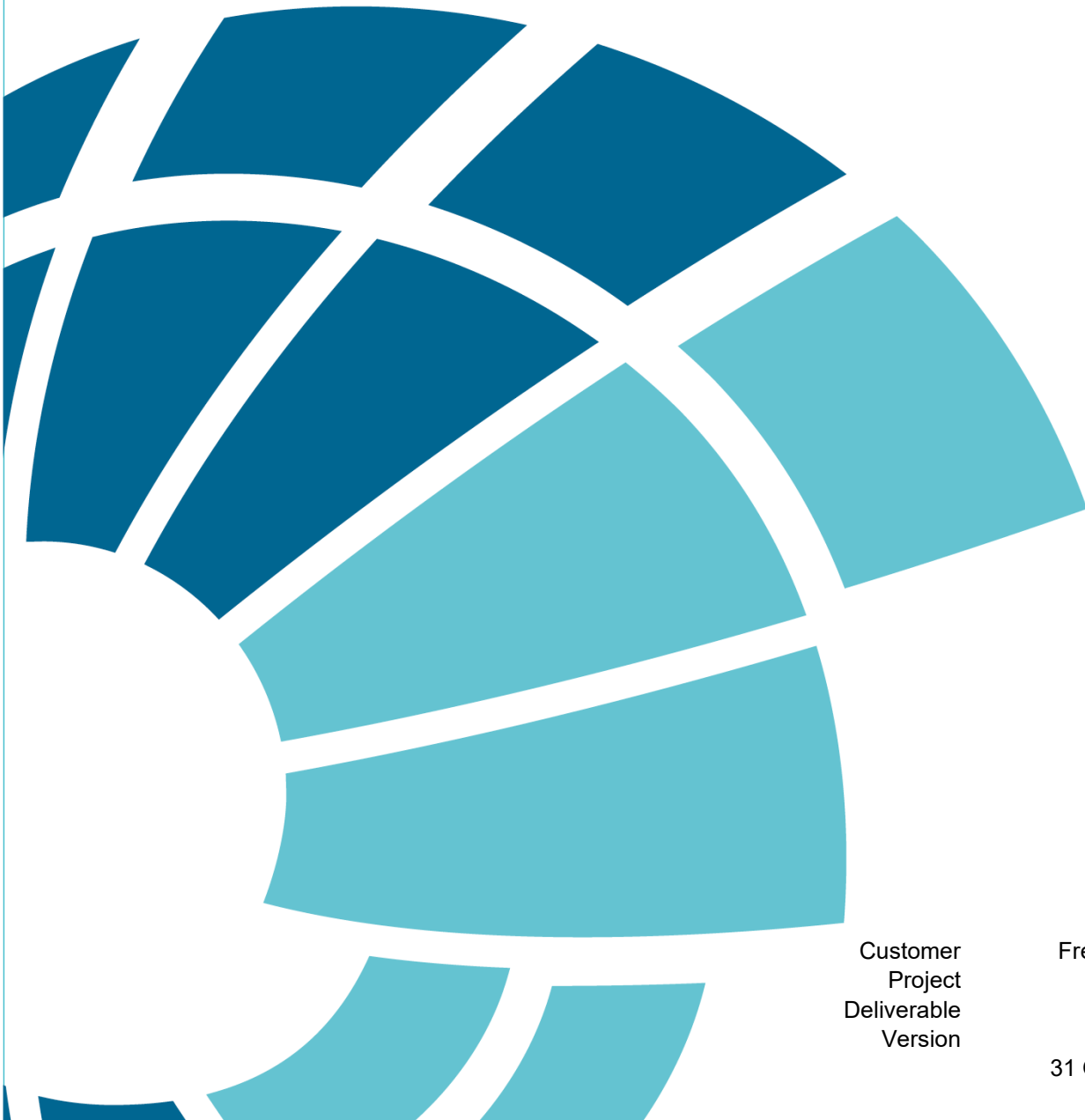


# Inner Harbour Maintenance Dredging

Environmental Review Document



Customer  
Project  
Deliverable  
Version

Fremantle Ports  
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### Amendment Record

The Amendment Record below records the history and issue status of this document.

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## Acronyms

Acronym	
AH Act	Aboriginal Heritage Act 1972
AHIS	Aboriginal Heritage Inquiry System
BCH	Benthic Communities and Habitats
BC Act	Biodiversity Conservation Act 2016
BHM	Benthic Habitat Mapping
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CCL	Cockburn Cement Limited
CD	Chart Datum
CRFHPA	Cottesloe Reef Fish Habitat Protection Area
CoF	City of Fremantle
CR	Critically Endangered
DEMP	Dredging Environmental Management Plan
DWC	Deep Water Channel
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environmental Regulation
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMF	Environmental Management Framework
EP Act	Environmental Protection Act 1986
EP Sea Dumping Act	Environment Protection (Sea Dumping) Act 1981
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EQMF	Environmental Quality Management Framework
EQO	Environmental Quality Objective
ERD	Environmental Review Document
GHG	Greenhouse Gases
ha	Hectare
IMS	Invasive Marine Species
LAU	Local Assessment Unit
LoR	Limit of Reporting

Acronym	
MQMP	Marine Quality Monitoring Program
MLR	Minimum light requirements
NAGD	National Assessment Guidelines for Dredging
NMP	Noise Management Plant
PAHs	Polycyclic Aromatic Hydrocarbons
PAR	Photosynthetic Active Radiation
PCWS	Perth Coastal Waters Study
PSD	Particle size distributions
SAP	Sampling and Analysis Plan
SMCWS	Southern Metropolitan Coastal Waters Study
TOC	Total Organic Carbon
TRHs	Total Recoverable Hydrocarbons
TSS	Total Suspended Solids
UCL	Upper confidence limit
WA	Western Australia
ZoHI	Zone of High Impact
ZoI	Zone of Influence
ZoMI	Zone of Moderate Impact

## Executive Summary

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Fremantle Ports is planning to undertake Maintenance Dredging campaign in April 2023 to remove 60,000 m<sup>3</sup> of sediment that has been accumulating in the Inner Harbour and Entrance Channel navigational area since the capital dredging performed in 2010, and additional four campaigns to remove 5,000 m<sup>3</sup> per year until 2027, with the purpose of keeping safety navigational standards for operations. The disposal area is in the deep section of the Gage Roads spoil ground (below 20 metres depth), which is to the southeast side of the disposal area.

This document presents the Environmental Review Document prepared for Fremantle Ports by BMT Commercial Australia Ltd Pty under section 40(2)(b) of the *Environmental Protection Act 1986* (EP Act) intending to provide an environmental assessment of the dredging activity described above.

The development of this document consists of desktop review of available environmental information produced during the planning stage of this Proposal, public information, peer-reviewed journal articles and other scholarly works, and relevant State and Federal governmental policies and guidelines.

The environmental assessment was undertaken within the study area that comprises the Swan River estuary, specifically the Inner Harbour and its Entrance Channel, the Gage Roads offshore disposal area, and the extent of the modelled sediment plume.

The key environmental factors assessed in this ERD are:

- Marine environmental quality
- Benthic communities and habitats
- Social surroundings

Other environmental factors were also assessed are:

- Marine fauna
- Coastal processes
- Greenhouse gas emissions

It is anticipated that this project presents a low environmental risk due to:

- the short duration of the dredging and sediment disposal activities (approximately 10 days)
- the history of environmental modifications within the Inner Harbour and Fremantle Ports in general, since the beginning of the colonisation of Perth, Western Australia
- sediment sampling and analysis verifying that sediments to be dredged from the Inner Harbour and Entrance Channel and disposed at Gage Roads are suitable for ocean disposal
- the dredging being proposed to be undertaken in April to reduce impacts on seagrass meadows as seagrasses begin a dormancy stage due to reduction of availability of natural sunlight during autumn/winter in the region of the Proposal

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- most dredging being completed in 2023, with the removal of 60,000 m<sup>3</sup> of sediment. An additional 5,000 m<sup>3</sup> is expected to be dredged per year for the following four years, from 2024 to 2027.
- ocean disposal at the previously utilised Gage Roads disposal area in deep water, reducing the risk of remobilisation and impacts on benthic communities and habitats
- plume modelling predicting a very low risk of negative impacts from sedimentation and turbidity during dredging and disposal activities
- the small volume of material to be dredged and disposed at sea.
- although the underwater noise associated with the operation of the dredge and any associated work boats has the potential to result in impacts to marine fauna, the Proposal area is an active shipping channel and the increase of noise levels due to the dredging operations are unlikely significantly impact marine fauna.

Considering the outcomes of the environmental assessment it is believed that the Proposal is unlikely to have a significant environmental impact. The social surroundings and the stakeholder consultation process will be further developed to liaise with all the relevant parties present within the study area.

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## 1 Proposal

### 1.1 Proposal content

#### 1.1.1 Overview

The Proponent for the Proposal is Fremantle Ports. A short description and Proponent details for this Proposal are provided in Table 1.1.

Table 1.1 Summary of key Proposal details

<b>Proposal title</b>	Inner Harbour Maintenance Dredging
<b>Proponent name</b>	Fremantle Ports
<b>Short description</b>	The Maintenance Dredging project intends to remove accumulated sediment from the Swan River deposited within the Inner Harbour and the Entrance Channel (since capital dredging in 2010) to ensure navigation safety standards are met. An initial volume of 60,000 m <sup>3</sup> is expected to be dredged in April 2023, with a further volume of 5,000 m <sup>3</sup> dredged each year until 2027.

### 1.2 Background

Fremantle Ports is the managing authority for the Port of Fremantle (hereafter; the Port) in Western Australia (WA). The Port Inner Harbour (hereafter; Inner Harbour) provides navigational access between the Swan River and the Indian Ocean that is vital for container trade into the state as well as livestock exports and motor vehicle imports. The Inner Harbour at Fremantle handles almost all the container trade of WA.

Fremantle Ports is proposing to undertake maintenance dredging to ensure continuity of ship access to the loading facilities within the Inner Harbour. The dredging will remove sediments from the bottom of the channel and Inner harbour, which is a routine requirement because sedimentation gradually fills the channel and the harbour.

### 1.3 Dredging and sediment disposal

Recent hydrographic surveys of the Inner Harbour show approximately 60,000 m<sup>3</sup> of material has accumulated since the capital dredging in 2010. The Port currently uses a sweep bar to maintain water depths within the Inner Harbour and material is redistributed to adjacent deeper areas of seabed. The Port is proposing to complete small-scale Maintenance Dredging campaigns over the next 5 years to remove larger volumes of material deposited since 2010, and future deposition based on known sedimentation rates in the Inner Harbour. It is proposed material from the Inner Harbour will be placed at the historical Gage Roads offshore disposal area located southwest of the Deep-Water Channel and utilised in the 2010 capital dredging campaign (hereafter; disposal area). Figure 1.1 illustrates the location map of the Proposal.

### 1.4 Timeline

The dredging and sediment disposal activities are proposed to occur over 10 days during April 2023 to remove 60,000 m<sup>3</sup> and a further volume of 5,000 m<sup>3</sup> to be dredged each year until 2027.

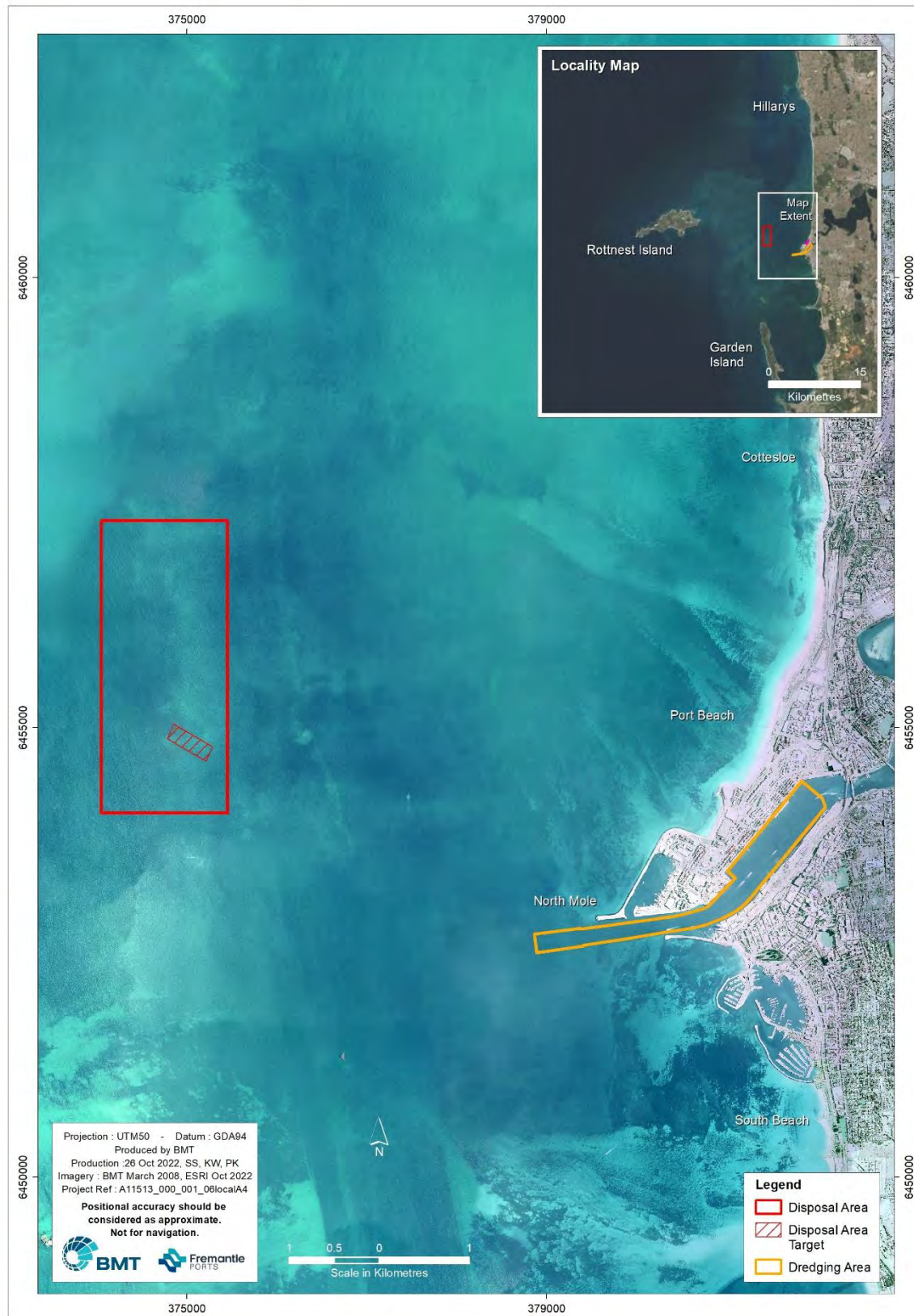


Figure 1.1 Location map of dredging design and offshore disposal area

## 2 Local and Regional Context

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### 2.1 The Inner Harbour location and regional context

The Inner Harbour is located at the mouth of the Swan River. The area where the Inner Harbour is located is called the Lower Estuary and ranges from Blackwall Reach to Fremantle Harbour with a narrow winding channel incised through the coastal limestone. The channel is 16 metres deep near Blackwall Reach but less than 5 metres deep near the bridges. In the channel are sediments of dark brown/grey coloured fine sand with clay/silt present (O2M 2022).

#### 2.1.1 Heritage

Nyoongar people were drawn to areas around the Swan River estuary and surrounding wetlands, the Derbal Yerrigan, for camping, fishing and hunting particularly over *birak* (the summer period between December and January, Hughes-Hallett 2010). Legends and stories telling of the river's formation and of tribal histories are part of the rich tradition passed down through the generations. Fish and waterfowl were easily accessible at Pelican Point. The Mooro tribe of Yellagonga used the Pelican Point area, while Midgegooroo, the father of Yagan, moved with the Beeliar Tribe through the Alfred Cove area during the same period of time (Hughes-Hallett 2010).

#### 2.1.2 History of the Inner Harbour

Fremantle's port role began immediately after the Swan River Colony was founded in 1829, but the entrance to the Swan River estuary was blocked by a rocky bar, which made the mouth of the river virtually impassable for seagoing vessels. The preliminary work to build the Inner Harbour in the mouth of the Swan River commenced in 1892, as the discovery of gold in WA meant a working port was urgently needed (Brearley 2005).

Blasting and dredging the rocky bar created a channel, dredging deepened the river basin, and two moles were built to protect the harbour entrance. Land was reclaimed so quays and warehouses could be built. The Inner Harbour was opened on 4 May 1897, formed originally by a 130 m long and 9 m deep channel. Between 1914 and 1922, the channel was deepened to 11 metres (Brearley 2005).

#### 2.1.3 Environmental conservation history

The Swan River has a history of environmental protection since 1943, when the Swan River Reference Committee was initiated due to concerns for the health of the river and estuary. Further pollution and degradation led to the proclamation of the *Swan River Conservation Act* in 1958 with provision of statutory power for the management of the river by the Swan River Conservation Board, later the Swan River Trust. Increasing algal blooms and community concerns about the declining health of the river led to the Swan-Canning Cleanup Program, and three years of research in 1996-1999 to develop an action plan to cope with increasing degradation of the catchment and waterways. In 2015, the Department of Parks and Wildlife launched the Swan Canning River Protection Strategy as a coordinated management approach that is essential to maintain, protect and enhance the ecological and community benefits of the Riverpark.

#### 2.1.4 Physico-chemical and biological processes

The extreme seasonality of river flow causes great differences in the water regime of the estuary between summer and winter (Brearley 2005). Rainfall in winter brings fresh water that flows outwards to the sea. At the beginning of winter or when run-off is low, the fresh water flows seawards over the more dense salty water and the water column is stratified or layered. In years of high run-off, the whole estuary can be flushed with fresh water and the plume of coloured floodwaters can be seen stretching way out to sea as far as Rottnest Island.

In summer, the salinity of the Lower Estuary to about Perth water is similar to sea water (35 ppt), decreasing gradually towards the head of the estuary in the upper Swan. The Lower Estuary is only affected by fresh water when river flow is strong and prolonged. Marine water enters when the river flow is low so salinity is higher and stable for long periods. Flora and fauna are typically marine although not as diverse (Brearley 2005).

The temperature of the waters also follows the seasons. In the Lower Estuary surface temperatures are 12-14°C in winter and 22-24°C in summer. Temperatures also fluctuate more in the shallow areas and, like salinity, the variations have large implications for water life. The rise in temperature and sunlight in spring create favourable conditions for phytoplankton growth, fuelled by the nutrients brought by winter flow. The slower river flow also reduces flushing to the ocean so that blooms have time to develop (Brearley 2005).

Phytoplankton growth is also rapid in the salty Lower Estuary in summer, dependant on the cycling of nutrients but generally limited unless there are sudden additions of nutrients with summer floods (Brearley 2005).

The change from summer to autumn throughout the Swan River varies greatly; rainfall may be early or late and heavy or light – nitrate concentrations are typically low, but ammonium and phosphate may be high in areas of low oxygen. Sudden freshwater flows bring the nutrients that have accumulated over summer, and if the weather is still warm and sunny, conditions are perfect for algal blooms. Conversely, with a later onset of rain, conditions may be less favourable, and nutrients may be swept to sea before phytoplankton respond (Brearley 2005).

In winter to spring (July to October) the estuary waters are termed 'stratified'. The surface waters are fresh, and the deepest water is salt and below the influence of usual winter flushing and winds. Little light penetrates the dark floodwaters, plants cannot grow, no oxygen is produced, and the bottom layer becomes deoxygenated, which is an unfavourable condition for many animals. Occasionally the deep deoxygenated waters move to the surface, resulting in fish deaths (Brearley 2005).

## **2.2 Gage Roads offshore disposal area location and regional context**

Gage Roads is the name given to a natural depression offshore from the mouth of the Swan River, to the east of 5 Fathom Bank and north of Owen Anchorage. It is 22 m deep in some areas and was used as a spoil ground for the Inner Harbour capital dredging project in 2010 (SKM, 2009), and also has been used as an anchorage for Fremantle Port since the time of settlement. These activities have caused disturbances to the sediments. Due to this and the depth of the area, only sparse ephemeral marine biota is present.

SKM (2006) undertook a site survey and identified that the area is effectively the bottom of a basin gradually sloping into shallower depths along at its boundaries, without seabed features proud of the bottom, and no sand ripples were observed at any locations during the survey, indicating that sediment movement by wave action is likely to be minimal.

In summary, the proposed disposal area is in a natural depression on the western margin of Gage Roads to the west of the Deepwater Channel in a designated mooring area for vessels visiting the Port of Fremantle.

### 3 Marine Baseline Studies

This chapter represents the proposed scope of works for marine studies for the Inner Harbour Maintenance Dredging. These studies aim to provide baseline datasets to enable any impacts to be assessed.

#### 3.1 Baseline study elements

The baseline study elements for the Inner Harbour Maintenance Dredging Proposal are presented in Table 3.1.

**Table 3.1 Key Inner Harbour Maintenance Dredging Proposal elements**

Element	Location	Proposed extent
<b>Physical Elements</b>		
Bathymetry	Inner Harbour and Entrance Channel dredging area and Gage Roads offshore disposal area	The dredging will lower the bathymetry to the design depth of 14.7 metres and the removed material will be placed in the deepest area of the disposal area
<b>Project elements</b>		
Dredging	Fremantle Ports Inner Harbour and Entrance Channel	Removal of 60,000 m <sup>3</sup> in 2023 plus 5,000 m <sup>3</sup> each year for an additional 4 years, to a total of 80,000 m <sup>3</sup> from the Inner Harbour and Entrance Channel dredging design.
Disposal	Gage Roads offshore disposal area	Disposal of dredged sediment

##### 3.1.1 Benthic habitat investigation

The disposal area is located in deep waters of the Gage Roads anchoring area, in depths varying from 18 to 22 metres deep. The benthic habitat map available for this area is provided by Fremantle Ports (2019), this dataset was last updated in 2019 through desktop review using remote sensing techniques to validate the dataset from 2014, which was originally prepared using video tows and supervised imagery classification methodology.

The disposal area presents an ‘unknown area’ mostly over the deepest water layers mentioned above. The ‘unknown area’ is the result of poor resolution of the aerial imagery to correctly identify the bottom reflectance (bottom type) as the water-column absorption and scattering properties increases with depth, and it makes complicated to associate a given image spectrum with the pre-determined classes of spectra, e.g. sand, coral, seagrass.

The objective of the benthic habitat investigation is to obtain recent data to characterise the marine habitats in proposed disposal area. The potential impacts of the sea dumping on the benthic habitat will need to be evaluated. The benthic habitat mapping will support the definition of the marine management unit to be used in assessing the impacts of the sediment disposal and updated benthic

habitat map produced may be used to assess possible losses due to the disposal activities. It is proposed that the benthic habitat investigation includes:

1. Ground truth survey will be undertaken using towed underwater video (where necessary). The locations of the ground truth survey will be selected following review of the available imagery considering statistical analyses and the images will be captured by towing.
2. Update the project benthic habitat map in unknown areas.

The proposed timeframe for the benthic habitat mapping component is from 1 to 31<sup>st</sup> December 2022.

## 4 Legislative Context

### 4.1 Environmental impact assessment process

It is unlikely that the project will be referred to the Proposal to the Environmental Protection Authority (EPA) under *Section 38* of the *Environmental Protection Act 1986 (EP Act)*, as the potential for significant environmental impact from the maintenance dredging project is very low and the Department of Water and Environmental Regulation has advised not to refer maintenance dredging proposals.

The EPA applies a significance framework to make decisions through the environmental impact assessment (EIA) process, based on the concept of significance established under the *EP Act* (EPA 2021b). This Environmental Review Document (ERD) has been prepared in accordance with EPA's instructions on how to prepare an ERD (EPA 2022a), to provide sufficient information to assess the Proposal.

### 4.2 Other approvals and regulation

Regulatory instruments and frameworks relevant to the Proposal are outlined in Table 4.1.

**Table 4.1 Applicability of regulatory instruments and frameworks relevant to the Proposal**

Regulatory instrument/framework	Applicability to the Proposal	Evidence
<i>Biodiversity Conservation Act 2016 (BC Act)</i>	The WA BC Act provides for the conservation and protection of WA native flora and fauna. The underlying principles of the BC Act are to conserve and protect biodiversity, biodiversity components, and to promote the ecologically sustainable use of biodiversity components, throughout the State, with regard to the principles of ecologically sustainable development. Where projects may have a significant impact on biodiversity, the BC Act provides for facilitation and encouragement for use of measures to avoid or minimise potential impact. Significant impacts to biodiversity are not anticipated from the Proposal and assessment under the BC Act is therefore considered not required.	Section 7.1 Section 7.2 Section 8
<i>Biosecurity Act 2015</i>	The <i>Commonwealth Biosecurity Act 2015</i> provides a regulatory framework for management of biosecurity risks including: non-indigenous species, pests, disease and contaminants. This is managed by the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW). The <i>Biosecurity Act 2015</i> includes regulations for ballast water, biofouling and biosecurity risks associated with marine pests that will be considered as part of the Proposal for management of these risks.	Section 8
<i>Contaminated Sites Act 2003 (CS Act)</i> and <i>Contaminated Sites Guidelines (DER 2014)</i>	Contaminated Sites Database (DWER 2021) was undertaken to assess potential contaminated sites within the Proposal area and no records were identified.  The Contaminated Sites Guidelines (DER 2014) provide guidance on the assessment and management of contaminated sites under the CS Act.	Section 7

Regulatory instrument/framework	Applicability to the Proposal	Evidence
Fremantle Ports Marine Environmental Management Framework (MEMF; BMT 2020c)	<p>Fremantle Ports has a marine environmental management framework (MEMF; BMT 2020c) that provides guidance for environmental management and monitoring of Fremantle Ports Maintenance Dredging operations. The intention of the MEMF is to ensure that Fremantle Ports` Maintenance Dredging activities are completed with consideration of:</p> <ul style="list-style-type: none"> <li>• environmental factors and environmental regulatory requirements</li> <li>• protection of the environment</li> <li>• clear, relevant and practical identification of potential environmental impacts</li> <li>• open engagement with stakeholders</li> <li>• effective environmental monitoring and management.</li> </ul>	This Environmental Review Document
<i>Environment Protection (Sea Dumping) Act 1981</i> (EP Sea Dumping Act) and National Assessment Guidelines for Dredging (NAGD; CA 2009)	<p>The Commonwealth EP Sea Dumping Act applies to disposal of controlled material in Australian waters other than waters within the limits of the State or of the Northern Territory. The Department of Climate Change, Energy, the Environment and Water (DCCEEW) assesses environmental impacts and permits acceptable proposals to dump materials at sea extending seaward of low water mark to the limits of the Exclusive Economic Zone.</p> <p>The NAGD (CA 2009) in support of the EP Sea Dumping Act provides a framework for environmental impact assessment and permitting of the ocean disposal of dredged material and includes information on:</p> <ul style="list-style-type: none"> <li>• evaluating alternatives to ocean disposal</li> <li>• assessing sediment quality</li> <li>• assessing dredging and disposal areas</li> <li>• assessing potential impacts on the marine environment and other users</li> <li>• determining management and monitoring requirements.</li> </ul> <p>This ERD may be used to support assessment under the EP Sea Dumping Act.</p>	<p>Section 1.3</p> <p>Section 7.1</p> <p>Section 7.3</p> <p>Section 7.4</p>
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	<p>Activities anticipated to significantly impact matters of national environmental significance require assessment under the Commonwealth EPBC Act. The EPBC Act protected matters include:</p> <ul style="list-style-type: none"> <li>• listed threatened species and ecological communities</li> <li>• migratory species protected under international agreements</li> <li>• Ramsar wetlands of international importance</li> <li>• the Commonwealth marine environment</li> <li>• the Great Barrier Reef Marine Park</li> <li>• World Heritage properties</li> <li>• National Heritage places</li> <li>• nuclear actions.</li> </ul>	<p>Section 7.1</p> <p>Section 7.2</p> <p>Section 8</p>

Regulatory instrument/framework	Applicability to the Proposal	Evidence
	Significant impacts to matters of national environmental significance are not anticipated from the Proposal and assessment under the EPBC Act is therefore considered not required.	
<i>Heritage Act 2018</i>	The <i>Heritage Act 2018</i> establishes the State Register of Heritage Places that are protected for aesthetic, historic, scientific, or social significance, for the present community and future generations. A search of the Heritage Council Heritage Database (Heritage Council 2022) was undertaken to assess potential Heritage Places in the vicinity of the Project area. The search demonstrated that the dredging area is located within the Inner Harbour precinct (place number 22531). The City of Fremantle has identified this place as being of exceptional cultural heritage significance within the context of Fremantle and its conservation is required, recommending this place to be considered for entry in the Heritage Council of Western Australia's Register of Heritage Places.	Section 7.3.4
<i>Maritime Archaeology Act 1973 (MA Act)</i>	The WA MA Act protects pre-1900 maritime archaeological sites on State lands and in State waters, such as protected bays, harbours and rivers. Maritime archaeological sites include shipwrecks, early maritime infrastructure, land sites associated with exploration, maritime industries such as whaling and pearling camps) and shipwreck survivor camps. A search of the Western Australia Museum Shipwrecks Databases (GWA 2022) was undertaken to assess potential historic shipwrecks or relics in the vicinity of the Project area and it revealed several known wrecks in the vicinity of the Inner Harbour/Entrance Channel and proposed disposal area in Gage Roads.	Section 7.3.4.2.3
<i>Underwater Cultural Heritage Act 2018</i>	The <i>Commonwealth Underwater Cultural Heritage Act 2018</i> protects shipwreck >75 years old (or younger if declared by the Minister for the Environment) and their relics in Commonwealth and State waters (via supplementary legislation). A search of the Australasian Underwater Cultural Heritage Database (DAWE 2021) was undertaken to assess potential historic shipwrecks in the Project area. While several historic shipwrecks were identified in the vicinity of the Project area, no records were identified within the dredging and disposal area and the Project works will therefore have no interaction with them.	Section 7.3.4.2.3
<i>Aboriginal Cultural Heritage Act 2021 and Aboriginal Heritage Act 1972</i>	The Aboriginal Cultural Heritage Act 2021 (ACH Act) provides a framework for the recognition, protection, conservation and preservation of Aboriginal cultural heritage. Before the ACH Act comes into operation there will be a transitional period of at least 12 months during which the regulations, statutory guidelines and operational policies will be developed to ensure the ACH Act will have its intended effects. The transitional period will allow for the new Aboriginal cultural heritage management system to be fully established and to enable parties to prepare for the new system.  During the transitional period the Aboriginal Heritage Act 1972 will remain in force to allow proponents to continue to seek Section 18	Section 7.3.4.1

Regulatory instrument/framework	Applicability to the Proposal	Evidence
	<p>consent for any activity that will impact Aboriginal sites. Any Section 18 consents applied for and granted during this period will be limited to 5 years and will be subject to additional protection mechanisms, including the requirement to report new information about the existence or the characteristics of Aboriginal cultural heritage.</p> <p>A search of the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Inquiry System (AHIS 2022) revealed that there are three aboriginal sites within the vicinity of the proposal.</p> <p>The relevant registered Aboriginal heritage sites to this proposal is the Swan River - 3536. Fremantle Ports hold a section 18 approval under the Aboriginal Heritage Act 1972 for the purpose of dredging and maintenance of the Inner Harbour and disposal of dredge spoil at Gage Roads anchorage. This approval was in place for the capital dredging project undertaken in 2010 which shares the same footprint as this maintenance dredging proposal. Due to the associated consultation occurring in 2007, Fremantle Ports plans to undertake stakeholder consultation identified Aboriginal representatives for the Swan River site.</p>	

## 5 Stakeholder Engagement

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Fremantle Ports is developing a communications plan for the Inner Harbour Maintenance Dredging project to manage stakeholder consultation.

Fremantle Ports' have a long history and commitment to consultation and interaction with their stakeholders, including regular customer satisfaction surveys and stakeholder engagement, generating a strong social licence (Fremantle Ports 2021). The communication channels to engage with stakeholders include electronic newsletters, social media, news media, public events, community meetings, volunteer programs and through community investment and educational programs (Fremantle Ports 2021).

The key community stakeholders are reached directly through the independently-chaired Inner Harbour Community Liaison Group, which meets three times a year, with a sharing of information and views (Fremantle Ports 2021).

## 6 Environmental Factors and Principles

### 6.1 Identification of environmental factors and their significance

In accordance with the EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2022a), three key environmental factors (marine environmental quality, benthic communities and habitats and social surrounding) and three 'other environmental' factors (marine fauna, coastal processes and greenhouse gases) were determined as relevant to the proposal and considered within this ERD (Table 6.1).

The relevant environmental factors and the likely potential environmental impacts associated with the implementation of the Proposal were identified during early scoping of environmental approval pathways (BMT 2022a).

Table 6.1 Relevant Environmental Factors

EPA environmental factor	Significance	Relationship to the Proposal
Marine environmental quality	Key environmental factor	<ul style="list-style-type: none"> <li>The dredging activities associated with the Proposal have the potential to modify water quality from increased water column turbidity and the potential release of contaminants from within sediments.</li> <li>The disposal of sediment has the potential to modify the quality of sediments at the Gage Roads offshore disposal area.</li> <li>The presence of equipment associated with the Proposal poses a potential risk of hydrocarbon spills and waste generation.</li> </ul>
Benthic communities and habitats	Key environmental factor	<ul style="list-style-type: none"> <li>Capital dredging of the dredging area was completed in 2010 and the material to be removed has accumulated since then, so presence and risk of BCH loss is minimal.</li> <li>Modifications to water quality during dredging activities may directly or indirectly impact BCH occurring in the vicinity of the Proposal dredging and disposal areas due to stressor effects (loss of light, burial).</li> </ul>
Social surroundings	Key environmental factor	<ul style="list-style-type: none"> <li>Short-term sediment plumes may temporarily reduce the amenity in the vicinity of the Proposal area.</li> </ul>
Marine fauna	Other environmental factor	<ul style="list-style-type: none"> <li>The operation of the dredge and any associated work boats poses a potential risk of collision with marine fauna.</li> <li>Underwater noise associated with the operation of the dredge and any associated work boats has the potential to result in impacts to marine fauna.</li> <li>The mobilisation of the dredge, associated work boats and equipment to the Proposal area poses a potential risk of the introduction of marine species that will require control.</li> </ul>
Coastal processes	Other environmental factor	<ul style="list-style-type: none"> <li>The dredging will minimally alter the bathymetry of the seafloor within Inner Harbour and Entrance Channel and the risk of potentially altering water dynamics in the Lower Estuary is very low, as the proposal is maintenance dredging back to the target depth of 14.7 m.</li> </ul>

EPA environmental factor	Significance	Relationship to the Proposal
		<ul style="list-style-type: none"> <li>The disposal of 60 000 m<sup>3</sup> of sediment at a deep area of the previously used Gage Roads offshore disposal area will alter the bathymetry minimally and is unlikely to cause changes to local water circulation.</li> <li>Disposal is within the deepest area of historic Gage Roads disposal area, and the risk of potentially changing local water circulation is very low.</li> </ul>
Greenhouse gases (GHG)	Other environmental factor	<ul style="list-style-type: none"> <li>GHG emissions generated from dredging activities will be calculated, and are not anticipated to have a significant impact on the environment .</li> <li>GHG emissions will include fuel combustion during dredging.</li> </ul>

## 6.2 Consistency with environmental principles

The EP Act identifies a series of principles for environmental management. The environmental principles are the highest assessment level that a project must meet in order to be found environmentally acceptable by the EPA. The Proponent has considered these principles in relation to the implementation of the Project.

