Port Geographe Coastal Structures Environmental Monitoring and Management Plan

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Acronyms

80th percentile	Value below which 80% of the observations are found
CD	Chart datum
CEO	Chief Executive Officer of the Office of the Environmental Protection Authority (now Department of Water and Environmental Regulation)
CoB	City of Busselton
DoH	Department of Health
DoT	Department of Transport
DWER	Department of Water and Environmental Regulation
EAG	Environmental Assessment Guideline
EMF	Environmental Management Framework
EMMP	Environmental Monitoring and Management Plan
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
GPS	Global positioning system
H_2S	Hydrogen sulfide gas
LAC	Light attenuation coefficient; a measure of the attenuation of light with depth through the water column
OEPA	Office of the Environmental Protection Authority (now Department of Water and Environmental Regulation)
PGCMA	Port Geographe Coastal Management Area
ppm	Parts per million
Rolling two-year period	A period of 24 consecutive months measured backward from the current date
UWA	The University of Western Australia

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1 Summary

This Environmental Monitoring and Management Plan (EMMP) is submitted in accordance with Ministerial Statement 990 (Appendix A), Condition 7 for the Port Geographe Development Coastal Structures by the Department of Transport (DoT) on behalf of the Minister for Transport. The EMMP also addresses Conditions 4, 5 and 6 of Ministerial Statement 990 (Appendix A).

The content and format of this EMMP is consistent with the Environmental Protection Authority's (EPA) Environmental Assessment Guideline for Preparation of management plans under Part IV of the *Environmental Protection Act 1986* (EPA 2015). This guideline has been superseded by the EPA's Instructions on how to prepare *Environmental Protection Act 1986* Part IV Environmental Management Plans (EPA 2020a), it is intended that this EMMP will be revised to align with these guidelines should it require substantial changes be made to the management triggers or management actions in the future.

The environmental management targets to measure achievement of the condition environmental objectives for seagrass wrack management, sediment movement, and the harbour entrance channel, that must be met through implementation of this EMMP, are outlined in Table 1-1.

Table 1-1 Summary of the Port Geographe Development Coastal Structures project, and associated condition environmental objectives and environmental management targets.

Title of proposal	Port Geographe Development Coastal Structures
Proponent	Minister for Transport
Ministerial Statement number	990
Purpose of this EMMP	To fulfil the requirements of Conditions 7 of Ministerial Statement 990. This EMMP also addresses Conditions 4, 5 and 6 of Ministerial Statement 990
EPA's environmental objectives for the key environmental factors	Coastal processes To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected. Marine environmental quality To maintain the quality of water, sediment and biota so that the environmental values are protected. Benthic communities and habitat To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained. Air quality To maintain air quality and minimise emissions so that environmental values are protected. Social surroundings To protect social surroundings from significant harm. Human health To protect human health from significant harm.

Summary

Seagrass wrack management	
Condition environmental objective	Minimise the impact on the environment and human health due to trapped seagrass wrack.
Management targets	1. Maintain natural beachfront wrack dynamics by ensuring less than 60 000 m^3 of wrack is on the Western Beach by December each year. 2. 24 hour average H_2S concentrations adjacent to the Western Beach do not exceed Department of Health guidelines of 0.1 ppm. 3. Weekly (rolling 7-day) median light attenuation coefficient (LAC) at impact sites do not exceed the 80th percentile of the reference sites for two consecutive weeks (if completing offshore disposal during maintenance works). 4. No change in position of seagrass meadow edge outside of the predicted zone of influence of the offshore disposal area beyond natural variability (if completing offshore disposal during maintenance works).
Sediment movement	
Condition environmental objective	Minimise the impact on the environment and coastal processes due to interruption to sediment movement by the reconfigured coastal structures.
Management targets	1. Maintain natural alongshore sediment movement by ensuring less than 30 000 m^3 erosion within Wonnerup Beach (to the eastern extent of the Port Geographe Coastal Management Area) at the end of a rolling two-year period (when compared to the November 2014 survey). 2. Weekly (rolling 7-day) median light attenuation coefficient (LAC) values at impact sites do not exceed the 80th percentile of the reference sites for two consecutive weeks (if completing offshore disposal during maintenance works). 3. No change in position of seagrass meadow edge outside of the predicted zone of influence of the offshore disposal area beyond natural variability (if completing offshore disposal during maintenance works).
Harbour entrance channel	
Condition environmental objective	Minimise the impact on the environment due to the restricted exchange of water through the harbour entrance channel.
Management targets	1. Maintain cross sectional area of harbour entrance channel (below mean sea level) to no less than 120 m^2 for two consecutive surveys. 2. Weekly (rolling 7-day) median light attenuation coefficient (LAC) values at impact sites do not exceed the 80th percentile of the reference sites for two consecutive weeks (if completing offshore disposal during maintenance works). 3. No change in position of seagrass meadow edge outside of the predicted zone of influence of the offshore disposal area beyond natural variability (if completing offshore disposal during maintenance works).

Note:
1. EMMP = Environmental Monitoring and Management Plan; EPA = Environmental Protection Authority; H_2S = hydrogen sulfide; ppm = parts per million.

Summary

Corporate endorsement[1]

I hereby certify that to the best of my knowledge, the provisions within this Port Geographe Environmental Monitoring and Management Plan are true and correct and address the legal requirements of Conditions 4 to 7 of Ministerial Statement 990.

[Signature of duly authorised proponent representative]
Name: NINA LYHNE Signed:
Designation: A/DIRECTOR GENERAL Date: 8/9/2016

[1] Note the Director General of the Department of Transport has changed since this endorsement, however, given there are no changes to the management targets originally submitted, this endorsement is still appropriate.

2 Context, Scope and Rationale

2.1 Project description

The Port Geographe development is located ~3 km east of Busselton, Western Australia. Developed in the 1990s, the original project saw the construction of breakwaters and groynes extending into Geographe Bay, together with a series of residential canals and a private marina. In 1991, Ministerial Statement 391 was issued to Tallwood Nominees Pty Ltd (Tallwood Nominees) for the construction of Port Geographe. The development has been progressively developed since the early 1990s. However, before completion, Tallwood Nominees experienced financial difficulties and the development ceased in mid-2009.

The original design of the breakwater impeded the natural eastward littoral drift of sediment and wrack at the shoreline, causing large amounts of material to accumulate on the beach to the west of the harbour entrance channel (hereafter referred to as the 'Western Beach'). Decomposition of the accumulated wrack reduced the public amenity of this beach and resulted in reduced air quality in the surrounding area. The interrupted eastward littoral drift also led to erosion at Wonnerup Beach to the east of the development, presenting a risk to public and private infrastructure adjacent to the beach. Wrack and sediment deposition in the harbour entrance channel affected the flushing characteristics of the Port Geographe artificial waterways.

In 2013, DoT became a joint proponent for Ministerial Statement 391. Responsibility for the coastal structures component of the development, resided with DoT and responsibility for the land development and canal structures component with Tallwood Nominees, until the land was purchased by Aigle Royal Developments in April 2015.

In 2013 and 2014, DoT completed construction and capital dredging campaigns to re-align the breakwaters in order to facilitate natural eastward littoral drift, thereby reducing the social and environmental impacts caused by the previous design. The reconfigured Port Geographe coast has two breakwaters (eastern and western) forming the entrance channel, a revetment along the eastern shoreline to Wonnerup and a small lagoon formed at the junction of the eastern breakwater and revetment (Figure 2-1, Figure 2-2). In 2013, Ministerial Statement 391 was amended to clarify the conditions within the statement, confirm the modifications to the coastal structures, and allow greater flexibility around the dredging volumes required for the reconfiguration.

In November 2014, the Office of the Environmental Protection Authority (OEPA[2]) split Ministerial Statement 391 into two separate Ministerial Statements: Statement 989, for the management of the canal developments by the land owner; and Statement 990, for the management of the coastal structures by DoT. The proponent for Ministerial Statement 990 is the Minister for Transport and DoT completes environmental management on the Minister's behalf.

To ensure the conditions of Ministerial Statement 990 are met, DoT intends to maintain the area within the Port Geographe Coastal Management Area (PGCMA; Figure 2-1, Figure 2-2) that extends east and west of the reconfigured entrance channel, via periodic seagrass wrack and sediment management and harbour entrance channel maintenance dredging campaigns (summarised in sections below). These campaigns are facilitated by the presence of a permanent bypassing pipeline which, when deemed necessary, allows material to be pumped from one side of the development to the other (Figure 2-2).

[2] As of July 2017 OEPA merged with Department of Environmental Regulation and Department of Water to form Department of Water and Environmental Regulation

Figure 2-1 The Port Geographe Coastal Management Area and reconfigured breakwaters (updated version from Figure 1 in Ministerial Statement 990)

2.1.1 Seagrass wrack management

Storms and energetic sea conditions may result in trapped wrack on the Western Beach. Wrack management works may need to be completed to reduce trapped wrack on the beach when it has the potential to cause an environmental impact, primarily due to the production of hydrogen sulfide gas (H_2S). Aerobic decay of dry wrack generates substantially smaller amounts of H_2S than anaerobic decay (which occurs when wet wrack decays at the waterline). The method used to remove trapped wrack from the Western Beach will be dependent on the volume accumulated. Operationally, DoT may implement wrack management activities when accumulated volumes are above 30 000 m^3.

Historically ~60 000–80 000 m^3 of seagrass wrack can accumulate each winter on the Western Beach (BMT JFA 2015a), requiring management. Smaller volumes of trapped wrack may be moved into the littoral zone above the low water mark using mechanical equipment.

Larger volumes of trapped wrack (>80 000 m^3) may be removed from the Western Beach using mechanical equipment such as pumping equipment, cutter-suction dredge and/or trucking. Material may be deposited within the PGCMA via pipeline. Nearshore marine disposal is preferred (littoral zone of the Western Beach or in front of the eastern revetment), however; if these options are not suitable, material will be disposed offshore. The proposed offshore disposal area is the area previously utilised in the 2013–2014 capital dredging campaign realigned to be within the PGCMA (Table 2-1, Figure 2-2). The footprint of the offshore disposal area has been extended to match that of the 2013–2014 capital dredging campaign in order to increase its capacity to receive dredged material; this is considered to be of low environmental risk (Appendix B). Where possible, seagrass wrack management options will ensure that the nutrients provided by wrack remain within Geographe Bay. However, if disposal of material within the PGCMA is not appropriate, i.e. for very large volumes of wrack accumulation, material may be trucked offsite to be disposed of or beneficial reuse.

The timing of works will vary year to year due to the seasonal and interannual variability of coastal processes and wrack dynamics at the site. Works will typically occur outside of school holidays when beach use will be high. However, occasionally works may be required during holiday periods to effectively manage the shoreline within the PGCMA and the Port Geographe coastal structures to meet the requirements of Ministerial Statement 990. Prior to these occasions, DoT will consult with the City of Busselton and relevant community stakeholder representatives.

Table 2-1 Coordinates of Port Geographe offshore disposal area

Corner points[1]	Offshore disposal area position (GDA94 UTM50)	
	Easting	Northing
A	350813	6278360
B	351070	6278509
C	351400	6278513
D	351400	6278338
E	350985	6278337
F	350913	6278283

Note:
1. Proceeding clockwise started from westernmost point.
2. See Figure 2-2 for offshore disposal area location in Port Geographe Coastal Management Area.

Figure 2-2 The Port Geographe Coastal Management Area, permanently installed bypassing pipeline, offshore disposal area, and Ngari Capes Marine Park exclusion zone

2.1.2 Sediment management

Following the realignment of the Port Geographe coastal structures, it is likely that the eastern beaches will require additional nourishment. The primary location for nourishment will be the western end of Wonnerup Beach, to allow natural eastward littoral drift of material along the shoreline.

The supply options for nourishment material include internal sources from inside the PGCMA or external sources from outside the PGCMA (such as local quarries, sand pits). Internal sources of sand supply for beach nourishment should be investigated for all nourishment activities to minimise potential transport impacts to local residents and costs. However, if surveys indicate smaller volumes are required for beach nourishment (e.g. 10 000–30 000 m^3), material from external sources outside the PGCMA (such as local quarries, sand pits) may be used.

Sources from within the PGCMA include sand built-up on the Western Beach (mechanically bypassed via pipeline or trucks), the material dredged from the harbour entrance channel (via pipeline) and dredging of sand previously placed in the offshore disposal area during maintenance and capital campaigns (via pipeline). Sand from the Western Beach and the harbour entrance channel can have a high wrack content, therefore use of these sources should consider the impact based on the wrack content and mitigate such impacts as necessary.

It is intended that mechanical bypassing of sand from the Western Beach will be utilised only in instances where the removal of sediment will not be anticipated to impact the natural bypassing performance of the breakwaters. Therefore, there will need to be due consideration of:

- the beach profiles required to achieve natural bypassing of the reconfigured structures; and
- the propensity of this surplus sand to move into the entrance channel and cause a navigation hazard.

The justification for using the offshore disposal area as a sand source and the associated environmental impact assessment is included in Appendix B. Use of this sand source is considered to be of low environmental risk and sand will only be removed above a historic baseline to ensure the naturally occurring sand bar is not impacted.

In all instances, the relative impacts of the sand supply options on the environment, social surrounds and operational requirements will be assessed to determine the most appropriate method and the relevant approvals obtained on a per-campaign basis. Any sand sourced for nourishment will consist of predominantly fine to medium grain sand, and will be free from contamination and debris.

To facilitate the effective nourishment of Wonnerup Beach and to ensure beach amenity post-nourishment, small amounts of wrack that may have accumulated on Wonnerup Beach may be redistributed into the littoral zone prior to nourishment works. This will avoid its burial during nourishment, which would otherwise have the potential to lead to future anoxic conditions and H_2S generation.

The timing of works will vary year to year due to the seasonal and interannual variability of coastal processes and wrack dynamics at the site. Works will typically occur outside of school holidays when beach use will be high. However, occasionally works may be required during holiday periods to effectively manage the shoreline within the PGCMA and the Port Geographe coastal structures to meet the requirements of Ministerial Statement 990. Prior to these occasions, DoT will consult with the City of Busselton and relevant community stakeholder representatives.

2.1.3 Harbour entrance channel management

Maintenance dredging campaigns will be completed primarily to maintain the cross-sectional area of the harbour entrance channel to ensure safe navigation and adequate flushing and water circulation. Material may also be dredged from areas adjacent to the harbour entrance channel to prevent infill if necessary.

In most cases, a cutter-suction dredge will be used, and the disposal site will be dependent on the wrack content of the dredged material. If the scope only requires the removal of small volumes or isolated high spots, alternative methods such as wrack trawling or seabed ploughing may be considered. If the dredged material is expected to be suitable for beach nourishment (Section 2.1.2), it will be pumped through the bypassing pipeline and deposited through the Wonnerup Beach pipeline connection (Figure 2-2). If the wrack content of the material is expected to be high, it will be deposited in front of the eastern revetment via the established pipeline connection (Figure 2-2), after which the sandy material is anticipated to separate out and move eastwards to Wonnerup Beach. Both of these options are considered to minimise the risk of erosion on Wonnerup Beach. Nearshore disposal is preferred however if none of the disposal options listed above are suitable, the material will be disposed offshore. The offshore disposal area is within the PGCMA (Figure 2-2) and the location has been chosen to avoid and minimise impacts to seagrass meadows (refer to Section 2.1.1).

Each maintenance dredging campaign will remove ~15 000–60 000 m^3 of fine to medium grain sand and wrack from the harbour entrance channel.

The timing of works will vary year to year due to the seasonal and interannual variability of coastal processes and wrack dynamics at the site. Works will typically occur outside of school holidays when beach use will be high. However, occasionally works may be required during holiday periods to effectively manage the shoreline within the PGCMA and the Port Geographe coastal structures to meet the requirements of Ministerial Statement 990. Prior to these occasions, DoT will consult with the City of Busselton and relevant community stakeholder representatives.

2.1.4 Summary

A summary of the proposed campaigns at Port Geographe is outlined in Table 2-2. All details of the maintenance campaigns are indicative and will require review prior to each campaign.

Table 2-2 Summary of proposed maintenance dredging, wrack management and sand bypassing/nourishment campaigns at Port Geographe

Management	Location	Method	Disposal site	Campaign volume	Duration (weeks)
Seagrass wrack management	Western Beach	Moved into littoral zone using mechanical equipment Removed using earthmoving equipment, pumping equipment and/or cutter suction dredge and/or trucking	Western Beach littoral zone Eastern revetment pipeline connection Eastern end of Wonnerup Beach Offshore disposal area Appropriate disposal offsite and/or beneficial reuse	~30 000–50 000 m^3	1–12 Comprising multiple non-consecutive wrack work episodes (less than 5 days per episode) to coincide with appropriate weather events
Sediment management	External sources outside the PGCMA (such as local sand pits/quarries/accreting local shoreline)	Trucking Bypassing (pumping equipment) Dredging (cutter suction dredge)	Wonnerup Beach	~10 000–50 000 m^3	2–8 May comprise multiple smaller campaigns utilising external and/or internal sources separate to or coinciding

Management	Location	Method	Disposal site	Campaign volume	Duration (weeks)
	Internal sources inside the PGCMA (such as the Western Beach, entrance channel, offshore disposal area)	Trucking Bypassing (pumping equipment) Dredging (cutter suction dredge)			with other campaign types
Harbour entrance channel management	Entrance channel and adjacent areas	Cutter suction dredge	Wonnerup Beach pipeline connection Eastern revetment pipeline connection Offshore disposal area	~15 000–60 000 m^3	4–14

Notes:
1. 'PGCMA' = Port Geographe Coastal Management Area.

2.2 Key environmental factors

This EMMP considers six key environmental factors that relate to the environmental management of the Port Geographe coastal structures. These factors are (EPA 2020b):

- coastal processes
- marine environmental quality
- benthic communities and habitat
- air quality
- social surroundings
- human health.

The following sections describe the EPA's objectives for the protection of these key environmental factors and outline why they are relevant to the Port Geographe coastal structures and the ongoing maintenance of this development. The EMMP management approach outlines how the condition environmental objectives and associated management targets protect these four key environmental factors (Section 2.4.3).

2.2.1 Coastal processes

EPA's objective for coastal processes: To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.

The original design of the Port Geographe coastal structures impeded the natural eastward littoral drift of sediment and wrack at the shoreline, causing large amounts of material to accumulate on the beach to the west of the harbour entrance channel (Western Beach). The interrupted eastward littoral drift led to erosion at Wonnerup Beach to the east of the development. The reconfiguration of the Port Geographe breakwaters was intended to facilitate natural eastward littoral drift along the Geographe Bay coast and ensure that the mechanisms for the transport of sand and wrack from beaches west of the development to beaches east of the development are reinstated. The natural coastal processes are therefore monitored to ensure the reconfigured breakwaters are effectively promoting natural eastward littoral drift. However maintenance activities may also be required (see Section 2.1) before the beaches of the PGCMA reach equilibrium with the new coastal structures.

2.2.2 Marine environmental quality

EPA's objective for marine environmental quality: To maintain the quality of water, sediment and biota so that the environmental values are protected.

The eastward transport of sand and wrack along the alignment of the Port Geographe coastal structures may cause material to settle in the harbour entrance channel. This material may accumulate, reduce the cross sectional area of the channel, and potentially reduce water exchange between Geographe Bay marine waters and the Port Geographe waterways. Management of the harbour entrance channel depths, which is required for safe navigation and also to ensure adequate flushing of the artificial waterways, may involve maintenance dredging activities. These maintenance dredging and disposal activities have the potential to cause environmental impacts relating to marine water, sediment and biota quality at the dredging and disposal sites.

The presence of the Port Geographe coastal structures may cause large accumulations of trapped wrack. Therefore, in addition to maintenance dredging, further management activities may be required to maintain coastal processes and manage water and sediment quality within DoT's PGCMA (Section 2.1). These activities may include the mechanical bypassing of sediment and wrack from the Western Beach and sand

nourishment of Wonnerup Beach. Bypassing and nourishment activities have the potential to cause environmental impacts relating to water, sediment and biota quality in the vicinity of the works.

2.2.3 Benthic communities and habitat

EPA's objective for benthic communities and habitat: To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.

Extensive seagrass meadows exist in Geographe Bay and offshore of the Port Geographe coastal structures (outside of the PGCMA). Maintenance activities that involve offshore disposal of material have the potential to cause environmental impacts on seagrass meadows in the vicinity of the offshore disposal area. These impacts are mainly related to short-term turbidity and potential smothering of seagrass meadows.

2.2.4 Air quality, social surroundings and human health

EPA's objective for air quality: To maintain air quality and minimise emissions so that environmental values are protected.

EPA's objective for social surroundings: To protect social surroundings from significant harm.

EPA's objective for human health: To protect human health from significant harm.

The presence of the Port Geographe coastal structures may cause large accumulations of trapped wrack that, when decomposing, can impact air quality and visual amenity in the surrounding area. The presence of the wrack and decomposition of large accumulations of wrack by anaerobic bacteria on the Western Beach reduces the public amenity of the beach and results in reduced air quality in the surrounding area due to the generation of H_2S. Therefore maintenance activities may be required to manage the wrack accumulation. Additionally during maintenance activities (such as mechanical wrack bypassing), large quantities of H_2S can be released over a short period of time which can potentially result in adverse health effects (ChemCentre 2010).

2.3 Requirements of the conditions

This EMMP is submitted in accordance with Ministerial Statement 990, Conditions 4 to 7 for the Port Geographe Coastal Structures Development. The requirements of these conditions are addressed in sections of the EMMP as outlined in Table 2-3. The approach to how management actions have been developed to meet these conditions such that they follow the mitigation hierarchy and are protective of the EPA's key environmental factors, is explained in Section 2.4.3 and Section 2.4.4.

Table 2-3 Conditions of Ministerial Statement 990 and where they are addressed in this Environmental Monitoring and Management Plan

Ministerial Statement 990 Condition	Section in EMMP
4-1 Where determined to be project attributable, the proponent shall maintain beach profiles on beaches east and west of the development, within the project area shown in Schedule 1, Figure 1, to the requirements of the CEO.	Section 2.1.2 Section 3.2
5-1 The proponent shall, unless otherwise approved by the CEO, annually bypass, dredge or remove trapped seagrass wrack and or sediment accumulated west of or within the harbour entrance, to the requirements of the CEO.	Section 2.1, Section 3
5-2 The proponent shall transfer sufficient sand to Wonnerup Beach for coastal protection, to the requirements of the CEO.	Section 2.1.2 Section 3.2
6-1 The proponent is to maintain the harbour entrance channel as per Schedule 1, to ensure adequate flushing and water circulation of the artificial	Section 2.1.3, Section 3.3

Ministerial Statement 990 Condition	Section in EMMP
waterways within the Port Geographe development, to the requirements of the CEO.	
7-1 The proponent shall ensure impacts to the environment are minimised through the implementation of Conditions 7-2 to 7-8.	Entire document
7-2 Within three calendar months following the issue of the Ministerial Statement, unless otherwise approved by the CEO, the proponent shall prepare an Environmental Management and Monitoring Plan to the requirements of the CEO. The Plan shall: (1) when implemented, substantiate whether Condition 7-1 is being met. (2) detail measures to manage water and sediment quality impacts to Geographe Bay associated with coastal management activities including dredging and bypassing. (3) detail measures to manage trapped seagrass wrack accumulation on the beaches adjacent to the development, as shown in Schedule 1, Figure 1. (4) detail measures to manage significant environmental impacts with regard to coastal processes and sediment movement as a result of the development. (5) determine trigger levels for implementation of management measures to ensure Condition 7-1 is met. (6) identify management measures to be implemented in the event that criteria identified required by Condition 7-2(5) have been exceeded.	Entire document
7-3 The proponent shall implement the approved Environmental Management and Monitoring Plan required by Conditions 7-2, unless otherwise approved by the CEO.	Entire document
7-4 In the event that monitoring required by Condition 7-2 indicates trigger criteria have been exceeded, the proponent shall investigate to determine the likely cause(s) and provide a report that describes the investigation to the CEO within 10 days along with a description of the corrective management actions to be taken.	Section 3.1.6, Section 3.2.6, Section 3.3.6
7-5 The proponent shall implement the management actions identified in Condition 7-4 until the CEO determines that the remedial actions may cease.	Section 3.1.5, Section 3.2.5, Section 3.3.5
7-6 The proponent shall review the Environmental Management and Monitoring Plan annually, and revise where required, or as directed by the CEO.	Section 4
7-7 The proponent shall implement the approved revisions of the Environmental Management and Monitoring Plan required by Condition 7-6 until advised otherwise by the CEO.	Section 4
7-8 The Proponent shall make the Environmental Management and Monitoring Plan, required by 7-2 publicly available in a manner approved by the CEO.	Section 5

Note:
1. EMMP = Environmental Monitoring and Management Plan, CEO = Chief Executive Officer of the Department of Water and Environmental Regulation.

2.4 Rationale and approach of the EMMP

This document is intended to meet the requirements of several conditions in Ministerial Statement 990. The EMMP aims to ensure the breakwater reconfiguration is effective in enhancing natural coastal processes and outlines the maintenance works that may be required to ensure optimal performance of the coastal structures and minimise impacts on the environment in the PGCMA. The maintenance works (as described in Section 2.1) will be carried out in accordance with the EMMP and Environmental Management Plans (EMPs) to ensure minimal impact on the environment.

The following sections provide background information and details on the Port Geographe development that have been used to develop the management approach for this EMMP. Results of baseline studies, modelling investigations, and reviews of historic and recent datasets have been used to inform the management approach for meeting the condition environmental objectives stated in Section 1. The section below also outlines a number of assumptions and uncertainties associated with the development and the proposed management approach. The management actions, management targets, and monitoring commitments in the subsequent sections of this EMMP are aligned with the overall management approach presented below.

2.4.1 Baseline studies

A number of technical studies completed in the Geographe Bay region prior to the 2013/14 reconfiguration of the Port Geographe coastal structures help to provide an understanding of the possible impacts of the reconfiguration on the existing environment, hydrodynamics, and natural coastal processes. Modelling studies and environmental, metocean, and engineering investigations completed over a number of years, have informed the monitoring and management approach for this EMMP (Table 2-4). Brief summaries of the results of these studies are provided below.

Table 2-4 Environmental, metocean, and engineering studies completed for the Port Geographe coastal structures development

Study type	Organisation (and reference)	Timeframe	Key outcomes
Seagrass wrack dynamics in Geographe Bay	The University of Western Australia Seashore Engineering Pty Ltd BMT JFA Consultants Pty Ltd (Oldham et al. 2010, Pattiaratchi et al. 2011, Seashore Engineering 2014, BMT JFA 2015a)	2010–2015	• Wrack accumulation in large quantities on Geographe Bay beaches is a natural occurrence • Seagrass wrack is generally removed from the beaches when the offshore supply of available seagrass is exhausted • Average accumulation of wrack on beaches west of Port Geographe is ~60 000–80 000 m^3 per annum
Hydrogen sulfide (H_2S) generation	ChemCentre The University of Western Australia Seashore Engineering Pty Ltd (ChemCentre 2010, Oldham et al. 2010, Seashore Engineering 2015)	2010–2014	• H_2S generation when large accumulations of wrack in nearshore saturated zone • Some exceedances of H_2S guideline levels during previous bypassing campaigns with northerly winds
Port Geographe Sand and Seagrass Wrack Modelling Study	The University of Western Australia (Pattiaratchi & Wijeratne 2011)	2011	• Curved breakwater configuration would accelerate and enhance wrack and sand transport processes • Optimum performance of the reconfiguration will be achieved once adjacent beach profiles and offshore bathymetry stabilise around the new structures • Maintenance works will shift from bypassing of sand and wrack to management of harbour entrance channel accumulations

Study type	Organisation (and reference)	Timeframe	Key outcomes
Port Geographe harbour entrance channel flushing	The University of Western Australia (Pattiaratchi & Wijeratne 2016)	2016	• The modelled e-folding times for the existing configuration of the coastal structures ranged from three days (close to the entrance to the artificial waterways) to ~20 days (for locations furthest from the entrance to the waterways) • Depth variations in the entrance channel caused a larger difference in the e-folding times between entrance configurations of -1.8 m chart datum (CD) and -1.3 m CD • Movements of particles inside the artificial waterways were strongly affected by tidal and seiche-induced currents
Shoreline movement and sediment transport in Geographe Bay	Riedel & Byrne Consulting Engineers Pty Ltd Damara WA Pty Ltd Shore Coastal Pty Ltd Seashore Engineering Pty Ltd BMT JFA Consultants Pty Ltd (Riedel & Byrne 1990, Damara WA 2010, 2011; Shore Coastal 2010, 2014; Seashore Engineering 2014, BMT JFA 2015b)	1941–2015	• Historical shoreline movement highly dynamic • Predominantly eastward alongshore sediment transport • Sand supply from offshore Wonnerup sand bar • Sediment budget for Port Geographe indicates 20 000–65 000 m^3 naturally bypassed per year
Metocean conditions	BMT JFA Consultants Pty Ltd (BMT JFA 2015c)	2014	• Eastward surface currents across the Port Geographe development • Ebb and flood tide currents in the harbour entrance channel show oscillations of 30–40 min periods
Sediment and wrack quality	BMT Oceanica Pty Ltd (Oceanica & BMT JFA 2012, Oceanica 2013, BMT Oceanica 2014a, 2015a)	2012–2015	• Sediment and wrack material within the PGCMA is generally clean and contains no contaminants at levels of concern
Environmental monitoring during maintenance works	BMT JFA Consultants Pty Ltd BMT Oceanica Pty Ltd (BMT JFA 2015d,e)	2012–2014	• Seagrass meadow edge changes during capital and maintenance works within expected natural variability • Minor impacts on marine environmental quality and recreational amenity from temporary/localised increased water column turbidity

Metocean conditions

Wave and current measurements were collected at three locations in the Port Geographe development and using GPS drogues from October–December 2014 following the breakwater reconfiguration (BMT JFA 2015c). Current measurements outside of the harbour entrance channel showed evidence of ebb and flood tides in addition to predominantly easterly nearshore currents along the coast. Wind conditions and tides were found to influence currents and occasional long periods of easterly flow along the coast (BMT JFA 2015c).

