4724-113-EN-RPT-001 Preliminary Environmental Impact Assessment

Kwinana Bulk Berth 5

16 February 2024

The Power of Commitment

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Terminology

Terminology	Definition
Derbal Nara	Noongar name for Cockburn Sound
Fremantle Ports	Fremantle Port Authority Legislated management authority of the Port of Fremantle. Original established under the Fremantle Port Authority Act 1902, however now governed under the Port Authorities Act 1999
Access trestle	Steel piled marine structure supporting infrastructure
Wharf	Marine structure to which vessels may be moored to load and unload
Landside DE	Terrestrial development envelope within the project area, comprising landside infrastructure and construction activities, total area of 16.4 ha.
Marine DE	Marine development envelope within the project area, comprising marine infrastructure and construction activities, total area of 43.1 ha.
Marine loading arms	Marine structure consisting of mechanical arm for loading purposes

Abbreviations

Abbreviation	Expanded form
ACHA	Aboriginal Cultural Heritage Act
AHA	Aboriginal Heritage Act 1971
AHIS	Aboriginal Heritage Inquiry System
CO2- e	Carbon dioxide emissions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DE	Development Envelope
DER	Department of Environmental Regulation
DotE	Department of the Environment
DPAW	Department of Parks and Wildlife
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DWER	Department of Water and Environmental Regulation
EIA	Environmental Impact Assessment
EP Act	Western Australia Environmental Protection Act 1986
EPA	Environmental Protection Authority
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
EPWA	Energy Policy WA
GIS	Geographical Information System
GKB	Gnaala Karla Booja

Abbreviation	Expanded form
GKB AC	GKB Aboriginal Corporation
GKB CAC	GKB Cultural Advice Committee
GoWA	Government of Western Australia
Ha	Hectares
HSEQ	Health, Safety, Environment and Quality
JTSI	Department of Jobs, Tourism, Science and Innovation
KBB	Kwinana Bulk Berth
KBB 2.5	Kwinana Bulk Berth 2.5 proposed to be located at Kwinana Bulk Terminal.
KBB 5	Kwinana Bulk Berth 5 proposed to be located at Kwinana Bulk Jetty.
KBJ	Kwinana Bulk Jetty
KBSC	Kwinana Beach Service Corridor
KBT	Kwinana Bulk Terminal
KIA	Kwinana Industrial Area
km	Kilometre
kt	Kilotonne
LGA	Local Government Area
LVIA	Landscape and Visual Impact Assessment
M	metres
mAHD	Metres above height datum
MEQ	Marine Environment Quality
mg/L	Milligrams per litre
ML	Megalitres
MNES	Matters of National Environmental Significance
MS	Ministerial Statement
mtpa	Million tonnes per annum
MUBRL	Multi-user brine return line
MW	Megawatt
SIA	Strategic Industrial Area
SWALSC	South West Aboriginal Land and Sea Council
T	Tonnes
TBC	To be confirmed
WA	Western Australia

1. Introduction

Kwinana Bulk Terminal (KBT) and Kwinana Bulk Jetty (KBJ) are located in the Fremantle Port Outer Harbour and serve as essential bulk cargo handling facilities, integral to the operations of Fremantle Port Authority (Fremantle Ports). These facilities are situated approximately 22 km south of Fremantle, within the City of Kwinana, Western Australia (WA).

Kwinana Bulk Jetty (KBJ) is under the ownership of Fremantle Ports and operates in collaboration with approved third parties. It plays a crucial role in the import and export of both dry and liquid bulk products, serving the needs of WA. KBJ, through KBB 3 and 4, facilitates significant imports, such as fuel, sulfur, anhydrous ammonia, bitumen, and fertilizer, all of which are vital for the WA economy.

Following the closure of the BP refinery, KBJ has assumed an increasingly significant role in facilitating the importation of fuel and other chemicals, including ammonia products. However, the existing berths at KBJ are facing overwhelming demand, leading to prolonged vessel waiting times and even the refusal of trade. This situation has led to customer dissatisfaction, reduced supply chain efficiency, and an increase in costs for Fremantle Ports' clients. To fulfill Fremantle Ports' statutory commitment to facilitating trade, it is imperative to explore viable solutions that can reduce waiting times for Fremantle Ports' clients and meet the current and future demands effectively (Fremantle Ports, 2022).

This document, the Preliminary Environmental Impact Assessment (PEIA), focuses on the proposed development of KBB 5 at KBJ. The development of KBB 5 will need to be considered in conjunction with other potential developments that may pose cumulative environmental impacts[1]. These developments include:

- Westport – a substantial new freight hub proposed to be located to the north of the site (incorporating new berths to replace KBB 2), and
- H2Perth – A Woodside Energy project that is planned to export through KBJ,

1.1 Purpose of the PEIA

The purpose of the PEIA is to undertake a structured assessment of the preliminary environmental impacts associated with the proposed development and planned operations, of the proposed KBB 5 Project (the Project).

Given the scale of the Project a formal referral under Part IV of the WA Environmental Protection Act 1986 (EP Act) is likely required. As an efficiency measure this PEIA has been structured in a manner that would permit the development of an environmental referral document more effectively and efficiently.

The PEIA provides:

- An introduction to the Project location (Section 2.1), existing activities at KBB 5 (Section 2.2)
- An overview of the KBB 5 proposed development, including an indicative development envelope (Section 2.5)
- A summary of the approach to the identification of EPA key environmental factors and commentary on factors not considered relevant (Section 5)
- Consideration of each key environmental factor through a desktop assessment (refer Sections 6 to 14 including:
    - Relevant legislation, policy and guidance
    - Receiving environment
    - Potential impacts and risks
    - Preliminary assessment of potential impacts
    - Proposed future studies for impact assessment
- Consideration of cumulative impacts (Section 16)
- An approval strategy including assessment of the approvals pathways (Section 17)

[1] The cumulative environmental impacts associated with the proposed development of KBB 5 at KBJ is not considered within the PEIA however will need to be included in primary regulatory approval submissions.

- A summary of future studies and assessments required for impact assessment (Section 18) and
- A detailed environmental approvals schedule outlining key tasks (e.g. including studies and assessments) required to submit primary and secondary environmental approvals (Section 18).

1.2 Scope and limitations

This report: has been prepared by GHD for PwC and may only be used and relied on by PwC for the purpose agreed between GHD and PwC as set out in section 1.1 of this report.

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

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

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

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

2. Project

2.1 Project location

The Port of Fremantle comprises two harbours (refer Figure 1). The Inner Harbour, designed by Irish-born engineer C.Y. O'Connor and opened on 4 May 1897, is located at the mouth of the Swan River adjacent to the historic City of Fremantle. The Outer Harbour, ~20 km further south at Kwinana-Cockburn Sound was opened on 11 January 1955. Its deep-water bulk port facilities were developed to service the Kwinana industrial area, which expanded rapidly in the 1960s and 70s. (FPA, 2018).

The Outer Harbour is comprised of Gage Roads, Owen Anchorage and Cockburn Sound. The three-roadstead's provided spacious anchorages, mostly sheltered seaward by Rottnest Island and Garden Island, ~16 km south-east, and the chain of reefs between and seaward of these islands, extending for nearly ~30 km from Rottnest Island to about ~8 km south-south-west of Cape Peron.

The Outer Harbour of the Port of Fremantle (Cockburn Sound) can only be accessed via the Success and Parmelia Channels connecting Cockburn Sound to Gage Roads (Fremantle Ports, 2018). The proposed Project location, in the southeast of Cockburn Sound, is within the Outer Harbour and will be an extension to KBJ as an additional berth (Figure 1).

Figure 1 Declared Port Waters of Fremantle Port (FPA, 2018)

2.2 Existing activity

2.2.1 KBB 3 and 4

KBJ consists of 2 common user berths (KBB3 and KBB4), further detailed in Table 1 . These berths support vessels unloading dry and liquid bulk cargoes (refer Figure 2).

The berths can accommodate vessels of up to 245 metres (m). Grabs and hoppers are available for geared vessels. From the hoppers, the cargo is either trucked off the berth or transported by conveyor to sheds located at the base of the jetty.

Fremantle Ports has one common user pipeline on the facility. The other pipelines are owned by third parties for the import of caustic soda, anhydrous ammonium, and a range of other liquid bulk cargoes. With the closure of the BP refinery, the import of fuel is a growing trade for this facility. Fuel terminal operators including Coogee Chemicals Pty Ltd and Puma Energy are investing significantly in their tanks' storage capacity to support fuel imports (FPA, 2023).

Table 1 KBJ berth characteristics (FPA, 2023).

Wharf parameters	Berth 3	Berth 4
Length of Berth (combined length 480 m)	259 m	221 m
Designed Depth Alongside	14.0 m	14.0 m
Maximum Berthing Displacement	85,000 tonnes (t)	85,000 t
BMH Marine Siwertell auger type unloader	-	Capacity 1,200 t per hour; ~ 17,000 t in a 22-hour working day

The majority of vessels accessing KBB 3 and 4 use the Cockburn Sound Anchorage (see Figure 3). Gage Roads and Outer Anchorages offer other suitable anchorages (FPA, 2018).

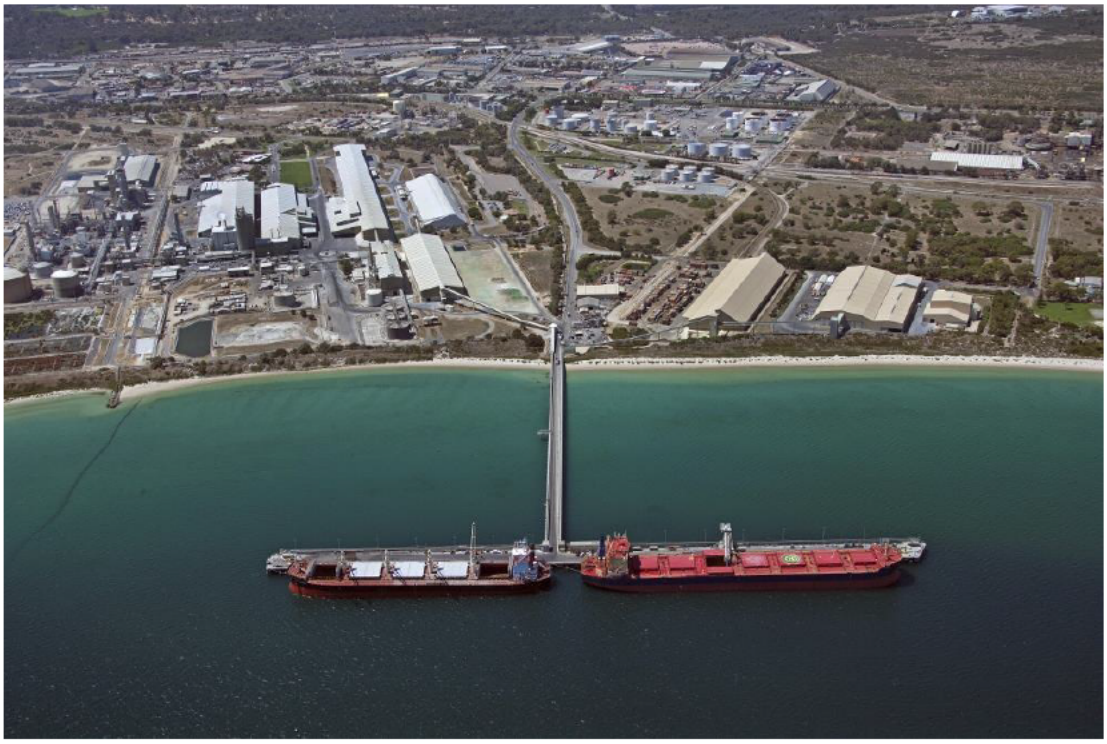

Figure 2 KBB 3 (LHS) and KBB 4 (RHS) (FPA, 2020).

2.2.2 Existing anchorages

The majority of vessels utilizing KBB 2 use the Cockburn Sound Anchorage (see Figure 3) Gage Roads and Outer Anchorages offer other suitable anchorages (FPA, 2018).

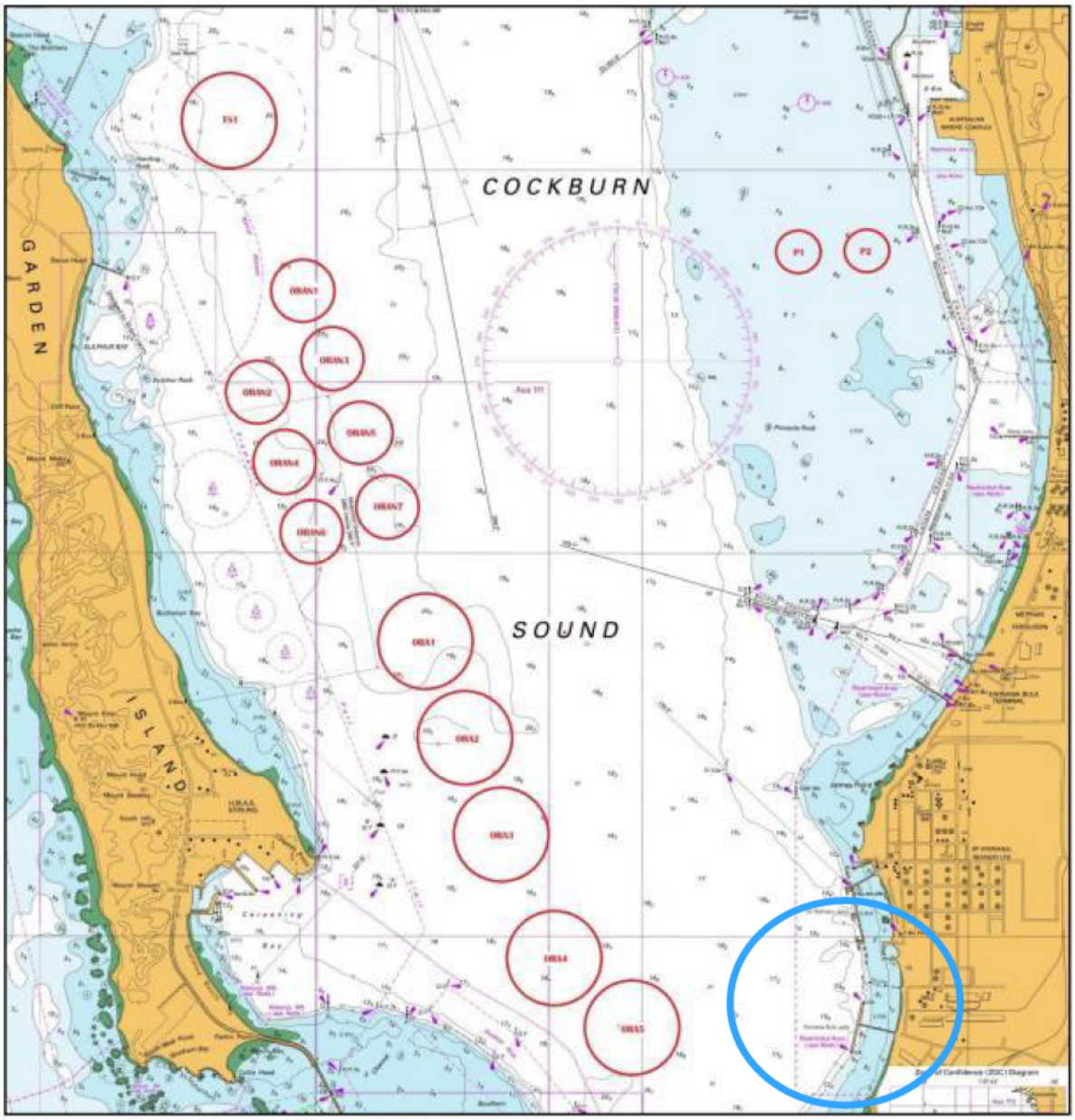

Fig 1.2 Cockburn Sound Anchorages

Figure 3 *Cockburn Sound Anchorages (FPA, 2018).*

2.2.3 Existing Approvals

License (L4474/1976/14) was issued under Part V of the EP Act for Category 58 and 58A to the FPA in April 2012, specifically for the Kwinana Bulk Jetty (KBJ) (DWER 2019). The prescribed category description is outlined in Table 2.