Table 6.2 Consideration of Environmental Principles

Principle	Consideration
<p>1. The precautionary principle</p> <p>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by:</p> <p>a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</p> <p>b) an assessment of the risk-weighted consequences of various options.</p>	<ul style="list-style-type: none"> <li>The Proposal has been designed to avoid any serious or significant environmental harm. Detailed investigations have been undertaken and used to supplement information from existing surveys/investigations to inform the understanding of the existing environment and identify the potential environmental impacts from the Proposal. Where there were areas of uncertainty regarding potential impacts, conservative assumptions are made.</li> <li>Management actions to address residual impacts and ensure impacts are as predicted will be addressed within a corresponding Dredging Environmental Management Plan (DEMP).</li> </ul> <p>The Proponent considers that the Proposal meets the application of the precautionary principle.</p>
<p>2. The principle of intergenerational equity</p> <p>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</p>	<ul style="list-style-type: none"> <li>The Proposal is not predicted to have long-term adverse effects on the health, diversity or productivity of the environment.</li> </ul> <p>The Proponent considers that the Proposal meets the principle of intergenerational equity.</p>
<p>3. Principles relating to improved valuation, pricing and incentive mechanisms</p> <p>(1) Environmental factors should be included in the valuation of assets and services.</p>	<ul style="list-style-type: none"> <li>The Proponent accepts that costs for environmental mitigation and management are part of the overall Proposal costs. This includes residual impact management actions that will be addressed within a corresponding DEMP.</li> </ul>

Principle	Consideration
<p>(2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</p> <p>(3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.</p> <p>Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.</p>	<p>The Proponent considers that the Proposal meets the principle of improved valuation, pricing and incentive mechanisms.</p>
<p>4. The principle of the conservation of biological diversity and ecological integrity</p> <p>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</p>	<ul style="list-style-type: none"> <li>The Proponent has identified three key environmental factors (benthic communities and habitats, marine environmental quality and social surroundings) relevant to the Proposal.</li> <li>Detailed investigations have been undertaken to identify potential impacts and mitigation options to minimise the impact of the Proposal and align with the Environmental Protection Authority's objective for each environmental factor. No long-term impacts on environmental values are expected to occur.</li> </ul> <p>The Proponent considers that the Proposal meets the principle of conservation of biological diversity and ecological integrity.</p>
<p>5. The principle of waste minimisation</p> <p>All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.</p>	<ul style="list-style-type: none"> <li>The Proposal's approach to waste is consistent with the waste management (avoid, recover, disposal) principles.</li> <li>The sediment being dredged from the Inner Harbour meets the requirements of the NAGD (2009) and it is suitable for ocean disposal.</li> <li>Waste management for the Proposal will be addressed within a corresponding EMP.</li> </ul> <p>The Proponent considers that the Proposal meets the principle of waste minimisation.</p>

## 7 Assessment of Key Environmental Factors

### 7.1 Marine environmental quality

#### 7.1.1 EPA objective

To maintain the quality of water, sediment, and biota so that environmental values are protected (EPA 2016a).

#### 7.1.2 Policy and guideline

The legislative instruments, policies and guidelines considered applicable to the environmental impact assessment of marine environmental quality are provided in Table 7.1.

**Table 7.1 Legislative instruments, policies and guidelines relevant to the environmental impact assessment of marine environmental quality**

Legislative instruments, policies and guidelines
Statement of Environmental Principles, Factors and Objectives (EPA 2022b)
Environmental Factor Guideline – Marine Environmental Quality (EPA 2016a)
Technical Guidance – Protecting the Quality of Western Australia’s Marine Environment (EPA 2016b)
Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2021)
National Assessment Guidelines for Dredging (CA 2009)
Contaminated Sites Guidelines (DWER 2021)

#### 7.1.3 Receiving environment

##### 7.1.3.1 Water quality

Perth’s coastal water quality is influenced by input from the Swan River, leaching from local sediments, groundwater and stormwater discharges, wastewater discharges, as well as seasonal differences in local hydrodynamics (SKM 2009; Section 5.3.3.3). The Perth Coastal Waters Study (PCWS; DEC 1996 [cited in SKM 2009]) and Southern Metropolitan Coastal Waters Study (SMCWS; Simpson *et al.* 1993) funded by the Water Authority of Western Australia (now Water Corporation) provide historical data on temporal and spatial variation in water quality parameters from Yanchep to Mandurah in the early 1990s. In winter, river discharge was found to provide a significant source of nitrogen to Perth’s coastal waters, and Secchi depth ranged from 2.6 m in Comet Bay (Mandurah) to 12.3 m at the offshore site at Marmion (Simpson *et al.* 1993). Light attenuation at sites in Owen Anchorage was found to be significantly higher and more variable in winter, likely associated with increased resuspension of organic material and sediments by wind and swell waves (Simpson *et al.* 1993). In summer, water clarity was generally higher and nutrient levels were found to be lower than in winter, largely due to lower riverine influences (Simpson *et al.* 1993).

Baseline water quality monitoring undertaken by SKM from October 2007 to November 2008 assessed water clarity at three sites in the vicinity of Fremantle Port (SKM 2009). Over the monitoring period, daily median turbidity (measured by in-situ loggers) ranged from 0.1 to 58.8 NTU, and concentrations of total suspended solids (TSS) ranged from 0.6 – 8.2 mg L<sup>-1</sup> (SKM 2009). Daily median turbidity generally remained below 2 NTU with periodic elevations recorded predominantly during or immediately after strong winds (SKM 2009).

Fremantle Port's Marine Quality Monitoring Program (MQMP) assesses water quality yearly in summer at 28 sites across the Inner Harbour, Rous Head Harbour, Shipping Channels and Outer Harbour. Water quality monitoring at sites near the dredging and disposal area has shown that water quality in the vicinity of the Proposal area rarely, if ever exceed environmental quality guidelines set for the area (BMT Oceanica 2017, BMT 2018, BMT 2019, BMT 2020b, BMT 2021, BMT 2022d).

Concentrations of chemical stressors (e.g. nutrients) and toxicants (e.g. filtered copper, benzene, toluene, ethylbenzene and xylene [BTEX] and total recoverable hydrocarbons [TRHs]) in marine waters over the last six years (2017–2022) were generally below the limit of reporting (LoR) or below applicable guideline values (where relevant; ANZECC & ARMCANZ 2000; EPA 2017; ANZG 2018), with the exception of filtered copper, which has on occasion exceeded the ANZG (2018) 99% species protection guideline at sites near the disposal area (BMT Oceanica 2017, BMT 2018, BMT 2019, BMT 2020b, BMT 2021, BMT 2022d). Concentrations of TSS were low for the monitoring period in summer, ranging from 0.6 – 1.2 mg L<sup>-1</sup> and 0.2 – 2.4 mg L<sup>-1</sup> near the dredging and disposal area, respectively: (BMT Oceanica 2017, BMT 2018, BMT 2019, BMT 2020b, BMT 2021, BMT 2022d).

### **7.1.3.2 Sediment quality**

Sediment quality in Perth offshore waters is typically free from contamination due to the very limited avenue for toxicants to enter, with shipping being the only potential source in the proposed dredging area.

To test marine quality in the Proposal area, marine sediments were sampled from 17 sites within the dredging area and from 10 sites within the disposal area on 8–9 December 2021 (BMT 2022b), in accordance with a sediment Sampling and Analysis Plan (SAP; GHD 2021). Due to a subsequently revised maintenance dredge area, a Supplementary Sampling and Analysis Plan (SSAP; GHD 2022) was prepared and seven extra sites were sampled (O2M 2022). Sediments were sampled according to the National Assessment Guidelines for Dredging (NAGD; CA 2009) and the Contaminated Sites Guidelines (DWER 2021).

Sediment samples collected from within the dredging area and disposal area were analysed for particle size distribution (PSD), total organic carbon (TOC), pH, metals (aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver and zinc), organotins (tributyltin [TBT], dibutyltin [DBT], monobutyltin [MBT]), pesticides (organochlorine & organophosphorus), and hydrocarbons (polycyclic aromatic hydrocarbons [PAHs], total recoverable hydrocarbons [TRHs], total petroleum hydrocarbons [TPHs] and benzene, toluene, ethylbenzene and xylene [BTEX]).

Dredging area sediments were predominantly very well sorted, dark brown/grey coloured fine sand with clay/silt present. Sediments from the disposal area were also predominantly comprised of sand, although had comparably lower composition of clay and silt sized particles. A slight sulfidic odour was noted at several sites within the Inner Harbour, which was not observed from offshore Disposal area sediments. Sediment total organic carbon (TOC) concentrations ranged from 0.12% to 3.64% for Inner Harbour sediments, while TOC concentrations from the disposal area sediments were comparably lower, ranging from 0.04% to 0.25%. The pH level in sediments in Inner Harbour and Disposal area was relatively similar with the pH ranging from 8.37 to 9.10 across both areas.

The 95% UCL for total metals, organotin, pesticides and hydrocarbons were all below the NAGD Screening Levels (CA 2009) where relevant guidelines were available for comparison within the Inner Harbour, indicating the sediments are clean and suitable for unconfined disposal at the offshore disposal area. The sampling results from the disposal area were all below the NAGD screening levels (CA 2009) and sediments from the offshore disposal area are clean and considered suitable to receive Inner Harbour dredged material.

### 7.1.3.3 Environmental values

In accordance with Environmental Factor Guideline – Marine Environmental Quality (EPA 2016a), a review of the environmental values (ecosystem health, fishing and aquaculture, recreation and aesthetics, cultural and spiritual, and industrial water supply) in EPA's Environmental Quality Management Framework (EQMF; EPA 2016a) was undertaken to identify those environmental values and corresponding environmental quality objectives (EQOs) that are applicable to the Proposal area, and require consideration in the environmental impact assessment of marine environmental quality (Table 7.2). The review identified two environmental values and three corresponding EQOs that are considered applicable to the Proposal (Table 7.2).

**Table 7.2 Environmental values and environmental quality objectives applicable to the Proposal area**

Environmental value	Environmental quality objective (EQO)	Applicability to the Proposal	Reasoning
Ecosystem health (ecological value)	Maintenance of ecosystem integrity	Applicable	The Proposal may result in impacts to ecosystem integrity from the effects of potential physical and chemical stressors and from the effects of potential toxicants in marine waters and/or sediments and requires assessment.
Fishing and aquaculture (social use value)	Maintenance of seafood safe for human consumption	Not applicable	Maintenance of ecosystem integrity is an adequate proxy.
	Maintenance of aquaculture	Not applicable	Maintenance of ecosystem integrity is an adequate proxy. There are no aquaculture leases in the project area.
Recreation and aesthetics (social use value)	Maintenance of aesthetic values	Applicable	The Proposal will cause temporary increased water column turbidity resulting in reduced visual clarity of waters at the dredging and Disposal area, and potentially at other surrounding areas. The significance of reduced visual clarity of water associated with the implementation of the Proposal will depend on the intensity, extent and duration of turbid plumes generated during the Proposal and requires assessment.
	Maintenance of secondary contact recreation values	Applicable	
	Maintenance of primary contact recreation values	Not applicable	Maintenance of secondary contact recreation values is an adequate proxy, as there is a very low risk of primary contact within the Inner Harbour, Entrance Channel or disposal area.
Cultural and spiritual (social use value)	Cultural and spiritual values of the marine environment are protected	Applicable	The Proposal may result in impacts to heritage sites. This requires assessment.

Environmental value	Environmental quality objective (EQO)	Applicability to the Proposal	Reasoning
Industrial water supply (social use value)	Maintenance of water quality for industrial use	Not applicable	Maintenance of ecosystem integrity is an adequate proxy. There is no industrial water supply in the Proposal area.

#### 7.1.4 Study effort

The study effort to inform the environmental impact assessment of marine environmental quality is outlined in Table 7.3. It is noted that the Proposal area has been the subject of numerous marine water and sediment quality investigations over many years and there is a significant body of data / information available to inform the Proposal from grey literature and published sources.

**Table 7.3 Study effort to inform the environmental impact assessment of marine environmental quality**

Title	Description
Fremantle Ports Maintenance Dredging: Sediment Sampling and Analysis Plan Implementation Report (BMT 2022b)	Dredging and disposal area sediments were sampled and analysed in 2021 to assess the physical and chemical characteristics of the sediments.
Supplementary Sampling and Analysis Plan Implementation Report, Fremantle Ports Authority Maintenance Dredging (O2M 2022)	Dredging and disposal area sediments were sampled and analysed in 2022 including the subsequently revised Maintenance Dredging footprint to assess the physical and chemical characteristics of the sediments at additional sites.
Fremantle Ports Inner Harbour Maintenance Dredging – Dredge Plume Modelling (BMT 2022c)	Hydrodynamic and sediment plume dispersion modelling was undertaken to predict the likely duration, extent and intensity of turbid plumes generated from dredging and disposal and the extent of potential sedimentation.
Fremantle Ports Marine Quality Monitoring Program Annual Reports (BMT Oceanica 2014, 2015, 2016, 2017, BMT 2018c, BMT 2019, 2020b, 2022c, 2022d)	As part of their Marine Quality Monitoring Program (MQMP), Fremantle Ports undertakes annual marine quality monitoring in the Inner Harbour, Rous Head and Deepwater Channel. A subset of sediment and water quality results from this program was used to inform the Proposal.

#### 7.1.5 Potential environmental impacts

The anticipated potential environmental impacts on marine environmental quality arising from the Proposal are outlined in Table 7.4.

**Table 7.4 Anticipated potential environmental impacts on marine environmental quality arising from the Proposal**

EPA factor	Potential environmental impact	Report section for assessment
Marine environmental quality	Increased water column turbidity	Section 7.1.6.1
	Release of contaminants	Section 7.1.6.2

EPA factor	Potential environmental impact	Report section for assessment
	Hydrocarbon spills and waste generation	Section 7.1.6.3

### 7.1.6 Assessment of potential environmental impacts

#### 7.1.6.1 Increased water column turbidity

The disturbance of sediment during dredging and disposal activities associated with the Proposal may result in temporary increases in water column turbidity from the generation of turbid plumes within and/or adjacent to the dredging and disposal area. Increased water column turbidity may result in:

- indirect loss of BCH
- reduced visual amenity

Particle size distribution (PSD) analyses undertaken by BMT (2022b) and O2M (2022) demonstrated that sediments from the dredging area are predominately characterised by sand (0.06-2.00mm) with small portions of clay (<2µm), silt (2-60 µm) and gravel (>2 mm) sized particles, indicating a low risk of generating persistent turbid plumes from dredging and disposal. Higher concentrations of clay increases the turbidity rates within the water column, however, according to BMT (2022e), the concentration levels are low (<20 mg/L) and the TSS exceedance are limited to the dredging footprint within Inner Harbour, as detailed below.

The dredging and disposal activities are proposed to occur over seven days per week for a duration of ~10 days (this duration is based on the operational downtime rate of the dredge and does not account for potential standby from weather or mechanical breakdown etc). During the dredging activity, it is estimated that there will be a maximum of ten dredging and disposal cycles per day.

Based on the Proposal's operational schedule, the generation of turbid plumes will be temporary and anticipated to be minimised due to the movement of the dredge to different positions within the dredge area and also the disposal activities.

To better understand the likely intensity, extent and duration of turbid plumes generated from dredging and disposal, plume dispersion hydrodynamic modelling was completed by BMT (2022e) using the SWAN (wave model) and TUFLOW-FV (hydrodynamic model). The modelling was based on the most likely dredge scenario and conservative dredging source term and dredge schedule inputs. The modelled scenario was simulated based on the conditions experienced during the hindcast period of April 2019, which is the representative year from the past 10 years of metocean conditions.

The dredge plume modelling results from the simulations were processed as spatial plots to illustrate 50th and 95th percentile contours of predicted elevations in depth averaged total suspended solids (TSS; BMT 2022e).

It is important to highlight that elevated TSS itself does not harm seagrasses, rather it is the continuous light reduction (measured as daily light integral [DLI]) associated with the sediments held in suspension or sedimentation that can result in seagrass loss (EPA 2021b).

According to BMT (2022e), the total suspended solids (TSS) was modelled for points of interest around the disposal area and the dredge area (upstream and nearshore). The points of interest were placed over benthic habitats (Figure 7.1).

The TSS values at each location were assessed for each time step over the duration of the plume dispersion and until ambient conditions had been restored. For this duration, the total (non-consecutive) minutes of specific TSS nominal values were aggregated into days. Table 7.5 quantifies the number of days, the nominal TSS values of 2 mg/L, 5 mg/L, 10 mg/L and >20 mg/L were exceeded at each location.

The daily moving mean estimate of the TSS for all points do not exceed 20 mg/L. The highest daily moving mean among all points was 20 mg/L at Upstream 1. The instantaneous TSS exceeded 20 mg/L for a cumulative period of 1.34 days over 10-day dredging period and TSS exceeded 10 mg/L for a cumulative period of 6.19 days over 10 day dredging period at Upstream 1 (Table 7.5).

Figure 1.1 to Figure 1.19 in Annex A describe the timeseries TSS and daily moving mean TSS for each of the above locations. The dredging and disposal operations have been planned to occur over 24 hours in a day. The 24-hour moving mean provides an average daily estimate of the predicted TSS values during the 10-day campaign (more important than instantaneous TSS levels for receptors). Table 7.5 quantifies the number of days, the nominal TSS values of 2 mg/L, 5 mg/L, 10 mg/L and >20 mg/L were exceeded at each location. The nominal TSS values are in alignment with the values used in the environmental impact assessment (BMT 2022b).

Daily moving mean estimate of the TSS for all points do not exceed above 20 mg/L. Highest daily moving mean among all points was 20 mg/L at Upstream 1. The instantaneous TSS exceeded 20 mg/L for a cumulative period of 1.34 days over the 10-day dredging period at Upstream 1 (Table 7.5).

From Upstream 2 to Upstream 5, the maximum daily moving mean of TSS is predicted to decrease from 15 mg/L to around 4 mg/L. At the furthest Upstream 5, the maximum instantaneous TSS is predicted to exceed 0.67 days over the 10-day dredging period.

The daily moving mean of TSS concentrations from Nearshore 1 to Nearshore 6 did not show TSS concentration higher than 6 mg/L. Highest daily moving mean of TSS concentration for the Nearshore locations was observed at Nearshore 4 with 6 mg/L of TSS on April 13 (start of the dredge campaign). The instantaneous TSS exceeded 10 mg/L for a total of 3.18 days over the 10-day dredging period. Daily moving mean for Nearshore locations 1, 2, 3, 5, and 6, ranged between 1 mg/L and 4 mg/L.

The daily moving mean TSS concentration at the disposal area did not exceed 6 mg/L. Generally, the daily moving mean of TSS at Disposal 1, 3, 4, 5, 6, 7, and 8 ranged between 2mg/L and 5mg/L with Disposal 2 having a daily moving peak of 6mg/L. With relevance to the presence of seagrass, Disposal 2 and 4 showed the highest and longest duration of instantaneous TSS with 10 mg/L exceeded over 0.21 and 0.15 days respectively.

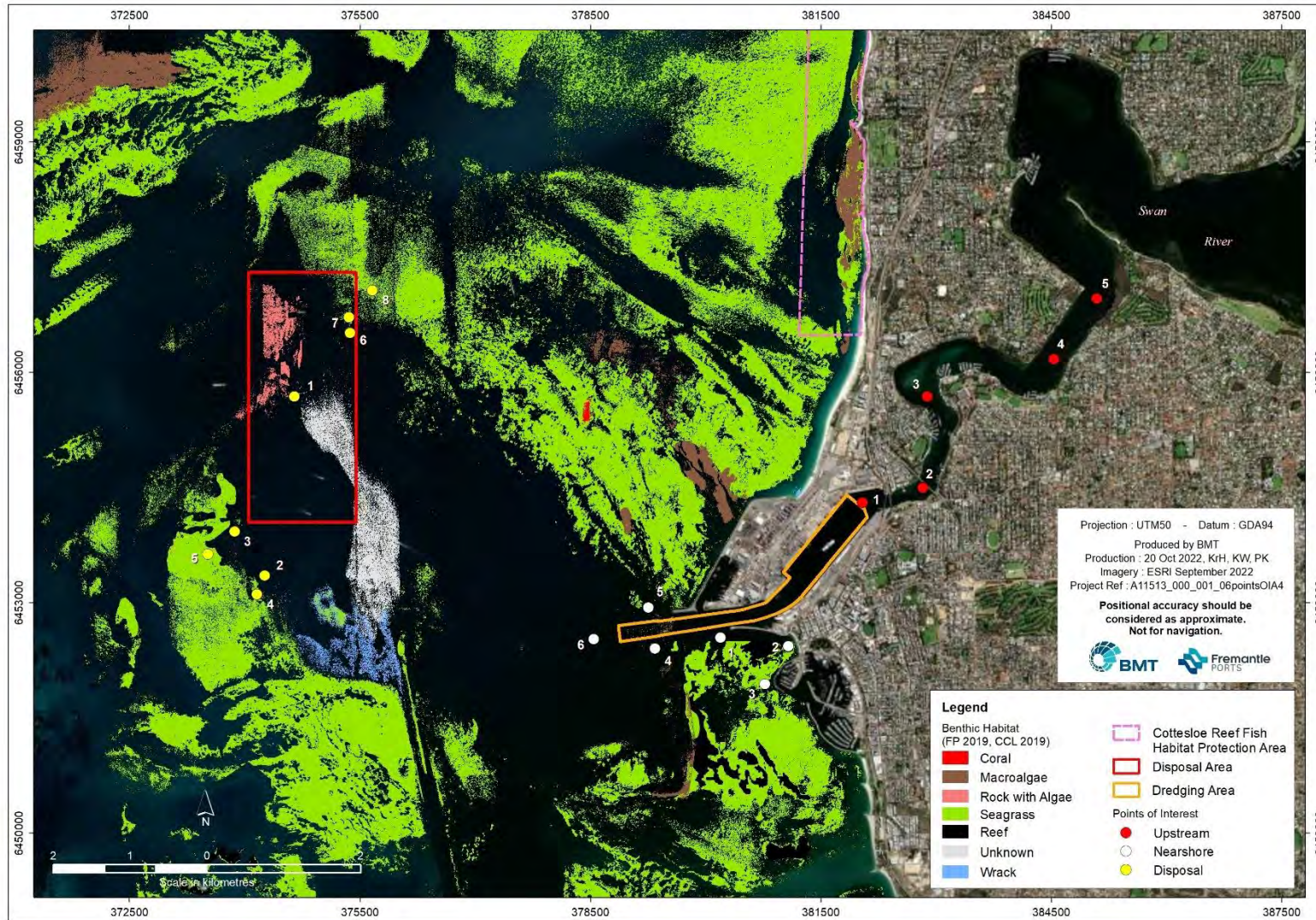


Figure 7.1 Location of interest for analysis

Table 7.5 Nominal TSS exceedance over the dredging and disposal period.

Locations	Total number of days nominal TSS values are predicted to be exceeded			
Nominal TSS values	2 mg/L	5 mg/L	10 mg/L	20 mg/L
Upstream 1	10.31	9.11	6.19	1.34
Upstream 2	9.99	7.42	3.76	0.44
Upstream 3	9.74	6.39	3.02	0.10
Upstream 4	5.30	2.50	0.26	0.00
Upstream 5	2.26	0.67	0.00	0.00
Nearshore 1	3.76	0.46	0.00	0.00
Nearshore 2	1.30	0.00	0.00	0.00
Nearshore 3	1.03	0.00	0.00	0.00
Nearshore 4	6.23	4.26	3.18	0.00
Nearshore 5	1.33	0.20	0.00	0.00
Nearshore 6	1.30	0.00	0.00	0.00
Disposal 1	0.84	0.20	0.11	0.00
Disposal 2	3.92	1.32	0.21	0.00
Disposal 3	1.54	0.42	0.00	0.00
Disposal 4	3.82	1.06	0.15	0.00
Disposal 5	0.75	0.07	0.00	0.00
Disposal 6	2.14	1.16	0.00	0.00
Disposal 7	1.89	0.76	0.00	0.00
Disposal 8	2.20	0.85	0.00	0.00

Increased water column turbidity will be subject to active monitoring and/or management during implementation of the Proposal, to ensure that there are appropriate contingency measures in place should any issues arise. The monitoring and management requirements are detailed in a corresponding Dredging Environmental Management Plan (DEMP; BMT 2022f).

It is proposed to undertake water clarity monitoring to meet the environmental criteria of turbidity levels at boundary of ZoMI/ZoL to minimise social impacts on aesthetic quality from increased water column turbidity associated with dredging activity. TSS and water transparency will be measured and the criteria adopted are measurements above 10 mg/L of TSS and Secchi disk measurements below 1.6 m (equivalent to the EPA [2017] water clarity EQG for the maintenance of primary contact recreation).

#### 7.1.6.2 Release of contaminants

Physical disturbance of the seabed during dredging and disposal activities can potentially lead to the release of toxicants bound in sediments to the water column. Accordingly, in December 2021 (BMT 2022b) and May 2022 (O2M 2022), sediment samples from within the proposed Inner Harbour Maintenance Dredging area and offshore disposal area were sampled and analysed for contaminants

of concern in accordance with NAGD (CA 2009). Chemical testing of sediments determined that all sediments were clean; the 95% upper confidence limits (UCLs), maximums and all individual sample concentrations of metals were below the NAGD Screening Levels (CA 2009).

As such, the potential risk of the release of contaminants has been determined to be extremely low and unlikely to result in impacts to marine environmental quality. Due to the low risk of the release of contaminants, it is considered that there is no requirement for dedicated sediment quality monitoring and/or management during implementation of the Proposal.

#### **7.1.6.3 Hydrocarbon spills and waste generation**

Various hydrocarbons including fuel, oil and lubrications will be used for the operation of dredging machinery associated with the Proposal. There is a potential risk to the receiving environment should a hydrocarbon spill occur. Rubbish and hazardous waste may also be generated, which can pollute the environment if not appropriately contained and removed from site. The potential risk of hydrocarbon spills and waste generation will be avoided or minimised during the Proposal by ensuring:

- the contractor for marine dredging and disposal activities will have their own refuelling and spill management procedures to adhere to and an oil spill contingency plan for responding to any marine oil pollution events
- there will be no storage of fuel and petroleum products, nor shall any equipment and machinery be serviced on site
- any refuelling on site will occur in a designated area that does not drain into adjacent stormwater systems or waterways
- any spillage of fuels and petroleum products will be reported by the relevant Contractor to Fremantle Ports immediately.

Hydrocarbon use and waste will be subject to active monitoring and/or management during implementation of the Proposal, to ensure that there are appropriate contingency measures in place should any issues arise. The monitoring and management requirements are detailed in a corresponding DEMP (BMT 2022f)

#### **7.1.7 Cumulative impacts**

Although there is a risk an individual project may have potential impacts to the environment, impacts from other projects in the region can lead to increased deleterious effects on environmental and social values. However, effects of dredging activities at Inner Harbour shipping channel and disposal of material at Gage Roads offshore disposal area on marine environmental quality were determined to be short-term and highly unlikely to induce permanent changes in the marine environment, either in isolation or when considered in association with other projects in the region. As such, further assessment of cumulative impacts was discounted.

#### **7.1.8 Mitigation**

The mitigation hierarchy has been applied to the Proposal to ensure the EPA objective for marine environmental quality is maintained and the identified environmental values for marine environmental quality are protected. Mitigation measures are summarised in Table 7.6.

Table 7.6 Summary of mitigation measures to ensure maintenance of marine environmental quality

Potential environmental impact	Avoid	Minimise	Management and monitoring
Increased water column turbidity	<ul style="list-style-type: none"> <li>Not applicable</li> </ul>	<ul style="list-style-type: none"> <li>The short duration of the dredging (less than 10 days) will enable lower persistent levels of turbidity.</li> <li>Project timing in autumn period when seagrasses are dormant</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of a DEMP (BMT 2022f)</li> </ul>
Release of contaminants	<ul style="list-style-type: none"> <li>The dredging and disposal area sediments present a low contamination risk</li> </ul>	<ul style="list-style-type: none"> <li>Not applicable</li> </ul>	<ul style="list-style-type: none"> <li>Not required due to the low risk</li> </ul>
Hydrocarbon spills and waste generation	<ul style="list-style-type: none"> <li>There will be no storage of fuel and petroleum products</li> </ul>	<ul style="list-style-type: none"> <li>Contractor for marine dredging activities will have their own refuelling and spill management procedures to adhere to and an oil spill contingency plan for responding to any marine oil pollution events</li> <li>Any refuelling on site will occur in a designated area that does not drain into adjacent stormwater systems or waterways</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of a DEMP (BMT 2022f)</li> </ul>

#### 7.1.9 Assessment and significance of residual impact

During marine dredging and disposal works, the Proposal is likely to result in temporary disturbances to water quality by elevating TSS, but no permanent, long-term change is expected. There are not considered to be any significant or any long-term impacts (contamination) to marine environmental quality associated with disturbance of sediments through dredging or disposal activities.

In light of the above, it was determined that there is no significant residual impact to marine environmental quality predicted to occur from the Proposal, and so consideration of offsets for this environmental factor is not required.

#### 7.1.10 Environmental outcome

After the application of mitigation measures, and in consideration of the information presented above, the Proponent believe that the EPA objective for marine environmental quality (i.e. to maintain the quality of water, sediment and biota so that environmental values are protected) will be met.

To monitor and manage any effects on marine quality associated with the proposal, the Proponent has developed outcome-based conditions for maintaining marine environmental quality during implementation of the Proposal, and seek to meet the following objectives:

- Maintain daily light integral levels to avoid indirect loss of seagrass from increased water column turbidity associated with dredging activities within Inner Harbour and sediment disposal.

- b. Maintain water clarity to minimise social impacts on primary contact recreation and aesthetic quality from increased water column turbidity associated with sediment disposal.
- c. Prevent hydrocarbon spills or release of waste into the environment from dredging and dredge spoil disposal.

Outcome-based conditions have been developed in accordance with EPA (2022c); specific environmental triggers, thresholds and monitoring and management requirements for meeting these conditions are detailed in the DEMP (BMT 2022f).

**Table 7.7 Outcome-based conditions for Marine Environmental Quality**

Outcome-based condition
Surface or bottom TSS (mg/L; or its local turbidity equivalent) at any individual ZoMI/ZoI boundary site is >10 mg/L above the reference data (pre-dredging baseline data collected at the same site) during the dredging activity campaign <sup>1</sup> .
Secchi depth measurement at any impact site during the dredging activity sampling occasion must not be reduced by 20% (equivalent to the EPA [2017] water clarity EQG for the maintenance of aesthetic quality).
Surrogate outcome conditions
No reported hydrocarbon spills or release of waste into the environment from dredging and sediment disposal.

Note: three field campaigns are being proposed – 1) baseline campaign 1 week before dredging; 2) campaign during the dredging activity, ~10 days after the commencement of the dredging operation; 3) a post-dredging campaign 1 week after the dredging operation is finished.

## 7.2 Benthic communities and habitats

### 7.2.1 EPA objective

To protect benthic communities and habitats (BCH) so that biological diversity and ecological integrity are maintained (EPA 2016c).

### 7.2.2 Policy and guidance

The legislative instruments, policies and guidelines considered applicable to the environmental impact assessment of BCH are provided in Table 7.8

**Table 7.8 Legislative instruments, policies and guidelines relevant to the environmental impact assessment of benthic communities and habitats**

Legislative instruments, policies and guidelines
Statement of Environmental Principles, Factors and Objectives (EPA 2022d)
Environmental Factor Guideline – Benthic Communities and Habitats (EPA 2016c)
Technical Guidance – Protection of Benthic Communities and Habitats (EPA 2016d)
Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2021b)

### 7.2.3 Receiving environment

The nearshore marine environment of Perth's coastal waters predominantly consists of a thin sand veneer overlying limestone pavement, which in turn supports a diversity of benthic primary producers, including seagrasses, macroalgae and corals. Seagrasses are the dominant primary producer type, with the local taxonomy characterised by blends of monospecific and mixed stands of perennial (*Amphibolis antarctica*, *Amphibolis griffithii*, *Posidonia angustifolia*, *Posidonia australis*, *Posidonia*

*coriacea*, *Posidonia sinuosa*, *Syringodium isoetifolium*, *Thalassodendron pachyrhizum* and *Zostera tasmanica*) and ephemeral (*Halophila ovalis*) seagrass species (Kendrick *et al.* 2002; Kirkman and Kirkman 2000; SKM 2009).

### 7.2.3.1 Benthic ecology

Perth coastal waters support a diverse range of benthic communities and habitats (BCH) including mixed assemblages of tropical and temperate species from the influence of the Leeuwin Current. The varied geomorphology of the marine environment, which is predominantly characterised by sand and reef platform substrates, also promotes diversity for BCH. The dominant seagrass genera are *Amphibolis* spp. and *Posidonia* spp. (Kirkman and Kirkman 2000).

Mapping of BCH was undertaken to determine the type, distribution and extent of BCH occurring within and surrounding the dredging and disposal area, detailed in Section 7.2.6.2.1. The dominant BCH categories and habitat coverage in the ZoI, ZoMI and ZoHI is presented in Table 7.9.

**Table 7.9 Habitat coverage in each zone**

Habitat	Dredging area			Disposal area			LAU (ha <sup>1</sup> )
	ZoI (ha <sup>1</sup> )	ZoMI (ha <sup>1</sup> )	ZoHI (ha <sup>1</sup> )	ZoI (ha <sup>1</sup> )	ZoMI (ha <sup>1</sup> )	ZoHI (ha <sup>1</sup> )	
Seagrass <sup>2</sup>	28.35	0.17	0.44	365.26	0.05	0.02	3,592.25
Sand <sup>3</sup>	178.21	16.89	11.96	1,084.30	78.77	31.26	9,467.05
Macroalgae <sup>4</sup>	0.40	0.18	0.68	0.00	0.00	0.00	182.90
Reef	11.39	0.00	0.00	12.03	0.00	0.00	103.11
Wrack	0.00	0.00	0.00	9.08	0.00	0.00	38.29
Coral	0.00	0.00	0.00	0.00	0.00	0.00	1.99
Rock with Algae	0.00	0.00	0.00	0.03	0.00	0.00	32.78
Unknown <sup>5</sup>	0.00	0.00	0.00	10.87 <sup>7</sup>	17.754 <sup>7</sup>	6.44 <sup>7</sup>	108.21
No Data <sup>6</sup>	98.21	158.25	81.30	170.65	0.00	0.00	13.43
<b>Total</b>	<b>316.49</b>	<b>175.49</b>	<b>94.38</b>	<b>1,652.18</b>	<b>96.57</b>	<b>37.73</b>	<b>13,540.00</b>

Notes:

1: ha – hectare; LAU – local assessment unit.

2: 'seagrass' is the compilation of Fremantle Ports (2019) classes 'seagrass dense', 'seagrass sparse', 'seagrass dense low confidence', and 'seagrass sparse low dense', and the CCL (2019) class 'vegetated'.

3: sand is the compilation of Fremantle Ports (2019) class 'sand' and CCL (2019) class 'non-vegetated'.

4: macroalgae is the compilation of Fremantle Ports (2019) classes 'macroalgae' and 'macroalgae low confidence'.

5: unknown areas are likely attributable to the combination of habitat structure type and quality of imagery obtained, limiting the ability to decipher habitat boundaries. There is a plan to tow these areas to determine the benthic habitat.

6: No data: area outside Fremantle Ports (2019) and CCL (2019). Investigations are not proposed as the 'no data' area is located in the south of the disposal area ZoI, where impacts of the dredging are unlikely to occur.

### 7.2.3.2 Environmental values

Benthic communities are biological communities that live in or on the seabed and benthic habitats are the seabed substrates that the benthic communities grow on or in (EPA 2016c). The Proposal has the potential to impact on the environmental value of 'ecosystem health', resulting in subsequent impacts to BCH, and requires consideration in the environmental impact assessment of BCH.

#### 7.2.4 Study effort

The study effort to inform the environmental impact assessment of BCH is outlined in Table 7.10.

**Table 7.10 Study effort to inform the environmental impact assessment of benthic communities and habitats**

Title	Description
Benthic Habitat Classification Dataset (FPA 2019)	Fremantle Ports has been undertaking investigations since 2006 to map benthic habitats to understand the composition, distribution and types of benthic habitats occurring in the vicinity of their operations.
Benthic Habitat Classification Dataset (CCL 2019)	Cockburn Cement Limited (CCL) has been undertaking efforts investigations since 1999 to map benthic habitats and, consented the use of their 2019 dataset for in the analysis of benthic habitat mapping due to the extension of the Zone of Influence from the disposal activities at Gage Roads.
Fremantle Ports Inner Harbour Maintenance Dredging – Dredge Plume Modelling (BMT 2022c)	Hydrodynamic and sediment plume dispersion modelling was undertaken to predict the likely duration, extent and intensity of turbid plumes generated from dredging and disposal and the extent of potential sedimentation.