Within the inner entrance channel and the Port Geographe canals, ebb and flood tide currents were aligned with the channel direction. A consistent oscillation at 30–40 minutes was measured at the inner entrance channel, with initial observations suggesting this is related to periods of increased swell waves (BMT JFA 2015c).

Shoreline movement

Shoreline movement along Geographe Bay is highly dynamic, being influenced by coastal structures, offshore sand bars, drain outlets and variability in climatic conditions. Prior to construction of the Port Geographe development, the erosion from updrift groyne fields and the eastward migration of salients (typically associated with large offshore sand bars) influenced the shoreline in the vicinity of Port Geographe (Shore Coastal 2010, Damara WA 2011). The construction of Port Geographe in the late 1990s introduced the requirement for the alongshore sediment supply to downdrift beaches in the Wonnerup area to be provided by mechanical sand bypassing. Modelling by The University of Western Australia (UWA) found that the 2013/2014 reconfiguration of the Port Geographe breakwaters and re-alignment of the adjacent beaches would facilitate the eastward movement of sediment across the development once the Western Beach was saturated with sand and the new equilibrium beach profile was achieved (see below for more detail; Pattiaratchi & Wijeratne 2011).

Sediment transport

Sediment transport rates across Geographe Bay are influenced by the direction of storm events and the interaction with varying coastal orientations and exposure (Damara WA 2011). There are summer/winter cycles in cross shore sediment transport in Geographe Bay with onshore transport in summer and offshore transport in winter (Damara WA 2010). This leads to the formation of beach erosion scarps and offshore sand bars over winter, with gradual onshore migration of the sand bar and restoration of the beach profile in summer (Damara WA 2010).

A sediment budget for Port Geographe was developed using aerial imagery of Geographe Bay from 1941 to 2008 (Damara WA 2011). This analysis concluded that 20 000–30 000 m^3 was bypassed eastwards at Port Geographe annually. A sediment budget of Wonnerup found that the Wonnerup sand bar feeds 25 000–35 000 m^3 into the Wonnerup area annually; there is 15 000–20 000 m^3 of eastward alongshore sediment supply into Wonnerup annually; and 40 000–50 000 m^3 of eastward alongshore sediment transport out of the Wonnerup area annually.

Historical estimates of the required bypassing volumes at Port Geographe are based on annual longshore sediment transport rates varying from 20 000–65 000 m^3. Between 2009 and 2012 an average of ~55 000 m^3 of sand per annum was removed from the Western Beach and deposited at Wonnerup Beach during bypassing campaigns (BMT JFA 2015b). During the management of multiple dredging and sand bypassing campaigns at Port Geographe over recent years, specialist consultants have estimated that the average alongshore sediment transport rate is 65 000 m^3 per annum (Seashore Engineering 2014, BMT JFA 2015b).

Wrack and sand transport modelling

The recommended layout of the Port Geographe breakwater reconfiguration was modelled by UWA to determine whether it would accelerate and enhance wrack and sand transport processes, and reduce seagrass wrack accumulation (Pattiaratchi & Wijeratne 2011). The modelling exercise found the following:

- Natural bypassing of sand and seagrass wrack from west to east across the development can occur once the Western Beach is saturated with sand. The performance of the reconfiguration will not be optimised until this occurs.
- Occasional trapping of small quantities of seagrass wrack may occur from time to time across the development.
- The recommended layout was predicted to cause the least amount of siltation in the harbour entrance channel compared to other reconfiguration options.
- The design of the eastern end of the revetment improves conditions that previously caused erosion to the western end of Wonnerup Beach.
- The reconfiguration will potentially alter the coastal management focus from bypassing of seagrass wrack and sediment from the Western Beach to sediment management within the harbour entrance channel.

Harbour entrance channel modelling

Hydrodynamic modelling studies have been completed by UWA to understand the influence of obstructions within the harbour entrance channel on water exchange and flushing (Pattiaratchi & Wijeratne 2016). The study modelled four different scenarios for the cross sectional area of the Port Geographe harbour entrance channel with depths at -2.8 m chart datum (CD; the design depth of the channel), -2.3 m CD, -1.8 m CD and -1.3 m CD. The study found that there was a substantial change in flushing and water exchange characteristics in the artificial waterways between the results from the -1.8 m CD and -1.3 m CD scenarios. Mean tidal amplitudes within the artificial waterways decreased by 5% for the -1.8 m CD scenario and by 15% for the -1.3 m CD scenario, when compared with the modelled results from the scenario with a design depth of -2.8 m CD. E-folding flushing times increased by 12% for the -1.8 m CD scenario and 35% for the -1.3 m CD scenario when compared with the modelled results from the scenario with a design depth of -2.8 m CD.

Nearshore bathymetry

Since 2013, the nearshore bathymetry in the vicinity of Port Geographe has been influenced by the reconfiguration works. Changes observed from comparison of pre- and post-reconfiguration hydrographic surveys have shown widening of the Western Beach, re-alignment of the breakwaters, relocation and reorientation of the navigable entrance channel, release of sediment trapped in pocket beaches and the disposal of sediments in offshore, nearshore and beach areas (BMT JFA 2015e).

A post-construction and beach nourishment hydrographic and topographic survey was completed in November 2014 across the entire PGCMA. These data are considered to be the initial benchmark survey and will be used to assess future performance of the reconfigured coastal structures and comparison with future surveys will assist with identifying the need for maintenance works.

Benthic habitats

The benthic habitat within Geographe Bay is predominantly seagrass beds (Oldham et al. 2010). The most common seagrasses within Geographe Bay are *Posidonia australis*, which covers 60% of the bay, and *Amphibolis antarctica* (Oldham et al. 2010). Seagrass meadows are present ~600 m offshore of the Port

Geographe development (outside of the PGCMA), with some smaller patches of seagrass closer to shore (Figure 2-1). The remaining substrate within Geographe Bay is typically bare sand, with some patches of shallow limestone outcrops (DAL et al. 1995, DEC 2013).

Seagrasses within Geographe Bay shed their leaves annually and these leaves are stored offshore in seagrass meadows and unvegetated zones during spring, summer and autumn (Oldham et al. 2010). During storms in late-autumn and winter each year, the leaves are transported inshore and large quantities of wrack are deposited on Geographe Bay beaches as a result of high water levels (Oldham et al. 2010). It is estimated that 32 600–35 200 tonnes of seagrass wrack is generated annually in Geographe Bay (Oldham et al. 2010).

Wrack will usually remain on the beach for days or weeks until a subsequent storm transports the wrack alongshore. Smaller, thin aggregations of seagrass wrack below high water level are likely to be moved naturally while larger aggregations (>1 m) above high water level are only likely to move during storm events and high water periods such as spring tides (Oldham et al. 2010). Seagrass wrack is generally removed from the beaches when the offshore supply of available seagrass is exhausted (Pattiaratchi et al. 2011). Physical and chemical degradation of the material takes place as the wrack is transported on and off beaches, with nutrients ultimately returned to the marine environment.

During the management of multiple wrack bypassing campaigns at Port Geographe, specialist consultants have estimated that the average accumulation of wrack on the beaches in the western section of the PGCMA has previously been in the order of ~60 000–80 000 m^3 per annum (Seashore Engineering 2014, BMT JFA 2015a).

Hydrogen sulfide generation

The Department of Health (DoH) provides odour guidelines relating to human health effects from exposure to H_2S (Table 2-5). The DoH notes that the 2 ppm H_2S limit is associated with bronchial effects in some asthmatics. The other limit values include safety margins and therefore an exceedance does not necessarily mean a health consequence (DoH 2015).

Table 2-5 Recommended hydrogen sulfide exposure limits for public protection

Limit (ppm)	Averaging timeframe[1]
2	30 minutes
0.1	24 hours
0.014	90 days

Source: DoH (2015)
Notes:
1. The averaging timeframe is the time over which the measured level of H_2S in air is averaged, and relates to potential short- or long-term effects.
2. ppm = parts per million

Monitoring of H_2S generation during wrack bypassing works has been completed since 2008. During maintenance activities (such as mechanical bypassing), large quantities of H_2S can be released over a short period of time which can potentially result in adverse health effects (ChemCentre 2010). Investigations by Oldham et al. (2010) found that H_2S production is likely to be greatest in accumulations of fresh seagrass wrack within the nearshore saturated zone. Data collected from 2010–2014 were examined to determine past exceedances of DoH guidelines during the works (Seashore Engineering 2015). The review found three recorded occasions where the DoH 30 minute guideline of 2.0 ppm H_2S was exceeded. These three occasions coincided with light northerly winds during the bypassing works (Seashore Engineering 2015). There were up to 11 recorded occasions where the 24 hour guideline of 0.1 ppm H_2S was exceeded, though

some of the 2010 exceedances were considered to be associated with instrument/calculation error (Seashore Engineering 2015).

Water and sediment quality

Geographe Bay generally experiences high water clarity, however episodes of naturally high levels of turbidity occur between autumn and spring due to the mobilisation of wrack and sediment into the water column during storm events. Sediment and wrack sampling and analyses have been completed on numerous occasions within the PGCMA to assess for elevated levels of contaminants:

- wrack sampled from the harbour entrance channel in January 2012 prior to maintenance dredging works (Oceanica & BMT JFA 2012)
- sediment sampled from the Port Geographe marina and proposed capital dredging channel and breakwater footprint in December 2012 (Oceanica 2013)
- sediment sampled from the Port Geographe canals in May 2014 for proposed maintenance dredging (BMT Oceanica 2014a)
- sediment sampled from the Western Beach, nearshore & offshore areas of the PGCMA, and Wonnerup Beach in August 2015 and May 2019 for proposed maintenance dredging and bypassing works (BMT Oceanica 2015a; BMT 2019).

All of the sampling results indicated that the sediments and wrack were generally clean and concentrations of metals, organotins, and hydrocarbons were all below the relevant guidelines (Oceanica & BMT JFA 2012, Oceanica 2013, BMT Oceanica 2014a, BMT Oceanica 2015a).

Environmental monitoring during works

The environmental impact assessments prepared for previous maintenance dredging and bypassing campaigns identified an increase in water column turbidity and smothering of seagrass meadows during offshore disposal as the key environmental issues that could arise during the campaigns (Oceanica 2013, BMT Oceanica 2014a, 2015a). These issues were actively monitored and managed during the previous maintenance campaigns in accordance with Dredging Environmental Management Plans (BMT Oceanica 2014b,c).

The bypassing and capital and maintenance dredging close-out reports (BMT JFA 2015d,e) describe the results of the environment monitoring during the works and confirmed that none of the above issues resulted in an adverse environmental impact. Turbidity monitoring indicated that considerable reductions in water clarity at the dredging and disposal sites recovered within a few days (BMT JFA 2015d,e). Monitoring of the seagrass meadows in the vicinity of the offshore disposal area indicated some areas of change in the seagrass meadow edge. After detailed analysis of multi-beam back scatter data from 2013–2014, the changes were found to be within the expected natural variability of seagrass movements and/or likely to be caused by natural physical disturbances, such as storms, rough conditions or localised currents (BMT JFA 2015e).

2.4.2 Key assumptions and uncertainties

There are a number of key assumptions and uncertainties associated with the reconfigured Port Geographe coastal structures and their ongoing management. They are primarily related to the wrack and sand modelling completed prior to the reconfiguration works (Pattiaratchi & Wijeratne 2011, Section 2.4.1), and the ongoing maintenance requirements of the development.

It is anticipated that the reconfiguration will enhance the natural coastal processes of wrack and sediment movement, and facilitate adequate water exchange through the harbour entrance channel as predicted by the modelling study (Pattiaratchi & Wijeratne 2011, 2016; Section 2.4.1). If this occurs, then it is anticipated that minimal maintenance works will be required, and in some years, no maintenance works will be needed as the reconfiguration is performing as designed under typical metocean conditions. If any maintenance works are required to fulfil DoT's commitments under Ministerial Statement 990, it is expected that these works will be of small-scale and short duration, and therefore significant environmental impacts are not expected (based on results of environmental monitoring completed for previous maintenance dredging and bypassing campaigns at Port Geographe, Section 2.4.1).

It is assumed from the results of the modelling study (Pattiaratchi & Wijeratne 2011) that:

- The conceptual modelling work will translate to the physical site bringing about improved natural bypassing of sediment and wrack.
- The reconfigured entrance channel delivers satisfactory flushing rates and water exchange to artificial waterways, maintaining water, sediment and biota quality.
- There will be occasional trapping of small quantities of seagrass wrack across the development.
- Drifting of sediment and wrack across the face of the development will not considerably impact water exchange between marine waters and the artificial waterways.

However, some uncertainties remain:

- Littoral drift capacity from the Western Beach to Wonnerup Beach is uncertain.
- It is uncertain to what degree H_2S levels will be lowered by the reduction in saturated wrack volumes on the Western Beach.
- Impacts of natural bypassing of sediment across the harbour entrance channel are uncertain with some increase in sediment management expected due to siltation. This could affect timing of maintenance dredging works required to maintain navigational safety.

Understanding of the project attributable impacts on wrack and sediment movement continue to improve as the natural coastal processes adjust to the reconfigured coastal structures. Adaptive monitoring and management is ongoing in three key areas of the PGCMA – the Western Beach, Wonnerup Beach and the harbour entrance channel – to assist with this understanding. Flexible and adaptive management and maintenance works will be required to manage these ongoing uncertainties.

2.4.3 Management approach

The management of Port Geographe via this EMMP is focused on monitoring and management of three key components:

- seagrass wrack accumulations
- sediment movement
- harbour entrance channel depths.

These three components are directly related to Conditions 4–7 in Ministerial Statement 990, and are addressed in separate implementation sections of the EMMP (see Section 3). Each of the condition environmental objectives for seagrass wrack management, sediment movement and the harbour entrance channel are intended to be protective of the EPA environmental factors (and corresponding environmental objectives) described in Section 2.2. The risk-based management actions (see Sections 3.1.2, 3.2.2 and

3.3.2) and the reviewed and revised management actions (see Sections 3.1.5, 3.2.5 and 3.3.5) have been developed in accordance with the mitigation hierarchy (avoid, minimise, rehabilitate, offset; as per Section 6.3.2 of EAG17; EPA 2015) to ensure the condition environmental objectives (and the EPA environmental objectives) can be met (Section 2.4.4). DoT recognises that there is some overlap of the monitoring and management actions between the three components, but for completeness, they are repeated in the individual component sections in Section 3 to ensure that it is clear how the condition environmental objective for each component (and ultimately the EPA environmental objective for each key environmental factor) will be met.

There are potential impacts on the environment due to the presence of the Port Geographe coastal structures development. DoT also recognises that completing maintenance works to alleviate these environmental impacts also has the potential to affect the environment. Therefore it is proposed that monitoring and management under the EMMP is implemented through a staged approach. This will allow for adequate consideration of the causal factors and determination of the most appropriate management responses. The first stage involves routine monitoring and management to determine the performance of the reconfigured coastal structures in enhancing natural coastal processes, and the need to complete maintenance works based on the results of the monitoring. The second stage of monitoring and management is required when maintenance works are deemed necessary, and it will focus on the potential impact on the environment during the maintenance works.

Prior to the start of any maintenance works, an EMP specific to the type of maintenance is required based on monitoring and management detailed in this EMMP. This will include the current monitoring and management requirements, but will also be amended, if necessary, to include additional requirements if future sampling or reviews indicate environmental or socio-economic issues that have not been previously identified.

2.4.4 Rationale for choice of management actions

The management targets and management actions identified in the following sections of the EMMP have been developed based on the mitigation hierarchy (avoid, minimise, rehabilitate, offset; EPA 2015), and detailed reviews of the various baseline studies, modelling studies, and environmental, metocean, and engineering investigations completed for the Port Geographe development over a number of years (Section 2.4.1). Previous dredging, bypassing and nourishment campaigns completed at Port Geographe informed the various management targets for seagrass wrack management, sediment movement, and maintenance of the harbour entrance channel. For each of these campaigns, the close-out reports, results of environmental monitoring, and subsequent recommendations were reviewed to assist with developing the most appropriate management targets and management actions to ensure the impact on the environment from the presence of the Port Geographe coastal structures and any required maintenance works is firstly avoided, and then minimised as far as practicable.

The staged management approach presented in Section 2.4.3 and the monitoring and management actions outlined in the EMMP are considered to be consistent with DoT's Maintenance Dredging Environmental Management Framework (EMF; BMT 2020, Appendix C) which applies to DoT's ongoing statewide maintenance dredging program. Previous revisions of the EMF has been regularly reviewed, revised, and provided to environmental regulatory authorities (such as Department of Biodiversity, Conservation and Attractions and Department of Water and Environmental Regulation [DWER]). The EMF has previously been acknowledged by DWER as a reasonable management framework for managing the maintenance activities being completed at Port Geographe from 2013–2016 prior to the development and implementation of this EMMP (letter dated 8/10/14; reference: ST07-2013-0007).

Context, Scope and Rationale

DoT has had a long association with the Port Geographe development and its environmental issues, and has been responsible for coastal management activities since 2009. Based on that experience, previous studies, and the anticipated short-term duration and small-scale nature of the anticipated maintenance works, the choice of management actions and targets are considered to be appropriate to minimise and mitigate any environmental impacts, and ensure effective and efficient environmental management in order to achieve the environmental objectives stated in Section 2.2.

3 Implementation of the EMMP

3.1 Seagrass wrack management

Seagrass wrack is deposited on Geographe Bay beaches and is transported naturally alongshore. The reconfigured Port Geographe coastal structures aim to enhance this natural transport of wrack alongshore. If wrack accumulates in large quantities against the coastal structures, the degradation of this material can release H_2S and affect beach amenity and air quality. Management of wrack at Port Geographe may involve mechanical bypassing of material from the western side to the eastern side of the Port Geographe coastal structures.

3.1.1 Condition environmental objective

Minimise the impact on the environment and human health due to trapped seagrass wrack.

3.1.2 Management actions

Risk-based management actions (Table 3-1) have been identified and prioritised to achieve the condition environmental objective stated above (Section 3.1.1), and the EPA's environmental objectives (Section 2.2). These management actions focus the greatest management effort on minimising large accumulations of wrack on the Western Beach and reducing the impacts on seagrass meadows if maintenance works (mechanical bypassing and offshore disposal) are required. These management actions were specifically developed to minimise the impact on the environment and human health due to trapped seagrass wrack. The management actions assist with achieving the EPA's environmental objectives outlined in Section 2.2 by:

- ensuring littoral transport is not interrupted by monitoring coastal conditions and completing maintenance works (key environmental factor: coastal processes)
- removing large accumulations of wrack on the coast that generate harmful levels of H_2S (key environmental factor: air quality, social surroundings, human health)
- completing environmental monitoring of water quality for the maintenance works (key environmental factor: marine environmental quality)
- completing environmental monitoring of turbidity during maintenance works to avoid and minimise impacts to seagrass (key environmental factor: benthic communities and habitats)
- completing environmental monitoring of seagrass meadows for the maintenance works (when disposing offshore) to avoid and minimise impacts to seagrass (key environmental factor: benthic communities and habitats).

These management actions will be implemented by DoT for the Port Geographe development.

Table 3-1 Risk-based management actions that will be implemented to meet the condition environmental objective relating to seagrass wrack management

Environmental factor	Environmental objective	Impacts	Management actions	Risk-based priority	Timing
Coastal processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected	Interrupted littoral transport and accumulation of wrack	Implement coastal monitoring program (Table 3-3)	Medium, adverse impact	All project phases
Air quality/Social surroundings/Human health	To maintain air quality and minimise emissions so that environmental values are protected To protect social surroundings from significant harm To protect human health from significant harm	Increased H_2S levels from accumulated wrack	Monitor H_2S levels	Medium, adverse impact	Annually, Autumn to Spring
Marine environmental quality	To maintain the quality of water, sediment and biota so that the environmental values are protected	Reduced water clarity due to suspended sediment and wrack	Complete maintenance works in accordance with an Environmental Management Plan Complete turbidity monitoring (nearshore & offshore dredging/disposal)	Low, adverse impact	During maintenance works (nearshore and offshore dredging/disposal)

Environmental factor	Environmental objective	Impacts	Management actions	Risk-based priority	Timing
Benthic communities and habitat	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained	Smothering/reduced light penetration to nearby seagrass meadows during maintenance works (with offshore disposal)	Complete maintenance works in accordance with an Environmental Management Plan Complete turbidity monitoring (nearshore & offshore dredging/disposal) Complete seagrass meadow monitoring (offshore dredging/disposal)	Low, adverse impact	Before, during, and after maintenance works (offshore dredging/disposal)

Notes:
1. H_2S = hydrogen sulphide.
2. Environmental objectives as defined in EPA (2020).

3.1.3 Management targets

A number of management targets will be employed to measure and report against achievement of the condition environmental objective (Table 3-2). The outcomes of the Port Geographe capital dredging and breakwater reconfiguration project and previous wrack bypassing campaigns (Section 2.4) have informed the specific management targets.

Table 3-2 Management targets to measure the efficacy of management actions related to the seagrass wrack management condition environmental objective

Condition environmental objective	Minimise the impact on the environment and human health due to trapped seagrass wrack
Management target #1	Maintain natural beachfront wrack dynamics by ensuring less than 60 000 m^3 of wrack is on the Western Beach by December each year
Management target #2	24 hour average H_2S concentrations adjacent to the Western Beach do not exceed Department of Health guidelines of 0.1 ppm
Management target #3	Weekly (rolling 7-day) median light attenuation coefficient (LAC) values at impact sites do not exceed the 80th percentile of the reference sites for two consecutive weeks (if completing offshore disposal during maintenance works)
Management target #4	No change in position of seagrass meadow edge outside of the predicted zone of influence of the offshore disposal area beyond natural variability (if completing offshore disposal during maintenance works)

Note:
1. H_2S = hydrogen sulfide gas, ppm = parts per million.

3.1.4 Monitoring

The purpose of the monitoring program is to inform, through the management targets, if the condition environmental objective is being achieved and when management actions will have to be reviewed and revised. This section describes how DoT will complete routine monitoring to assess the performance of the Port Geographe coastal structures in promoting natural wrack dynamics, and also the monitoring that will be completed during maintenance works (if required) to determine whether the management targets are achieved.

Routine monitoring

Routine monitoring tasks will be completed by DoT. DoT will implement a routine coastal monitoring program that will involve collecting, analysing and interpreting a number of coastal datasets over various timeframes (Table 3-3). Routine H_2S monitoring will be completed between Autumn and Spring adjacent to the Western Beach (Table 3-3).

Table 3-3 Routine monitoring to measure the efficacy of management actions against the management targets for seagrass wrack management

Parameter	Method	Location	Frequency
Seagrass wrack accumulation	Aerial photography	Western Beach (Freycinet Drive to Guerin Street)	At least once between Autumn and Spring each year
	Site inspections by coastal technical advisor and photo monitoring		Approximately monthly, Autumn to Spring
	Hydrographic and/or topographic surveys		Three times per year
Hydrogen sulfide (H_2S) generation	H_2S monitoring using in situ measuring and data logging device	Adjacent to Western Beach	Annually, Autumn to Spring

If the results of the routine monitoring indicate that the relevant management targets have not been met, then maintenance works (mechanical wrack bypassing) will likely be completed (as outlined in Section 2.1.1).

During-works monitoring

Monitoring during maintenance works will be completed in accordance with the methods in Table 3-4 and described in detail in an EMP. Monitoring will focus on the key issues of water column turbidity, smothering and reduction of light for seagrass meadows, and H_2S generation. The EMP will also consider other environmental management measures to further reduce the impact of the works on the environment as per the EMF (BMT 2020, Appendix C).

Weekly environmental monitoring checklists will be prepared during the maintenance works to identify any environmental issues, assess conformance with the EMP, and communicate any issues with collection of environmental monitoring data. Results of the during-works monitoring are reviewed frequently to determine whether there is any need to review and revise the management actions as per Section 3.1.5 below.

Table 3-4 During-works monitoring to measure the efficacy of management actions against the management targets for seagrass wrack management

Parameter	Method	Location	Frequency
Water column turbidity	Site photographs	Dredging and disposal areas	Daily during works
	Plume sketches[1]		Daily during works
	Aerial photography		Once during works
	Secchi depths[1]	Offshore disposal area	Daily during works (when offshore disposal occurring)
Light attenuation[2]	In situ data loggers or hand-held meter	Impact sites in seagrass meadow adjacent to offshore disposal area, reference sites west of Port Geographe	Before, during and after offshore disposal
Seagrass meadow edge[3]	Multi-beam surveys and/or towed video surveys	Seagrass meadow edge adjacent to offshore disposal area	Before and after offshore disposal
Hydrogen sulfide (H_2S) generation[4]	H_2S monitoring using in situ measuring and data logging device	Adjacent to Western Beach	Daily during works

Notes:
1. See Appendix D for example plume sketch and Secchi depth record templates.
2. If offshore dredging/disposal is undertaken, monitoring of light levels over seagrass meadows will be done before, during and after works. Suitable locations for 1–2 impact and 2–4 reference sites for light monitoring will be determined prior to offshore disposal. The impact sites will likely be in the seagrass meadow north of the offshore disposal area, and reference sites likely to the west of Port Geographe (Figure 2-2).
3. If offshore dredging/disposal is undertaken, the seagrass meadow edge position will be monitored at 2–4 locations outside of the predicted zone of influence of the offshore disposal area. The monitoring sites will likely be to the west of Port Geographe (Figure 2-2).
4. Odour monitoring will be required if wrack is expected to be present in the material to be bypassed and monitoring will be completed. Odour monitoring during maintenance works will be completed using 1 odour logger adjacent to the Western Beach on a continuous basis. This area is considered to pose the highest risk for potential odour issues.

3.1.5 Review and revision of management actions

Where the management target(s) are not met or exceeded, DoT will review and revise the risk assessment and management actions and potentially identify additional management actions in accordance with the mitigation hierarchy (avoid, minimise, rehabilitate, offset; as per Section 6.3.2 of EAG17; EPA 2015), where necessary. During this process, the risks, key impacts, and associated management actions for seagrass wrack management will be reviewed and revised. The following are examples of revised and additional management actions for each of the impacts listed in Table 3-1:

(1) Interrupted littoral transport and accumulation of wrack

- (i) Increase frequency of coastal monitoring program
- (ii) Revise coastal monitoring program
- (iii) Revise method/frequency/timing of maintenance works to reduce accumulated wrack volumes
- (iv) Issue community notice and install appropriate warning signs regarding conditions.

(2) Increased H_2S levels from accumulation of wrack

- (i) Push seagrass wrack to the back of the beach as far as practicable to reduce potential for H_2S generation
- (ii) Revise H_2S monitoring program

(iii) Issue community notice and install appropriate warning signs regarding potential odour issues.