Table 2 Prescribed category description and assessed production capacity

Prescribed category description (Schedule 1, Environmental Protection Regulations 1987)	Assessed production capacity
Category 58: Bulk material loading or unloading: premises on which clinker, coal, ore, ore concentrate or any other bulk granular material (other than salt) is loaded onto or unloaded from vessels by an open materials loading system.	Not more than 50 000 t per day (cumulative)
Category 58A: Bulk material loading or unloading: premises on which salt is loaded onto or unloaded from vessels by an open materials loading system.	

The following monitoring activities are required as part of the license conditions (DWER 2019):

– **Cockburn Sound Monitoring:** Monitoring includes water quality physicochemical, carbon, nutrients and Total Suspended Solids (TSS), Biological response, organics, mussels, sediment quality for metals in all operational areas: (Monitoring of Cockburn Sound has been undertaken as per annual reporting, or single reporting).

2.3 Project description

The project key characteristics are detailed in Table 3.

Table 3 Project key characteristics

Element	Description
General	
Project description	– New wharf construction – Construction of vehicle access trestle interconnecting KBB3/4 and KBB5 – Development of common user bulk liquids loading/unloading facility including: • Provision of new common user process pipework and supports, • Road network and civil works upgrades, • Services upgrades – potable / wash water, wastewater, fire water, power, comms, • Security upgrades, and • New building works for pipe manifold and supporting maintenance, administration, security and services functions.
Construction period	
Marine	~ 24 months
Terrestrial	~ 27 months
Footprint	
Marine footprint	– Berth pocket utilising existing natural depths to design depth of ~13.5 m FLWM (future deepening capability of structures -17.4 m FLWM) – Vessel maneuvering area to design depth of ~14.7 m FLWM (limited by Outer Harbour access channel)
Terrestrial footprint	61 ha
Vegetation Clearing	TBC ha
Marine Infrastructure	
Export/Import capacity	– Accommodate a bulk liquids throughput of approximately 5.11 Mtpa.

Element	Description
Wharf	– One berth with capability for loading / unloading multiple liquid bulk products via Marine Loading Arm (MLA). – Gull Wing Berth configuration • 6 x Berthing Dolphins • 6 x Mooring Dolphins • Approximately ~74 m x 34 m loading platform connected to access trestle to shore
Access Trestle	– Approximately ~555 m x 14 m access trestle to shore • Featuring a pipe rack and 2 way vehicle roadway – Vehicle access connection from KBB3 to KBB5 trestle – 150 m x 5 m (typical, width varies) • Featuring a 1 way vehicle roadway – tidal traffic control
Shipping Berths and Channel[2]	– Berth • approximately 360 m in length – natural depths • Future expansion - approximately 520 m in length – Channel / swing basin / Aprons – none (natural depths)
Landside infrastructure	
Capacity	– Accommodate a bulk liquids throughput of approximately 5.11 Mtpa
Loading infrastructure	– Multi-product liquids handling precinct including: • Common Use process pipework with ancillary emergency shutdown, valving, metering, pigging and purging infrastructure • Manifold building receiving third party customer pipelines and interface with common use pipelines. • third Party customer pipeline easement • Road network and civil works upgrades • Services upgrades – potable / wash water, waste water, fire water, power, comms • Security upgrades – Includes new building works for manifold building and supporting maintenance, admin security and services functions.
Construction Elements – Marine Construction	
Construction of the access trestle	– Conventional marine construction utilising floating plant or over the top construction methods. – Pile driving works: up to ~130 steel piles of up to 1200 mm diameter and installation of a concrete access trestle. – Pile driving works: up to ~25 steel piles of up to 1200 mm diameter and installation of a KBB3 – KBB5 interconnecting access trestle. – Indicative number of impact pile strikes per 24-hour period is 2000 - 3000.
Construction of the wharf	– Conventional marine construction utilising floating plant or over the top construction methods. – Pile driving works: up to ~130 steel piles of up to 1200 mm diameter and installation of a concrete wharf deck, and concrete dolphins and interconnecting steel walkways. – Indicative number of impact pile strikes per 24-hour period is 2000 - 3000.
Construction Elements – Landside	
Demolition works	– Demolition of existing infrastructure including material handling infrastructure, conveyors / transfer towers, storage silos, pavements, adjacent warehouse / storage facilities (if required)
Refurbishment and life extension works	– Minimal – works are predominantly new build

[2] No dredging is required.

Element	Description
Adaptation and new build works	– Including; • New roads and vehicle access siding and turnouts • Trunk services upgrades – HV / LV, water • Sheds / pads – foundation, pavements and large-scale industrial buildings • Fire water – ring mains, hydrants, sprinkler systems and storage tanks – Works will be conventional civil and heavy industrial construction featuring elements of onsite stick build and attempt to maximise the use of offsite fabrications particularly for Process and fire equipment materials handling infrastructure and machines
Operational Elements – Marine	
Bulk Liquids Handling	– Marine activities will be similar to existing operations in the outer harbour precinct relevant to the KBB3/4 structure the facility augments and include; • Shipping (import and export cargoes) in bulk tankers predominantly in Handymax up to Long Range 2 (LR2) Class (up to 285m long). • Loading and unloading of bulk liquids product via Marine loading Arm (MLA) • Conveying bulk product between ships and the landside terminal via pipeline (import and export) • Pigging and purging of lines – between products • Spill collection and washdown with collection of wastewater and piping or collection via sicker truck to shore for storage and treatment off site • Maintenance of; – maritime structures (overwater and overdeck works) – materials handling infrastructure; structural mechanical and electrical – Shipping and liquids handling works will be undertaken 24 hours a day, 7 days a week
Operational Elements – Landside	
Bulk Liquids Handling	– Landside and Terminal operations will be similar to existing operations in the outer harbour terminal precinct relevant to the KBJ precinct. – The Port operations will provide and operate common use infrastructure to facilitate bulk liquids handling of a variety of bulk products by a number of private sector, third party operators who may provide supplementary infrastructure specific to their product requirements; • Transfer cargo to and from the precinct via third party pipelines located in adjacent services easements. • Transfer bulk liquids (and vapour return) from third party pipelines, via manifold building to common use pipelines and conveyance thereafter to the marine facility. • Storage – None – all products are stored offsite by third parties. • Management of product cross contamination via pigging and purging of lines with product returned via third party pipelines to various proponents for management. • Spillage management to meet license requirements. • Maintenance of: – Liquids handling process/piping infrastructure; structural, mechanical and electrical – roads and subdivision services – buildings – Liquids handling will be undertaken 24 hours a day, 7 days a week

2.4 Project Schedule

A preliminary project schedule is provided in Figure 4 including design, approvals, construction and operation phases.

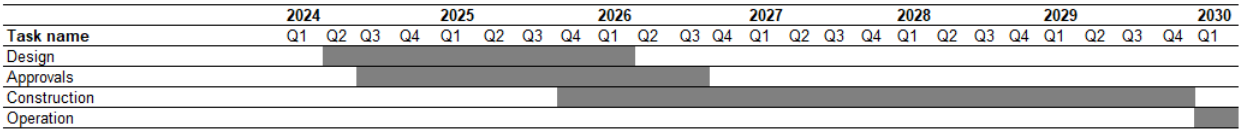

Figure 4 Indicative project schedule

2.4.1 Landside construction schedule

Construction work is proposed 24 hours per day, 7 days per week, with favourable conditions. Supporting activities associated with piling (e.g. site preparation) will be undertaken 24 hours per day, 7 days per week. However, noising and impactive activities beyond the port boundaries e.g. foundation piling activities are proposed to be conducted 12 hours per day (7am to 7pm), 13 days per fortnight.

2.4.2 Marine construction schedule

Construction work is proposed 24 hours per day, 7 days per week, with favourable conditions. Supporting activities associated with piling (e.g. site preparation) will be undertaken 24 hours per day, 7 days per week. However, physical piling activities are proposed to be conducted 12 hours per day (7am to 7pm), 13 days per fortnight. Occasionally for safety reasons, there will be the requirement to continue piling activities up to 10 pm to accommodate the completion of a pile.

2.5 Development and disturbance footprint

The project comprises a landside development envelope (landside DE) and a marine development envelope (marine DE), collectively termed the Project Area (See Figure 5):

- The landside DE for landside infrastructure and construction activities comprising a total area of 16.4 ha and consists of the terrestrial area. This area has been determined by incorporating FPA tenure. It is likely this area will contain the landside disturbance footprint (see Figure 6)
- The marine DE comprises a total area of 43.1ha and consists of the offshore area of the project area. While the marine disturbance footprint that has not yet been defined, it is likely that it will be contained within the marine DE. (see Figure 7)

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Price Water House Coopers
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Indicative Project Area

FIGURE 5

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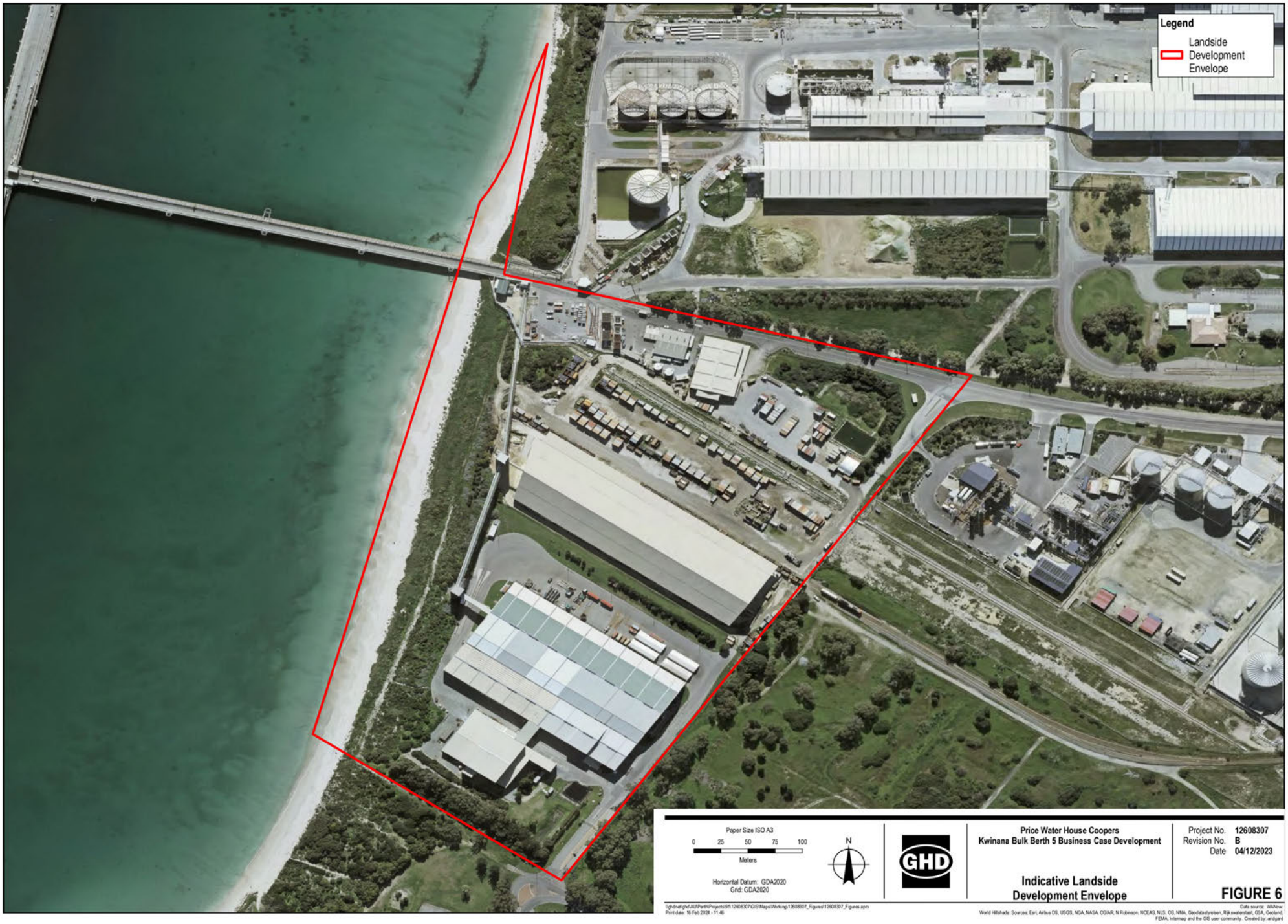

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Kwinana Bulk Berth 5 Business Case Development

Indicative Landside Development Envelope

Project No. 12608307
Revision No. B
Date 04/12/2023

FIGURE 6

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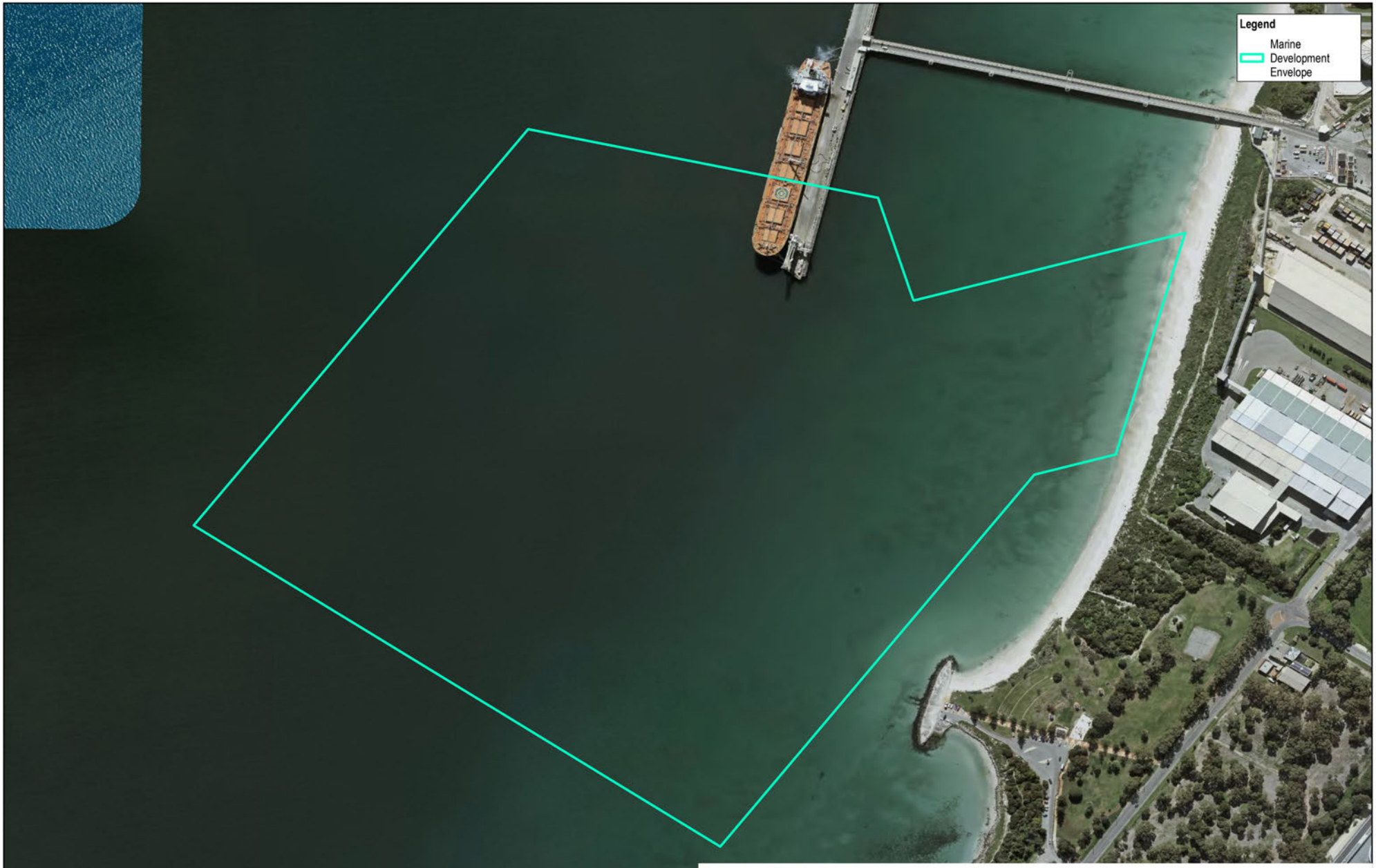

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Indicative Marine Development Envelope

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FIGURE 7

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2.6 Landside Infrastructure

2.6.1 Description

The following section outlines a description of the landside infrastructure (see Figure 8) that is proposed within the landside DE (see Figure 6). The proposed landside infrastructure includes access roads, fire systems, water tanks, buildings and carparking.

