applicable to this DEMP:

- marine environmental quality
- benthic communities and habitats
- social surroundings
- marine fauna
- flora and vegetation
- terrestrial environmental quality.

The environmental factors, associated objectives, site-specific environmental values and potential environmental impacts relevant to this DEMP are summarised Table 1-4.

Table 1-4 Environmental factors, objectives and potential environmental impacts relevant to the Port Beach Sand Nourishment via Dredging Environmental Management Plan

Environmental factor	EPA Objective	Proposed activities affecting the environmental factor	Potential environmental impacts to the environmental factor
Marine environmental quality	To maintain the quality of water, sediment and biota so that environmental values are protected	The dredging and placement activities associated with the Project has the potential to modify water quality from increased water column turbidity	Increased water column turbidity
		The presence of machinery and equipment associated with the Project poses a potential risk of hydrocarbon spills and waste generation	Hydrocarbon spills and waste generation
		The mobilisation of the dredge and associated support vessels to the Project area poses a	Introduced marine species

Environmental factor	EPA Objective	Proposed activities affecting the environmental factor	Potential environmental impacts to the environmental factor
		potential risk of the introduction of marine species	
Benthic communities and habitats	To protect benthic communities and habitats (BCH) so that biological diversity and ecological integrity are maintained	The dredging and placement activities associated with the Project has the potential to result in direct and indirect impacts to benthic communities and habitats occurring in the vicinity of the Project area	Direct loss
			Indirect loss
Social surroundings	To protect social surroundings from significant harm	The dredging and placement activities associated with the Project has the potential to reduce aesthetic and amenity values in the Port Beach area.	Public safety
			Reduced public amenity and restricted access
			Navigational hazards
			Wind-blown dust and sand
			Odour generation
			Social impacts from noise
Marine fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained	The operation of the dredge and associated support vessels poses a potential risk of marine mammal collision	Marine mammal collision
		The mobilisation of the dredge and associated support vessels to the Project area poses a potential risk of the introduction of marine species	Introduction of invasive marine species
Flora and vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained	Use of onshore machinery during placement activities may lead to terrestrial vegetation disturbance or introduction of invasive weed species.	Vegetation disturbance/removal
Terrestrial fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained	Use of onshore machinery during placement activities may facilitate the spread of red imported fire ants.	Spread of red imported fire ants

1.7 Rationale and approach

This section provides the Proponent's rationale and approach for the development of this DEMP. This DEMP has been prepared based on the potential impacts identified in the Port Beach sand nourishment via dredging ERD (BMT 2021) and outlines the environmental management actions and any associated monitoring and reporting to be implemented during the marine dredging and placement works associated with the Project. For factor-specific descriptions of environmental impact assessment findings and associated assumptions/uncertainties, refer to BMT (2021).

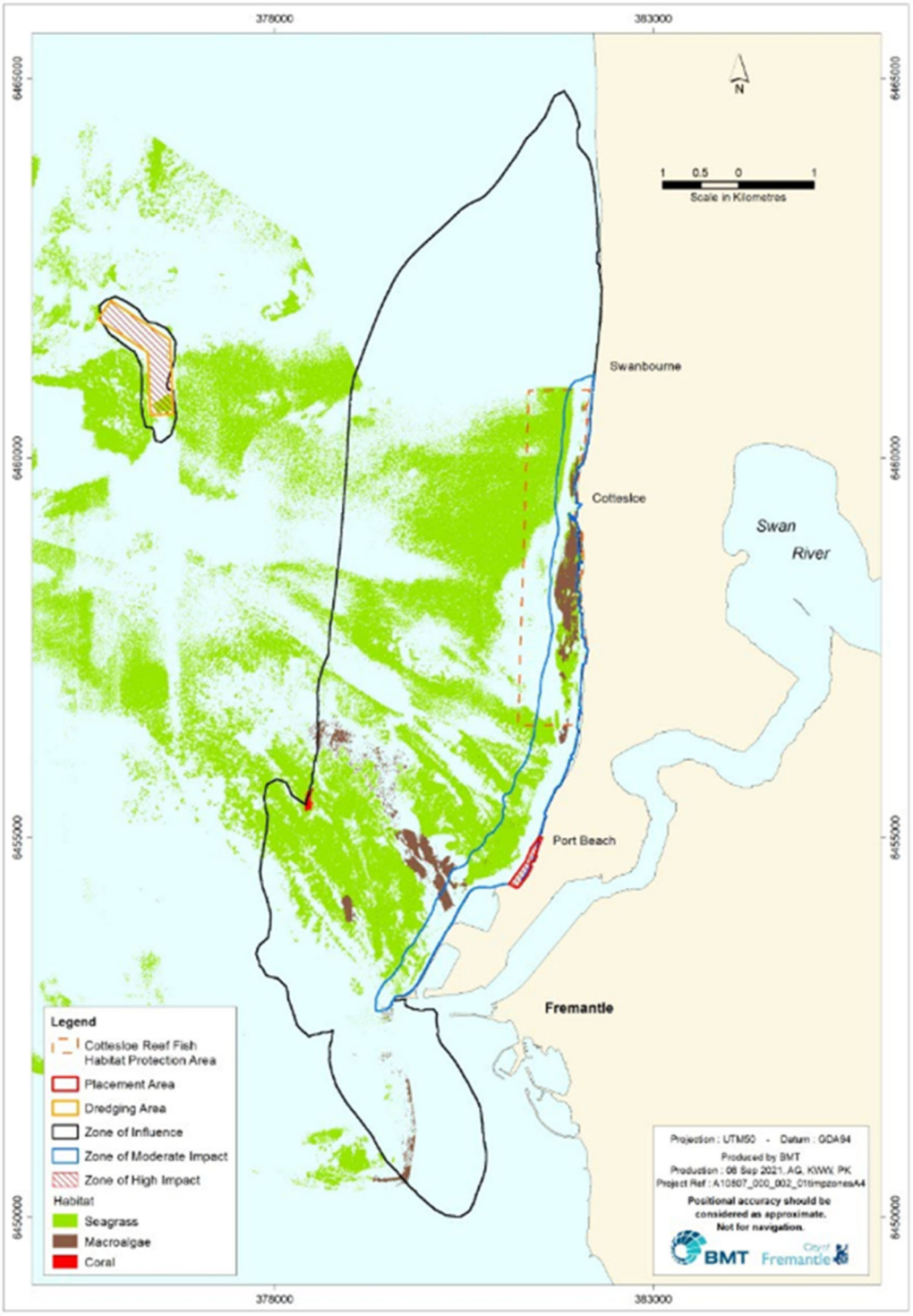
1.7.1 Key assumptions and uncertainties

This DEMP has been informed by findings of field surveys, hydrodynamic modelling, and environmental impact assessments. The ERD (BMT 2021) and this DEMP are also informed by the Proponent's experience with long term management and monitoring of coastal processes in the Proposal area.

In accordance with EPA's Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2016d), impact zones have been conservatively established to determine the potential extent and significance of direct and indirect impacts to BCH as a consequence of the dredging and placement activities (BMT 2021), based on predictive modelling of the dredge/placement turbid plume intensity, extent and duration and the tolerances of benthic primary producers. The established impact zones are depicted in Figure 1-3.

Table 1-5 Impact zones, definitions and boundary threshold(s)

Impact zone	Definition[2]	Boundary threshold(s)
Zone of high impact (ZoHI)	The area where impacts on benthic communities and habitats (BCH) are predicted to be irreversible. The term irreversible means 'lacking a capacity to return or recover to a state resembling that prior to being impacted within a timeframe of five years or less'. Areas within and immediately adjacent to proposed dredge and disposal sites are typically within the ZoHI.	• Boundary of the dredging and placement area • Where sedimentation/burial is >10 cm or 10,000 g/m^2
Zone of moderate impact (ZoMI)	The area within which predicted impacts on BCH are recoverable within a period of five years following completion of the dredging and placement activities. The ZoMI abuts and lies immediately outside of the ZoHI.	• The 95th percentile of the area where a TSS concentration of 10 mg/L was exceeded • Where sedimentation / burial is 5 – 10 cm or 5,000 – 10,000 g/m^2
Zone of influence (ZoI)	The area within which changes in environmental quality associated with turbid plumes are predicted and anticipated during dredging and placement activities, but where these changes would not result in a measurable impact on BCH.	• The 100th percentile of the area where a TSS concentration of >2 mg/L above background was exceeded (representing the maximum predicted extent of visible plumes)



Notes:
1. Zone of influence (ZoI) = the 100th percentile of the area where a TSS threshold of 2 mg/L above background is predicted to be exceeded
2. Zone of moderate impact (ZoMI) = the 95th percentile of the area where a TSS threshold of 10 mg/L was exceeded
3. Zone of high impact (ZoHI) = comprising direct losses due to the development footprint

Figure 1-3 Zones of high and moderate impact and zone of influence, defined for the Proposal

The Proponent considers that this DEMP is based on the best available information. The adaptive management process adopted by this DEMP (Section 4) allows for management actions and monitoring to be revised if new information becomes available.

1.7.2 Monitoring and management approach

The Port Beach sand nourishment via dredging ERD (BMT 2021) and this DEMP were developed via a risk-based approach and apply the mitigation hierarchy - avoid, minimise, management and monitoring - to ensure that environmental factors are protected.

1.7.3 Rationale for provisions

This DEMP has been prepared in accordance with EPA (2020b) Instructions on how to prepare *Environmental Protection Act 1986* Part IV Environmental Management Plans, including the following:

- management-based provisions - have been used where objective measurements are not practicable, and therefore the implementation of management actions is required, and
- outcome-based provisions - have been used where objective measurement is practicable, and therefore these provisions become performance-based.

All environmental factors (marine environmental quality, benthic communities and habitats, social surroundings, marine fauna, flora and vegetation, terrestrial fauna) have management-based provisions. The environmental factors of BCH, marine environmental quality and social surroundings have additional outcome-based provisions, which were conservatively derived criteria were developed based on:

- on published tolerances of seagrasses to turbidity (Collier et al. 2009, Lavery et al. 2009)
- laboratory testing of sediments from the Proposal area (to derive light attenuation coefficient criteria; BMT 2021a).

2 Monitoring and Management Framework

To mitigate effects associated with the proposal, the Proponents have identified proposed outcome-based conditions for protecting marine environmental quality, benthic communities and habitats and social surroundings during implementation of the Proposal (BMT 2021a).

Outcome-based conditions have been developed in accordance with EPA (2021d); specific environmental triggers, thresholds and monitoring and management requirements for meeting these conditions are detailed in Sections 2.1 to 2.3.

Table 2-1 Outcome-based conditions for the Proposal

Outcome-based condition
Marine environmental quality
Median LAC from any ZoMI/ZoI boundary site for three consecutive ~2-week monitoring periods during dredging operations exceeds: • >0.1084 above the median of baseline measurements from the same site (LAC equivalent of a TSS concentration of 10 mg/L); and, • >0.1084 above the median of pooled reference site measurements (LAC equivalent of a TSS concentration of 10 mg/L).
Surface or bottom TSS (mg/L; or its local turbidity equivalent) at any individual ZoMI/ZoI boundary site is >10 mg/L above 80th percentile of reference data (pre-dredging baseline data collected at the same site) on three consecutive sampling occasion
Secchi depth measurement at any impact site on three consecutive sampling occasions must not be <1.6 m (equivalent to the EPA [2017] water clarity EQG for the maintenance of primary contact recreation)
No reported hydrocarbon spills or release of waste into the environment from dredging and sand placement
Benthic communities and habitats
Direct disturbance of benthic communities and habitats to be confined to Proposal footprint
No serious damage to benthic communities and habitats outside the Zone of High Impact
No impacts to benthic communities and habitats within the Zone of Moderate Impact unless they are recoverable
No impacts outside the Zone of Moderate Impact, including no impact in in the Zone of Influence
Social surroundings
No public or navigational safety incidents from dredging and sand placement

2.1 Outcome-based provisions

The following relevant environmental factors that may be affected by potential environmental impacts associated with the Project have been assigned outcome-based provisions:

- marine environmental quality
- benthic communities and habitats
- social soundings.

The outcome-based provisions are outlined in Table 2-2. Monitoring methods associated with the outcome-based provisions are detailed in Section 2.3.

Table 2-2 Outcome-based provisions of the Port Beach Sand Nourishment via Dredging Environmental Management Plan

Environmental protection outcome	Environmental criteria: • Trigger criteria • Threshold criteria	Response		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
Marine environmental quality							
Increased water column turbidity							
Environmental protection outcome #1: Maintain light attenuation to meet the environmental criteria at the zone of moderate impact (ZoMI)/zone of influence (ZoI) boundary to avoid indirect loss of seagrass from increased water column turbidity associated with sand placement	**Trigger criteria:** Median light attenuation coefficient (LAC) from any ZoMI/ZoI boundary site for any ~2-week monitoring period during dredging operations exceeds: • >0.1084 above the median of baseline measurements from the same site (LAC equivalent of a TSS concentration of 10 mg/L); and, • >0.1084 above the median of pooled reference site measurements (LAC equivalent of a TSS concentration of 10 mg/L)	• The available remote imagery, site photographs, plume sketches and drone aerial photography from the relevant monitoring period will be reviewed to ascertain whether the trigger criteria exceedance is in relation to the placement operations • If it is found that the trigger criteria exceedance is in relation to the placement operations, the Project Management Consultant will be informed of the trigger criteria exceedance and their requirement to consult with the Contractor to determine and implement measures to reduce the intensity/extent of turbid plumes from placement operations (e.g. Slowing down the works, modifying the works locations, etc) • Continue the light attenuation monitoring	Environmental Consultant	Light attenuation monitoring (Section 2.3.1.1)	~2 weeks before, during and ~2 weeks after dredging operations	Environmental Consultant	• Monitoring data collected by the Contractor will be submitted weekly to the Environmental Consultant for review • The Environmental Consultant will report on the receipt and/or results of monitoring data in a weekly environmental monitoring checklist (template provided in Appendix B) • Reporting against the environmental criteria will be included in a Dredging Environmental Management Plan (DEMP) compliance report prepared by the Environmental Consultant and provided to Department of Water and Environmental Regulation (DWER) within 6 months of Project completion
				Remote imagery (Section 2.3.1.2)	Every 30 minutes during daylight hours (0700–1900) throughout the duration of dredging operations	Environmental Consultant	
				Site photographs (Section 2.3.1.4)	In the event of remote imagery unit malfunction, once daily on every operational dredging day	Contractor	
				Plume sketches (Section 2.3.1.5)	Once daily on every operational dredging day	Contractor	
				Drone aerial photography (Section 2.3.1.6)	Once monthly on an operational dredging day	Environmental Consultant	
	Threshold criteria: Median LAC from any ZoMI/ZoI boundary site for three consecutive ~2-week monitoring periods during dredging operations exceeds: • >0.1084 above the median of baseline measurements from the same site (LAC	• The available remote imagery, site photographs, plume sketches and drone aerial photography from the relevant monitoring period will be reviewed to ascertain whether the trigger criteria exceedance is in	Environmental Consultant	Light attenuation monitoring (Section 2.3.1.1)	~2 weeks before, during and ~2 weeks after dredging operations	Environmental Consultant	
				Remote imagery (Section 2.3.1.2)	Every 30 minutes during daylight hours (0700–1900) throughout the duration of dredging operations	Environmental Consultant	