#### 7.2.5 Potential environmental impacts

The anticipated potential direct and indirect losses of BCH arising from the Proposal are outlined in Section 7.2.6.1 and Section 7.2.6.2.

#### 7.2.6 Assessment of potential environmental impacts

##### 7.2.6.1 Direct loss

Dredging associated with the Proposal likely will not result in the direct loss of potential BCH occurring in the dredging area, as it is an active port area and the Inner Harbour and Entrance Channel have been regularly swept to maintain their depth since the capital dredging in 2010. Within the dredging area, the seafloor is composed of sand with presence of clay and silt. The dredging area is located within the Inner Harbour and has been subject to previous alteration from capital dredging works, and it likely consists of an area devoid of BCH, hence it is not subject to further assessment in this ERD.

Disposal of sediments associated with the Proposal will result in the direct loss of potential BCH occurring via the disposal and smothering with sediment over 0.1 m in height. The total area expected to receive sediment above 0.1 m in height during the disposal activities is 37.7 ha.

The categories of BCH were derived from the analysis of Fremantle Ports (2019) and Cockburn Cement Limited (CCL 2019) benthic habitat dataset, noting that:

- The 'Seagrass' category is the sum of 'seagrass dense', 'seagrass sparse', 'seagrass dense low confidence' and 'seagrass sparse low confidence' from Fremantle Ports (2019) and vegetated areas from CCL (2019).

- Unknown areas within a deep section of the disposal area are considered to be likely attributable to the combination of habitat structure type and quality of imagery obtained, limiting the ability to decipher habitat boundaries. As discussed in 3.1.1, an investigation survey is being organised by the Proponent to identify the bottom type over the unknown area.

Considering the predicted sedimentation above 0.1 m in height, the BCH to be directly affected is composed of:

- Sand (31.3 ha), representing 82.9% of the ZoHI
- Unknown area (6.44 ha), representing 17.1% of the ZoHI
- Seagrass (0.023 ha), representing 0.06% of the ZoHI

#### 7.2.6.2 Indirect loss

Potential indirect impacts to BCH associated with dredging and disposal activities include:

- Shading effects;
- Loss due to burial; and
- Stressor effects on marine fauna due to enhanced sediment concentrations in the water column.

##### 7.2.6.2.1 Shading effects

Increased water column turbidity associated with sediments mobilised into the water column from dredging and disposal activities can shade, and in turn, reduce the capacity of BCH to photosynthesize, in some cases leading to loss. The degree of disturbance and capacity for recovery depends on the period, intensity and timing of shading (McMahon and Lavery 2008, 2014; Lavery *et al.* 2009) and also seagrass species type (Collier *et al.* 2009, Lavery *et al.* 2009, Lavery *et al.* 2019). Typically, most seagrasses initially respond to stress from light reduction through physiological adjustments, before responding through morphological adjustments like loss of leaves, reduced shoot density or canopy height (Collier *et al.* 2007, 2008, 2009, 2012a, b; Lavery *et al.* 2009; McMahon *et al.* 2011, 2013). Research indicates that minimum light requirements (MLR) and resistance to shading vary between and within species, based on growth form, growth rate, seedling survival and seedbank persistence (Warry and Hindell 2009). Meadows of larger perennial species (e.g. *Posidonia spp.* and *Amphibolis spp.*) are generally considered to have higher resilience to shading, but a slower recovery potential relative to meadows of smaller ephemeral species that are better adapted to fast recovery predominantly through seed based reproductive strategy (Kilminster *et al.* 2015). Reduced benthic and altered light quantity, and increased suspended sediment are environmental conditions that can alter with dredging (PIANC 2011) and assess whether: 1) the stressors are known to impact seagrass (i.e. direct evidence of this); 2) there is no evidence of impact to seagrasses but it is biologically plausible; and 3) there is no evidence of impact and no evidence to support a biologically plausible cause-effect pathway (McMahon *et al.* 2017).

There is a significant body of research which has tested the specific tolerances of different species of seagrass to shading (e.g. Fitzpatrick and Kirkman 1995, Collier *et al.* 2007, 2008, 2009, 2012a,b; Lavery *et al.* 2009; McMahon *et al.* 2011, 2013, Statton *et al.* 2017). Typically, larger meadow forming perennial species, such as those that dominate the Proposal area, can tolerate significant levels of shading (down to 10–20% of ambient light) for periods of up to three months, before morphological (sublethal) responses at the individual plant level commence. Following six months of shading, however, effects can be more catastrophic at the individual plant level (e.g. loss of up to 90% leaf biomass) with extended periods of recovery (up to two years) required before health is regained. For smaller ephemeral species, morphological responses tend to commence after only 30 days of shading (Longstaff & Dennison 1999).

Research undertaken on the effects of shading on *P. sinuosa* in Cockburn Sound (Collier *et al* 2009) indicated that this species can tolerate much greater periods of intense shading than anticipated during the proposed dredging for the Proposal. The time taken for shoot loss (a sub-lethal impact) to occur in *P. sinuosa* is generally longer than for other seagrass species (3–6 months), with some shoots surviving over 12 months under conditions below minimum light requirements (Collier *et al.* 2009 and references contained therein). These experimental studies also demonstrated that shoot density can decline by up to 82% within 105 days under the heavy shade treatment, though 6% of shoots can remain for up to 198 days. Collier *et al.* (2009) estimates that complete shoot loss in high shade can take up to two years.

Although seagrasses losses are frequently associated with anthropogenic activities, Kilminster *et al* (2018) reported that the largest recent losses of seagrasses in Western Australia were driven by a marine heatwave in 2011 (1,000 km<sup>2</sup>) and subsequent synergistic interactions, with light availability from floods and increased turbidity associated with microbial breakdown of seagrass biomass, that continued to drive seagrass loss for over 2 years.

The proposed 10 days dredging and disposal activity is not enough to cause any significant impacts to the seagrass outside the Proposal area, noting that the plume is not predicted to behave in a manner that will induce continuous shading over one area during this time (BMT 2022e).

In light of the above, and in accordance with EPA (2021b), the following steps have been undertaken to determine the potential impacts of shading on BCH in the area associated with the Proposal:

1. Identify water quality thresholds values (TSS concentrations) that pose a shading risk to the seagrasses species that occur in the Proposal area
2. Characterise patterns in plume dispersion according to TSS concentration for generally expected (50<sup>th</sup> percentile) and worst case (95<sup>th</sup> percentile) conditions (BMT 2022e)
3. Determine the duration that BCH in the Proposal area are predicted to exceed 95<sup>th</sup> percentile of TSS threshold values, and
4. Determine the extent of BCH that occurs within each of the TSS contours.

The focus of this assessment has conservatively targeted understanding potential consequences of worst-case scenario predications (95<sup>th</sup> percentile TSS concentrations; BMT 2022e) as expected shading associated under 'generally expected conditions' (50<sup>th</sup> percentile TSS concentrations; BMT 2022e) would occur in a small area and induce TSS concentrations that are below tolerance thresholds known to induce either sublethal or lethal responses in seagrasses, based on the Proposal design.

Based on the outcomes of modelling (BMT 2022e), it is predicted under the worst-case scenario that the 95<sup>th</sup> percentile extent of BCH that may be shaded at some stage during dredging and disposal activities is 2,373 ha, of which 586 ha is surrounding the dredging area and 1,786 ha is surrounding the disposal area.

The risk of shading causing a lethal or even sub-lethal response to seagrasses in the Proposal area, even under a worst-case scenario, is considered extremely low, since the dredging program is set to run for 10 days, which is below known tolerance limits for meadow forming species in the area (see reference to the work of Collier *et al* 2009 above).

#### 7.2.6.2.2 *Sediment and burial during disposal*

BCH adjacent to the dredging and disposal area may be subject to smothering from sediment deposition associated with the settlement of suspended sediments, mobilised into the water column during dredging and disposal activities.

The effects of burial on seagrasses are neither well understood or linear in response, although it is important to note that burial is a natural process with recurrent events caused by storms, riverine inputs or bioturbating fauna (Cabaco *et al.* 2008). It appears that while low to moderate levels of burial (e.g. up to 40 mm) may promote adaptations to persist with the prevailing environmental conditions like vertical growth, leaf elongation, and flowering, the growth comes at an expense to internal carbohydrate stores (Statton *et al.* 2017a, b), which are important for their long-term survival. Effects of burial can be compounded by other factors, such as stressor effects associated with shading and burial acting in cohort are understood to be more detrimental to plant health than burial alone, with the combined effects appearing to hamper vertical growth, which is one of the plants key coping mechanisms to sedimentation (Statton *et al.* 2017b). It is also understood that where source sediments are organic-rich (e.g. 4–5% total organic carbon), effects of burial on seagrasses are likely to be much more severe than by burial of sediments low in organic matter as the additional organic component potentially increases exposure of plants to anoxia. Sediment TOC concentrations ranged from 0.12% to 3.64% for Inner Harbour sediments.

Unfortunately, there have been no experimental studies that have examined the threshold levels for burial for *P. sinuosa*, and as such, effects of burial on *P. sinuosa* must be inferred from other species. McMahon *et al.* (2017) determined burial by up to 40 mm of sediments in ambient light had no effect on either *Cymodocea serrulata* or *Halodule uninervis* (both tropical species), however, above this depth, burial significantly affected the plants' physiology, productivity, morphology and biomass, though the effects depended on the duration of burial and the species of seagrass (McMahon *et al.* 2017). After 14 weeks of burial, *C. serrulata* showed reduced shoot density and biomass compared to controls, while *H. uninervis* demonstrated either no significant differences to controls or a positive effect of burial. These findings indicated that the threshold for sub-lethal effects of burial in *C. serrulata* was 40 mm burial for 14 weeks and for *H. uninervis* was 70 mm of burial for >14 weeks (laverylavery).

The distribution of seagrass assemblages in Owen Anchorage was examined by Chisholm (2009) in relation to hydrodynamic disturbance and burial and erosion tolerance, and it showed high survival rates (>90%) in sediment heights at -2, 0, 4 and 8 cm, and total mortality for the 16 cm burial treatment.

In light of the above and given the dredging and disposal works will run for a maximum period of 10 days, 0.1 m (10 cm) was notionally considered as a burial depth representing a conservative threshold value for *P. sinuosa* that may induce a lethal response, and may result in a permanent loss at the meadow scale. The sediment source material for the Proposal (Inner Harbour) has proportionally low total organic carbon (<4%), and as such sublethal threshold values of 4 cm and less than 6 weeks of period of burial proposed by EPA (2021b) for *C. serrulata* and *H. uninervis* in response to exposure to organic-rich sediments (4%) are not considered relevant to the present study (Lavery *et al.*, 2019).

To determine the extent of burial for the Proposal, plume dispersion modelling enabled assessment of elevated sediment deposition within and adjacent to the disposal area (Figure 7.2). Sediment deposition was expressed as bottom concentration ( $\text{g/m}^2$ ) where each  $1000 \text{ g/m}^2$  approximates a deposited thickness of 1 cm surface layer (BMT 2022e). Modelling shows that sediment deposition at the end of the dredging activity was mostly within the disposal area. The sedimentation levels decreased significantly (to 10 cm) at a distance of 300 m from the centre of the designated disposal area. The sedimentation level was insignificant (less than 2 cm), beyond 400 m from the disposal design. The model sedimentation results demonstrated a relatively insignificant settlement (less than 5 cm) of the suspended sediment within the northeastern corner of the Inner Harbour dredge footprint due to the scale of dredging and restrictions on overflow (30 minutes).

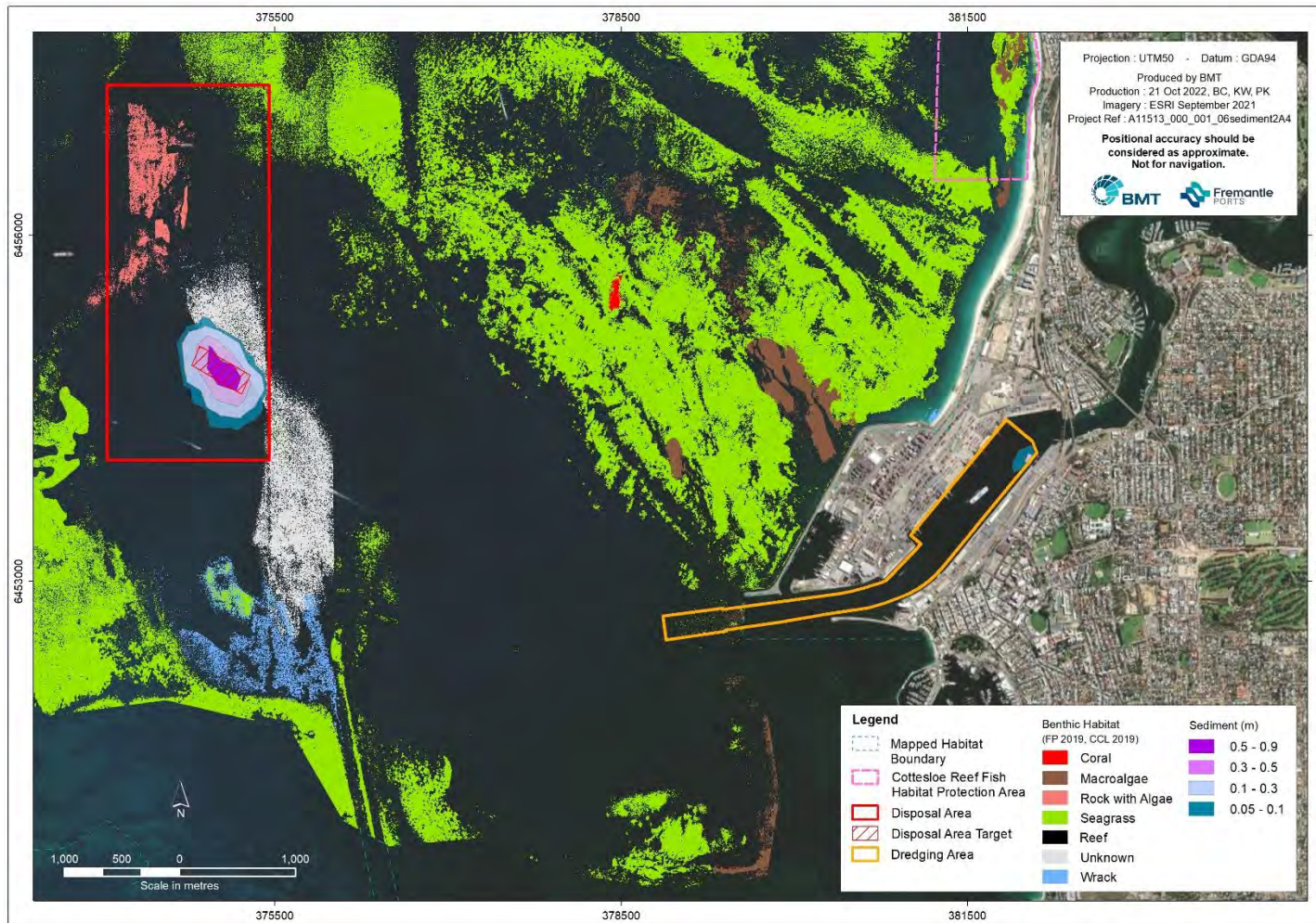


Figure 7.2 Modelled sediment deposition from the settlement of suspended sediments mobilised into the water column from dredging and disposal activities associated with the Proposal

### 7.2.7 Defining zones of impact

In accordance with EPA's Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2021a), impact zones have been conservatively established to determine the potential extent and significance of direct and indirect impacts to Benthic Community Habitats (BCH) as a consequence of the Proposal (Table 7.11), based on predictive modelling of the dredge/disposal turbid plume intensity, extent and duration (BMT 2022e). The established impact zones for the Gage Roads offshore disposal area and the dredging area are shown in Figure 7.3 and the established impact zones for the dredging area are illustrated in Figure 7.4.

**Table 7.11 Impact zones, definitions, and boundary thresholds**

Impact zone	Definition	Boundary threshold
Zone of High Impact (ZoHI)	The area where impacts on BCH are predicted to be irreversible. The term irreversible means 'lacking a capacity to return or recover to a state resembling that prior to being impacted within a timeframe of five years or less'. Areas within and immediately adjacent to proposed dredge and disposal sites are typically within the ZoHI.	<ul style="list-style-type: none"> <li>Boundary of the dredging area within the Inner Harbour shipping channel, where the target depth to be reached is 14.7 metres chart datum.</li> <li>Boundary of the disposal area where modelled sedimentation &gt;0.1 m.</li> </ul>
Zone of Moderate Impact (ZoMI)	The area within which predicted impacts on BCH are recoverable within a period of five years following completion of the dredging and disposal activities. The ZoMI abuts and lies immediately outside of the ZoHI.	<b>Environmental Protection Outcome</b> <ul style="list-style-type: none"> <li>The area where the modelled 95<sup>th</sup> percentile of the TSS concentration is &gt;10 mg/L.</li> <li>At the Gage Roads offshore disposal area, the ZoMI has a 100 m buffer zone surrounding the ZoHI at the east and the west.</li> <li>At the Inner Harbour, the ZoMI has a 100 m buffer zone surrounding the ZoHI at the west of the river mouth.</li> </ul>
Zone of Influence (ZoI)	The area within which changes in environmental quality associated with turbid plumes are predicted and anticipated during dredging and disposal activities, but where these changes would not result in a measurable impact on BCH.	<ul style="list-style-type: none"> <li>The area where the modelled 95<sup>th</sup> percentile of the TSS concentration was 2 to 10 mg/L.</li> </ul>

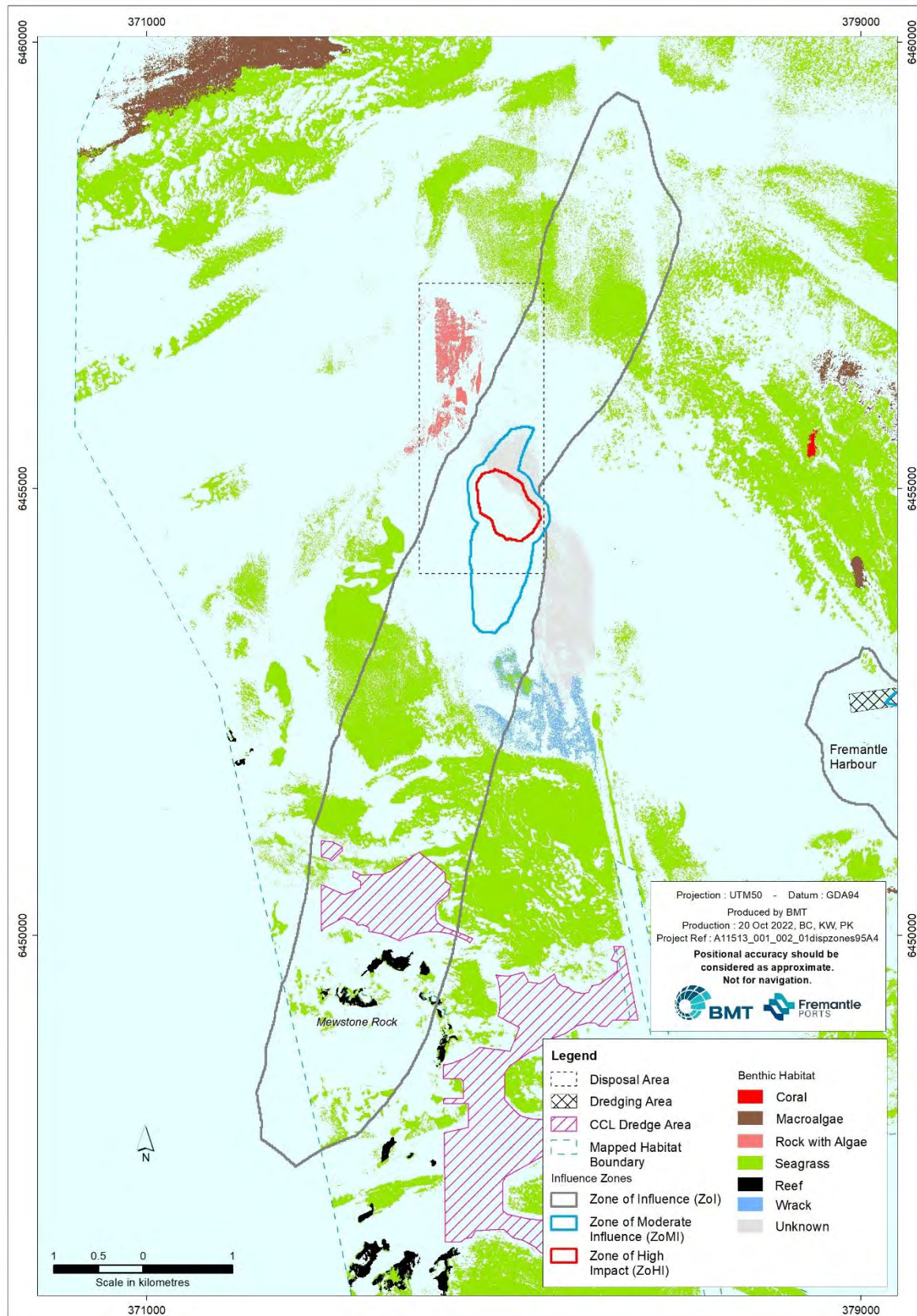


Figure 7.3 ZoHI, ZoMI and ZoI for the Gage Roads offshore disposal area

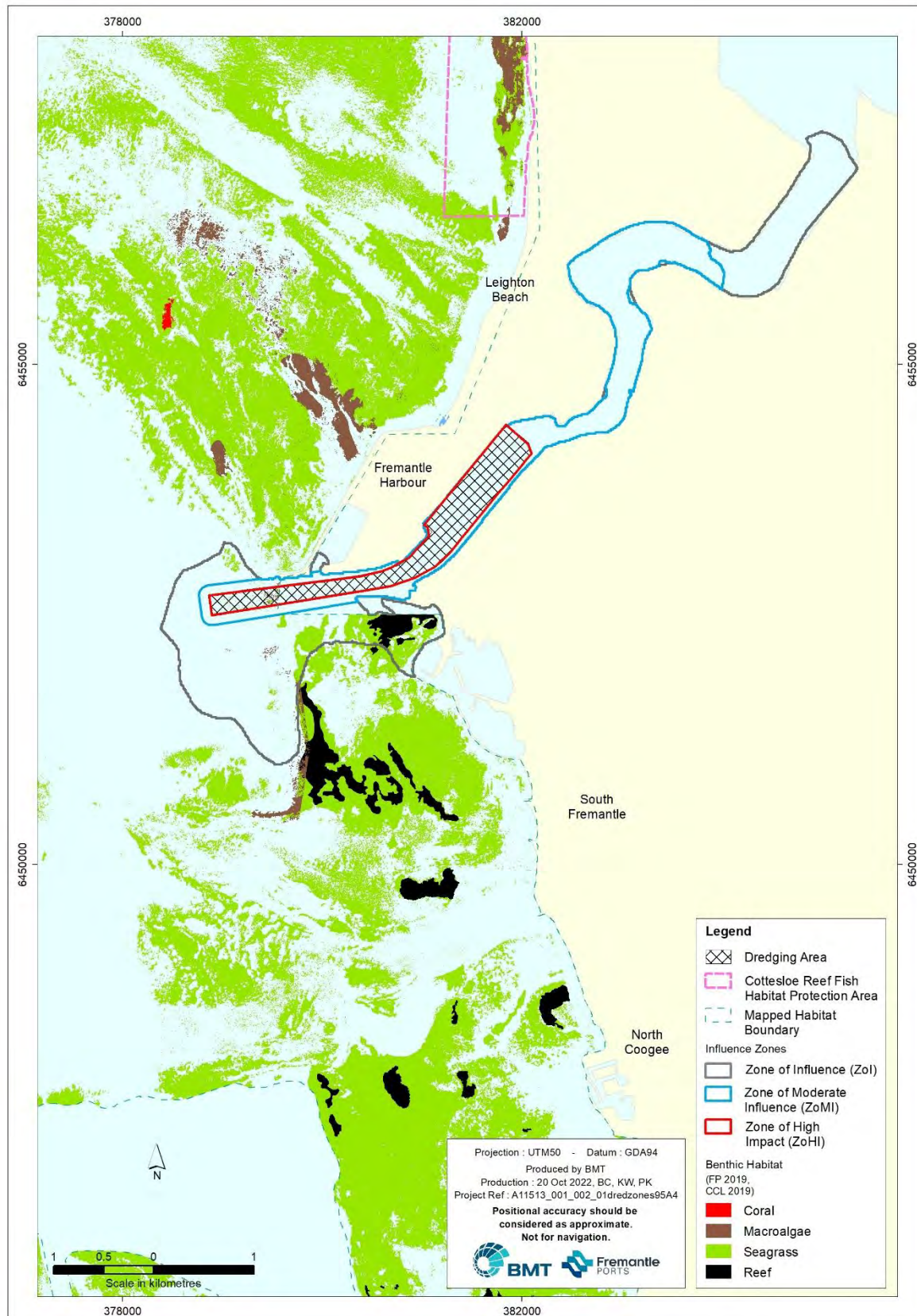


Figure 7.4 ZoHI, ZoMI and Zol for the dredging area

### 7.2.8 Stressor effects on marine invertebrate communities

Enhanced TSS concentrations generated by dredging and disposal of material can lead to a range of impacts to benthic invertebrate communities or associated epibenthic fauna that occur within the seagrass systems. Effects of suspended solids on filter feeding organisms can occur as a consequence of abrasion and the clogging of filtration mechanisms, thereby interfering with ingestion and respiration, with potentially adverse effects on growth, reproduction and/or mortality (Buermann *et al.* 1997), while indirect effects stem primarily from increased turbidity leading to altered light regimes and resultant changes in feeding efficiency and behaviour (e.g. avoidance; Kerr 1995).

As described above, modelling was used to understand the potential dispersion of sediment plumes, while effects of increased concentrations of TSS on epibenthic fauna and examples of TSS tolerance thresholds reported to cause either acute or chronic mortality for adult and juvenile decapod crustaceans and benthic molluscan eggs/larvae are provided in Table 7.12. The TSS concentrations caused by dredging and disposal activities (typically <20 mg/L outside of the immediate dredging and disposal area) would not cause impacts to these fauna at any life stage. Potential impacts on corals has not been considered as there are no corals identified within the areas of impact or influence.

**Table 7.12 Lowest total suspended solids concentrations reported to cause mortality in various life stages of decapod crustaceans and benthic molluscan eggs/larvae**

Taxa/life stage	Lowest TSS concentration causing mortality	Effect	Reference
Crabs	3,500	10% mortality over 28 days	Lunz (1987)
Other adult decapod crustaceans	230	40% mortality over 28 days	Wilber and Clarke (2001)
Juvenile crabs	1,800	5% mortality over 28 days	Peddicord and McFarland (1976)
Other juvenile decapod crustaceans	180	10% mortality over 21 days	Wilber and Clarke (2001)
Eggs/larvae of benthic molluscan taxa	188	Negative impacts to oyster egg development	Wilber and Clarke (2001)

Notes: 'TSS' = total suspended solids

### 7.2.9 Cumulative impacts and loss assessment

An assessment of the potential cumulative impacts for BCH in the vicinity of the Proposal area is presented herein. Cumulative BCH loss has been calculated in-line with the methods for determining cumulative impact on BCH provided in EPA's Technical Guidance – Protection of Benthic Communities and Habitats (EPA 2016e). These methods include eight steps to calculate cumulative BCH loss and assess the significance of potential losses and are described in the context of the Proposal below.

#### Step 1: What is the 'local assessment unit'?

The local assessment unit (LAU) has been defined as the BCH mapping study area for the Proposal that equates 13,540 ha (Figure 7.5).

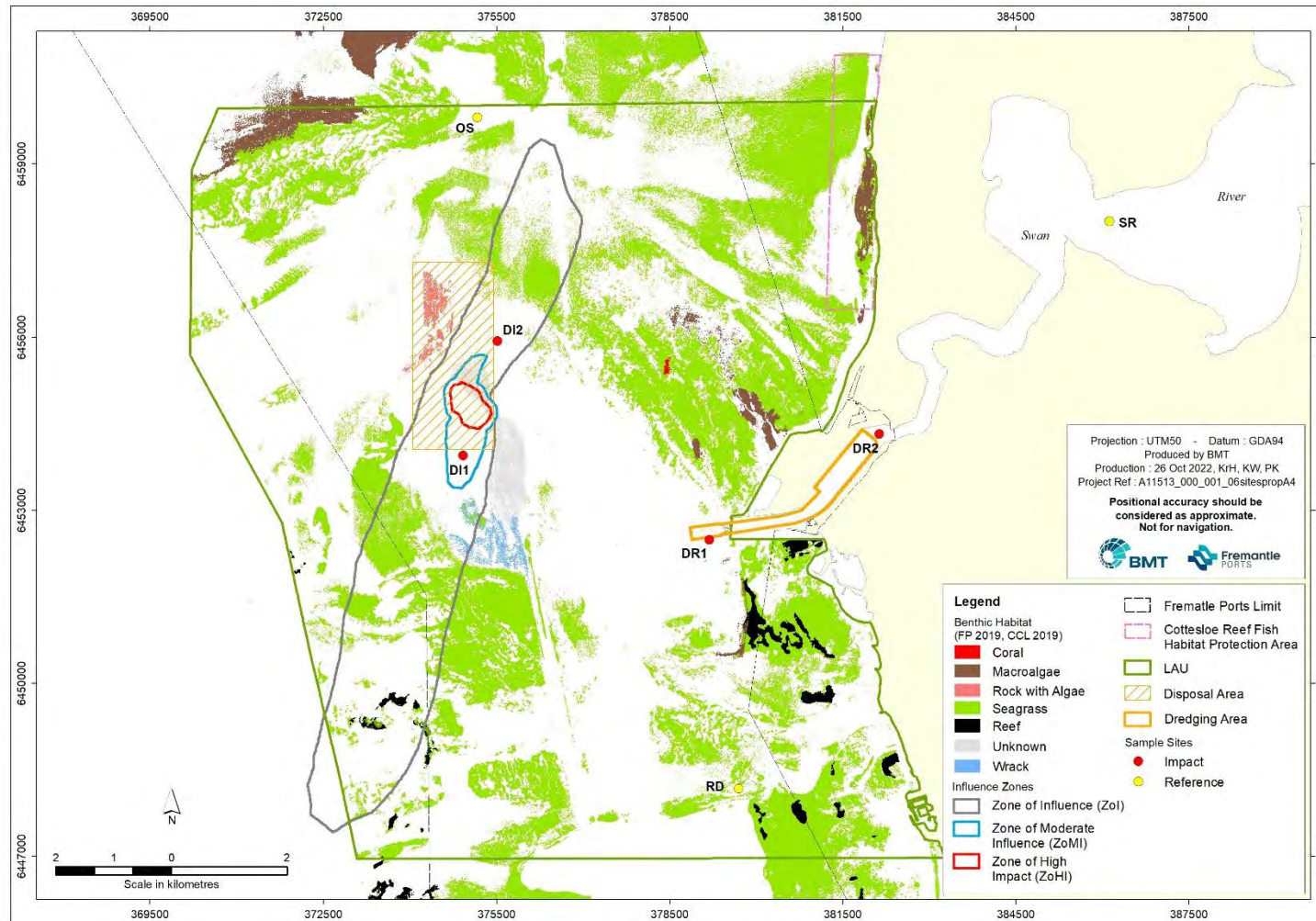


Figure 7.5 Local assessment unit for the Inner Harbour Maintenance Dredging

**BMT (OFFICIAL)****Step 2: What is there now? What is the current area of each benthic community type and associated habitat within the LAU?**

Mapping of BCH was undertaken to determine the type, distribution, and extent of BCH occurring within and surrounding the dredging and disposal area (Table 7.9).

**Step 3: Do any of the benthic communities have any particular tenure or conservation, ecological or social values that should be conserved?**

The dredging area (ZoHI) is an active port with heavy shipping operation, and the area has been swept since 2010 to reduce the accumulation of sediment, which means that it is expected to present only coloniser seagrass meadows. There are no other specific benthic communities which have a particular tenure or conservation, ecological or social values that is under protection within the zones of impact. The negative impact on the ZoMI and the ZoI are expected to be insignificant due to the short duration of the Proposal. The disposal area was previously used during the 2010 capital dredging program.

**Step 4: What area of each community and habitat was originally present within the LAU? (i.e. original baseline)**

Because changes to the Inner Harbour, Entrance Channel and Gage Roads resulting in loss of BCH began as far back as 1897 with the opening of the Inner Harbour, it is not possible to obtain baseline habitat mapping or aerial photographs to accurately assess the historical area of BCH. For Fremantle Ports Inner Harbour deepening project an estimate of the benthic community and habitat was based on existing data and available aerial photography from the 1980's and a summary is provided below (SKM 2009).

The historical loss estimates of BCH within the LAU are based on conservative assumptions of permanent loss most recently carried out by SKM (2009) and revised later by Oceanica (2010) as part of calculating potential impacts to BCH associated with the capital dredging project. Historical loss of BPPH in the Gage Roads management unit was estimated to be between 16% to 30% of the total area amounting to a best-case loss of about 30 ha and a worst-case loss of about 58 ha (SKM 2009).

It was noted that these may also be overestimates of historical loss because there would have normally been very little seagrass in the intertidal zone or in the first few meters of water depth from the beach as verified by aerial imagery. Apart from the reduction in BPPH associated with loss of seagrass beds resulting from the historical coastline changes, the construction of over 5 km of rock breakwaters and seawalls to the present time may have increased the area available for macroalgal habitat. For these reasons, it is considered that the calculation of historical BPPH loss is on the conservative side and overestimates the loss. Notwithstanding this, the more conservative, worst case of the estimates (58 ha) has been used for the cumulative loss calculation.

**Step 5: What percentage of the original area of each benthic community and its associated habitat is present now?**

The historical loss estimates of BCH within the LAU are based on conservative assumptions of permanent loss most recently carried out by SKM (2009) and BMT-Oceanica (2010) as part of calculating potential impacts to BCH associated with the capital dredging project.

The pre-European seagrass coverage was potentially 6,841 ha, which comprehends areas shallower than 10 metres that are not reef, but includes any areas with current seagrass coverage.

Predicted BCH loss in the Gage Roads Management unit was approximately 38 ha which is 0.28% of the current BCH area of 13,540 ha. Historical Loss is calculated to be 58 ha resulting in total cumulative

loss of 96 ha which is 0.71% of the total current plus historical area of BCH in the Management unit (1107ha).

SKM (2009) based their estimates on existing data and available aerial photography from the 1980s. Applying the same areal extent of BCH identified in the habitat mapping undertaken for the dredging and reclamation Project, SKM determined that at worst case, ~58 ha of BCH (dominant seagrass with macroalgae and coral) had been lost prior to dredging and reclamation activities. Post dredging and reclamation, SKM (2009) predicted a further 47 ha loss due to the dredging and reclamation Project.

Given that there have been significant disturbances to BCH in the area since 2009, including the capital dredging in 2010 (SKM 2009) and the Port Beach sand nourishment via dredging project (BMT 2022g), it is assumed that more than 165 ha of BCH has now been permanently lost.

#### **Step 6: How much more will be impacted and lost if this Proposal was implemented?**

Habitat losses due to the Proposal are shown in Table 7.9. A total loss of 0.02 ha of BCH (seagrass) from within an existing offshore disposal area (disturbed area) and 31.26 ha of unvegetated sediments is expected to occur within the disposal footprint, while 94.428 ha of sediment area in the dredging location will be permanently disturbed.

The duration and intensity of the sediment plume associated with dredging was predicted to rapidly diminish with distance from the dredge footprint and there are not predicted be any losses of BCH due as a result of indirect impacts.

#### **Step-7: How much would be lost in total if the Proposal proceeds?**

If the Proposal were to proceed, in total, 132 ha, or 5.57% of BCH will be lost from the Proposal area. It is important to note that this is a maintenance dredging project following the capital dredging in 2010. This Proposal will not result in a greater depth, it will return the dredge area to design depth and slightly decrease the depth at the disposal ground. Although these seagrass losses have been included in the calculations it is important to note that they would have established after completion of the capital dredging program and will likely recover or re-establish.