2.6.1.1 Road and access

Site roads are planned to be:

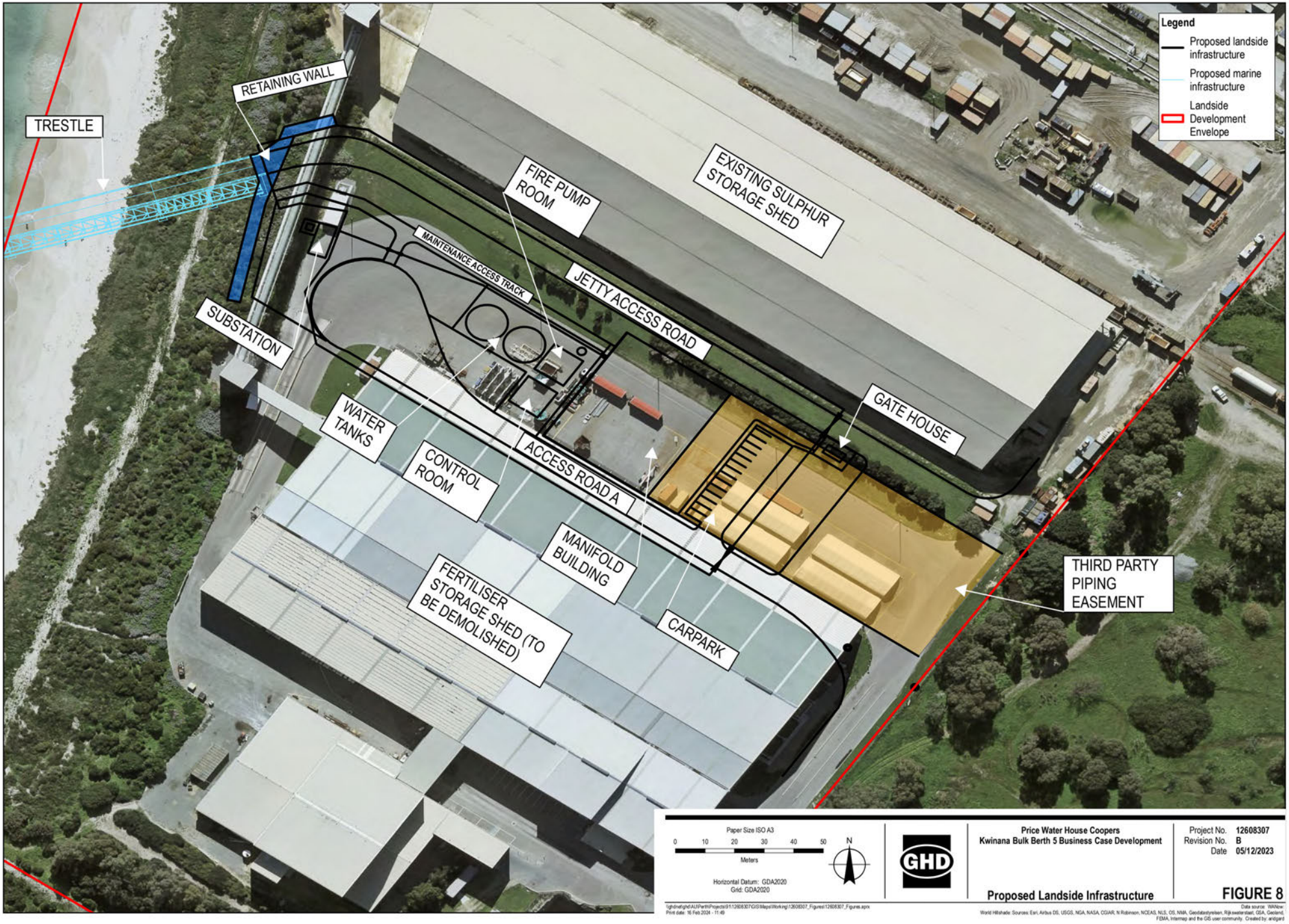
– North site access - access from the public road network to / from the jetty (and onward to KBB3 via the interlinking bridge). The roadway will be two (2) way and security controlled.
– Southern site access – service access from the public road network to / from the manifold building and fire and electrical services. The roadway will be two (2) way and security controlled.

Manifold Building is planned to be:

– Manifold building will be a 2-storey industrial shed that will receive third party pipelines from the easement to the west and support process pipework to agglomerate third party products into the relevant common user pipework's and house relevant valving, controls, pigging and purging infrastructure.

2.6.1.2 Fire systems

The landside facility supports a significant fire response system for the facility (including the wharf) featuring freshwater storage tanks, pumping and foam concentrate systems.


Legend
Proposed landside infrastructure
Proposed marine infrastructure
Landside Development Envelope
TRESTLE
RETAINING WALL
FIRE PUMP ROOM
EXISTING SULPHUR STORAGE SHED
MAINTENANCE ACCESS TRACK
JETTY ACCESS ROAD
SUBSTATION
WATER TANKS
CONTROL ROOM
ACCESS ROAD A
GATE HOUSE
MANIFOLD BUILDING
FERTILISER STORAGE SHED (TO BE DEMOLISHED)
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Date 05/12/2023
Proposed Landside Infrastructure
FIGURE 8
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2.6.2 Construction

Plant and equipment required for the construction of the landside process and ancillary infrastructure will include multiple numbers of the equipment detailed in Table 4.

Table 4 Landside construction equipment

Equipment	Proposed use
Mobile cranes	Construction cranes ranging from 20 tonnes up to 200 tonnes (or possibly more) will be required for general and heavy lifting
Elevated Work Platforms	For general working at heights construction
Hydraulic piling hammers and power packs	Foundation /Piling operations
Earth moving equipment (graders, bull dozers, haul trucks, excavators, rollers)	For bulk earth works and excavations
Water trucks	Dust suppression work
Assorted prime mover trucks, trailers and other associated transport equipment	Transportation and logistics
General construction tools and equipment (welders, flame cutters, hydraulic jacks, power tolls and hand tools)	General construction

Landside infrastructure and associated construction activities include:

– Roads
– Trunk services
– Process / Liquids transfer infrastructure:
  - Pipeline and process equipment will be supplied in prefabricated and pre furnished modules as far as possible.
– Sheds / pads:
  - Shed will be conventionally constructed, with steel frames fabricated off site and assembled on site

The following services will be installed:

– Wash water
– Fire water
– Electrical services

Works will generally be conventional construction works. It is assumed that stackers will be imported through existing logistics infrastructure and land transfer and will not be imported fully assembled.

2.7 Marine infrastructure

2.7.1 Description

The following section outlines a description of the marine infrastructure that is proposed within the marine DE (see Figure 9 to Figure 11). The proposed marine infrastructure includes an access trestle, a wharf structure, and marine loading arms.

2.7.1.1 Access trestle

A steel piled access trestle of approximately 555 m in length (see Figure 9) is proposed to be constructed from the shoreline to the wharf. The access trestle will support a pipe trestle with multiple process (bulk liquids) pipelines,

fire and wash water, and electrical, security and instrumentation, and a two-lane roadway for vehicle access to the wharf

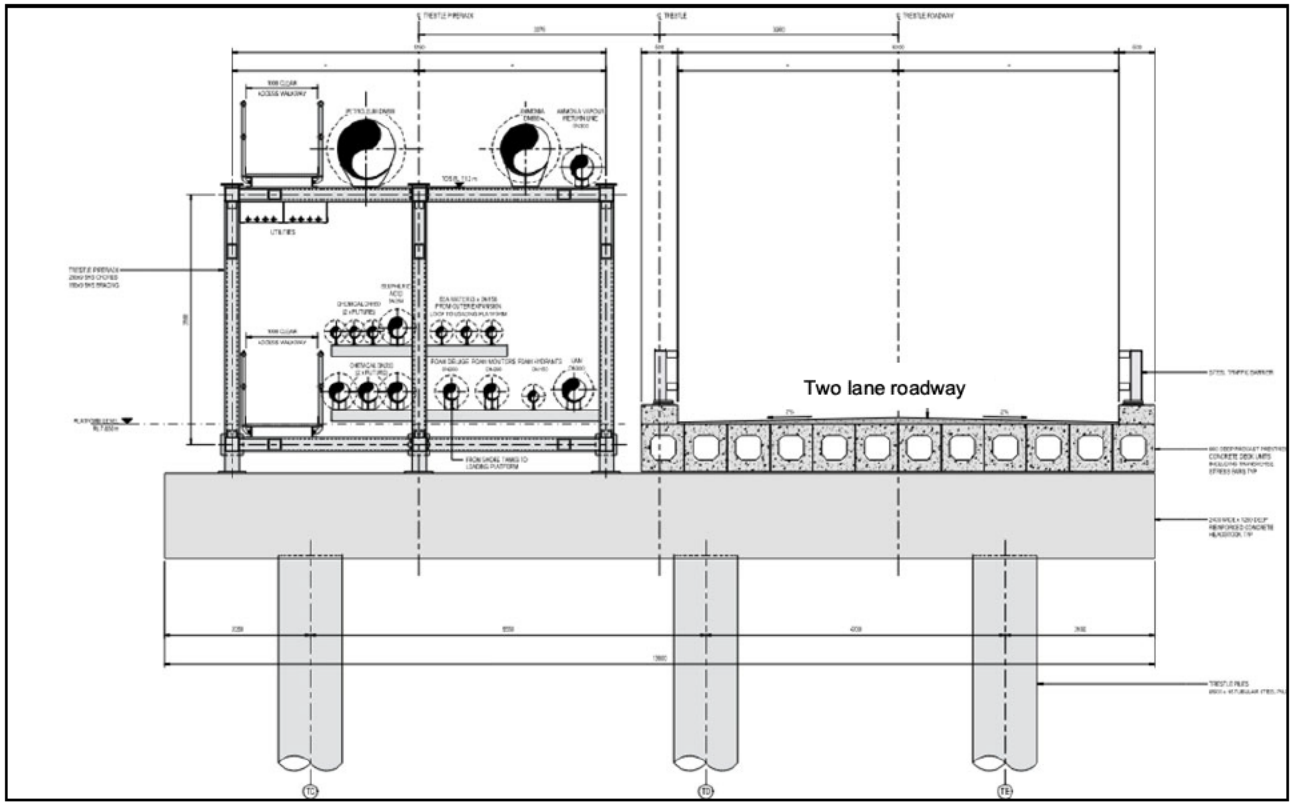

Figure 9 Access trestle (typical section)

2.7.1.2 Wharf Structure

The proposed wharf structure will be oriented parallel to existing bathymetry and to the south of KBB3/4. The wharf consists of a loading platform, 6 berthing dolphins and 6 mooring dolphins as shown in Figure 10. The wharf will feature a loading platform approximately 74 m long x 34 m wide and provide for berthing of a variety of vessels over an effect berth pocket 360 m long. The wharf will be designed to accommodate:

- Marine loading Arms
- Process pipework and associated equipment including provisions for emergency shutdown, pigging and purging.
- Ship to Shore Gangway (access for vessels)
- Spill management bunds and sumps
- Access for maintenance and operations

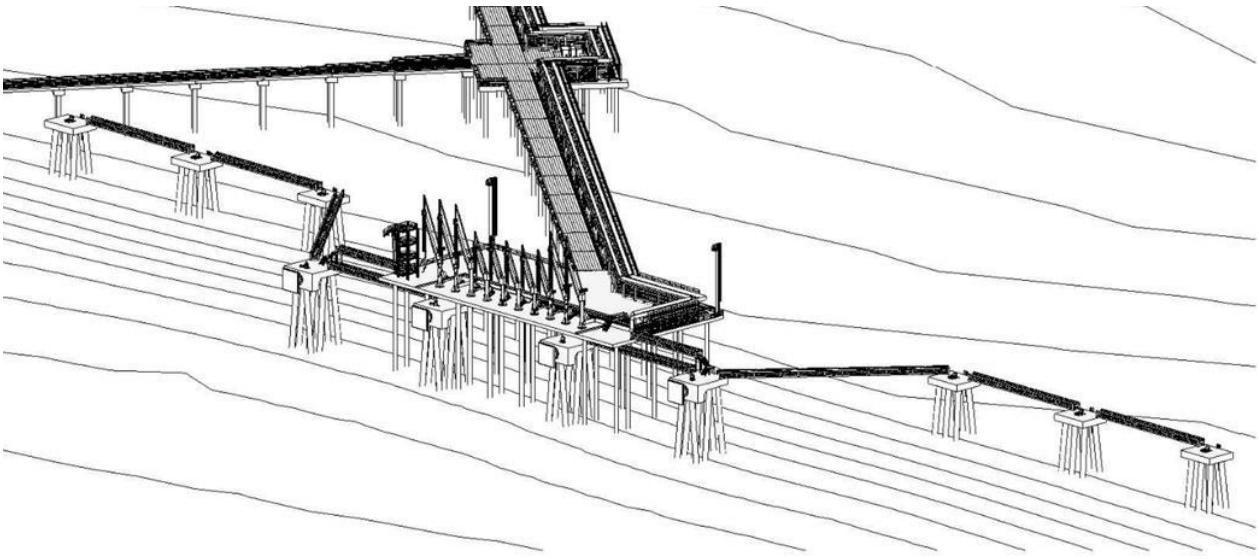

Figure 10 Wharf structure

2.7.1.3 Marine Loading Arms

Marine loading arms will be provided to facilitate connection from the jetty to vessel manifolds for the transfer of liquids (import and export).

Loadings arms are electrically and hydraulically controlled and track with the vessel to allow for movement of the vessel at the berth (with tide and with weather) without stressing loading pipework.

The marine loading arms are proprietary equipment provided by reputable manufacturers and are fitted with controls to facilitate safe and effective product transfer including manifold centring, and automatic, spill free emergency release coupling.

2.7.1.4 Aids to navigation

Aids to navigation will include demarcation of the new berth. The facility is in natural depths and does not require supplementary dredging works. Consequently, channel markers, departure leads and marker buoys for the departure channel, berth pockets, and swing basins are in place for the outer harbour for existing KBB3/4 operations. Where required, supplementary aids to navigation will be provided in accordance with the requirements of FPA, the International Association of Lighthouse Authorities (IALA) and to the requirements of WA maritime safety regulators.

Paper Size ISO A3

0 25 50 75 100

Meters

N

Horizontal Datum: GDA2020
Grid: GDA2020

GHD

Price Water House Coopers
Kwinana Bulk Berth 5 Business Case Development

Project No. 12608307
Revision No. B
Date 05/12/2023

Proposed Marine Infrastructure

FIGURE 9

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Data source: WANdw
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community. Created by: aridgard

2.7.2 Construction

Plant and equipment required for the construction of the access trestle and wharf structure will include multiple numbers of the equipment detailed in Table 5.