Environmental protection outcome	Environmental criteria: • Trigger criteria • Threshold criteria	Response		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
	equivalent of a TSS concentration of 10 mg/L); and, • >0.1084 above the median of pooled reference site measurements (LAC equivalent of a TSS concentration of 10 mg/L)	relation to the placement operations • If it is found that the threshold criteria exceedance is in relation to the placement operations, the Project Management Consultant will be informed of the threshold criteria exceedance and their requirement to consult with the Contractor to cease dredging operations until approval to continue is provided by DWER • Notify and consult with DWER in relation to the threshold criteria exceedance		Site photographs (Section 2.3.1.4)	In the event of remote imagery unit malfunction, once daily on every operational dredging day	Contractor	
				Plume sketches (Section 2.3.1.5)	Once daily on every operational dredging day	Contractor	
				Drone aerial photography (Section 2.3.1.6)	Once monthly on an operational dredging day	Environmental Consultant	
	Trigger criteria: Surface or bottom TSS (mg/L; or its local turbidity equivalent) at any individual ZoMI/ZoI boundary site is >10 mg/L above the 80th percentile of reference site data on any one sampling occasion	Confirm trigger criteria exceedance: Modify dredge / placement methods to reduce plume extent • Continue monitoring and reporting	Environmental Consultant	In-water plume monitoring (Section 2.3.1.2)	~2 weeks before, during and ~2 weeks after dredging operations	Environmental Consultant	• Monitoring data collected by the Contractor will be submitted fortnightly to the Environmental Consultant for review • The Environmental Consultant will report on the receipt and/or results of monitoring data in a fortnightly environmental monitoring checklist (template provided in Appendix B) Reporting against the environmental criteria will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to DWER within 6 months of Project completion
	Threshold criteria: Surface or bottom TSS (mg/L; or its local turbidity equivalent) at any individual ZoMI/ZoI boundary site is >10 mg/L above 80th percentile of reference data (pre-dredging baseline data collected at the same site) on three consecutive sampling occasion	Confirm threshold level exceedance: • Cease dredging until placement methods can be modified to maintain water quality • Notify DWER • If required, consult with DWER to determine best methods to assess potential impacts on BCH	Environmental Consultant	In-water plume monitoring (Section 2.3.1.2)	~2 weeks before, during and ~2 weeks after dredging operations	Environmental Consultant	

Environmental protection outcome	Environmental criteria: • Trigger criteria • Threshold criteria	Response		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
Environmental protection outcome #2: Maintain water clarity to meet the environmental criteria at boundary of ZoMI/ZoI to minimise social impacts on primary contact recreation and aesthetic quality from increased water column turbidity associated with sand placement	**Trigger criteria:** Median Secchi depth from Impact sites must not be: • <1.6 m (equivalent to the EPA [2017] water clarity Environmental Quality Guideline [EQG] for the maintenance of primary contact recreation) on any one sampling occasion.	• The available remote imagery, site photographs, plume sketches and drone aerial photography from the relevant monitoring period will be reviewed to ascertain whether the trigger criteria exceedance is in relation to the placement operations • If it is found that the trigger criteria exceedance is in relation to the placement operations, the Project Management Consultant will be informed of the trigger criteria exceedance and their requirement to consult with the Contractor to determine and implement measures to reduce the intensity/extent of turbid plumes from placement operations • Continue the water clarity monitoring	Environmental Consultant	Water clarity monitoring (Section 2.3.1.6)	Once daily on every operational dredging day	Contractor	• Monitoring data collected by the Contractor will be submitted fortnightly to the Environmental Consultant for review • The Environmental Consultant will report on the receipt and/or results of monitoring data in a fortnightly environmental monitoring checklist (template provided in Appendix B) • Reporting against the environmental criteria will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to DWER within 6 months of Project completion
				Remote imagery (Section 2.3.1.2)	Every 30 minutes during daylight hours (0700–1900) throughout the duration of dredging operations	Environmental Consultant	
				Site photographs (Section 2.3.1.4)	In the event of remote imagery unit malfunction, once daily on every operational dredging day	Contractor	
				Plume sketches (Section 2.3.1.5)	Once daily on every operational dredging day	Contractor	
				Drone aerial photography (Section 2.3.1.6)	Once monthly on an operational dredging day	Environmental Consultant	
	Threshold criteria: Secchi depth measurement at any impact site on three consecutive sampling occasions must not be: • <1.6 m (equivalent to the EPA [2017] water clarity EQG for the maintenance of primary contact recreation).	• The available remote imagery, site photographs, plume sketches and drone aerial photography from the relevant monitoring period will be reviewed to ascertain whether the trigger criteria exceedance is in relation to the placement operations • Review the public complaints register (described in Section 2.2) to determine if there have been any complaints	Environmental Consultant	Water clarity monitoring (Section 2.3.1.6)	Once daily on every operational dredging day	Contractor	• Monitoring data collected by the Contractor will be submitted fortnightly to the Environmental Consultant for review • The Environmental Consultant will report on the receipt and/or results of monitoring data in a fortnightly environmental monitoring checklist (template provided in Appendix B) • Reporting against the environmental criteria will be included in a
				Remote imagery (Section 2.3.1.2)	Every 30 minutes during daylight hours (0700–1900) throughout the duration of dredging operations	Environmental Consultant	

Environmental protection outcome	Environmental criteria: • Trigger criteria • Threshold criteria	Response		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
		received in relation to the reduced water clarity • If it is found that the threshold criteria exceedance is in relation to the placement operations and there have been relevant public complaints received, the Project Management Consultant will be informed of the threshold criteria exceedance and their requirement to consult with the Contractor to manage the timing of dredging and placement operations to minimise plume generation and dispersion • Notify and consult with DWER in relation to the threshold criteria exceedance		Site photographs (Section 2.3.1.4)	In the event of remote imagery unit malfunction, once daily on every operational dredging day	Contractor	DEMP compliance report prepared by the Environmental Consultant and provided to DWER within 6 months of Project completion
				Plume sketches (Section 2.3.1.5)	Once daily on every operational dredging day	Contractor	
				Drone aerial photography (Section 2.3.1.6)	Once monthly on an operational dredging day	Environmental Consultant	
Benthic communities and habitat							
Indirect loss							
Environmental protection outcome #3: Maintain light attenuation to meet the environmental criteria at the ZoMI/ZoI boundary to avoid indirect loss of seagrass from increased water column turbidity associated with sand placement	Refer to the potential environmental impact of increased water column turbidity for the environmental factor of marine environmental quality						

2.2 Objective-based provisions

The following relevant environmental factors that may be affected by potential environmental impacts associated with the Project have been assigned objective-based provisions:

- marine environmental quality
- benthic communities and habitats
- social surroundings
- marine fauna
- flora and vegetation
- terrestrial fauna.

The objective-based provisions are outlined in Table 2-3. Monitoring methods associated with the outcome-based provisions are detailed in Section 2.3.

Table 2-3 Objective-based provisions of the Port Beach Sand Nourishment via Dredging Environmental Management Plan

Environmental protection objective	Management			Monitoring			Reporting
	Target	Action	Responsibility	Action	Timing/frequency	Responsibility	
Marine environmental quality							
Hydrocarbon spills and waste generation							
Environmental protection objective #1: No hydrocarbon spills or release of waste into the environment from dredging and sand placement	No reported hydrocarbon spills or release of waste into the environment from dredging and sand placement	A clean and tidy work area will be maintained with safe storage of all potentially hazardous substances	Contractor	Inspections will be completed during site visits	Fortnightly throughout the duration of dredging and placement operations	Project Management Consultant (or delegate)	• Review records and site inspection logs will be maintained by the Project Management Consultant and submitted to the Environmental Consultant • Reporting against the management target will be included in a Dredging Environmental Management Plan (DEMP) compliance report prepared by the Environmental Consultant and provided to Department of Water and Environmental Regulation (DWER) within 6 months of Project completion • In the event of a hydrocarbon spill that is likely to impact on coastal waters, Fremantle Ports' Vessel Traffic Service (VHF Channel 12 or 08 9431 6333) and/or Department of Transport's (DoT's) Maritime Environmental Emergency Response Unit (24-hour reporting number: 08 9480 9224) will be notified immediately (within 1-hour of receiving notification of the incident)
		Fuels and oils will be stored in contained areas and any fuelling will occur within a bunded area.	Contractor	Inspections will be completed during site visits	Fortnightly throughout the duration of dredging operations	Project Management Consultant (or delegate)	
		There will be a spill kit available on site with all necessary materials for mitigating an accidental hydrocarbon spill	Contractor	Inspections will be completed during site visits	Fortnightly throughout the duration of dredging operations	Project Management Consultant (or delegate)	
		The Contractor will prepare a Construction Environmental Management Plan (CEMP) that includes oil spill contingency procedures to be implemented in the event of an accidental hydrocarbon spill	Contractor	Review of the CEMP provided by the Contractor will be completed	Once-off prior to the commencement of dredging operations	Project Management Consultant	
		Work areas will be clear of waste/rubbish following demobilisation from site	Contractor	Inspections will be completed during site visits	Once-off following completion of dredging operations	Project Management Consultant (or delegate)	
		The dredge and any associated support vessels will be required to obtain a low-risk rating from the Department of Primary Industries and Regional Development (DPIRD) risk assessment tool (https://vesselcheck.fish.wa	Contractor	Review of the DPIRD risk assessment tool reports provided by the Contractor will be completed	Once-off prior to the dredge and any associated support vessels mobilising to site	Project Management Consultant	

Environmental protection objective	Management			Monitoring			Reporting
	Target	Action	Responsibility	Action	Timing/frequency	Responsibility	
		.gov.au/) prior to mobilising to site from an interstate or international location					
Benthic communities and habitat							
Direct loss							
Environmental protection objective #2: Ensure no permanent loss of BCH outside of the zone of high impact (ZoHI)	No dredging and sand placement outside of the defined areas (as described in Section 1.4)	The dredge will have an accurate positioning system installed and the position of the dredge will be monitored during dredging operations	Contractor	Review of the dredge position data provided by the Contractor will be completed	Weekly throughout the duration of dredging operations	Environmental Consultant	• The Environmental Consultant will report on the receipt and/or results of the dredge position data in a weekly environmental monitoring checklist (template provided in Appendix B) • Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to DWER within 6 months of Project completion
		Placement position logs including details of the timing and position will be maintained	Contractor	Review of the placement position logs provided by the Contractor will be completed	Weekly throughout the duration of dredging operations	Environmental Consultant	
Social surroundings							
Public and navigational safety							
Environmental protection objective #3: No public or navigational safety incidents from dredging and sand placement	Any / all reported community concerns about a potential safety hazard, near miss, or incident as a result of public or navigational safety issues associated with dredging and sand placement are addressed in-line with the Community Engagement and Communications Management and Implementation Plan (CECMIP)	A public complaints register will be developed and maintained with responses provided to any public complaints within 1 week of receipt	Proponent	Review of the public complaints register will be completed	As required (in the event of receiving notification that a public complaint has been received)	Proponent	• Review records and site inspection logs will be maintained by the Project Management Consultant and provided to the Environmental Consultant • The Environmental Consultant will provide a summary of any public complaints received in a weekly environmental monitoring checklist (template provided in Appendix B) • Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to DWER within 6 months of Project completion
		A Temporary Notice to Mariners (TNTM) from DoT's Marine Safety Branch will be obtained at least 14 days prior to the commencement of works to inform the public of potential navigational hazards associated with dredging and placement. The contractor is also to consult with Fremantle Ports in relation to this notice.	Contractor	Review of the TNTM published on DoT's website will be completed	Once-off prior to the commencement of dredging operations	Project Management Consultant	
		The dredge, associated support vessels and any associated marine equipment will be fitted with the appropriate marine	Contractor	Review of the inspection logs provided by the Contractor will be completed	Once-off prior to the commencement of dredging operations	Project Management Consultant	

Environmental protection objective	Management			Monitoring			Reporting
	Target	Action	Responsibility	Action	Timing/frequency	Responsibility	
		safety equipment, markers and/or lighting to the satisfaction of Fremantle Ports' Harbour Master					• In the event of a navigational safety incident, Fremantle Ports' Vessel Traffic Service (VHF Channel 12 or 08 9431 6333) will be notified immediately (within 1-hour of receiving notification of the incident) • In the event of public or navigational safety incident, the relevant dredging and/or placement activities will be suspended until the appropriate measures are implemented to prevent further related incidents from arising again
		The Contractor will comply with the relevant requirements in Fremantle Ports' Port Information Guide (Fremantle Ports 2018) while operating in Fremantle Ports' limits	Contractor	Inspections will be completed during site visits	Fortnightly throughout the duration of dredging operations	Project Management Consultant (or delegate)	
		The Contractor will prepare a CEMP that includes a Traffic, Pedestrian and Cyclist Safety Management Plan, an Occupational Health and Safety Plan and a Vessel Safety Plan to be implemented and adhered to during dredging and sand placement	Contractor	Review of the CEMP provided by the Contractor will be completed	Once-off prior to the commencement of dredging operations	Project Management Consultant	
		Fencing and signage will be appropriately installed to inform the public of the Project works and to prevent the public from accessing operational areas during operational periods	Contractor	Inspections will be completed during site visits	Fortnightly throughout the duration of dredging operations	Project Management Consultant (or delegate)	
		A minimum of one dedicated safety spotter will be present at the placement area during operations to monitor and manage public safety	Contractor	Inspections will be completed during site visits	Fortnightly throughout the duration of dredging operations	Project Management Consultant (or delegate)	
Reduced visual amenity, wind-blown dust and sand, odour generation and noise							
Environmental protection objective #4: Minimise social impacts from potential reduced public amenity, wind-blown dust and sand, odour generation or noise associated with dredging and sand placement	Any / all community concerns raised in relation to reduced public amenity, wind-blown dust and sand, odour generation or noise associated with dredging and sand placement are addressed in-line with the Community Engagement and Communications Management and Implementation Plan (CECMIP)	A public complaints register will be developed and maintained with responses provided to any public complaints within 1 week of receipt	Proponent	Review of the public complaints register will be completed	As required (in the event of receiving notification that a public complaint has been received)	Proponent	• Review records will be maintained by the Project Management Consultant and provided to the Environmental Consultant • The Environmental Consultant will provide a summary of any public complaints received in a weekly environmental monitoring checklist (template provided in Appendix B) • Reporting against the management target will
		The operation of machinery associated with dredging and sand placement activities will not occur outside of the exempt hours for generating construction noise (outside 0700 to 1900 on Monday to Saturday, on a Sunday or on a public holiday) in accordance with	Contractor	Review of the Noise Management Plan and approval provided by the Contractor will be completed	Once off prior to the operation of machinery associated with dredging and sand placement activities outside of the exempt hours for generating construction noise (outside 0700 to 1900 on Monday to Saturday, on a Sunday or on a public	Project Management Consultant	