#### **Step 8: What will be the consequence for biological diversity and ecological integrity if the Proposal proceeds?**

The EPA's environmental objective is to ensure no net loss of BCH and, where possible, to generate a net increase. In light of the information presented in addressing steps 1–7, it is concluded that the loss of an additional 0.46 ha of seagrass and 0.68 ha of macroalgae in an area that is already disturbed (major shipping channel and an active port) presents no ecological consequence for the biological diversity and ecological integrity of the Proposal area.

#### **7.2.10 Mitigation**

The mitigation hierarchy has been applied to the Proposal to ensure the EPA objective for BCH is maintained and the identified environmental values for BCH are protected. Mitigation measures are summarised in Table 7.13.

Table 7.13 Summary of mitigation measures to ensure maintenance of BCH

Potential environmental impact	Avoid	Minimise	Management and monitoring
Direct loss	<ul style="list-style-type: none"> <li>Dredging and disposal area is located within an area of lower concentration of seagrass and macroalgae, pending the outcome of the video tow investigation into the unknown category.</li> </ul>	<ul style="list-style-type: none"> <li>Selection of the disposal area to minimise direct removal of BCH</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of a DEMP (BMT 2022f)</li> </ul>
Indirect loss	<ul style="list-style-type: none"> <li>There will be no indirect impacts from the release of contaminants as they have been determined to be suitable for ocean disposal</li> </ul>	<ul style="list-style-type: none"> <li>Less than 10 days of dredging will result in a short period of turbidity</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of a DEMP (BMT 2022f)</li> </ul>

### 7.2.11 Assessment and significance of residual impact

The Proposal is unlikely to result in the net loss of any previously undisturbed BCH. The dredging is in an active harbour subject to the influences of this activity and its footprint consists of seabed that was previously dredged and it has been swept to maintain navigational safety, so it likely consists of an area devoid of BCH (i.e. have previously been characterised as permanent loss). There is predicted to be direct loss of 0.44 ha of seagrass and 0.68 ha of macroalgae.

There is a low risk that indirect effects of turbidity and burial associated with the plume generated during disposal may cause sublethal responses to a relatively small area of BCH (61.3 ha), but effects are likely to be physiological (e.g. reduced rates of productivity, depletion of carbohydrate reserves, etc) and temporary (last a matter of weeks) as the duration of works is below time thresholds known to induce morphological responses. There is not predicted to be any lethal / permanent impacts of BCH due to indirect mechanism associated with the Proposal.

It was determined that there is no significant residual impact to BCH predicted to occur from the Proposal, and so consideration of offsets for this environmental factor is not required.

### 7.2.12 Environmental outcome

After the application of mitigation measures, Fremantle Ports believe that the EPA objective for BCH (i.e. to protect BCH so that biological diversity and ecological integrity are maintained) will be met.

To monitor and manage any effects on BCH associated with the proposal, the Proponent has developed outcome-based conditions for protecting benthic communities and habitats during implementation of the Proposal, which are described in Table 7.14 and seek to meet the following objectives:

1. Ensure no direct loss of BCH outside of the zone of high impact (ZoHI)
2. Ensure no indirect impacts to BCH from increased water column turbidity or burial associated with dredging or sand disposal.

Outcome-based conditions have been developed in accordance with EPA (2022c); specific environmental triggers, thresholds and monitoring and management requirements for meeting these conditions are detailed in the DEMP (BMT 2022f).

Table 7.14 Outcome-based conditions for Benthic Communities and Habitats

Outcome-based condition
Direct disturbance of benthic communities and habitats to be confined to Proposal footprint
No serious damage to benthic communities and habitats outside the Zone of High Impact
No impacts to benthic communities and habitats within the Zone of Moderate Impact unless they are recoverable
No impacts outside the Zone of Moderate Impact, including no impact in the Zone of Influence

### 7.3 Social surroundings

#### 7.3.1 EPA objective

To protect social surroundings from significant harm (EPA 2016g).

#### 7.3.2 Policy and guidance

The legislative instruments, policies and guidelines considered relevant to the environmental impact assessment of coastal processes are provided in Table 7.15.

Table 7.15 Legislative instruments, policies, and guidelines relevant to the environmental impact assessment of coastal processes

Legislative instruments, policies, and guidelines
Statement of Environmental Principles, Factors, Objectives and Aims of EIA (EPA 2022b)
Environmental Factor Guideline – Social Surroundings (EPA 2016h)
Environmental Protection (Noise) Regulations 1997 (DEP 1997)
State Planning Policy 5.4 – Road and Rail Traffic Noise (DPLH 2019)

#### 7.3.3 Receiving environment

As the dredging is located within the Swan River mouth (Fremantle Port Inner Harbour), and the Disposal area is offshore, consideration of the social setting and community values of the dredging area will be the key focus for the assessment.

##### 7.3.3.1 Site usage - shipping

The main industrial facility in the vicinity of the Proposal area is Fremantle Port's Inner Harbour and Rous Head Harbour. The Inner Harbour has served WA's maritime trade needs since 1897 and continues today as the fourth largest and one of the most efficient container ports in Australia. Aside from its container trade, it also handles vehicle imports and non-containerised cargo such as machinery, steel, heavy equipment, livestock and scrap metal (Fremantle Ports 2022). The Inner Harbour also includes the west facing Rous Head Harbour, a large port-related industrial estate created on land reclaimed from material dredged from the Inner Harbour and its shipping access channel. The land is utilised by a variety of port-related companies and logistics service providers. A large ferry terminal is located at the western end of Rous Head Harbour, providing regular services to and from Rottnest Island.

##### 7.3.3.2 Economic and tourism

The Proposal area is zoned as 'Industrial and Port Installations' under the Metropolitan Region Scheme (MRS). The locality is also utilised by port-related and light industry that add economic value to the area. Even with lockdowns and restrictions, Fremantle attracted approximately 35,000 tourists in 2020

(City of Fremantle 2021). Key tourist destinations of Fremantle City are Fremantle Markets, WA Maritime Museum, The Round House, Fremantle Prison and Fremantle History Museum.

The Inner Harbour is an important link between the Swan River estuary and nearby coastal waters, particularly for recreation boating activities. Anchoring is not permitted in the Inner Harbour and Entrance Channel and these areas do not have high recreational boating values apart from being a link between the Swan River estuary and coastal waters. The offshore Fremantle marine area is important for recreational boating and travel to and from Rottnest Island. Most land-based operational areas of the Inner Harbour port facilities are not available for public access for security reasons. Public access areas will remain unchanged.

### **7.3.3.3 Recreation**

The Swan River is a popular recreational location for Perth residents and visitors. A survey of recreational boat and shore-based fishing was undertaken in the Swan-Canning Estuary basin between August 2017 and July 2018 (DPIRD 2019b). Common species targeted and kept by recreational anglers in the lower Swan-Canning Estuary include tailor, whiting, Australian herring, black bream, flathead, trumpeter, blue swimmer crab and the western king and school prawns (Brearley 2005). The recreational catch for blue swimmer crabs is deemed to be significant with 58% released of a total of 667,000 caught in 2017/18 (DPIRD 2019b). The species caught is highly dependent on the season. For example, flatheads were most common in spring, black bream in autumn and whiting in summer when salinity within the Inner harbour is at a maximum (Brearley 2005). The proposed Gage Roads offshore spoil ground are not highly utilised recreational fishing areas (DEP 1996).

### **7.3.4 Heritage**

#### **7.3.4.1 Aboriginal heritage**

A search of the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Inquiry System (AHIS 2022; Annex B) demonstrated that there are three 'Registered Aboriginal Sites' protected under the *Aboriginal Heritage Act 1972* (AH Act) in the vicinity of the Proposal area. The enquiries returned the following message:

"South West Settlement Indigenous Land Use Agreement (ILUA) Disclaimer:

Your heritage enquiry is on land within or adjacent to the following Indigenous Land Use Agreement(s): Whadjuk People Indigenous Land Use Agreement.

On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and, respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah #2 and Wagyl Kaip & Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).

The ILUAs bind 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) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an '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. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.

Likewise, from 8 June 2015 the Department of Mines, Industry Regulation and Safety (DMIRS) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.

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If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMIRS, you should seek advice as to the requirement to use the NSHA for your proposed activity. The full ILUA documents, maps of the ILUA areas and the NSHA template can be found at <https://www.wa.gov.au/organisation/department-of-the-premier-and-cabinet/south-west-native-title-settlement>.

Further advice can also be sought from the Department of Planning, Lands and Heritage at [AboriginalHeritage@dplh.wa.gov.au](mailto:AboriginalHeritage@dplh.wa.gov.au).

There are three registered sites within Fremantle and North Fremantle: Swan River (Table 7.16); Fremantle: Cantonment Hill (Table 7.17), and Rocky Bay (Table 7.18).

**Table 7.16 Swan River registered site 3536**

ID	3536
Name	Swan River
Status	Registered Site
Type	Mythological
Region	Metro/Wheatbelt
Restrictions	No Gender Restrictions
File Restricted	No
Location Restricted	No
Boundary Reliable	Yes
MGA Coordinate	389909mE 6460503mN Zone 50 [Reliable]
Knowledge Holders	*Registered Knowledge Holder names available from DPL
Legacy ID	S02548
Protected Area	No
Duplicate ID	Contact DPLH for list of duplicate Place
Boundary Last Update Date	26/05/2022

**Table 7.17 Fremantle: Cantonment Hill registered site 3419**

ID	3419
Name	Fremantle: Cantonment Hill
Status	Registered Site
Type	Ceremonial, Mythological, Camp, Named Place, Plant Resource
Region	Metro/Wheatbelt
Restrictions	No Gender Restrictions
File Restricted	No
Location Restricted	No
Boundary Reliable	No
MGA Coordinate	382525mE 6453972mN Zone 50 [Unreliable]

Knowledge Holders	*Registered Knowledge Holder names available from DPL
Legacy ID	S02701
Protected Area	No
Duplicate ID	Contact DPLH for list of duplicate Place
Boundary Last Update Date	11/01/2011

Table 7.18 Rocky Bay registered site 3596

ID	3596
Name	Rocky Bay
Status	Registered Site
Type	Mythological, Named Place
Region	Metro/Wheatbelt
Restrictions	No Gender Restrictions
File Restricted	Yes
Location Restricted	Yes
Boundary Reliable	No
MGA Coordinate	Not available when location is restricted
Knowledge Holders	*Registered Knowledge Holder names available from DPL
Legacy ID	S02422
Protected Area	No
Duplicate ID	Contact DPLH for list of duplicate Place
Boundary Last Update Date	-

The dredging area is located within the 'Swan River No 3536 Registered Aboriginal Site'.

It is noted that Fremantle Ports undertook consultation with Indigenous groups in late 2004 for the proposed Inner Harbour deepening project and this process resulted in approval from the Minister of Indigenous Affairs (SKM 2009). It is appreciated that this consent was based on an earlier and lesser final dredging depth. In May 2007, further consultation occurred with Indigenous group related to a description of the amended project scope which resulted in consent under Section 18 of the *Aboriginal Heritage Act 1972* obtained for the project. This approval was in place for the capital dredging project undertaken in 2010 which shares the same footprint as this maintenance dredging proposal. Due to the associated consultation occurring in 2007, Fremantle Ports plans to undertake stakeholder consultation with identified Aboriginal representatives for the Swan River site.

#### 7.3.4.1.1. Other heritage places

Nine 'Other Heritage Places' were identified in the vicinity of the dredging area from the search of the DPLH AHIS (2022; Annex C):

##### 1. Fremantle Arthur Head (No 3774)

2. Fremantle Anglesea Point (No 3420)
3. Fremantle Manjaree (No 3421)
4. Indian Ocean (No 3776)
5. Mosman Park (No 21253)
6. Blackwall Reach, Bicton (No 3650)
7. Blackwall Reach, Mosman Park (No 3651)
8. South Fremantle (No 3775)
9. Colonial Sugar Refinery (No 3569)

These 'Other Heritage Places' are lodged with the status 'stored data/not a site' indicating they have been assessed by the Aboriginal Cultural Material Committee with a determination that they do not meet the definition of Section 5 of the AH Act (i.e. these sites are not protected under the AH Act). As a result, there is no need to include any further details.

#### **7.3.4.2 Natural heritage**

According to Eastern Metropolitan Regional Council (2009), the Swan River offers an iconic landscape locally and internationally recognised for its natural, cultural and historic values, and the Statement of Significance for the Rivers states that the waterways and surrounds of the Swan River and Helena River bounded by Windan Bridge, Whiteman Bridge, Roe Highway and Middle Swan Road are based on a distinctive geological formation with an evolved ecosystem, hence this area is subdivided in 4 precincts. The sites and places included on those precincts have been identified by undertaking audits of existing heritage lists and data bases. The audit and collation of historic sites drew on listings backed by WA legislation including the Heritage Council of Western Australia (HCWA) database which incorporates places from the former Register of National Estate (now dormant) and National Trust (WA) classified places as well as places on municipal inventories. None of those precincts are located within the Proposal area.

##### **7.3.4.2.1 European heritage**

A search of the Heritage Council (2022) Inherit Database indicates that there are several sites surrounding the Proposal area which are considered heritage areas, and a list of the most relevant ones is presented in Table 7.19.

Table 7.19 European heritage surrounding the Proposal area

Site / construction date	Place number	Heritage area / Date	Heritage list / Date	National heritage list / Date	State register / Date	Statement of significance
Indian Ocean	22532	Yes 08/03/2007	n/a	n/a	n/a	The Indian Ocean has social significance to the Fremantle and wider community as a foreshore and recreation area providing many facilities and is a popular venue for families, community events, celebrations and activities.
Victoria Quay, Fremantle 1903	03602	Yes 08/03/2007	Yes 08/03/2007	Nominated 15/08/2005	Registered 14/06/2021	<p>Victoria Quay, Fremantle has national significance as the first landfall and entry point for tens of thousands of migrants to Australia, as well as travelling Australians and members of the armed services.</p> <p>Victoria Quay, Fremantle is representative of the development pattern of Australian harbours and has national significance as a mostly intact, industrial landscape that remains connected to a working port.</p> <p>Victoria Quay, Fremantle, valued by special interest groups, the local community and wider public for its port and river related activities and cultural facilities, contributes to the identity of Fremantle and in particular the city's West End.</p> <p>The establishment of the Harbour and associated facilities at Fremantle led to Fremantle's emergence over Albany as the State's premier port and facilitated economic growth through improved trade and communications for industry, commerce, and agriculture.</p> <p>Both individually and collectively, the buildings and structures on Victoria Quay, Fremantle display complex and striking aesthetic characteristics, and form groups of related buildings within the larger industrial precinct. The buildings and structures reflect the various phases of Western Australia's development from the late 1800s.</p> <p>Victoria Quay, Fremantle provides important evidence of Federal Government immigration policies, and of the role of immigration in developing Australia's economy and increasing the population throughout the twentieth century; the place is associated with the changing character of Australian immigration from 1906, which contributed to the development of Australia's multicultural society; the innovative wharf structure exhibits a high degree of engineering accomplishment and technical proficiency.</p>

Site / construction date	Place number	Heritage area / Date	Heritage list / Date	National heritage list / Date	State register / Date	Statement of significance
						<p>Victoria Quay, Fremantle has associations with a number of individuals and groups, including its designer, C. Y. O'Connor, its construction workforce, State and Federal politician Lord John Forrest, sculptor P. G. Porcelli, Immigration Officer A. O. Neville, and the Public Works Department.</p> <p>Victoria Quay, Fremantle is associated with the maritime workers who have been employed at the place and demonstrates changing attitudes to industrial relations. It was also the site of the 'Bloody Sunday' battle between police forces and waterside workers over working conditions in May 1919.</p> <p>Victoria Quay, Fremantle played a major role in Australia's defence operations during World War II, with Australian, American, British and Dutch wartime service groups operating from the Quay. Many structures from this period remain.</p> <p>Victoria Quay, Fremantle is a major archaeological resource as the development of Victoria Quay, Fremantle necessitated reclamation works, rapid construction and subsequent recycling and redisposal of buildings as the operational needs of the port developed.</p> <p>Victoria Quay, Fremantle is valued by the general community as the main port, once the only port, connecting the mainland with Wadjemup/Rottnest Island; and, Victoria Quay, Fremantle is a significant element in the wider precincts of the West End of Fremantle, Fremantle Harbour and the mouth of the Swan River. Victoria Quay, Fremantle is linked to these areas through visual, functional and historic associations.</p>
Inner Harbour 1903	22531	Yes 08/03/2007	Yes 08/03/2007	n/a	n/a	n/a
Port of Fremantle Passenger Terminal	03363	n/a	Yes 08/03/2007	n/a	Registered 07/04/2000	Refer to Heritage Council of Western Australia (HCWA)'s Assessment Documentation of Places for Entry in the Register of Heritage Places.
Fremantle Traffic Bridge	04027	n/a	Yes	n/a	Registered	n/a

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Site / construction date	Place number	Heritage area / Date	Heritage list / Date	National heritage list / Date	State register / Date	Statement of significance
& Ferry Capstan Base 1866			08/03/2007		30/03/2021	
Stirling Bridge, Landscaping 1974	19089	n/a	Yes 08/03/2007	n/a	n/a	Stirling Bridge has social value as a well-known and used landmark over the Swan River. The bridge is representative of 1970s bridge construction techniques and was designed to acknowledge the historic significance of the area, with approach embankments well set back to maintain views through the bridge. At the time of completion, Stirling Bridge was the longest public bridge in Western Australia. The bridge was built to meet traffic requirements through North Fremantle generated by the continuing development of heavy industry at Kwinana and general urban expansion and was the first stage of the Fremantle Eastern By-pass.
Boat Shed	19709	n/a	Yes 17/11/2015	n/a	n/a	Aesthetic, Historical, Social, Representative & Rarity.
North mole lighthouse 1903	18640	n/a	Yes 08/03/2007	n/a	n/a	The Lighthouse has historic significance for its associations with the development of the harbour and port of Fremantle. It has aesthetic significance for its landmark qualities. It has rarity value for being one of two identical cast iron lighthouses which were constructed and shipped out to Fremantle in 1903.
Round Head and Arthur Head Reserve 1830 to 1831	00896	n/a	Yes 08/03/2007	n/a	Registered 19/04/1993	n/a

Notes: n/a – not applicable

#### 7.3.4.2.2 Marine protected areas

There are no marine protected areas within the proposed dredging areas or disposal ground, or zones of impact. The nearest marine parks are the Swan Estuary Marine Park to the east, Marmion Marine Park to the north (approximately 25 km) and the Shoalwater Islands Marine Park to the south (approximately 20 km). The *EPBC Act* Protected Matters Report is presented in Annex D. All three Marine Parks are outside a 5 km buffer zone around the proposed dredging areas and disposal area, and are not included within the zones of impact.

Approximately 2 km to the north of the proposal dredging design lies Cottlesloe Reef Fish Habitat Protection Area (CRFHPA). This reef ecosystem comprises of seagrass patches, kelp beds and sponge gardens, all of which provide habitat and shelter for a variety of aquatic life including fish, shellfish, crustaceans, common seadragons (*Phyllopteryx taeniolatus*), and the rare leafy seadragons (*Phycodurus eques*) (Department of Fisheries 2001).

Approximately 400 m upstream from the boundary of the dredging design is the Swan-Canning River Development Control Area. The Development Control Area includes the waters of the Swan and Canning rivers and adjoining parks and recreation reserves. It extends upstream from the Fremantle Traffic Bridge to Moondyne Brook on the Avon River, to the Lower Diversion Dam on the Helena River, along Southern River to the Allen Road crossing and along the Canning River to its confluence with Stinton Creek (WA 2006).

#### 7.3.4.2.3 Maritime heritage

A search of the WA Museum Shipwrecks Databases (GWA 2022) and the Australasian Underwater Cultural Heritage Database (DAWE 2022a) was undertaken to assess potential historic shipwrecks and/or relics in the vicinity of the Proposal area. While several historic shipwrecks and relics were identified in the vicinity of the Proposal area, there is no shipwreck identified within the dredging area. The list of shipwrecks identified surrounding the dredging and disposal area is presented in Table 7.20.

Table 7.20 Maritime heritage surrounding the Proposal area

Shipwreck	When Lost	Where Lost	Latitude Longitude	Museum Reference	Unique Number	Protected
Fremantle Harbour Unidentified	1887	Fremantle Harbour	-32.051687 115.744036	n/a	988	Protected State
North Mole Barge	n/a	Off North Mole	-32.051903 115.725987	76800	928	Protected Federal
South Mole Barge Unidentified	n/a	South Mole	-32.0581916667 115.7260583333	n/a	968	Unknown
Lygnern	18/09/1928	Gage Road	-32.060566 115.727158	6320	1482	Protected Federal
Carnac	1940	50 m upstream Fremantle Traffic Bridge, Swan River	-32.04169 115.755176	n/a	1179	Not protected State
Unidentified Wreck No. 2 Swan River	Unknown	Point Direction, Pier 21 Area	-32.03314 115.760653	n/a	1589	Unknown
EVA	Unknown	Jetty at Point Direction, North Fremantle	-32.0325679 115.7606379	120032	272	Unknown
City of Perth	1890	Rocky Bay, Swan River	-32.0295166667 115.7573	n/a	48	Protected State
Mayfield	1945	Rocky Bay, Swan River	-32.029461 115.757407	n/a	1367	Not protected State
ALC-40 – Landing Barge	Unknown	Swan River	-32.0274618167 115.7709814833	n/a	969	Unknown
Point Roe Box Barge 1	Unknown	Roe Point, Swan River	-32.0257833333 115.77301	n/a	375	Unknown

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Shipwreck	When Lost	Where Lost	Latitude Longitude	Museum Reference	Unique Number	Protected
Point Roe Box Barge 2	Unknown	Roe Point, Swan River	-32.0254766667 115.7733166667	n/a	970	Unknown

Note: n/a – not applicable

The location of the Fremantle Harbour Unidentified, lost in 1887 (unique number 988) is not well defined, and although it is located within Fremantle Ports area, the snapshot of the shipwreck databases shows the present location is now land based (Figure 7.6).

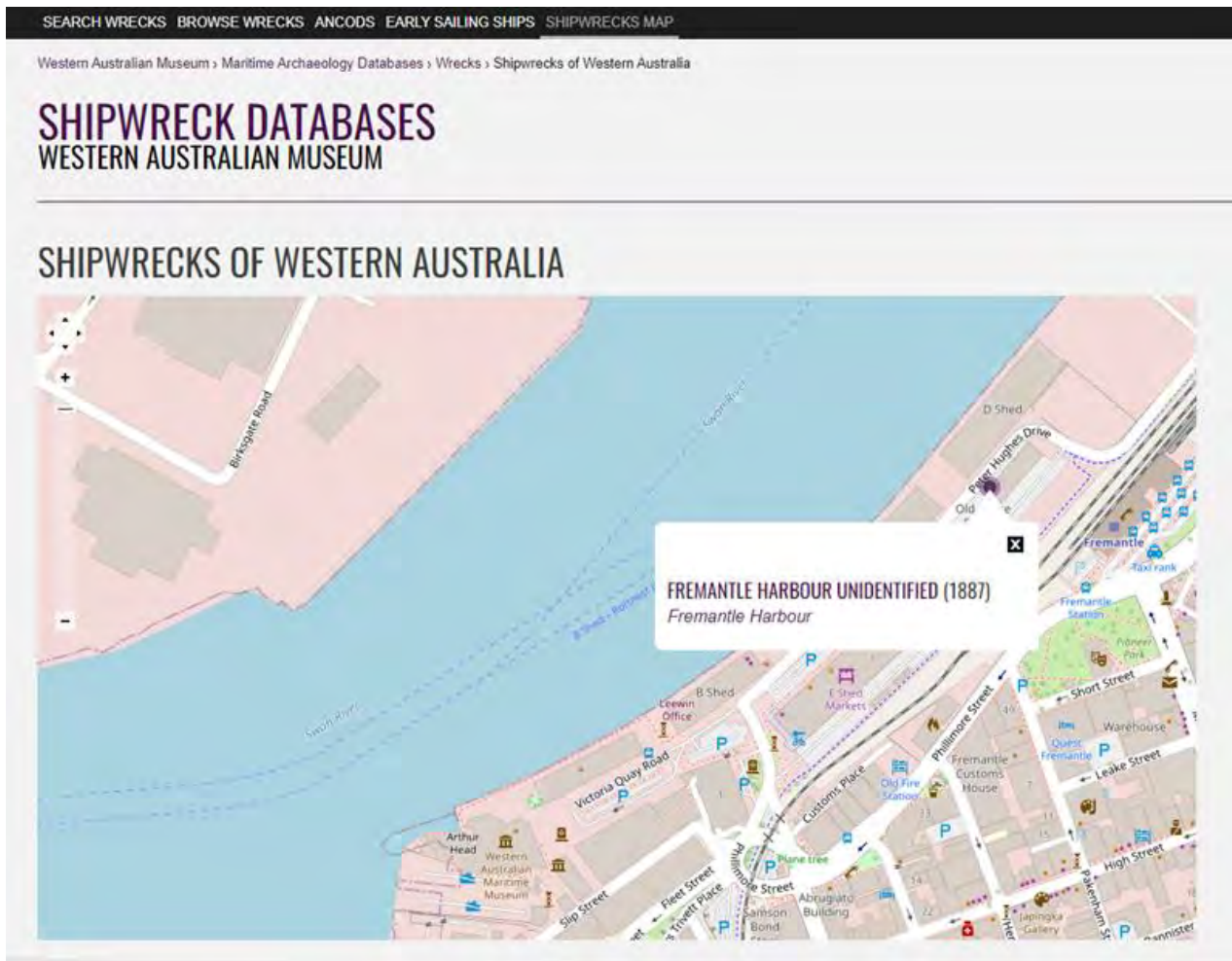


Figure 7.6 Snapshot of shipwreck databases (Western Australia Museum) showing the present land-based location of the Fremantle Harbour Unidentified (1887).

### 7.3.5 Environmental values

With reference to the Environmental Factor Guideline – Social Surroundings (EPA 2016g), “the social surroundings of man are his aesthetic, cultural, economic and social surroundings to the extent that those surroundings directly affect or are affected by his physical or biological surroundings”. A review of the key social value categories outlined in the Environmental Factor Guideline – Social Surroundings (EPA 2016g) was undertaken to determine those values that are applicable to the Proposal area and require consideration in the environmental impact assessment of social surroundings (Table 7.21).

**Table 7.21 Social values applicable to the Proposal**

Social value		Applicability to the Proposal	Reasoning
Heritage	Aboriginal heritage	Applicable	The Swan River (no 3536) is a mythological registered sites and must be appropriately recognised in future planning.
	Natural heritage	Not Applicable	The Swan River mouth has been highly modified through past development and the Maintenance Dredging is not causing any new or additional impact than the impacts predicted for the capital dredging in 2010.
	Maritime heritage	Not applicable	There is one shipwreck (Fremantle Harbour Unidentified) identified close to the dredging area and 11 other shipwrecks in close proximity to the Proposal area, however none of those shipwrecks were impacted by the capital dredging in 2010, so it presumed that none of them will be impact by the Proposal.
	European heritage	Not Applicable	While the Proposal area does not contain any State registered places managed under the Heritage Act 2018 it is located within the North Fremantle precinct. This Precinct is on the Heritage list managed by City of Fremantle (CoF) under the Planning and Development Act 2005 and Local Planning schemes. Under this listing the City of Fremantle must retain and conserve Significant landscape areas. As the Proposal will not result in any changes to a significant landscape area it is unlikely European Heritage will be impacted by the Proposal.
Amenity		Applicable	Implementation of the Proposal may impact the visual appeal of the Swan River, resulting in higher turbidity levels that affect the landscape. Noise, dust and potentially odour generated from dredging activities may direct impact local sensitive receptors.
Economic		Not applicable	Boating traffic is unlikely to be significantly impacted by the dredging program as small craft will be able to pass by the working dredge.

### 7.3.6 Study effort

The study effort to inform the environmental impact assessment of social surroundings is outlined in Table 7.22.

Table 7.22 Study effort to inform the environmental impact assessment of social surroundings

Title	Description
Fremantle Ports Maintenance Dredging: Sediment Sampling and Analysis Plan Implementation Report (BMT 2022b)	Dredging and disposal area sediments were sampled and analysed in 2021 to assess the physical and chemical characterises of the sediments.
Supplementary Sampling and Analysis Plan Implementation Report (O2M 2022)	Dredging and disposal area sediments were sampled and analysed in 2022 including the subsequently revised Maintenance Dredging area to assess the physical and chemical characterises of the sediments at additional sites.
Fremantle Ports Inner Harbour Maintenance Dredging – Dredge Plume Modelling (BMT 2022c)	Hydrodynamic and sediment plume dispersion modelling was undertaken to predict the likely duration, extent and intensity of turbid plumes generated from dredging and disposal and the extent of potential sedimentation.  The detailed methods and results of the sediment plume dispersion hydrodynamic modelling are presented in BMT (2022e) including description of collection of met ocean data.
Fremantle Ports Marine Quality Monitoring Program Annual Reports (BMT Oceanica 2014, 2015, 2016, 2017, BMT 2018c, BMT 2019, 2020b, 2022c, 2022d)	As part of their Marine Quality Monitoring Program (MQMP), Fremantle Ports undertakes annual marine quality monitoring in Inner Harbour, Rous Head and Deep Water Channel. A subset of sediment and water quality results from this program was used to inform the Proposal.

### 7.3.7 Potential environmental impacts

The anticipated potential environmental impacts on social surroundings arising from the Proposal are outlined in Table 7.23.

Table 7.23 Anticipated potential environmental impacts on social surroundings arising from the Proposal

EPA factor	Potential environmental impact	Report section for assessment
Social surroundings	Public health and safety	Section 7.3.8.1
	Reduced public amenity and restricted area	Section 7.3.8.2
	Navigational hazards	Section 7.3.8.3
	Disturbance to heritage (Aboriginal, European or Maritime)	Section 7.3.8.4
	Odour generation	Section 7.3.8.5
	Social impacts from noise and dust	Section 7.3.8.6

### 7.3.8 Assessment of potential environmental impacts

#### 7.3.8.1 Public health and safety

The dredging activities within Inner Harbour is expected to be in a short duration, for less than 10 days, and the sediment sampling results showed no toxicity levels that could cause any harm to public health

and safety. Due to the low risk of the release of contaminants, impacts to public health are not anticipated, and it is considered that there is no requirement for associated monitoring or management to be undertaken for the Proposal.

#### **7.3.8.2 Reduced public amenity and restricted area**

Dredging activities are not expected to have a detrimental effect on aesthetics of the Fremantle Ports area, given that the area is a working port with an existing aesthetic value typical of an industrial port. Most land-based operational areas of the Inner Harbour port facilities are not available for public access for security reasons. Public access areas to these areas will remain unchanged.

The Inner Harbour waters are of relatively low aesthetic quality, however the coastal waters have high aesthetic value. Turbidity plumes may reduce the aesthetic value of the coastal waters, reducing recreational appreciation of the waters. The TSS levels for Bathers Beach showed levels below 1 mg/L for the 50<sup>th</sup> percentile, and below 5 mg/L for the 95<sup>th</sup> percentile. Any decrease in aesthetic value will be temporary and limited to the duration of the dredging program.

The turbidity levels during the dredging activities within the Inner Harbour channel are expected to be lower than turbidity levels during the wet season, when frequent rainfall carries sediment to the waterways and the Swan River tends to present dark brown colours due to the high levels of TSS in contrast with clear waters during the dry season (Swan River Trust 2001). It is expected that the turbidity levels during the dredging activities within the Inner Harbour or due to the presence of the dredging vessel will cause a very low impact to the public amenity.

#### **7.3.8.3 Navigational hazards**

The Inner Harbour provides for commercial shipping and is an important link of boating traffic between the Swan River and Indian Ocean. The Gage Roads offshore disposal area is an 'offshore mooring area', designated by Fremantle Ports.

Dredging operations may pose a navigational hazard to commercial and recreational vessels transiting through Fremantle Ports' Inner Harbour. The presence of the dredge, associated support vessels and any associated marine equipment (including environmental monitoring equipment) near the disposal area may also pose a navigational hazard to potential recreational vessels transiting in the area. The impact on navigational safety from the Proposal is anticipated to be limited because:

- A public complaints register will be developed and maintained with responses provided to any public complaints within 1 week of receipt.
- prior to the implementation of the Proposal, a Temporary Notice to Mariners from DoT's Marine Safety Branch will be obtained and remain in place throughout the duration of the Proposal to inform the public of potential navigational hazards associated with the Proposal
- dredging operations will mostly be completed in less than 10 days and the dredge, associated support vessels and any associated marine equipment (including environmental monitoring equipment) will be fitted with the appropriate marine safety lighting to maintain visibility during low light conditions
- prior to implementation of the Proposal, relevant stakeholders will be consulted and informed of potential navigational hazards associated with the Proposal (refer to Section 5).

While shipping activity is heavy within the Entrance Channel and Inner Harbour and to a lesser extent the Gage Roads offshore disposal area, impacts from loss of access areas and navigation will be negligible. During dredging and disposal activities the dredge and support vessels will observe all speed limits and will pose an insignificant net increase to existing shipping volumes.

The monitoring and/or management requirements associated with the maintenance of navigational safety during Proposal implementation, including the appropriate contingency measures to be implemented should any issues arise, will be detailed in a corresponding DEMP (BMT 2022f).

#### **7.3.8.4 Disturbance to heritage (Aboriginal, European or Maritime)**

A review of potential Aboriginal, European and Maritime heritage sites in the vicinity of the Proposal area was undertaken in Section 7.3.4. Swan River is a known site of Indigenous mythological significance. Fremantle Ports hold a Section 18 approval under the *Aboriginal Heritage Act 1972* for the purpose of dredging and maintenance of the Inner Harbour and disposal of dredge spoil at Gage Roads anchorage. This approval was in place for the capital dredging project undertaken in 2010 which shares the same footprint as this maintenance dredging proposal. Due to the associated consultation occurring in 2007, Fremantle Ports plans to undertake stakeholder consultation with identified Aboriginal representatives for the Swan River site.

The disposal area is located in an active mooring and anchorage area designated by Fremantle Ports, and the same area was used as a spoil ground for the capital dredging in 2010. As stated above, Fremantle Ports hold a section 18 approval for the purpose of disposal of dredge spoil at Gage Roads anchorage.

#### **7.3.8.5 Odour generation**

The Proposal area is located within Fremantle Port Inner Harbour, which is noted to be subject to odour impacts from Fremantle Port (City of Fremantle Local Planning Policy 2.3). A slight sulfidic odour was noted at most sites within the Inner Harbour during sediment sampling (BMT 2022). Debris content ranged from 5-80% in Inner Harbour samples with marine flora roots and wrack present (O2M 2022). Based on the field observations of the dredging area sediment samples and chemical analysis results, it is anticipated that potential odour generation from the Proposal will be minor and presents a low risk of resulting in social impacts. Regardless of the anticipated low risk, odour generation will be subject to active monitoring and/or management during the implementation of the Proposal, to ensure that there are appropriate contingency measures in place should any issues arise. The monitoring and/or management requirements will be detailed in a corresponding DEMP (BMT 2022f).

#### **7.3.8.6 Social impacts from noise**

The dredging area is within an active shipping channel and a highly developed area that is subject to already high ambient background noise created by port-related industry and transport infrastructure (major roads and railway). Any operational noise associated with dredging is therefore not anticipated to be in hearing range of the local community and presents a low risk of resulting in social impacts from noise.

The disposal area is located ~5km from the shoreline. The operation of the dredge near the disposal area during sediment disposal has the potential to generate additional noise at Gage Roads offshore disposal area during Proposal implementation.

Noise generated from the Proposal will be temporary and short-term in duration. Assuming a best-case dredging production scenario, the timing of cycles for the dredge to load dredged material from the dredging area is expected to be every ~2 hours for ~30 minutes. Therefore, noise generated from the dredge vessel near the dredging area will be intermittent. Prior to implementation of the Proposal, relevant stakeholders will be consulted and informed of the potential for the generation of noise associated with the Proposal (refer to Section 5).