Table 5 Marine Construction Equipment

Equipment	Proposed use
Jack-up (JUB) and floating construction barges	Pile installation, drilling operations, heavy lifting operations, transport of piles, assistance works and supply of truss modules
Advancing Truss System (ATS)	Pile installation, superstructure installation along the jetty
Heavy lift vessel/s	Supply and installation of ship loaders /unloaders Supply and installation of wharf structural modules
Crawler crane on JUB / barges	Installation of truss modules, piles, drill rig, piling hammers, assistance works
Crane on ATS	Pile installation, break and grab operations, superstructure installation
Crawler cranes	Loading of trusses and piles at the jetty abutment, lay down areas and load out facilities
Hydraulic piling hammers and power packs	Piling operations
RCD-Rig and power pack, drill tubes, pumps	Drilling operations
Crew boats	Crew transfer
Tugs	Tow of barges and JUB's
Multi-cats	Assisting tow of barges and JUB's, positioning of anchors
Assorted prime mover trucks, trailers, and other associated transport equipment	Onshore pile transportation

2.7.2.1 Access Trestle

The access trestle will be typically constructed using two methods of construction, one for the inner shallow area and the second for the outer deeper area.

The inner area will be constructed using an over-the-top construction method potentially featuring an advancing truss system for driving piles and advancing the access trestle superstructure. The outer area will be constructed by driving piles from jack up or floating barges and placing a deck or similar on top of the piles.

2.7.2.2 Wharf Structure

Typically, the wharf structure will be constructed by driving piles from jack up or floating barges and placing a deck or similar on top of the piles.

2.7.2.3 Piling

Marine infrastructure (including wharf, dolphins, access trestle, and KBB3-KBB5 bridge) will require a total of ~ 285 piles to be driven for the development.

2.7.2.4 Construction traffic

Indicative marine construction vessel types are provided in Table 6.

Table 6 Indicative marine construction vessel types and movement

Type	Maximum speed [3]	Description	Frequency and duration
Tug	Variable	General provision of tugs and towages, positioning moorings, anchors etc.	TBC
Multi-cat	7	Supply and delivery of material	TBC
Survey boat	10	Provide survey services to ensure bathymetry of berth	TBC
Sweep boat and barge	Variable	Supply delivery and storage of materials, mooring lines and anchors	TBC
Heavy Lift Ship	> 12 knots (ocean going)	The heavy lift whip will install ship loader / unloader machines to the wharf	TBC
Jack-up barge (JUB) Or floating construction barge	Variable / typically towed	JUB / floating typically positioned at the site of construction and will generally be used for pile driving and lifting topside modules (and drilling if required). The barges will typically be stationary while installing structures and be moved by tugs to the next location.	TBC
Tug	Variable	These vessels will generally provide support services to the main construction barges, including tug and towage, supply of material and people, moving anchors and mooring lines, crew transfers etc.	TBC
Material barge	Variable		TBC
Working platforms/pontoons	Variable		TBC
Safety boat	Variable		TBC
Work boat	Variable		TBC
Crew boat	10		TBC
Multi-cat	5-7		TBC

2.7.2.5 Supporting infrastructure on marine infrastructure

The following infrastructure is likely to be installed and operated on the marine infrastructure:

- Fire water
- Wash down and effluent handling
- Process instrumentation and control
- Power
- Lighting
- Security
- Cathodic Protection

2.8 Operations

2.8.1 Shipping

Shipping (import and export cargoes) will be undertaken via tanker predominantly in Handymax and up to LR2 (up to 285 m long).

- Vessels will access the new KBB5 berth via existing access channels to the Outer Harbour and the KBB2.5 wharf directly from natural deep water.

[3] Maximum speed in marine DE.

– Vessel servicing provisions (including pilotage and tugs) are expected to continue via the use of third party services with the vessel mix (and consequent towage and pilotage demands) consistent with existing outer harbour operations.

  Vessel traffic is forecast to increase from existing KBB3/4 levels (~ 3.5 Mtpa / TBC vessel per year) to 7 Mtpa / 200 (TBC) vessels per year, over the project forecast (to 2054). (Note, subject to trade plan, for environmental benchmarking this could be as much as 2 x existing traffic).

2.8.2 Vessel type

The design vessel specification remains in line with that set out in the preliminary KBB5 Business Case (January 2023) basis of design.

The design vessels to be supported by the jetty structure are provided in Table 7. The range of vessels is intended to provide flexibility in use of the multi-user facility and includes provision for future vessels that are not currently utilised at KBB3/KBB4 (LR2 vessels). It is noted that the navigation channels to approach KBJ are currently of insufficient depth to support fully loaded LR2 vessels. It is assumed the LR2 vessels would be partially loaded or, alternatively, deepening works might be undertaken in future to allow deeper draft vessel access to Cockburn Sound (excluded from this scope of work).

Table 7 Design Vessel Specifications (PIANC WG33 75% non-exceedance probability)

Parameter	Handysize (smallest design vessel)	Very large Gas Carrier	Long Range 1 (LR1)	Long Range 2 (LR2) – small	Long Range 2 (LR2) – large (largest design vessel
Length Overall (LOA)	160 m	230 m	200 m	20 m	285 m
Beam (B)	25.6 m	37 m	32.2 m	43 m	49.5 m
Draft (d) (fully loaded)	11.9 m	12 m	12.6 m	15.1 m	16.9 m
Deadweight Tonnage (DWT)	22,000 t	56,000 t	50,000 t	100, 000t	150,000 t

Note: The Larger LR1/2 vessels are restricted to Fuels handling
The deeper drafted vessels will operate in the Port partially laden within the context of this project.
Dredging is still excluded from the project scope for KBB5

2.8.3 Supply chain

The KBB5 liquids terminal will distribute and receive bulk liquids via third party product pipeline to adjacent processing and storage facilities.

The KBB5 terminal may feature an interconnecting bridge between KBB3/4 and KBB5. This bridge would facilitate drive through access for the existing truck supported smaller sale bulk solids handling across KBB3/4. This truck demand currently enters the port via Port Road and the KBB5 facility would facilitate a localised re-routing of this traffic via Kwinana Beach Road;

– Operational workforce trip generation TBC.

2.8.4 Liquids Handling

The KBB5 port terminal will provide and operate common user infrastructure to facilitate bulk liquids transfer of a variety of bulk products by a number of private sector, third party operators who may provide supplementary infrastructure specific to their product requirements.

The materials handling activities consist of:

– Transfer of product from multiple third party pipelines to common user pipelines via valving at the manifold building.
– Purging and pigging of pipelines for third party and common user facilities, to facilitate emptying pipelines between products and shipments, maintenance and cleaning.
– Loading and unloading of liquid product via pipelines and marine loading arms across the wharf to vessels.

– Return of vapour and boil off gasses to third party proponent via vapour lines for reprocessing.

Operations will specifically consider:

– Spill management via bunding at high-risk locations for connection / dis-connection, active elements and areas of human intervention, with wash water and contaminant collection for removal and treatment offsite (as trade waste or returned to third party product provider for preprocessing).
– Leak detection (gaps and pressure instrumentation).
– Emergency shutdown.
– Remote observation and management with instrumentation and controls monitoring from port control room.

2.8.5 Product to be handled at KBB 5

Based on the approved trade plan, KBB5 is to accommodate a bulk liquids throughput of approximately 5.11 Mtpa.

The concept design is to reflect the proposed trade plan products as shown in Table 8.

Table 8 Proposed trade product and volumes

Product	Number of Product lines	Maximum Tonnage (tpa)[4]	Prospective GLR (tph) [5]
Anhydrous Ammonia (Export)	2 (Product + vapour return)	1,000,000	1,200
Fuels (Petroleum)	2 (simultaneous handling)	2,500,000	800
Liquid Hydrogen	Future	250,000	300
Liquid Carbon Dioxide	2 (Product + vapour return)	1,000,000	1,850
Sulphuric Acid	1	300,000	700
UAN	1	650,000	1,000
Spare	1	**~800,00**	~ 1,000
Total	**9**	**~6,500,00**	

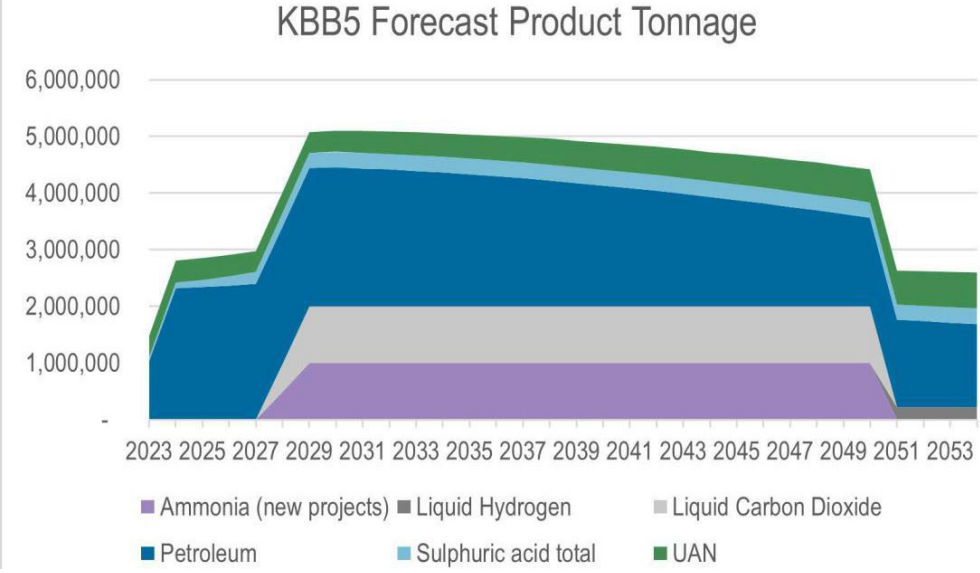


Figure 12 KBB Liquid Bulk Forecast

[4] *Trade Plan figures have been rounded for Functional Requirements for concept design*
[5] *GLR is the Gross loading rate – Product Vols / time for a vessel at berth from first line on to last line off –-> Peak liquids transfer / pumping rates are higher ~ 1.5 x GLR*

3. Local and regional context

Cockburn Sound, situated ~20 km south of the Perth-Fremantle region in WA, holds a prominent position within Perth's Southern Metropolitan Coastal Waters. It boasts two distinctive attributes that set it apart along the metropolitan coast. They are its significant protection from ocean swells and its notable depth. These unique characteristics and its proximity to the metropolitan area, has resulted in development that has made Cockburn Sound the most extensively utilised marine embayment in WA.

The industrial complex at Kwinana, a cornerstone of WA's industry, is supported by Cockburn Sound. This complex encompasses vital marine infrastructure essential for the functioning of the broader Perth Metropolitan area. Beginning with the establishment of an oil refinery on the eastern shoreline during the 1950s, rapid subsequent industrial growth has resulted in the construction of iron, steel, alumina, and nickel refineries, chemical and fertiliser plants, a wastewater treatment facility, a desalination plant, a power station, and a bulk grain terminal. Cockburn Sound also plays a pivotal role supporting the operations of the Royal Australian Navy. The waters of Cockburn Sound hold substantial value to the community due to its diverse recreational and commercial uses, including swimming, sailing, fishing, aquaculture, and tourism.

The marine environment of Cockburn Sound is shaped by intricate interactions between physical and ecological processes. Its regional ecological importance arises from its natural features, including the protected embayment configuration, coastal sediment dynamics, marine water currents, groundwater influence, and input from catchment runoff. Notable ecological attributes encompass seagrass species adapted to sheltered conditions and organic-rich silts on the seafloor of the deep basin, which sustains unique marine life found exclusively along the central west coast of WA. The exceptional nature of the sheltered deep waters along the exposed WA coastline has led to the development of distinct ecosystem elements unique to Cockburn Sound (DEP 1996; DAL & PPK 2001; Oceanica 2007 in BMT, 2023).

3.1 Climate

Cockburn Sound is influenced by the regional climatic pattern of hot, dry summers and cool, wet winters and the changing flow of the Leeuwin Current, which brings warm tropical waters down the WA coast from Indonesia. Classified as a temperate extra-tropical region, there is a prevailing influence from diffuse high-pressure systems, an occasional influence from mid-latitude low pressure cells or fronts and the rare influence of tropical systems (Gentilli 1971). Storms can occur at any time of year but are most prevalent during winter. Synoptic conditions provide a distinct seasonal shift between a strong diurnal land-sea breeze cycle in summer (December–March) and more variable conditions in winter (July–September). During summer, winds in the range of 5–9 m/s are typically from the south and the southwest. Winter winds are more variable, fluctuating between occasional calm periods and strong storms, with velocities generally between 2–7 m/s and direction typically swinging from mild north-east winds to the intense westerlies associated with storm events (Steedman & Craig 1979, Masselink & Pattiaratchi 2001 in BMT, 2023). The average annual rainfall is 887 mm, the majority of which falls between May and October.

3.2 Tide Levels

Mean maximum range for the Port of Fremantle is approximately 0.4 to 0.8 m. Details of tides can be found in the Australian National Tide Tables and Admiralty Tide Tables Volume 4. Tidal characteristics are detailed in Table 9.

Table 9 Port of Fremantle tidal characteristics (FPA, 2018)

Characteristic	Measurement
Highest Astronomical Tide	1.380m
Mean High Water Springs	1.130m
Mean High Water	1.020m
AHD	0.756m
Mean Sea Level	0.790m

Characteristic	Measurement
Mean Low Water	0.550m
Indian Spring Low Water	0.450m
Lowest Astronomical Tide	0.240m
Fremantle Datum	0.000m

3.3 Marine geology

Cockburn Sound is a shallow, elongated coastal basin situated between two Pleistocene limestone dune ridges: the Garden Island Ridge to the west and the Spearwood Dunes to the east (Skene et al. 2005 in BMT, 2023). The central basin typically maintains a depth of 18–20 m, with steep rises leading to sandbanks in the north and south, the Garden Island shoreline to the west, and the Eastern Shelf to the east. The Eastern Shelf, extending from James Point to Woodman Point, is a relatively flat shoal with an approximate depth of 8 m. It consists of a thin sediment layer covering limestone outcrops, with isolated reefs along its western margin.

Kwinana Beach, where KBB 5 is proposed to be constructed, features a narrow sandy shoal immediately offshore, ~700 m in width with water depths of less than 5 m. At the western edge of this shoal, the water depth rapidly deepens to around 20 m, defining the Cockburn Sound basin, characterised by homogeneous calcareous mud and silt. This unique underwater topography provides an ideal setting for the installation of KBB 5 without the need for dredging (BMT, 2023) and helps justify its location.

3.4 Coastal processes

The interplay between the energy of the swell and wind waves determines the dominant sediment transport direction at the shoreline and net sediment transport is typically southward in the north of the Sound and northward in the south (DOT 2009 in BMT, 2023). Along the east coast of Garden Island net sediment transport is generally southward driven by the penetration of wave energy from ocean swells.

An analysis of coastal hazards (CZM et al. 2013 in BMT, 2023) identified three areas with existing acute erosion in Cockburn Sound: Garden Island north of Colpoys Point, Palm Beach and the KBT. Two areas with anticipated severe long-term erosion were identified: Woodman Point and Kwinana Industrial Area (KIA). The historic shoreline erosion along the KIA strip and at Kwinana Beach has also been recognised by the WA Department of Transport (DOT) and these areas have been identified in a register of WA coastal erosion hotspots (Seashore 2019 in BMT, 2023).