Environmental protection objective	Management			Monitoring			Reporting
	Target	Action	Responsibility	Action	Timing/frequency	Responsibility	
		Australian Standards 1269 and 2436 and Environmental Protection (Noise) Regulations 1997 (DEP 1997), unless approval of a Noise Management Plan is provided by City of Fremantle's (CoF's) environmental health services team			holiday) in accordance with Australian Standards 1269 and 2436 and Environmental Protection (Noise) Regulations 1997 (DEP 1997)		be included in a DEMP compliance report prepared by the Environmental Consultant and provided to DWER within 6 months of Project completion
Marine fauna							
Introduced marine species (IMS)							
Environmental protection objective #5: No introduction of IMS to the Project site from the arrival of the dredge and any associated support vessels	No reported observations of IMS on the dredge and any associated support vessels at the Project site	The dredge and any associated support vessels will be cleaned and/or visually inspected for IMS prior to mobilising to the Project site from any location	Contractor	Review of the inspection logs provided by the Contractor will be completed	Once-off prior to the dredge and any associated support vessels mobilising to site	Project Management Consultant	• Review records will be maintained by the Project Management Consultant and submitted to the Environmental Consultant • Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to DWER within 6 months of Project completion • In the event of a sighting of suspected IMS, the suspected IMS will be isolated and reported to DPIRD's FishWatch (24-hour reporting number: 1800 815 507) immediately (within 24-hours of receiving notification of the sighting) and actions will be taken as directed by DPIRD
		The dredge and any associated support vessels will be required to obtain a low-risk rating from the Department of Primary Industries and Regional Development (DPIRD) risk assessment tool (https://vesselcheck.fish.wa.gov.au/) prior to mobilising to site from an interstate or international location	Contractor	Review of the DPIRD risk assessment tool reports provided by the Contractor will be completed	Once-off prior to the dredge and any associated support vessels mobilising to site	Project Management Consultant	
Marine mammal collision							
Environmental protection objective #6: No collision with marine mammals from the operation of the dredge	No reported collision incidents with marine mammals from the operation of the dredge	Vessel Masters responsible for operating the dredge will be suitably trained to understand marine mammal behaviours, actions and reporting requirements in the event of marine mammal injury or mortality and provisions	Contractor	Review of the training records provided by the Contractor will be completed	Once-off prior to the commencement of dredging operations	Project Management Consultant	• Review records will be maintained by the Project Management Consultant and provided to the Environmental Consultant • The Environmental Consultant will report on

Environmental protection objective	Management			Monitoring			Reporting
	Target	Action	Responsibility	Action	Timing/frequency	Responsibility	
		under *Environmental Protection and Biodiversity Conservation Regulations – Part 8 Division 8.1: Interacting with cetaceans*					the receipt and/or results of the mammal observation and interaction logs in a weekly environmental monitoring checklist (template provided in Appendix B) • Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to DWER within 6 months of Project completion • In the event of marine mammal injury or mortality resulting from a reported collision including from the operation of the dredge, DWER and DBCA will be notified and consulted with immediately (within 24-hours of receiving notification of the incident)
		The suitably trained Vessel Master(s) responsible for operating the dredge will document any observations and/or interactions with marine mammals within the monitoring zone (area within a 300 m radius from the dredge) and the corrective actions taken using the marine mammal observation and interaction logs (templates are provided in Appendix E)	Contractor	Review of the marine mammal observation and interaction logs provided by the Contractor will be completed	Weekly throughout the duration of dredging operations	Environmental Representative	
Flora and vegetation							
Native vegetation disturbance/removal							
Environmental protection objective #7: No native vegetation disturbance/removal from sand placement	No reported observations of native vegetation disturbance/removal from sand placement	Designated access routes through areas devoid of native vegetation will be used while transferring machinery and equipment between the laydown area and placement area	Contractor	Inspections will be completed during site visits	Fortnightly throughout the duration of dredging operations	Project Management Consultant (or delegate)	• Site inspection logs will be maintained by the Project Management Consultant and submitted to the Environmental Consultant • Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided

Environmental protection objective	Management			Monitoring			Reporting
	Target	Action	Responsibility	Action	Timing/frequency	Responsibility	
		Placement of nourishment material will be completed in a manner that avoids deposition over any native vegetation	Contractor	Inspections will be completed during site visits	Fortnightly throughout the duration of dredging operations	Project Management Consultant (or delegate)	to DWER within 6 months of Project completion • If there is a requirement for native vegetation disturbance/removal, the Proponent will obtain a Native Vegetation Clearing Permit to be issued by DWER under Part V of the *Environmental Protection Act 1986*
Terrestrial fauna							
Red imported fire ants (RIFA)							
Environmental protection objective #8: No spreading of RIFA outside of the Quarantine Area for RIFA established by DPIRD from the Project	No reported spreading of RIFA outside of the Quarantine Area for RIFA established by DPIRD from the Project	The Contractor will prepare a CEMP that includes the necessary quarantine requirements for RIFA as directed by DPIRD (phone between 0830 to 1630 on weekdays: 08 93683080; email: padis@dpird.wa.gov.au) to be implemented and adhered to during dredging and sand placement	Contractor	Review of the CEMP provided by the Contractor will be completed	Once-off prior to the commencement of dredging operations	Project Management Consultant	• Review records and site inspection logs will be maintained by the Project Management Consultant and provided to the Environmental Consultant • The Environmental Consultant will report on the receipt and/or results of the mammal observation and interaction logs in a weekly environmental monitoring checklist (template provided in Appendix B) • Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to DWER within 6 months of Project completion • In the event of a sighting of suspected RIFA, the
		Works completed in accordance with DPRID RIFA requirements.	Contractor	Inspections will be completed during site visits	Fortnightly throughout the duration of dredging operations	Project Management Consultant (or delegate)	

Environmental protection objective	Management			Monitoring			Reporting
	Target	Action	Responsibility	Action	Timing/frequency	Responsibility	
		Any machinery and equipment used for the Project within the Quarantine Area for RIFA will be appropriately cleaned of soil and inspected for RIFA prior to leaving site	Contractor	Review of the inspection logs provided by the Contractor will be completed	As required prior to the demobilisation of machinery and equipment from site	Project Management Consultant	suspected RIFA will be isolated and reported to DPIRD (phone between 0830 to 1630 on weekdays: 08 93683080; email: padis@dpird.wa.gov.au) immediately (within 24-hours of receiving notification of the sighting) and actions will be taken as directed by DPIRD

2.3 Monitoring methods

2.3.1.1 Light attenuation monitoring

Sub-sea light loggers will be deployed to monitor light attenuation at four impact sites located on the zone of moderate impact (ZoMI) / zone of Influence (ZoI) boundary near the placement area and adjacent to mapped seagrass habitats, and at four reference sites located outside of the ZoI (Table 2-4; Figure 2-1). The deployment period for the loggers will be ~2 weeks before, during and ~2 weeks after dredging operations. During the deployment period, the loggers will be serviced every ~2 weeks. The servicing will involve logger retrieval, data download and redeployment.

The loggers will measure integrating light count data at ~15-minute intervals within the period from ~2 hours after sunrise to ~2 hours before sunset to ensure the sun is at a sufficient angle to minimise the reflectance of incident light from the water surface (EPA 2005). The integrating light count data downloaded from the loggers will be processed to LAC as per the EPA (2005) Manual of Standard Operating Procedures. The LAC data will be analysed as appropriate for comparison against the environmental criteria for the light attenuation monitoring in Table 2-2.

The Environmental Consultant will be responsible for implementing the light attenuation monitoring, data analysis and reporting.

Table 2-4 Coordinates of water quality monitoring sites

Site	Coordinates (UTM50 GDA2020)	
	Easting	Northing
Impact WQ 1	381752.01	6459833.86
Impact WQ 22	381450.33	6456467.67
Impact WQ 3	380894.59	6455086.26
Impact WQ 4	379703.72	6453403.17
Reference WQ 1	381479.94	6450269.27
Reference WQ 2	381755.59	6464955.72
Reference WQ 1	381493.35	6449612.12
Reference WQ 2	381742.18	6465438.52

Note:

1. Refer to Figure 2-1 for the location of monitoring sites.

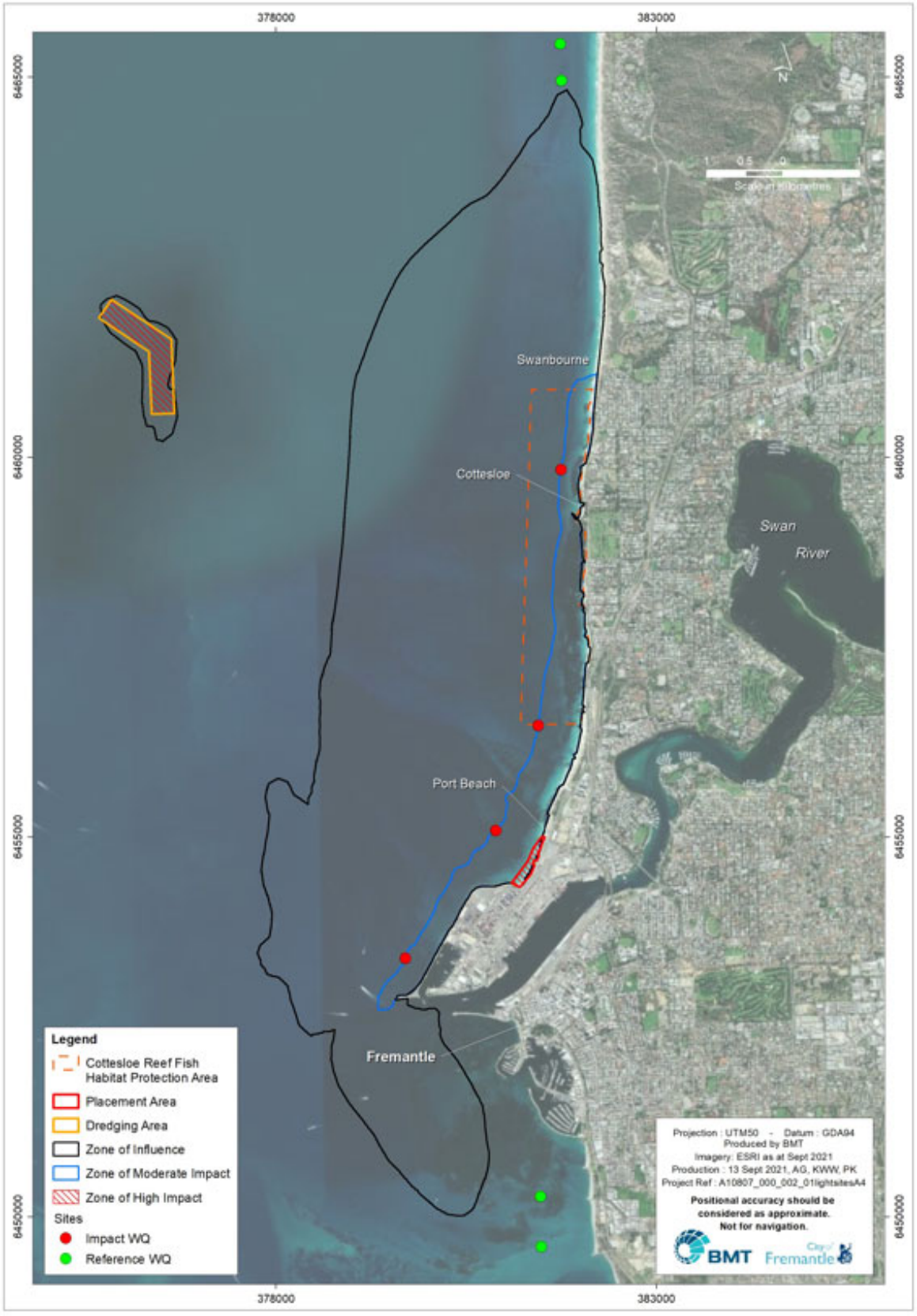


Figure 2-1 Locations of water quality monitoring sites

2.3.1.2 In-water plume monitoring

Water sampling for turbidity (Table 4.1) will be completed fortnightly during the dredging campaign. Prior to dredging, the correlation between TSS and Nephelometric Turbidity Unit (NTU) will be defined such that real-time turbidity measures may be assessed against modelled / predicted TSS contours, using samples collected from the Project area. The in-water monitoring program will comprise:

- monitoring of NTU once, two weeks before dredging / placement activities
- monitoring of NTU fortnightly during dredging / placement activities
- monitoring of NTU once, two weeks after the completion of dredging / placement activities.

Monitoring will involve the lowering of a sensor through the water column three times to calculate a median value for surface and bottom NTU, at each Impact and Reference site (Figure 2-1, Table 2-4). To determine an exceedance of the trigger criterion, median TSS (converted from NTU using the laboratory defined relationship) will be compared to trigger thresholds defined in Table 2-2.

The Contractor / Environmental Representative will process the data to determine whether the trigger / threshold criteria have been exceeded (Table 2-2). An exceedance will be confirmed by using the following multiple lines of evidence approach to determine whether there is a link between dredging and backfill activities and elevated turbidity at sensitive receptor monitoring locations:

- analysis quality assurance and quality control (i.e. human error)
- function checks on the multi parameter water sensor
- comparison of data to modelled parameters within the ZoI i.e. >2 mg/L above background (reference sites) and/or baseline (pre-dredging baseline data collected at the same site)
- effects of natural metocean or weather conditions that could be affecting this site that are not related to dredging and disposal (e.g. storm activity).

Detailed sampling and analysis procedures will be provided to field personnel as part of Turbidity Sampling and Analysis Plan.