(3) Smothering or reduction of light penetration on nearby seagrass meadows during maintenance works (with offshore disposal)

(i) Revise dredging and/or disposal methods and/or locations

(ii) Consider seagrass shoot density monitoring adjacent to offshore disposal area (and at reference sites) in consultation with the DWER

(iii) Seagrass meadow edge monitoring after end of maintenance works.

Reviewed and revised management actions will be implemented by DoT to mitigate and manage any impacts so that the management targets and the condition environmental objective for seagrass wrack management are met.

3.1.6 Reporting

Annual reporting

The annual Statement of Compliance, required to be submitted by DoT to fulfil Condition 3-6 of Ministerial Statement 990, will state whether the condition environmental objective for seagrass wrack management has been met (Table 3-5). In the event that the condition environmental objective is not achieved during the reporting period, the Statement of Compliance will include a description of the effectiveness of revised and/or additional management actions implemented by DoT and an analysis of the trends from the monitoring results.

The annual Statement of Compliance will be submitted by 26 February each year in accordance with Condition 3-6 of Ministerial Statement 990.

Table 3-5 EMMP reporting table for condition environmental objective relating to seagrass wrack management

Key environmental factors: Coastal processes, marine environmental quality, benthic communities and habitat, air quality, social surroundings and human health (Ministerial Statement 990, Conditions 5-1, 6, 7)		
Management targets for seagrass wrack management	**Reporting on the management target**	**Status**
Management target #1: Maintain natural beachfront wrack dynamics by ensuring less than 60 000 m^3 of wrack is on the Western Beach by December each year	Natural beachfront wrack dynamics were/were not maintained	■ YES ■ NO
Management target #2: 24 hour average H_2S concentrations adjacent to the Western Beach do not exceed Department of Health guidelines of 0.1 ppm	Department of Health H_2S 24 hour average guidelines were/were not exceeded	■ YES ■ NO
Management target #3: Weekly (rolling 7-day) median light attenuation coefficient (LAC) values at impact sites do not exceed the 80th percentile of the reference sites for two consecutive weeks (if completing offshore disposal during maintenance works)	Weekly median LAC values at impact sites did/did not exceed the 80th percentile of the reference sites for two consecutive weeks	■ YES ■ NO
Management target #4: No change in position of seagrass meadow edge outside of the predicted zone of influence of the offshore disposal area beyond natural variability (if completing offshore disposal during maintenance works)	Seagrass meadow edge position did/did not change beyond natural variability	■ YES ■ NO

Notes:
1. The status of achievement of the condition environmental objective is indicated by the following symbols: ■ = achieved ■ = not achieved.
2. H_2S = hydrogen sulphide; ppm = parts per million.

Reporting on exceedances of management targets

If a management target related to seagrass wrack management is exceeded (or not met), the CEO of DWER will be notified within ten days of identification of the exceedance. An investigation report will be prepared that describes the investigation into the exceedance and the corrective management actions in accordance with Condition 7-4 of Ministerial Statement 990.

3.2 Sediment movement

Alongshore sediment transport at Port Geographe is in a predominantly eastward direction. The reconfigured Port Geographe coastal structures aim to enhance this natural transport of sediment alongshore. If sediment accumulates in large quantities against coastal structures, it can indicate an interruption to natural sediment transport processes and result in erosion of downdrift beaches. Management of sediment at Port Geographe may involve mechanical bypassing of material from the western side to the eastern side of the development (see Section 2.1.2) to avoid/remediate erosion on downdrift Wonnerup Beach.

3.2.1 Condition environmental objective

Minimise the impact on the environment and coastal processes due to interruption to sediment movement by the reconfigured coastal structures.

3.2.2 Management actions

Risk-based management actions (Table 3-6) have been identified and prioritised to achieve the condition environmental objective stated above (Section 3.2.1), and the EPA's environmental objectives (Section 2.2). These management actions focus the greatest management effort on minimising project attributable erosion in the PGCMA and reducing the impacts on seagrass meadows if maintenance works (mechanical bypassing and offshore dredging/disposal, and/or nourishment) are required. These management actions were specifically developed to minimise the impact on the environment and coastal processes due to the interruption to sediment movement by the reconfigured coastal structures. The management actions assist with achieving the EPA's environmental objectives outlined in Section 2.2 by:

- ensuring littoral transport is not interrupted by monitoring coastal conditions and completing maintenance works (key environmental factor: coastal processes)
- completing environmental monitoring of water and sediment quality for the maintenance works (key environmental factor: marine environmental quality)
- completing environmental monitoring of turbidity during maintenance works to avoid and minimise impacts to seagrass (key environmental factor: benthic communities and habitats)
- completing environmental monitoring of seagrass meadows for the maintenance works (when disposing offshore) to avoid and minimise impacts to seagrass (key environmental factor: benthic communities and habitats).

These management actions will be implemented by DoT for the Port Geographe development.

Table 3-6 Risk-based management actions that will be implemented to meet the condition environmental objective relating to sediment movement

Environmental factor	Environmental objective	Impacts	Management actions	Risk-based priority	Timing
Coastal processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected	Project attributable erosion at Wonnerup Beach	Implement coastal monitoring program (Table 3-8)	Medium, adverse impact	All project phases
		Project attributable accretion at Western Beach	Implement coastal monitoring program (Table 3-8)	Low, adverse impact	All project phases
Marine environmental quality	To maintain the quality of water, sediment and biota so that the environmental values are protected	Reduced water clarity due to suspended sediment and wrack	Complete maintenance works in accordance with an Environmental Management Plan Complete turbidity monitoring (nearshore and offshore dredging/disposal)	Low, adverse impact	During maintenance works (nearshore and offshore dredging/disposal)
Benthic communities and habitat	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained	Smothering/reduced light penetration to nearby seagrass meadows during maintenance works (with offshore dredging/disposal)	Complete maintenance works in accordance with an Environmental Management Plan Complete turbidity monitoring (nearshore and offshore dredging/disposal) Complete seagrass meadow monitoring (offshore dredging/disposal)	Low, adverse impact	Before, during, and after maintenance works (offshore dredging/disposal)

Note:
1. Environmental objectives as defined in EPA (2020).

3.2.3 Management targets

A number of management targets will be employed to measure and report against achievement of the condition environmental objective (Table 3-7). The outcomes of the Port Geographe capital dredging and breakwater reconfiguration project and previous sediment bypassing campaigns (Section 2.4) have informed the specific management targets.

Table 3-7 Management targets to measure the efficacy of management actions related to the sediment movement condition environmental objective

Condition environmental objective	Minimise the impact on the environment and coastal processes due to interruption to sediment movement by the reconfigured coastal structures
Management target #1	Maintain natural alongshore sediment movement by ensuring less than 30 000 m^3 erosion within Wonnerup Beach (to the eastern extent of the Port Geographe Coastal Management Area) at the end of a rolling two-year period (when compared to the November 2014 survey)
Management target #2	Weekly (rolling 7-day) median light attenuation coefficient (LAC) values at impact sites do not exceed the 80th percentile of the reference sites for two consecutive weeks (if completing offshore disposal during maintenance works)
Management target #3	No change in position of seagrass meadow edge outside of the predicted zone of influence of the offshore disposal area beyond natural variability (if completing offshore disposal during maintenance works)

3.2.4 Monitoring

The purpose of the monitoring program is to inform, through the management targets, if the condition environmental objective is being achieved and when management actions will have to be reviewed and revised. This section describes how DoT will complete routine monitoring to assess the performance of the Port Geographe coastal structures in promoting natural sediment transport, and also the monitoring that will be completed during maintenance works (if required) to determine whether the management targets are achieved.

Routine monitoring

Routine monitoring tasks will be completed by DoT. DoT will implement a routine coastal monitoring program that will involve collecting, analysing and interpreting a number of coastal datasets over various timeframes (Table 3-8). If the results of the routine monitoring indicate that the relevant management targets have not been met, then maintenance works (mechanical sand bypassing/nourishment) will likely be completed (as outlined in Section 2.1.2).

Table 3-8 Routine monitoring to measure the efficacy of management actions against the management targets for sediment movement

Parameter	Method	Location	Frequency
General beach condition	Site inspections by coastal technical advisor and photo monitoring	Beaches within and adjacent to PGCMA	Approximately monthly, Autumn to Spring
	Aerial photography	PGCMA	At least once between Autumn and Spring each year
Beach face and nearshore seabed elevations	Hydrographic and/or topographic surveys	PGCMA and surrounds (large-scale)	Annually (November or December)
		PGCMA (small-scale)	Biannually (in addition to large-scale survey)
Natural sediment transport volumes	Analysis of changes in hydrographic and/or topographic survey data	PGCMA	Annually
Sediment contaminant status	Sediment sampling and analysis as per DoT's Maintenance Dredging Environmental Management Framework (BMT 2020, Appendix C)	Proposed sand bypassing area on Western Beach	Every five years (or prior to maintenance works if period between works is greater than five years)

Note:
1. PGCMA = Port Geographe Coastal Management Area; DoT = Department of Transport.

During-works monitoring

Monitoring during maintenance works will be completed in accordance with the methods in Table 3-9 and described in detail in EMP. Monitoring will focus on the key issues of water column turbidity, and smothering and reduction of light for seagrass meadows. The EMP will also consider other environmental management measures to further reduce the impact of the works on the environment as per the EMF (BMT 2020; Appendix C).

Weekly environmental monitoring checklists will be prepared during the maintenance works to identify any environmental issues, assess conformance with the EMP, and communicate any issues with collection of environmental monitoring data. Results of the during-works monitoring tasks are reviewed frequently to determine whether there is any need to review and revise the management actions as per Section 3.2.5 below.

Table 3-9 During-works monitoring to measure the efficacy of management actions against the management targets for sediment movement

Parameter	Method	Location	Frequency
Water column turbidity	Site photographs	Dredging and disposal site	Daily during works
	Plume sketches[1]		Daily during works
	Aerial photographs		Once during works
	Secchi depths[1]	Offshore disposal area	Daily during works (when offshore dredging/disposal occurring)
Light attenuation[2]	In situ data loggers or hand-held meter	Impact sites in seagrass meadow adjacent to offshore disposal area, reference sites west of Port Geographe	Before, during and after offshore dredging/disposal
Seagrass meadow edge[3]	Multi-beam surveys and/or towed video surveys	Seagrass meadow edge adjacent to offshore disposal area	Before and after offshore dredging/disposal
Hydrogen sulfide (H_2S) generation[4]	H_2S monitoring using in situ measuring and data logging device	Adjacent to Western Beach	Daily during works (if required)

Notes:
1. See Appendix D for example plume sketch and Secchi depth record templates.
2. If offshore dredging/disposal is undertaken, monitoring of light levels over seagrass meadows will be done before, during and after works. Suitable locations for 1–2 impact and 2–4 reference sites for light monitoring will be determined prior to offshore disposal. The impact sites will likely be in the seagrass meadow north of the offshore disposal area, and reference sites likely to the west of Port Geographe (Figure 2-2).
3. If offshore dredging/disposal is undertaken, the seagrass meadow edge position will be monitored at 2–4 locations outside of the predicted zone of influence of the offshore disposal area. The monitoring sites will likely be to the west of Port Geographe (Figure 2-2).
4. Odour monitoring will be required if wrack is expected to be present in the material to be bypassed and monitoring will be completed. Odour monitoring during maintenance works will be completed using 1 odour logger adjacent to the Western Beach on a continuous basis. This area is considered to pose the highest risk for potential odour issues.

3.2.5 Review and revision of management actions

Where the management target(s) are not met or exceeded, DoT will review and revise the risk assessment and management actions and potentially identify additional management actions in accordance with the mitigation hierarchy (avoid, minimise, rehabilitate, offset; as per Section 6.3.2 of EAG17; EPA 2015), where necessary. During this process, the risks, key impacts, and associated management actions for sediment movement will be reviewed and revised. The following are examples of revised and additional management actions for each of the impacts listed in Table 3-6.

(1) Project attributable erosion at Wonnerup Beach

- (i) Increase frequency of coastal monitoring program
- (ii) Revise coastal monitoring program
- (iii) Revise method/frequency/timing of sediment management works to minimise erosion impacts

(2) Project attributable accretion at Western Beach

- (i) Increase frequency of coastal monitoring program
- (ii) Revise coastal monitoring program

(iii) Revise method/frequency/timing of sediment management works to minimise accretion impacts

(3) Smothering or reduction of light penetration on nearby seagrass meadows during maintenance works (with offshore dredging/disposal)

(i) Revise dredging and/or disposal methods and/or locations

(ii) Consider seagrass shoot density monitoring adjacent to offshore disposal area (and at reference sites) in consultation with DWER

(iii) Seagrass meadow monitoring after end of maintenance works.

Reviewed and revised management actions will be implemented by DoT to mitigate and manage any impacts so that the management targets and the condition environmental objective for sediment movement are met.

3.2.6 Reporting

Annual reporting

The annual Statement of Compliance, required to be submitted by DoT to fulfil Condition 3-6 of Ministerial Statement 990 will state whether the condition environmental objective for sediment movement has been met (Table 3-10). In the event that the condition environmental objective is not achieved during the reporting period, the Statement of Compliance will include a description of the effectiveness of revised and/or additional management actions implemented by DoT and an analysis of the trends from the monitoring results.

The Statement of Compliance will be submitted annually by the 26 February in accordance with Condition 3-6 of Ministerial Statement 990.

Table 3-10 EMMP reporting table for condition environmental objective relating to sediment movement

Key environmental factors: Coastal processes, marine environmental quality and benthic communities and habitat (Ministerial Statement 990, Conditions 4–7)		
Management targets for sediment movement	**Reporting on the management target**	**Status**
Management target #1: Maintain natural alongshore sediment movement by ensuring less than 30 000 m^3 erosion within Wonnerup Beach (to the eastern extent of the Port Geographe Coastal Management Area) at the end of a rolling a two-year period (when compared to the November 2014 survey)	Natural alongshore sediment transport was/was not maintained	■ YES ■ NO
Management target #2: Weekly (rolling 7-day) median light attenuation coefficient (LAC) values at impact sites do not exceed the 80th percentile of the reference sites for two consecutive weeks (if completing offshore disposal during maintenance works)	Weekly median LAC values at impact sites did/did not exceed the 80th percentile of the reference sites for two consecutive weeks	■ YES ■ NO
Management target #3: No change in position of seagrass meadow edge outside of the predicted zone of influence of the offshore disposal area beyond natural variability (if completing offshore disposal during maintenance works)	Seagrass meadow edge position did/did not change beyond natural variability	■ YES ■ NO

Note:
1. The status of achievement of the condition environmental objective is indicated by the following symbols: ■ = achieved, ■ = not achieved.

Reporting on exceedances of management targets

If a management target related to sediment movement is exceeded (or not met), the CEO of DWER will be notified within ten days of identification of the exceedance. An investigation report will be prepared that describes the investigation into the exceedance and the corrective management actions in accordance with Condition 7-4 of Ministerial Statement 990.

3.3 Harbour entrance channel

Maintaining the cross-sectional area of the Port Geographe harbour entrance channel will ensure that water exchange between Geographe Bay and the artificial waterways and canals is not restricted. Any substantial restriction of the cross-sectional area of the harbour entrance channel as a result of sand and seagrass wrack accumulation may need to be managed through maintenance dredging campaigns.

3.3.1 Condition environmental objective

Minimise the impact on the environment due to the restricted exchange of water through the harbour entrance channel.

3.3.2 Management actions

Risk-based management actions (Table 3-11) have been identified and prioritised to achieve the condition environmental objective stated above (Section 3.3.1), and the EPA's environmental objectives (Section 2.2). These management actions focus the greatest management effort on minimising restricted exchange of water through the harbour entrance channel and reducing the impacts on seagrass meadows if maintenance works (maintenance dredging and offshore disposal) are required. These management actions were specifically developed to minimise the impact on the environment due to the restricted exchange of water through the harbour entrance channel. The management actions assist with achieving the EPA's environmental objectives outlined in Section 2.2 by:

- ensuring harbour entrance channel is not restricted by monitoring channel depths and completing maintenance dredging works (key environmental factor: marine environmental quality)
- completing environmental monitoring of water and sediment quality for the maintenance works (key environmental factor: marine environmental quality)
- completing environmental monitoring of turbidity during maintenance works to avoid and minimise impacts to seagrass (key environmental factor: benthic communities and habitats)
- completing environmental monitoring of seagrass meadows for maintenance works (when disposing offshore) to avoid and minimise impacts to seagrass (key environmental factor: benthic communities and habitats).

These management actions will be implemented by DoT for the Port Geographe development.

Table 3-11 Risk-based management actions that will be implemented to meet the condition environmental objective relating to the harbour entrance channel

Environmental factor	Environmental objective	Impacts	Management actions	Risk-based priority	Timing
Marine environmental quality	To maintain the quality of water, sediment and biota so that the environmental values are protected.	Restricted flushing and water circulation leading to poor water quality	Implement coastal monitoring program (Table 3-13)	Medium, adverse impact	All project phases
		Reduced water clarity due to suspended sediment and wrack	Complete maintenance works in accordance with an Environmental Management Plan Complete turbidity monitoring (nearshore and offshore disposal)	Low, adverse impact	During maintenance works (nearshore and offshore disposal)
Benthic communities and habitat	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained	Smothering/reduced light penetration to nearby seagrass meadows during maintenance works (with offshore disposal)	Complete maintenance works in accordance with an Environmental Management Plan Complete turbidity monitoring (nearshore and offshore disposal) Complete seagrass meadow monitoring (offshore disposal)	Low, adverse impact	Before, during, and after maintenance works (offshore disposal)

Note:
1. Environmental objectives as defined in EPA (2020).

3.3.3 Management targets

A number of management targets will be employed to measure and report against achievement of the condition environmental objective (Table 3-12). The outcomes of the Port Geographe capital dredging and breakwater reconfiguration project, previous maintenance dredging campaigns and research completed by UWA on water exchange through the entrance channel (Pattiaratchi & Wijeratne 2016, Section 2.4.1) have informed the specific management targets.

Table 3-12 Management targets to measure the efficacy of management actions relative to the harbour entrance channel condition environmental objective

Condition environmental objective	Minimise the impact on the environment due to the restricted exchange of water through the harbour entrance channel
Management target #1	Maintain cross sectional area of harbour entrance channel (below mean sea level) to no less than 120 m^2 for two consecutive surveys.
Management target #2	Weekly (rolling 7-day) median light attenuation coefficient (LAC) values at impact sites do not exceed the 80th percentile of the reference sites for two consecutive weeks (if completing offshore disposal during maintenance works)
Management target #3	No change in position of seagrass meadow edge outside of the predicted zone of influence of the offshore disposal area beyond natural variability (if completing offshore disposal during maintenance works)

3.3.4 Monitoring

The purpose of the monitoring program is to inform, through the management targets, if the condition environmental objective is being achieved and when management actions will have to be reviewed and revised. This section describes how DoT will complete routine monitoring to assess the performance of the Port Geographe coastal structures in maintaining the functionality of the harbour entrance channel, and also the monitoring that will be completed during the maintenance works (if required) to determine whether the management targets are achieved.

Routine monitoring

Routine monitoring tasks will be completed by DoT. DoT will implement a routine coastal monitoring program that will involve collecting, analysing and interpreting a number of coastal datasets over various timeframes (Table 3-13). If the results of the routine monitoring indicate that the relevant management targets have not been met, then maintenance works (maintenance dredging) will likely be completed (as outlined in Section 2.1.3).

Table 3-13 Routine monitoring to measure the efficacy of management actions against the management targets for the harbour entrance channel

Parameter	Method	Location	Frequency
Harbour entrance channel sand/wrack accumulation	Site inspections by coastal technical advisor and photo monitoring	Harbour entrance channel	Approximately monthly, Autumn to Spring
Harbour entrance channel cross-sectional area	Hydrographic surveys	Harbour entrance channel	Three times per year
General water quality	Visual observations during site inspections	Harbour entrance channel and adjacent coastal waters	Approximately monthly, Autumn to Spring
Sediment/wrack contaminant status	Sediment sampling and analysis as per DoT's Maintenance Dredging Environmental Management Framework (BMT 2020, Appendix C)	Proposed dredging areas in harbour entrance channel	Every five years (or prior to dredging campaign if period between works is greater than five years)

Note:
1. DoT = Department of Transport.

During-works monitoring

Monitoring during maintenance works will be completed in accordance with the methods in Table 3-14 and described in detail in an EMP. Monitoring will focus on the key issues of water column turbidity, smothering and reduction of light for seagrass meadows, and H_2S generation. The EMP will also consider various other environmental management measures to further reduce the impact of the works on the environment as per the EMF (BMT 2020, Appendix C).

Weekly environmental monitoring checklists will be prepared during the maintenance works to identify any environmental issues, assess conformance with the EMP and communicate any issues with collection of environmental monitoring data. Results of the during-works monitoring tasks are reviewed frequently to determine whether there is any need to review and revise the management actions as per Section 3.3.5 below.

Table 3-14 During-works monitoring to measure the efficacy of management actions against the management targets for the harbour entrance channel

Parameter	Method	Location	Frequency
Water column turbidity	Site photographs	Dredging and disposal site	Daily during works
	Plume sketches[1]		Daily during works
	Aerial photographs		Once during works
	Secchi depths[1]	Offshore disposal area	Daily during works (when offshore disposal occurring)
Light attenuation[2]	In situ data loggers or hand-held meter	Impact sites in seagrass meadow adjacent to offshore disposal area, reference sites west of Port Geographe	Before, during and after offshore disposal
Seagrass meadow edge[3]	Multi-beam surveys and/or towed video	Seagrass meadow edge adjacent to offshore disposal area	Prior to and after offshore disposal
Hydrogen sulfide (H_2S) generation	H_2S monitoring using in situ measuring and data logging device	Adjacent to Western Beach	Daily during works (if wrack is expected to be present)

Notes:
1. See Appendix D for example plume sketch and Secchi depth record templates.
2. If offshore dredging/disposal is undertaken, monitoring of light levels over seagrass meadows will be done before, during and after works. Suitable locations for 1–2 impact and 2–4 reference sites for light monitoring will be determined prior to offshore disposal. The impact sites will likely be in the seagrass meadow north of the offshore disposal area, and reference sites likely to the west of Port Geographe (Figure 2-2).
3. If offshore dredging/disposal is undertaken, the seagrass meadow edge position will be monitored at 2–4 locations outside of the predicted zone of influence of the offshore disposal area. The monitoring sites will likely be to the west of Port Geographe (Figure 2-2).
4. Odour monitoring will be required if wrack is expected to be present in the material to be bypassed and monitoring will be completed. Odour monitoring during maintenance works will be completed using 1 odour logger adjacent to the Western Beach on a continuous basis. This area is considered to pose the highest risk for potential odour issues.

3.3.5 Review and revision of management actions

Where the management target(s) are not met or exceeded, DoT will review and revise the risk assessment and management actions and potentially identify additional management actions in accordance with the mitigation hierarchy (avoid, minimise, rehabilitate, offset; as per Section 6.3.2 of EAG17; EPA 2015), where necessary. During this process, the risks, key impacts, and associated management actions for maintaining the harbour entrance channel will be reviewed and revised. The following are examples of revised and additional management actions for each of the impacts listed in Table 3-11:

(1) Restricted flushing and water circulation leading to poor water quality

- (i) Increase frequency of coastal monitoring program
- (ii) Revise coastal monitoring program
- (iii) Revise method/frequency/timing of maintenance works
- (iv) Modify dredging depth and areas to reduce risk/likelihood of sediment/wrack accumulation in harbour entrance channel

(v) Modify management of Western Beach sediment accumulation to reduce transport of material into harbour entrance channel

(2) Smothering or reduction of light penetration on nearby seagrass meadows during maintenance works (with offshore disposal)

(i) Revise dredging and/or disposal methods and/or locations

(ii) Consider seagrass shoot density monitoring adjacent to offshore disposal area (and at reference sites) in consultation with the DWER

(iii) Seagrass meadow monitoring after end of maintenance works.

Reviewed and revised management actions will be implemented by DoT to mitigate and manage any impacts so that the management targets and the condition environmental objective for the harbour entrance channel are met.

3.3.6 Reporting

Annual reporting

The annual Statement of Compliance required to be submitted by DoT to fulfil Condition 3-6 of Ministerial Statement 990 will state whether the condition environmental objective for the harbour entrance channel has been met (Table 3-15). In the event that the condition environmental objective is not achieved during the reporting period, the Statement of Compliance will include a description of the effectiveness of revised and/or additional management actions implemented by DoT and an analysis of the trends from the monitoring results.

The annual Statement of Compliance will be submitted by 26 February each year in accordance with Condition 3-6 of Ministerial Statement 990.

Table 3-15 EMMP reporting table for condition environmental objective relating to the harbour entrance channel

Key environmental factors: marine environmental quality and benthic communities and habitat, (Ministerial Statement 990, Condition 6, 7)		
Management targets for the harbour entrance channel	**Reporting on the management target**	**Status**
Management target #1: Maintain cross sectional area of harbour entrance channel (below mean sea level) to no less than 120 m^2 for two consecutive surveys	Harbour entrance channel cross sectional area was/was not maintained	■ YES ■ NO
Management target #2: Weekly (rolling 7-day) median light attenuation coefficient (LAC) values at impact sites do not exceed the 80th percentile of the reference sites for two consecutive weeks (if completing offshore disposal during maintenance works)	Weekly median LAC values at impact sites did/did not exceed the 80th percentile of the reference sites for two consecutive weeks	■ YES ■ NO
Management target #3: No change in position of seagrass meadow edge outside of the predicted zone of influence of the offshore disposal area beyond natural variability (if completing offshore disposal during maintenance works)	Seagrass meadow edge position did/did not change beyond natural variability	■ YES ■ NO

Note:
1. The status of achievement of the condition environmental objective is indicated by the following symbols: ■ = achieved, ■ = not achieved.

Reporting on exceedances of management targets

If a management target related to the harbour entrance channel is exceeded (or not met), the CEO of DWER will be notified within ten days of identification of the exceedance. An investigation report will be prepared that describes the investigation into the exceedance and the corrective management actions in accordance with Condition 7-4 of Ministerial Statement 990.

4 Adaptive Management and Reviews

DoT will implement adaptive management to learn from the monitoring and evaluation against management targets, and the implementation of revised management measures, to more effectively meet the three condition environmental objectives relating to seagrass wrack management, sediment movement, and the harbour entrance channel. The extent to which natural coastal processes will replicate the modelling results is likely to evolve as the coastal system adjusts to the reconfiguration and may vary from year to year in response to natural weather variability, and will require ongoing monitoring to establish whether natural wrack and sediment movement are enhanced by the reconfigured coastal structures.

Each year there will be natural variability in the coastal processes at Port Geographe. As a result, the interaction between natural sediment and seagrass wrack movement, and the reconfigured structures will change from year to year, requiring flexible and adaptive management approaches. The adaptive approach to be followed is described below:

- Systematic evaluation of routine monitoring data and comparison to benchmark data and modelling results on an annual basis to assist with:
    - assessing the proposal impacts and corresponding risk-based management actions
    - verifying whether responses to the proposal impacts are similar to modelled predictions
    - assessing the need to modify the November 2014 initial benchmark survey due to equilibration of the coast to reconfigured coastal structures and/or larger scale coastal changes (for example climate change and sea level rise).
- An increased understanding of the sediment and wrack transport dynamics and entrance channel flushing characteristics will arise from routine monitoring results and further data collection and research by DoT. This will assist with reducing the various assumptions and uncertainties listed in Section 2.4.2, and for planning and refining maintenance works.
- Management measures will be considered in EMPs to address unforeseen circumstances such as public complaints or environmental incidents such as hydrocarbon spills etc.
- Any environmental issues and recommendations arising from the close-out reports from maintenance works will be reviewed in detail to improve management of future campaigns.
- In accordance with Condition 7-6 of Ministerial Statement 990, the EMMP will be reviewed annually, or as directed by the CEO of DWER, and revised by DoT where required. In accordance with Condition 7-7 of Ministerial Statement 990, DoT will implement the approved revisions of the EMMP until advised otherwise by the CEO of DWER.
- The annual review of the EMMP and preparation of the annual Statement of Compliance will assess the effectiveness of the management targets, management actions and general performance of the EMMP to identify the need to revise the management approach.
- Amendments to the EMMP will also ensure best practice methods continue to be applied as knowledge, technology and requirements change. This may include amended or new environmental policies, new environmental guidelines, improved environmental understanding and outcomes following the annual Statement of Compliance reporting. Amendments to the EMMP are documented in Appendix E.
- The EMMP references a number of appendices, external management plans and environmental frameworks (e.g. BMT 2020; Appendix C). Any changes to these documents that may require subsequent changes to this document will be incorporated into the annual review of the EMMP.