Kwinana Beach is located at cell 17 following the Cockburn Sound Coastal Alliance (CSCA) classification (transect ‘zones’; CZM et al. 2019 in BMT, 2023). The CSCA is a partnership between the cities of Cockburn, Fremantle, Kwinana and Rockingham and Perth Region National Resources Management, and receives support from the WA DOT, Department of Planning, Lands and Heritage (DPLH), Department of Water and Environmental Regulation (DWER), Cockburn Sound Management Council (CSMC) and the Department of Defence. The coastal management unit is 12, south boundary of KBT (BMT Oceanica et al. 2019 in BMT, 2023).

3.5 Hydrodynamics

The hydrodynamic conditions in Cockburn Sound generally result in a low energy and slowly flushed marine environment. Water movement is primarily wind driven, leading to near-shore currents that usually flow along the shore at speeds averaging 0.1 m/s, within a range of 0 m–0.25 m/s(Dames & Moore 1999 in BMT, 2023). Water exchange through the northern and southern entrances to Cockburn Sound is constrained by Parmelia Bank and the Garden Island Causeway, respectively. These features limit the flow of water in and out of Cockburn Sound (Dames & Moore 1999).

Between storm events, the surface mixed layer in Cockburn Sound typically ranges between 5 and 10 m deep, occasionally displaying weak vertical stratification during light wind periods (DEP 1996 in BMT, 2023). Flushing times, calculated using hydrodynamic modelling, are estimated at 24 days in summer, 31 days in autumn, 26 days in winter, and 47 days in spring (Antenucci et al. 2009 in BMT 2023). The longer flushing times in spring align with low residual velocities observed throughout the Sound during this season (Harris & Antenucci 2009 in BMT 2023). Regional-scale variations in alongshore pressure gradients, such as the propagation of coastally trapped waves

along the Western Australian coast, can also influence local exchange and flushing patterns in Cockburn Sound (Ruiz-Montoya & Rowe 2014 in BMT, 2023).

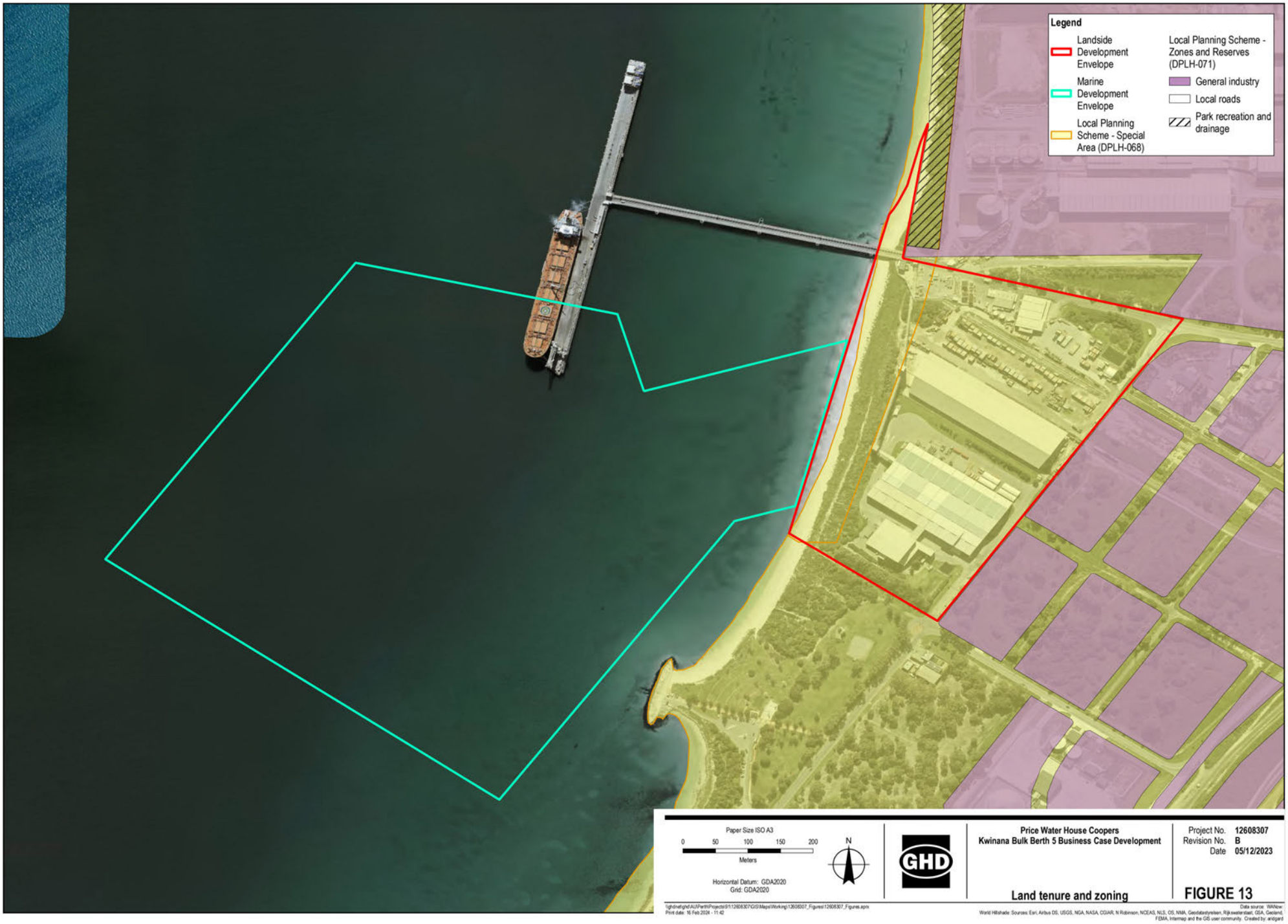
3.6 Wave climate

The wave climate in Cockburn Sound is primarily characterised by short-period waves (with a period of less than 8 seconds) generated by local winds. Garden Island acts as a barrier to incident swell waves from the southwest, allowing only a small portion (as little as 5%) of the swell energy to penetrate into the southern part of Cockburn Sound. The sheltering effect depends on the direction of the incident waves and the specific location within Cockburn Sound.

There is a gap between Carnac Island and Garden Island that permits some west and northwest swell to reach Kwinana Beach, and southwest swell also refracts around the top end of Garden Island into Cockburn Sound. The Southern Flats and the Causeway combinedly restrict majority of the south-west swell from reaching James Point. Numerical modelling indicates that ~95% of the south-west swell energy is dampened or attenuated before it reaches James Point, while roughly 80% of north-west swell energy is also attenuated before it arrives (DAL, 1998 in BMT, 2023).

3.7 Land tenure and zoning

The project area is located within the local planning scheme – special areas, and is adjacent to general industry owned zones (north and east of the project area) (see Figure 13).


Legend
Landside Development Envelope
Marine Development Envelope
Local Planning Scheme - Special Area (DPLH-068)
Local Planning Scheme - Zones and Reserves (DPLH-071)
General industry
Local roads
Park recreation and drainage
Paper Size ISO A3
0 50 100 150 200
Meters
N
Horizontal Datum: GDA2020
Grid: GDA2020
GHD
Price Water House Coopers
Kwinana Bulk Berth 5 Business Case Development
Land tenure and zoning
Project No. 12608307
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Date 05/12/2023
FIGURE 13
Data source: WANow; World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community. Created by: aridgard

4. Methods

4.1 Desktop assessment

An initial desktop assessment was conducted to determine the key environmental aspects for the Project, including identification of key environmental factors in accordance with EPA guidelines (EPA, 2023).

The assessment involved a review of publicly available spatial datasets sourced from the Government of Western Australia (GoWA 2023), review of publications, relevant technical studies and government managed databases. The spatial information sources utilised in the assessment are presented in Table 10.

Table 10 Information sources

Aspect	Information source
Climate	Bureau of Meteorology (BoM) Climate Data Online
Geology, landform and soils	1:500 00 State interpreted bedrock geology ((GoWA 2023; DPIRD-016) 1:2500 00 State interpreted bedrock geology (GoWA 2023; DPIRD-014) Soil Landscape Mapping - Systems (GoWA 2023; DPIRD-064)
Acid Sulphate Soils (ASS)	Australian Soil Resources Information System (ASRIS) (GoWA 2023; DWER-052)
Contaminated sites	Contaminated sites Database (GoWA 2023; DWER-059)
Conservation reserves and areas	Department of Biodiversity, Conservation and Attractions (DBCA) – Legislated Lands and Waters (GoWA 2023; DBCA-011) DBCA – Lands of Interest (GoWA 2023; DBCA-012)
Environmentally Sensitive Areas (ESA)	Clearing Regulations – Environmentally Sensitive Areas (ESAs) (GoWA 2023; DWER-046)
Hydrology	Public Drinking Water Source Areas (PDWSAa) (GoWA 2023; DWER-033) *Rights in Water and Irrigation Act 1914* (RIWI Act), Surface Water Areas and Irrigation Districts (GoWA 2023; DWER-037) RIWI Act, Groundwater Areas (GoWA 2023; DWER-034) Ramsar sites (GoWA 2023; DBCA-010) Directory of Important Wetlands in Australia - Western Australia (GoWA 2023; DBCA-045)
Vegetation	Beard (1979) Statewide Vegetation Statistics (GoWA 2023)
Threatened and Priority Ecological Communities	DBCA Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) spatial dataset (GoWA 2023; DBCA-038)
Conservation Significant Flora and Fauna	DBCA *NatureMap* database (DBCA 2023)
Heritage	Aboriginal Heritage Places (GoWA 2023; DPLH-001) Aboriginal Heritage Inquiry System (AHIS) (GoWA 2023; DPLH 2022) Heritage Council WA - State Register (GoWA 2023; DPLH-003)
MNES	Protected Matters Search Tool (PMST)

4.2 Technical studies

The following preliminary technical studies were undertaken to support this PEIA:

– Preliminary vegetation unit mapping and fauna habitat site assessment
– Preliminary underwater noise modelling
– Preliminary environmental noise and vibration modelling.

5. Environmental Principles and Factors: Assessment Overview

This PEIA includes an initial assessment to determine the key environmental constraints for the Project in accordance with the key environmental factors outlined by the EPA. The environmental factors that were considered for this PEIA associated potential impacts to the Project, consideration of significance and the preliminary assessment undertaken are found in Table 11.

Table 11 Key Environment factors associated potential impacts from the project, consideration of significance and preliminary assessment undertaken.

Theme	Key Environmental Factors	Sub areas	Potential impacts from the project	Consideration of significance	Section	Preliminary assessment undertaken
SEA	Marine Environmental Quality	Underwater noise	Construction – vessel and piling noise. Operations – trade vessel noise. Incidents	Potential significant impact.	Refer Section 6	Preliminary underwater noise modelling for construction and operation for fauna behavioural changes, injury and death.
		Marine Pests	Foreign trade vessel arrival and use associated with construction and operations.			
		Water quality	Construction vessel operations Contamination of water and sediment Contamination from antifouling paints Spill associated with import/export of hydrocarbons, ammonia and other chemicals			
	Marine Fauna	Marine Fauna	Habitat loss and/or displacement Injured marine fauna Underwater acoustic interference – pile driving activities Underwater acoustic interference – vessels Light pollution	Potential significant impact.	Refer Section 7	Preliminary desktop assessment of marine fauna impact on vessel strikes
	Benthic Communities and Habitats	Benthic Habitat	Physical footprint of project on seabed Habitat loss and/or displacement Sea-bed disturbance from construction of wharf and associated infrastructure. Spill associated with import/export of hydrocarbons and chemicals	Potential significant impact.	Refer Section 8	Preliminary benthic habitat desktop assessment.
	Coastal Processes	Coastal processes	Coastal modifications Temperature variability Restricted nearshore current and buoyancy effects Sheltered areas and reduced turbulence	Potential significant impact.	Refer Section 9	Preliminary desktop assessment coastal processes impacts
LAND	Flora and Vegetation	Flora and Veg	Clearing of vegetation associated with construction footprint Introduction and spread of weeds and generation and deposition of dust	Potential significant impact. Dependent on whether native vegetation will be cleared. Dependent on the conservation status of the native vegetation.	Refer Section 10	Preliminary vegetation unit mapping including identification of threatened species and communities.
	Terrestrial Environmental Quality	Contaminated sites	Ground disturbance associated with construction footprint Further and/ or contamination of soils and groundwater within the landside DE and potentially off-site	Potential significant impact. Mobilisation of existing contaminated soils.	Refer Section 11	A preliminary contaminated sites desktop assessment
	Terrestrial Fauna	Fauna	Construction footprint and potential removal of habitat. Operations	Potential presence of conservation significant fauna. Potential significant impact.	Refer Section 0.	A preliminary desktop assessment of presence and occurrence of fauna.
		Subterranean fauna	Ground disturbance associated with construction footprint	Due to underlying soils and geology (refer Section 11.3.1) subterranean fauna not considered present.		None

Theme	Key Environmental Factors	Sub areas	Potential impacts from the project	Consideration of significance	Section	Preliminary assessment undertaken
	Landforms	Land use	Ground disturbance associated with construction footprint	Due to industrial zoning and inherent impacted nature of coastal dunes impact not considered significant.		Preliminary desktop assessment of land use, reserves and conservation areas.
PEOPLE	Social surroundings	Indigenous heritage	Disturbance to land or areas used for cultural heritage purposes, or known to have cultural heritage values Restriction of access to country, including Aboriginal heritage sites or places of interest Impacts on amenity – including places of cultural significance – due to dust and light	Project involves ground disturbance. Potential significant impact. Refer Section 13	Refer Section 12	Preliminary indigenous heritage desktop assessment is detailed in Section 13.3.2.
		Heritage	Disturbance to land or areas used for cultural heritage purposes, or known to have cultural heritage values Restriction of access to Country, including Noongar cultural places of interest	Project involves ground disturbance. Potential significant impact. Refer Section 13		Preliminary heritage desktop assessment (non-indigenous) is detailed in Section 13.3.4
		Noise	Noise emissions associated with construction and operations. Construction vehicle movements and excavation activities Routine and non-routine noise emissions. Increased traffic in the Project area	Potential significant impact. Refer Section 13		Preliminary environmental noise modelling (during construction and operation) and a comparison against the Environmental Protection (Noise) Regulations 1997.
		Visual Impact	Altered visual amenity as a result of constructed Project infrastructure Increased traffic in the Project area	Potential significant impact. Refer Section 13		Visual amenity assessment is detailed in Section 13.3.6
		Sub-merged heritage[6]	Seabed disturbance from wharf construction	Bathymetric survey required for benthic habitat mapping will identify seabed raised abnormalities.		Assessment of bathymetric data required.
	Human Health	Public safety	No radioactive materials planned to be transported through proposed facility	N/A		Not required
WATER	Inland waters	Groundwater quality at KBB 3 &4	Ground disturbance associated with construction footprint	Potential significant impact. Impacts to confined water table from ground disturbance – ongoing monitoring has confirmed presence of contaminants.	Refer Section14	A preliminary contaminated sites desktop assessment
AIR	Greenhouse Gas Emissions	Greenhouse gas emissions	GHG emissions from construction and operations	GHG emission calculations are required to demonstrate the level of emissions from the construction and operations of the Project prior to determining level of significance. To note, the WA State Government has a net zero by 2030 aspiration for all government departments and agencies, including FPA.	Refer Section 14.4	Estimation of Scope 1 emissions associated with construction. Estimation of Scope 1 and 2 emissions associated with operations.
	Air quality	Air quality	Emissions from equipment associated with construction and operations	Impacts to air quality from the construction of the Project are unlikely to be significant. It is envisaged that this environmental factor can continue to be managed via an EP Act Part V prescribed premises licence (with licence relevant to bulk trade).		Not required.

[6] Although this is not an EPA Key Environmental Factor subarea, it is an emerging area of interest to regulators.