2.3.1.3 Remote imagery

Remote imagery units (RIUs) will be installed at the placement area to monitor turbid plumes associated with the dredging and placement operations. The RIUs will capture time- and date-stamped images to a resolution of ≥12 megapixels every 30 minutes during daylight hours (0700–1900) throughout the duration of the dredging and placement operations. Each image captured by the RIUs will be forwarded to the Environmental Consultant in real-time. The Environmental Consultant will be responsible for coordinating installation of RIUs, reviewing the RIU imagery weekly, and notifying the Project Management Consultant in the event of a RIU malfunction (site photographs will be captured by the Contractor in contingency, as outlined in Section 2.3.1.4).

2.3.1.4 Site photographs

Site photographs of the dredging and/or placement area will be captured in the event of RIU malfunction to monitor turbid plumes associated with the dredging and placement operations. When

required, site photographs will be time- and date-stamped and captured once daily on every operational dredging day throughout the duration of the Project. Site photographs will be taken at a time (nominally between 1100 and 1300) and in a direction to minimise sun glint from the water surface, where practical. A digital camera with a resolution of ≥12 megapixels will be used to take the photographs. The Contractor will be responsible for capturing site photographs, when communicated of the requirement from the Project Management Consultant. The Contractor will be required to submit site photographs weekly to the Environmental Consultant for review.

2.3.1.5 Plume sketches

Plume sketches recording the extent of visible turbid plumes at the dredging and placement area will be completed once daily on every operational dredging day throughout the duration of the Project. Plume sketches will be completed on a pre-designed plume sketch template (Appendix C) between 1100 and 1300 when sun glint on the water surface is minimal, where practical. The Contractor will be responsible for completing the plume sketches and will be required to submit the completed plume sketch templates weekly to the Environmental Consultant for review.

2.3.1.6 Drone aerial photography

Drone aerial photography of the placement area will be captured to monitor turbid plumes associated with the placement operations. However, drone aerial photography will not be captured at the dredging area where line-of-vision (pilot requirements) of a drone cannot be maintained from shore.

Drone aerial photography will be captured at least once monthly on an operational dredging day during the Project to provide a large-scale visual record of the placement operations and to provide a view of the full extent of associated turbid plumes. The Environmental Consultant will be responsible for coordinating the drone aerial photography flights and reviewing the imagery.

2.3.1.7 Water clarity monitoring

Secchi depth measurements will be taken at the placement area and at a reference area to monitor water clarity during placement operations. Secchi depth measurements will be taken fortnightly throughout the duration of the Project.

Secchi depth measurements will be taken at all Impact and Reference sites (Table 2-4, Figure 2-1). Secchi depth measurements will be taken between 1100 and 1300 when sun glint on the water surface is minimal, where practical.

The Contractor / Environmental representative will be responsible for taking the Secchi depth measurements in accordance with the following procedure:

(1) arrive at site and collect a Global Positioning Unit (GPS) coordinate to provide evidence of the actual location where the Secchi depth measurement was collected

(2) lower the Secchi disk over the sunny side of the boat to avoiding shading which could impact on the visibility of the Secchi disk through the water

(3) lower the Secchi disk slowly through the water column and look (without sunglasses) directly down the cord until the black and white quadrants on the Secchi disk are no longer visible

(4) record the depth (to the nearest 0.1 m) of the Secchi disk (where the black and white quadrants are no longer visible) from the water surface using the markings on the attached rope for reference (each marking is 0.1 m apart)

(5) if the black and white quadrants on the Secchi disk are still visible when the Secchi disk reaches the seafloor, then the depth of the Secchi disk from the water surface should be recorded with a ">" symbol before the depth (e.g. where the depth of the Secchi disk from the water surface is 2.3 m, the Secchi depth measurement should be recoded as “>2.3 m”)

(6) ensure Secchi depth measurements and GPS coordinates are recorded on the Secchi depth measurement field sheet provided in Appendix D.

An Environmental Consultant will be responsible for assessing against the environmental criteria for the Secchi depth measurements.

3 Roles and Responsibilities

The roles and responsibilities for the implementation of the objective-based and outcome-based provisions detailed in Section 2 of this DEMP are summarised in Table 3-1.

Table 3-1 Roles and responsibilities of the Dredging Environmental Management Plan for the Port Beach Sand Nourishment via Dredging Project

Role	Responsibility
Proponent	• Responsible for the overall implementation and compliance of this Dredging Environmental Management Plan (DEMP)
Project Management Consultant	• Delegate of the Proponent • Responsible for the management of contractors • Responsible for the implementation and compliance with the relevant items of this DEMP
Environmental Consultant	• Delegate of the Proponent • Responsible for the provision of specialist environmental advice, as required • Responsible for liaison with the relevant environmental regulators, as required • Responsible for the implementation and compliance with the relevant items of this DEMP
Contractor	• Selected contractor/s engaged to undertake all, or part, of the dredging and sand placement • Responsible for the implementation and compliance with the relevant items of this DEMP

4 Adaptive Management and Review

4.1 Adaptive management

Adaptive management is a systematic process for improving management practices by using the outcomes of monitoring and evaluation and incorporating learnings from these outcomes into revised management actions as necessary.

In relation to this DEMP, the Proponent is committed to:

- implementing the environmental management and monitoring actions outlined in Section 2
- regularly evaluating against the environmental protection objectives and outcomes in accordance with the timings and frequencies described in Section 2
- adjusting monitoring or management actions, if required, to more effectively meet the environmental protection objectives or outcomes defined in Section 2.

4.2 Reporting and auditing

Reporting against the management targets for evaluation against the environmental protection objectives in Table 2-3 and the environmental criteria for evaluation against the environmental protection outcomes in Table 2-2 will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to DWER within 6 months of Project completion.

4.3 Review

Review and revision of this DEMP will be undertaken on as required basis. It is considered that review and revision of this DEMP should occur in response to the following circumstances:

- further knowledge becomes available on environmental management or monitoring practices to more effectively meet the environmental protection objectives or outcomes
- further knowledge becomes available in relation to identified potential environmental impacts associated with the Project
- new potential environmental impacts associated with the Project are identified
- there are significant changes to the dredging and sand placement methods
- to address any conditions imposed by relevant regulatory authorities.

Upon review and revision of this DEMP, the changes made will be documented in a document revision register to be appended to the DEMP and the revision status of the document will be updated as required. Where there are significant changes made to this DEMP, the document will be resubmitted to the relevant regulatory authorities for review and/or approval, as required. A ‘significant change’ includes changes to monitoring (e.g. timing, location, duration) or trigger criteria.

5 Stakeholder Consultation

The Proponent has undertaken stakeholder consultation for the Project that included relevant regulatory, industry and community stakeholders. For a description of the stakeholder consultation process, refer to Section 4 of the ERD (BMT 2021).

Stakeholder consultation in relation to this DEMP will continue before, during and after the implementation of the Project. The key stakeholders that will be consulted with include:

- DWER
- DoT
- Fremantle Ports
- Local community groups and businesses.

The Proponent will develop and maintain a public complaints register for the Project with responses provided to any public complaints within 1 week of receipt as detailed in Table 2-3. In event of an environmental incident, the relevant regulatory authorities will be notified and consulted with as detailed in Table 2-3 and Table 2-2.

6 References

BMT (2021) Port Beach Sand Nourishment via Dredging – Environmental Review Document. Prepared for City of Fremantle by BMT Commercial Australia Pty Ltd, Report No. R-10807-5, Perth, Western Australia, Draft, 2021

Collier CJ, Lavery PS, Ralph PJ, Masini RJ (2009) Shade-induced response and recovery of the seagrass *Posidonia sinuosa*. Journal of Experimental Marine Biology and Ecology 370:89– 103

DEP (1997) Environmental Protection (Noise) Regulations 1997 (As at 24 Jan 2017). Western Australian Government Department of Environmental Protection, Perth, Western Australia, October 1997

EPA (2005) Manual of Standard Operating Procedures for Environmental Monitoring against the Cockburn Sound Environmental Quality Criteria (2003–2004) – A Supporting Document to the State Environmental (Cockburn Sound) Policy 2005. Environmental Protection Authority, Perth, Western Australia, January 2005

EPA (2017) Environmental Quality Criteria Reference Document for Cockburn Sound – A Supporting Document to the State Environmental (Cockburn Sound) Policy 2015. Environmental Protection Authority, Perth, Western Australia, April 2017

EPA (2021a) How to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans: Instructions. Perth, Western Australia, October 2021

EPA (2021b) Environmental outcomes and outcomes-based conditions: Interim Guidance. Environmental Protection Authority, Perth, Western Australia, October 2021

Fremantle Ports (2018) Port Information Guide. Fremantle Port. Available at <https://www.fremantleports.com.au/shipping> [Accessed 6 August 2021]

GHD (2017) Our Coastal Future - Port, Leighton and Mosman Beaches - Coastal Adaptation Plan. Prepared for the City of Fremantle and Town of Mosman Park

Lavery PS, McMahon K, Mulligan M, Tennyson A (2009) Interactive effects of timing, intensity and duration of experimental shading on *Amphibolis griffithii*. Marine Ecology Progress Series 394:21–33

MRA (2019) Port Beach Coastal Adaptation Options. Prepared for City of Fremantle by M P Rogers and Associates Pl, Report No. R1189, Perth, Western Australia, September 2019

Appendix A Dredging Area and Placement Area Design

AT CORRECT SCALE THIS IS 100 mm

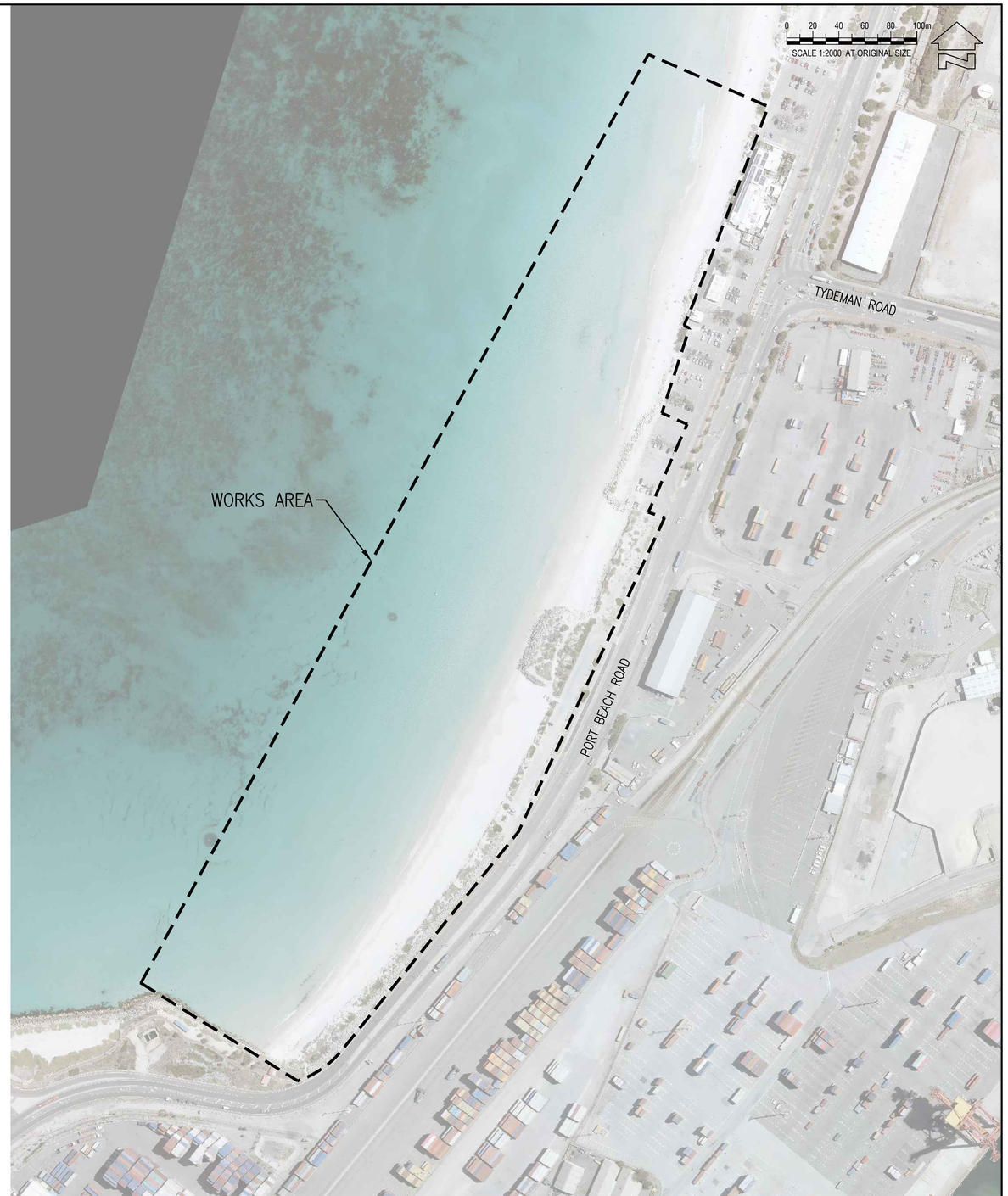
City of Fremantle

PORT BEACH
SAND NOURISHMENT

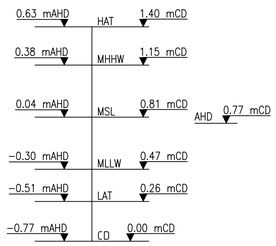
DRAWING No.	TITLE
D1746-02-01	DRAWING LIST & LOCALITY PLAN
D1746-02-02	GENERAL ARRANGEMENT
D1746-03-01	EXISTING CONDITIONS & SURVEY - SHEET 1 OF 2
D1746-03-02	EXISTING CONDITIONS & SURVEY - SHEET 2 OF 2
D1746-04-01	LAYOUT - SHEET 1 OF 2
D1746-04-02	LAYOUT - SHEET 2 OF 2
D1746-05-01	SECTIONS & DETAILS - SHEET 1 OF 2
D1746-05-02	SECTIONS & DETAILS - SHEET 2 OF 2
D1746-06-01	DUNE STABILISATION

GENERAL NOTES:

1. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE TECHNICAL SPECIFICATION. ANY DISCREPANCIES ARE TO BE REFERRED TO THE SUPERINTENDENT BEFORE PROCEEDING.
2. SURVEY PROVIDED BY DEPARTMENT OF TRANSPORT, COMPLETED IN APRIL 2020. THE LEVELS AND CONTOURS REFLECT THE CONDITIONS OF THE SITE AT THE TIME OF SURVEY ONLY.
3. HORIZONTAL DATUM IS MAP GRID OF AUSTRALIA 1994 (MGA94), VERTICAL DATUM IS CHART DATUM (CD).
4. THE CONTRACTOR SHALL CONFIRM THE LOCATION OF & PROTECT ANY SERVICES IN THE WORKS AREA. CONTACT DIAL BEFORE YOU DIG ON 1100.
5. SET OUT COORDINATES AND DIMENSIONS ARE TO BE CONFIRMED ON SITE PRIOR TO WORKS COMMENCING. REFER ANY DISCREPANCY TO THE SUPERINTENDENT. IF IN DOUBT ASK.
6. AERIAL PHOTOGRAPH SOURCED FROM NEARMAP, TAKEN IN NOVEMBER 2019.
7. DISTANCES AND LEVELS SHOWN IN METRES, UNLESS NOTED OTHERWISE.
8. SITE ACCESS AND LAYDOWN AREAS TO BE CONFIRMED WITH SUPERINTENDENT PRIOR TO WORKS.
9. ON COMPLETION OF THE WORKS A SET OF MARKED UP AND SIGNED "AS CONSTRUCTED" DRAWINGS SHALL BE FORWARDED TO THE SUPERINTENDENT.