Adaptive Management and Reviews

- DoT may review the frequency and methods of the monitoring and maintenance programs outlined in this EMMP (to the approval of the CEO of DWER) if the reconfigured coastal structures are shown to be effective in minimising the impacts to the environment from trapped wrack, the harbour entrance channel is flushing naturally and natural shoreline equilibrium is achieved on the Western Beach and Wonnerup Beach.
- As outlined in DoT's approved Compliance Assessment Plan for Ministerial Statement 990 (BMT Oceanica 2015b), and in accordance with the EPA's Post Assessment Guideline 2 (EPA 2012a), the life of the proposal for the Port Geographe project was expected to extend to 2020, however; this was subject to demonstration that natural coastal processes have been reinstated at Port Geographe with minimal project attributable impacts, which has not been realised. The need to continue implementation of this EMMP will be reviewed on an ongoing basis and, in discussion with the CEO of DWER.

5 Stakeholder Consultation

The Port Geographe capital dredging and breakwater reconfiguration project has involved extensive and ongoing stakeholder consultation with community, industry and government since 2004. DoT has consulted with stakeholders while developing this EMMP to ensure consistency with the EPA's expectations on the principles of the environmental impact assessment process. This section provides a summary of consultation that has occurred for the Port Geographe project, which has involved extensive and ongoing stakeholder engagement with community, industry and government since 2004. The comments raised during consultations with stakeholders were considered in the development of the EMMP (Table 5-1).

DoT will ensure the EMMP is made publicly available via DoT's website in accordance with EPA (2012b) and within 28 days of its approval by the CEO to fulfil Condition 7-8.

DoT will consult with relevant stakeholders including the City of Busselton and community representatives prior to and during each management activity, as appropriate.

Table 5-1 Stakeholder consultation, comments and responses to the Port Geographe Environmental Monitoring and Management Plan

Organisation	Type of consultation & date	Stakeholder comments[1]	DoT response to comments
Port Geographe Community Consultation Forum	Regular meetings since 2009	Wonnerup Beach should remain a priority for replenishment and protection Beach amenity is important to the community Reduced levels of H_2S from trapped seagrass remains a community priority Entrance channel needs to remain navigable	Noted; and all elements addressed in this EMMP (Section 3)
City of Busselton (CoB)	Meeting in April 2015	Protection of coastal infrastructure is essential Desire for community input into EMMP management measures CoB to integrate new lagoon area into bacterial sampling program	Coastal protection is integral part of the EMMP sediment management and beach nourishment activities (Section 3.2) EMMP will be released for public comment and consultation Noted; EMMP does not need to include bacterial sampling program in the new lagoon area
General public and stakeholders	Ongoing via dedicated email inbox and project phone line	Wonnerup Beach sand nourishment required to protect infrastructure Protect Wonnerup foreshore vegetation Post-reconfiguration coastal maintenance works on the Western Beach should be minimal	Coastal protection is integral part of the EMMP sediment management and beach nourishment activities (Section 3.2) Vegetation will be managed primarily as per EMPs (Section 2.4.3) Noted; need for works will be carefully considered (Section 2.1.2)

Organisation	Type of consultation & date	Stakeholder comments[1]	DoT response to comments
General public and stakeholders	Consultation on Draft EMMP July–August 2016	No works should be undertaken to bypass sand from the Western Beach to Wonnerup Beach.	Clarification provided in EMMP as to when bypassing sand from Western Beach may be necessary (Section 2.1.2)).
		Alternate sand sources i.e. offshore sand bars and estuary inlet sand sources should be defined within the EMMP as possible sand sources.	Clarification provided in EMMP detailing the consideration of alternative sources of nourishment material (Section 2.1.2).
		There should be no pumping or pushing of seagrass wrack off the Western Beach from December onwards.	Clarification provided in EMMP detailing the timing of wrack management, including the contingency measures that may be required if the management targets are not met (Section 2.1.1).
		Future wrack and sand management works (mechanical intervention) in the PGCMA should be minimised and only undertaken when necessary.	The management targets within the EMMP have been carefully considered and developed to avoid unnecessary mechanical (human) intervention whilst meeting the environmental objectives.
		Volume management targets for future wrack and sand management works (mechanical intervention) in the PGCMA should be lowered.	The monitoring tasks and the management targets within the EMMP have been carefully considered and developed to allow for necessary mechanical (human) intervention to meet the environmental objectives.
		The PGCMA in which the EMMP is applicable should be aligned to management areas associated with the original development (under Ministerial Statement 391), thereby limiting the area of potential works and associated costs.	A PGCMA was established as part of Ministerial Statement 990 which replaces and supersedes all previous conditions and commitments under Ministerial Statement 391. It is a regulatory requirement and is considered appropriate for the implementation of the Port Geographe Reconfiguration Project to ensure any potential project attributable impacts can be appropriately managed.

Notes:
1. The stakeholder comments listed here are a summary of the key comments received by DoT that are directly relevant to the EMMP.
2. DoT = Department of Transport; H_2S = hydrogen sulfide gas; EMMP = Environmental Monitoring and Management Plan; EMP = Environmental Management Plan.

6 References

BMT (2020) Department of Transport Maintenance Dredging – Environmental Management Framework. Prepared for the Department of Transport by BMT Commercial Pty Ltd, Report No. R-1666_00-37, Perth, Western Australia, August 2020

BMT (2019) Port Geographe Sediment Sampling and Analysis Plan Implementation Report. Prepared for the Department of Transport by BMT Western Australia Pty Ltd, Report No. R-1463_01-2/Rev0, Perth, Western Australia, July 2019

BMT JFA (2015a) Port Geographe Operational Maintenance Management Plan. Prepared for the Department of Transport by BMT JFA Consultants Pty Ltd, Report Ref: R-300.12-14.3-1, Perth, Western Australia, February 2015

BMT JFA (2015b) Review of Long-shore Sediment Transport budgets – Technical Memo. Prepared for the Department of Transport by BMT JFA Consultants Pty Ltd, Report No. P-180.22-1, Perth, Western Australia, March 2015

BMT JFA (2015c) Port Geographe Metocean Monitoring Data Report. Prepared for the Department of Transport, Report No. R-300.12-14.3-1, Perth, Western Australia, January 2015

BMT JFA (2015d) Port Geographe Bypassing 2014 Closeout Report. Prepared for the Department of Transport by BMT JFA Consultants Pty Ltd, Report No. R-300.12-14.2-1 Rev0, Perth, Western Australia, February 2015

BMT JFA (2015e) Port Geographe Capital Dredging and Canal Maintenance Dredging 2013/14 Closeout Report. Prepared for the Department of Transport by BMT JFA Consultants Pty Ltd, Report No. R300.12-14.1-1, Perth, Western Australia, May 2015

BMT Oceanica (2014a) Port Geographe Marina Canals – Dredging Environmental Impact Assessment. Prepared for the Department of Transport by BMT Oceanica Pty Ltd, Report No. 924_03_001/3_Rev1, Perth, Western Australia, July 2014

BMT Oceanica (2014b) Port Geographe Marina Canals – Dredging Environmental Management Plan. Prepared for the Department of Transport by BMT Oceanica Pty Ltd, Report No. 924_03_001/2_Rev1, Perth, Western Australia, July 2014

BMT Oceanica (2014c) Port Geographe Wrack Bypassing and Beach Nourishment – Dredging Environmental Management Plan. Prepared for the Department of Transport by BMT Oceanica Pty Ltd, Report No. 924_05_001/1_Rev1, Perth, Western Australia, October 2014

BMT Oceanica (2015a) Port Geographe – Bypassing Environmental Impact Assessment. Prepared for the Department of Transport and BMT JFA Consultants Pty Ltd by BMT Oceanica Pty Ltd, Report No. 924_06_001/2_Rev0, December 2015

BMT Oceanica (2015b) Port Geographe Coastal Structures Compliance Assessment Plan – Ministerial Statement 990. Prepared for the Department of Transport by BMT Oceanica Pty Ltd, Report No 924_08_002/1_Rev0, Perth, Western Australia, November 2015

ChemCentre (2010) Report on the real time monitoring and management of hydrogen sulfide generation as a result of sea grass wrack bypass at Port Geographe, Report No. 09EH0421. Prepared for the Department of Transport, Perth, Western Australia, July 2010

DAL, UWA, WAWA (1995) Geographe Bay Study 1993–1995 Summary Report. Prepared for Water Authority of Western Australia by DA Lord & Associates and Centre for Water Research University of Western

References

Australia, Department of Botany University of Western Australia, Water Authority of Western Australia (Southwest Region), Perth, Western Australia, June 1995

Damara WA (2010) Port Geographe Sand Management – Busselton Sediment Sampling. Prepared for the Department of Transport by Damara WA Pty Ltd, Report No. 95-01-Rev A, Perth, Western Australia

Damara WA (2011) Coastal Erosion Study: Assessment of Climate Change Impacts. Prepared for the Shire of Busselton by Damara WA Pty Ltd, Report No. 96-00-01, Busselton, Western Australia

DEC (2013) Ngari Capes Marine Park management plan 2013–2023, Management Plan Number 74. Department of Environment and Conservation, Perth, Western Australia, January 2013

DoH (2015) Department of Health – Hydrogen sulfide and public health http://ww2.health.wa.gov.au/Articles/F_I/Hydrogen-sulfide-and-public-health [Accessed 13 January 2021]

EPA (2012a) Post Assessment Guideline for Preparing a Compliance Assessment Plan. Office of the Environmental Protection Authority, Report No PAG 2, Perth, Western Australia, August 2012

EPA (2012b) Post Assessment Guideline for Making Information Publicly Available. Office of the Environmental Protection Authority, Report No PAG 4, Perth, Western Australia, August 2012

EPA (2015) Environmental Assessment Guideline for Preparation of management plans under Part IV of the Environmental Protection Act 1986. Environmental Protection Authority, Report No EAG 17, Perth, Western Australia, August 2015

EPA (2020a) Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans. Environmental Protection Authority, Perth, Western Australia, September 2020

EPA (2020b) Statement of Environmental Principles, Factors and Objectives. Environmental Protection Authority, Perth, Western Australia, April 2020

Oceanica (2013) Port Geographe Capital Dredging 2013 – Dredging Environmental Impact Assessment. Prepared for the Department of Transport by Oceanica Consulting Pty Ltd, Report No. 924_02_001/1_Rev2, Perth, Western Australia, August 2013

Oceanica, BMT JFA (2012) Port Geographe 2012 Maintenance Dredging – Data Report. Prepared for the Department of Transport by Oceanica Consulting Pty Ltd and BMT JFA Consultants Pty Ltd, Report No. 924_001/2_Rev0, Perth, Western Australia, April 2012

Oldham CE, Lavery PS, McMahon K, Pattiaratchi C, Chiffings TW (2010) Seagrass wrack dynamics in Geographe Bay, Western Australia. Prepared for the Department of Transport, Report No. DPI 1062/07, Perth, Western Australia, April 2010

Pattiaratchi C, Wijeratne S (2011) Port Geographe Sand and Seagrass Wrack Modelling Study. Prepared for the Department of Transport by the University of Western Australia, Perth, Western Australia, May 2011

Pattiaratchi C, Wijeratne S (2016) Port Geographe reconfiguration: Effects of channel obstructions on flushing characteristics. Prepared for the Department of Transport by the University of Western Australia, Perth, Western Australia, January 2016

Pattiaratchi C, Wijeratne S, Bosserelle C (2011) Sand and seagrass wrack modelling in Port Geographe, south-western Australia. In Coasts and Ports 2011: Diverse and Developing: Proceedings of the 20th Australasian Coastal and Ocean Engineering Conference and the 13th Australasian Port and Harbour Conference. Engineers Australia, Perth, Western Australia, p. 564, September 2011

Riedel & Byrne (1990) Port Geographe Sand Bypassing and Coastal Management. Prepared by Riedel & Byrne Consulting Engineers Pty Ltd for Interstruct Holdings Pty Ltd, Rep No. R437, Perth, Western Australia

References

Seashore Engineering (2014) DOT400312-34 Independent Technical Advice (Construction) – Port Geographe: Sand Management. Prepared for the Department of Transport by Seashore Engineering Pty Ltd, Report No: SE003-16 Rev A, Perth, Western Australia, August 2014

Seashore Engineering (2015) Review of Historic Odour Monitoring Records. Prepared for BMT JFA Consultants Pty Ltd, Report No. SE016_03B, Perth, Western Australia, March 2015

Shore Coastal (2010) Geographe Bay Shoreline Movement. Prepared for the Shire of Busselton by Shore Coastal Pty Ltd, Busselton, Western Australia

Shore Coastal (2014) Busselton Coastal Management Plan Beach Monitoring (Year 1). Prepared for the City of Busselton by Shore Coastal Pty Ltd, Busselton, Western Australia

Appendix A Ministerial Statement 990: Port Geographe Development Coastal Structures

Hon Albert Jacob MLA
Minister for Environment; Heritage

Statement No: 990

STATEMENT TO AMEND CONDITIONS APPLYING TO A PROPOSAL (PURSUANT TO THE PROVISIONS OF SECTION 46 OF THE *ENVIRONMENTAL PROTECTION ACT 1986*)

PORT GEOGRAPHE DEVELOPMENT COASTAL STRUCTURES
CITY OF BUSSELTON

Proposal:	The proposal is for the construction of coastal structures to establish a harbour entrance to the Port Geographe Development with reduced trapping of seagrass wrack, 3 kilometres east of the town of Busselton. The key components of the Proposal are further documented in Schedule 1.
Proponent:	Minister for Transport
Proponent Address:	13th Floor, Dumas House, 2 Havelock Street, WEST PERTH WA 6005
Assessment Number:	1977

Previous Assessment Number: 936

Report of the Environmental Protection Authority: 1509

Previous Report Number: 783

Previous Ministerial Statement Number: 391

The implementation of the proposal to which the above report of the Environmental Protection Authority relate is subject to the following conditions and procedures, which replace and supersede all previous conditions and commitments of Statement 391.

Published on:

12th Floor, Dumas House, 2 Havelock Street, West Perth Western Australia 6005
Phone: +61 8 6552 5800 Facsimile: +61 8 6552 5801
Email: Minister.Jacob@dpc.wa.gov.au

1 Proposal Implementation

1-1 The proponent shall implement the proposal as documented and described in Schedule 1 of this statement subject to the implementation conditions and procedures of this statement.

2 Proponent Nomination and Contact Details

2-1 The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within 28 days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.

3 Compliance Reporting

3-1 At least six calendar months prior to the first Statement of Compliance required pursuant to Condition 3-6 the proponent shall:

(1) prepare a Compliance Assessment Plan in accordance with the OEPA's Post Assessment Guideline for Preparing a Compliance Assessment Plan, as amended from time to time and to the approval of the CEO; and

(2) submit the Compliance Assessment Plan required pursuant to Condition 3-1(1) to the CEO.

3-2 The proponent shall revise the approved Compliance Assessment Plan in accordance with the OEPA's Post Assessment Guideline for Preparing a Compliance Assessment Plan, as amended from time to time, and submit the revised Compliance Assessment Plan to the approval of the CEO.

3-3 The proponent shall assess compliance in accordance with the approved Compliance Assessment Plan.

3-4 The proponent shall collect and maintain information and documentation in accordance with the approved Compliance Assessment Plan.

3-5 The proponent shall advise the CEO of any non-compliance or potential non-compliance within seven days of such awareness.

3-6 The proponent shall prepare a Statement of Compliance for each consecutive 12 month period commencing on the date of the Statement and submit each Statement of Compliance to the CEO no later than three months following the end of each 12 month period it addresses.

3-7 The proponent shall ensure that each Statement of Compliance is made available to the public in accordance with the approved Compliance Assessment Plan and within twenty eight days of its submission pursuant to Condition 3-6.

3-8 The proponent shall ensure that each Statement of Compliance:

(1) indicates the extent to which the proponent has complied with the implementation conditions contained in this Statement in the preceding twelve month period;

(2) is prepared using the OEPA's Post Assessment Form for a Statement of Compliance, as amended from time to time;

(3) provides all information required by the OEPA's Post Assessment Form for a Statement of Compliance, as amended from time to time; and

(4) is signed by the proponent, if the proponent is an individual, or a person who is a director or the director's delegate, if the proponent is a public body, company or association or body of persons, corporate or unincorporated.

3-9 The CEO has the discretion to, by notice in writing:

(1) require the proponent to submit a Statement of Compliance more or less frequently than annually and alter the period addressed by the Statement of Compliance;

(2) alter the due date of the Statement of Compliance;

(3) prescribe the manner in which Statement of Compliance is made available to the public, should this be necessary; and

(4) where a Statement of Compliance contains trade secrets or documentation that would reveal information of a commercial value, waive the requirement to make any of the Statement of Compliance, in part or wholly, publicly available, should this be requested by the proponent.

4 Foreshore

4-1 Where determined to be project attributable, the proponent shall maintain beach profiles on beaches east and west of the development, within the project area shown in Schedule 1, Figure 1, to the requirements of the CEO.

5 Sand Trap, Harbour Entrance Channel and Sand Bypass

5-1 The proponent shall, unless otherwise approved by the CEO, annually bypass, dredge or remove trapped seagrass wrack and or sediment accumulated west of or within the harbour entrance, to the requirements of the CEO.

5-2 The proponent shall transfer sufficient sand to Wonnerup Beach for coastal protection, to the requirements of the CEO.

6 Flushing of Artificial Waterways

6-1 The proponent is to maintain the harbour entrance channel as per Schedule 1, to ensure adequate flushing and water circulation of the artificial waterways within the Port Geographe development, to the requirements of the CEO.

7 Environmental Management and Monitoring Plan

7-1 The proponent shall ensure impacts to the environment are minimised through the implementation of Conditions 7-2 to 7-8.

7-2 Within three calendar months following the issue of the Ministerial Statement, unless otherwise approved by the CEO, the proponent shall prepare an Environmental Management and Monitoring Plan to the requirements of the CEO. The Plan shall:

(1) when implemented, substantiate whether Condition 7-1 is being met.
(2) detail measures to manage water and sediment quality impacts to Geographe Bay associated with coastal management activities including dredging and bypassing.
(3) detail measures to manage trapped seagrass wrack accumulation on the beaches adjacent to the development, as shown in Schedule 1, Figure 1.
(4) detail measures to manage significant environmental impacts with regard to coastal processes and sediment movement as a result of the development.
(5) determine trigger levels for implementation of management measures to ensure Condition 7-1 is met.
(6) identify management measures to be implemented in the event that criteria identified required by Condition 7-2(5) have been exceeded.

7-3 The proponent shall implement the approved Environmental Management and Monitoring Plan required by Conditions 7-2, unless otherwise approved by the CEO.

7-4 In the event that monitoring required by Condition 7-2 indicates trigger criteria have been exceeded, the proponent shall investigate to determine the likely cause(s) and provide a report that describes the investigation to the CEO within 10 days along with a description of the corrective management actions to be taken.

7-5 The proponent shall implement the management actions identified in Condition 7-4 until the CEO determines that the remedial actions may cease .

7-6 The proponent shall review the Environmental Management and Monitoring Plan annually, and revise where required, or as directed by the CEO.

7-7 The proponent shall implement the approved revisions of the Environmental Management and Monitoring Plan required by Condition 7-6 until advised otherwise by the CEO.

7-8 The Proponent shall make the Environmental Management and Monitoring Plan, required by 7-2 publically available in a manner approved by the CEO.

HON ALBERT P JACOB JP MLA
MINISTER FOR ENVIRONMENT; HERITAGE

26 NOV 2014

The Proposal

Schedule 1

The proposal is for the construction of coastal structures to establish a harbour entrance to the Port Geographe Development with reduced trapping of seagrass wrack, 3 kilometres east of the town of Busselton. (see Figure 1). The main characteristics of the proposal are summarised in Table 1 below.

Table 1: Key Characteristics Table

Element	Description of proposal
Location	Geographe Bay, East of Busselton (see Figure 1)
Infrastructure	Coastal structures including: - Western training wall, and - Eastern seawall.
Channel dimensions	Channel detailed in Figure 1. Design depth: -2.8m Chart Datum (to a maximum -3.3m Chart Datum with over dredge).
Excavation works	Capital dredge material transferred to beach and/or offshore disposal area.
Area of seabed disturbance	Channel area detailed in Figure 1.

Table 2: Abbreviations

Abbreviation	Term
CEO	The Chief Executive Officer of the Department of the Public Service of the State responsible for the administration of section 48 of the *Environmental Protection Act 1986*, or their delegate.
m	metres

Figures (attached)

Figure 1: Port Geographe Coastal Structures and Management Zone

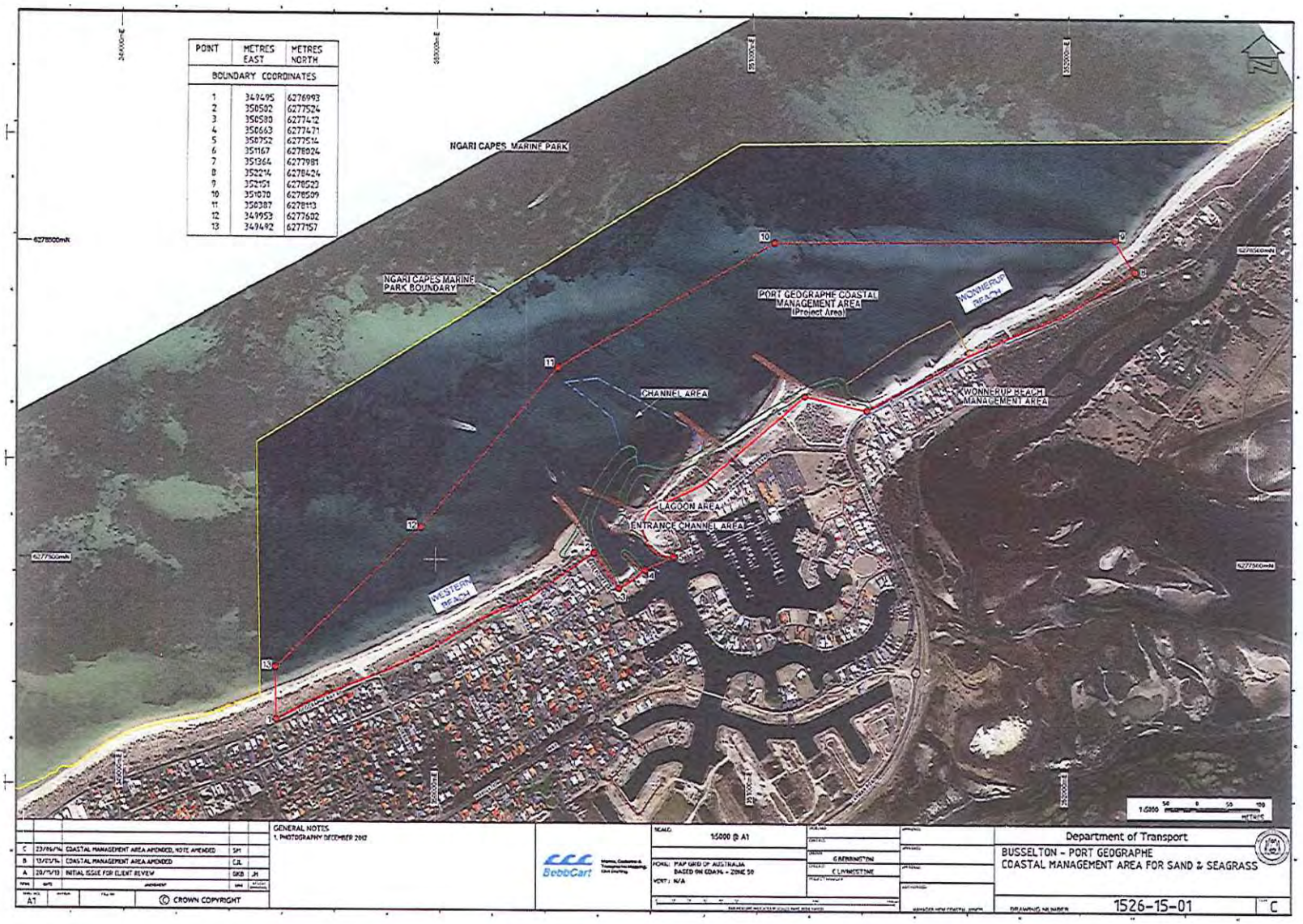

Figure 1: Port Geographe Coastal Structures and Management Zone

Appendix B Port Geographe Offshore Disposal Area Dredging Environmental Impact Assessment

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Technical Note

Project:	Port Geographe Dredging FY19–20		
From:	Karina Inostroza Katharine Thorne		
Date:	13 February 2020	**To:**	Justin Fifield, David Chamizo
Doc Ref:	Tn-1666_00 -11	**CC:**	Linden Clarke, Louise Synnot,
Subject:	Port Geographe Offshore Disposal Area Dredging Environmental Impact Assessment		

1 Background

The Port Geographe marina is managed by Department of Transport (DoT) under an Environmental Monitoring and Management Plan (EMMP; BMT 2019a) pursuant to condition 7 of Ministerial Statement 990. Under the EMMP, DoT coordinate environmental management within the Port Geographe Coastal Management Area (PGCMA; Figure 1.1) as follows:

- seagrass wrack management – to manage the build-up of seagrass wrack on the Western Beach
- sediment management – to maintain the Wonnerup Beach profile
- harbour entrance channel management – to maintain water quality in the harbour and navigable waters

The EMMP defines the sediment and seagrass wrack disposal areas to be used during seagrass wrack and sediment bypassing and maintenance dredging campaigns. These are (Figure 1.1; BMT 2019a):

- Western Beach littoral zone
- Eastern revetment pipeline connection
- Wonnerup Beach pipeline connection
- Offshore disposal area

The present offshore disposal area is ~280 m from the boundary of the Ngari Capes Marine Park (NCMP) and ~400 m north-east of the marina entrance channel, with a footprint of 32 029 m^2. This disposal area is located over an area of bare sand, with a 20 m buffer from any seagrass beds to avoid potential impacts on the seagrass. Material is disposed to this area via a temporary pipeline extending offshore from the dredge area. The capacity of this area to receive dredged material from maintenance campaigns is limited by the need to maintain a minimum water depth to ensure safe navigation during all tides for commercial and recreational boats. The previously nominated disposal area used during the 2013/14 Port Geographe reconfiguration and capital dredging (clipped to be within the PGCMA) was a larger footprint (85 927 m^2) in the same location comprising bare sand, with a 20 m buffer from any seagrass beds.

Recent observations and hydrographic surveys have indicated the offshore disposal area is nearing maximum capacity following the maintenance dredging campaigns completed since the Port Geographe reconfiguration (2014, 2018/19 and 2019) and the capital dredging for the reconfiguration (in 2013/14), and is therefore unable to receive additional dredged material for future maintenance dredging campaigns without the accumulation of sand at the offshore disposal area becoming a high risk to navigational safety.

Figure 1.1 The Port Geographe Coastal Management Area, permanently installed bypassing pipeline, offshore disposal area, extended offshore disposal area, and Ngari Capes Marine Park exclusion zone

The sand for beach nourishment at Wonnerup can either be internally sourced (from within the PGCMA) or externally sourced (from outside of the PGCMA; BMT 2019a). The EMMP (BMT 2019a) defines two sources of sediment for beach nourishment within the PGCMA: the Western Beach and the harbour entrance channel. However, these sediments typically have a high seagrass wrack content and are unsuitable for direct beach nourishment. Therefore, previous beach nourishment campaigns (2014, 2015, 2017, 2018 and 2019) have sourced material externally, from local sand pits. Sourcing sand externally that has characteristics suitable for a beach environment, compatible with the naturally occurring sand in the PGCMA, and in large enough quantity is challenging. External sand sourcing also has a significant cost implication and is considered unsustainable in the long-term.

Despite the sediment dredged from the Western Beach and the harbour entrance channel having a high wrack content directly after dredging and disposal, it is substantially decomposed and further degraded into fine particles during the dredging. This wrack fragments are then readily dispersed during and after dredging by waves and currents, particularly during winter. Therefore the remaining material accreted in the offshore disposal area is primarily clean marine sand.