6. Key Environmental Factor - Marine environmental quality[7]

6.1 Introduction

Maintaining, and where required improving, Marine Environmental Quality (MEQ) in Cockburn Sound is required to protect the integrity and biodiversity of the marine ecosystem, support the industries that are dependent on water resource, maintain recreational activities and protect recreational users. The construction and operation of KBB 5 north of Kwinana Beach in Cockburn Sound is likely to have adverse impacts on MEQ.

6.2 Relevant legislation, policy and guidance

6.2.1 EPA Objective

The EPA's environmental objective for marine environmental quality is: "To maintain the quality of water, sediment, and biota so that environmental values are protected" (EPA, 2016i).

6.2.2 Relevant legislation

Following legislation that was considered relevant for MEQ include:

- *Environmental Protection Act (1986)*
- *Biodiversity Conservation Act 2016 (BC Act) and Biodiversity Conservation Regulations 2018*
- *Contaminated Sites Act 2003 (CS Act [DER 2003])*
- *Oil and Noxious Substances Act 1987*
- *Western Australian Biosecurity and Agriculture Management Act 2007*
- *Western Australia Fish Resources Management Act 1994*

6.2.3 EPA policy and guidance

EPA policy and guidance that were considered relevant for MEQ include:

- Environmental factor guideline – Marine Environmental Quality (EPA, 2016b)
- Technical guidance – Protecting the quality of Western Australia's marine environment
- (EPA, 2016f)
- Statement of environmental principles, factors and objectives (EPA, 2020c)
- State Environmental (Cockburn Sound) Policy 2015 (EPA, 2015)

State Environmental (Cockburn Sound) Policy 2015

In 2005, the EPA introduced the State Environmental (Cockburn Sound) Policy 2005 (SEP) which defined Environmental Quality Objectives (EQO) for evaluating environmental performance within Cockburn Sound. The Government of Western Australia issued an updated version of the State Environmental (Cockburn Sound) Policy in 2015. The Environmental Quality Criteria (EQC) Reference Document for Cockburn Sound (EPA, 2017) provides clear environmental criteria for effective environmental management of Cockburn Sound. The criteria ensure proposals that have the potential to significantly affect MEQ are assessed in a sound and consistent manner that demonstrates the EPA's objectives in Cockburn Sound will continue to be met. The management framework is based on, and consistent with, the National Water Quality Management Strategy (NWQMS [ANZECC

[7] This section is sourced from the KBB 5 Business Case – Preliminary Environmental Impact Assessment (BMT, 2023) (Appendix A).

& ARMCANZ 2000]) and is underpinned by the principles of the National Strategy for Ecologically Sustainable Development (Steering Committee, 1992).

The Cockburn Sound Environmental Quality Management Framework (EQMF) is based on the protecting the following Environmental Values (EV; EPA 2017):

1. Ecosystem health
2. Fishing and aquaculture
3. Recreation and aesthetics
4. Cultural and spiritual values, and
5. Industrial water supply.

Each of the above EV, has associated EQOs (see Table 12). For MEQ, each of the EV and EQO potentially apply to this PEIA. For the EQO for maintenance of ecosystem integrity, KBB 5 is located within an area assigned a Moderate level of ecological protection (EPA, 2015).

Table 12 Cockburn Sound Environmental Values and associated Environmental Quality Objectives (BMT, 2023)

Environmental Values	Environmental Quality Objectives and their descriptions
Ecosystem Health	**Maintenance of ecosystem integrity** Ecosystem integrity is considered in terms of structure (e.g., the biodiversity, biomass and abundance of biota) and function (e.g. food chains and nutrient cycles). Three levels of ecological protection shall apply to Cockburn Sound (High, Moderate, and Low).
Fishing and Aquaculture	**Maintenance of seafood safe for human consumption** Seafood is safe for human consumption when collected or grown. **Maintenance of aquaculture** Water is of a suitable quality for aquaculture purposes
Recreation and Aesthetics	**Maintenance of primary contact recreation values** Primary contact recreation (e.g., swimming) is safe to undertake. **Maintenance of secondary contact recreation values** Secondary contact recreation (e.g., boating) is safe to undertake. **Maintenance of aesthetic values** The aesthetic values are protected
Cultural and Spiritual	**Cultural and Spiritual values of the marine environment are protected** Indigenous cultural and spiritual values are not compromised.
Industrial water supply	**Maintenance of water quality for industrial use** Water is of suitable quality for industrial uses.

Two main types of Environmental Quality Criteria have been developed to remain consistent with ANZECC & ARMCANZ (2000):

– **Environmental quality guidelines (EQG)** are threshold numerical values or narrative statements which if met indicate there is a high degree of certainty that the associated environmental quality objective has been achieved. If the guideline is not met, then there is uncertainty as to whether the associated environmental quality objective has been achieved and a more detailed assessment against an environmental quality standard is triggered. This assessment is risk-based and investigative in nature. EQG is generally equivalent to the water quality guidelines described in ANZECC & ARMCANZ (2000).
– **Environmental quality standards (EQS)** are threshold numerical values or narrative statements that indicate a level beyond which there is a significant risk that the associated environmental quality objective has not been achieved and a management response is triggered. The response would normally focus on identifying the cause (or source) of the exceedance and then reducing loads of the contaminant of concern (i.e., source control) and may also require in situ remedial work to be undertaken. EQS are generally equivalent to the water quality objectives described in ANZECC & ARMCANZ (2000). As discussed earlier, this is a risk-based approach that relies on increasing levels of evidence of an impact before a management response is triggered.

Additional EPA policies and guidance that were considered relevant to MEQ include:

– Statement of Environmental Principles, Factors and Objectives (EPA, 2023)
– Environmental Factor Guideline: Marine Environmental Quality (EPA, 2016a)
– Technical Guidance: Protecting the Quality of Western Australia's Marine Environment (EPA, 2016b).

6.2.4 Other policy and guidance

Other policy and guidance documents that were considered relevant for marine environmental quality include:

Other policies and guidance associated with this PEIA include:

– Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
– Guideline: Assessment and management of contaminated sites (DWER 2021b).
– Fremantle Ports Marine Environmental Management Framework (MEMF; BMT 2020)
– International Convention for the Prevention of Pollution from Ships (1973) and its Protocol of 1978 (MARPOL 73 78)
– Guide for Applying Working with Nature to Navigation Infrastructure Projects (PIANC 2018)
– Guidelines and guidance documents related to the implementation of the International Convention for the Control and Management of Ship`s Ballast Water and Sediments (2004)
– Australian Biofouling Management Requirements (DAWE 2022)
– Anti-fouling and In-water Cleaning Guidelines (DAFF 2015)
– Biofouling Management Tools and Guidelines (DPIRD 2022).

6.3 Receiving environment

6.3.1 Water quality

The water quality in Cockburn Sound area has been impacted by extensive industrial development in the southern region of Metropolitan Perth since the 1950s (DCE 1979; DEP 1996; DAL and PPK 2001). During the 1970s, elevated nutrient inputs stimulated algal growth (resulting in high chlorophyll-a concentrations) and low water clarity/high light attenuation reduced light availability to benthic primary producers. This reduced water clarity contributed to the historical decline of seagrass populations in the region (Chiffings, 1979). The refinement of industrial wastewater treatment processes and the redirection of point source discharges (DEP, 1996), including the re-routing of the Woodman Point wastewater and CSBP discharge away from Cockburn Sound, has resulted in a substantial reduction of nutrient loads to Cockburn Sound. The availability of nitrogen plays a crucial role in the productivity of Cockburn Sound (Lourey et al, 2006) and the concerted effort on reducing nitrogen inputs (DEP 1996) has led to a shift in the nitrogen balance in the Sound, from a state of surplus nitrogen in the water column to an apparent deficit between supply and demand (Greenwood et al*,* 2016). Despite significant reductions in nitrogen inputs, phytoplankton biomass has not responded as predictably as expected (Mohring & Rule 2013; Keesing et al, 2016). Median chlorophyll-a concentrations exceeded 2 µg/L in the late 1970s (Cary *et al*, 1995), dropping to around 1 µg/L in the mid-1980s, briefly surging to ~2 µg/L in the mid-1990s (MAFRL, 2017), and subsequently generally declining to present concentrations of around 1 µg/L.

Salinity in Cockburn Sound varies between around 34.5–37 PSU annually (Water Corporation, 2013), decreasing in winter months when rainfall and runoff dilute the water column, and an increasing in summer due to evaporation (Van Senden & Miller, 2005). Water temperatures in January and February are warmer than those in December and March (Keesing et al, 2016). The waters of Cockburn Sound are generally well mixed and well oxygenated (CSMC, 2023) but there are periods, mainly during late summer and autumn or associated with extreme weather events, when bottom waters become stratified and low dissolved oxygen (DO) concentrations may be experienced for short periods (CSMC, 2023). Stratification in the Sound is naturally driven by salinity and temperature gradients created by local and regional meteorological and oceanographic events (D'Adamo, 2002). Stratification is generally weak and disrupted by strong winds, particularly summer sea breezes (DEP, 1996).

The DO concentrations decrease as seawater temperature rises, with the lowest concentrations in February (Keesing et al, 2016). Generally, the EQG for DO in the Sound is not exceeded (CSMC, 2013). However, elevated

water temperatures linked to an abnormal heat wave for >8 weeks in the summer of 2011 (February to mid-March) reduced DO concentrations across the Sound, particularly in the deep southern basin (Rose et al, 2012). No instances of dead fish or other biota were reported during this event, but low DO could increase seagrass vulnerability to stressors and enhance nutrient/contaminant release from sediments.

Concentrations of potential toxicants in Cockburn Sound are annually assessed by the Fremantle Ports Marine Quality Monitoring Program (MQMP), and prior to 2021 CSMC. Concentrations of potential contaminants were below their EQC values (where available) for both moderate and high ecological protection areas. A further 70 potential toxicants without guidelines were mostly below their respective detection limits or limits of reporting, or present at low concentrations. Contaminants with concentrations above the limit of reporting (but with no EQC) were all within accepted international standards where available (BMT, 2022).

6.3.2 Sediment quality

Sediments serve as reservoirs for accumulated nutrients, potentially retaining elevated concentrations after periods of water column nutrient stress are resolved. Sediment nutrient recycling can sustain phytoplankton growth long after external pressures have subsided. This occurs through nutrient release from sediments and rapid uptake by the pelagic algal community, maintaining phytoplankton biomass (chlorophyll-a concentration) (Keesing et al, 2016). Bottom waters in deep sections of Cockburn Sound exhibited elevated concentrations of nitrogen and phosphorus compared to surface waters, as expected from sediment nutrient resupply at depth (Keesing et al, 2016).

Sediment exposure to contamination in Cockburn Sound has largely been a consequence of industrial development, shipping, and other boating activity, similar to those pressures affecting marine water quality (BMT, 2018). Due to the proximity of existing wharves to the marine DE, shipping and port activities are key potential sources of sediment contaminants, including the antifoulant tributyltin (TBT) from historical contamination, various petroleum hydrocarbons and some metals.

6.4 Potential impacts and risks

The potential impacts identified on MEQ are described in Table 13.

Table 13 Potential impacts to marine environmental quality (BMT 2023)

Potential impact	Type of impact	Construction and/ or Operation Impact	Context
Spills	Indirect	Operations	KBB 5 will import and/or export environmentally hazardous and potentially toxic liquids (ammonia, liquid hydrogen, liquid carbon dioxide, LPG, miscellaneous chemicals, petroleum, and/or sulfuric acid) which present risk of a spill to the marine environment.
		Construction	Vessels and marine construction activities use various hydrocarbons, including fuel, oil, and lubricants and presents a potential risk of hydrocarbons spills.
Contamination of water and sediments	Cumulative	Operations and Construction	The Project will increase port activities and associated waste generation has the potential to increase the risk of contamination of waters and sediment.
Contamination from antifouling paints	Cumulative	Operations and Construction	The Project will increase the volume of shipping, which will increase the risk of contamination of waters and sediment with products contained in antifoulant coatings.
Elevated turbidity from vessel movements and construction activities	Indirect / Direct	Operations and Construction	Vessels approaching and departing the area may generate a localised plume of sediments due to propulsion turbulence.

Potential impact	Type of impact	Construction and/ or Operation Impact	Context
Introduction of marine pests and invasive species	Indirect	Operations and Construction	Construction and operations have the potential to allow the settlement of introduced marine pests from vessels, construction machinery and equipment.

6.5 Preliminary assessment of impacts

6.5.1 Spills

The proposed KBB 5 will be used to import and/or export environmentally hazardous and potentially toxic liquids (i.e. ammonia, liquid hydrogen, liquid carbon dioxide, LPG, miscellaneous chemicals, petroleum, and/or sulphuric acid (see section 2.8.3). The vessels mooring at KBB 5 will contain reservoirs of fuel, oil and grease.

There is a risk of the unplanned discharge or spill of these potentially toxic products to the marine environment during vessel transit (e.g. ship striking the wharf when mooring, a moored ship being struck by another ship or failure of the mooring system) or loading/unloading product (e.g. pipeline failure during product loading/unloading or loading arm failure). There is a potential for vessel spills of fuel, oil and grease during both construction and operations activities.

- Spills may lead to the contamination of marine water and sediment and potentially impact on marine fauna, benthic habitats, and overall ecosystem integrity via:
- Acute toxicity/mortality
- Chronic toxicity, affect feeding, reproduction and growth
- Smothering of benthic habitats disrupting ecological processes
- Coating on wildlife restricting vital life functions and may lead to mortality.

It is not possible to quantify the environmental impacts of a potential spill before the event, because the scale and duration of an event cannot be predicted. However, the toxicity and capacity for dispersal of the products that will be handled can give an indication of the risk to the marine environment. Some of the proposed products are highly toxic and readily dispersed and the potential impacts on marine environmental quality can are therefore significant.

6.5.2 Contamination of waters and sediment

Routine activities will introduce undefined but environmentally hazardous and potentially toxic compounds into the Project area. There is a risk of these compounds entering the marine environment in site run off or as dust. Compounds with the potential to contaminate water and sediment around KBB 5 include:

- **Heavy Metals**: Industrial materials bought onto site can lead to the release of heavy metals such as zinc, lead, mercury, cadmium, and copper. These metals may come from cargo or items such as zinc anodes or copper pipe delivered to site. Metals can accumulate in sediments and water, posing risks to aquatic life.
- **Organic Pollutants**: This category includes a range of chemicals such as polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and hydrocarbons from general industrial activities. For example, emissions from vehicles on site may contain hydrocarbon residues and poorly maintained vehicles may leak oils. These substances are often toxic, can persist in sediments and water, affecting aquatic ecosystems and potentially causing harm to marine organisms.
- **Nutrients**: Increased nutrient input, including nitrogen and phosphorus, result from port activities at the Project area or inland industrial areas, such as shipping, loading/unloading, and industrial processes. Excess nutrients can lead to eutrophication, algal blooms, and oxygen depletion in the water, impacting the marine ecosystem.

6.5.3 Contamination from antifouling paints

Antifoulant coatings are applied to the hull of vessels to discourage the settlement or slow the growth of sessile marine organisms that attach to the hulls and maintain vessel efficiency and performance. The active constituents in the paints are often toxic (e.g. historical use of TBT and present use of copper-based paints) and can leach into the environment or get deposited with flakes of paint from vessels stationed at ports and harbours. Toxic antifoulants can accumulate in sediments and water, posing risks to aquatic life.

6.5.4 Elevated suspended sediments/turbidity from vessel movements

Vessels approaching and departing the area may generate a localised plume of sediments due to propulsion turbulence. Elevated turbidity can reduce light penetration affecting the growth of seagrasses and corals. Suspended sediments can cause minor smothering on areas adjacent to the shipping channel and berths, can clog the gills of fish and reduce the feeding efficiency of filter-feeding organisms. Resuspended sediments can introduce pollutants, including heavy metals and other contaminants, to the water column leading to adverse effects on the marine environment.