LOCALITY PLAN
1:2,000



TAKEN FROM DOT FREMANTLE SUBMERGENCE CURVE DOT 01615-13-02A 26/04/2017

TIDAL LEVELS
1:20

AT CORRECT SCALE THIS IS 100 mm

CAD:D17460201[A]

REV	DATE	APPROVED	AMENDMENT	REV	DATE	APPROVED	AMENDMENT
A	10.02.21	CRD	PRELIMINARY ISSUE				

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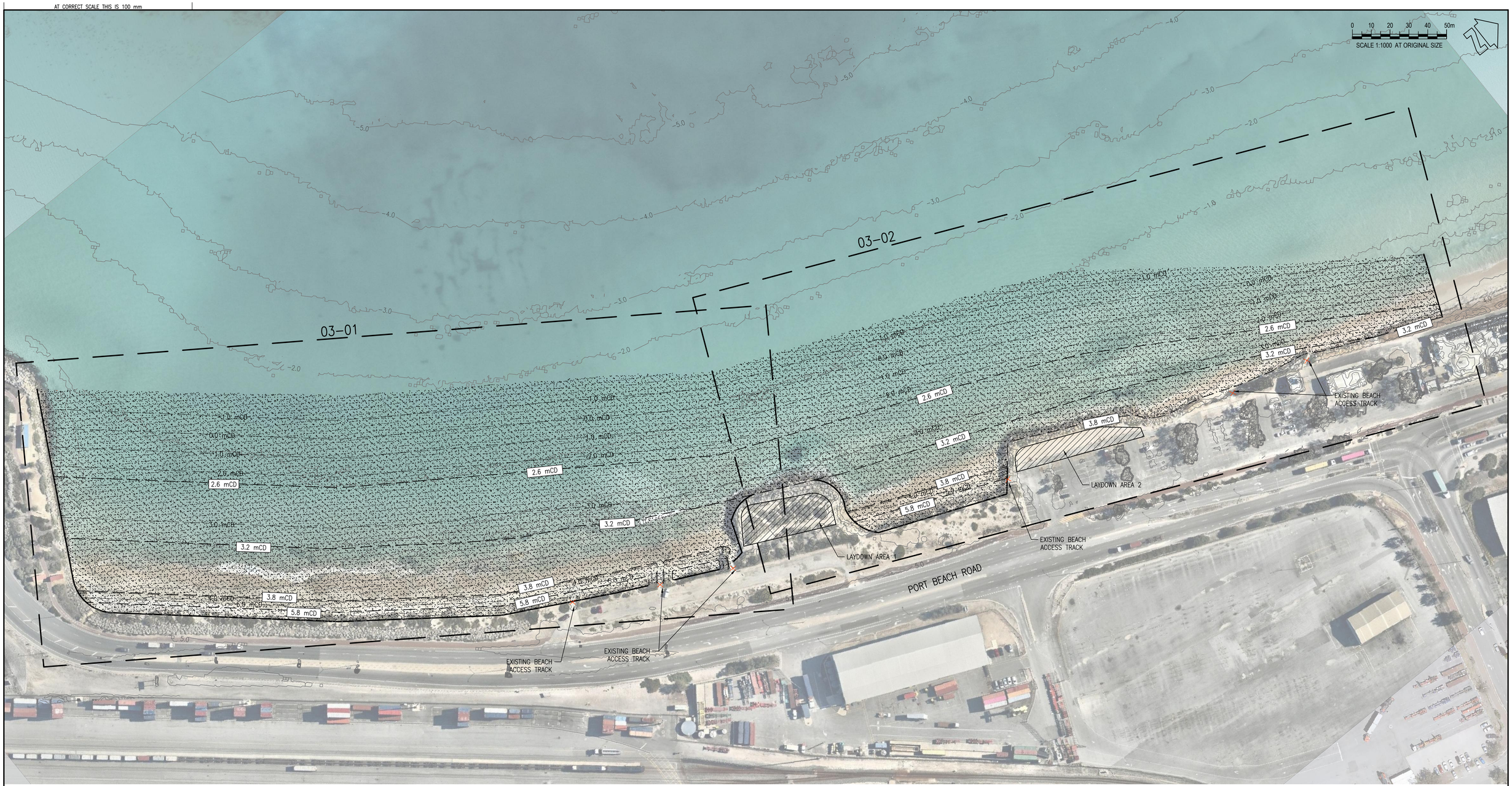
CLIENT City of Fremantle

DESIGNED	CHECKED	APPROVED
L DE LUCIA	C DOAK	
DRAWN	CHECKED	
R BORJA	C DOAK	

m p rogers & associates pl
coastal and port engineers
Suite 1, 128 Main Street
Osborne Park 6017
Western Australia
t: +61 8 9254 6600
f: +61 8 9254 6699
admin@coastsandports.com.au

PROJECT PORT BEACH SAND NOURISHMENT
TITLE DRAWING LIST & LOCALITY PLAN
SCALE AT A1 AS SHOWN
DRAWING NUMBER D1746-02-01
REV A

AT CORRECT SCALE THIS IS 100 mm



AT CORRECT SCALE THIS IS 100 mm

LEGEND:

- SAND NOURISHMENT
- LAYDOWN AREA
- 3.8 mCD — DESIGN LEVEL MAJOR CONTOUR
- 1.0 — EXISTING CONTOUR
- 1.0 mCD — DESIGN LEVEL MINOR CONTOUR
- BEACH ACCESS TRACK

NOTES:

1. SURVEY PROVIDED BY DEPARTMENT OF TRANSPORT, COMPLETED IN APRIL 2020. THE LEVELS AND CONTOURS REFLECT THE CONDITIONS OF THE SITE AT THE TIME OF SURVEY ONLY.
2. HORIZONTAL DATUM IS MAP GRID OF AUSTRALIA 1994 (MGA94), VERTICAL DATUM IS CHART DATUM (CD).
3. AERIAL PHOTOGRAPH SOURCED FROM NEARMAP TAKEN IN MAY 2020.
4. CONTOURS SHOWN AT 1.0m INTERVALS.

CAD:D17460202[A]

REV	DATE	APPROVED	AMENDMENT	REV	DATE	APPROVED	AMENDMENT
A	10.02.21	CRD	PRELIMINARY ISSUE				

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DRAWN	CHECKED	
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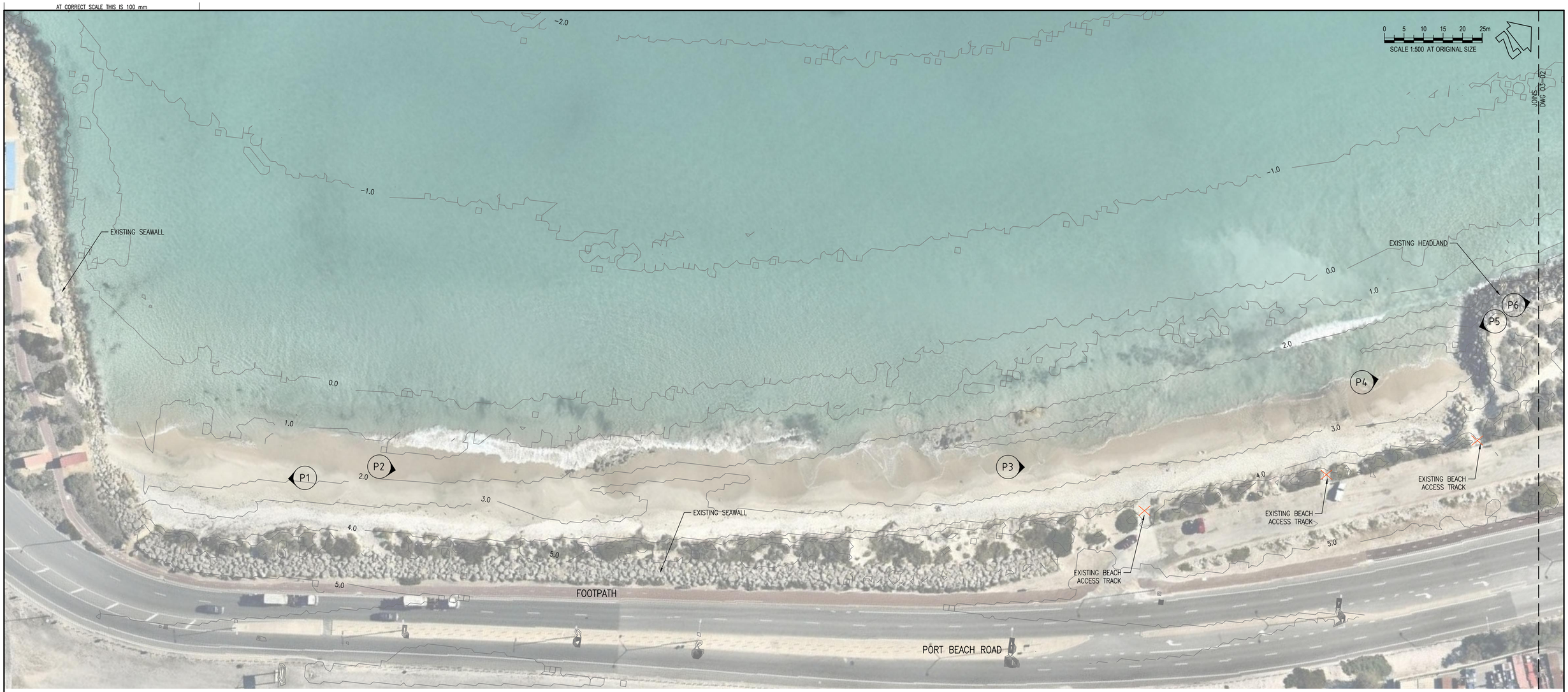
m p rogers & associates pl
coastal and port engineers
Suite 1, 128 Main Street
Osborne Park 6017
Western Australia
t: +61 8 9254 6600
f: +61 8 9254 6699
admin@coastsandports.com.au

PROJECT: PORT BEACH SAND NOURISHMENT

TITLE: GENERAL ARRANGEMENT

SCALE AT A1	DRAWING NUMBER	REV
1:1,000	D1746-02-02	A

AT CORRECT SCALE THIS IS 100 mm



PHOTOGRAPH 1

PHOTOGRAPH 2

PHOTOGRAPH 3

PHOTOGRAPH 4

PHOTOGRAPH 5

PHOTOGRAPH 6

LEGEND:

1.0 — EXISTING CONTOUR

BEACH ACCESS TRACK

P1 — PHOTO LOCATION, PHOTOS TAKEN IN APRIL 2020.

NOTES:

1. SURVEY PROVIDED BY DEPARTMENT OF TRANSPORT, COMPLETED IN APRIL 2020. THE LEVELS AND CONTOURS REFLECT THE CONDITIONS OF THE SITE AT THE TIME OF SURVEY ONLY.
2. HORIZONTAL DATUM IS MAP GRID OF AUSTRALIA 1994 (MGA94), VERTICAL DATUM IS CHART DATUM (CD).
3. AERIAL PHOTOGRAPH SOURCED FROM NEARMAP TAKEN IN MAY 2020.
4. CONTOURS SHOWN AT 1.0m INTERVALS.

CAD:D17460301[A]

AT CORRECT SCALE THIS IS 100 mm

REV	DATE	APPROVED	AMENDMENT	REV	DATE	APPROVED	AMENDMENT
A	10.02.21	CRD	PRELIMINARY ISSUE				

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DESIGNED	CHECKED	APPROVED
L DE LUCIA	C DOAK	
DRAWN	CHECKED	
R BORJA	C DOAK	

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coastal and port engineers

Suite 1, 128 Main Street
Osborne Park 6017
Western Australia

t: +61 8 9254 6600
f: +61 8 9254 6699
admin@coastsandports.com.au

PROJECT: PORT BEACH SAND NOURISHMENT

TITLE: EXISTING CONDITIONS & SURVEY SHEET 1 OF 2

SCALE AT A1	DRAWING NUMBER	REV
1:500	D1746-03-01	A

AT CORRECT SCALE THIS IS 100 mm

JOINS DWG 03-01

0 5 10 15 20 25m
SCALE 1:500 AT ORIGINAL SIZE

PHOTOGRAPH 7

PHOTOGRAPH 8

PHOTOGRAPH 9

PHOTOGRAPH 10

PHOTOGRAPH 11

PHOTOGRAPH 12

PHOTOGRAPH 13

LEGEND:

- 1.0 — CONTOUR
- BEACH ACCESS TRACK
- DRAINAGE OUTLET
- P1 — PHOTO LOCATION, PHOTOS TAKEN IN APRIL 2020.

NOTES:

1. SURVEY PROVIDED BY DEPARTMENT OF TRANSPORT, COMPLETED IN APRIL 2020. THE LEVELS AND CONTOURS REFLECT THE CONDITIONS OF THE SITE AT THE TIME OF SURVEY ONLY.
2. HORIZONTAL DATUM IS MAP GRID OF AUSTRALIA 1994 (MGA94), VERTICAL DATUM IS CHART DATUM (CD).
3. AERIAL PHOTOGRAPH SOURCED FROM NEARMAP TAKEN IN MAY 2020.
4. CONTOURS SHOWN AT 1.0m INTERVALS.