The DoT is therefore proposing that the offshore disposal area be extended to the previous footprint used during the 2013/14 reconfiguration and that it will be managed hereon as a temporary staging area for material dredged from the Western Beach and the harbour entrance channel. Sand within the offshore disposal area placed during previous dredging activities will be dredged for use as

nourishment of Wonnerup Beach. This will restore the capacity of the offshore disposal area for sediment disposal, allow a more sustainable approach to future dredging and disposal and a more sustainable option to provide suitable material for beach nourishment. Additionally the larger footprint of the offshore disposal area will allow half the area to be used as a disposal area and the other as a dredge area contemporaneously, with the areas to be swapped the following year following the natural wrack removal from the disposed sediments.

1.1 This memorandum

This memorandum provides and Environmental Impact Assessment (EIA) of extending and dredging the offshore disposal area, and using the material to nourish Wonnerup Beach. It includes an overview of the proposed scope of works, an assessment of the potential environmental impacts, potential environmental management and the associated updates to the EMMP.

2 Proposed Dredging and Disposal

Based on observations and hydrographic surveys during the 2019 maintenance dredging campaign, a significant portion of the offshore disposal area seabed is between -1.5 m and -1 m chart datum as a result of previous disposal during maintenance and capital dredging campaigns. To restore the capacity of the offshore disposal area and allow ongoing use for future maintenance campaigns, DoT proposes to extend the offshore disposal area commencing at the end of 2020 to the 2013/14 capital dredging footprint and utilise material previously disposed to the offshore disposal area for beneficial re-use as beach nourishment thereby reducing the dependence on sourcing sand from external pits.

The duration of these works is expected to be 4–8 weeks and will be completed in conjunction with other maintenance works in Port Geographe.

It is intended that the material dredged from the extended offshore disposal area will only comprise material that was placed there during previous capital and maintenance dredging works and not the underlying naturally occurring sand bank. Therefore a baseline horizon will be defined using historic bathymetry data and dredging will not extend below this horizon.

The proposed dredging will be completed using a small cutter-suction dredge, as used in previous maintenance dredging campaigns. This type of dredge uses a rotating cutter head to loosen the sediment and create a slurry, which is immediately entrained into a suction tube directly behind the cutter head. Due to the rapid intake velocity at the cutting head, sediment released into the water column at the cutting head is generally minimal. The dredge will pump slurry via a submerged pipeline to Wonnerup Beach. It is expected that some reprofiling of the Wonnerup Beach will be required using land-based machinery.

3 Potential Environmental Impacts

Previous environmental impact assessments have been completed for maintenance dredging and bypassing campaigns at Port Geographe (BMT 2019b, BMT Oceanica 2015). The key potential impacts on environmental factors[1] that may arise due to the proposed works at Port Geographe have been assessed in the context of the Environmental Protection Authority's Environmental Factors and Objectives (EPA 2018). While it is anticipated that there will be little to no change in the impacts associated with the extension of the offshore disposal area and the additional dredging of this offshore disposal area, potential impacts have been conservatively re-assessed below.

[1] As defined by EPA (2018), environmental factors are those parts of the environment that may be impacted by an aspect of a proposal. Environment means living things, their physical, biological and social surroundings, and interactions between all of these.

3.1 Impact to coastal processes

Nearshore and offshore sand bars are generally a source of sediment to the coastline and therefore the dredging has the potential to interrupt the onshore sediment from the sand bar over which the extended offshore disposal area is located. However this sand bar has been artificially augmented following its use as a disposal area and it is intended that only sediment that has previously been disposed to the area will be dredged. To ensure this, a baseline horizon will be defined using historical bathymetry data and dredging in the extended offshore disposal area will only occur above this horizon and therefore the natural onshore sediment feed should remain uninterrupted.

The placement of dredged material on Wonnerup Beach will have a positive impact on the coastline. The sediment supply to Wonnerup Beach has been interrupted by the presence of the Port Geographe coastal structures and the use of the dredge material as beach nourishment on Wonnerup Beach will serve to protect the coastline from erosion. In addition, the material to be dredged will be compatible with the beach sand on Wonnerup as they have a similar particle size distribution and origin as the material.

3.2 Direct impacts to benthic habitats

The removal of sediment from the extended offshore disposal area and nourishment of Wonnerup Beach has the potential to impact benthic communities and habitats via direct removal of benthic flora and fauna, and smothering from the settlement of suspended sediment in the nearshore area at Wonnerup Beach. There is also potential for indirect loss of benthic flora due shading from sediment plumes generated during dredging and disposal activities (discussed in Section 3.3) or from the release of contaminants (discussed in Section 3.4).

The extended offshore disposal area is surrounded by large extensive seagrass meadows, predominately *Posidonia australis*, which covers 60% of Geographe Bay, and *Amphibolis antarctica* (Oldham et al. 2010). The extended offshore disposal area was originally defined based on an absence of seagrass habitat (Oceanica 2013a) and because of historical use as a disposal area for dredged sediment, it is unlikely that any seagrass have recolonised this area as continued disposal of dredged sediments would inhibit colonisation. To support this, towed video surveys were opportunistically completed in the offshore disposal area in September and December 2019. Review of the towed videos indicated the offshore disposal area is characterised by bare sand with some areas of wrack, the majority of which was fine and freely moving over the sand (Figure 3.1). Additionally, review of aerial images downloaded from Nearmap indicates that the entire extended offshore disposal area is bare sand with occasional overlying wrack.

Seagrass monitoring has been completed during every maintenance campaign involving offshore disposal in accordance with campaign specific management plans. The more recent monitoring has been more comprehensive, in accordance with the capital dredging EIA (Oceanica 2013a) for disposal to the extended offshore disposal area and the EMMP (BMT 2019a) for the currently nominated offshore disposal area. The results of the monitoring has indicated that there has not been any significant impact on the seagrass meadows (Oceanica 2013b, BMT JFA 2015, BMT 2019c, BMT DRAFT). Further details of this monitoring in included in Section 3.3.

The risk of significant permanent loss of benthic habitats within the extended offshore disposal area from direct removal or within the nearshore area at Wonnerup Beach from smothering is therefore anticipated to be negligible. Therefore, no additional monitoring and management is considered necessary.

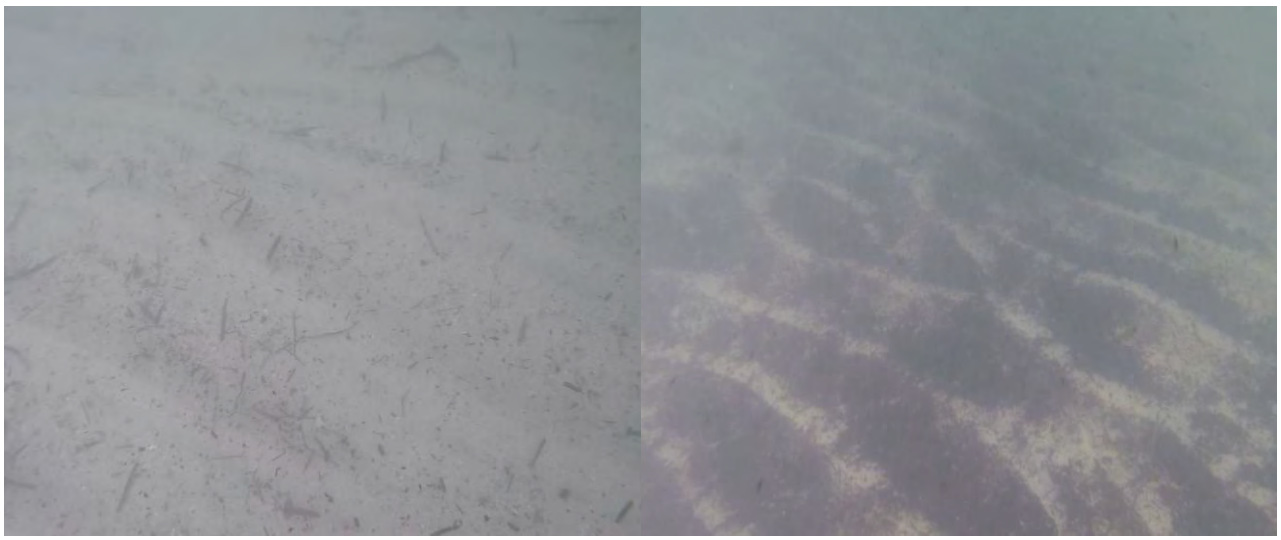

Figure 3.1 Images from towed video survey of the offshore disposal area 20 December 2019

3.3 Increase in water column turbidity

The disturbance of sediments during maintenance dredging campaigns may cause a temporary increase in water turbidity at the proposed dredging and nourishment areas. Potential impacts from increased water column turbidity include permanent or temporary loss of benthic communities and habitat due to shading at and adjacent to the dredging and discharge areas. Studies suggest that reduced light for 3–6 months will cause sub-lethal effects (reduction in productivity, decline in biomass) to occur in seagrass (Lavery et al. 2009; Collier et al. 2007).

Sediment samples collected within the offshore disposal area in May 2019 were found to consist of fine-medium sand sized particles. The associated settling velocity of the sediment was rapid (i.e. 90% of particles settled through 1 m of water within 50 seconds or shorter). Therefore, any turbid plumes generated at the dredging and disposal areas will be short-lived and dissipate rapidly (BMT 2019b). Monitoring of turbid plumes generated during previous maintenance campaigns demonstrated that they typically remained localised to the dredge or discharge outlets and dissipated rapidly (within 24 hours) under calm weather conditions (BMT 2019c). Additionally, it is anticipated that the dredging the offshore disposal area will generate less turbidity than previous unconfined disposal activities due to the rapid intake velocity at the dredge cutting head.

The seagrass monitoring during maintenance campaigns involving offshore disposal has indicated no significant impact on seagrass meadows (Oceanica 2013b, BMT JFA 2015, BMT 2019c, BMT DRAFT). Specifically, monitoring of potential seagrass meadow edge retreat adjacent to the offshore disposal area via multibeam surveys, completed in accordance with the EMMP, during the 2018/19 maintenance dredging campaign[2] showed there was no change to the positions of seagrass meadow edges between the pre-and post-maintenance dredging (BMT 2019c). Further, subsea deployment of light loggers to monitor light attenuation coefficient (LAC) at impact (north of the offshore disposal area) and reference sites (located west of Port Geographe marina) during the 2018/2019 and 2019 maintenance dredging campaigns showed LAC at impact sites was comparable to reference site data and no exceedances on EMMP triggers were recorded (BMT 2019c; BMT DRAFT).

In previous beach nourishment campaigns at Wonnerup Beach, sand built-up on from the Western Beach was either bypassed, or sand was externally sourced from outside the PGCMA (i.e. sand pits and/or local quarries) and placed above the low water mark. During the campaign, localised light to medium-brown plumes were observed along the shoreline and extended ~100 m from the shore (BMT 2019d). However, there is no benthic habitat in this area.

[2] Note potential seagrass meadow edge retreat was also monitored during the 2019 maintenance dredging campaign, however the results of the monitoring were not available at the time of this memorandum preparation.

Therefore, no significant impacts to nearby benthic flora from increased water column turbidity are anticipated during the dredging of the offshore disposal area and nourishment at Wonnerup Beach. Despite the low risk, monitoring of turbidity and potential impacts to seagrass will be completed as required by the EMMP (BMT 2019a).

3.4 Release of contaminants

Sediments were sampled from the offshore disposal area and analysed in May 2019. Concentrations of all metals and hydrocarbons (polycyclic aromatic hydrocarbons [PAHs], total recoverable hydrocarbons [TRH], total petroleum hydrocarbons [TPH], and benzene, toluene, ethylbenzene and xylene [BTEX]) were below the National Assessment Guidelines for Dredging (NAGD) Screening Levels (CA 2009; BMT 2019b). Additionally, the dredged material from previous maintenance and capital dredging campaigns disposed to the offshore disposal area (in 2013/14, 2014, 2018/19 and 2019), were tested and found to be free of contaminants prior to dredging. Therefore dredging at the extended offshore disposal area is not anticipated to result in the release of contaminants.

3.5 Hydrocarbon spills and waste

Various hydrocarbons will be used during the proposed dredging of the extended offshore disposal area, with the use of a cutter suction dredge, including fuel, oil and lubricants for the dredge and support vessels. There is a potential risk of accidental hydrocarbon spills to the marine and terrestrial environmental which could negatively impact marine fauna and the public. Rubbish and hazardous waste may also be generated, which can pollute the environment if not contained and removed from the site. Therefore, hydrocarbon use and waste will be actively managed in accordance with the EMMP (BMT 2019a) and the campaign-specific environmental management plan during dredging of sediments at the offshore disposal area.

3.6 Acid sulfate soils

Acid sulfate soils (ASS) are naturally occurring soils, sediments and peats that contain iron sulfides (DER 2015). ASS are commonly found in low-lying land bordering coastal or estuarine wetlands throughout WA (DER 2015). Dredging can disturb ASS and expose it to oxygen creating the potential to cause environmental and economic impacts (DER 2015).

Some of the dredged material that is disposed to the offshore disposal area originates from the canals of Port Geographe marina. The canals, which are situated outside of the PGCMA boundary, are located in a moderate to high ASS risk area (DWER 2019) and have been previous indicators of some acidity (Sullivan et al. 2018). ASS was analysed for in sediments sampled from the canals in May 2019, and the results demonstrated that the pH was >9 in all sediment samples, indicating no existing acidity (BMT 2019b). Furthermore, disposal of dredged material to the offshore disposal area is not subjected to atmospheric oxygen and the extended offshore disposal area is located in an area not known to be at risk with ASS (DWER 2019). Therefore, the generation of acidity from the disturbance of ASS is unlikely during dredging of the extended offshore disposal area, and additional monitoring and management is not required.

3.7 Hypoxia

Hypoxia is the condition in which dissolved oxygen (DO) is below the level necessary to sustain most animal life (CENR 2000). The oxidation of iron sulphides and bacterial decomposition of organic material in the sediments can increase the chemical and biological oxygen demand of the water. If large amounts of organic material were to be released into the water column at the dredging and disposal areas, bacterial decomposition of this material could deplete oxygen levels and lead to hypoxia.

It is unlikely that large amounts of organic material will be released into the water column during dredging due to the rapid intake velocity of the cutter suction dredge. Hypoxia is therefore considered a low environmental risk during dredging activities and no environmental indicators of

hypoxic conditions (i.e. localised fish kills or algal blooms) have been observed during previous maintenance dredging campaigns (BMT 2019c). Therefore, no additional monitoring and management is considered necessary.

3.8 Introduced marine species

The arrival of dredge machinery required for dredging may potentially introduce non-native marine species which can disrupt the local ecosystem. Introduced marine species may be transported between dredging locations within ballast water and on vessel hulls (i.e. biofouling). However, the risk of transferring non-native marine species to the surrounding marine environment during maintenance dredging is negligible because:

- the dredge vessel to be used during the maintenance dredging campaigns has no ballast water
- prior to mobilisation, the dredge and pipes will be cleaned to ensure that no water, sediment or biofouling remains
- when loading the vessel onto the trailer for transport the vessel will be travelling to the Boat Harbour by road, from a location within WA state waters, and has been operating solely in WA waters for more than 10 years.

In consideration of the above, no active management associated with introduced marine species is required.

3.9 Vegetation disturbance/removal

No native vegetation is anticipated to be directly removed or disturbed during the dredging or beach nourishment at Wonnerup Beach. As discussed in Section 3.2, the extended offshore disposal area comprises bare sand and wrack and should clearing or disturbance of native vegetation be required during any future maintenance campaigns, an application for a Native Vegetation Clearing Permit will be prepared and submitted for approval.

3.10 Wind-blown dust and sand

The deposition/disturbance of sand on Wonnerup Beach during the beach nourishment and profiling and from movement of machinery may cause wind-driven transport of dust and sand. If wind-blown material is transported or deposited in public areas it can potentially cause a number of social and environmental issues. It is considered unlikely, wind-blown dust and sand will cause any social or environmental issues during the dredging and beach nourishment as sediment deposited on Wonnerup Beach will in the form of a wet slurry and therefore it is unlikely to generate significant dust. Additionally the material will be of similar composition and physical characteristics as the Wonnerup Beach sands and so there is no greater risk of dust generation. Finally, there have been no public complaints received regarding wind-blown dust and sand during previous bypassing campaigns.

3.11 Impact to threatened and migratory species

An EPBC Act Protected Matters Search Tool report identified 62 threatened flora and fauna species and two threatened ecological communities as potentially occurring in the vicinity (within 5 km) of Port Geographe marina (BMT 2019b). The potential impacts from the campaign to threatened flora and fauna species and ecological communities were assessed as part of the EIA for maintenance dredging at Port Geographe (BMT 2019b) and it was considered that there is a low risk of threatened flora and fauna species or ecological communities being impacted by maintenance campaigns at Port Geographe. Therefore no additional management associated with threatened and migratory species is considered required.

3.12 Environmental impact of noise

Machinery used during the maintenance campaigns will generate noise that can disturb marine and terrestrial fauna located within hearing range of the campaign. The marine habitat in the vicinity of the Port Geographe marina is not considered to be an important area for feeding, reproduction or

sheltering by marine fauna (BMT 2019b). Due to the small-scale and short duration of the proposed dredging campaigns and the low-frequency sounds generated by the dredge equipment, it is unlikely significant impacts to marine fauna from machine generated noise.

3.13 Public safety, access and visual amenity

The operation of heavy machinery during dredging and disposal operations will temporarily impact visual amenity and may pose a short-term risk to public safety, particularly vessel operators and beach users. The dredge vessel will be operating in the offshore disposal area and a submerged pipeline from the dredge vessel will be laid down on Wonnerup Beach for nourishment.

To limit the impact on the public:

- fencing and public information signs will be installed on site
- pipeline lay-down areas will be specifically designated and sign-posted to preserve public safety
- dredging and nourishment areas will not be accessible to the public.

The risk to public safety is considered to be medium, therefore public safety will be actively managed in accordance with the EMMP and a campaign-specific environmental management plan.

3.14 Odour generation

The decomposition of seagrass wrack has the potential to generate hydrogen sulfide gas, which has an unpleasant odour. Field observations of sediment samples collected from the offshore disposal area in May 2019 recorded no sulfidic odour and no organic matter (BMT 2019c). However, wrack was observed at the offshore disposal area during opportunistic towed videos in September and December 2019.

During previous maintenance dredging campaigns, sand and wrack was disposed to the offshore disposal area and remained underwater settling to the seafloor. It is unlikely that the wrack deposited at this area will generate odour due to the exposed location, and wind- or wave-induced mixing would result in the rapid breakdown of wrack. As such, odour is unlikely to be a major concern during dredging of the extended offshore disposal area and nourishment at Wonnerup Beach.

3.15 Social impact of noise

The machinery used during the proposed dredging and disposal works may generate noise that could potentially disturb the local community located within hearing range of the works. There are a number of residential properties located along the Wonnerup Beach that could be affected by the proposed works.

The noise generated by the cutter suction dredge and land-based machinery during the proposed dredging and nourishment works, will not differ from previous maintenance dredging and bypassing campaigns. The additional dredging of the extended offshore disposal area is not anticipated to result in greater noise levels for residents due to the increased distance from residential premises. Therefore no additional management of noise impacts will be implemented, however a complaints register will be maintained during works.

3.16 Navigational hazards

The proposed dredging operations may pose a temporary and localised navigational hazard to vessels using Port Geographe marina because the dredge has no self-propulsion (using only anchors and spuds to move) and a 40 m floating pipeline will be deployed from its stern. The pipeline from the proposed offshore dredge to Wonnerup Beach will be submerged to the seabed, and the pipeline will come onshore and dispose the dredged material onto Wonnerup Beach. The dredge area is not anticipated to pose additional navigational hazards to previous maintenance dredging campaigns and the impact on navigation from maintenance dredging campaigns should be limited because:

- the dredge is equipped with lights and will be clearly visible at night
- floating segments of pipeline will be equipped with lights clearly visible on the water surface during the day and night
- the dredge will maintain a navigable channel and vessel access will be monitored where practicable
- a Temporary Notice to Mariners will be issued to inform the public of navigational hazards associated with maintenance dredging.

Additionally longer-term benefit the works, which include the reduction of navigational impacts posed by the accretion in the offshore disposal area far outweigh the short-term impact to navigation during the works. The impact on navigation from the proposed dredging campaign will be monitored and managed in accordance with a campaign-specific environmental management plan.

3.17 Disturbance/damage to heritage sites

The proposed dredging and beach nourishment involves the removal of recently deposited sediments. The dredging and disposal areas are not within a Registered Aboriginal Heritage Site, with the nearest Registered Site ~1 km south-east of the project area (BMT 2019e). The project dredging and beach nourishment areas are restricted to previously disturbed areas with no excavation below natural ground level. Disturbance of previously undocumented Aboriginal sites is considered unlikely. Given the above considerations, the proposed works are not considered to present a significant risk of adversely impacting Aboriginal Heritage Sites.

The project area is within South West Boojarah Indigenous Land Use Agreements (ILUA) executed on 8 June 2015. The ILUA binds the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) and a subsequent 'Activity Notice' issued under the NSHA, if there is a risk that an activity will 'impact' (i.e. by excavating, damaging, destroying or altering in any way) an Aboriginal heritage site (DPLH 2019). No impacts are anticipated to Aboriginal Heritage Sites and therefore entering into a NSHA for maintenance campaigns is not an anticipated requirement.

4 Management of Potential Environmental Impacts

Environmental monitoring and management of proposed dredging of the extended offshore disposal area and nourishment at Wonnerup Beach will be completed in accordance with the DoT's Port Geographe EMMP (BMT 2019a). The EMMP details the management actions and management targets that were developed achieve and measure achievement of the condition environmental objectives for to seagrass wrack management, sediment movement and the harbour entrance channel maintenance. Routine monitoring and during works monitoring is also detailed in the EMMP.

As per the EMMP, a campaign-specific Dredging Environmental Management Plan (DEMP) will be prepared prior to the commencement of dredging and nourishment. Monitoring actions as detailed in the EMMP (Table 4.1) will focus on the key issues of water column turbidity and smothering and reduction of light for seagrass meadows. The campaign-specific DEMP will also consider various other environmental management measures to further reduce the impact of the works on the environment in accordance with the DoT's Maintenance Dredging Environmental Management Framework (BMT 2018). This will include limiting continuous turbidity generating operations in the extended disposal area to two months.

Table 4.1 Monitoring during dredging of the extended offshore disposal area

Parameter	Method	Location	Frequency
Water column turbidity	Site photographs	Dredging and disposal site	Daily during works
	Plume sketches[1]		Daily during works
	Aerial photographs		Once during works
	Secchi depths[1]	Offshore disposal area	Daily during works
Light attenuation	In situ data loggers or hand-held meter	Impact sites in seagrass meadow adjacent to offshore disposal area, reference sites west of Port Geographe	Before, during and after offshore disposal/dredging
Seagrass meadow edge	Multi-beam surveys and/or towed video	Seagrass meadow edge adjacent to offshore disposal area	Prior to and after offshore disposal/dredging

5 Anticipated Changes to the EMMP

Given the demonstrated low risk of environmental impacts from proposed dredging of the extended offshore disposal area (Section 3), few changes to the EMMP will be required (BMT 2019a). The proposed changes are as follows (note references below refer to references within the EMMP):

- Section 2.1.1 Seagrass wrack management
  This section has been updated to include the extended offshore disposal area with the below text and an updated set of coordinates and associated map of the offshore disposal area:

  'Nearshore disposal is preferred, however if none of the nearshore disposal options listed above are suitable, offshore disposal will be considered. The proposed offshore disposal area is the area previously utilised in the 2013–2014 capital dredging campaign clipped to be within the PGCMA (Table 2.1, Figure 2.2). The footprint of the offshore disposal area has been extended to match that of the 2013–2014 capital dredging campaign in order to increase its capacity to receive dredge material; this is considered to be of low environmental risk. Refer to Appendix B for the justification and environmental impact assessment for this extension.'

- Section 2.1.2 Sediment management
  This section has been re-ordered to improve clarity and updated with the below text to include the extended offshore disposal area as a sediment source for beach nourishment at Wonnerup Beach as follows:

  'Sources from within the PGCMA include sand built-up on the Western Beach (mechanically bypassed via pipeline or trucks), the material dredged from the harbour entrance channel (via pipeline) and dredging of sand previously placed in the offshore disposal area during maintenance and capital campaigns (via pipeline). Sand from the Western Beach and the harbour entrance channel can have a high wrack content, therefore use of these sources should consider the impact based on the wrack content and mitigate such impacts as necessary.'

  and:

  'The justification for using the offshore disposal area as a sand source and the associated environmental impact assessment is included in Appendix B. Use of this sand source is considered to be of low environmental risk and sand will only be removed above a historic baseline to ensure the naturally occurring sand bar is not impacted.'

- Section 2.1.3 Harbour entrance channel management
  This section has been updated to refer to Section 2.1.1 for the definition of the extended offshore disposal area.

6 References

BMT (2018) Department of Transport Maintenance Dredging – Environmental Management Framework. Prepared for Department of Transport by BMT Western Australia Pty Ltd, Report No. 1368_00_001/1_Rev1, Perth, Western Australia, February 2018

BMT (2019a) Port Geographe Coastal Structures – Environmental Monitoring and Management Plan. Prepared for Department of Transport by BMT Western Australia Pty Ltd, Report No. 924_09_001/1_Rev4, Perth, Western Australia, May 2019

BMT (2019b) Port Geographe Coastal Structures –Environmental Impact Assessment. Prepared for Department of Transport by BMT Western Australia Pty Ltd, Report No. R-1463_01-3, Perth, Western Australia, September 2019

BMT (2019c) Environmental Monitoring and Management Summary for the 2018/19 Port Geographe Maintenance Dredging Close-out Report. Prepared for Department of Transport by BMT Western Australia Pty Ltd, Report No. Tn-1463_01-1, Perth, Western Australia, August 2019

BMT (2019d) Environmental Monitoring and Management Summary for the 2019 Port Geographe Bypassing Close-out Report. Prepared for Department of Transport by BMT Western Australia Pty Ltd, Report No. Tn-1666_00-2, Perth, Western Australia, August 2019

BMT (2019e) Port Geographe Maintenance Dredging 2019 Aboriginal Heritage Risk Assessment. Prepared for the Department of Transport by BMT Western Australia Pty Ltd, Report No. Tn-DT1-1666-00-042-01, Perth, Western Australia, August 2019

BMT (DRAFT) Port Geographe Capital Maintenance Dredging 2019 Closeout Report. Prepared for the Department of Transport by BMT Western Australia Pty Ltd

BMT JFA 2015 Port Geographe Capital Dredging and Canal Maintenance Dredging 2013/14 Closeout Report. Prepared for the Department of Transport by BMT JFA Consultants Pty Ltd, Report No. R-300.12-14.1-1, Perth Western Australia, May 2015

BMT Oceanica (2015) Port Geographe Bypassing Environmental Impact Assessment. Prepared for Department of Transport by BMT Oceanica Pty Ltd, Report No. 924_06_001/2_Rev0, Perth, Western Australia, December 2015

CA (2009) National Assessment Guidelines for Dredging, Prepared by Commonwealth of Australia, Canberra, ACT

CENR (2000) Integrated Assessment of Hypoxia in the Northern Gulf of Mexico. National Science and Technology Council, Committee on Environment and Natural Resources, Washington DC, USA

Collier CJ, Lavery PS, Masini RJ, Ralph PJ (2007) Morphological, growth and meadow characteristics of the seagrass *Posidonia sinuosa* along a depth-related gradient of light availability. Mar Ecol Prog Ser 337:103–115

DER (2015) Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes: Acid Sulfate Soils Guideline Series. Prepared by the Department of Environment Regulation, Perth, Western Australia, June 2015

DPLH (2019), Aboriginal Heritage Inquiry System. Available online at https://maps.daa.wa.gov.au/AHIS/ [Accessed 23/08/2019].