6.5.5 Introduction to marine pests and invasive species

Introduced marine pests (IMPs) are a significant ecological risk, but because of the wide-ranging nature of the threat (i.e., anything from phytoplankton to fish could be introduced), can be very difficult to detect and monitor. Ballast water exchange and hull fouling are major pathways for the spread of marine pests. Construction vessels travel at slow speeds or are stationary and are often present on site for long periods. There is possibly a greater risk of IMPs occupying construction vessels than trading vessels. IMPs potentially impact on local marine life by competing with native species for food or space, preying on native species, crossbreeding with native species or by changing the habitat.

6.6 Proposed future studies for impact assessment

Based on the assessment of potential impacts presented in Section 6.5, surveys are recommended as detailed in Section 6.6.1 to 6.6.3.

6.6.1 Spills Risk Assessment and Modelling

KBB 5 will import and/or export environmentally hazardous and potentially toxic liquids (ammonia, liquid hydrogen, liquid carbon dioxide, LPG, miscellaneous chemicals, petroleum, and/or sulfuric acid) which present risk of a spill to the marine environment. Vessels and marine construction activities use various hydrocarbons, including fuel, oil, and lubricants and presents a potential risk of hydrocarbons spills. A risk assessment (including spill modelling) of hydrocarbon and import/export products (expected to include ammonia, liquid hydrogen, liquid carbon dioxide, LPG, miscellaneous chemicals, petroleum, and/or sulphuric acid) used during construction and operation of the Project is required to identify the potential for environmental impact involving the spill/leakage of liquid products or hazardous substances.

6.6.2 Water and Sediment Quality Baseline

The Project will increase port activities, which will increase waste generation on site increasing the risk of contamination of waters and sediment. A baseline survey of potential contaminant concentrations is required to determine the presence/impact of potential contamination in the Project area, and to inform ongoing operational environmental monitoring, if required (BMT, 2023[8], [9]).

6.6.3 Contamination from antifoulant paints

The Project will increase shipping volumes potentially exposing waters and sediment to the active constituents of antifoulant paints. A baseline survey[10] of potential contaminant concentrations is required to determine the presence/impact of antifouling chemicals.

[8] GHD sort clarification from BMT regarding duration of potential monitoring. The initial response is:
EPA guidance suggests ideally a minimum 2 years baseline to assist in the development of environmental quality criteria, though with adequate justification using existing datasets in the Cockburn Sound region it's possible the requirement for longer term data collection can be reduced and given the sound is heavily sampled review of existing datasets would likely infer an element of baseline.
Depending on what is already available publicly and, in the literature, seasonal data over a year would be beneficial to build a contemporary understanding of water quality.
Sediments typically accumulate potential toxicants over the long-term, and this could potentially be a one-off survey. The planned surveys should be designed to provide adequate spatial representation of the Project area (maybe using existing sites to build on and placement of others) and include reference sites.

[9] Further Clarification from BMT is currently being sought.
GHD interprets that the studies required are effectively a Water and Sediment Quality Baseline. There are 3 potential scenario's regarding duration. The "likely scenario" is carried forward in the PEIA Schedule.
Worst case scenario – 2 years of baseline water quality monitoring.

- EPA guidance suggests ideally a minimum 2 years baseline to assist in the development of environmental quality criteria, though with adequate justification using existing datasets in the Cockburn Sound region it's possible the requirement for longer term data collection can be reduced and given the sound is heavily sampled review of existing datasets would likely infer an element of baseline.

Likely scenario – 1 year (= 13 months to ensure full seasonal cycle) of baseline

- Depending on what is already available publicly and, in the literature, seasonal data over a year would be beneficial to build a contemporary understanding of water quality

Best case scenario – although beneficial, existing monitoring data from FPA sufficient.

- Depending on what is already available publicly and, in the literature, seasonal data over a year would be beneficial to build a contemporary understanding of water quality

One-off sediment sampling is considered sufficient for characterization of potential contaminants in marine sediments and would therefore be combined with water quality monitoring.

[10] Additional parameters will be added to sediment sampling undertaken as part of the baseline to incorporate contamination from antifoulant paints.

7. Key Environmental Factor - Marine Fauna[11]

7.1 Introduction

Marine fauna includes animals that live their entire life in the ocean (e.g., sharks, whales, dolphins, dugongs, sea snakes, most fish and crustaceans (EPA, 2016e)) and animals that either leave or enter the ocean for breeding or resting purposes (e.g. turtles, seals, sea lions, penguins, and crabs (EPA, 2016e)). Animals, such as seabirds, that rely on fish and other marine life for food are also be considered to be marine fauna (EPA 2016e).

All marine fauna is an important part of the broader marine and coastal ecosystem. However, some species, or groups of species, play critical roles in maintaining key ecological functions and processes within the ecosystem (EPA, 2016e). For some species, the number of individuals has declined to levels where they are now considered threatened under State and Federal legislation. Some marine fauna have high public appeal for their economic, cultural and spiritual importance (2016e). Given their importance, it is important to identify marine fauna, particularly threatened species, present within the Project area to understand the potential impacts of the proposed development.

7.2 Relevant legislation, policy and guidance

7.2.1 Environmental Objective

To protect marine fauna so that biological diversity and ecological integrity are maintained. Listed threatened and migratory species and MNES are protected under the Environment Protection and Biodiversity Act 1999 (EPBC Act).

7.2.2 Relevant legislation

Following legislation that were considered relevant for marine fauna includes:

– *Environment Protection and Biodiversity Act 1999*
– *Environmental Protection Act 1986*
– *Biodiversity Conservation Act 2016*
– *Conservation and Land Management Act 1984*
– *Fish Resources Management Act 1994.*

7.2.3 EPA policy and guidance

Following EPA policy/guidance that were considered relevant for marine fauna include:

– Environmental Factor Guideline: Marine Fauna (EPA, 2016e)
– Statement of Environmental Principles, Factors and Objectives (EPA, 2023).

7.2.4 Other policy and guidance

Other policies and guidance that were considered relevant for marine fauna include:

– Threat Abatement Plan for impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (CoA, 2018)
– National Light Pollution Guidelines for Wildlife (DCCEEW,2023a)
– National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA,2017a)
– Recovery Plan for Marine Turtles in Australia (CoA, 2017b)

[11] This section is entirely sourced from the KBB 5 Business Case – Preliminary Environmental Impact Assessment (BMT, 2023) (See appendix A)

- Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (CoA, 2013a)
- Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (CoA, 2014)
- Blue Whale Conservation Management Plan 2015–2025 (DoE, 2015a)
- Conservation Management Plan for the Southern Right Whale 2011–2021 (DSEWPAC, 2012)
- Approved Conservation Advice for *Megaptera novaeangliae* (Humpback Whale) (TSSC, 2015a)
- Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern) (DSEWPC , 2011)
- Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008)
- Recovery plan for the White Shark (*Carcharodon carcharias*) (DSEWPAC, 2013)
- Approved Conservation Advice for *Rhincodon typus* (Whale Shark) (TSSC, 2015b)
- Approved Conservation Advice for *Pristis pristis* (Largetooth Sawfish) (DoE, 2014a)
- Sawfish and River Sharks Multispecies Recovery Plan (DoE, 2015b)
- Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (DoE, 2015c)
- Other species specific recovery plans for listed threatened species and ecological communities that have been made or adopted under the *Environment Protection and Biodiversity Conservation Act 1999*
- Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (DCCEEW, 2023b)
- Department of Biodiversity, Conservation and Attractions (DBCA) Priority Species.

7.3 Receiving environment

Under Part 13 of the EPBC Act, a species can be listed as one, or a combination, of the following protection designations:

- threatened (further divided into categories; extinct, extinct in the wild, critically endangered, endangered, vulnerable, conservation-dependent)
- migratory
- whale or other cetaceans
- marine.

An EPBC Protected Matters Search Tool (PMST) report was generated for the marine DE (with a 10 km buffer) to determine the Matters of National Environmental Significance (MNES) and identify other matters protected by the EPBC Act that may occur in or relate to the Project area (DCCEW 2023b; Annex A). A DBCA NatureMap search was also conducted on marine DE (with a 10 km buffer) to provide a list of both conservation sensitive species and common taxa that may occur within the marine DE (Annex B). Solely freshwater species, terrestrial mammals and terrestrial birds that occurred in the reports were excluded. A range of taxa were identified, including mammals, reptiles, sharks, fish and birds. Species recovery plans, conservation advice, management plans and threat abatement plans for relevant species that may occur within the Project area were identified and any applicable requirements included in the assessment. For relevant MNES identified in the PMST search, likelihood of occurrence was assessed based on the extent of construction and operational activities for the Project, the known distribution, habitat preference, sightings and historical records of species.

A Biologically Important Area (BIA) is an area that provides important habitat for the survival of a species i.e., breeding, foraging, migration or distribution area. BIAs are not defined under the EPBC Act but are designed to assist decision-making under the EPBC Act and were assessed in the PEIA.

7.3.1 Marine mammals

Seven EPBC listed threatened and/or migratory marine mammals were identified as potentially occurring within 10 km of the marine DE (Table 14). An additional seven species marine mammals were listed in the PMST report under ‘other protected matters’ (Table 14) including:

- Five dolphin species
- One fur seal species.

Identified BIA's for marine mammals that spatially overlap the marine DE are presented in Table 15 and Figure 14. Seasonal sensitivities of these BIA's are presented in Table 16.

Table 14 Listed marine mammal species potentially occurring within 10km of the marine DE (BMT, 2023)

Common Name	Species Name	EPBC Act Status	BC Act Status	Type of Presence (EPBC)	Likelihood of Occurrence
Southern Right Whale	*Eubalaena australis*	EN, Mi	VU	Breeding known to occur within area	Low
Blue Whale	*Balaenoptera musculus*	EN, Mi	EN	Species or species habitat likely to occur within area	Low
Bryde's Whale	*Balaenoptera edeni*	Mi	Mi	Species or species habitat may occur within area	Low
Killer Whale, Orca	*Orcinus orca*	Mi	Mi	Species or species habitat may occur within area	Low
Pygmy Right Whale	*Caperea marginata*	Mi	Mi	Species or species habitat may occur within area	Low
Humpback Whale	*Megaptera novaeangliae*	Mi	CD, Mi	Species or species habitat known to occur within area	Low
Minke Whale	*Balaenoptera acutorostrata*	C	-	Species or species habitat may occur within area	Low
Australian Sea lion	*Neophoca cinerea*	EN	EN	Species or species habitat known to occur within area	Moderate
Bottlenose Dolphin	*Tursiops truncatus s. str.*	C	-	Species or species habitat may occur within area	Low
Pantropical Spotted Dolphin	*Stenella attenuata*	C	Mi	Species or species habitat may occur within area	Low
Common Dolphin	*Delphinus delphis*	C	-	Species or species habitat may occur within area	Low
Indian Ocean Bottlenose Dolphin	*Tursiops aduncus*	C	Mi	Species or species habitat likely to occur within area	High
Risso's Dolphin	*Grampus griseus*	C	-	Species or species habitat may occur within area	Low
Long-nosed Fur seal	*Arctocephalus forsteri*	Ma	OS	Species or species habitat may occur within area	Low

Table 15 Biologically Important Areas for marine mammals overlapping the marine DE (BMT, 2023)

Common Name	Species Name	Behaviour	Location
Pygmy Blue Whale	*Balaenoptera musculus brevicauda*	Distribution	South-East Marine Region, South West Marine Region, North West Marine Region, Outside
Humpback Whale	*Megaptera novaeangliae*	Migration (north and south)	West coast - Bunbury to Lancelin including Rottnest Island. Migration corridor use on both northern and southern migration. On northern migration whale can be found well offshore, whilst on southern migration majority of whales close inshore.
Southern Right Whale	*Eubalaena australis*	Migration	Locations with at least 2 sightings (separated by no more than 10 km) of cow: calf pairs or unaccompanied adults in 2 separate years out of 8 years. Extended to 5 km offshore.
Australian Sea Lion	*Neophoca cinerea*	Foraging (male)	Mid west coast, includes Beagle Island, Fisherman Island, Jurien Bay, Cervantes and Buller Colonies

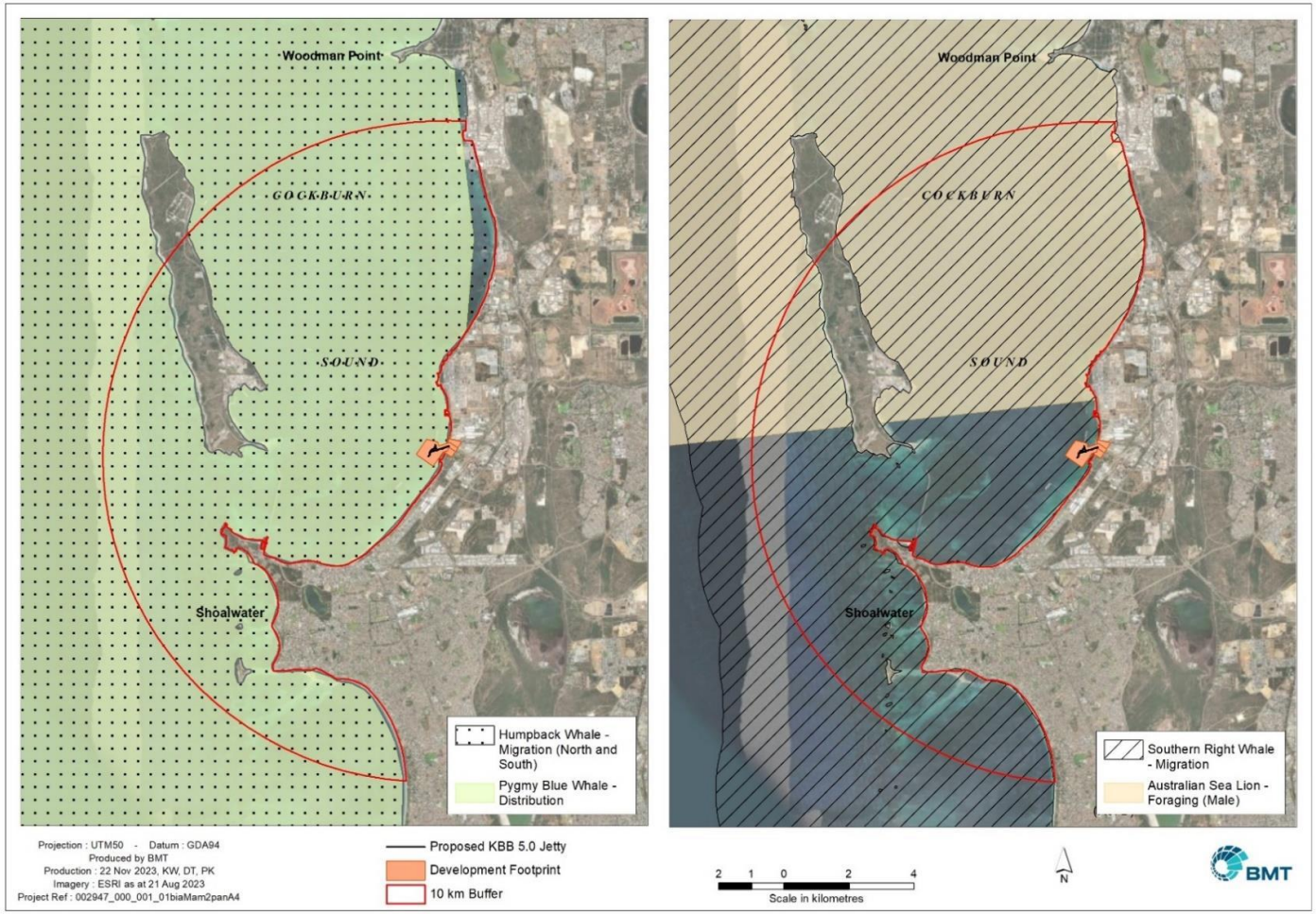


Figure 14 Marine mammal Biologically Important Areas that spatially overlap the marine DE (BMT, 2023)

Table 16 Seasonal sensitivities of Biologically Important Areas that overlap the marine DE (BMT, 2023)

Species	Event	January	February	March	April	May	June	July	August	September	October	November	December
Pygmy Blue Whale	Distribution												
Humpback Whale	Migration (north and south)												
Southern Right Whale	Migration												
Australian Sea Lion	Foraging												
KEY		Activity can occur											
		Lower level of abundance/activity/presence											
		Peak period of activity											

7.3.1.1 Whales

7.3.1.1.1 Southern right whale

Southern right whales have a circumpolar distribution in the Southern Hemisphere between about 16°S and 65°S. Calving/nursery areas appear to be exclusively coastal, either off continental land masses or oceanic islands (CoA, 2012a). Regular calving areas occur between Augusta in WA and Port Lincoln in South Australia, with less regular calving occurring around the southwest coast and as far north as Perth (Marsh et al, 1995). There have been a few documented sightings of this species in the region (see Annex A), but southern right whales are not common off the Perth coastline due to the low numbers of this endangered species. Although the marine DE spatially overlaps the migration BIA (Figure 14), given the semi-enclosed nature of the south-eastern extent of Cockburn Sound, the existing level of disturbance and shallow water depths the species is highly unlikely to be present within the marine DE.