CAD:D17460302[A]

AT CORRECT SCALE THIS IS 100 mm

REV	DATE	APPROVED	AMENDMENT	REV	DATE	APPROVED	AMENDMENT
A	10.02.21	CRD	PRELIMINARY ISSUE				

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CLIENT City of Fremantle

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DRAWN	CHECKED	
R BORJA	C DOAK	

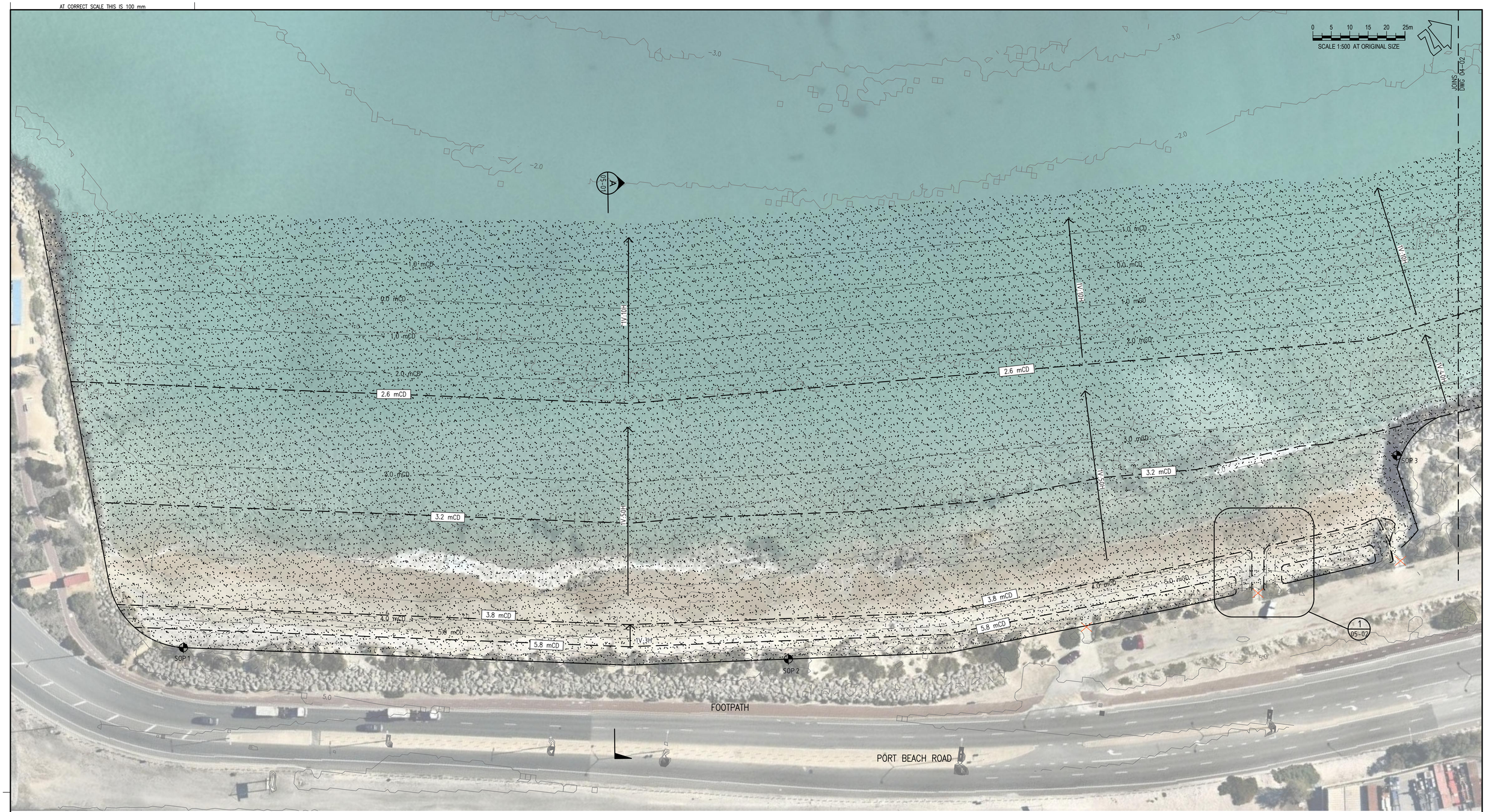
m p rogers & associates pl
coastal and port engineers
Suite 1, 128 Main Street
Osborne Park 6017
Western Australia
t: +61 8 9254 6600
f: +61 8 9254 6699
admin@coastsandports.com.au

PROJECT: PORT BEACH SAND NOURISHMENT

TITLE: EXISTING CONDITIONS & SURVEY SHEET 2 OF 2

SCALE AT A1	DRAWING NUMBER	REV
1:500	D1746-03-02	A

AT CORRECT SCALE THIS IS 100 mm



SAND NOURISHMENT VOLUMES		
SOP#	SECTION	VOLUME (m^3)
SOP1-SOP2	A	55,000
SOP2-SOP3		43,000
SOP3-SOP4	B	8,000
SOP4-SOP5	C	21,000
SOP5-SOP6	D, E	23,000
TOTAL VOLUME		150,000

LEGEND:

- SAND NOURISHMENT
- SOP 2 — SETOUT POINT
- 3.8 mCD — DESIGN LEVEL MAJOR CONTOUR
- 1.0 — EXISTING CONTOUR
- 1.0mCD — DESIGN LEVEL MINOR CONTOUR
- BEACH ACCESS TRACK

NOTES:

1. SURVEY PROVIDED BY DEPARTMENT OF TRANSPORT, COMPLETED IN APRIL 2020. THE LEVELS AND CONTOURS REFLECT THE CONDITIONS OF THE SITE AT THE TIME OF SURVEY ONLY.
2. HORIZONTAL DATUM IS MAP GRID OF AUSTRALIA 1994 (MGA94), VERTICAL DATUM IS CHART DATUM (CD).
3. AERIAL PHOTOGRAPH SOURCED FROM NEARMAP TAKEN IN MAY 2020.
4. CONTOURS SHOWN AT 1.0m INTERVALS.

CAD:D17460401[A]

AT CORRECT SCALE THIS IS 100 mm

REV	DATE	APPROVED	AMENDMENT	REV	DATE	APPROVED	AMENDMENT
A	10.02.21	CRD	PRELIMINARY ISSUE				

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CLIENT City of Fremantle

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DRAWN	CHECKED	
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m p rogers & associates pl
coastal and port engineers
Suite 1, 128 Main Street
Osborne Park 6017
Western Australia
t: +61 8 9254 6600
f: +61 8 9254 6699
admin@coastsandports.com.au

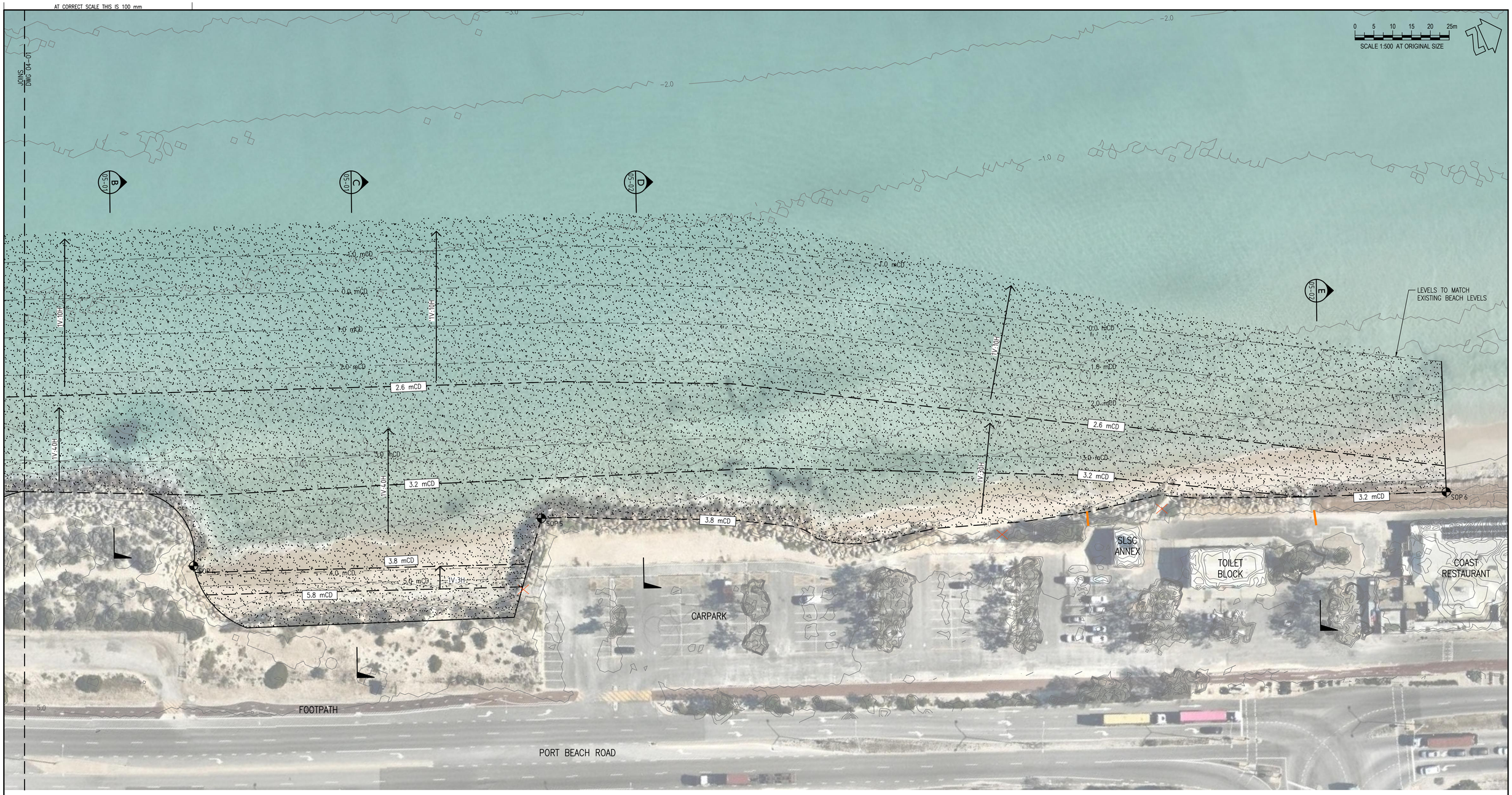
PROJECT: PORT BEACH SAND NOURISHMENT

TITLE: LAYOUT
SHEET 1 OF 2

SCALE AT A1	DRAWING NUMBER	REV
1:500	D1746-04-01	A

AT CORRECT SCALE THIS IS 100 mm

JOINS DWG 04-01



SAND NOURISHMENT VOLUMES		
SOP#	SECTION	VOLUME (m^3)
SOP1-SOP2	A	55,000
SOP2-SOP3		43,000
SOP3-SOP4	B	8,000
SOP4-SOP5	C	21,000
SOP5-SOP6	D, E	23,000
TOTAL VOLUME		150,000

LEGEND:

- SAND NOURISHMENT
- 3.8 mCD — DESIGN LEVEL MAJOR CONTOUR
- 1.0 mCD — DESIGN LEVEL MINOR CONTOUR
- DRAINAGE OUTLET
- SOP 2 — SETOUT POINT
- 1.0 — EXISTING CONTOUR
- BEACH ACCESS TRACK

NOTES:

1. SURVEY PROVIDED BY DEPARTMENT OF TRANSPORT, COMPLETED IN APRIL 2020. THE LEVELS AND CONTOURS REFLECT THE CONDITIONS OF THE SITE AT THE TIME OF SURVEY ONLY.
2. HORIZONTAL DATUM IS MAP GRID OF AUSTRALIA 1994 (MGA94), VERTICAL DATUM IS CHART DATUM (CD).
3. AERIAL PHOTOGRAPH SOURCED FROM NEARMAP TAKEN IN MAY 2020.
4. CONTOURS SHOWN AT 1.0m INTERVALS.

CAD:D17460402[A]

AT CORRECT SCALE THIS IS 100 mm

REV	DATE	APPROVED	AMENDMENT
A	10.02.21	CRD	PRELIMINARY ISSUE

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CLIENT City of Fremantle

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DRAWN	CHECKED	
R BORJA	C DOAK	

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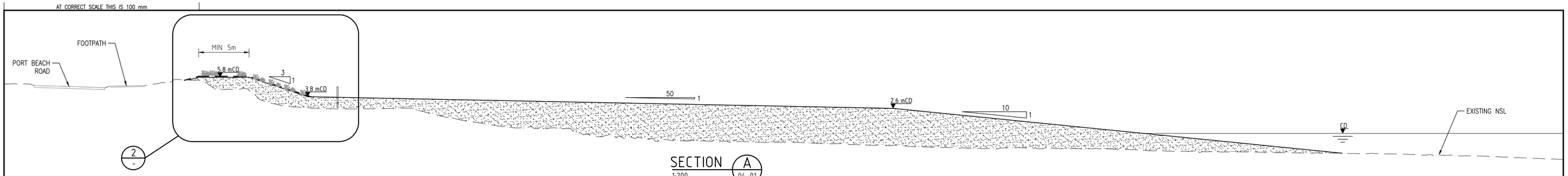
coastal and port engineers
Suite 1, 128 Main Street
Osborne Park 6017
Western Australia
t: +61 8 9254 6600
f: +61 8 9254 6699
admin@coastsandports.com.au