In accordance with Australian Standards 1269 and 2436, and the *Environmental Protection (Noise) Regulations 1997* (DEP 1997), noise from construction work outside 0700 and 1900 Monday to Saturday, on a Sunday or public holiday requires assessment and approval by the relevant local council

or governing bodies for the area in the form of a Noise Management Plan (NMP). Dredging and disposal activities associated with the Proposal are proposed to be undertaken seven days per week, 24 hours per day. Therefore, a Noise Management Plan will be prepared for the Proposal and issued to Fremantle Ports environmental team for assessment and approval before undertaking any work outside of the exempt hours for generating construction noise as specified above. The monitoring and/or management requirements associated with potential social impacts during the Proposal, including the appropriate contingency measures to be implemented should any issues arise, are detailed in a corresponding DEMP (BMT 2022f).

#### 7.3.9 Cumulative impacts

While the Proposal is in a location with high public visitation, the possibility of cumulative impacts from other proposed development within or surrounding the Proposal area is considered negligible.

#### 7.3.10 Mitigation

The mitigation hierarchy has been applied to the Proposal to ensure the EPA objective for social surroundings is maintained and the identified social values are protected. Mitigation measures are summarised in Table 7.24.

Table 7.24 Summary of mitigation measures to protect social surroundings from significant harm

Potential environmental impact	Avoid	Minimise	Management and monitoring
Public health and safety	<ul style="list-style-type: none"> <li>Impacts to public health from the potential release of contaminants has been avoided by undertaking sediment sampling and analysis to demonstrate that dredging and disposal area sediments present a low contamination risk.</li> </ul>	<ul style="list-style-type: none"> <li>Sediment will be placed in deep layers (&gt;18 m) at the Gage Roads offshore disposal area, where it is expected to have minimal mobilisation due to wave climate.</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of a DEMP (BMT 2022f)</li> </ul>
Reduced public amenity and restricted access	<ul style="list-style-type: none"> <li>Not applicable</li> </ul>	<ul style="list-style-type: none"> <li>The Inner Harbour and Entrance Channel are an active port with large shipping operation since the colonisation of Perth area and the public amenity and access are compatible with industrial area.</li> </ul>	<ul style="list-style-type: none"> <li>Not required due to the low risk</li> </ul>
Navigational hazards	<ul style="list-style-type: none"> <li>Not applicable</li> </ul>	<ul style="list-style-type: none"> <li>Prior to the implementation of the Proposal, the contractor for marine dredging activities will establish a communication plan with Fremantle Ports, and obtain any relevant permits as required by Fremantle Ports, to coordinate dredging operations within an active shipping channel and ensure the appropriate procedures are in place to maintain navigational safety</li> <li>Prior to the implementation of the Proposal, a Temporary Notice to Mariners from DoT's Marine Safety Branch will be obtained and remain in place throughout the duration of the Proposal to inform the public of potential navigational hazards associated with the Proposal</li> <li>Dredging operations will mostly be completed in less than 10 days and the dredge, associated support vessels and any associated marine equipment (including environmental monitoring equipment) will be fitted with the appropriate marine safety lighting to maintain visibility during low light conditions</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of a DEMP (BMT 2022f)</li> </ul>

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Potential environmental impact	Avoid	Minimise	Management and monitoring
		<ul style="list-style-type: none"> <li>Prior to implementation of the Proposal, relevant stakeholders will be consulted and informed of potential navigational hazards associated with the Proposal</li> </ul>	
Disturbance to heritage (Aboriginal, European or Maritime)	<ul style="list-style-type: none"> <li>The Swan River is recognised as Indigenous mythological significance.</li> </ul>	<ul style="list-style-type: none"> <li>Fremantle Ports hold a section 18 approval under the Aboriginal Heritage Act 1972 for the purpose of dredging and maintenance of the Inner Harbour and disposal of dredge spoil at Gage Roads anchorage. This approval was in place for the capital dredging project undertaken in 2010 which shares the same footprint as this maintenance dredging proposal. Due to the associated consultation occurring in 2007, Fremantle Ports plans to undertake stakeholder consultation with identified Aboriginal representatives for the Swan River site.</li> </ul>	<ul style="list-style-type: none"> <li>To be identified through stakeholder consultation</li> </ul>
Odour generation	<ul style="list-style-type: none"> <li>Not applicable</li> </ul>	<ul style="list-style-type: none"> <li>Sediment sampling and analysis of dredging area sediments was completed to assess the suitability of the sediments for dredging and disposal and field observations demonstrated that the sediments from the dredging area generally did not exhibit a sulfidic odour</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of a DEMP (BMT 2022f)</li> </ul>
Social impacts from noise and dust	<ul style="list-style-type: none"> <li>Not applicable</li> </ul>	<ul style="list-style-type: none"> <li>Fremantle Ports undertakes noise assessments during normal import/export operations and for specific ships and assesses results against the prescribed standards of the Environmental Protection (Noise) Regulations 1997. Fremantle Ports has also developed a set of operational procedures for the allocation of berths for vessels so as to minimise the impact of noise and odour on the surrounding environment during operational activities.</li> </ul>	<ul style="list-style-type: none"> <li>Not required due to the low risk</li> </ul>

### 7.3.11 Assessment and significance of residual impact

Through the application of the mitigation hierarchy and development of the DEMP (BMT 2022f) there are no long-term impacts anticipated to social surroundings from the implementation of the Proposal. Further, the amenity value of Inner Harbour has been consistently recognized throughout all stages of the Fremantle Ports public stakeholder consultation process for addressing port operations. The Proposal will result in an enhanced safer navigation for the ships, and it is believed that such operational values would be lost without the Project.

In light of the above, it was determined that there is no significant residual negative impact to social surroundings predicted to occur as a result of the Proposal; however, Fremantle Ports are preparing a stakeholder consultation plan.

### 7.3.12 Environmental outcome

After the application of mitigation measures, Fremantle Ports believe that the EPA objective for social surroundings (i.e. to protect social surroundings from significant harm) is expected to be met.

Further, ongoing monitoring is expected to measure any changes to social surroundings such that management will be triggered to prevent impacts to nearby community.

To monitor and manage any effects on marine quality associated with the proposal, the Proponents have developed outcome-based conditions for preventing harm to social surroundings during implementation of the Proposal, which are described in Table 7.25.

Outcome-based conditions have been developed in accordance with EPA (2021g); specific environmental triggers, thresholds and monitoring and management requirements for meeting these conditions are detailed in the DEMP (BMT 2022f).

**Table 7.25 Outcome-based conditions for social surroundings**

Outcome-based conditions
No public or navigational safety incidents from dredging and sediment disposal
No social impacts from potential reduced public amenity, odour generation or noise associated with dredging and disposal activities

## 7.4 Summary of key environmental impacts

The summary of key environmental impacts is presented in Table 7.26.

Table 7.26 Summary of key environmental factors, potential impacts, proposed mitigation, and environmental outcomes

Marine environmental quality	
<b>EPA objectives</b>	To maintain the quality of water, sediment and biota so that environmental values are protected (EPA 2016a).
<b>Potential environmental impacts</b>	<b>Increased water column turbidity</b>
	<ul style="list-style-type: none"> <li>Dredging and disposal activities will lead to a period (approximately 10 days) of enhanced total suspended solids (TSS) and water column turbidity leading to: <ul style="list-style-type: none"> <li>reduced light, and</li> <li>potential smothering effects</li> </ul> </li> </ul>
	<b>Release of contaminants</b>
	<ul style="list-style-type: none"> <li>Disturbance to the seafloor during dredging and disposal activities may release toxicants to the water column, if present in source material.</li> </ul>
<b>Mitigation</b>	<b>Hydrocarbon spills and waste generation</b>
	<ul style="list-style-type: none"> <li>Various hydrocarbons including fuel, oil and lubrications will be used for the operation of the dredge.</li> <li>Incidental fuel spills associated with hydrocarbon use have the potential to contaminate the marine environment.</li> </ul>
	<b>Avoid</b>
	<ul style="list-style-type: none"> <li>sediment sampling and analysis demonstrated that dredging and disposal area sediments present a low contamination risk</li> <li>Equipment and machinery shall not be serviced on site</li> </ul>
<b>Residual impact</b>	<b>Minimise</b>
	<ul style="list-style-type: none"> <li>Short duration of operation (~10 days) will result in low potential impacts due to included turbidity</li> <li>Contractor for marine dredging activities shall have their own refuelling and spill management procedures to adhere to and an oil spill contingency plan for responding to any marine oil pollution events</li> <li>Any refuelling on site will occur in a designated area that does not drain into adjacent stormwater systems or waterways</li> </ul>
	<b>Monitoring/management</b>
	<ul style="list-style-type: none"> <li>Implementation of a Dredging Environmental Management Plan (DEMP, BMT 2022f)</li> </ul>
The Proposal is likely to result in temporary disturbances to water quality by elevating TSS, but no long-term change is expected. Further, management controls will be employed to limit sediment plume dispersion during disposal works, while management procedures for the	

	handling of hydraulic fluids and fuels will be incorporated in the DEMP. Sediment quality testing has demonstrated that source material from Inner Harbour is suitable for ocean disposal. There is no significant residual impact to marine quality predicted to occur from the Proposal
<b>Proposed environmental outcomes</b>	<ul style="list-style-type: none"> <li>• Surface (1 metre below surface) or bottom (1 metre off the seafloor) TSS (mg/L) at any individual ZoMI/ZoI boundary site is higher than 10 mg/L above the reference data (pre-dredging baseline data collected at the same site) during the dredging activity sampling occasion.</li> <li>• Secchi depth measurement at any impact site during the dredging sampling occasion must not be reduced by more than 20% (equivalent to the EPA [2017] water clarity EQG for the maintenance of aesthetic quality)</li> <li>• No reported hydrocarbon spills or release of waste into the environment from dredging and disposal.</li> </ul>
<b>Benthic communities and habitats - BCH</b>	
<b>EPA objectives</b>	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained (EPA 2016d)
<b>Potential environmental impacts</b>	<b>Direct loss</b>
	<ul style="list-style-type: none"> <li>• Disposal activities will result in less than 0.1% of loss of seagrass meadows of the total area due to potential impacts from &gt;0.1m of sediment deposition</li> </ul>
	<b>Indirect loss</b>
	<p>While the following stressor effects on Benthic Communities and Habitats (BCH) may arise due to the Proposal, there is no anticipated loss of BCH due to indirect impacts:</p> <ul style="list-style-type: none"> <li>• It is predicted that 2,373 ha of BCH will be shaded by a plume that may potentially induce some form of sublethal response (physiological) at the individual plant level across the predicted period of dredging and disposal activities, however, due to the short duration of exposure to shading (maximum of 7 days of exposure to high shading levels), there is not predicted to be any indirect loss of BCH</li> <li>• It is predicted that 0.02 ha of seagrass may be buried by sediments (&gt; 10cm) due to disposal activities, which represents approximately 0.06% of the total area to be covered by sediment above 10 cm height.</li> <li>• Increased TSS concentrations due to dredging and disposal are well below thresholds that are reported to cause stressor effects to benthic invertebrate communities.</li> </ul>
<b>Mitigation</b>	<b>Avoid</b>
	<ul style="list-style-type: none"> <li>• Dredging area is devoid of BCH</li> <li>• Indirect impacts to BCH from the release of contaminants will be avoided as sediment sampling and analysis has demonstrated that the material is suitable for ocean disposal.</li> </ul>
	<b>Minimise</b>
	<ul style="list-style-type: none"> <li>• Dredging design within the Inner Harbour capital dredging area</li> </ul>

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	<ul style="list-style-type: none"> <li>• Short duration of dredging and disposal activities (less than 10 days)</li> <li>• Utilisation of an existing, previously approved disposal area</li> <li>• Selection of the proposed disposal location within the disposal area to minimise direct impacts to BCH</li> <li>• Project timing in autumn period when seagrasses are dormant.</li> </ul>
	<b>Monitoring/management</b> <ul style="list-style-type: none"> <li>• Implementation of a DEMP (BMT 2022f)</li> </ul>
<b>Residual impact</b>	<p>The Proposal is unlikely to result in the loss of any previously undisturbed BCH. The 0.05 ha of seagrass that occurs in the ZoHI of the disposal area consists of coloniser species that have limited ecological value relative to surrounding BCH.</p> <p>The ZoHI of the dredging area is in an active harbour which has been swept regularly since the capital dredging in 2010 to maintain safe navigation standards.</p> <p>After the application of mitigation measures, there is no significant residual impact to BCH predicted to occur from the Proposal.</p>
<b>Proposed environmental outcomes</b>	<ul style="list-style-type: none"> <li>• Direct disturbance of benthic communities and habitats to be confined to Proposal footprint (dredge area and disposal area)</li> <li>• No permanent loss of benthic communities and habitats outside the Zone of High Impact, i.e. recoverable impact</li> <li>• No impacts outside the Zone of Moderate Impact, including no impact in the Zone of Influence</li> </ul>
<b>Social surroundings</b>	
<b>EPA objectives</b>	To protect social surroundings from significant harm (EPA 2016e)
<b>Potential environmental impacts</b>	<b>Public health and safety</b> <ul style="list-style-type: none"> <li>• the supplementary sampling and analysis plan implementation report (O2M, 2022) results showed that concentrations of potential contaminants of concern within the sediment samples were below the relevant environmental and human health guidelines.</li> </ul> <b>Reduced public amenity</b> <ul style="list-style-type: none"> <li>• It is expected that turbidity levels during the dredging activities within the Inner Harbour or due to the presence of the dredging vessel will have a very low impact to the public amenity due to the short duration of the project</li> <li>• The 50<sup>th</sup> percentile TSS figure (BMT 2022e) shows TSS in the Swan River is very low, and the highest TSS concentrations, of up to 2 mg/L, were predicted to occur only within the Inner Harbour.</li> <li>• The 95<sup>th</sup> percentile TSS figure (BMT 2022e) shows TSS over 20 mg/L restricted to the Inner Harbour, from South Mole lighthouse to the Fremantle Bridge. From the Fremantle Traffic Bridge to Chidley Reserve, the TSS was reduced from 10 mg/L to 20 mg/L to approximately 2 mg/L to 5 mg/L.</li> <li>• TSS concentration was below 2mg/L at the disposal area when considering 50<sup>th</sup> percentile of time (BMT 2022e).</li> <li>• TSS concentration above 20 mg/L at the disposal site were restricted to the designated disposal locations (southeast corner).</li> </ul>

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	<b>Navigational hazards</b>
	<ul style="list-style-type: none"> <li>The presence of the dredge, associated support vessels and any associated marine equipment (including environmental monitoring equipment) within the dredging area in the Inner Harbour may pose a temporary navigational hazard to potential recreational vessels transiting through the area.</li> </ul>
	<b>Disturbance to heritage (Aboriginal, European or Maritime)</b>
	<ul style="list-style-type: none"> <li>A review of Aboriginal, European and Maritime heritage sites found that the relevant registered Aboriginal heritage site to this proposal is the Swan River – 3536 site.</li> </ul>
	<b>Odour generations</b>
	<ul style="list-style-type: none"> <li>Based on the field observations of the dredging area, sediment samples and chemical analysis results during the implementation of the SSAP (O2M 2022), it anticipated that odour generation from the Proposal will be minor and presents a low risk of resulting in social impacts.</li> </ul>
	<b>Social impacts from noise</b>
	<ul style="list-style-type: none"> <li>While the operation of the dredge within the dredging area and during sediment disposal has the potential to generate additional noise at Fremantle this will be temporary and short-term. It is important to note that dredging is being completed within an active Port and any additional noise is likely to be undetectable by the public.</li> </ul>
<b>Mitigation</b>	<b>Avoid</b>
	<ul style="list-style-type: none"> <li>Impacts to public health from the potential release of contaminants will be avoided as the concentration of contaminants in the sediment samples were below the relevant environmental and human health guidelines.</li> <li>The relevant registered Aboriginal heritage sites to this proposal is the Swan River - 3536. Fremantle Ports hold a section 18 approval under the <i>Aboriginal Heritage Act 1972</i> for the purpose of dredging and maintenance of the Inner Harbour and disposal of dredge spoil at Gage Roads anchorage. This approval was in place for the capital dredging project undertaken in 2010 which shares the same footprint as this maintenance dredging proposal. Due to the associated consultation occurring in 2007, Fremantle Ports plans to undertake stakeholder consultation with identified Aboriginal representatives for the Swan River site. There are no Maritime heritage sites located in the dredging and disposal areas that could be potentially impacted by the Proposal.</li> </ul>
<b>Mitigation</b>	<b>Minimise</b>

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- Prior to implementation of the Proposal, Aboriginal representatives will be consulted and informed of the Project.
- Sediment will be placed in a deep area (>18 m) of the Gage Roads offshore disposal area, where it is expected to have minimal mobilisation due to wave climate.
- The Inner Harbour and Entrance Channel are an active port with large shipping operations.
- Prior to the implementation of the Proposal, the contractor for marine dredging activities will establish a communication plan with Fremantle Ports, and obtain any relevant permits as required by Fremantle Ports, to coordinate dredging operations within an active shipping channel and ensure the appropriate procedures are in place to maintain navigational safety.
- Prior to the implementation of the Proposal, a Temporary Notice to Mariners from DoT's Marine Safety Branch will be obtained and remain in place throughout the duration of the Proposal to inform the public of potential navigational hazards associated with the Proposal.
- Dredging operations are estimated to be completed in less than 10 days and the dredge, associated support vessels and any associated marine equipment (including environmental monitoring equipment) will be fitted with the appropriate marine safety lighting to maintain visibility during low light conditions.
- Prior to implementation of the Proposal, relevant stakeholders will be consulted and informed of the Proposal.
- Sediment sampling and analysis of dredging area sediments was completed to assess the suitability of the sediments for dredging and disposal and field observations demonstrated that the sediments from the dredging area generally did not exhibit a sulfidic odour

### Monitoring/management

- Implementation of a DEMP (BMT 2022f)

<b>Residual impact</b>	Through the application of the mitigation hierarchy and development of the DEMP, there are no long-term impacts anticipated to social surroundings from the implementation of the Proposal.
<b>Proposed environmental outcomes</b>	<ul style="list-style-type: none"> <li>• No public or navigational safety incidents from dredging and sediment disposal</li> <li>• No social impacts from potential reduced public amenity, odour generation or noise associated with dredging or disposal activities</li> </ul>

## 8 Assessment of Other Environmental Factors

Potential environmental impacts on other environmental factors are anticipated to be low risk, therefore these environmental factors do not require assessment in detail by the EPA.

### 8.1 Receiving Environment

#### 8.1.1 Introduced marine pest species

The introduction of marine pests in WA waters has remained relatively low over the past ~50 years (Huisman *et al.* 2008). However, owing to the variety of habitat types along the WA coastline, ranging from temperate to tropical ecosystems, the likelihood of a pest outbreak is considered high (Huisman *et al.* 2008). To date, there have been 102 species of marine algae and animals that have been reported as introduced into WA marine and estuarine waters (Wells *et al.* 2010). Of these 102 reported species, 60 species are considered to have become established (DoF, 2016). The majority of introduced species (34 species) have been recorded only in harbours, with the remaining 26 species being recorded both in harbours and along adjacent coastal areas (Huisman *et al.* 2008). As ~60% of these introduced marine species are temperate inhabiting species, the greatest concentrations (46 species) of introduced species are found in marine and estuarine waters around Fremantle (including Cockburn Sound, Cottesloe, Garden Island, Rockingham, and the lower Swan-Canning Estuary; Huisman *et al.* 2008). Introduced marine species in the Fremantle bioregion include algae (two species), dinoflagellates (one species), bryozoans (eight species), crustaceans (11 species), hydroids (four species), molluscs (eight species), polychaetes (four species), ascidians (five species), and fish (three species; Huisman *et al.* 2008).

It is important to note that most introduced marine species cause no apparent harm in marine ecosystems, and instead simply become additional species in the local environment. It is a minority of introduced species that become pests that cause disease in native species and humans, interfere with fisheries and aquaculture, foul industrial equipment, disrupt local ecosystems and/or alter the surrounding habitat (Wallentinus and Nyberg 2007; Wells *et al.* 2010). Introduced marine pest known to occur in marine and estuarine waters around Fremantle include the Asian date or bag mussel (*Musculista senhousia*) and European fan worms (*Sabella spallanzanii*; DAWE 2021). Other marine pest species to monitor for in marine and estuarine waters around Fremantle include the Asian green mussel (*Perna viridis*), American slipper limpet (*Crepidula fornicata*), Asian basket clam (*Corbula* [Potamocorbula] *amurensis*), Asian shore crab (*Hemigrapsus sanguineus*), Black striped false mussel (*Mytilopsis sallei*), Chinese mitten crab (*Eriocheir sinensis*), Asian paddle crab (*Charybdis japonica*), rapa or veined whelk (*Rapana venosa*), soft shell or long-necked clam (*Mya arenaria* and *Mya japonica*) and charru mussels (DAWE 2021).

Fremantle Ports has undertaken a baseline introduced marine species study in conjunction with CSIRO's Centre for Research on Introduced Marine Pests (CRIMP) in April and May 1999 (CRIMP 2000). The survey focused on habitats and niches within the port and its adjacent coastline, that are likely to be inhabited by introduced species if present. Of the Australian Ballast Water Management Advisory Council (ABWMAC) listed marine pest species, only two were found within the Fremantle Port survey area – the European fan worm (*Sabella spallanzanii*) and a small infaunal mussel (*Musculista senhousia*). In addition, the dinoflagellate species (*Alexandrium tamarense*) was detected in low concentrations (CRIMP 2000). No other Australian Ballast Water Management Advisory Council pest species were recorded.

The European fan worm was found throughout the CRIMP survey area, notably in Rous Head Harbour, North Quay and at channel marker 10 (CRIMP 2000). The population within Rous Head Harbour is of

particular concern as sightings indicated the presence of large numbers of juvenile worms coating the pylons at all depths. *S. spallanzanii* causes major fouling on man-made structures and may prevent the settlement of other organisms. When present in high densities, *S. spallanzanii* may adversely affect shellfish culture operations which rely on the settlement of wild spat either by reducing the available surface for settlement or by reducing the availability of planktonic food in the water column (CRIMP 2000).

The small infaunal mussel, *Musculista senhousia*, was found in the Inner Harbour, Southern Flats of Cockburn Sound and the Northern Bank Area (CRIMP 2000). This opportunistic bivalve can colonise man-made structures as well as forming thick mats of byssus that anchor into the soft sediment habitats, out-competing resident biotic communities (Crooks 1998).

Several other introduced and cryptogenic species were recorded. These are recognised as having been translocated to Australia but do not pose significant economic or environmental threat (CRIMP 2000). In 2007 Fremantle Ports partnered with the Department of Fisheries (DoF; now Department of Primary Industries and Development [DPIRD]) to reassess the abundance and distribution of the previously identified marine pest species. The European fan worm was not as widespread as previously reported and no specimens of the Asian date mussel were found. Fremantle Ports will continue to work with DPIRD in monitoring marine pest species.

### 8.1.2 Significant fauna

The significant fauna for this project includes sea mammals like sea lions, whales and dolphins, and sea turtles, which poses risk to negative interactions with the dredging operation.

#### 8.1.2.1 Marine mammals

The most common species of marine mammals expected within the project area are listed in the EPBC Act Protected Matters Report (Annex D) and the most relevant are as follows:

- Australian Sea-lion (*Neophoca cinerea*) - Endangered
- Bottlenose dolphin (*Tursiops truncatus*)
- Bryde's whale (*Balaenoptera edeni*)
- Blue whale (*Balaenoptera musculus*)- Endangered
- Common dolphin (*Delphinus delphis*)
- Gray's and straptooth beaked whale
- Humpback whale (*Megaptera novaeangliae*)
- Indican Ocean Bottlenose Dolphin (*Tursiops aduncus*, Swan River dolphin)
- Killer whale (*Orcinus orca*)
- Long-nosed Fur-seal (*Arctocephalus forsteri*)
- Minke whale (*Balaenoptera acurostrata*)
- Pigmy right whale (*Caperea marginata*) – Endangered

- Risso's dolphin (*Grampus griseus*)
- Southern right whale (*Eubalaena australis*) - Endangered
- Spotted dolphin (*Stenella attenuata*)

The only resident marine mammal species interacting directly with the Proposal area is the bottlenose dolphin *Tursiops aduncus* in the Swan River. All other species are migratory and uses the area sporadically. The Indo-Pacific bottlenose dolphin grows to 2.6 m long, and weighs up to 230 kg. The Swan River dolphins are a core group of around 20 dolphins resident year-round in the estuary, while 16 others make occasional visits throughout the year (Chabanne *et al* 2012). These dolphins are 'part-time' estuary residents. In the estuary, dolphins tend to spend most of their time in the lower to middle reaches of the Swan River and, in the Canning River, following tidal movement upstream before turning back towards the river mouth when the tide turns. In the Ocean, the dolphins are found in habitats such as Owen Anchorage and the seagrass meadows on Parmelia and Success banks between Cockburn Sound and Fremantle (Finn & Holker, 2009).

#### 8.1.2.2 Sea turtles

The sea turtles that occur within the Proposal area uses the environment to forage or related behaviours. There are four species of sea turtles within the area:

- Loggerhead turtle (*Caretta caretta*) – Endangered
- Green turtle (*Chelonia mydas*) – Vulnerable
- Leatherback turtle (*Eretmochelys imbricata*) – Endangered
- Flatback turtle (*Natator depressus*) – Vulnerable

#### 8.1.2.3 Sea birds

The Swan River is an important habitat for over 80 species of seabirds, which 35 are seen regularly (DBCA, 2022). The Australian fairy tern (*Sternula nereis*; listed under Vulnerable) migrates southward from the Gascoyne and Pilbara coasts to breed. The closest breeding location from the Proposal area is Point Walker sandbar, providing a central meeting place where the terns travel to find their mates and build up their fat reserves before starting to lay their eggs between October and February. Dredging activities were listed by Dunlop (2015) as a disturbance that can affect the Australian fairy tern, however, the impact is caused when these sea birds use dredge-spoil banks to lay their eggs, which is not the case in this Proposal, as the dredged material will be disposed offshore.

#### 8.1.3 Commercial and recreational fisheries

Various commercial fisheries operate within the West Coast Bioregion, including Australia's most valuable single-species wild capture fishery, the western rock lobster fishery (DPIRD 2021a). A range of finfish and invertebrate species are targeted within the West Coast Bioregion, including sharks, West Australian dhufish, snapper, baldchin groper, emperors, scallops, abalone, blue swimmer crabs and octopus, using demersal line and net methods, trawling, diving and potting methods (DPIRD 2017). Beach-based methods such as beach seining, near-shore gillnetting, and hand-hauled nets are used to capture whitebait, mullet and whiting in a very restricted number of locations. The region is heavily used for both shore- and boat-based recreational fishing.

The WA fisheries and target species relevant to the Proposal area, and the likelihood of interaction with the Proposal, are summarised in Table 8.1 and Table 8.2.

Table 8.1 Western Australian fisheries relevant to the Proposal area

Fishery	Commercial or recreation use	Target species	Operation use, vessels/licenses and closure periods
West Coast Rock Lobster Managed Fishery	Both	Western rock lobster ( <i>Panulirus cygnus</i> )	Cape Leeuwin to Shark Bay. Most abundant between Perth and Geraldton. There are ~677 commercial vessels that operate within this fishery and ~50,000 recreational licence holders in WA. Operates 12 months of the year (DPIRD 2021).
West Coast Roe's Abalone Resource	Both	Roe's abalone ( <i>Haliotis roei</i> )	South Australian border to Shark Bay. There are ~51 commercial vessels that operate within this fishery and ~16,000 recreational licence holders in WA, though most activity is between Perth and Eucla (Strain <i>et al</i> , 2020).
Octopus Interim Managed Fishery	Both	Octopus ( <i>Octopus tetricus</i> )	The interim octopus fishery is in a planned expansion phase. There are currently ~34 interim commercial vessels that operate within this fishery, though octopus continue to be caught as by-product by the rock lobster fishery. Currently operates 12 months of the year (DPIRD 2018).
Abrolhos islands and mid-west trawl managed fishery	Commercial	Saucer Scallop ( <i>Ylistrum balloti</i> , formerly <i>Amusium balloti</i> )	East of Rottnest Island and north of Geographe Bay. There are ~10 commercial vessels that operate within this fishery. Operates 12 months of the year (DPIRD 2020a; Kangas <i>et al</i> , 2021).
Cockburn Sound Crab Managed Fishery	Both	Blue swimmer crab ( <i>Portunus armatus</i> )	The Cockburn Sound crab managed fishery has been closed since 2014 to protect the blue swimmer crab breeding stock. In 2019 recruitment and egg production remained below limit reference levels (DPIRD 2020b).
Cockburn Sound Fish Net Managed Fishery	Both	Southern garfish ( <i>Hyporhamphus melanochir</i> ) and Australian herring ( <i>Arripis georgianus</i> )	There is ~1 commercial vessel that operates within this fishery, employing 2 fishers per month, and ~14,000 recreational net fishing licence holders in WA. Operates 12 months of the year (Smith <i>et al</i> , 2017).
West Coast Purse Seine Managed Fishery	Commercial	Pilchard ( <i>Sardinops sagax</i> ) and Scaly mackerel ( <i>Sardinella lemuru</i> )	Lancelin to Cape Bouvard. Limited to 12 commercial licences within this fishery. Operates 12 months of the year, with area closures in Cockburn Sound, Warnbro Sound and Marmion Marine Park (DPIRD 2019a).
West Coast Demersal Scalefish Managed Fishery	Recreational	100+ demersal species inhabiting marine water between 20-250 m in the West Coast Bioregion	There are ~60 commercial vessels that operate within this fishery and ~123,000 recreational licence holders in WA. The demersal fishery is closed from 15 <sup>th</sup> October to 15 <sup>th</sup> December throughout the West Coast Bioregion, with

Fishery	Commercial or recreation use	Target species	Operation use, vessels/licenses and closure periods
	Commercial	Pink snapper ( <i>Chrysophrysauratus</i> ), West Australian dhufish ( <i>Glaucosoma hebraicum</i> ), and Baldchin groper ( <i>Choerodon rubescens</i> )	additional closures in Cockburn and Warnbro Sounds (DPIRD 2021b).
Shore-based Inner Coastal Finfish Resources	Recreational	Australian herring ( <i>Arripis georgianus</i> ), Tailor ( <i>Pomatomus saltatrix</i> ), and Whiting ( <i>Sillaginidae spp.</i> )	Recreational shore-based fishing operates 12 months of the year throughout the West Coast Bioregion and does not require recreational licences.

**Table 8.2 Distribution, key life strategies and habitat associations of commercially and recreationally important species in the West Coast Bioregion**

Species	Distribution/key life strategies	Habitat associations	Likelihood of interaction with the Proposal
Australian herring ( <i>Arripis georgianus</i> )	Australian herring occur in coastal areas from Shark Bay in WA, across the south coast to South Australia and as far east as Victoria (DPIRD 2018). They are found mainly inshore, around offshore islands and in southern estuaries, such as Wilson Inlet and Oyster Harbour. Australian herring spawn along the south-west coastline from Perth to Cape Leeuwin from late May to early June (DPIRD 2018).	Sand, seagrass, estuaries, coastal bays	Moderate
Baldchin groper ( <i>Choerodon rubescens</i> )	Baldchin groper are only found in WA waters between Coral Bay and Cape Naturaliste (DoF 2011a). They are sedentary, bottom-dwelling fish and are most abundant at the Houtman Abrolhos Islands where spawning occurs from early spring to mid-summer, with the peak period being November to early January (DoF 2011a).	Reef	Low
Blue swimmer crab ( <i>Portunus armatus</i> )	Blue swimmer crabs are found Australia-wide, but greatest abundances occur mainly between Karratha and Dunsborough in WA (DPIRD 2021c). They inhabit sandy, muddy, algal and seagrass habitats in estuaries, sheltered bays and offshore waters up to 50 m deep (DPIRD 2021c). Spawning in the West Coast Bioregion is restricted to the warmer months, with mating occurring in late-summer when females are soft-shelled (Johnston et al. 2020). In the ocean, females mostly spawn in late-spring and early-summer (DPIRD 2021c).	Sand, seagrass, mud, macroalgae	Low–moderate

Species	Distribution/key life strategies	Habitat associations	Likelihood of interaction with the Proposal
Octopus ( <i>Octopus tetricus</i> )	Distribution in Western Australia extends continuously from Shark Bay to Esperance (Hart <i>et al.</i> 2018). Octopuses utilise all near-coastal habitat types in the West Coast Bioregion. Lowest dispersal activity is exhibited in shelf waters and restricted population density is observed in sandy substrates, which offer limited shelter availability. Spawning occurs year-round (Hart <i>et al.</i> 2018).	Sand, seagrass, macroalgae, reef, submerged structures	Low
Pilchard ( <i>Sardinops sagax</i> )	Pilchards are found primarily in temperate waters from Hervey Bay in southeast Queensland to Red Bluff in WA (DPIRD 2019). Within Australian waters pilchards are almost totally restricted to waters of the continental shelf (DPIRD 2019). Spawning occurs during spring-summer in the southern part of its range, and in summer-autumn in the northern part (DPIRD 2019).	Pelagic, sand	Low
Pink snapper ( <i>Chrysophrys uratus</i> )	Found in warm temperate to sub-tropical waters from Karratha southwards to the Great Australian Bight (DPIRD 2020c). Pink snapper are a bottom-dwelling fish, typically residing in waters 20–250 m deep. Adults live near reefs but also over muddy and sandy bottoms along the continental shelf and in more protected waters when spawning. Juveniles are common in bays, inlets, and estuaries, which provide important nursery areas (DPIRD 2020c). Spawning peaks between May and September in Carnarvon and October to December in Perth, with a known aggregation site in Cockburn Sound off Perth (DPIRD 2020c).	Reef, mud, sand	Low-moderate
Roe's abalone ( <i>Haliotis roei</i> )	Distributed from Shark Bay southward to Victoria (Strain and Heldt 2018). They mostly inhabit shallow limestone reefs along the west coast, especially around Perth and near Geraldton (DoF 2011b). Roe's abalone spawn mostly in winter, while greenlip and brownlip spawn in late spring and summer (DoF 2011b).	Reef	Low
Saucer scallop ( <i>Ylistrum balloti</i> , formerly <i>Amusium balloti</i> )	Distributed from Israelite Bay in WA, across the tropics, to the southern coast of NSW (Chandrapavan <i>et al.</i> 2020). Despite its extensive distribution, the species tends to be restricted to areas of bare sand in the more sheltered environments found in the lee of islands and reef systems (DPIRD 2020a). Spawning occurs during winter (DPIRD 2020a).	Sand	Low–moderate

Species	Distribution/key life strategies	Habitat associations	Likelihood of interaction with the Proposal
Scaly mackerel ( <i>Sardinella lemuru</i> )	Scaly mackerel occur in coastal pelagic waters. Like other similar species, scaly mackerel may be migratory although little is known of their movements in WA waters. Distribution extends from the Pilbara region to Fremantle (DPIRD 2019). In WA there is a single spawning season between December and March with a peak during January and February, coinciding with the period of warmest water temperatures (DPIRD 2019).	Pelagic, sand	Low
Southern garfish ( <i>Hyporhamphus melanochir</i> )	Distributed from Eden, NSW to Lancelin, WA (Smith <i>et al.</i> 2017). A schooling species that occurs in shallow, coastal waters (<20 m) and is typically found near seagrass beds owing to seagrass forming a significant part of the diet of adults and eggs requiring attachment to seagrass or macroalgae for successful development (Smith <i>et al.</i> 2017). Spawning in WA occurs over an extended period during the warmer months of the year (September-April), but with a peak in activity in spring/early summer (~December).	Seagrass, macroalgae	Low-moderate
Tailor ( <i>Pomatomus saltatrix</i> )	Distributed from Hervey Bay, QLD, south around to the Dampier Archipelago, WA (Bray 2020). Pelagic species usually found in the open ocean, move inshore to feed in coastal waters, bays and estuaries, to depths of 15 m (Bray 2020). Tailor hunt along inshore coastal waters, estuaries and nearshore reefs (Bray 2020). Spawning occurs offshore during late winter and spring (Bray 2020).	Pelagic, estuaries and reef	Low
West Australian dhufish ( <i>Glaucosoma hebraicum</i> )	Dhufish are endemic to WA and occur between Shark Bay and the Recherche Archipelago near Esperance. They are most common along WA's lower west coast between Kalbarri and Augusta (DPIRD 2016). Dhufish are generally sedentary demersal fish. Adult dhufish can usually be found on reefs 20–50 m deep, while juveniles often occur in sandy habitats at similar depths to adults (DPIRD 2016). Spawning occurs from November to April with a peak period in January and February when water temperatures are elevated. Spawning appears to take place over isolated reef outcrops and weed-covered sandy areas (DPIRD 2016).	Reef, sand, macroalgae	Low
Western rock lobster ( <i>Panulirus cygnus</i> )	Temperate species found on the continental shelf off the coast of WA (DoF 2011c). Juvenile and adult rock lobsters associate with onshore reef habitats (DoF 2011c). Mating occurs during late	Reef	Low

Species	Distribution/key life strategies	Habitat associations	Likelihood of interaction with the Proposal
	winter and spring, peaking from October to November (Melville-Smith and de Lestang 2006)		
Whiting ( <i>Sillaginidae</i> spp.)	Found in sandy and seagrass habitats in shallow inshore waters, mangroves/estuarine waters throughout the Indo-West Pacific region. Spawning occurs from August to March for <i>S. schomburgkii</i> and October to April (peak from December to March) for <i>S. analis</i> in Shark Bay (Harvey <i>et al.</i> 2017).	Sand, estuaries, seagrass and mangroves	Moderate

### 8.1.4 Coastal processes

#### 8.1.4.1 Climate

The Proposal area is located within the greater South-west Marine Region, which is divided further into seven bioregions, as defined by the Integrated Marine and Coastal Regionalisation of Australia Version 4.0 (DEWHA 2008). The Southwest Shelf Province bioregion comprises the narrow, continental shelf from Fremantle in the north, around the southern coast and ending before Esperance in the south. With a maximum depth of ~200 m, this nearshore bioregion is characterised by a high level of marine biodiversity (in particular seagrasses and macroalgae) and warm water influences from the Leeuwin Current (DEWHA 2008).