DWER (2019) Acid Sulfate Soils risk maps. Western Australian Department of Water and Environmental Regulation. Available at <https://catalogue.data.wa.gov.au/dataset/acid-

sulfate-soil-risk-map-50k-dwer-049/resource/9bc86dad-0170-495a-9c67-04cccec27f64> [Accessed 29 December 2019]

EPA (2018) Statement of Environmental Principles, Factors and Objectives. Environmental Protection Authority, June 2018

Lavery PS, McMahon K, Mulligan M, Tennyson A (2009) Interactive effects of timing, intensity and duration of experimental shading on *Amphibolis griffithii*. Mar Ecol Prog Ser 394:21–33

Oceanica (2013a) Port Geographe Capital Dredging 2013 Dredging Environmental Impact Assessment. Prepared for BMT JFA Consultants Pty Ltd by Oceanica Consulting Pty Ltd, Report No. 924_02_001/1_Rev2, Perth, Western Australia, August 2013

Oceanica (2013b) Po Port Geographe Environmental Monitoring Closeout. Prepared for BMT JFA Consultants Pty Ltd by Oceanica Consulting Pty Ltd, Report No. 924_01_001, Perth, Western Australia, August 2013

Oldham CE, Lavery PS, McMahon K, Pattiaratchi C, Chiffings TW (2010) Seagrass wrack dynamics in Geographe Bay, Western Australia. Prepared for Department of Transport, Perth, Western Australia, April 2010

Sullivan LA, Ward NJ, Bush RT, Toppler NR, Choppala G (2018) National Acid Sulfate Soils Guidance: Overview and management of monosulfidic black ooze (MBO) accumulations in waterways and wetlands. Department of Agriculture and Water Resources, Canberra, Australian Capital Territory, July 2018

Appendix C Department of Transport Maintenance Dredging – Environmental Management Framework (August 2020)

Department of Transport Maintenance Dredging Environmental Management Framework

Reference: R-1666_00-37
Date: August 2020

Document Control Sheet

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Acronyms and Definitions

Capital dredging	Removal and relocation of natural previously undisturbed seabed to increase water depth for the Department of Transport's navigational waterways and/or channels, swing basins and berth pockets
DAWE	Australian Department of Agriculture, Water and the Environment
DBCA	Western Australian Department of Biodiversity Conservation and Attractions
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
DoT	Western Australian Department of Transport
DPLH	Western Australian Department of Planning, Lands and Heritage
DWER	Western Australian Department of Water and Environmental Regulation
EMF	Department of Transport's Maintenance Dredging Environmental Management Framework
EPA	Western Australian Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
IDER	Initial Desktop Environmental Review
ILUA	Indigenous Land Use Agreement
Maintenance dredging	Dredging to maintain Department of Transport's design depths at existing sites, previously disturbed seabed areas, navigational waterways and/or channels, swing basins and berth pockets
NAGD	National Assessment Guidelines for Dredging
SAP	Sampling and Analysis Plan
TNtM	Temporary Notice to Mariners
WA	Western Australia

Executive Summary

The Western Australian Department of Transport (DoT) is responsible for the management of a number of coastal facilities and small craft waterways around Western Australia. A fundamental component of the DoT's maintenance responsibilities is the requirement to maintain safe navigable waters at these sites, which is facilitated by a state-wide maintenance dredging program. Maintenance dredging is undertaken in accordance with this Environmental Management Framework (EMF). DoT has the authority to carry out maintenance dredging under the *Marine and Harbours Act 1981* and, as the managing department, is responsible for meeting environmental protection requirements under the *Environmental Protection Act 1986*.

The purpose of this EMF is to guide DoT in effective and efficient environmental management and monitoring of maintenance dredging for pre-determined design depths and/or historic depths at DoT sites. The EMF outlines:

- the DoT's maintenance dredging program and typical works completed at the various sites
- the steps required to determine maintenance dredging requirements
- environmental regulatory context, relevant guidelines and approvals for maintenance dredging
- typical environmental management and monitoring.

Capital dredging within DoT sites and/or seabed lease areas may align with the underlying environmental principles of this EMF; however, these projects should follow appropriate regulatory processes, requirements, approvals and advice that may supersede this document. Capital dredging undertaken by third-party leaseholders within DoT sites, and the required environmental regulatory processes and approvals, is the responsibly of the lessees, unless otherwise agreed with DoT.

Compliance with this EMF is audited ~annually. Following the completion of each audit, the EMF will be reviewed and updated as appropriate to ensure it incorporates amended or new environmental policies; new environmental guidelines; improved environmental understandings; and, improved dredging processes. This review schedule ensures the evolution and application of best practice environmental management to the DoT's maintenance dredging program.

This EMF revision incorporates lessons learnt from the previous document revision and includes minor changes based on the findings of the 2017/18 and 2018/19 EMF internal audits and updates to regulatory department names. legislation and guidelines.

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1 Introduction

1.1 Maintenance dredging program

The Western Australian Department of Transport (DoT) is responsible for the management of a number of coastal facilities and small craft waterways around Western Australia (WA) from Esperance in the south to Wyndham in the far north (Figure 1-1). A fundamental component of the DoT's management responsibilities is to maintain safe navigable waters at these sites, which is facilitated by a state-wide maintenance dredging program. DoT's maintenance dredging program is central to the viability of the state's commercial fishing and marine tourism industry and to the safe use of waterways by recreational boat users. The specific maintenance dredging requirements at any site is determined by facility user feedback and the rate of siltation. The rate of natural siltation is dependent on the frequency and intensity of metocean events, and is periodically monitored and assessed at each site using hydrographic and topographic surveys.

DoT manages maintenance dredging (the removal of material from an ocean, estuary, river bed, beach or bank, including bypassing and seabed levelling methods) of pre-determined design and historic depths at numerous sites around WA (Table 1-1, Figure 1-1) under Section 5(1) of the *Marine and Harbours Act 1981*. As the managing department for maintenance dredging activities at these sites, DoT has a responsibility to ensure the environment is protected under the *Environmental Protection Act 1986* (EP Act) and minimise potential environmental impacts from maintenance dredging projects.

Many of DoT's maintenance dredging projects are executed using hydraulic collection and delivery methods where material is removed by small cutter-suction dredge, and pumped as a hydraulic slurry to a disposal area via a combination of flexible floating, submerged, inland or buried pipelines (Table 1-2). Some sites, such as sand bypassing sites in Mandurah and Dawesville, use hybrid mechanical collection and hydraulic delivery methods. Material is mechanically collected using land-based excavators and hydraulically pumped and delivered as a slurry to a disposal area via a pump and pipe arrangement (Table 1-2). Other sites use land-based mechanical methods to remove material from the collection area and deliver it to the disposal area. Material is collected excavators, loaded onto trucks by wheel loaders and carted to disposal area by road trucks and/or articulated dump trucks (Table 1-2). Some sites require water-based mechanical method to level isolated high-spots using a sweep-bar/plough attached to vessel. Wrack material may also be removed from the seabed and water column using a trawl net (Table 1-2).

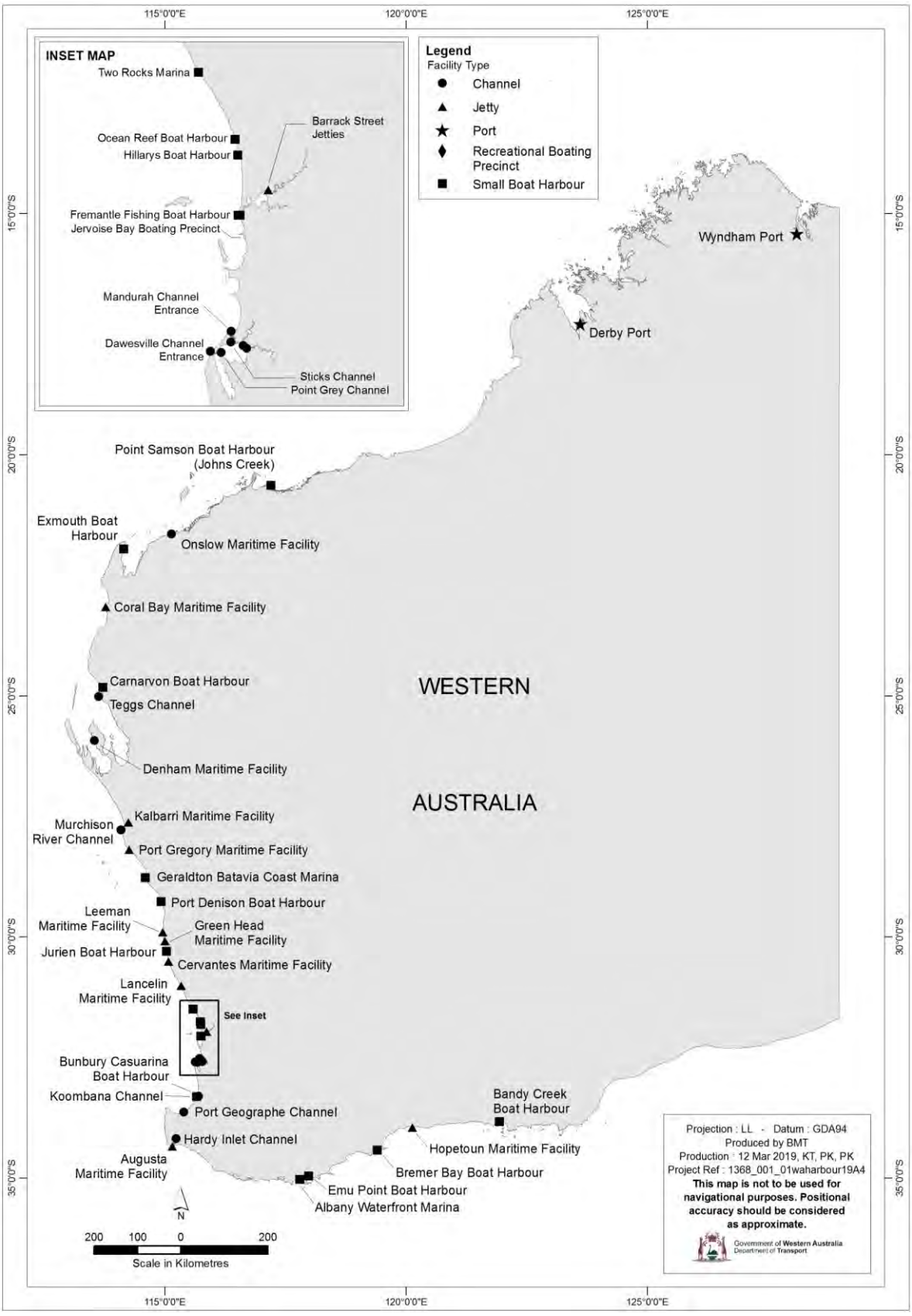


Figure 1-1 Department of Transport maintenance dredging sites

Table 1-1 Department of Transport maintenance dredging sites and typical dredge frequency

Region	Site	Asset/facility	Typical dredge frequency
Kimberley	Wyndham Port	Port	Ongoing
	Derby Port	Port	No previous maintenance dredging
Pilbara	Point Samson Boat Harbour (John's Creek)	Small Boat Harbour	Infrequent
	Onslow Maritime Facility	Channel and Harbour Basin	5–10 years
Gascoyne	Exmouth Boat Harbour	Small Boat Harbour	5 years (channel) 2–3 years (sand trap)
	Coral Bay Maritime Facility	Jetty	No previous maintenance dredging
	Carnarvon Boat Harbour	Small Boat Harbour	10 years
	Teggs Channel	Channel	5–10 years
	Denham Maritime Facility	Channel and Harbour Basin	7–10 years
Mid-West	Kalbarri Maritime Facility	Jetty	Infrequent
	Murchison River Channel (Kalbarri)	Channel	Biennial
	Port Gregory Maritime Facility	Jetty	No previous maintenance dredging
	Geraldton Batavia Coast Marina	Small Boat Harbour	No previous maintenance dredging
	Port Denison Boat Harbour	Small Boat Harbour	Infrequent
	Leeman Maritime Facility	Jetty	No previous maintenance dredging
	Green Head Maritime Facility	Jetty	Infrequent
Wheatbelt	Jurien Bay Boat Harbour	Small Boat Harbour	Infrequent wrack trawling 5–10 years dredging
	Cervantes Maritime Facility	Jetty	Infrequent
	Lancelin Maritime Facility	Jetty	3–5 years
Metropolitan	Two Rocks Marina	Small Boat Harbour	Infrequent
	Ocean Reef Boat Harbour	Small Boat Harbour	Biennial
	Hillarys Boat Harbour	Small Boat Harbour	No previous maintenance dredging
	Barrack Street Jetties	Jetty	No previous maintenance dredging
	Fremantle Fishing Boat Harbour	Small Boat Harbour	No previous maintenance dredging

Region	Site	Asset/facility	Typical dredge frequency
	Jervoise Bay	Recreational Boating Precinct	Infrequent
Peel	Mandurah Entrance Channel*	Channel	Annual
	Sticks Channel	Channel	Infrequent
	Point Grey Channel	Channel	5–10 years
	Dawesville Entrance Channel	Channel	Annual
South West	Bunbury Casuarina Boat Harbour	Small Boat Harbour	No previous maintenance dredging
South West	Koombana Channel (Bunbury Cut)	Channel	Infrequent
South West	Port Geographe Channel	Small Boat Harbour	Annual
South West	Augusta Maritime Facility	Jetty	Infrequent
South West	Hardy Inlet Channel	Channel	5–10 years
South West	Augusta Boat Harbour	Small Boat Harbour	No previous maintenance dredging
Great Southern	Albany Waterfront Marina	Small Boat Harbour	No previous maintenance dredging
Great Southern	Emu Point Boat Harbour (Albany)	Small Boat Harbour	Infrequent
Great Southern	Bremer Bay Boat Harbour	Small Boat Harbour	Infrequent
Goldfields /Esperance	Hopetoun Maritime Facility	Jetty	No previous maintenance dredging
Goldfields /Esperance	Bandy Creek Boat Harbour (Esperance)	Small Boat Harbour	Biennial

Notes:
(1) Sites listed in order of coastal location from north to south.
(2) * = Joint management with local government/shire.

Table 1-2 Dredge methods

Hydraulic methods: cutter suction dredging	Hybrid mechanical and hydraulic	Water-based mechanical (ploughing)	Land-based mechanical
	 	 	
• Different sizes and capacities • Supported by auxiliary equipment, pipeline sets (up to 5 km) and boosters • Suits larger works in the waterways and harbours	• Land based excavators • Hydraulic slurry pumps • Series of pipelines • Suits larger scale and repititive sand trap management works	• Land based earthmoving equipment and trucks • Suits sand bypassing works in coastal management areas and within harbor reserves	• Small tug or barge equipped with a plough/leveler • Suits smaller works and high spots in entrance channels to harbours

1.2 Project team

DoT's maintenance dredging program is facilitated by a project team that meets regularly to discuss ongoing maintenance dredging requirements. The project team may include the:

- Principal's Representative and Superintendent (DoT)
- DoT's engineering and project management consultant
- DoT's environmental consultant
- DoT's dredging contractor(s).

1.3 Purpose and development

This Environmental Management Framework (EMF) has been specifically developed to address DoT's maintenance dredging operations. DoT acknowledges the *Ports Australia – Environmental Code of Practice for Dredging and Dredged Material Management* (Ports Australia 2016). However, it is considered the application of this Code of Practice is more appropriate to commercial industrial ports as opposed to small coastal facilities and craft waterways. This EMF is intended to ensure that DoT's maintenance dredging activities are completed with appropriate consideration of environmental factors and all relevant environmental regulatory requirements. The EMF is based on the principles of:

- protection of the environment
- clear, relevant and practical identification of potential environmental impacts
- open engagement with stakeholders

- effective environmental monitoring and management.

Capital dredging within DoT sites and/or seabed lease areas may align with the underlying environmental principles of the EMF; however, these projects should follow appropriate environmental regulatory processes, requirements, approvals and advice that may supersede this document. Capital dredging undertaken by third-party leaseholders within DoT sites, and the required environmental regulatory processes and approvals, is the responsibly of the lessees, unless otherwise agreed with the DoT.

This EMF revision incorporates lessons learnt from the previous document revision (BMT 2018) and includes minor changes based on the findings of the 2017/18 and 2018/19 EMF internal audits and updates to regulatory department names and guidelines.

2 Environmental Management Framework

DoT's maintenance dredging typically involves the removal of relatively small volumes of clean marine sands from harbour basins, navigational channels and beach sand traps, and generally has a relatively low environmental impact. DoT's maintenance dredging projects have typically not been referred to the Environmental Protection Authority (EPA) for assessment, and potential environmental impacts are managed through the EMF, which follows the basic principles for referral of a proposal under the EP Act. There may be some situations where formal environmental approval(s) and advice are required, as determined during assessment of environmental impacts (Step 2 of the EMF process; Section 2.2; Figure 2-1).

The EMF outlines the following four steps to manage maintenance dredging and to ensure appropriate consideration of environmental factors and relevant environmental regulatory requirements (Figure 2-1):

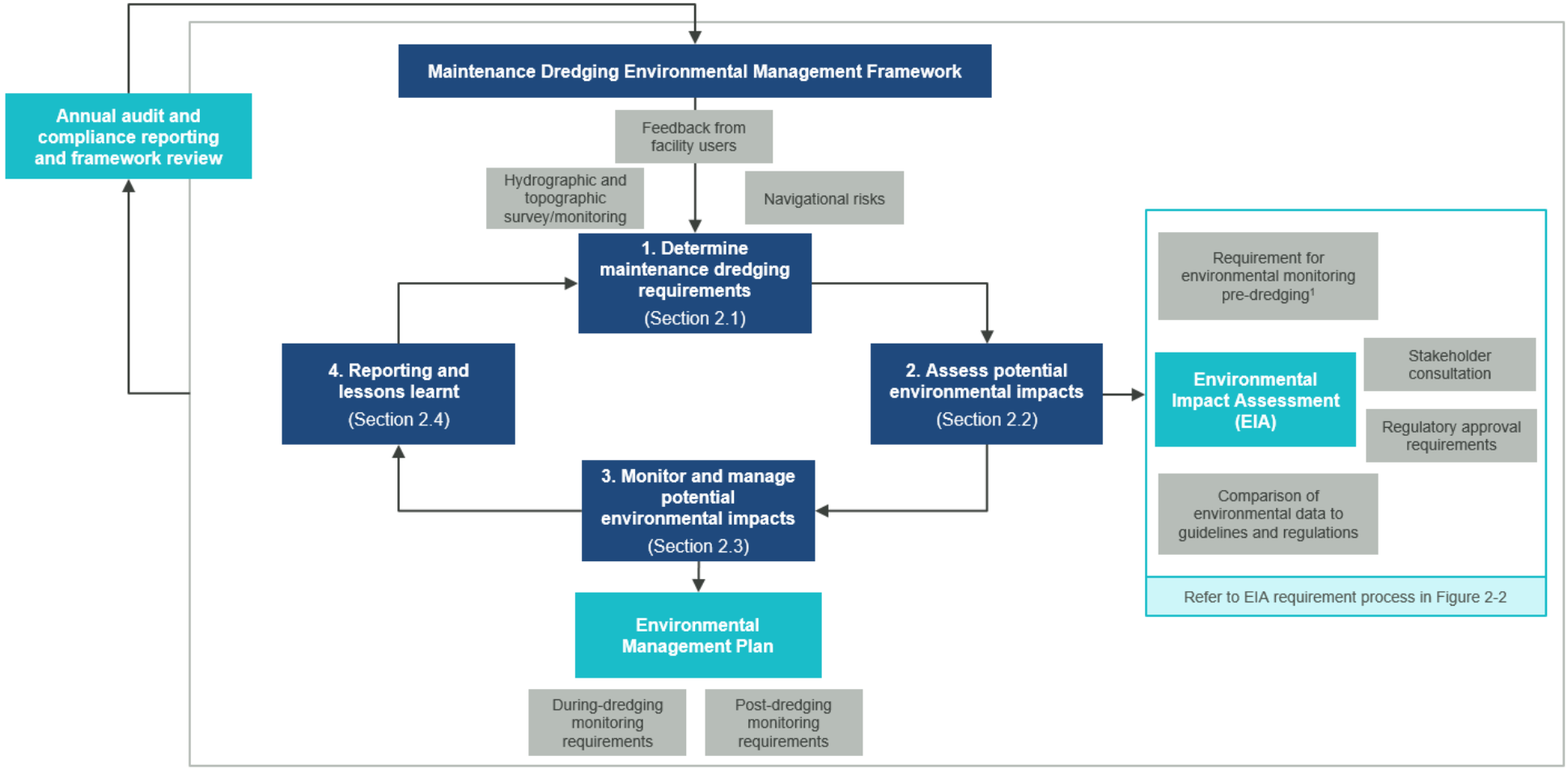
(1) Determine maintenance dredging requirements (Section 2.1)

(2) Assess potential environmental impacts (Section 2.2)

(3) Monitor and manage environmental impacts (Section 2.3)

(4) Reporting and lessons learnt (Section 2.4).

The dedicated processes and reporting requirements of the EMF ensures maintenance dredging projects are managed in-line with recognised environmental criteria, and with consideration of potential environmental impacts. The EMF also undergoes annual review to ensure best practice methods continue to be applied as knowledge, technology, dredging methods and regulatory requirements change (Section 3).



Note:
(1) Any required pre-dredging environmental monitoring will be documented in a Sampling and Analysis Plan, as appropriate.

Figure 2-1 Maintenance Dredging Environmental Management Framework

2.1 Determine maintenance dredging requirements (Step 1)

DoT undertakes periodic hydrographic and/or topographic surveys to monitor the requirement for maintenance dredging in most sites in the maintenance dredging program, including entrance channels and harbour basins. In addition, DoT uses recent satellite and/or drone georeferenced images to monitor the requirement in coastal sites including sand traps, beach nourishment sites, coastal management areas and low-lying mudflats. The frequency of surveys and drone imagery at a site is determined on an as needed basis and may include consideration of the rate of sedimentation and erosion, historical trends, navigational risks, metocean events, feedback from users and local stakeholders, and environmental quality conditions (e.g. water quality). The typical dredging frequency at each site is provided in Table 1-1. The survey data assists in prioritising areas for maintenance dredging, provides information on the form and stability of any previous disposal area, and the presence of significant accretion or erosion. The requirement for maintenance dredging will be determined by DoT's engineering consultant using the assessment of survey data and other inputs (e.g. user feedback, navigation risks, aerial imagery, lessons learnt from previous dredging projects). This may be documented in a survey review which will assess the need to dredge. The review may recommend:

- Do nothing and continue monitoring. This is typically when the reduction in navigational depth does not constitute an immediate or short term safety hazard.
- Maintenance dredging to restore safe navigation depths.
- Other alternative actions to improve navigation such as the relocation of navigation aids. This is typically when it is possible to delay the requirement for maintenance dredging.

If maintenance dredging is required, the most recent survey data will be used to define the areas and volumes to be dredged. The site characteristics such as the weather, geotechnical and environmental conditions will be used to determine a suitable dredging method. During the planning phase of maintenance dredging, the disposal and dredge design options will be assessed to ensure environmental impacts at both the dredging and disposal areas are minimised.

2.2 Assess potential environmental impacts (Step 2)

The significance of potential environmental impacts for maintenance dredging will be assessed in the context of the EPA's environmental factors and associated environmental objectives that underpin the environmental impact assessment process in WA (EPA 2020). This assessment is documented in an Environmental Impact Assessment (EIA), which will include information on the proposed dredging and disposal of material; relevant environmental monitoring results; potential environmental impacts; stakeholder consultation; and potential environmental monitoring and/or management.

It is intended that an EIA remains current across multiple maintenance dredging projects for sites where the environmental risks, regulatory process and the proposed dredging (design and volume) and disposal is similar or unchanged. In situations where there is an existing EIA, an Initial Desktop Environmental Review (IDER; Appendix A) will be completed to determine whether the existing EIA adequately addresses the potential environmental impacts of the proposed maintenance dredging project. The IDER will review the existing EIA together with other available information including:

closeout reports, data reports, government records and site manager/client feedback. Completion of the IDER will identify one of three possible outcomes regarding the application of the existing EIA (Figure 2-2):

(1) The existing EIA is adequate in addressing environmental, engineering and/or stakeholder aspects and will be applied to the upcoming maintenance dredging project.

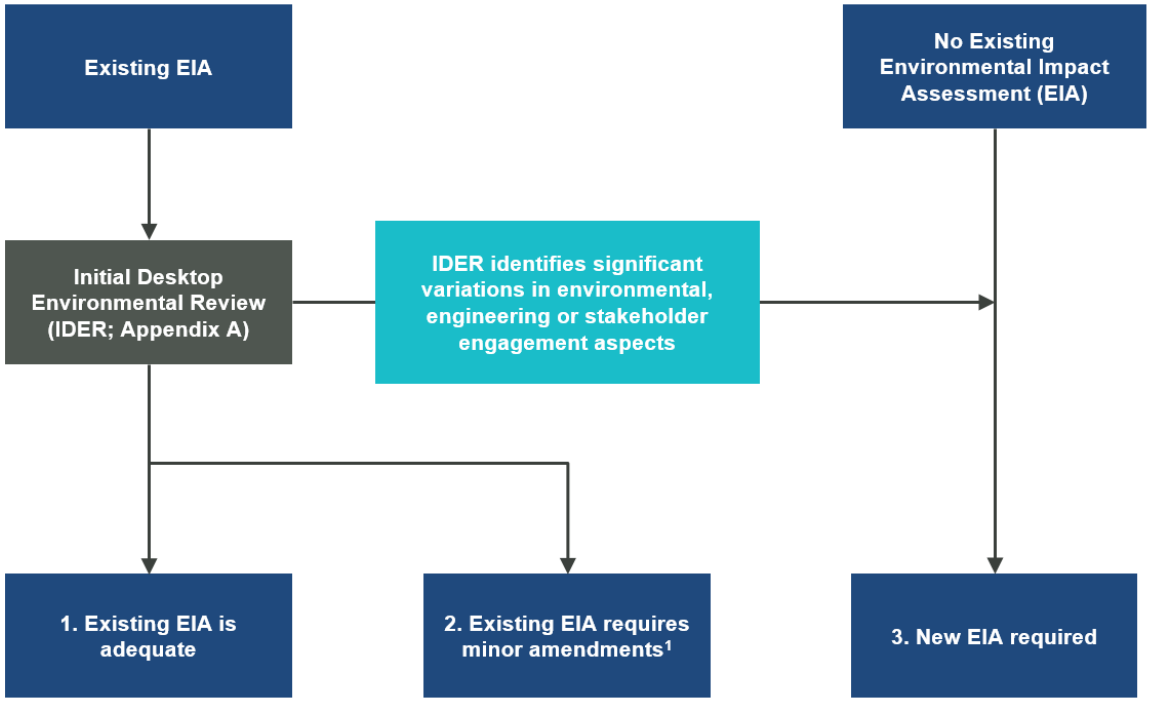
(2) The existing EIA requires minor amendments before it can be applied to the upcoming maintenance dredging project.

(3) A new EIA[1] is required for the upcoming maintenance dredging project if the IDER identifies significant variations in environmental, engineering and/or stakeholder aspects of the proposed project when compared to the previous EIA.

The IDER is completed by DoT's environmental consultant and reviewed by DoT's engineering consultant and project management consultant, in consultation with the project team, and retained for auditing purposes.

At locations where maintenance dredging occurs frequently, the IDER will be assessed annually or more frequently if DoT's environmental consultant is aware of changes to: environmental risks (e.g. oil spill or change of industries operating from the site); the regulatory process; the proposed dredging (design and volume); and/or the disposal (method and site).

[1] Sites with no existing DEIA automatically require the preparation of a new DEIA.



Note:

(1) The existing Environmental Impact Assessment (EIA) may be updated to reflect the required amendments or documented in the Initial Desktop Environmental Review (IDER; Appendix A).