PROJECT: PORT BEACH SAND NOURISHMENT

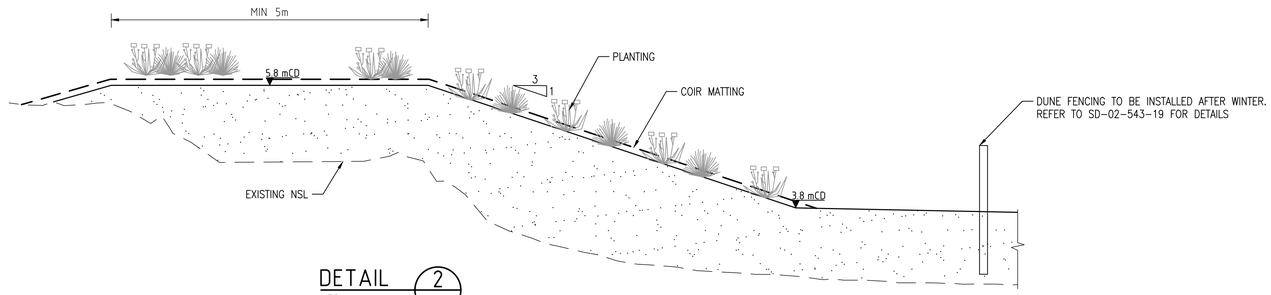
TITLE: LAYOUT
SHEET 2 OF 2

SCALE AT A1	DRAWING NUMBER	REV
1:500	D1746-04-02	A

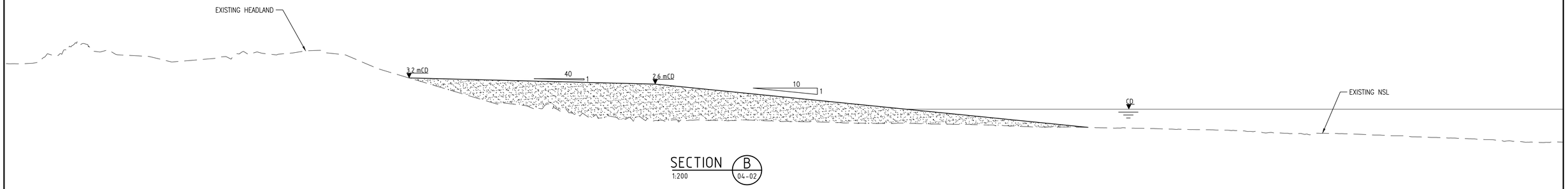
AT CORRECT SCALE THIS IS 100 mm



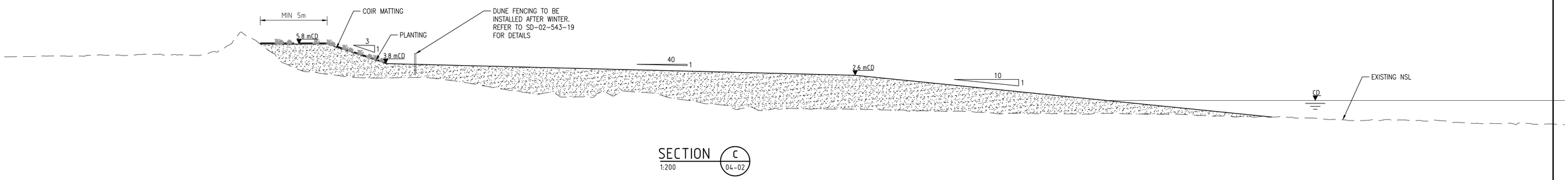
SECTION A
1:200 04-01



DETAIL 2
1:50 -



SECTION B
1:200 04-02



SECTION C
1:200 04-02

CAD:D17460501[A]

REV	DATE	APPROVED	AMENDMENT	REV	DATE	APPROVED	AMENDMENT
A	10.02.21	CRD	PRELIMINARY ISSUE				

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DRAWN	CHECKED	
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coastal and port engineers

Suite 1, 128 Main Street
Osborne Park 6017
Western Australia

t: +61 8 9254 6600
f: +61 8 9254 6699
admin@coastsandports.com.au

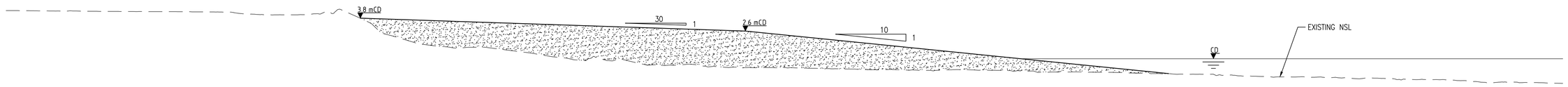
PROJECT PORT BEACH SAND NOURISHMENT

TITLE SECTIONS & DETAILS SHEET 1 OF 2

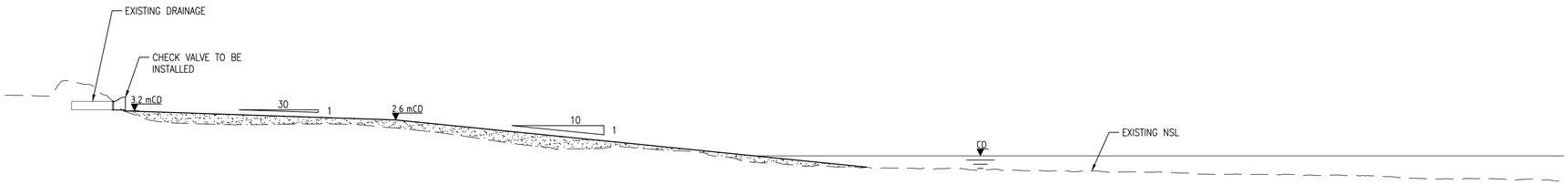
SCALE AT A1 AS SHOWN | DRAWING NUMBER D1746-05-01 | REV A

AT CORRECT SCALE THIS IS 100 mm

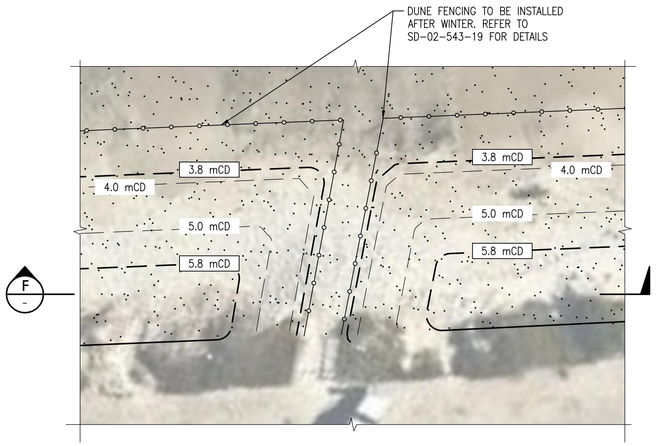
AT CORRECT SCALE THIS IS 100 mm



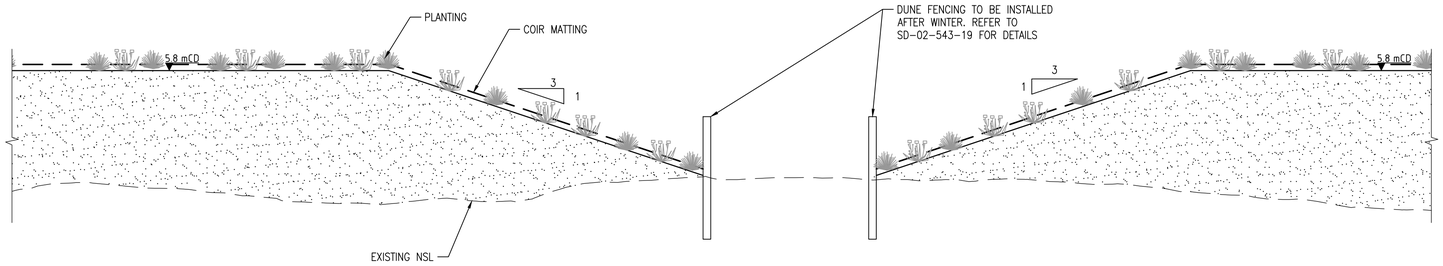
SECTION D
1:200
04-02



SECTION E
1:200
04-02



DETAIL 1
1:200
04-01



SECTION F
1:50
-

CAD:D17460502[A]

REV	DATE	APPROVED	AMENDMENT
A	10.02.21	CRD	PRELIMINARY ISSUE

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DRAWN	CHECKED	
R BORJA	C DOAK	

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coastal and port engineers

Suite 1, 128 Main Street
Osborne Park 6017
Western Australia

t: +61 8 9254 6600
f: +61 8 9254 6699
admin@coastsandports.com.au

PROJECT: PORT BEACH SAND NOURISHMENT

TITLE: SECTIONS & DETAILS
SHEET 2 OF 2

SCALE AT A1	DRAWING NUMBER	REV
AS SHOWN	D1746-05-02	A

AT CORRECT SCALE THIS IS 100 mm

AT CORRECT SCALE THIS IS 100 mm

AT CORRECT SCALE THIS IS 100 mm

LEGEND:

- COIR MATTING AND VEGETATION
- SAND NOURISHMENT
- 3.8 mCD — DESIGN LEVEL MAJOR CONTOUR
- DUNE FENCING
- 1.0 — EXISTING CONTOUR
- BEACH ACCESS TRACK

CAD:D17460601[A]

REV	DATE	APPROVED	AMENDMENT
A	10.02.21	CRD	PRELIMINARY ISSUE

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DRAWN	CHECKED	
R BORJA	C DOAK	

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coastal and port engineers

Suite 1, 128 Main Street
Osborne Park 6017
Western Australia

t: +61 8 9254 6600
f: +61 8 9254 6699
admin@coastsandports.com.au

PROJECT: PORT BEACH SAND NOURISHMENT

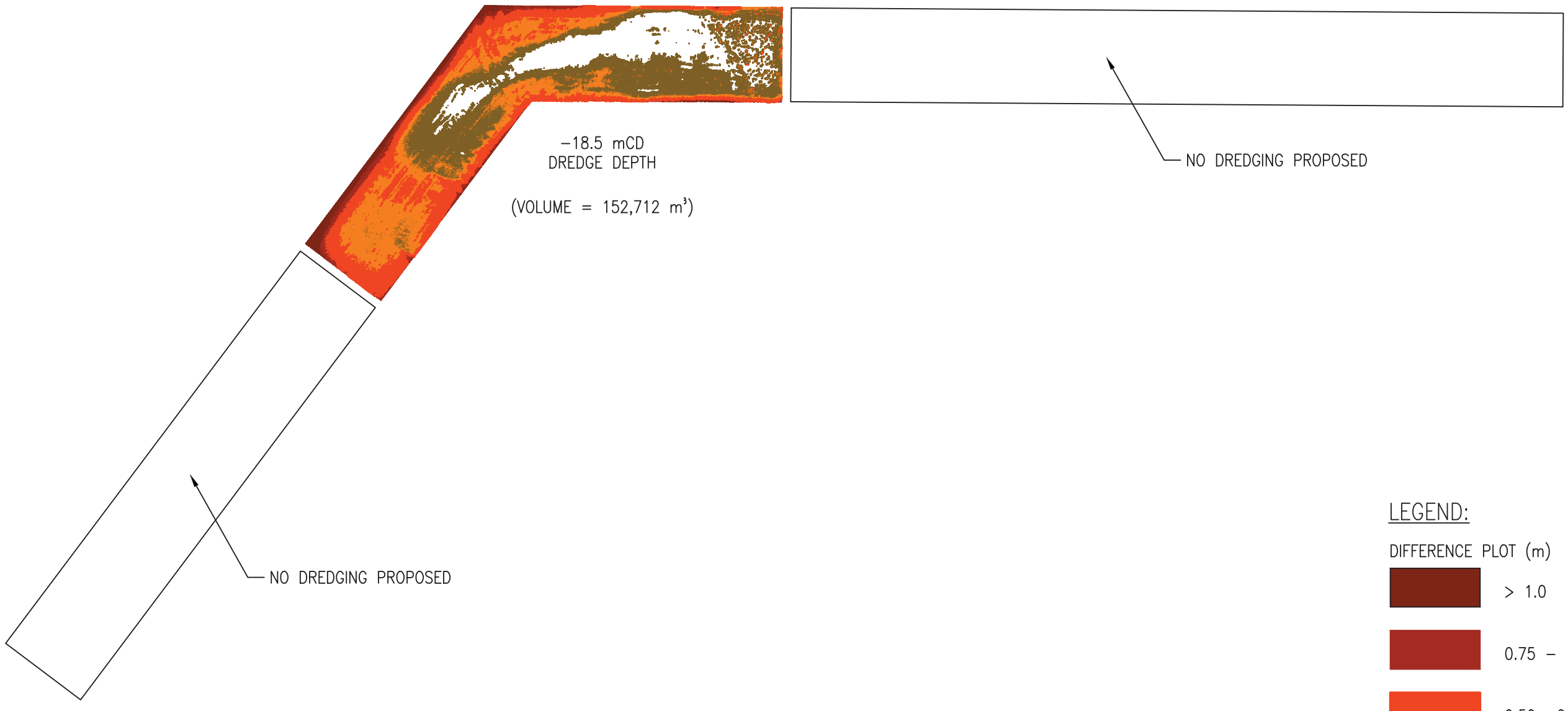
TITLE: DUNE STABILISATION

SCALE AT A1	DRAWING NUMBER	REV
1:1,000	D1746-06-01	A

AT CORRECT SCALE THIS IS 100 mm

0 115 230 345 460 575m

SCALE 1:15,000 AT ORIGINAL SIZE



LEGEND:

DIFFERENCE PLOT (m)

- > 1.0
- 0.75 – 1.00
- 0.50– 0.75
- 0.25 – 0.50
- 0 – 0.25

AT CORRECT SCALE THIS IS 100 mm

m p rogers & associates pl
coastal and port engineers
Suite 1, 128 Main Street
Osborne Park 6017 t: +61 8 9254 6600
Western Australia admin@coastsandports.com.au

DRAWN R BORJA

CHECKED C DOAK

DIFFERENCE PLOT

CITY OF FREMANTLE – DEEPWATER CHANNEL

SCALE AT A3 1:15,000

MARCH 2021

SK1746–04–03A

P:\MRA Paying Jobs\K1746 CoF – Port Beach Adaptation\5 MRA Dwgs\Sketches\SK DWC\SK1746-DWC

Appendix B Weekly Environmental Monitoring Checklist Template

PO Box 2305 Churchlands
WA 6018 Australia
Tel: +61 8 6163 4900
www.bmt.org

Weekly Environmental Monitoring
Port Beach Sand Nourishment via Dredging – Week #X

Environmental monitoring of the Port Beach Sand Nourishment via Dredging between XX–XX MONTH 20XX is to be in accordance with the Port Beach Sand Nourishment via Dredging Environmental Management Plan (DEMP; BMT 2021). See table and comments below for results of the required environmental monitoring tasks.