The Perth area experiences a Mediterranean climate that is typically characterised by hot and dry summers and mild and wet winters. In Fremantle, the average monthly temperatures range from a minimum of ~10°C in July to a maximum of ~28°C in February (BoM 2021). The average annual rainfall is ~771.8 mm, with the average monthly rainfall ranging from a minimum of ~6 mm in January to a maximum of ~165 mm in June (BoM 2021).

An eastward moving subtropical high-pressure belt causes predominant south-westerly winds in the summer and easterly winds in the winter (Pattiaratchi *et al.* 1997). During winter, the high-pressure belt is disrupted by mid-latitude depressions that generate high energy storms, with the strongest winds usually from the north-west (Pattiaratchi *et al.* 1997). During summer, strong south-westerly sea breezes occur in the afternoons, with velocities frequently exceeding 15 m/s (Pattiaratchi *et al.* 1997).

#### 8.1.34.2 Coastal processes and hydrodynamics

The Fremantle bioregion is a microtidal, wave-dominated, sandy coastline with a maximum spring tide range of 0.6 m (Hodgkin and Hesp 1998). The region is characterised by subtropical waters (16–20°C) that are influenced by the warm, low-nutrient waters of the Leeuwin Current (Collins 1988). The wave energy level varies along the Perth coastline in response to differences in exposure, however, all beaches are subjected to a similar seasonal variation in incident wave conditions characterised by more energetic conditions in winter than in summer (Lemm *et al.* 1999). The Fremantle bioregions are a moderate-to-high-energy ocean beach, though oceanic swell is largely buffered by outer reefs and nearby islands causing greater attenuation of offshore waves than beaches positioned further northward along the Perth coastline. Overall, the inshore wave height at Fremantle is 77% lower than the corresponding offshore wave height (Masselink and Pattiaratchi 2001a).

Fremantle is exposed to one of the most energetic sea breeze systems in the world. In contrast to the 'classic' sea breeze system, characterised by sea breezes blowing in the onshore direction, the sea breeze in Perth blows in a predominantly alongshore direction (i.e. from the south-southwest). In the

summer months, the sea breeze is present more than 60% of the time and the mean sea breeze velocity at the coastline is about 8 m/s (Masselink and Pattiaratchi 2001b).

Seasonal variation in wave and wind energy conditions across Perth beaches causes variation in littoral drift direction; nearshore sediments being transported towards the north in summer and towards the south in winter (Masselink and Pattiaratchi 2001a). As a result, beaches located to the north of coastal structures or natural headlands/outcrops will undergo erosion during summer and accretion during winter. Reversal of the littoral drift direction is principally responsible for causing seasonal changes in beach width along the Perth coastline. However, offshore sediment transport in the winter by storms also plays a role in beach erosion.

#### 8.1.4.3 Geology and geomorphology

The Perth coastal region comprises extensive build-ups of Tamala Limestone which have formed a complex series of submarine to emergent ridges that dominate the nearshore bathymetry and coastal geomorphology (Brooke *et al.* 2010). North of the Swan River mouth, three limestone ridges lie within 5 km of the shoreline, their crests are typically less than 2 km apart with a relief of 10–12 m (Brooke *et al.* 2010). Modern inner-shelf sediments generally occur as thin, discontinuous sheets over rocky or algal substrates and include subtropical and cool-water biogenic carbonate composed of molluscs, foraminifera, bryozoans, and calcareous red algae (Collins 1997 [cited in Richardson *et al.* 2005], James *et al.* 1999). Terrigenous components are more abundant in coastal areas than elsewhere, and include quartzite, granite, siltstone, feldspar and quartz grains (Richardson *et al.* 2005). These terrigenous grains are common proximal to large river mouths where they can exceed 50% of surface sediments (Collins 1997 [cited in Richardson *et al.* 2005], James *et al.* 1999).

## 8.2 Assessment of other environmental factors

The summary of the assessment of other environmental factors are presented in Table 8.3.

**Table 8.3 Other environmental factors, potential impacts, proposed mitigation and outcomes**

Marine fauna	
<b>EPA objective</b>	To protect marine fauna so that biological diversity and ecological integrity are maintained (EPA 2016h).
<b>Policy and guidance</b>	<i>Environment Protection and Biodiversity Conservation Act 1999</i> <i>Biodiversity Conservation Act 2016</i> Environmental Factor Guideline – Marine Fauna (EPA 2016h)
<b>Potential environmental impacts to significant fauna</b>	A search of the Department of Agriculture, Water and the Environment (DAWE 2021b) Protected Matters Database Department of Agriculture, Water and the Environment (DAWE 2021b) Protected Matters Database was undertaken to identify significant fauna potentially occurring in the vicinity (5 km buffer zone) of the dredging and disposal area. The assessment demonstrated that for all of the listed threatened, migratory and conservation fauna species potentially occurring in the vicinity of the dredging and disposal area, there is a low risk of potential interaction with the Proposal. Due to the low risk of impacts to significant fauna, it is considered that there is the requirement for associated marine mammal observation to be undertaken for the Proposal.
<b>Potential environmental impacts to marine mammal collision</b>	There is a potential risk of marine mammal collision from the presence and operation of the dredge and associated support vessels. Potential impacts of marine mammal collision incidences may include death, injury, adverse behavioural and physiological changes, and reduced body condition and/or

immune function to individual fauna. Marine mammals that rest of the surface such as whales, seals and dolphins are more vulnerable to this type of impact. Due to the mobility of marine mammals including whales, seals and dolphins, it is likely that they will actively avoid the audible and slow moving dredge and associated support vessels, reducing the potential risk of marine mammal collision. Avoidance of the dredge and associated support vessels may require additional energy expenditure, however, due to the short duration (~10 days) of the Proposal, this impact is only short-term.

The draghead and the suction pipe may also present a risk of collision and/or entrainment for species that forage or shelter on the seabed. This risk is also considered to be low because of the mobility of marine mammals that are likely to exhibit active avoidance. Further, the dredging area is not an important area for feeding or sheltering by marine mammals and does not contain any ecologically significant BCH. The dredging area is located within an active shipping port that has been subject to previous alteration from dredging and is subject to frequent disturbance from shipping activities in the navigation area.

Regardless of the anticipated low risk of marine mammal collision, active monitoring and/or management will be undertaken during the implementation of the Proposal, to ensure that there are appropriate contingency measures in place should any issues arise. The monitoring and/or management requirements are detailed in the corresponding DEMP (BMT 2022f).

#### Potential environmental impacts to commercial and recreational fisheries

A review of the commercial and recreational fisheries and target species relevant to the Proposal area is provided in Section 8.1.2. The review also included an assessment of the potential for the Proposal to interact with target species. From assessment, it was demonstrated that most target species presented a low risk of interaction with the Proposal, with the exception of the blue swimmer crab (*Portunus armatus*), pink snapper (*Chrysophrys auratus*), saucer scallop (*Ylistrum balloti*, formerly *Amusium balloti*) and southern garfish (*Hyporhamphus melanochir*) which presented a low to moderate risk and the Australian herring (*Arripis georgianus*) and whiting (*Sillaginidae spp.*) which presented a moderate risk. While these target species may potentially interact with the Proposal, the risk of the Proposal impacting on these species is anticipated to be low due to:

- dredging and disposal activities will be temporary and short-term in duration (~10 days)
- the dredging area is located within an active port that has been subject to previous alteration from dredging and is subject to frequent disturbance from shipping activities in the navigation area and is therefore unlikely to be an ecologically significant area for marine fauna
- there is a low risk of the potential for indirect impacts to marine fauna from the potential release of contaminants as demonstrated by sediment sampling and analysis of dredging and disposal area sediments
- the dredging and disposal activities will not coincide with known peak spawning periods for those target species identified to present a low to moderate or moderate likelihood of interaction with the Proposal
- predicted temporary increases in concentrations of total suspended solids (TSS) from dredging and disposal activities will not be sufficient to cause either acute or chronic mortality of adult and juvenile decapod crustaceans and benthic molluscan eggs/larvae
- the available literature describing tolerance thresholds to TSS exposure for finfish species of the key commercial and recreational fisheries applicable to the Proposal area is limited, however, there is no evidence to suggest that turbid plumes from dredging would lead to adverse impacts to these taxa that

	<p>are most vulnerable to increased turbidity during early life stages (Harvey <i>et al.</i> 2017).</p> <p>Due to the low risk of impacts to commercial and/or recreational fisheries, it is considered that there is no requirement for associated monitoring and/or management to be undertaken for the Proposal.</p>
<b>Potential environmental impacts due to introduction of invasive marine species (IMS)</b>	<p>The arrival of the dredge and associated support vessels may potentially introduce non-native marine species which can disrupt the local ecosystem.</p> <p>The risk of the Proposal transferring non-native species to the surrounding marine environment will depend on the location of where the dredge and associated support vessels will be sourced from.</p>
<b>Mitigation</b>	<p><b>Avoid:</b> Not applicable</p> <p><b>Minimise:</b> Mitigation measures to minimise potential impacts to marine fauna will include:</p> <ul style="list-style-type: none"> <li>• The dredge and any associated support vessels will be cleaned and/or visually inspected for IMS prior to mobilising to the Project site from any location.</li> <li>• The dredge and any associated support vessels will be required to obtain a low-risk rating from the Department of Primary Industries and Regional Development (DPIRD) risk assessment tool (<a href="https://vesselcheck.fish.wa.gov.au/">https://vesselcheck.fish.wa.gov.au/</a>) prior to mobilising to site from an interstate or international location.</li> </ul> <p><b>Monitoring/management:</b> Implementation of a DEMP (BMT 2022f).</p>
<b>Outcomes</b>	<p><b>Residual impact:</b> After the implementation of mitigation measures, the EPA objective for marine fauna is expected to be met (EPA 2016h).</p>
<b>Outcome-based conditions</b>	<p>No collision with marine mammals from the operation of the dredge</p> <p>No introduction of IMS to the Project site from the arrival of the dredge and any associated support vessels</p>
<b>Coastal processes</b>	
<b>EPA objective</b>	<p>To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected (EPA 2016f).</p>
<b>Policy and guidance</b>	<p>Statement of Environmental Principles, Factors and Objectives (EPA 2022d)</p> <p>Environmental Factor Guideline – Coastal Processes (EPA 2016f)</p> <p>WA Coastal Zone Strategy (DPLH 2017)</p> <p>State Planning Policy No. 2.6: State Coastal Planning Policy (WAPC 2013)</p> <p>State Coastal Planning Policy Guidelines (WAPC 2020)</p>
<b>Potential environmental impacts to nearshore wave climate from altering the seafloor bathymetry offshore on the sediment transport dynamics</b>	<p>Altering the offshore seafloor bathymetry due to disposal activities was not predicted to effect wave climate or sediment transport dynamics.</p>
<b>Potential environmental</b>	<p>It is not predicted any new environmental impact that haven't been predicted by the capital dredging in 2010 and, hence, it is unlikely that the Proposal will affect</p>

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<b>impacts that cause interruption of longshore sediment transport and changes in erosion/deposition patterns</b>	the interruption of longshore sediment transport and changes in erosion/deposition patterns.
<b>Mitigation</b>	<p><b>Avoid:</b> Not applicable</p> <p><b>Minimise:</b> disposal of sediment in the deepest layers (below 18 m) of the Gage Roads offshore disposal area. Dredging design to depth of 14.7 m, which was the depth of the capital dredging in 2010.</p> <p><b>Management/monitoring:</b> Not applicable due to the low risk.</p>
<b>Outcomes</b>	<b>Residual impact:</b> there is no significant residual impacts to coastal processes predicted to occur from the Proposal.
<b>Outcome based condition</b>	No detectable impact to seagrass or macroalgal assemblages outside the Proposal footprint.
<b>Greenhouse gases</b>	
<b>EPA objective</b>	To mitigate greenhouse gas emissions and consequently minimise the risk of contributing to climate change (EPA 2019).
<b>Policy and guidance</b>	<ul style="list-style-type: none"> <li>Environmental Factor Guideline – Greenhouse Gas Emissions (EPA 2020)</li> <li><i>Environment Protection and Biodiversity Conservation Act</i> 1999 (EPBC Act)</li> <li><i>Environmental Protection Act</i> (EP Act).</li> <li>Environmental Protection Authority. (2022a). Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual</li> <li>Environmental Protection Authority. (2022b). Statement of Environmental Principles, Factors and Objectives</li> <li><i>National Greenhouse and Energy Reporting Act</i> 2007 (NGER Act)</li> </ul>
<b>Potential environmental impacts due to the generation of emissions from the operation of machinery</b>	<p>Machinery used during the dredging will emit Scope 1 GHG into the atmosphere.</p> <p>A breakdown of the Greenhouse gas emissions that will be produced by the dredge will be provided by the contractor to Fremantle Ports for inclusion into their Scope 1 emissions.</p>
<b>Potential environmental impacts due to the loss of carbon sink</b>	Removal of benthic habitat reduces carbon sequestration capacity of area.
<b>Mitigation</b>	<p><b>Avoid:</b> Not applicable</p> <p><b>Minimise:</b> Dredging has been proposed within the Inner Harbour within areas of minimal organic material. Contractors will utilise energy efficient equipment where possible.</p> <p><b>Management/monitoring:</b> Not applicable due to the low risk. A GHG management plan will not be required as it is expected that GHG emissions generated will be minimal.</p>

<b>Outcomes</b>	<b>Residual impact:</b> Significant impacts to air quality (greenhouse gas emissions) from the implementation of the Proposal are unlikely to occur. It is expected that EPA objective for greenhouse gases will be met (EPA 2019).
<b>Outcome-based condition</b>	GHG emissions shall be consistent with Scope 1 GHG.

## 9 Offsets

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No offsets are proposed for this Proposal because there were no significant residual impacts identified in this ERD.

## 10 Holistic Impact Assessment

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Several environmental assessments have been undertaken to gain a better understanding of the impact of the Proposal may have on the surrounding environment. As a result, three key environmental factors have been identified: Marine Environmental Quality, Benthic Communities and Habitats (BCH), and Social Surrounds.

The EPA's key factor objectives for this Proposal relate to maintaining biodiversity and protecting environmental and social values from significant harm. The EPA's principles and objectives have been thoroughly considered for these key factors to minimise the predicted temporary impacts of the Proposal. The impacts mitigation and residual impact for these key factors is discussed throughout the ERD.

The predicted impacts to the key environmental factors are closely interconnected through the temporary reduction in water quality. The reduction in water quality is expected to reduce the amenity of the area linking these factors with Social Surroundings. The presence of equipment in the marine area and their associated noise is unlikely to reduce the local aesthetic and amenity of the area which is an active port.

In the long-term, it is anticipated this Proposal will positively impact local users by maintaining the safety of the shipping operation.

No offsets are considered necessary for the Proposal as no significant residual impact is anticipated.

Holistic impacts of the Proposal are considered acceptable and aligns with EPA principles and objectives. All impacts can be avoided or mitigated following EPA's mitigation hierarchy; where this is not possible, the DEMP will be implemented.

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## **Annex A Timeseries TSS and daily moving mean TSS for each of the location of interest for analysis**

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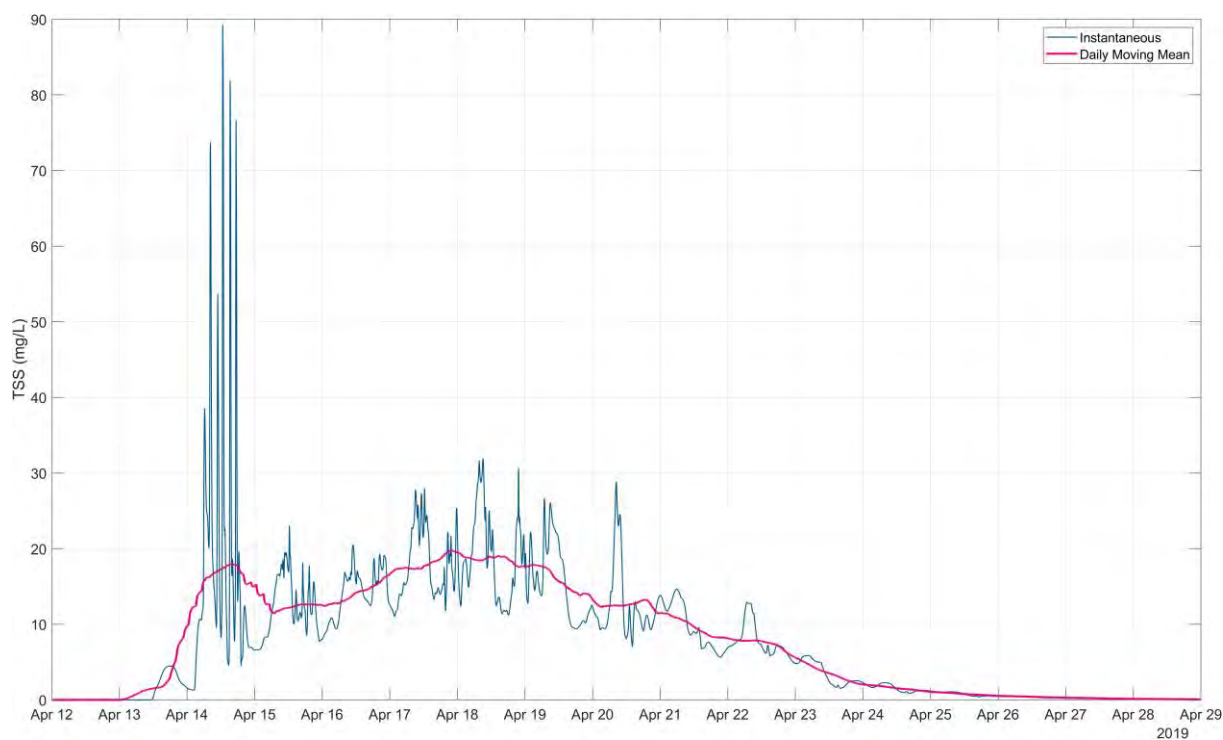


Figure 1.1 Time series plot of the instantaneous and daily moving mean TSS for Upstream 1

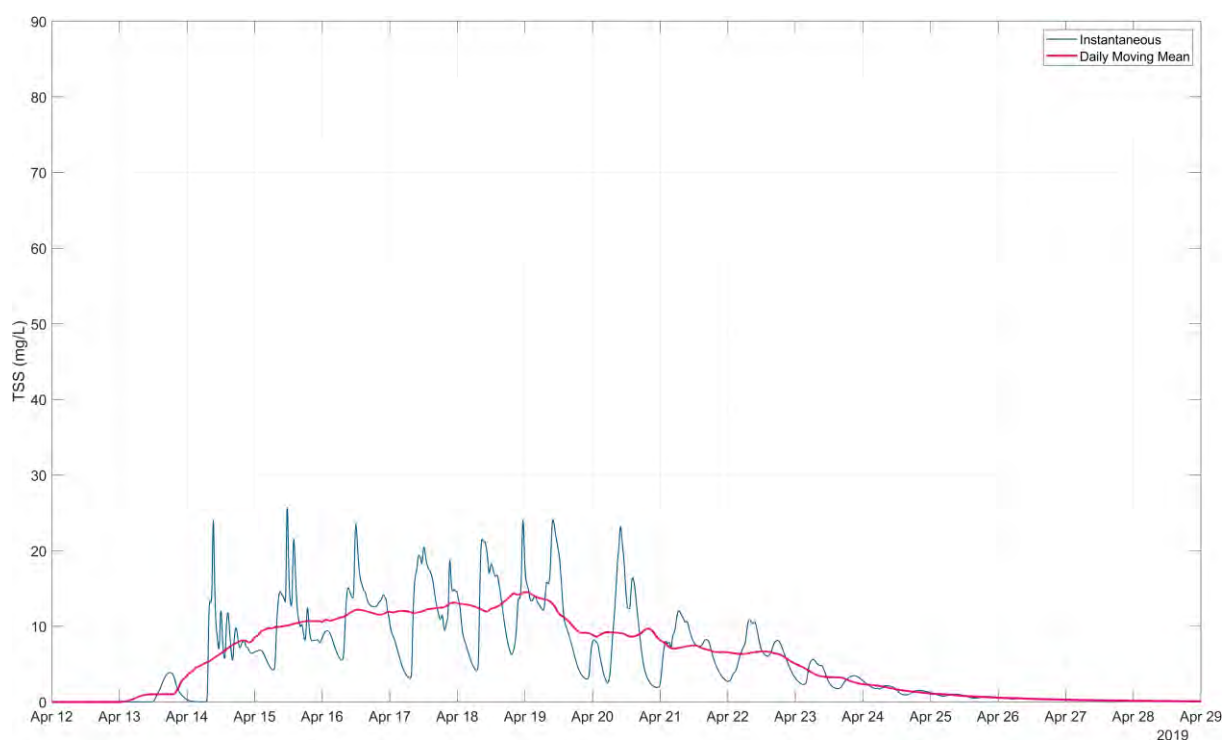


Figure 1.2 Time series plot of the instantaneous and daily moving mean TSS for Upstream 2

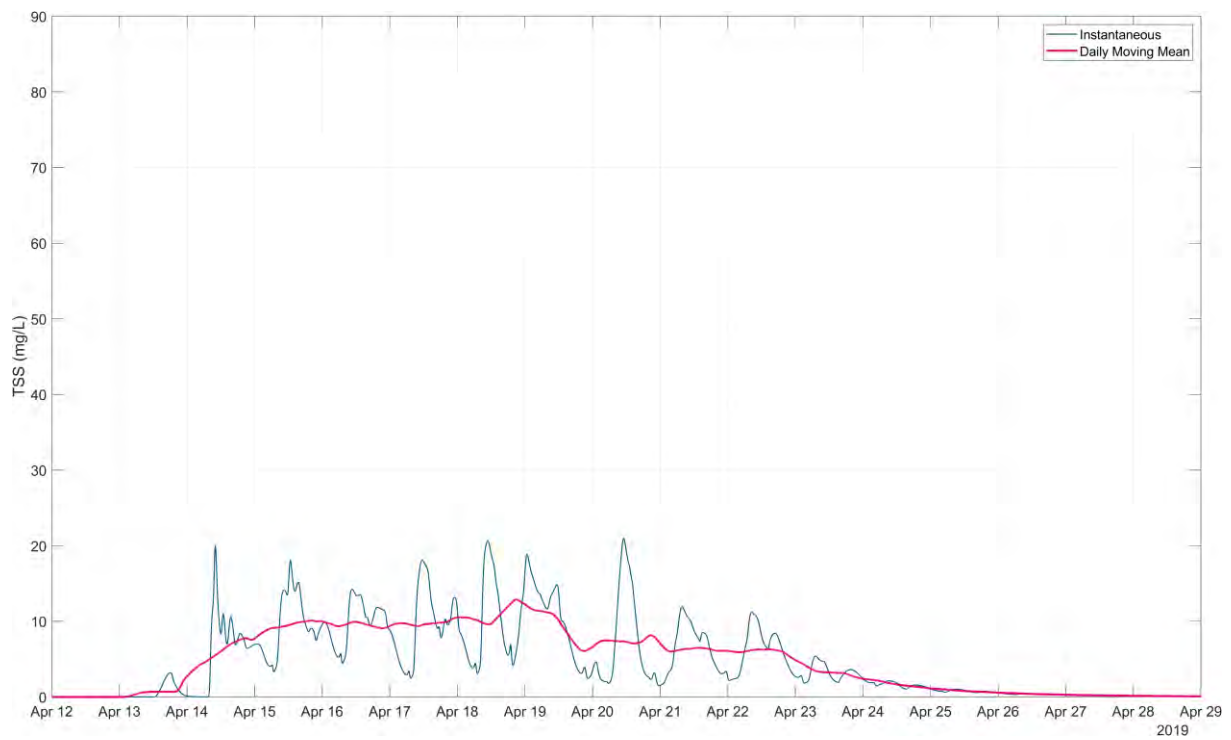


Figure 1.3 Time series plot of the instantaneous and daily moving mean TSS for Upstream 3

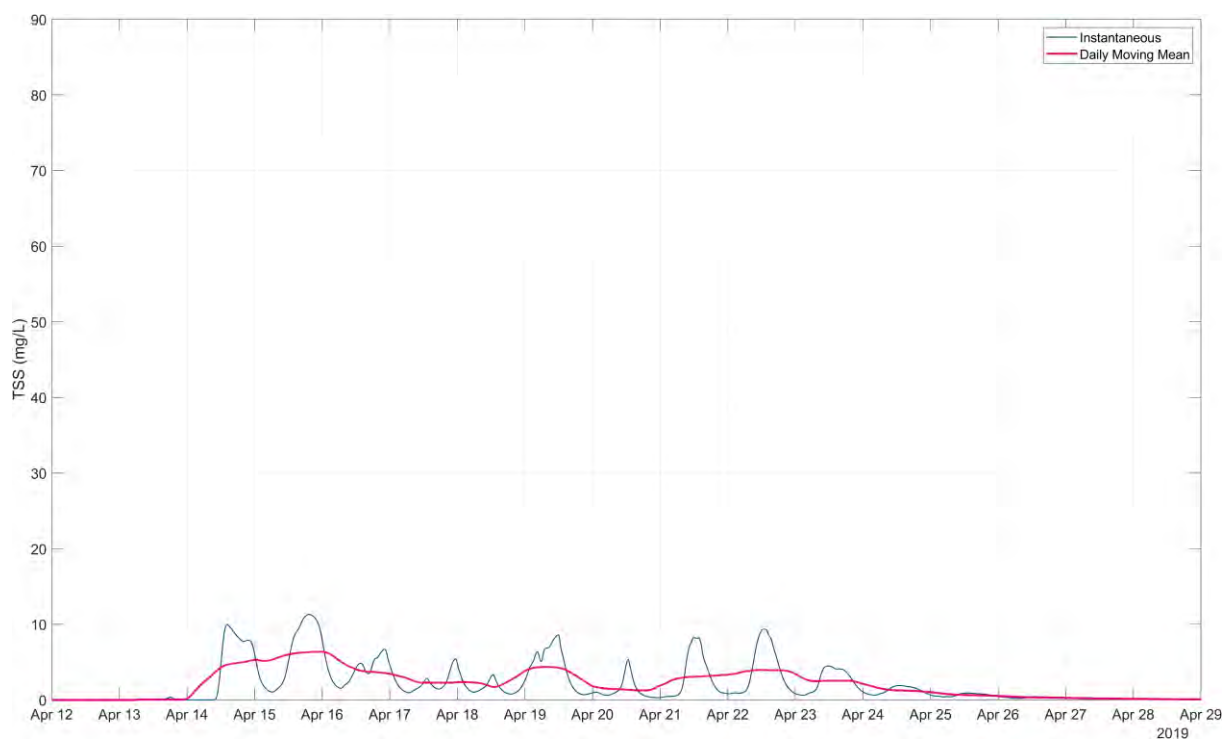


Figure 1.4 Time series plot of the instantaneous and daily moving mean TSS for Upstream 4

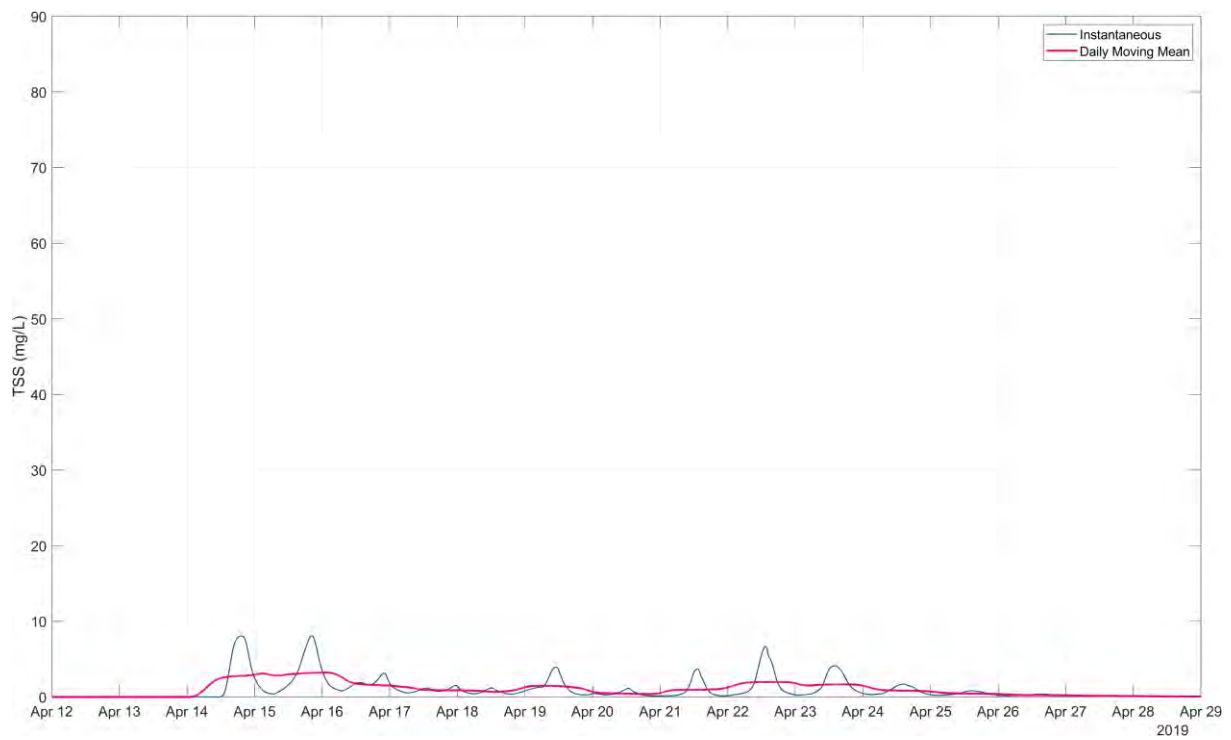


Figure 1.5 Time series plot of the instantaneous and daily moving mean TSS for Upstream 5

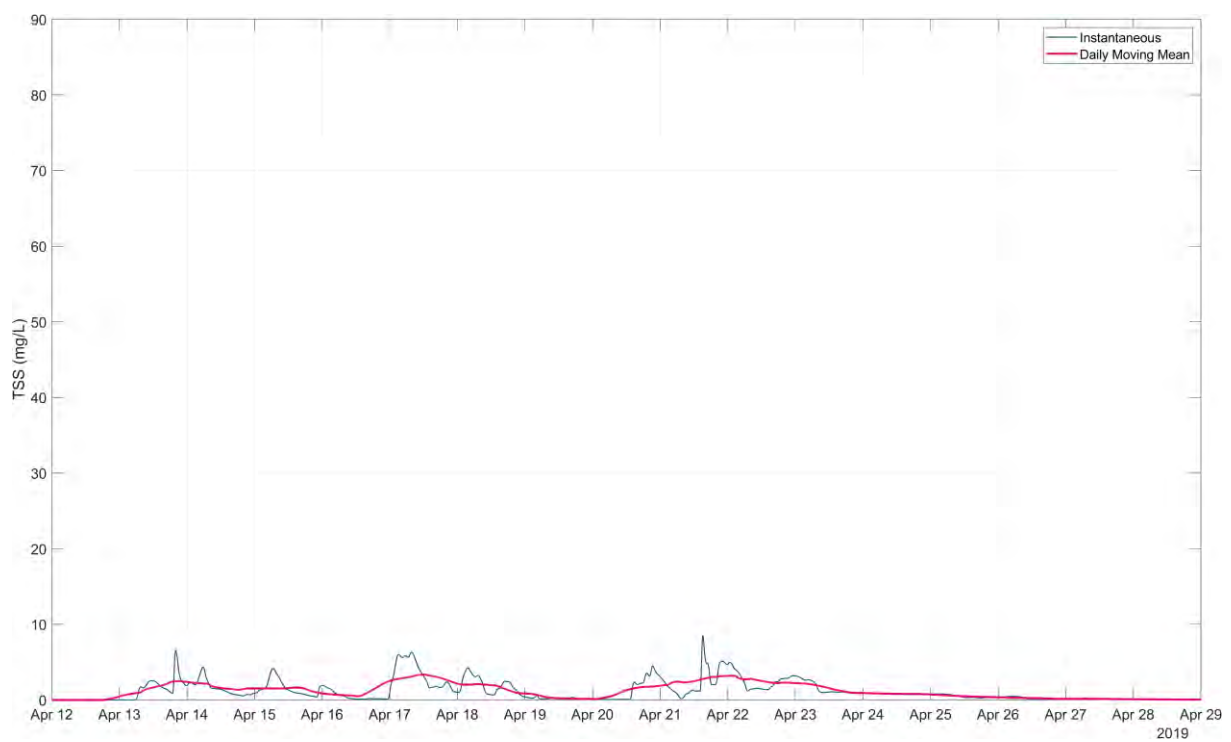


Figure 1.6 Time series plot of the instantaneous and daily moving mean TSS for Nearshore 1