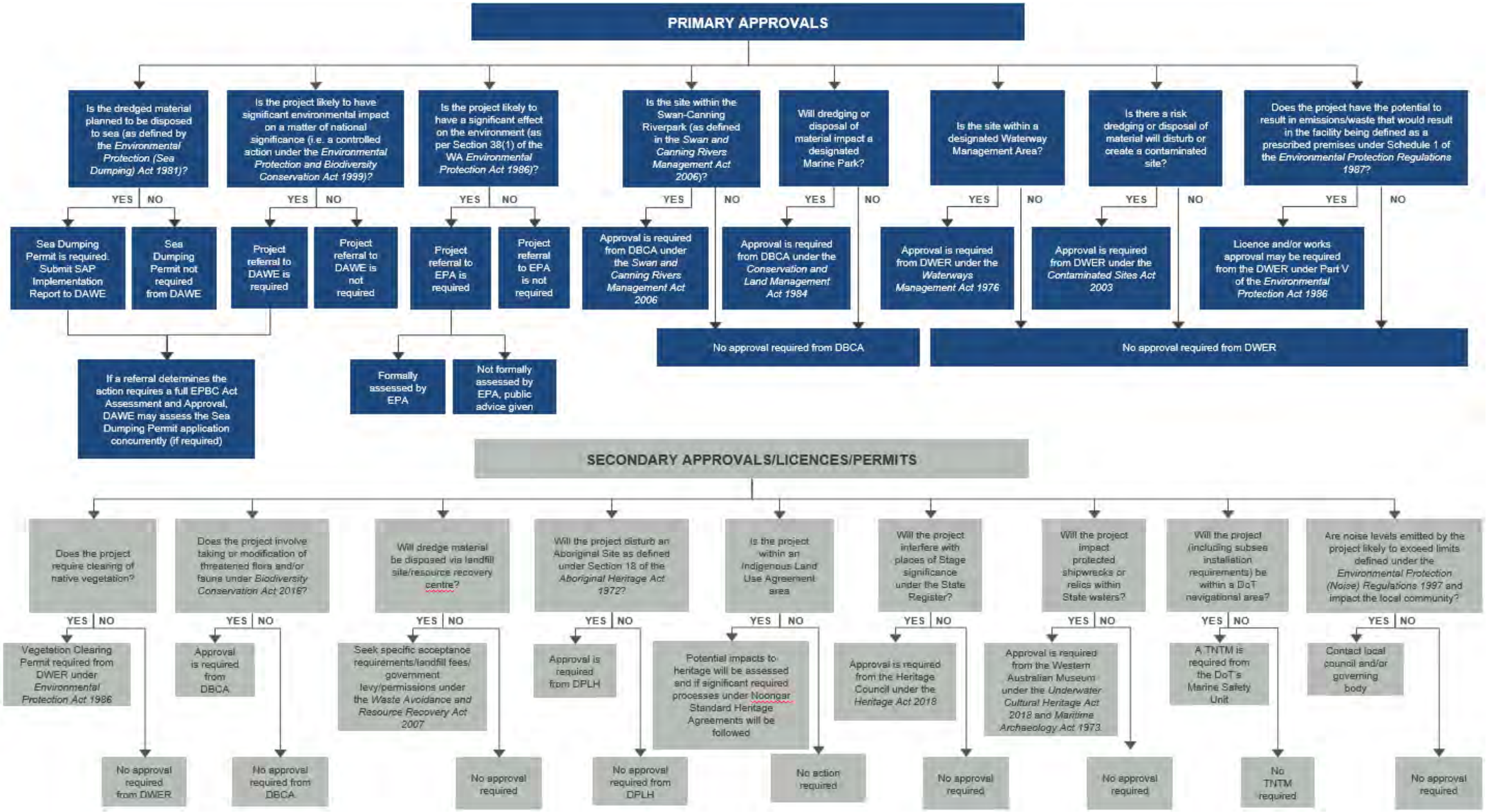
Figure 2-2 Determining the requirement for an Environmental Impact Assessment

2.2.1 Determine regulatory approval requirements

The primary and secondary approvals that will be considered for each maintenance dredging project are outlined in Figure 2-3. If the EIA identifies the potential for significant adverse environmental impacts or a high level of stakeholder concern, then it is appropriate to seek advice from the relevant regulatory authorities depending on the potential impacts associated with the maintenance dredging project (Figure 2-3).

Potential environmental impacts of maintenance dredging at several DoT sites have previously been assessed under the EP Act. In these instances, further environmental approval may not be required if the works were considered within the original approval.

In the case of emergency dredging requirements, safety issues will take precedence over all other matters, including application of the EMF. In such instances the DoT Marine Safety will be consulted.



Notes:

(1) The approvals, licences and permits detailed in this figure are those that most commonly apply to maintenance dredging projects. Some approvals, licences and permits, specifically those relevant to environmental sampling requirements, may not be included.

(2) DAWE = Australian Department of Agriculture, Water and the Environment; DPLH = Western Australian Department of Planning, Lands and Heritage; DWER = Western Australian Department of Water and Environmental Regulation, DBCA = Western Australian Department of Biodiversity, Conservation and Attractions, DoT = Western Australia Department of Transport, EPBC Act = *Environmental Protection and Biodiversity Conservation Act 1999*; EPA = Western Australian Environmental Protection Authority; ILUA = Indigenous Land Use Agreement; SAP = Sediment Sampling and Analysis Plan; TNtM = Temporary Notice to Mariners.

Figure 2-3 Primary and secondary environmental approval pathways

2.2.2 Monitoring pre-dredging

Environmental monitoring may be completed before, during and after dredging (Sections 2.3.1 and 2.3.2) to quantify and minimise potential environmental impacts. Pre-dredging monitoring typically involves sediment sampling of the material to be dredged. Sediment sampling may also support characterisation of dredged material for engineering and geotechnical purposes. Sampling material from the proposed disposal areas may be required if ocean disposal and/or onshore disposal is being considered. Other pre-dredge monitoring (e.g. water quality, habitat mapping) may also be required, depending on the outcome of the IDER during preliminary project scoping and may be used to inform the preparation of the EIA (Section 2.2).

Pre-dredging environmental monitoring is required to be completed in accordance with a detailed sampling and analysis plan (SAP) that outlines sampling areas/sites, sampling design, sampling methods, rationale and justification for the proposed sampling approach, rationale for chemical and physical analyses, quality assurance and control procedures, and necessary transport and storage requirements. SAPs will be prepared with reference to relevant/current environmental guidelines and regulations (Section 2.2.3).

A SAP may not be required in instances where the sampling scope is small and there is confidence that field sampling can be completed in-line with relevant sampling requirements. Justification for this should be included in the IDER.

2.2.3 Environmental guidelines

There are a number of environmental guidelines and regulations that apply to the assessment and management of environmental impacts of maintenance dredging, including the:

- *National Assessment Guidelines for Dredging* (NAGD; CA 2009) – provides a framework governing ocean disposal of dredged material. The NAGD approach to the assessment of marine sediments is applied to maintenance dredging projects regardless of whether the project involves ocean disposal.
- *Contaminated Sites Guidelines* (DER 2014) – provides guidance for the disposal of sediments with potential to create a contaminated site and/or contaminated leachate
- *Acid Sulfate Soils Guidelines* (DER 2015; Sullivan et al. 2018) – provide guidance for identifying acid sulfate soils and assessment methods when disturbing sediments within estuarine environment and/or in an acid sulfate soil risk area
- *Landfill Waste Classifications and Waste Definitions* (DEC 2009) – provides guidance for disposal of dredged material to a gazetted landfill site
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018) – provides guidance for assessment of marine water quality (return water discharged to the marine/freshwater environment)

It is DoT's environmental consultant's responsibility to ensure that the most relevant guidelines and regulations are applied at the time of environmental assessment. This includes application of any new/updated guidelines and/or assessment of any new or emergent contaminants of concern.

2.2.4 Stakeholder consultation

Prior to each maintenance dredging project the DoT Regional Coordinator, the Operations Manager and/or the Port/Harbour Manager/Master will be notified, where applicable. DoT shall also notify the local Department of Biodiversity, Conservation and Attractions (DBCA), the local Department of Water and Environmental Regulation (DWER) and the relevant local government authority of dredging, as appropriate. For sites with ongoing and regular maintenance dredging requirements, notification of works will be provided annually or if there are significant changes to the dredge works.

Depending on the location, duration and scope of work, DoT and/or DoT's engineering and project management consultant may also:

- consult with community groups such as surf clubs, schools, sea rescue, resident associations, commercial and recreational fishing associations
- consult with traditional owner groups
- install public information signage.

All stakeholder consultation (verbal or written) will be documented. A public complaints register will be maintained by DoT and is applicable to all phases of a dredging project. If requested and/or required, monitoring results of the project will be made available to stakeholders.

2.3 Monitor and manage potential environmental impacts (Step 3)

To direct appropriate management of the potential environmental impacts of each maintenance dredging project, as determined in the EIA (Section 2.2), an Environmental Management Plan (EMP) will be prepared by DoT's environmental consultant. It is intended that an EMP will be a live document, however; where the environmental risks, regulatory process and the proposed dredging (design and volume) and disposal is similar or unchanged, it may only require minor edits from the previous iteration. Therefore the IDER (Section 2.2) will identify one of two possible outcomes regarding the application of the existing EMP:

(1) Review and update EMP.

(2) Minor updates detailed in this IDER appended to the existing EMP.

The EMP will succinctly define the environmental monitoring and management, and contingency measures for dredging. The EMP will be informed by the EIA/IDER and include consideration of the material to be dredged (volume and characteristics), dredging methods, location (of dredging and disposal areas), and the duration and timing of the dredging works. Comprehensive environmental monitoring is often not warranted for removal of small volumes of clean marine sands over a temporary duration. The EMP may provide scope for both during-dredging (Section 2.3.1) and post-dredging (Section 2.3.2) environmental monitoring. The EMP will also include details regarding the parties responsible for completing each of the management actions.

The dredging contractor will then prepare a Project Execution Plan that describes the scope of dredging works, and includes reference to the contractor's environmental monitoring and management responsibilities as detailed in the DEMP.

Once the appropriate documentation has been completed as detailed above, the dredging project may commence. DoT is responsible for overall management of the dredging project, including the implementation of the EMP. Weekly progress reports that include updates on dredging operations, site inspections and environmental monitoring results are prepared by the project team in accordance with the EMP and submitted to DoT.

2.3.1 Monitoring during dredging

A range of environmental monitoring is generally completed during dredging to ensure the environmental aspects of the maintenance dredging project are documented and understood. The type of environmental monitoring required is based on the risk of potential impacts of the maintenance dredging project, as determined in the EIA/IDER (Section 2.2). Environmental impacts associated with turbidity and the release of contaminants are generally the focus of environmental monitoring for DoT's maintenance dredging program. Turbidity monitoring requirements may include site photographs, plume sketches on site maps, remote imagery and aerial photography to inform plume extent. Other monitoring, such as water quality or benthic habitat surveys may also be required. All environmental monitoring data collected during dredging will be reviewed in accordance with the requirements of the EMP to assess potential environmental impacts from the dredging project.

The DoT's dredging contractor may be required to undertake monitoring components during dredging. These monitoring procedures should be discussed during the preparation of the EMP to ensure that the monitoring commitments are feasible, well understood and required monitoring equipment is available.

2.3.2 Monitoring post-dredging

The post-dredging monitoring requirements will be determined within the EIA and documented in the EMP. Post-dredging monitoring is typically not required for DoT maintenance dredging projects.

2.4 Reporting and lessons learnt (Step 4)

On completion of the dredging project, a closeout report will be prepared. The closeout report provides a summary of the maintenance dredging, environmental monitoring undertaken and any operational and/or environmental issues or incidents. In addition, the closeout report will include details of any management measures implemented, and capture lessons learnt and recommendations for future dredging at the site. The closeout report provides an important reference for planning any future maintenance dredging projects and will be finalised within three months of completion of dredging. Closeout reporting should be completed for each maintenance dredging project; though for ongoing dredging projects reporting may be completed on an annual basis in a reduced format.

3 Review and Audit

This EMF is a controlled document that will be reviewed regularly to ensure best practice methods continue to be applied as knowledge, technology, dredging methods and regulatory requirements change. EMF reviews will identify and address any recommendations arising from the maintenance dredging program, as appropriate.

An annual internal audit of the maintenance dredging program will be carried out by DoT and the DoT's environmental consultant to ensure that all environmental commitments within the EMF have been met during the 12-month audit period. To review the EMF commitments, at least two projects that occurred during the respective audit period – ranging in size, type and complexity – will be audited. An audit report will be prepared and include any non-conformances and recommendations for changes to the maintenance dredging program and/or EMF. The audit report will be submitted to DoT for review and comment prior to finalisation.

4 Third-party Leaseholders

DoT is responsible for maintenance dredging of previously disturbed seabed areas and historic depths within DoT sites (Table 1-1, Figure 1-1), as per this EMF. There may be occasions where DoT is required to advise or assist third-party leaseholders in relation to monitoring and management of their maintenance dredging within DoT sites and/or seabed lease areas. In these instances, there is an expectation from DoT that any proposed maintenance dredging and disposal activities will be managed in accordance with the underlying principles of this EMF. However, the expectation is that third-party leaseholders undertaking maintenance dredging will obtain relevant environmental approvals, and projects with the potential to cause significant environmental impacts will follow the relevant regulatory environmental impact assessment process in WA (EPA 2020).

As this EMF is applicable to maintenance dredging, proposed capital dredging undertaken by third-party leaseholders within DoT sites and/or seabed lease areas, and the required environmental regulatory processes and approvals, is the responsibly of the lessees, unless otherwise agreed with the DoT.

At a minimum, DoT expects third-party leaseholders dredging (capital or maintenance) within DoT assets and/or seabed lease areas, to assess that:

- potential environmental impacts associated with proposed dredging and disposal have been considered;
- relevant regulatory requirements and/or approvals have been followed; and
- appropriate monitoring and management measures for the project are in place.

5 References

ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. . Available from www.waterquality.gov.au/anz-guidelines [Accessed 14 August 2020]

BMT (2018a) Department of Transport Maintenance Dredging Environmental Management Framework. Prepared for Department of Transport by BMT Western Australia Pty Ltd, Report No. 1368_00_001/1_Rev1, Perth, Western Australia, February 2018

CA (2009) National Assessment Guidelines for Dredging. Commonwealth of Australia, Canberra, Australian Capital Territory

DEC (2009) Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009). Prepared by the Department of Environment and Conservation, Perth, Western Australia, December 2009

DER (2014) Assessment and Management of Contaminated Sites – Contaminated Sites Guidelines. Prepared by the Department of Environment Regulation, Perth, Western Australia, December 2014

DER (2015) Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes: Acid Sulfate Soils Guideline Series. Prepared by the Department of Environment Regulation, Perth, Western Australia, June 2015

EPA (2020) Statement of Environmental Principles, Factors and Objectives. Environmental Protection Authority, Perth, Western Australia, April 2020

Ports Australia (2016) Environmental Code of Practice for Dredging and Dredged Material Management. Available at <http://www.portsaustralia.com.au/assets/Publications/Ports-Australia-Dredging-Code-of-Practice.pdf> [Accessed 21 February 2018]

Sullivan L, Ward N, Toppler N and Lancaster G (2018) National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual, Department of Agriculture and Water Resources, Canberra ACT, June 2018

Appendix A Initial Desktop Environmental Review

Initial Desktop Environmental Review

Site:			
Project No:			
Competed by:		**Date:**	
Reviewed by:	*Principal's Representative and Superintendent (DoT), DoT's engineering and project management consultant, facility manager, other (as required)*	**Date:**	
Last dredging campaign (year/volume):			

The Initial Desktop Environmental Review (IDER) is used to determine the appropriate sampling, analysis, monitoring, management and documentation requirements for each DoT maintenance dredging project. For sites that require maintenance dredging more frequently, the IDER is to be completed annually. To assist in preparing the IDER, the project team will consider changes to contractors on site, environmental investigation(s) at the site that may provide contextual information, details of environmental incidents on site etc. Depending on the outcome of the IDER (Table 3), there may be a requirement to update/review the existing Environmental Impact Assessment (EIA) and/or Environmental Management Plan (EMP)[1] .

Table 1 Key project characteristics

Project element	Description	Construction works	Indicative timing
Berth pocket *Turning basin* *Channel*	*Volume/depth (-CD) (volumes and depths must include over-dredge allowance)*	*Plant used for dredging*	*Time of year and period of operation*
Dredging area total	*Description, area estimate, total dredge volume (include over-dredge allowance)*		
Disposal area (s)	*Description, area estimate*	*Plant used for dredging*	*Time of year and period of operation*
Comments on applicability of the existing EIA to the key project characteristics	*Do key project characteristics require a new EIA? If yes/no, why?*		

[1] If the relevant report only requires minor updates it may be appropriate to detail these minor updates within Table 2 and include this IDER as an addendum to that report.

Table 2 Initial Desktop Environmental Review

Question	Detail/comment, as required	Updates to existing EIA required?	Updates to existing EMP required?
Is this **maintenance dredging**? (if this is a capital dredging program the IDER process does not apply)	*Yes/No*		
Does the **existing Environmental Impact Assessment** (EIA) cover this activity (Table 1)? • similar **dredging and disposal method** with no new known risk • correct impact/contaminant sources addressed • adequate assessment of impact pathways and potential marine/terrestrial receptors • in-line with current regulatory requirements • prepared within a reasonable timeframe (nominally 5 years)? • all site-specific conditions (i.e. climatic, oceanographic, biogeographic, social or environmental) considered • Does the EIA consider whether the dredging and/or disposal areas occur within an Indigenous Land Use Agreement area (ILUA), and if so are there any impacts to Aboriginal heritage anticipated	*Reference previous EIA*		
Are there any **historical site use(s)** that require monitoring and management as part of the proposed maintenance dredging campaign?	*Where relevant, include references used to determine historical site use*		
Have there been any significant **changes to operations/operators/land use(s)** within the vicinity of the dredging site since previous maintenance dredging or not captured in the existing EIA?	*Detail whether changes to land use or operations could introduce new or different environmental risk as assessed in the existing EIA*		
Are there any significant **lessons learnt** from the previous dredge project that should be addressed for the upcoming project?	*Review the last closeout report and detail lessons learnt (as relevant to environmental impacts) and how they may be addressed during the upcoming project*		
Is the site listed as a potentially contaminated or **contaminated site**? Is there any available documentation on this contaminated status?	*Check contaminated site status online and in consultation with DoT*		
Do **historical sampling results** indicate a higher risk of contamination at this site? If so, are the data: • representative of the proposed dredge and disposal footprint and associated volumes? • collected within a reasonable timeframe (nominally 5 years)? • adequate to establish potential contaminants of concern and compare to guideline values?	*Any comments on currency, spatial coverage, parameters analysed, sampling methods and data quality. Provide reference to data use to make this assessment.*		
Is there any previous **regulatory approval, advice or consultation** that should be considered as part of the EIA?	*Does this maintenance dredging project require permit(s) or approval that is no longer current or not sought under the existing EIA? (i.e. vegetation clearing, contaminated site status change, new stakeholder consultation)*		
Are there any **other** site-specific environmental risks that may require consideration?			

Table 3 Outcome of IDER (tick as appropriate)

Dredging Environmental Impact Assessment		
1	The existing EIA is adequate in addressing environmental, engineering and/or stakeholder aspects and will be applied to the upcoming maintenance dredging project	☐
2	The existing EIA requires minor amendments before it can be applied to the upcoming maintenance dredging project	☐
3	A new EIA is required for the upcoming maintenance dredging project due to significant variations in environmental, engineering and/or stakeholder aspects of the proposed project when compared to the previous EIA	☐
Dredging Environmental Management Plan		
1	Review and update EMP	☐
2	Minor updates detailed in this IDER appended to the existing EMP	☐

Appendix B Audit Table

Table B-1 Department of Transport's Environmental Management Framework Audit Table

Audit item #	EMF Section No.	EMF Section Heading	Commitment	Responsibility	Timeframe	Evidence	Status
1	2.1	Determine maintenance dredging requirements	DoT undertakes hydrographic and/or topographic surveys to monitor the requirement for maintenance dredging. The frequency of surveys at sites is determined on an as needs basis and may include: • consideration of the rate of sedimentation • historical trends • navigational risks • metocean events • coastal aerial georeferenced imagery • feedback from users and; • environmental quality conditions The requirement for maintenance dredging will be determined by DoT's engineering consultant using the assessment of survey data and other inputs (e.g. user feedback, navigation risks, aerial imagery, lessons learnt from previous dredging projects). This may be documented in a survey review which may recommend further actions to improve navigation i.e. maintenance dredging or alternative methods to delay requirement for maintenance dredging (e.g. relocation of navigation aids).	DoT's engineering consultant	Prior to commencement of dredging project		
2	2.1	Determine maintenance dredging requirements	If maintenance dredging is required, the most recent survey data is used to define the areas and volumes to be dredged.	DoT's engineering consultant	Prior to commencement of dredging project		
3	2.1	Determine maintenance dredging requirements	The disposal and dredge designs options are assessed to ensure environmental impacts at both the dredging and disposal areas are minimised.	DoT's engineering consultant	Prior to commencement of dredging project		
4	2.2	Assess potential environmental impacts	The significance of potential environmental impacts for maintenance dredging will be assessed in the context of the EPA's environmental factors and associated environmental objectives that underpin the EIA process in Western Australia (EPA 2020).	DoT's environmental consultant	Prior to commencement of dredging project		
5	2.2	Assess potential environmental impacts	The environmental impact assessment will be documented in a EIA, which will include information on the proposed dredging and disposal of material; relevant environmental monitoring results; potential environmental impacts; stakeholder consultation; and potential environmental monitoring and/or management.	DoT's environmental consultant	Prior to commencement of dredging project		
6	2.2	Assess potential environmental impacts	In situations where there is an existing EIA, an IDER will be completed to determine whether this existing EIA adequately addresses the potential environmental impacts of the upcoming maintenance dredging project. Completion of the IDER will identify one of three possible outcomes regarding the application of the existing EIA (1) The existing EIA is adequate in addressing environmental, engineering and/or stakeholder aspects and will be applied to the upcoming maintenance dredging project. (2) The existing EIA requires minor amendments before it can be applied to the upcoming maintenance dredging project. (3) A new EIA is required for the upcoming maintenance dredging project if the IDER identifies significant variations in environmental, engineering and/or stakeholder aspects of the proposed project when compared to the previous EIA. Sites with no existing EIA automatically require the preparation of a new EIA.	DoT's engineering consultant DoT's environmental consultant	Prior to commencement of dredging project		

Audit Table

Audit item #	EMF Section No.	EMF Section Heading	Commitment	Responsibility	Timeframe	Evidence	Status
7	2.2	Assess potential environmental impacts	The IDER is completed by the DoT's environmental consultant, in consultation with the project team, and retained for auditing purposes.	DoT's engineering consultant DoT's environmental consultant	Prior to commencement of dredging project		
8	2.2	Assess potential environmental impacts	At locations where maintenance dredging occurs frequently, the IDER will be assessed annually or more frequently if the DoT's environmental consultant is aware of changes to: environmental risks (e.g. oil spill or change of industries operating from the site); the regulatory process; the proposed dredging (design and volume); and/or the disposal (method and site).	DoT's environmental consultant	Prior to commencement of dredging project		
9	2.2.1	Determine regulatory approval requirements	If the EIA identifies the potential significant adverse environmental impacts, or there is a high level of stakeholder concern, then it is appropriate to seek advice from the relevant regulatory authorities depending on the potential impacts associated with the maintenance dredging project.	DoT's environmental consultant	Prior to commencement of dredging project		
10	2.2.1	Determine regulatory approval requirements	In the case of emergency dredging works, safety issues may take precedence over all other matters, including application of the EMF, and the DoT Marine Safety Unit will be consulted.	DoT's environmental consultant	Prior to commencement of dredging project		
11	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	A Sea Dumping Permit from the Australian DAWE will be obtained for the disposal of dredged material to sea (as defined by the *Environment Protection (Sea Dumping) Act 1981*).	DoT's environmental consultant	Prior to commencement of dredging project		
12	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	The project will be referred to the DAWE if maintenance dredging is likely to have a significant impact on matters of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999*.	DoT's environmental consultant	Prior to commencement of dredging project		
13	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	The project will be referred to the EPA under Section 38(1) of the *Environmental Protection Act 1986* (EP Act) if maintenance dredging is anticipated to have a significant effect on the environment and previous approvals have not been obtained.	DoT's environmental consultant	Prior to commencement of dredging project		
14	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	Projects that are within the Swan-Canning Riverpark will be referred to the DBCA under the Swan and *Canning Rivers Management Act 2006*.	DoT's environmental consultant	Prior to commencement of dredging project		
15	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	Projects that are likely to impact ecological and social values of a Marine Park will be referred to the DBCA under the *Conservation and Land Management Act 1984*.	DoT's environmental consultant	Prior to commencement of dredging project		
16	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	A Licence to Dredge under the *Waterways Conservation Act 1976 w*ill be obtained for dredging projects that occur within Waterway Management Areas.	DoT's environmental consultant	Prior to commencement of dredging project		
17	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	DWER shall be consulted if dredging or disposal activities disturb or have the potential to create a contaminated site as per the *Contaminated Sites Act 2003.*	DoT's environmental consultant	Prior to commencement of dredging project		
18	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	Correct licence or works approval sought from DWER under Part V of the EP Act if dredging or disposal activities have the potential to result in emissions/pollutants that would result in the site being defined as a prescribed premises under Schedule 1 of the *Environmental Protection Regulations 1987.*	DoT's environmental consultant	Prior to commencement of dredging project		
19	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	A Vegetation Clearing Permit will be obtained from DWER for projects that that require the disturbance or clearing of native vegetation.	DoT's environmental consultant	Prior to commencement of dredging project		
20	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	Projects that involve taking or modification of threatened flora and/or fauna will be referred to the DBCA under the *Biodiversity Conservation Act 2016.*	DoT's environmental consultant	Prior to commencement of dredging project		
21	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	Projects that require disposal of dredge material via a landfill site/resource recovery centre will seek specific acceptance requirements/fees/permissions under the *Waste Avoidance and Resource Recovery Act 2007.*	DoT's environmental consultant	Prior to commencement of dredging project		

Audit Table

Audit item #	EMF Section No.	EMF Section Heading	Commitment	Responsibility	Timeframe	Evidence	Status
22	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	The EIA will document if an application for consent for the disturbance of an Aboriginal site is required to be submitted via a notice under Section 18 of the *Aboriginal Heritage Act 1972.*	DoT's environmental consultant	Prior to commencement of dredging project		
23	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	If the project areas are within an ILUA, potential impacts to heritage will be assessed and if significant, required processes under relevant Noongar Standard Heritage Agreements will be followed	DoT's environmental consultant	Prior to commencement of dredging project		
24	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	Projects that interfere with places of State significance under the State Register shall be referred to the Heritage Council under the *Heritage Act 2018.*	DoT's environmental consultant	Prior to commencement of dredging project		
25	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	Project likely to impact protected shipwrecks or relics within State waters will seek advice/approval from the Western Australian Museum, under the *Underwater Cultural Heritage Act 2018* and *Maritime Archaeology Act 1973.*	DoT's environmental consultant	Prior to commencement of dredging project		
26	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	Project works (including subsea installation requirements) planned in a navigational area governed by DoT will obtain a Temporary Notice to Mariners via DoT's Marine Safety Unit.	DoT's environmental consultant	Prior to commencement of dredging project		
27	2.2.1 (Figure 2-3)	Determine regulatory approval requirements	Projects likely to exceed noise limits defined under the *Environmental Protection (Noise) Regulations 1997* will seek approval from local council and/or governing body.	DoT's environmental consultant	Prior to commencement of dredging project		
28	2.2.2	Monitoring pre-dredging	Pre-dredging environmental monitoring is required to be completed in accordance with a detailed SAP that outlines sampling areas/sites, sampling design, sampling methods, sampling rationale for chemical and physical analyses, quality assurance and control procedures, and necessary transport and storage requirements.	DoT's environmental consultant	Prior to commencement of dredging project		
29	2.2.2	Monitoring pre-dredging	SAPs will be prepared with reference to relevant/current environmental guidelines and regulations and should document the rationale and justification for the proposed sampling approach. A SAP may not be required in instances where the sampling scope is small and there is confidence that field sampling can be completed in-line with relevant sampling requirements. Justification for this should be included in the IDER.	DoT's environmental consultant	Prior to commencement of dredging project		
30	2.2.3	Environmental guidelines	It is the environmental consultant's responsibility to ensure that the most relevant guidelines and regulations are applied at the time of environmental assessment.	DoT's environmental consultant	Prior to commencement of dredging project		
31	2.2.4	Stakeholder consultation	Prior to each maintenance dredging project the DoT Regional Coordinator, the Operations Manager and/or the Port/Harbour Manager/Master will be notified, where applicable.	DoT's environmental consultant	Prior to commencement of dredging project		
32	2.2.4	Stakeholder consultation	DoT will also notify the local DBCA, the local DWER and the relevant local government authority of dredging, as appropriate.	DoT's environmental consultant	Prior to commencement of dredging project		
33	2.2.4	Stakeholder consultation	For sites where there is ongoing and regular maintenance dredging requirements, notification of works will be provided annually or if there are significant changes to the dredge works.	DoT's environmental consultant	Annually or as appropriate		
34	2.2.4	Stakeholder consultation	Depending on the location, duration and scope of work, DoT and/or DoT's engineering consultant may also: • consult with community groups such as surf clubs, schools, sea rescue, resident associations, • commercial and recreational fishing associations • consult with traditional owner groups • install public information signage.	Principal Representative or Superintendent DoT's engineering consultant	All phases of dredging project		