Environmental Monitoring Checklist

Monitoring task	Monday (XX/XX/20XX)		Tuesday (XX/XX/20XX)		Wednesday (XX/XX/20XX)		Thursday (XX/XX/20XX)		Friday (XX/XX/20XX)		Saturday (XX/XX/20XX)		Sunday (XX/XX/20XX)	
	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?
Plume sketch (dredging area)														
Plume sketch (placement area)														
Remote imagery (dredging area)														
Remote imagery (placement area)														
Site photograph (dredging area)														
Site photograph (placement area)														

Monitoring task	Monday (XX/XX/20XX)		Tuesday (XX/XX/20XX)		Wednesday (XX/XX/20XX)		Thursday (XX/XX/20XX)		Friday (XX/XX/20XX)		Saturday (XX/XX/20XX)		Sunday (XX/XX/20XX)	
	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?
Dredge position log														
Placement position log														
Marine mammal observation log														
Marine mammal interaction log														
Secchi depth measurements														

Notes:
1. Red text indicates a non-conformance with requirements outlined in the DEMP (BMT 2021)
2. *Red italicised text* indicates partial non-conformance with requirements outlined in the DEMP (BMT 2021)
3. **Black bold text** indicates that data was not collected for a valid reason e.g. non-operational machinery, poor weather
4. 'N/A' indicates there was no requirement for data to be collected in accordance with the requirements of the DEMP (BMT 2021)

Comments on environmental monitoring non-conformances:

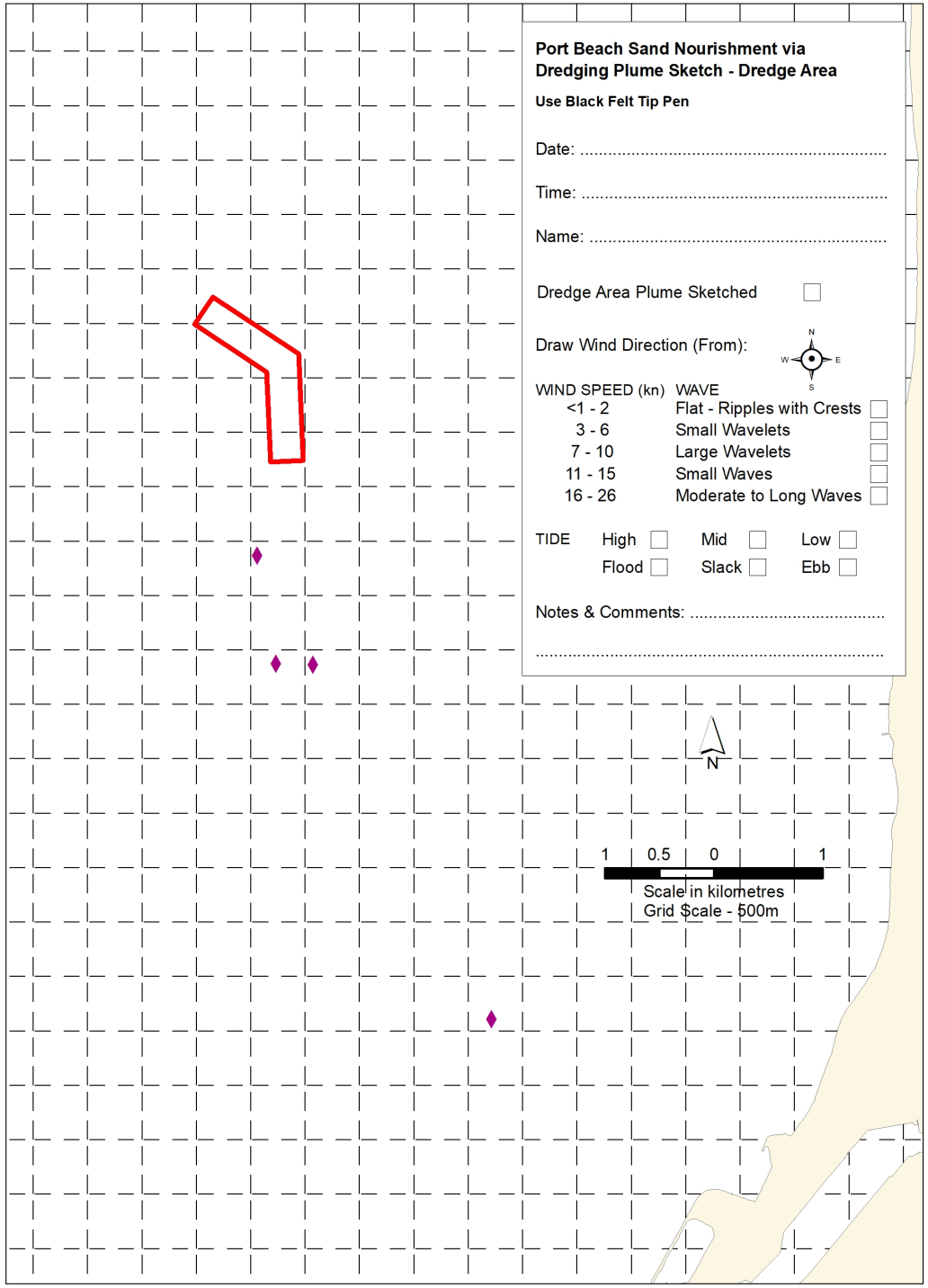
Comments on other environmental issues:

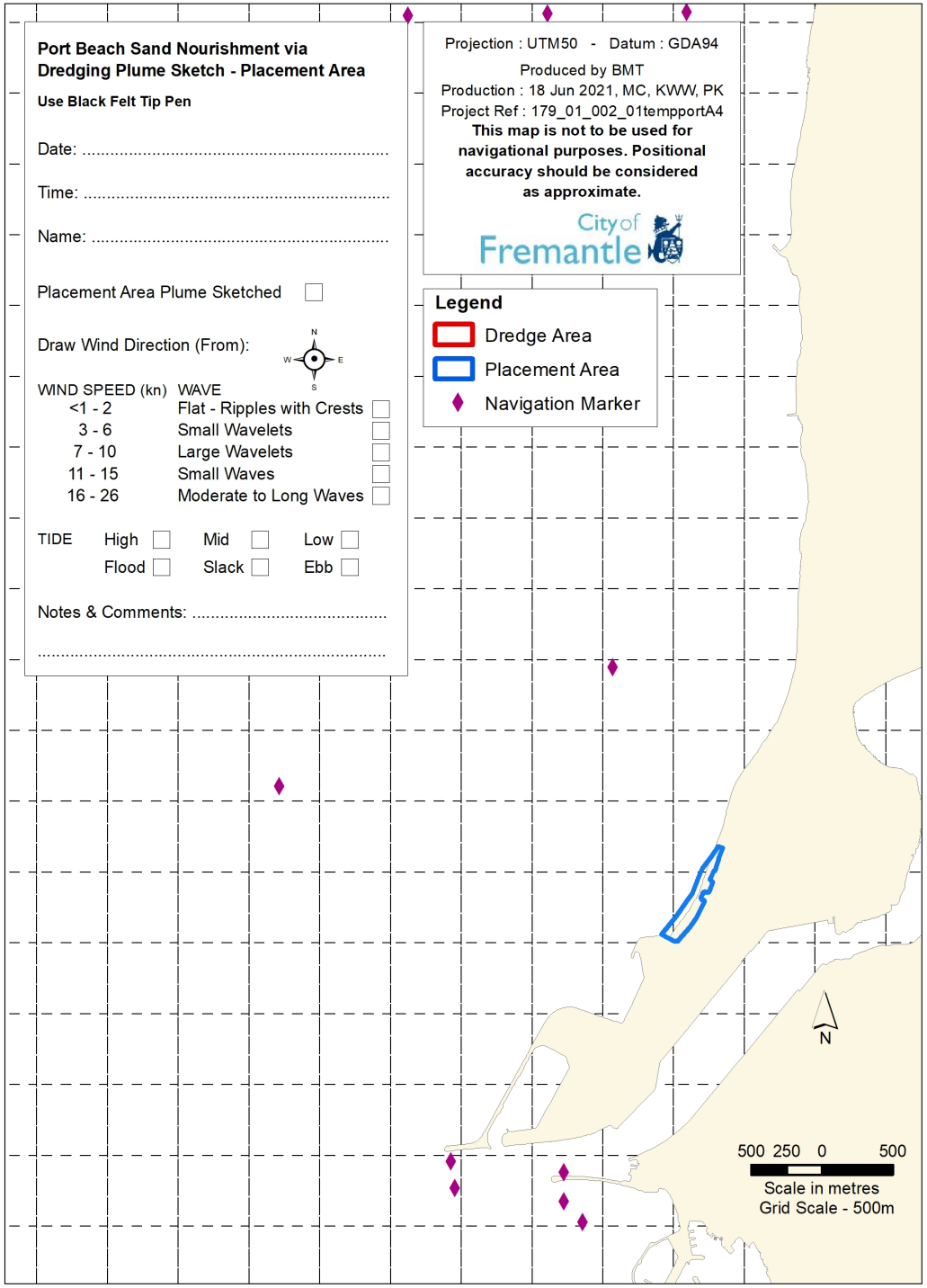
Environmental monitoring data still to be received:

References:

BMT (2021) Port Beach Sand Nourishment via Dredging Environmental Management Plan. Prepared for City of Fremantle by BMT Commercial Australia Pty Ltd, Report No. R-10807-6, Perth, Western Australia, September 2021

Appendix C Plume Sketch Template


Port Beach Sand Nourishment via Dredging Plume Sketch - Dredge Area
Use Black Felt Tip Pen
Date: .....
Time: .....
Name: .....
Dredge Area Plume Sketched
Draw Wind Direction (From):
N
W
E
S
WIND SPEED (kn) WAVE
<1 - 2 Flat - Ripples with Crests
3 - 6 Small Wavelets
7 - 10 Large Wavelets
11 - 15 Small Waves
16 - 26 Moderate to Long Waves
TIDE High Mid Low
Flood Slack Ebb
Notes & Comments: .....
.....
N
1 0.5 0 1
Scale in kilometres
Grid Scale - 500m


Port Beach Sand Nourishment via Dredging Plume Sketch - Placement Area
Use Black Felt Tip Pen
Date: .....
Time: .....
Name: .....
Placement Area Plume Sketched
Draw Wind Direction (From):
N
W
E
S
WIND SPEED (kn) WAVE
<1 - 2 Flat - Ripples with Crests
3 - 6 Small Wavelets
7 - 10 Large Wavelets
11 - 15 Small Waves
16 - 26 Moderate to Long Waves
TIDE High Mid Low
Flood Slack Ebb
Notes & Comments: .....
.....
Projection : UTM50 - Datum : GDA94
Produced by BMT
Production : 18 Jun 2021, MC, KWW, PK
Project Ref : 179_01_002_01tempportA4
This map is not to be used for navigational purposes. Positional accuracy should be considered as approximate.
City of Fremantle
Legend
Dredge Area
Placement Area
Navigation Marker
N
500 250 0 500
Scale in metres
Grid Scale - 500m

Appendix D Secchi Depth Measurement Field Sheet

PO Box 2305 Churchlands
WA 6018 Australia
Tel: +61 8 6163 4900
www.bmt.org

Secchi Depth Measurements Field Sheet
Port Beach Sand Nourishment via Dredging

Date		**Vessel**		**Project No.**	
Recorder		**Sea state**		**Wind**	

Site	Secchi Depth (m)	Depth to sea floor (m)	Waypoint	Comment

Appendix E Marine Mammal Observation and Interaction Logs

Marine Fauna Observation Log

Date		**Location**		**Page #**		**Of**	
MFO(s)		**Skipper**		**Vessel**			
Shift start time		**Operation in progress at shift start**	☐ Dredging ☐ Dumping ☐ Transit	**Shift end time**			
Interactions this shift?	☐ Y ☐ N	**If yes, how many interaction logs?**					

Position			Pod Information								Comments	Weather Conditions									
												Glare									
GPS Waypoint	Time	Vessel Heading(°)	Cue	Relative Bearing	Distance	Actual Swim dir.	Fauna type	# of fauna	od number	Observer (initials)	Behaviour observed (swim speed, direction change)	From	To	Strength (1–3)	Sea state	Wind speed (kts)	Wind direction	Cloud cover (0–8)	Swell	Visibility (0–3)

Relative bearing – bow of the vessel is 0°

Actual swim direction Where the fauna is headed, N, S, E, W – based on true north

Fauna type:
HB - Humpback
WH - Other whale
T - Turtle
DO - Dolphin
DU - Dugong
S - Shark
U - Unknown

Glare levels:
0 – No glare
1 – Gentle glare
2 – Brighter glare
3 – Mirror like glare

Visibility:
0 – No visibility
1 – Limited visibility
2 – Visibility ok
3 – Visibility perfect

Cues : *BR – Breach* *BL – Blow* *FS – Fin Slap* *TS – Tail Slap* *SW – Swim* *SF – Surface Lying* *SP - Splash*

BMT has a proven record in addressing today's engineering and environmental issues.

Our dedication to developing innovative approaches and solutions enhances our ability to meet our client's most challenging needs.

Perth
Level 4, 20 Parkland Road
Osborne Park Western Australia 6017
PO Box 2305 Churchlands WA 6018
Australia
Tel +61 8 6163 4900
Email environment@bmtglobal.com

Brisbane
Level 5, 348 Edward Street
Brisbane Queensland 4000
PO Box 203 Spring Hill Queensland 4004
Australia
Tel +61 7 3831 6744
Fax +61 7 3832 3627
Email environment@bmtglobal.com

Melbourne
Level 5, 99 King Street
Melbourne Victoria 3000
Australia
Tel +61 3 8620 6100
Fax +61 3 8620 6105
Email environment@bmtglobal.com

Newcastle
Level 1, 161 King Street
Newcastle New South Wales 2300
Tel +61 2 4940 8882
Fax +61 2 4940 8887
Email environment@bmtglobal.com

Adelaide
5 Hackney Road
Hackney Adelaide South Australia 5069
Australia
Tel +61 8 8614 3400
Email info@bmtdt.com.au

Northern Rivers
Suite 5
20 Byron Street
Bangalow New South Wales 2479
Australia
Tel +61 2 6687 0466
Fax +61 2 6687 0422
Email environment@bmtglobal.com

Sydney
Suite G2, 13-15 Smail Street
Ultimo Sydney New South Wales 2007
Australia
Tel +61 2 8960 7755
Fax +61 2 8960 7745
Email environment@bmtglobal.com

London
Zig Zag Building, 70 Victoria Street
Westminster
London, SW1E 6SQ
UK
Tel +44 (0) 20 8090 1566
Email environment.uk@bmtglobal.com

Leeds
Platform
New Station Street
Leeds, LS1 4JB
UK
Tel +44 (0) 113 328 2366
Email environment.uk@bmtglobal.com

Aberdeen
11 Bon Accord Crescent
Aberdeen, AB11 6DE
UK
Tel +44 (0) 1224 414 200
Email environment.uk@bmtglobal.com

Asia Pacific
Indonesia Office
Perkantoran Hijau Arkadia
Tower C, P Floor
Jl: T.B. Simatupang Kav.88
Jakarta, 12520
Indonesia
Tel: +62 21 782 7639
Email asiapacific@bmtglobal.com

Arlington
2900 South Quincy Street, Suite 210
Arlington, VA 22206
United States
Tel: +1 703 920 7070
Email inquiries@dandp.com