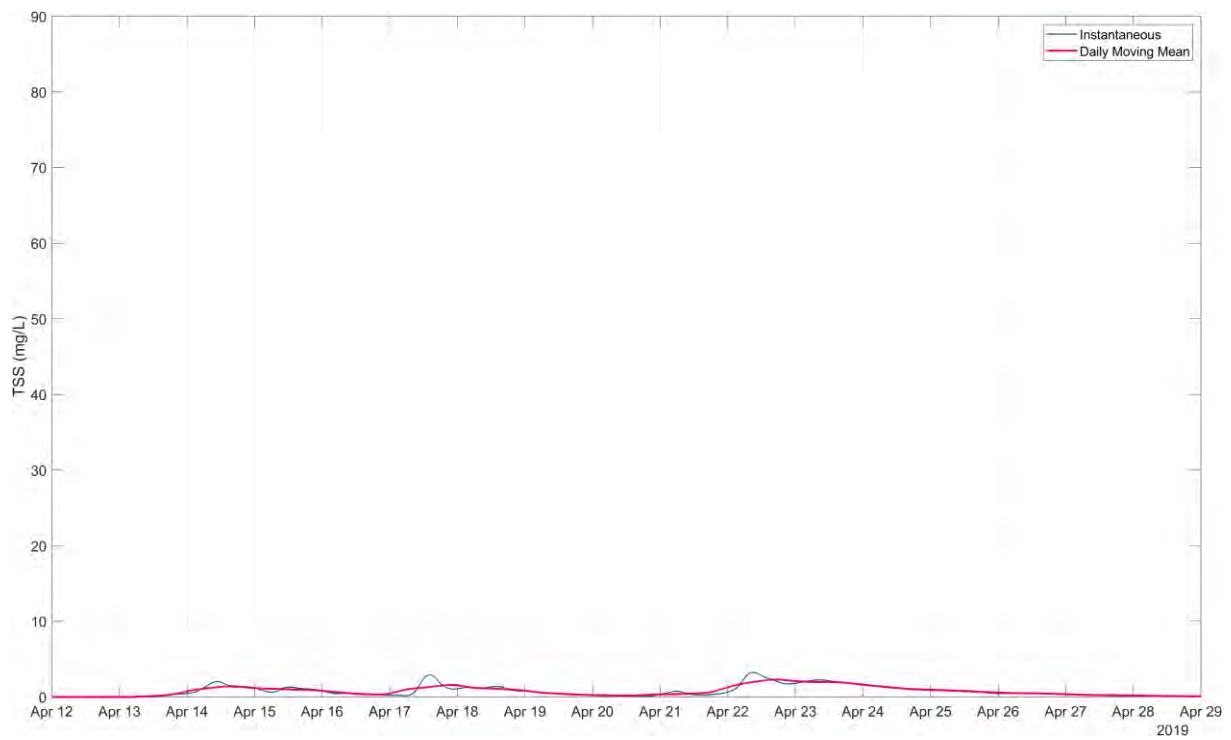


Figure 1.7 Time series plot of the instantaneous and daily moving mean TSS for Nearshore 2

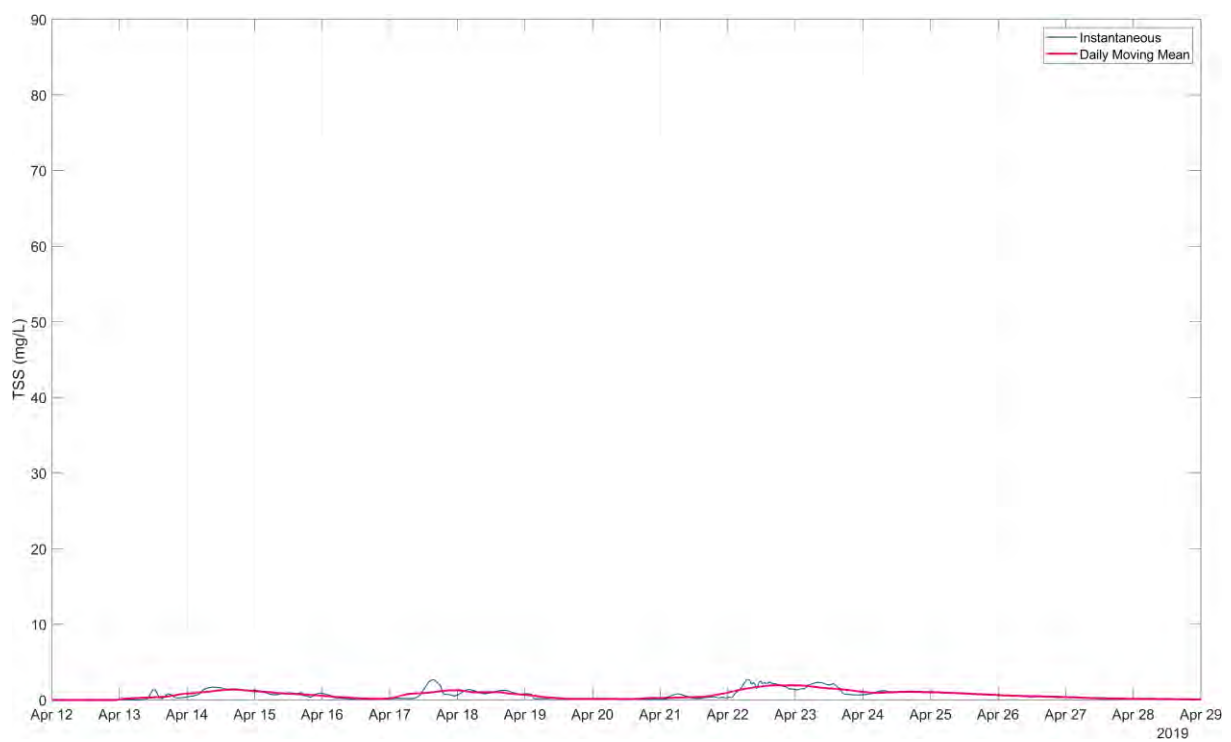


Figure 1.8 Time series plot of the instantaneous and daily moving mean TSS for Nearshore 3

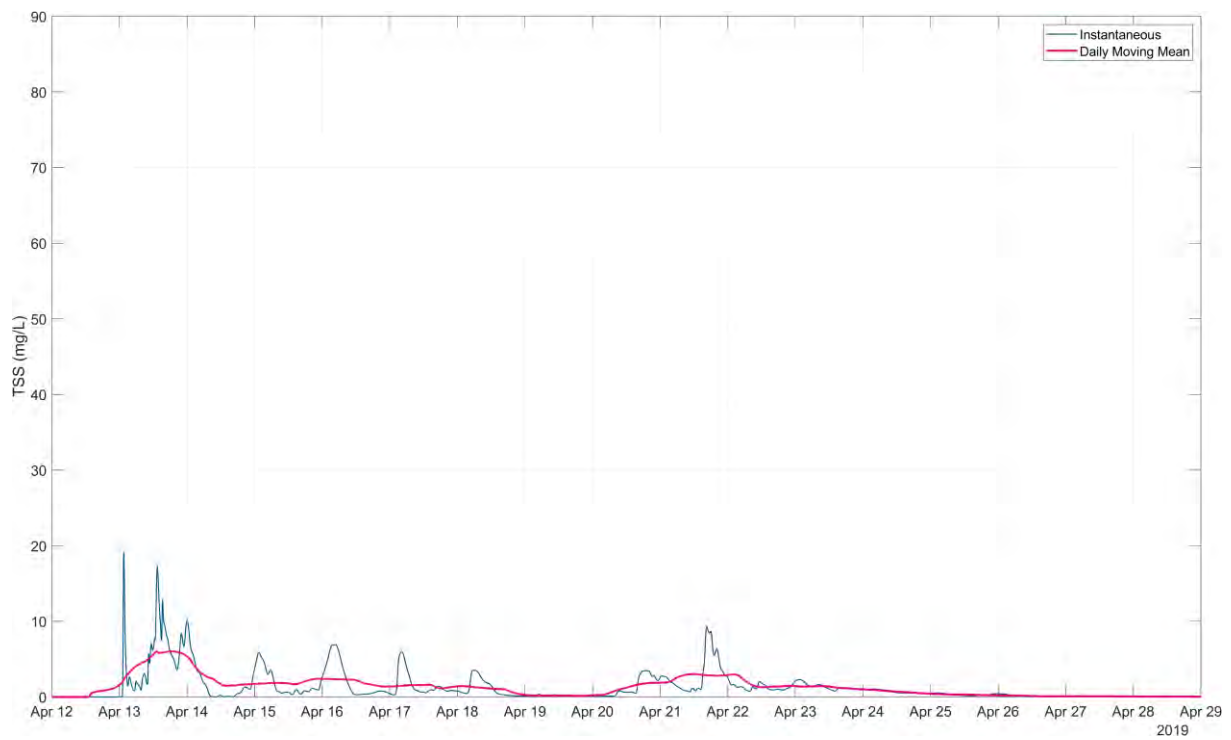


Figure 1.9 Time series plot of the instantaneous and daily moving mean TSS for Nearshore 4

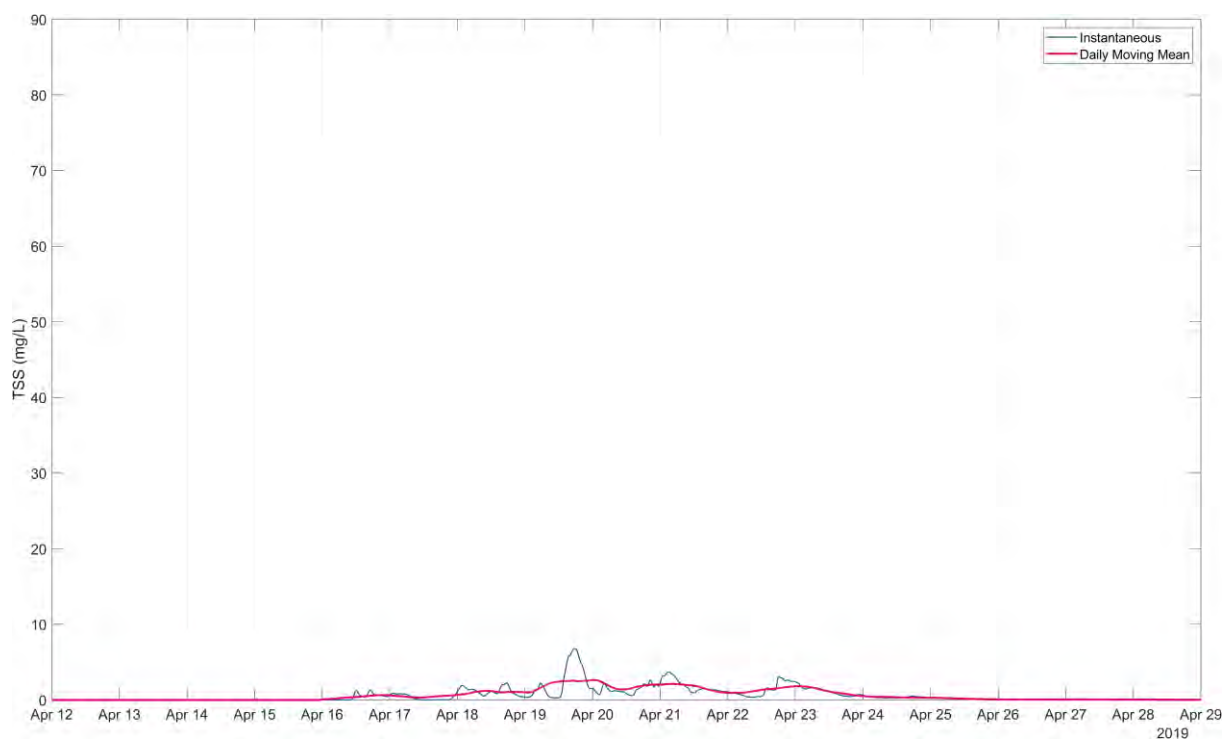


Figure 1.10 Time series plot of the instantaneous and daily moving mean TSS for Nearshore 5

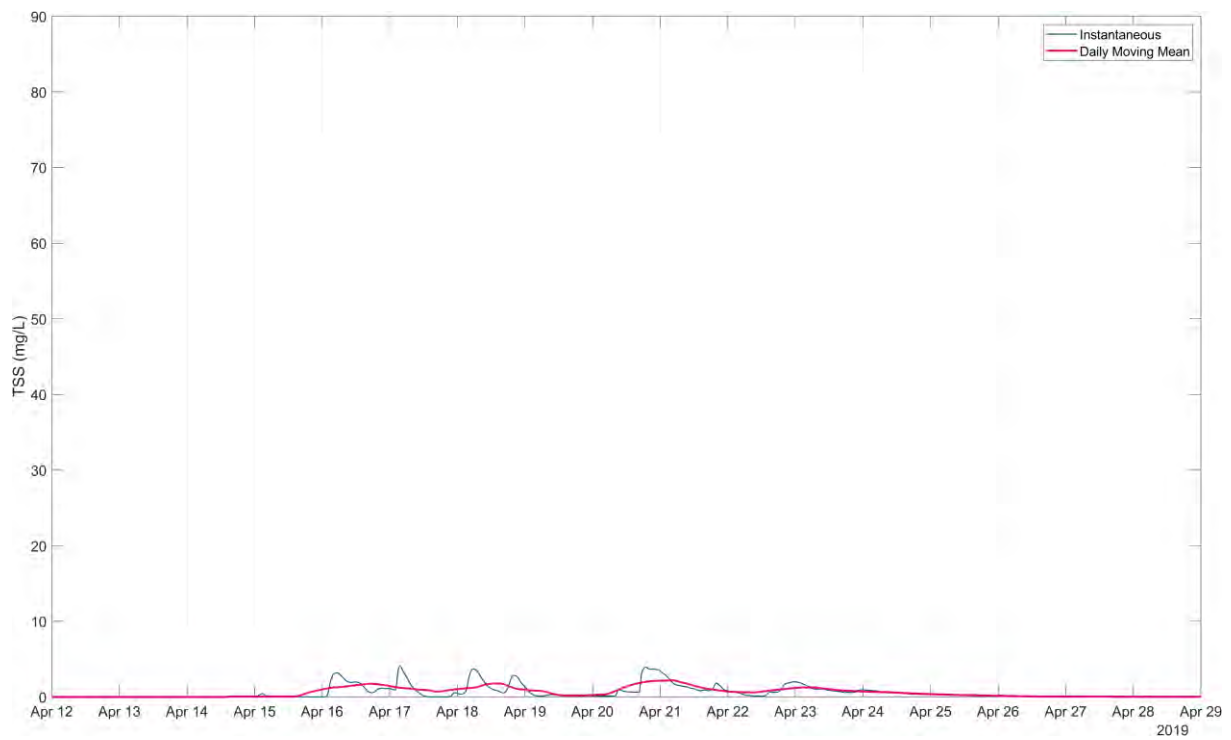


Figure 1.11 Time series plot of the instantaneous and daily moving mean TSS for Nearshore 6

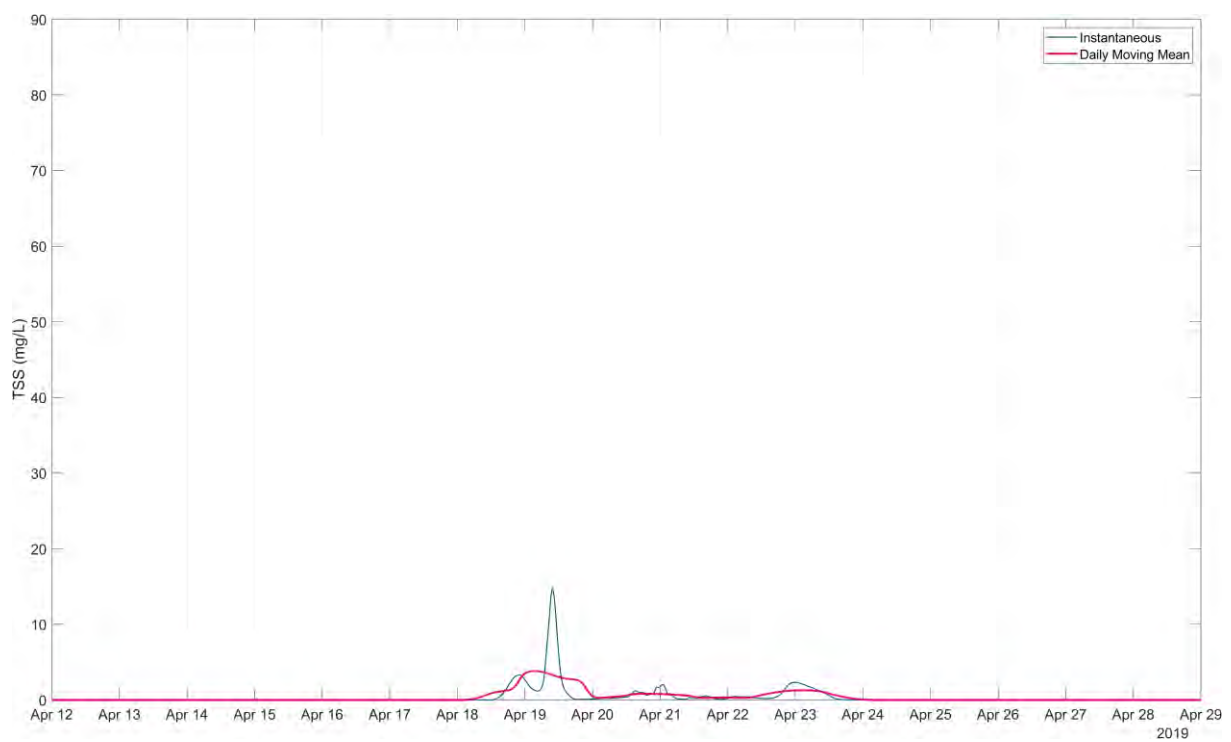


Figure 1.12 Time series plot of the instantaneous and daily moving mean TSS for Disposal 1

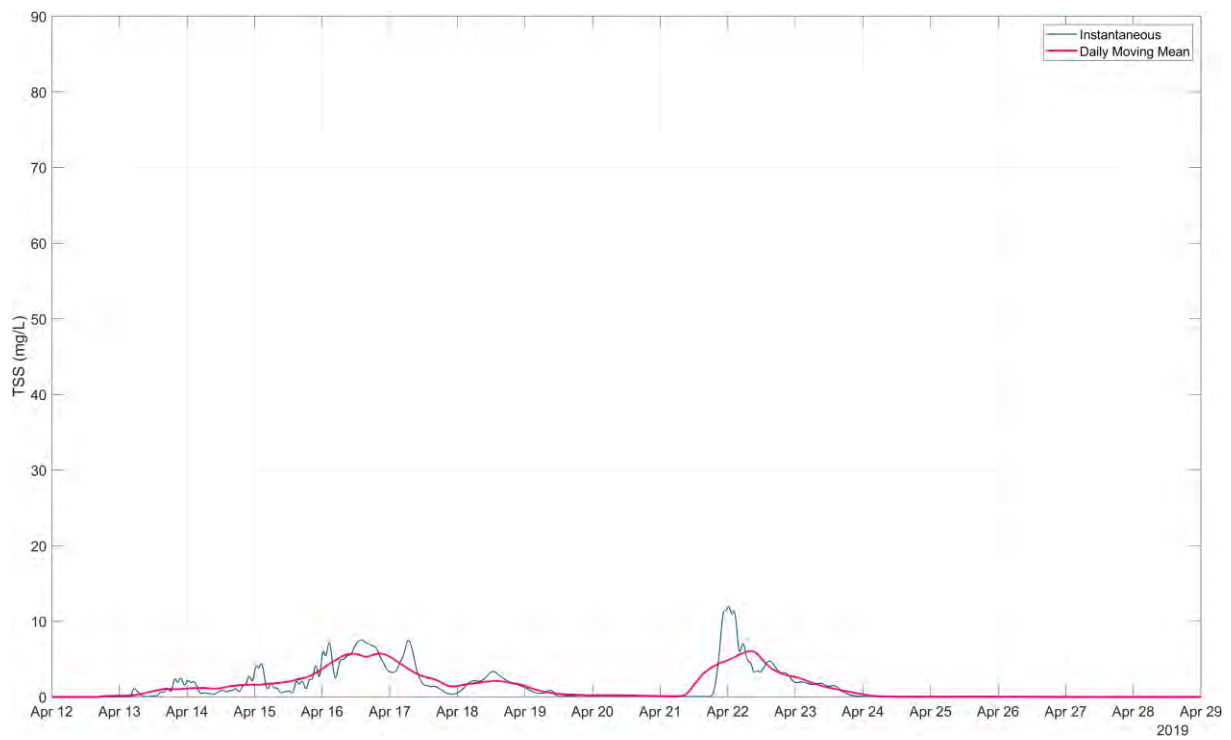


Figure 1.13 Time series plot of the instantaneous and daily moving mean TSS for Disposal 2

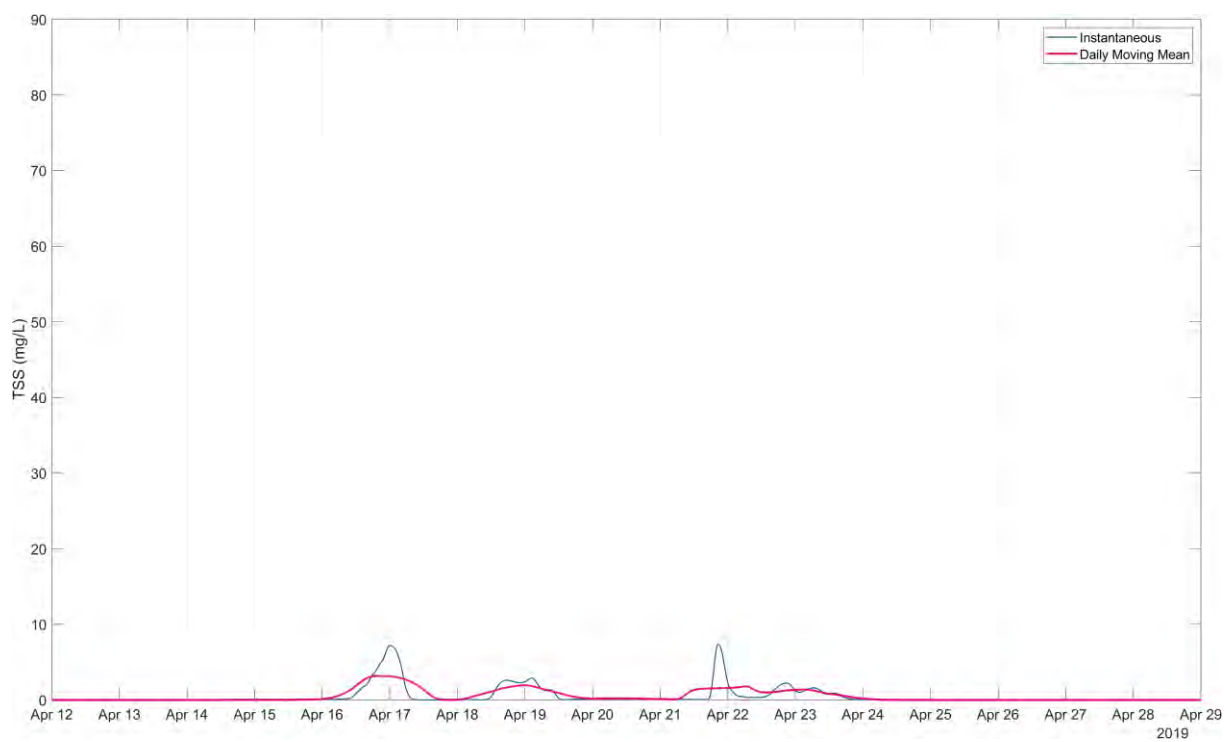


Figure 1.14 Time series plot of the instantaneous and daily moving mean TSS for Disposal 3

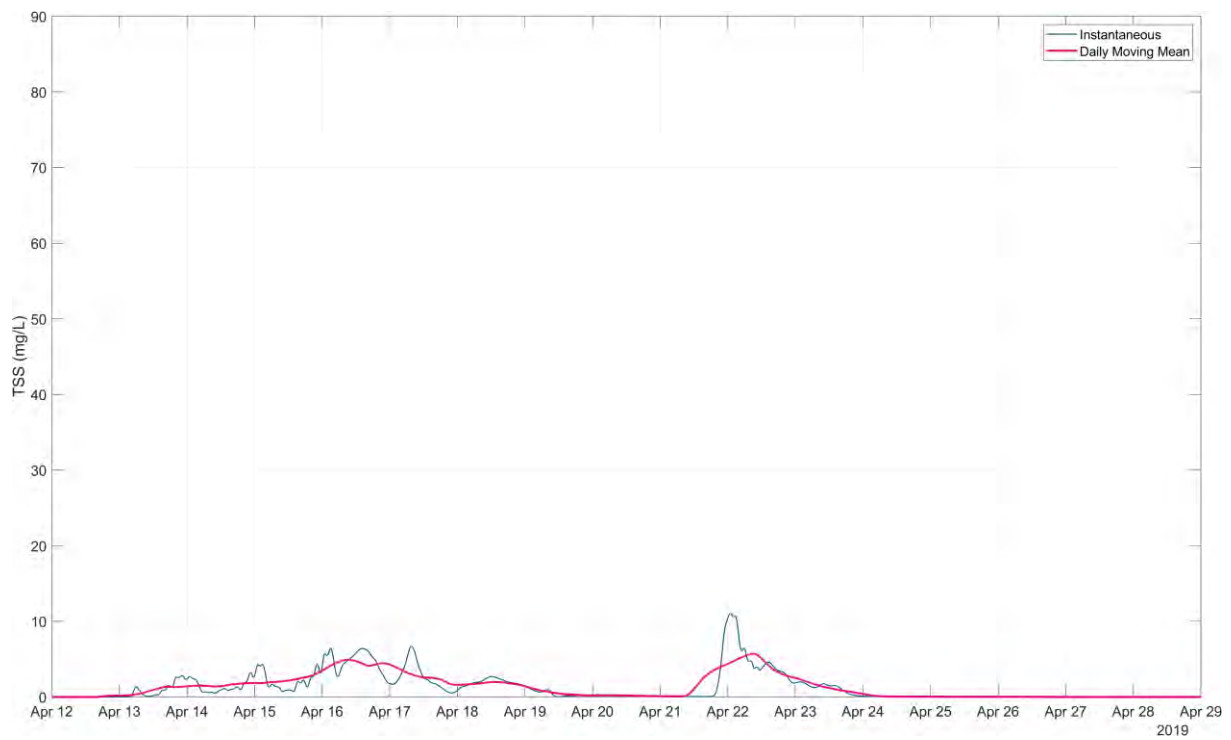


Figure 1.15 Time series plot of the instantaneous and daily moving mean TSS for Disposal 4

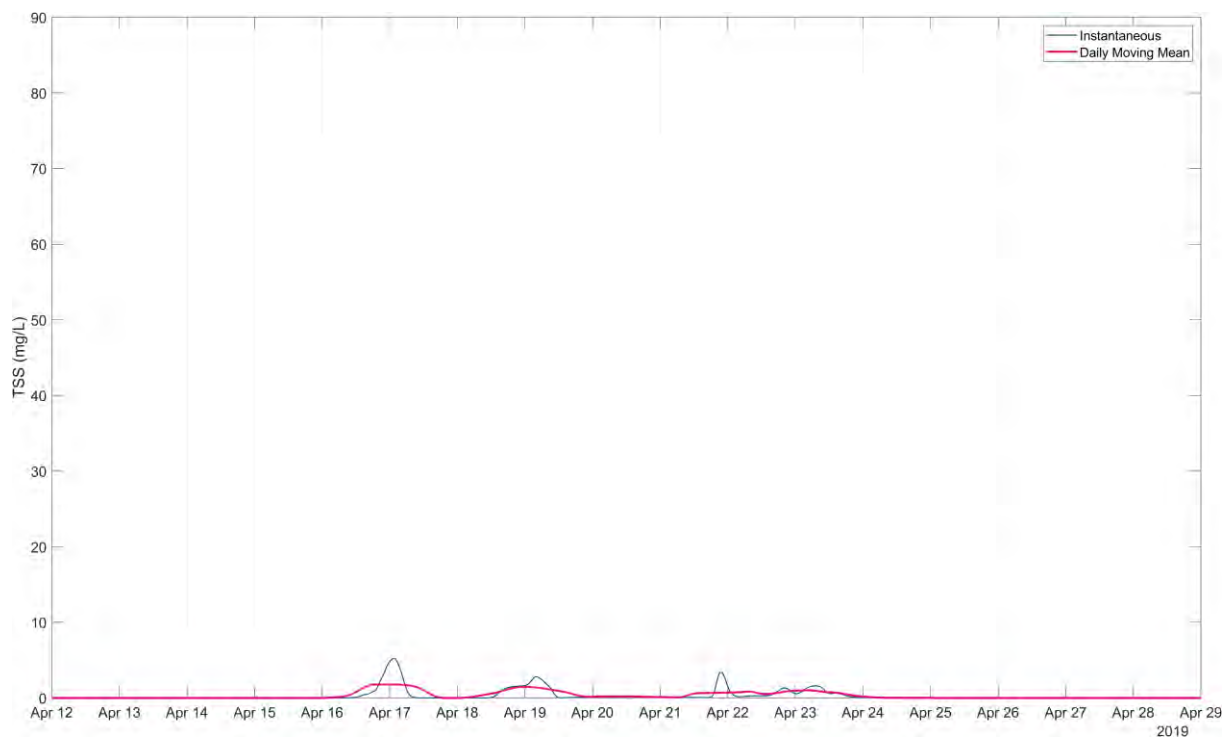


Figure 1.16 Time series plot of the instantaneous and daily moving mean TSS for Disposal 5

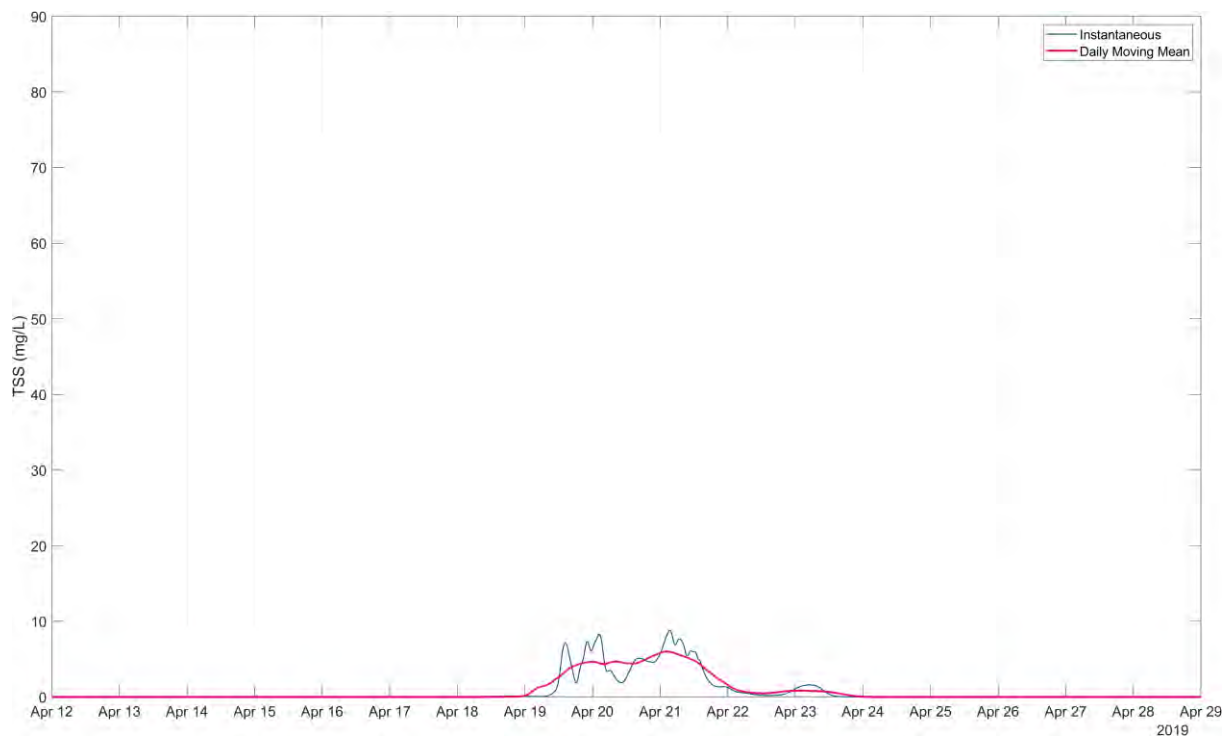


Figure 1.17 Time series plot of the instantaneous and daily moving mean TSS for Disposal 6

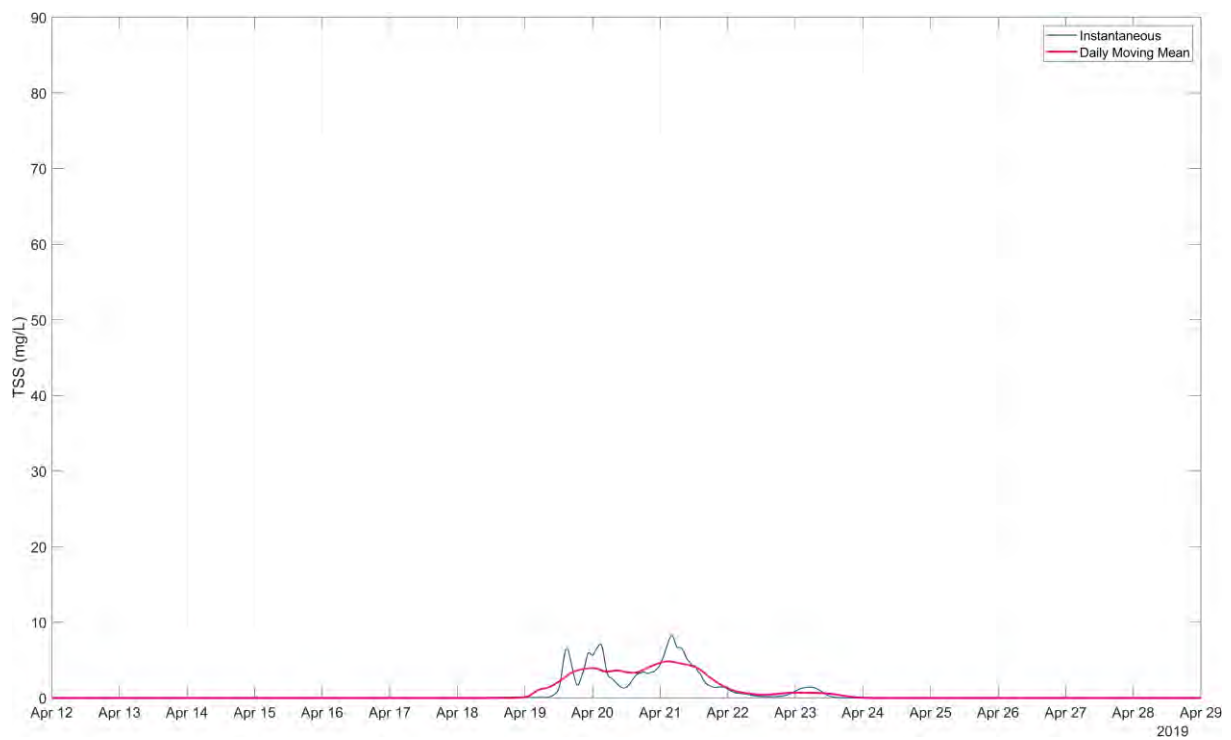


Figure 1.18 Time series plot of the instantaneous and daily moving mean TSS for Disposal 7

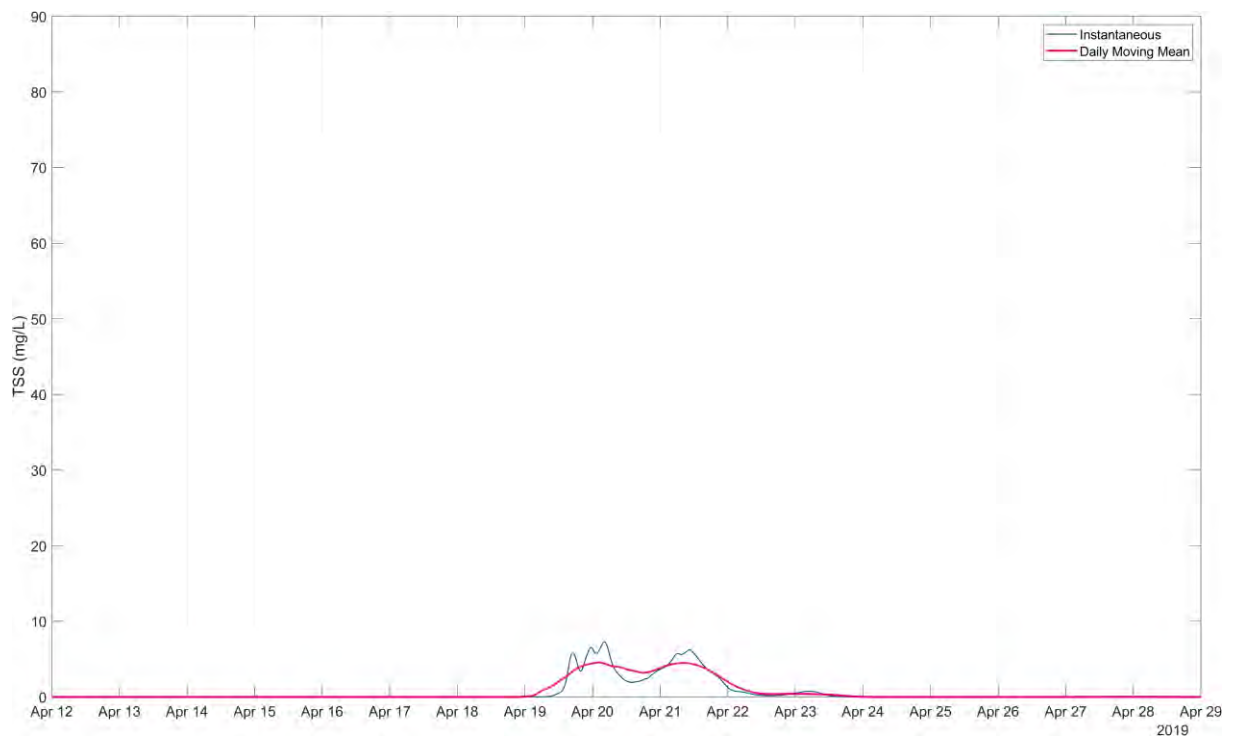


Figure 1.19 Time series plot of the instantaneous and daily moving mean TSS for Disposal 8

## **Annex B    Aboriginal Heritage Sites Report**

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## List of Registered Aboriginal Sites

### Search Criteria

2 Registered Aboriginal Sites in Custom search area - Polygon - 115.781014996916°E, 32.0167454809196°S (GDA94) : 115.784276563078°E, 32.0189287125815°S (GDA94) : 115.776036816985°E, 32.0276611190038°S (GDA94) : 115.763505536467°E, 32.0264968462421°S (GDA94) : 115.761445599944°E, 32.0286798455304°S (GDA94) : 115.762818890959°E, 32.0310083207569°S (GDA94) : 115.758527356535°E, 32.0407581677502°S (GDA94) : 115.754235822112°E, 32.0414857266423°S (GDA94) : 115.736039716155°E, 32.055599224866°S (GDA94) : 115.728143292815°E, 32.0560356901117°S (GDA94) : 115.713380414397°E, 32.0574905592266°S (GDA94) : 115.713037091643°E, 32.0548717781627°S (GDA94) : 115.73741300717°E, 32.0535623595224°S (GDA94) : 115.741017896086°E, 32.0502159823098°S (GDA94) : 115.749600964934°E, 32.0413402153265°S (GDA94) : 115.757669049651°E, 32.0393030326194°S (GDA94) : 115.76110227719°E, 32.0333367367834°S (GDA94) : 115.760415631682°E, 32.0292619698869°S (GDA94) : 115.755952435881°E, 32.0263513111063°S (GDA94) : 115.766767102629°E, 32.0231494796188°S (GDA94) : 115.774835187346°E, 32.0254780954358°S (GDA94) : 115.775865155608°E, 32.0254780954358°S (GDA94) : 115.781014996916°E, 32.0167454809196°S (GDA94)

### Disclaimer

The *Aboriginal Heritage Act 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Planning, Lands and Heritage by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at [AboriginalHeritage@dplh.wa.gov.au](mailto:AboriginalHeritage@dplh.wa.gov.au) and we will make every effort to rectify it as soon as possible.