Audit Table

Audit item #	EMF Section No.	EMF Section Heading	Commitment	Responsibility	Timeframe	Evidence	Status
35	2.2.4	Stakeholder consultation	All relevant stakeholder consultation (verbal or written) will be documented.	Principal Representative or Superintendent DoT's engineering consultant DoT's environmental consultant DoT's dredging contractor(s)	All phases of dredging project		
36	2.2.4	Stakeholder consultation	A public complaints register is maintained by DoT and applicable to all phases of a dredging project.	Principal Representative or Superintendent	All phases of dredging project		
37	2.3	Monitor and manage potential environmental impacts	To direct appropriate management of the potential environmental impacts of each maintenance dredging project, as determined in the EIA, an EMP will be prepared by DoT's environmental consultant.	DoT's environmental consultant	Prior to commencement of dredging project		
38	2.3	Monitor and manage potential environmental impacts	The EMP will be a live document, however where the environmental risks, regulatory process and the proposed dredging (design and volume) and disposal is similar or unchanged, it may only require minor edits from the previous iteration. Therefore the IDER, will identify one of two possible outcomes regarding the application of the existing EMP: (1) Review and update EMP. (2) Minor updates detailed in this IDER appended to the existing EMP.	DoT's environmental consultant	Prior to commencement of dredging project		
39	2.3	Monitor and manage potential environmental impacts	The EMP will succinctly define the environmental monitoring and management, and contingency measures for dredging. The EMP will be informed by the EIA/IDER and include consideration of the material to be dredged (volume and characteristics), dredging methods, location (of dredging and disposal areas), and the duration and timing of the dredging works.	DoT's environmental consultant	Prior to commencement of dredging project		
40	2.3	Monitor and manage potential environmental impacts	The EMP will include details regarding the parties responsible for completing each of the management actions.	DoT's environmental consultant	Prior to commencement of dredging project		
41	2.3	Monitor and manage potential environmental impacts	The dredging contractor will prepare a Project Execution Plan that describes the scope of dredging works, and includes reference to the contractor's environmental monitoring and management responsibilities as detailed in the DEMP.	DoT's dredging contractor(s)	Prior to commencement of relevant dredging project		
42	2.3	Monitor and manage potential environmental impacts	Weekly progress reports that include updates on dredging operations, site inspections and environmental monitoring results are prepared by the project team for review in accordance with the EMP and submitted to DoT.	Principal Representative or Superintendent DoT's engineering consultant DoT's environmental consultant DoT's dredging contractor(s)	During dredging project		
43	2.3.1	Monitoring during dredging	The type of environmental monitoring required is based on the risk of potential impacts of the maintenance dredging project, as determined in the EIA/IDER.	DoT's environmental consultant	Prior to commencement of dredging project		
44	2.3.1	Monitoring during dredging	All environmental monitoring data collected during dredging will be reviewed in accordance with the requirements of the EMP to assess potential environmental impacts from the dredging project.	DoT's environmental consultant	During and within three months of completion of dredging project		
45	2.3.2	Monitoring post-dredging	The post-dredging monitoring requirements will be determined within the EIA and documented in the EMP.	DoT's environmental consultant	Prior to commencement of dredging project		

Audit Table

Audit item #	EMF Section No.	EMF Section Heading	Commitment	Responsibility	Timeframe	Evidence	Status
46	2.4	Reporting and lessons learnt	On completion of the dredging project, a closeout report will be prepared. Closeout reporting should be completed for each maintenance dredging project; though for ongoing dredging projects reporting may be completed on an annual basis in a reduced format. The closeout report will provide a summary of: • the maintenance dredging • environmental monitoring undertaken • any operational and/or environmental issues or incidents • any management measures implemented • lessons learnt and recommendations for future dredging at the site.	Principal Representative or Superintendent DoT's engineering consultant DoT's environmental consultant DoT's dredging contractor(s)	Within three months of completion of dredging project		
47	3	Review and Audit	This EMF is a controlled document that will be reviewed regularly to ensure best practice methods continue to be applied as knowledge, technology, dredging methods and regulatory requirements change. EMF reviews will identify and address any recommendations arising from the monthly maintenance dredging program meetings and closeout reports.	DoT's environmental consultant	As required		
48	3	Review and Audit	An annual internal audit of the maintenance dredging program will be carried out by DoT and DoT's environmental consultant.	DoT's environmental consultant	~Annually		
49	3	Review and Audit	A minimum of two projects that occurred during the respective audit period – ranging in size, type and complexity – will be audited.	DoT's environmental consultant	~Annually		
10	3	Review and Audit	An audit report will be prepared and include any non-conformances and recommendations for changes to the maintenance dredging program and/or EMF.	DoT's environmental consultant	~Annually		

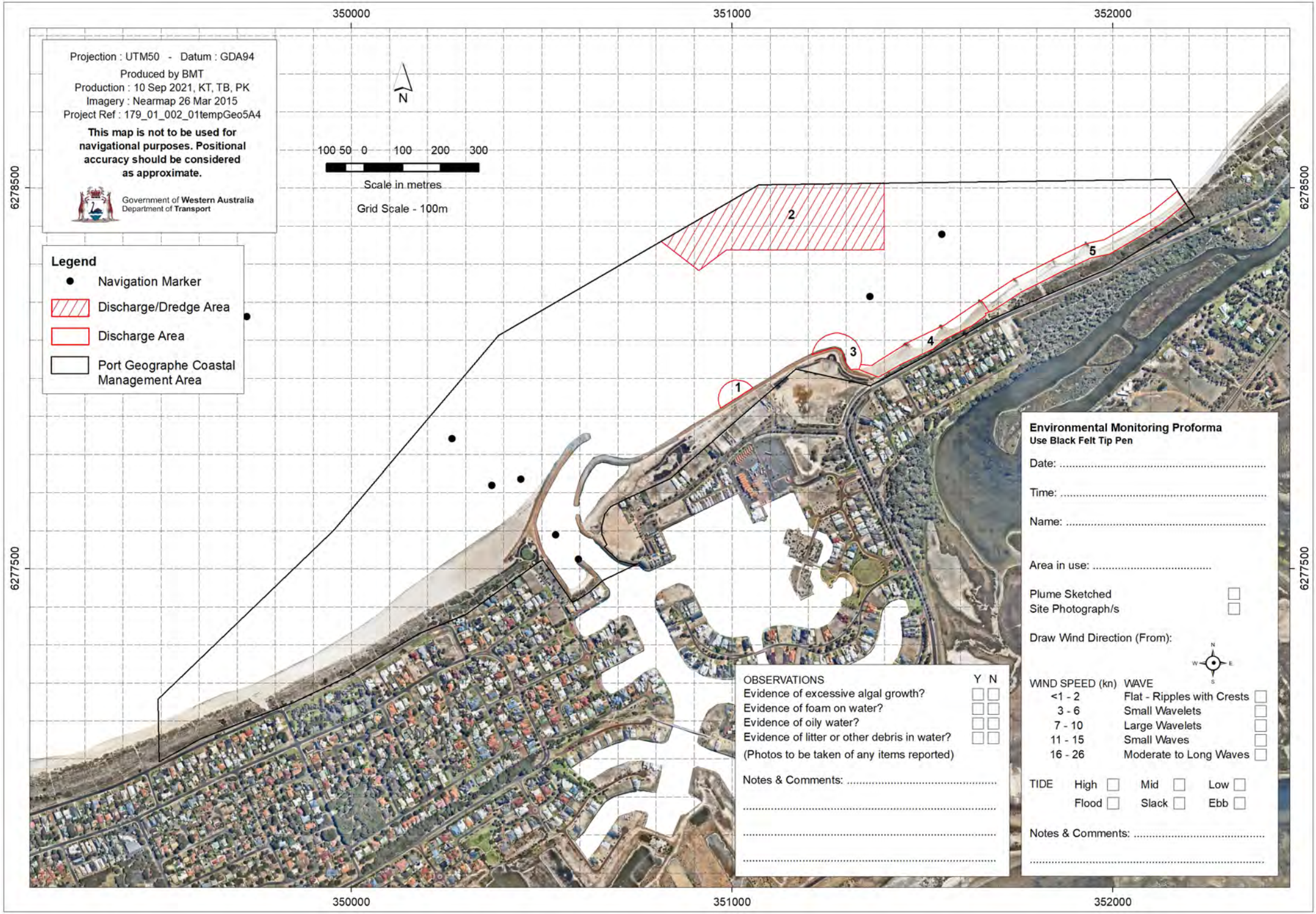
Note:

(1) DAWE = Australian Department of Agriculture, Water and the Environment; EIA = Environmental Impact Assessment; EMP = Environmental Management Plan; DBCA = Western Australian Department of Biodiversity, Conservation and Attractions; DoT = Western Australia Department of Transport; DWER = Western Australian Department of Water and Environmental Regulation; EPA = Environmental Protection Authority; ILUA = Indigenous Land Use Agreement; SAP = Sediment Sampling and Analysis Plan

References

EPA (2020) Statement of Environmental Principles, Factors and Objectives. Environmental Protection Authority, Perth, Western Australia, April 2020

Appendix D Example plume sketch templates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Produced by BMT
Production : 10 Sep 2021, KT, TB, PK
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Project Ref : 179_01_002_01tempGeo5A4
This map is not to be used for navigational purposes. Positional accuracy should be considered as approximate.
Government of Western Australia
Department of Transport
N
100 50 0 100 200 300
Scale in metres
Grid Scale - 100m
Legend
Navigation Marker
Discharge/Dredge Area
Discharge Area
Port Geographe Coastal Management Area
1
2
3
4
5
OBSERVATIONS Y N
Evidence of excessive algal growth?
Evidence of foam on water?
Evidence of oily water?
Evidence of litter or other debris in water?
(Photos to be taken of any items reported)
Notes & Comments: .....
Environmental Monitoring Proforma
Use Black Felt Tip Pen
Date: .....
Time: .....
Name: .....
Area in use: .....
Plume Sketched
Site Photograph/s
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: .....

Appendix E Updates and Revisions to the EMMP

Updates and Revisions to the EMMP – Revision 6B

Table 1 details the changes implemented in the annual review of Rev5 of the Port Geographe Coastal Structures – Environmental Monitoring and Management Plan (EMMP; BMT 2020) and justifications for these changes.

Table 1 Content changes since Rev5 version of the Port Geographe Coastal Structures Environmental Monitoring and Management Plan

Document section	Change	Reasoning
Throughout	Minor editorial changes.	To improve clarity and consistency.
Section 1 2nd paragraph	The following text was added: '*This guideline has been superseded by the EPA's Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans (EPA 2020a), it is intended that this EMMP will be revised to align with these guidelines should it require substantial changes be made to the management triggers or management actions in the future.*'	Text added to acknowledge the release of the new EPA guidelines for the preparation of environmental management plans (EPA 2020a).
Section 1 Table 1-1	The EPA environmental objectives for the key environmental factors were updated to align with EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2020b).	To align with EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2020b).

Section 2.1.1	The section was re-ordered to improve clarity and the following text updated from: "*Historically ~60 000–80 000 m^3 of seagrass wrack can accumulate each winter on the Western Beach (BMT JFA 2015a), requiring management. Should a relatively small volume of trapped wrack be present on the Western Beach (~60 000 m3), wrack may be pushed into the littoral zone above the low water mark using land-based earthmoving equipment. Larger volumes of trapped wrack (~80 000 m^3) may be removed from the Western Beach using one or a combination of pumping equipment, cutter-suction dredge and/or trucking. Material may be pumped through the permanent bypassing pipeline and deposited in front of the eastern revetment pipeline connection (Figure 2.2), after which material typically continues to move eastwards through natural processes.* *Seagrass wrack management options ensure that the nutrients provided by wrack remain within Geographe Bay. Aerobic decay of dry wrack generates substantially smaller amounts of H_2S than anaerobic decay (which occurs when wet wrack decays at the waterline).* *Nearshore disposal is preferred, however if none of the nearshore disposal options listed above are suitable, offshore disposal will be considered. The proposed offshore disposal area is the area previously utilised in the 2013–2014 capital dredging campaign clipped to be within the PGCMA (Table 2.1, Figure 2.2). The footprint of the offshore disposal area has been extended to match that of the 2013–2014 capital dredging campaign in order to increase its capacity to receive dredge material; this is considered to be of low environmental risk. Refer to Appendix B for the justification and environmental impact assessment for this extension.*" To: "*Historically ~60 000–80 000 m^3 of seagrass wrack can accumulate each winter on the Western Beach (BMT JFA 2015a), requiring management. Smaller volumes of trapped wrack may be moved into the littoral zone above the low water mark using mechanical equipment.* *Larger volumes of trapped wrack (~80 000 m^3) may be removed from the Western Beach using one or a combination of pumping equipment, cutter-suction dredge and/or trucking. Material may be deposited within the PGCMA via pipeline. Nearshore marine disposal is preferred (littoral zone of the Western Beach or in front of the eastern revetment), however, if these options are not suitable, material will be*	This section has been updated to improve the clarity of the seagrass wrack management activities completed and methods used by DoT and allow for the removal of wrack from the Western Beach for very large volumes of wrack accumulation.

Document section	Change	Reasoning
	disposed offshore. The proposed offshore disposal area is the area previously utilised in the 2013–2014 capital dredging campaign realigned to be within the PGCMA (Table 2 1, Figure 2 2). The footprint of the offshore disposal area has been extended to match that of the 2013–2014 capital dredging campaign in order to increase its capacity to receive dredged material; this is considered to be of low environmental risk (Appendix B). Where possible, seagrass wrack management options will ensure that the nutrients provided by wrack remain within Geographe Bay. However, if disposal of material within the PGCMA is not appropriate, i.e. for very large volumes of wrack accumulation, material may be trucked offsite to be disposed of or beneficial reuse."	
Section 2.1.1 4th paragraph	Timing of wrack management works removed and wording updated as follows: *"The timing of works will vary year to year due to the seasonal and interannual variability of coastal processes and wrack dynamics at the site. Works will typically occur outside of school holidays when beach use will be high. However, occasionally works may be required during holiday periods to effectively manage the shoreline within the PGCMA and the Port Geographe coastal structures to meet the requirements of MS 990. Prior to these occasions, DoT will consult with the City of Busselton and relevant community stakeholder representatives."*	DoT require flexibility in the timings for their management works to maintain the Port Geographe facility due to the seasonal and interannual variability of coastal processes and wrack dynamics at the site.
Section 2.1.2 1st paragraph	Wording updated from: "*It is anticipated that the shorelines and sediment levels within the PGCMA will eventually equilibrate to the reconfigured coastal structures and following this, sand is expected to naturally bypass across the harbour entrance channel to the beaches east of Port Geographe. However, prior to this,*" To: "*Following the realignment of the Port Geographe coastal structures,*"	Shoreline and sediment levels have not yet equilibrated to the reconfigured coastal structures such that sediment management is no longer required.
Section 2.1.2 7th paragraph	Paragraph added: "*To facilitate the effective nourishment of Wonnerup Beach and to ensure beach amenity post-nourishment, small amounts of wrack that may have accumulated on Wonnerup Beach may be redistributed into the littoral zone prior to nourishment works. This will avoid its burial during nourishment, which would otherwise have the potential to lead to future anoxic conditions and H_2S generation.*"	In 2020, it was noted that there was accumulation of a small amount of wrack on Wonnerup Beach therefore the preparation of the beach to receive sand has been added as part of the methods for sediment management to avoid its burial during nourishment, which would otherwise have the potential to lead to future anoxic conditions and H_2S generation.

Document section	Change	Reasoning
Section 2.1.2 8th paragraph	Timing of wrack management works removed and wording updated as follows: *"The timing of works will vary year to year due to the seasonal and interannual variability of coastal processes and wrack dynamics at the site. Works will typically occur outside of school holidays when beach use will be high. However, occasionally works may be required during holiday periods to effectively manage the shoreline within the PGCMA and the Port Geographe coastal structures to meet the requirements of MS 990. Prior to these occasions, DoT will consult with the City of Busselton and relevant community stakeholder representatives."*	DoT require flexibility in the timings for their management works to maintain the Port Geographe facility due to the seasonal and interannual variability of coastal processes and wrack dynamics at the site.
Section 2.1.3 3rd paragraph	Wording regarding timing of harbour entrance channel maintenance changed from "*between September and December*" to "*in September to March after winter storms are expected and outside of school holidays*"	Updated to allow flexibility in the timing of maintenance dredging.
Section 2.1.4 Table 2-2	Use of mechanical equipment and use of earth-moving equipment added to the method for seagrass wrack management.	Added to better reflect the works methods.
	Added "*Appropriate disposal offsite and/or beneficial reuse*" to seagrass wrack management disposal sites.	Added to allow for the removal of wrack from the beach.
	Timing removed and clarifications regarding works duration added.	Refer to previous updates for justification for changes to works timings.
Section 2.2 Section 2.2.1 Section 2.2.2 Section 2.2.3 Section 2.2.4	Social surroundings and human health added to the list of key environmental factors that related to the environmental management of the Port Geographe coastal structures. Wording of EPA objectives for key environmental factors updated.	Key environmental factors updated to take into account changes made in EPA's Statement of Environmental Principles, Factors and Objective (EPA 2020b)

Document section	Change	Reasoning
Section 2.2.4	Wording updated from: "*Decomposition of large accumulations of wrack by anaerobic bacteria on the Western Beach reduces the public amenity of the beach and results in reduced air quality in the surrounding area due to the generation of H2S. During maintenance activities (such as mechanical wrack bypassing), large quantities of H2S can be released over a short period of time which can potentially result in adverse health effects (ChemCentre 2010).*" To: "*The presence of the Port Geographe coastal structures may cause large accumulations of trapped wrack that, when decomposing, can impact air quality and visual amenity in the surrounding area. The presence of the wrack and decomposition of large accumulations of wrack by anaerobic bacteria on the Western Beach reduces the public amenity of the beach and results in reduced air quality in the surrounding area due to the generation of H2S. Therefore maintenance activities may be required to manage the wrack accumulation. Additionally during maintenance activities (such as mechanical wrack bypassing), large quantities of H2S can be released over a short period of time which can potentially result in adverse health effects (ChemCentre 2010).*"	Text updated to add clarity to how the management of the Port Geographe coastal structures relate to this key environmental factor.
Section 2.4 1st paragraph and throughout	"*Campaign-specific Environmental Management Plan*" updated to "*Environmental Management Plan*".	Updated to allow use of Environmental Management Plans across different campaigns that involve the same management activities and have the same potential environmental impacts. The requirement to prepare a new Environmental Management Plan will be determined prior to each campaign via a desktop review. This aligns with the DoT's Environmental Management Framework (BMT 2020).
Section 2.4.1 Water and sediment quality 4th bullet	Sediment sampling completed in May 2019 noted and reference added.	Added to ensure the EMMP is up-to-date.
Section 2.4.2 Last bullet	"*This could affect timing of maintenance dredging works required to maintain navigational safety.*" added with regards to siltation in the entrance channel.	Added for clarity

Document section	Change	Reasoning
Section 2.4.3 4th paragraph	Wording updated from: "*Prior to the start of any maintenance works, an EMP specific to that maintenance campaign will be prepared based on the requirements detailed in this EMMP.* " To: "*Prior to the start of any maintenance works, an EMP specific to the type of maintenance is required based on monitoring and management detailed in this EMMP*"	Updated to allow use of Environmental Management Plans across different campaigns that involve the same management activities and have the same potential environmental impacts. The requirement to prepare a new Environmental Management Plan will be determined prior to each campaign via a desktop review. This aligns with the DoT's Environmental Management Framework (BMT 2020).
Section 2.4.3 2nd paragraph	Reference to letter from OEPA updated.	It is no longer considered necessary to append this letter to the EMMP.
Section 3.1.2 2nd bullet point Table 3-1 Section 3.1.6 Table 3-5 Section 3.2.2 Table 3-6 Section 3.3.2 Table 3-11 Section 3.3.6 Table 3-15	Social surroundings and human health added to the list of key environmental factors that related to the environmental management of the Port Geographe coastal structures. Text of EPA objectives for key environmental factors updated.	Updated to take into account changes made in EPA's Statement of Environmental Principles, Factors and Objective (EPA 2020b)

Document section	Change	Reasoning
Section 3.1.4 During-works monitoring Table 3-4 Section 3.2.4 During works monitoring Table 3-9 Section 3.3.4 During works monitoring Table 3-14	Text detailing the specific monitoring actions moved to the table and number of monitoring sites added.	To improve clarity and readability.
Section 4 1st paragraph	Text updated from" "*The extent to which natural coastal processes will replicate the modelling results is yet to be realised, and will require ongoing monitoring to establish whether natural wrack and sediment movement are enhanced by the reconfigured coastal structures.*" To: "*The extent to which natural coastal processes will replicate the modelling results is likely to evolve as the coastal system adjusts to the reconfiguration and may vary from year to year in response to natural weather variability, and will require ongoing monitoring to establish whether natural wrack and sediment movement are enhanced by the reconfigured coastal structures.*"	Text updated based on observations since the reconfiguration of the Port Geographe coastal structures.

Document section	Change	Reasoning
Section 4 Last bullet	Wording updated from: "*As outlined in DoT's approved Compliance Assessment Plan for Ministerial Statement 990 (BMT Oceanica 2015b), and in accordance with the EPA's Post Assessment Guideline 2 (EPA 2012a), the life of the proposal for the Port Geographe project is expected to extend to 2020 subject to demonstration that natural coastal processes have been reinstated at Port Geographe with minimal project attributable impacts. The need to continue implementation of this EMMP will be reviewed at this time in discussion with the CEO of DWER.*" To: "*As outlined in DoT's approved Compliance Assessment Plan for Ministerial Statement 990 (BMT Oceanica 2015b), and in accordance with the EPA's Post Assessment Guideline 2 (EPA 2012a), the life of the proposal for the Port Geographe project was expected to extend to 2020 however this was subject to demonstration that natural coastal processes have been reinstated at Port Geographe with minimal project attributable impacts, which has not been realised. The need to continue implementation of this EMMP will be reviewed* on an ongoing basis and *in discussion with the CEO of DWER.*"	Wording updated as the Port Geographe coastal structures still require management beyond 2020.
Section 5 1st paragraph	Deleted: "*This consultation process is expected to be ongoing as the EMMP is reviewed and updated.*"	To better reflect DoT's public consultation specifically relating to the EMMP
Section 5 3rd paragraph	Paragraph added: *"DoT will consult with relevant stakeholders including the City of Busselton and community representatives prior to and during each management activity, as appropriate."*	To clarify that DoT's commitment to ongoing consultation with relevant stakeholders.

Document section	Change	Reasoning
Section 6	New references and in-text citations added: BMT (2020) Department of Transport Maintenance Dredging – Environmental Management Framework. Prepared for the Department of Transport by BMT Commercial Pty Ltd, Report No. R-1666_00-37, Perth, Western Australia, August 2020 BMT (2019) Port Geographe Sediment Sampling and Analysis Plan Implementation Report. Prepared for the Department of Transport by BMT Western Australia Pty Ltd, Report No. R-1463_01-2/Rev0, Perth, Western Australia, July 2019 EPA (2020a) Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans. Environmental Protection Authority, Perth, Western Australia, September 2020 EPA (2020b) Statement of Environmental Principles, Factors and Objectives. Environmental Protection Authority, Perth, Western Australia, April 2020	Updates to documents and guidelines
Appendix C	DoT's Environmental Management Framework updated to the latest version.	DoT's Environmental Management Framework updated to the latest version.
Appendix D	Appendix D (OEPA correspondence regarding suitability of DoT's Environmental Management Framework (8 October 2014)) removed.	It was considered no longer required to be included in the EMMP.
Appendix D	Appendix D Example plume sketch templates	Updated to latest version.

Notes:

1. DoT = Department of Transport; EMMP = Port Geographe Environmental Monitoring and Management Plan; EPA = Environmental Protection Authority; OEPA = Office of the Environmental Protection Authority (now the Department of Water and Environmental Regulation; PGCMA = Port Geographe Coastal Management Area.

References

BMT (2019a) Port Geographe Coastal Structures – Environmental Monitoring and Management Plan. Prepared for Department of Transport by BMT Western Australia Pty Ltd, Report No. 924_09_001/1_Rev4, Perth, Western Australia, May 2019

BMT (2020) Department of Transport Maintenance Dredging – Environmental Management Framework. Prepared for the Department of Transport by BMT Commercial Pty Ltd, Report No. R-1666_00-37, Perth, Western Australia, August 2020

EPA (2020a) Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans. Environmental Protection Authority, Perth, Western Australia, September 2020

EPA (2020b) Statement of Environmental Principles, Factors and Objectives. Environmental Protection Authority, Perth, Western Australia, April 2020

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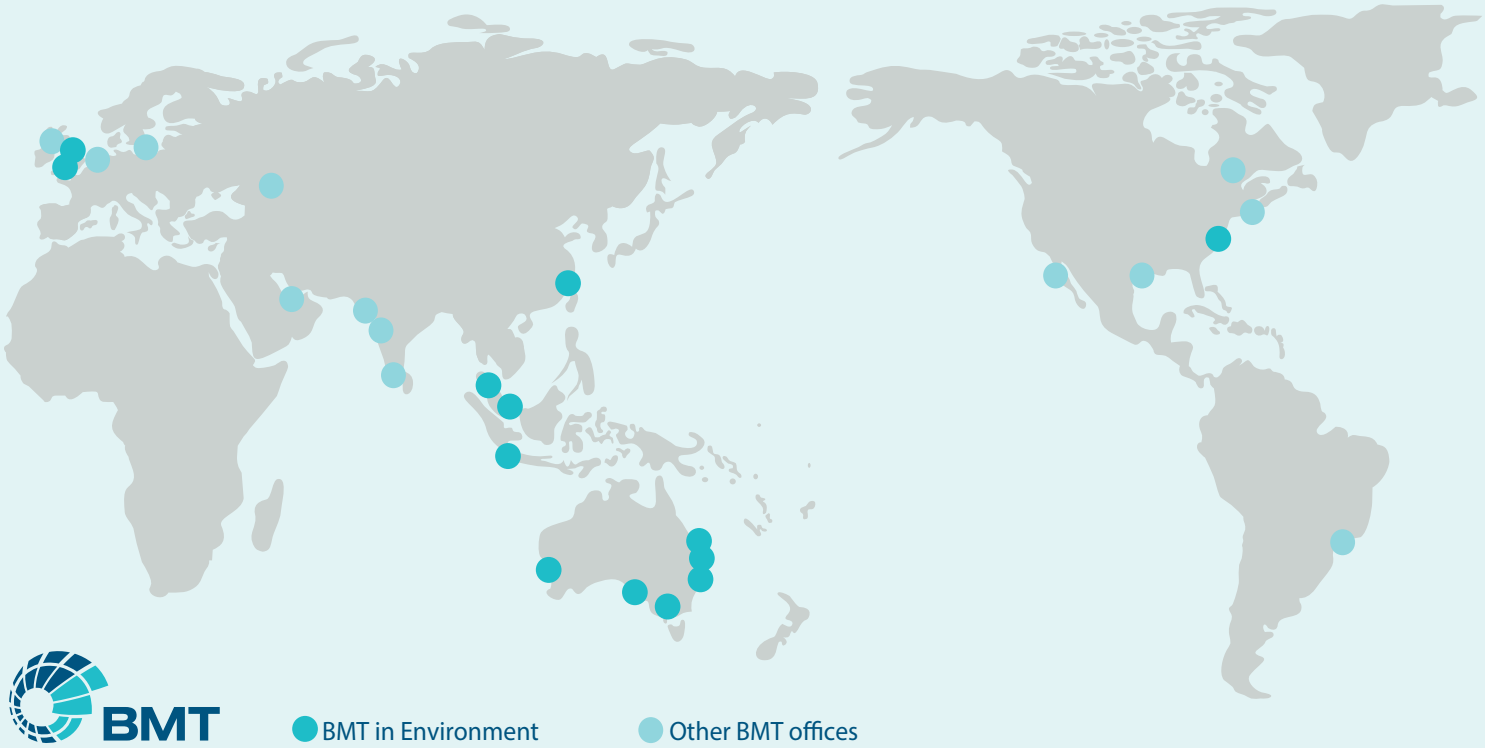

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