### South West Settlement ILUA Disclaimer

Your heritage enquiry is on land **within or adjacent to** the following Indigenous Land Use Agreement(s): Whadjuk People Indigenous Land Use Agreement.

On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and, respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah #2 and Wagyl Kaip & Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).

The ILUAs bind 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) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an '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. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.

Likewise, from 8 June 2015 the Department of Mines, Industry Regulation and Safety (DMIRS) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.

If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMIRS, you should seek advice as to the requirement to use the NSHA for your proposed activity. The full ILUA documents, maps of the ILUA areas and the NSHA template can be found at <https://www.wa.gov.au/organisation/departments-of-the-premier-and-cabinet/south-west-native-title-settlement>.

Further advice can also be sought from the Department of Planning, Lands and Heritage at [AboriginalHeritage@dplh.wa.gov.au](mailto:AboriginalHeritage@dplh.wa.gov.au).

## List of Registered Aboriginal Sites

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### Copyright

Copyright in the information contained herein is and shall remain the property of the State of Western Australia. All rights reserved.

### Coordinate Accuracy

Coordinates (Easting/Northing metres) are based on the GDA 94 Datum. Accuracy is shown as a code in brackets following the coordinates.

### Terminology (NB that some terminology has varied over the life of the legislation)

**Place ID/Site ID:** This is a unique ID assigned by the Department of Planning, Lands and Heritage to the place.

#### Status:

- **Registered Site:** The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972*.
- **Other Heritage Place which includes:**
  - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972*.
  - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this *stage* to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972*.

#### Access and Restrictions:

- **File Restricted = No:** Availability of information that the Department of Planning, Lands and Heritage holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Planning, Lands and Heritage holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Planning, Lands and Heritage receives written approval from the informants who provided the information. To request access please contact [AboriginalHeritage@dplh.wa.gov.au](mailto:AboriginalHeritage@dplh.wa.gov.au).
- **Boundary Restricted = No:** Place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km<sup>2</sup>) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact the Department of Planning, Lands and Heritage.
- **Restrictions:**
  - **No Restrictions:** *Anyone* can view the information.
  - **Male Access Only:** Only *males* can view restricted information.
  - **Female Access Only:** Only *females* can view restricted information.

**Legacy ID:** This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.



## Aboriginal Heritage Inquiry System

### List of Registered Aboriginal Sites

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
3536	SWAN RIVER	No	No	No Gender Restrictions	Registered Site	Mythological	*Registered Knowledge Holder names available from DPL	389909mE 6460503mN Zone 50 [Reliable]	S02548
3596	ROCKY BAY	Yes	Yes	No Gender Restrictions	Registered Site	Mythological, Named Place	*Registered Knowledge Holder names available from DPL	Not available when location is restricted	S02422

## Annex C Other Heritage Sites Report

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## List of Other Heritage Places

### Search Criteria

9 Other Heritage Places in Custom search area - Polygon - 115.78009945211°E, 32.0159207013407°S (GDA94) : 115.785592616173°E, 32.0173762079961°S (GDA94) : 115.780442774864°E, 32.0217425892422°S (GDA94) : 115.778039515587°E, 32.0258176906602°S (GDA94) : 115.775636256309°E, 32.027564107202°S (GDA94) : 115.772546351524°E, 32.0287283663978°S (GDA94) : 115.76773983297°E, 32.0269819720545°S (GDA94) : 115.762933314415°E, 32.0255266179993°S (GDA94) : 115.762246668907°E, 32.0278551733884°S (GDA94) : 115.763619959923°E, 32.0313478954773°S (GDA94) : 115.76430660543°E, 32.033094206572°S (GDA94) : 115.762246668907°E, 32.0371688029533°S (GDA94) : 115.75984340963°E, 32.0397880905945°S (GDA94) : 115.760530055137°E, 32.0435713737808°S (GDA94) : 115.757440150352°E, 32.0458994703334°S (GDA94) : 115.751260340782°E, 32.0467724912743°S (GDA94) : 115.746797144981°E, 32.0493915041334°S (GDA94) : 115.741647303673°E, 32.0523014305187°S (GDA94) : 115.736840785118°E, 32.0560841964815°S (GDA94) : 115.740617335411°E, 32.057539064825°S (GDA94) : 115.74576717672°E, 32.0595758416384°S (GDA94) : 115.74576717672°E, 32.0691771786508°S (GDA94) : 115.736840785118°E, 32.0749956802228°S (GDA94) : 115.610269143815°E, 32.0706318387552°S (GDA94) : 115.602372720475°E, 32.0403701443384°S (GDA94) : 115.62125547194°E, 32.0231980034156°S (GDA94) : 115.683053567643°E, 32.0394970623349°S (GDA94) : 115.694383218521°E, 32.0473545006087°S (GDA94) : 115.729745462174°E, 32.0534653751637°S (GDA94) : 115.737985208268°E, 32.0514284623189°S (GDA94) : 115.746911599869°E, 32.0424073032997°S (GDA94) : 115.752748086685°E, 32.0400791179291°S (GDA94) : 115.758241250748°E, 32.038332940045°S (GDA94) : 115.759957864517°E, 32.0342583954678°S (GDA94) : 115.760301187271°E, 32.0301836695807°S (GDA94) : 115.756524636978°E, 32.0261087623961°S (GDA94) : 115.758927896256°E, 32.0231980034156°S (GDA94) : 115.774377420182°E, 32.0255266179992°S (GDA94) : 115.772660806412°E, 32.0255266179992°S (GDA94) : 115.78009945211°E, 32.0159207013407°S (GDA94)

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Your heritage enquiry is on land within or adjacent to the following Indigenous Land Use Agreement(s): Whadjuk People Indigenous Land Use Agreement.

On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and, respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah #2 and Wagyl Kaip & Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).

The ILUAs bind 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) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an '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. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.

Likewise, from 8 June 2015 the Department of Mines, Industry Regulation and Safety (DMIRS) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.

If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMIRS, you should seek advice as to the requirement to use the NSHA for your proposed activity. The full ILUA documents, maps of the ILUA areas and the NSHA template can be found at <https://www.wa.gov.au/organisation/departments-of-the-premier-and-cabinet/south-west-native-title-settlement>.

Further advice can also be sought from the Department of Planning, Lands and Heritage at [AboriginalHeritage@dplh.wa.gov.au](mailto:AboriginalHeritage@dplh.wa.gov.au).

### Copyright

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### Coordinate Accuracy

Coordinates (Easting/Northing metres) are based on the GDA 94 Datum. Accuracy is shown as a code in brackets following the coordinates.

Terminology (NB that some terminology has varied over the life of the legislation)

Place ID/Site ID: This a unique ID assigned by the Department of Planning, Lands and Heritage to the place.

Status:

- Registered Site: The place has been assessed as meeting Section 5 of the Aboriginal Heritage Act 1972.
- Other Heritage Place which includes:
  - Stored Data / Not a Site: The place has been assessed as not meeting Section 5 of the Aboriginal Heritage Act 1972.
  - Lodged: Information has been received in relation to the place, but an assessment has not been completed at this stage to determine if it meets Section 5 of the Aboriginal Heritage Act 1972.

Access and Restrictions:

- File Restricted = No: Availability of information that the Department of Planning, Lands and Heritage holds in relation to the place is not restricted in any way.
- File Restricted = Yes: Some of the information that the Department of Planning, Lands and Heritage holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Planning, Lands and Heritage receives written approval from the informants who provided the information. To request access please contact [AboriginalHeritage@dplh.wa.gov.au](mailto:AboriginalHeritage@dplh.wa.gov.au).
- Boundary Restricted = No: Place location is shown as accurately as the information lodged with the Registrar allows.
- Boundary Restricted = Yes: To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km<sup>2</sup>) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact the Department of Planning, Lands and Heritage.
- Restrictions:
  - No Restrictions: Anyone can view the information.
  - Male Access Only: Only males can view restricted information.
  - Female Access Only: Only females can view restricted information.

Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.



# Aboriginal Heritage Inquiry System

## List of Other Heritage Places

For further important information on using this information please see the  
Department of Planning, Lands and Heritage's Disclaimer statement at  
<https://www.dplh.wa.gov.au/about-this-website>

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
3420	FREMANTLE: ANGLESEA POINT.	No	No	No Gender Restrictions	Lodged	Named Place	*Registered Knowledge Holder names available from DPL	381281mE 6452417mN Zone 50 [Unreliable]	S02702
3569	COLONIAL SUGAR REFINERY.	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter, Camp	*Registered Knowledge Holder names available from DPL	384192mE 6456275mN Zone 50 [Unreliable]	S02492
3588	FRESHWATER BAY.	No	No	No Gender Restrictions	Stored Data / Not a Site	Camp	*Registered Knowledge Holder names available from DPL	384639mE 6457649mN Zone 50 [Unreliable]	S02414
3650	BLACKWALL REACH, BICTON.	No	No	No Gender Restrictions	Stored Data / Not a Site	Water Source	*Registered Knowledge Holder names available from DPL	384639mE 6456649mN Zone 50 [Unreliable]	S02264
3651	BLACKWALL REACH, MOSMAN PK.	No	No	No Gender Restrictions	Stored Data / Not a Site	Water Source	*Registered Knowledge Holder names available from DPL	384639mE 6457649mN Zone 50 [Unreliable]	S02265
3774	FREMANTLE: ARTHUR HEAD.	No	No	No Gender Restrictions	Stored Data / Not a Site	Camp	*Registered Knowledge Holder names available from DPL	381139mE 6452749mN Zone 50 [Unreliable]	S02167
3775	SOUTH FREMANTLE	No	No	No Gender Restrictions	Stored Data / Not a Site	Ceremonial, Mythological	*Registered Knowledge Holder names available from DPL	382487mE 6454055mN Zone 50 [Unreliable]	S02168
3776	INDIAN OCEAN	No	No	No Gender Restrictions	Stored Data / Not a Site	Mythological	*Registered Knowledge Holder names available from DPL	372624mE 6445362mN Zone 50 [Reliable]	S02169
21253	Mosman Park	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter, Ceremonial, Grinding Patches / Grooves, Historical, Mythological, Water Source	*Registered Knowledge Holder names available from DPL	382770mE 6456397mN Zone 50 [Reliable]	

## **Annex D   *EPBC Act Protected Matters Report***

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# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 12-Sep-2022

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

# Summary

## Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

<a href="#">World Heritage Properties:</a>	1
<a href="#">National Heritage Places:</a>	1
<a href="#">Wetlands of International Importance (Ramsar</a>	1
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Area:</a>	None
<a href="#">Listed Threatened Ecological Communities:</a>	2
<a href="#">Listed Threatened Species:</a>	53
<a href="#">Listed Migratory Species:</a>	65

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

<a href="#">Commonwealth Lands:</a>	36
<a href="#">Commonwealth Heritage Places:</a>	1
<a href="#">Listed Marine Species:</a>	95
<a href="#">Whales and Other Cetaceans:</a>	12
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves Terrestrial:</a>	None
<a href="#">Australian Marine Parks:</a>	None
<a href="#">Habitat Critical to the Survival of Marine Turtles:</a>	None

## Extra Information

This part of the report provides information that may also be relevant to the area you have

<a href="#">State and Territory Reserves:</a>	5
<a href="#">Regional Forest Agreements:</a>	None
<a href="#">Nationally Important Wetlands:</a>	1
<a href="#">EPBC Act Referrals:</a>	15
<a href="#">Key Ecological Features (Marine):</a>	None
<a href="#">Biologically Important Areas:</a>	14
<a href="#">Bioregional Assessments:</a>	None
<a href="#">Geological and Bioregional Assessments:</a>	None

# Details

## Matters of National Environmental Significance

World Heritage Properties			[ Resource Information ]
Name	State	Legal Status	Buffer Status
<a href="#">Australian Convict Sites (Fremantle Prison)</a>	WA	Declared property	In buffer area only

National Heritage Places			[ Resource Information ]
Name	State	Legal Status	Buffer Status
Historic			
<a href="#">Fremantle Prison (former)</a>	WA	Listed place	In feature area

Wetlands of International Importance (Ramsar Wetlands)			[ Resource Information ]
Ramsar Site Name		Proximity	Buffer Status
<a href="#">Forrestdale and thomsons lakes</a>		Within 10km of Ramsar site	In buffer area only

Listed Threatened Ecological Communities			[ Resource Information ]
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For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Banksia Woodlands of the Swan Coastal Plain ecological community</a>	Endangered	Community likely to occur within area	In feature area
<a href="#">Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community</a>	Critically Endangered	Community likely to occur within area	In feature area

Listed Threatened Species			[ Resource Information ]
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Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.

Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
<a href="#">Anous tenuirostris melanops</a>			
Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Botaurus poiciloptilus</a>			
Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Calidris canutus</a> Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area	In feature area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
<a href="#">Calidris tenuirostris</a> Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Calyptorhynchus banksii naso</a> Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area	In feature area
<a href="#">Charadrius leschenaultii</a> Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
<a href="#">Charadrius mongolus</a> Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Diomedea amsterdamensis</a> Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Diomedea dabbenena</a> Tristan Albatross [66471]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Diomedea epomophora</a> Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Diomedea exulans</a> Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Diomedea sanfordi</a> Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Halobaena caerulea</a> Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In buffer area only
<a href="#">Leipoa ocellata</a> Malleefowl [934]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Limosa lapponica menzbieri</a> Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area	In feature area
<a href="#">Macronectes giganteus</a> Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Macronectes halli</a> Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Numenius madagascariensis</a> Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
<a href="#">Pachyptila turtur subantarctica</a> Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
<a href="#">Pterodroma mollis</a> Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In buffer area only
<a href="#">Rostratula australis</a> Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
<a href="#">Sternula nereis nereis</a> Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Thalassarche carteri</a> Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Thalassarche cauta</a> Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Thalassarche impavida</a> Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Thalassarche melanophris</a> Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Thalassarche steadi</a> White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Zanda latirostris listed as Calyptorhynchus latirostris</a> Carnaby's Black Cockatoo, Short-billed Black-cockatoo [87737]	Endangered	Breeding known to occur within area	In feature area
FISH			
<a href="#">Thunnus maccoyii</a> Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
MAMMAL			
<a href="#">Balaenoptera musculus</a> Blue Whale [36]	Endangered	Species or species habitat likely to occur within area	In feature area
<a href="#">Dasyurus geoffroii</a> Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Eubalaena australis</a> Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
<a href="#">Macroderma gigas</a> Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area	In buffer area only
<a href="#">Neophoca cinerea</a> Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Pseudocheirus occidentalis</a> Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
PLANT			
<a href="#">Andersonia gracilis</a> Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Caladenia huegelii</a> King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area	In feature area
<a href="#">Diuris drummondii</a> Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area	In feature area
<a href="#">Diuris micrantha</a> Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area	In feature area
<a href="#">Diuris purdiei</a> Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area	In buffer area only
<a href="#">Drakaea elastica</a> Glossy-leafed Hammer Orchid, Glossy-leafed Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area	In feature area
<a href="#">Drakaea micrantha</a> Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area	In buffer area only
<a href="#">Macarthuria keigheryi</a> Keighery's Macarthuria [64930]	Endangered	Species or species habitat may occur within area	In buffer area only
REPTILE			
<a href="#">Caretta caretta</a> Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Chelonia mydas</a> Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Dermochelys coriacea</a> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Natator depressus</a> Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

SHARK			
<a href="#">Carcharias taurus (west coast population)</a> Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area	In feature area
<a href="#">Carcharodon carcharias</a> White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
<a href="#">Pristis pristis</a> Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Rhincodon typus</a> Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Sphyrna lewini</a> Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area

Listed Migratory Species		[ <a href="#">Resource Information</a> ]	
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
<a href="#">Anous stolidus</a> Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Ardenna carneipes</a> Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Diomedea amsterdamensis</a> Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Diomedea dabbenena</a> Tristan Albatross [66471]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Diomedea epomophora</a> Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Diomedea exulans</a> Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Diomedea sanfordi</a> Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Hydroprogne caspia</a> Caspian Tern [808]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Macronectes giganteus</a> Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Macronectes halli</a> Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Onychoprion anaethetus</a> Bridled Tern [82845]		Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Sterna dougallii</a> Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Sternula albifrons</a> Little Tern [82849]		Species or species habitat may occur within area	In feature area
<a href="#">Thalassarche carteri</a> Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
<a href="#">Thalassarche cauta</a> Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Thalassarche impavida</a> Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Thalassarche melanophris</a> Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Thalassarche steadi</a> White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
Migratory Marine Species			
<a href="#">Balaenoptera edeni</a> Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
<a href="#">Balaenoptera musculus</a> Blue Whale [36]	Endangered	Species or species habitat likely to occur within area	In feature area
<a href="#">Caperea marginata</a> Pygmy Right Whale [39]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Carcharhinus longimanus</a> Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area	In feature area
<a href="#">Carcharodon carcharias</a> White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
<a href="#">Caretta caretta</a> Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Chelonia mydas</a> Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Dermochelys coriacea</a> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Eubalaena australis as Balaena glacialis australis</a> Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
<a href="#">Lamna nasus</a> Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area	In feature area
<a href="#">Megaptera novaeangliae</a> Humpback Whale [38]		Species or species habitat known to occur within area	In feature area
<a href="#">Mobula alfredi as Manta alfredi</a> Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat may occur within area	In feature area
<a href="#">Mobula birostris as Manta birostris</a> Giant Manta Ray [90034]		Species or species habitat may occur within area	In feature area
<a href="#">Natator depressus</a> Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Orcinus orca</a> Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
<a href="#">Pristis pristis</a> Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Rhincodon typus</a> Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Migratory Terrestrial Species			
<a href="#">Motacilla cinerea</a> Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
<a href="#">Arenaria interpres</a> Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Calidris alba</a> Sanderling [875]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Calidris canutus</a> Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area	In feature area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat likely to occur within area	In feature area
<a href="#">Calidris ruficollis</a> Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Calidris tenuirostris</a> Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Charadrius bicinctus</a> Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Charadrius leschenaultii</a> Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
<a href="#">Charadrius mongolus</a> Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Gallinago megala</a> Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
<a href="#">Gallinago stenura</a> Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
<a href="#">Limosa lapponica</a> Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
<a href="#">Limosa limosa</a> Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Numenius madagascariensis</a> Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
<a href="#">Numenius minutus</a> Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
<a href="#">Numenius phaeopus</a> Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Pandion haliaetus</a> Osprey [952]		Breeding known to occur within area	In feature area
<a href="#">Phalaropus lobatus</a> Red-necked Phalarope [838]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Pluvialis fulva</a> Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Pluvialis squatarola</a> Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Tringa brevipes</a> Grey-tailed Tattler [851]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Tringa nebularia</a> Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area	In feature area
<a href="#">Tringa stagnatilis</a> Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Tringa totanus</a>			
Common Redshank, Redshank [835]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Xenus cinereus</a>			
Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area	In feature area

## Other Matters Protected by the EPBC Act

Commonwealth Lands

[ [Resource Information](#) ]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - ARTILLERY BARRACKS - FREMANTLE [50155]	WA	In feature area
Defence - EAST FREMANTLE SMALL CRAFT BASE [50118]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50153]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50154]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50146]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50151]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50150]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50152]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50148]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50147]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50149]	WA	In buffer area only
Defence - PRESTON POINT TRAINING DEPOT [50174]	WA	In buffer area only
Defence - PRESTON POINT TRAINING DEPOT [50173]	WA	In buffer area only
Defence - PRESTON POINT TRAINING DEPOT [50172]	WA	In buffer area only
Unknown		
Commonwealth Land - [51125]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [51122]	WA	In buffer area only
Commonwealth Land - [50677]	WA	In buffer area only
Commonwealth Land - [50671]	WA	In buffer area only
Commonwealth Land - [50676]	WA	In buffer area only
Commonwealth Land - [50669]	WA	In buffer area only
Commonwealth Land - [50670]	WA	In buffer area only
Commonwealth Land - [51414]	WA	In buffer area only
Commonwealth Land - [51413]	WA	In buffer area only
Commonwealth Land - [51438]	WA	In buffer area only
Commonwealth Land - [50683]	WA	In buffer area only
Commonwealth Land - [50687]	WA	In buffer area only
Commonwealth Land - [50685]	WA	In buffer area only
Commonwealth Land - [50688]	WA	In buffer area only
Commonwealth Land - [51894]	WA	In buffer area only
Commonwealth Land - [51115]	WA	In buffer area only
Commonwealth Land - [51116]	WA	In buffer area only
Commonwealth Land - [51895]	WA	In buffer area only
Commonwealth Land - [50516]	WA	In feature area
Commonwealth Land - [50647]	WA	In buffer area only
Commonwealth Land - [50517]	WA	In feature area
Commonwealth Land - [51494]	WA	In buffer area only

Commonwealth Heritage Places			[ Resource Information ]
Name	State	Status	Buffer Status
Historic			
<a href="#">Artillery Barracks</a>	WA	Listed place	In feature area

Listed Marine Species			[ Resource Information ]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]	Vulnerable	Species or species habitat known to occur within area	In feature area
<a href="#">Anous stolidus</a> Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
<a href="#">Anous tenuirostris melanops</a> Australian Lesser Noddy [26000]		Species or species habitat may occur within area	In feature area
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
<a href="#">Ardenna carneipes as Puffinus carneipes</a> Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Arenaria interpres</a> Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Bubulcus ibis as Ardea ibis</a> Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Calidris alba</a> Sanderling [875]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Calidris canutus</a> Red Knot, Knot [855]		Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat likely to occur within area overfly marine area	In feature area
<a href="#">Calidris ruficollis</a> Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
<a href="#">Calidris tenuirostris</a> Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
<a href="#">Charadrius bicinctus</a> Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
<a href="#">Charadrius leschenaultii</a> Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
<a href="#">Charadrius mongolus</a> Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Charadrius ruficapillus</a> Red-capped Plover [881]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
<a href="#">Diomedea amsterdamensis</a> Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Diomedea dabbenena</a> Tristan Albatross [66471]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Diomedea epomophora</a> Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Diomedea exulans</a> Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Diomedea sanfordi</a> Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Gallinago megala</a> Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area overfly marine area	In buffer area only
<a href="#">Gallinago stenura</a> Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area overfly marine area	In buffer area only
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
<a href="#">Halobaena caerulea</a> Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In buffer area only
<a href="#">Himantopus himantopus</a> Pied Stilt, Black-winged Stilt [870]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
<a href="#">Hydroprogne caspia as Sterna caspia</a> Caspian Tern [808]		Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Larus pacificus</a> Pacific Gull [811]		Foraging, feeding or related behaviour may occur within area	In feature area
<a href="#">Limosa lapponica</a> Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
<a href="#">Limosa limosa</a> Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
<a href="#">Macronectes giganteus</a> Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Macronectes halli</a> Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
<a href="#">Motacilla cinerea</a> Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
<a href="#">Numenius madagascariensis</a> Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
<a href="#">Numenius minutus</a> Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Numenius phaeopus</a> Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Onychoprion anaethetus as Sterna anaethetus</a> Bridled Tern [82845]		Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Pachyptila turtur</a> Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area
<a href="#">Pandion haliaetus</a> Osprey [952]		Breeding known to occur within area	In feature area
<a href="#">Phalaropus lobatus</a> Red-necked Phalarope [838]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Pluvialis fulva</a> Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Pluvialis squatarola</a> Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
<a href="#">Pterodroma mollis</a> Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In buffer area only
<a href="#">Puffinus assimilis</a> Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Recurvirostra novaehollandiae</a> Red-necked Avocet [871]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Rostratula australis as Rostratula benghalensis (sensu lato)</a> Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
<a href="#">Stercorarius skua as Catharacta skua</a> Great Skua [823]		Species or species habitat may occur within area	In buffer area only
<a href="#">Sterna dougallii</a> Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Sternula albifrons as Sterna albifrons</a> Little Tern [82849]		Species or species habitat may occur within area	In feature area
<a href="#">Thalassarche carteri</a> Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
<a href="#">Thalassarche cauta</a> Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Thalassarche impavida</a> Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Thalassarche melanophris</a> Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
<a href="#">Thalassarche steadi</a> White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
<a href="#">Thinornis cucullatus as Thinornis rubricollis</a> Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Tringa brevipes as Heteroscelus brevipes</a> Grey-tailed Tattler [851]		Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Tringa nebularia</a> Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area overfly marine area	In feature area
<a href="#">Tringa stagnatilis</a> Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
<a href="#">Tringa totanus</a> Common Redshank, Redshank [835]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
<a href="#">Xenus cinereus</a> Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
Fish			
<a href="#">Acentronura australe</a> Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area	In feature area
<a href="#">Campichthys galei</a> Gale's Pipefish [66191]		Species or species habitat may occur within area	In feature area
<a href="#">Heraldia nocturna</a> Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
<a href="#">Hippocampus angustus</a> Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Hippocampus breviceps</a> Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
<a href="#">Hippocampus subelongatus</a> West Australian Seahorse [66722]		Species or species habitat may occur within area	In feature area
<a href="#">Histiogamphelus cristatus</a> Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
<a href="#">Lissocampus caudalis</a> Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
<a href="#">Lissocampus fatiloquus</a> Prophet's Pipefish [66250]		Species or species habitat may occur within area	In feature area
<a href="#">Lissocampus runa</a> Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
<a href="#">Maroubra perserrata</a> Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
<a href="#">Mitotichthys meraculus</a> Western Crested Pipefish [66259]		Species or species habitat may occur within area	In feature area
<a href="#">Nannocampus subosseus</a> Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area	In feature area
<a href="#">Phycodurus eques</a> Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area
<a href="#">Phyllopteryx taeniolatus</a> Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Pugnaso curtirostris</a> Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
<a href="#">Solegnathus lettiensis</a> Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area	In feature area
<a href="#">Stigmatopora argus</a> Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
<a href="#">Stigmatopora nigra</a> Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
<a href="#">Urocampus carinirostris</a> Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
<a href="#">Vanacampus margaritifer</a> Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
<a href="#">Vanacampus phillipi</a> Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
<a href="#">Vanacampus poecilolaemus</a> Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			
<a href="#">Arctocephalus forsteri</a> Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
<a href="#">Neophoca cinerea</a> Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat known to occur within area	In feature area
Reptile			
<a href="#">Aipysurus pooleorum</a> Shark Bay Seasnake [66061]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
<a href="#">Caretta caretta</a> Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Chelonia mydas</a> Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Dermochelys coriacea</a> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Disteira kingii</a> Spectacled Seasnake [1123]		Species or species habitat may occur within area	In feature area
<a href="#">Natator depressus</a> Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
<a href="#">Pelamis platurus</a> Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area	In buffer area only

Whales and Other Cetaceans			[ Resource Information ]
Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
<a href="#">Balaenoptera acutorostrata</a> Minke Whale [33]		Species or species habitat may occur within area	In feature area
<a href="#">Balaenoptera edeni</a> Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
<a href="#">Balaenoptera musculus</a> Blue Whale [36]	Endangered	Species or species habitat likely to occur within area	In feature area
<a href="#">Caperea marginata</a> Pygmy Right Whale [39]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
<a href="#">Delphinus delphis</a> Common Dolphin, Short-beaked Common Dolphin [60]	Endangered	Species or species habitat may occur within area	In feature area
<a href="#">Eubalaena australis</a> Southern Right Whale [40]		Breeding known to occur within area	In feature area
<a href="#">Grampus griseus</a> Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
<a href="#">Megaptera novaeangliae</a> Humpback Whale [38]		Species or species habitat known to occur within area	In feature area
<a href="#">Orcinus orca</a> Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
<a href="#">Stenella attenuata</a> Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area	In feature area
<a href="#">Tursiops aduncus</a> Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
<a href="#">Tursiops truncatus s. str.</a> Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area

Extra Information

State and Territory Reserves			[ <a href="#">Resource Information</a> ]
Protected Area Name	Reserve Type	State	Buffer Status
Alfred Cove	Nature Reserve	WA	In buffer area only
Cottesloe Reef	Fish Habitat Protection Area	WA	In buffer area only
Keanes Point Reserve	5(1)(g) Reserve	WA	In buffer area only
Swan Estuary - Alfred Cove	Marine Park	WA	In buffer area only
Swan River	Management Area	WA	In feature area

Nationally Important Wetlands				[ Resource Information ]
Wetland Name		State	Buffer Status	
<a href="#">Swan-Canning Estuary</a>		WA	In feature area	
EPBC Act Referrals				[ Resource Information ]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
<a href="#">Roe Highway extension, Kwinana Freeway to Stock Road, WA</a>	2009/5031	Controlled Action	Post-Approval	In buffer area only
<a href="#">Shark Hazard Mitigation Drum Line Program, WA</a>	2014/7174	Controlled Action	Completed	In feature area
<a href="#">Shenton Park Subdivision</a>	2004/1479	Controlled Action	Completed	In buffer area only
<a href="#">Warders Hotel, Block 1 Warders Cottages, Fremantle, WA</a>	2018/8144	Controlled Action	Post-Approval	In feature area
Not controlled action				
<a href="#">Construction and operation of an 8 turbine wind farm at Rous Head Harbour, Frema</a>	2003/933	Not Controlled Action	Completed	In feature area
<a href="#">Disposal of residential properties, Fremantle, WA</a>	2019/8593	Not Controlled Action	Completed	In feature area
<a href="#">Fremantle Ports Inner Harbour Capital Dredging Proposal</a>	2005/2477	Not Controlled Action	Completed	In feature area
<a href="#">High Street Upgrade, Fremantle, WA</a>	2018/8315	Not Controlled Action	Completed	In buffer area only
<a href="#">Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia</a>	2015/7522	Not Controlled Action	Completed	In feature area
<a href="#">INDIGO Central Submarine Telecommunications Cable</a>	2017/8127	Not Controlled Action	Completed	In feature area
<a href="#">Warders' Cottages Block 2 'W2'</a>	2022/9148	Not Controlled Action	Completed	In feature area
<a href="#">Warders' Cottages W2 minor works, Fremantle, WA</a>	2018/8185	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
<a href="#">City of Cockburn Sporting Facilities</a>	2005/2139	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
<a href="#">INDIGO Marine Cable Route Survey (INDIGO)</a>	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
<a href="#">South West Metropolitan Railway Project</a>	2003/1175	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Biologically Important Areas				
Scientific Name		Behaviour	Presence	Buffer Status
Seabirds				
<a href="#">Ardenna carneipes</a>				
Flesh-footed Shearwater [82404]		Aggregation	Known to occur	In buffer area only
<a href="#">Ardenna pacifica</a>				
Wedge-tailed Shearwater [84292]		Foraging (in high numbers)	Known to occur	In feature area
<a href="#">Eudyptula minor</a>				
Little Penguin [1085]		Foraging (provisioning young)	Known to occur	In feature area
<a href="#">Hydroprogne caspia</a>				
Caspian Tern [808]		Foraging (provisioning young)	Known to occur	In feature area
<a href="#">Larus pacificus</a>				
Pacific Gull [811]		Foraging (in high numbers)	Former Range	In feature area
<a href="#">Onychoprion anaethetus</a>				
Bridled Tern [82845]		Foraging (in high numbers)	Known to occur	In feature area
<a href="#">Puffinus assimilis tunneyi</a>				
Little Shearwater [59363]		Foraging (in high numbers)	Known to occur	In feature area
<a href="#">Sterna dougallii</a>				
Roseate Tern [817]		Foraging	Known to occur	In feature area
<a href="#">Sternula nereis</a>				
Fairy Tern [82949]		Foraging (in high numbers)	Known to occur	In feature area

Seals				
<a href="#">Neophoca cinerea</a>				
Australian Sea Lion [22]		Foraging (male)	Likely to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Whales			
<a href="#">Balaenoptera musculus brevicauda</a> Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area
<a href="#">Eubalaena australis</a> Southern Right Whale [40]	Calving buffer	Known to occur	In buffer area only
<a href="#">Eubalaena australis</a> Southern Right Whale [40]	Seasonal calving habitat	Known to occur	In feature area
<a href="#">Megaptera novaeangliae</a> Humpback Whale [38]	Migration (north and south)	Known to occur	In feature area

# Caveat

## 1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

## 2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

## 3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

## 4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
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- [-Online Zoological Collections of Australian Museums](#)
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- [-Tasmanian Herbarium](#)
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- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
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- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

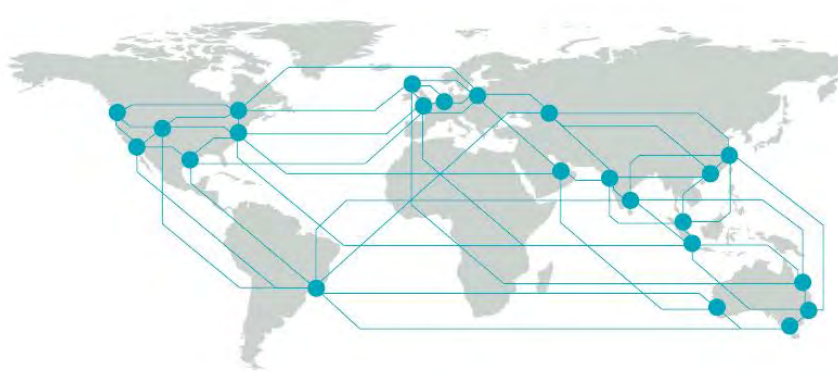
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