7.3.1.1.2 Blue whale

There are two recognised subspecies of blue whale in the southern hemisphere that are both recorded in Australian waters, the southern (or 'true' blue whale (Balaenoptera musculus intermedia) and the 'pygmy' blue whale (Balaenoptera musculus brevicauda). In general, southern blue whales occur in waters south of 60°S and pygmy blue whales occur in waters north of 55°S. As such, all blue whales potentially in waters around the marine DE are assumed to be pygmy blue whales.

Pygmy blue whales occur mostly at the continental shelf edge and slope with movement being predominantly fast with short (a few days) periods of slow movement and 'milling' indicative of foraging. Tracked whales did not use the shelf area (Thums et al, 2022) (Figure 15, Figure 16) represent important areas for foraging/breeding and migration. The closest known foraging/breeding areas (identified in red) are ~39 km from the marine DE (Figure 16). The closest known area used during migration is ~16 km from the Project area (Figure 16). Given the distance to these BIAs and the shallow water depths of the marine DE, it is unlikely these individuals will occur in the marine DE.

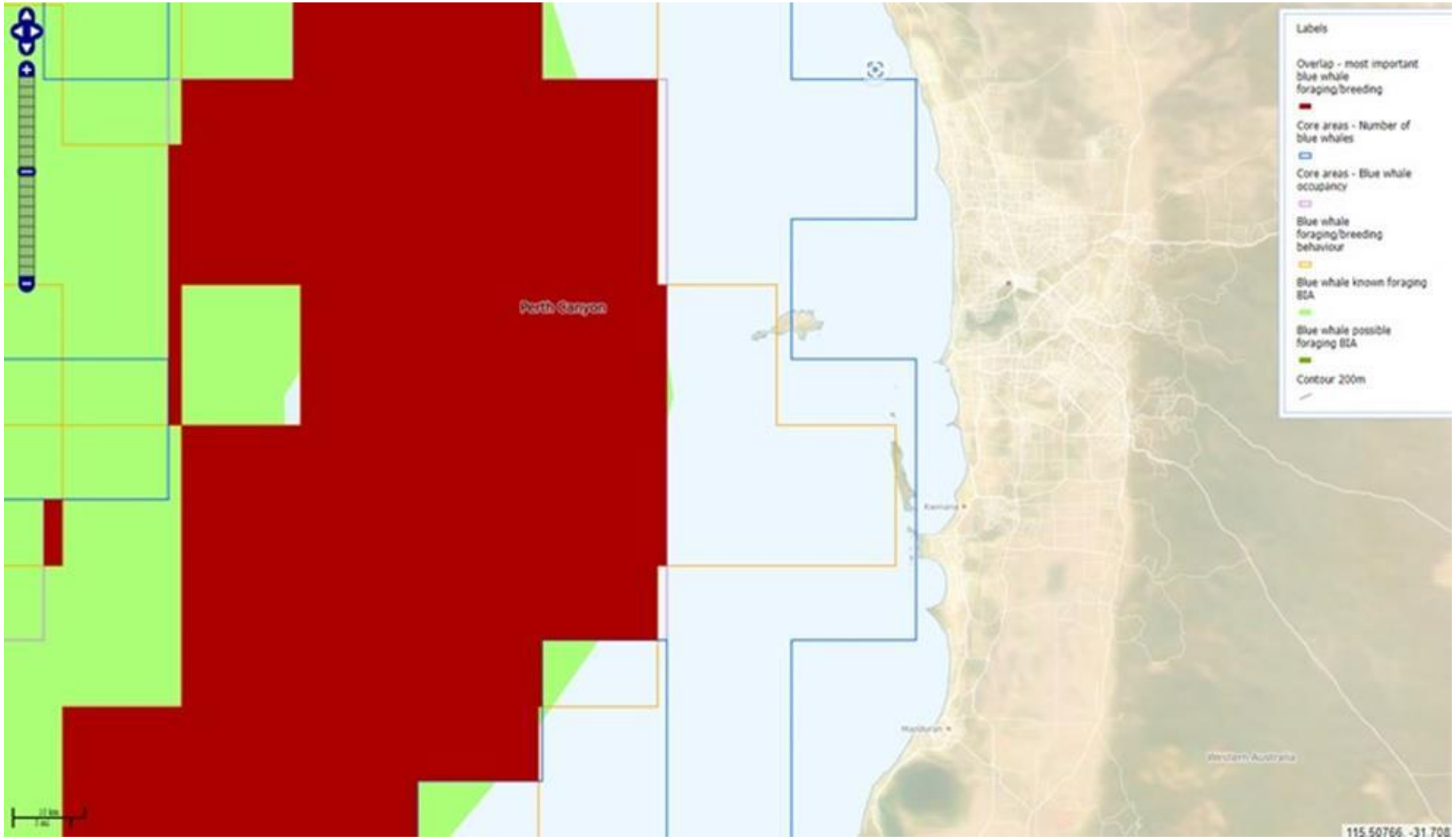


Figure 15 Core areas used by blue whales for foraging/breeding (BMT, 2023)

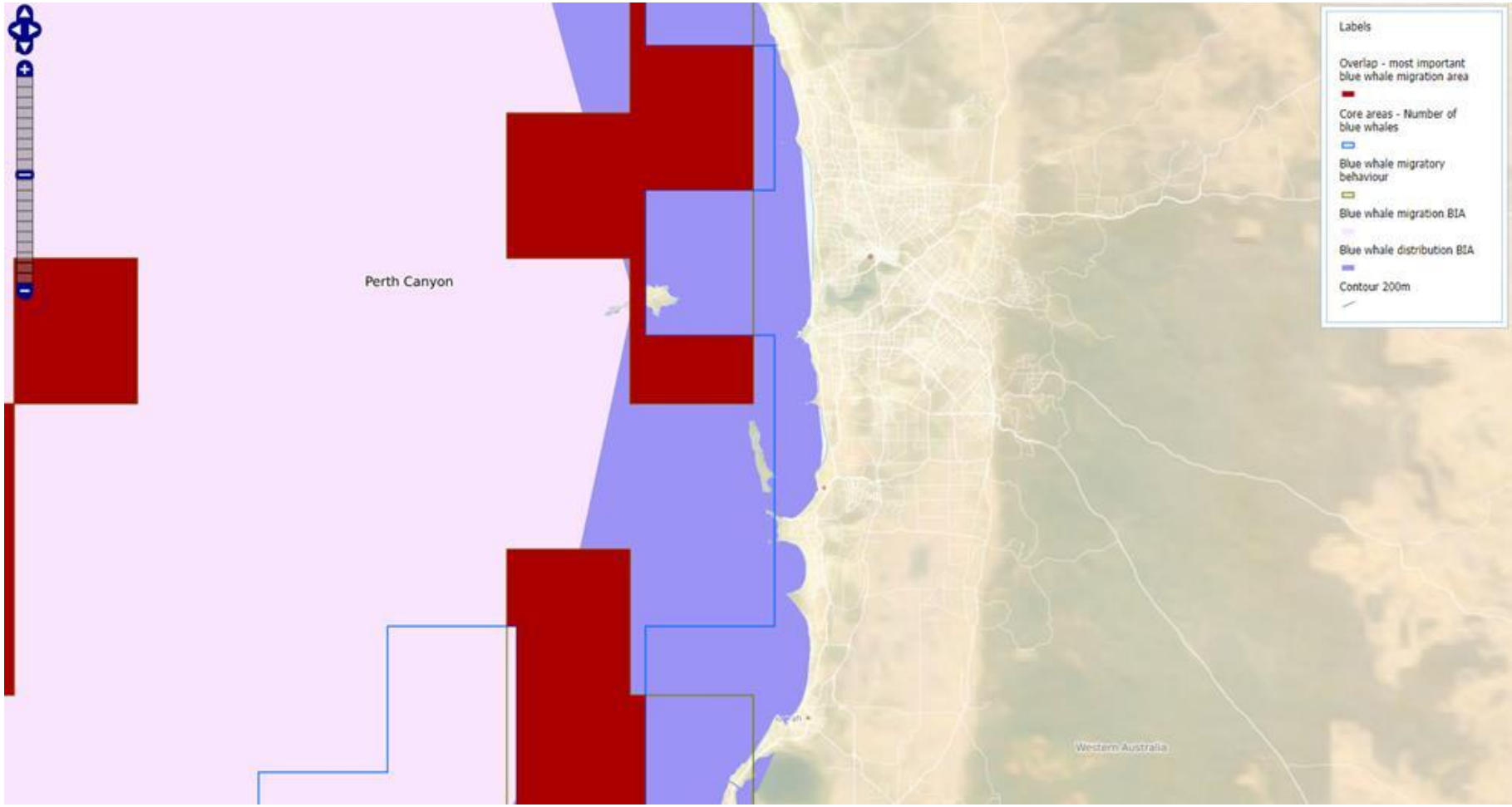


Figure 16 ***Core areas used by blue whales during migration (BMT, 2023)***

7.3.1.1.3 Humpback whale

Humpback whales migrate annually between summer feeding grounds in Antarctica and breeding aggregation areas in the Southern Kimberley, between Broome and the northern end of Camden Sound. The humpback whale migration pathway is within the continental shelf boundary or 200 m bathymetry along the WA coast but sightings indicate that the route can be much closer to shore (Jenner et al. 2001; Double et al, 2010). Humpback whales have habitat preferences related to social organisation, and mothers and calves (southern migration) show strong preference to shallower inshore waters (Ersts & Rosenbaun 2003; Irvine & Salgado Kent, 2017).

The marine DE overlaps humpback whale migration BIA (Figure 15) and whales may travel through this area on a seasonal basis as part of their migratory movements. However, the nearshore habitat has not been identified as supporting large numbers or aggregations of this species and only transient individuals are likely to occur during restricted temporal windows. Given the marine DE is located in relatively high levels of existing disturbance, its unlikely interactions will occur.

7.3.1.1.4 Bryde's whale

Bryde's whales are found in oceanic and nearshore tropical and subtropical waters and considered a pelagic species. The smaller, coastal form of Bryde's whale is limited to waters shallower than 200 m and moves along the coast in response to suitable prey, while the larger, offshore form is found in deeper water (500–1000 m; DCCEEW, 2023b). Insufficient information is available on specific Australian feeding or breeding grounds for the species. Inshore coastal forms appear to breed and give birth throughout the year while the offshore form breeds during winter (DCCEEW, 2023b). This species is known to occur in waters off WA and may transit the area during annual migrations. Given the marine DE is located in relatively shallow temperate waters, no known feeding or breeding grounds with high levels of existing disturbance its unlikely interactions will occur.

7.3.1.1.5 Orca

While orcas are known to be migratory, following regular seasonal movements, exact routes and timings are poorly understood. They may follow migratory movements of other whales (e.g., humpback whales). The preferred habitat of orca includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions in both warm and cold waters. Given there are no known feeding or breeding grounds in the marine DE and high levels of existing disturbance, large numbers of orca are unlikely to be encountered, although transient individuals may be occur.

7.3.1.1.6 Pygmy right whale

The pygmy right whale is the smallest baleen whale and is found in temperate and sub-Antarctic waters of the Southern Hemisphere where surface temperatures are about 5–20 °C (DCCEEW, 2023b). It is among the least studied cetaceans and is not known to be migratory but there may be north/south movements depending on reproductive and life history status; therefore, it is classified as Migratory under the EPBC Act and BC Act. While two records of stranded individuals near Fremantle exist (ALA, 2023), they are from more than 20 years ago and no further sightings have been documented. Given the lack of sightings and its sparse distribution combined with the marine DE existing level of disturbances, it is unlikely the pygmy right whale will be present in the proposed marine DE.

7.3.1.1.7 Minke whale

The minke whale is not listed as threatened or migratory, but as a cetacean is protected in Australian waters under the EPBC Act. Transient individuals may occur in the area of the proposed marine DE, though given there are no known feeding or breeding grounds in the marine DE and high levels of existing disturbance interactions are unlikely.

7.3.1.2 Dolphins

None of the five species of dolphin identified in Table 14 are listed as threatened or migratory, but as cetaceans are protected in Australian waters under the EPBC Act. Two of these species are listed as migratory under the BC Act (Table 14). In Cockburn Sound, bottlenose dolphins (Tursiops aduncus) most intensively frequent the shallow sandy bottom Kwinana Shelf and deep basin. Mother-calf pairs comprise ~20% of the Cockburn Sound dolphin population (Cannell, 2004). Dolphins have high site fidelity, remaining in the same general location year-round, and the population in Cockburn Sound is considered resident. This resident population is estimated to be ~74

individuals (Sutton & Shaw, 2019). Kwinana shelf to the east of Cockburn Sound is a core area for foraging and is also a nursery area. Foraging was found to be consistent throughout the day with an increase in the early hours of the afternoon (Sutton & Shaw, 2019). Given there is a resident population of bottlenose dolphins it is likely that individuals will be encountered in the area of the marine DE.

7.3.1.3 Seals

7.3.1.3.1 Australian sea lion

The Australian sea lion is Australia's only endemic pinniped species and only breeds in the coastal and offshore waters of South Australia and WA. Australian sea lion breeding cycles are long (17.4–17.8 months in duration) (Shaughnessy et al, 2006) which reduces reproductive opportunities by ~one third when compared with other annually breeding pinnipeds. Breeding is expected to occur at all times of the year across with a 4.6-month pupping season (Shaughnessy et al, 2006), inferring that prey availability must be relatively stable throughout the year. The Australian sea lion spends around 35 per cent of its time at or close to the sea floor. Adults tend to travel at the surface for a short distance, then commence repeated dives to the benthos (CoA 2 013b). The descents and ascents appear to be rapid, presumably to maximise the time spent near the sea floor. The sea lions around Cockburn Sound are almost exclusively sub adult and adult males. The marine DE overlaps the foraging (male) BIA (Table 14). Given this overlap, the proximity to Carnac Island (an important haul out location), and the sighting records from the NatureMap search (Annex B), it is likely that individuals will be encountered in the area of the marine DE.

7.3.1.3.2 Long-nosed fur seal

The long-nosed fur seal is not listed as threatened or migratory, but as a marine mammal is protected under the BC Act. Transient individuals may occur in the area of the marine DE likely forging in pelagic waters along the continental shelf (Baylis et al, 2008) but they tend to be found on rocky shorelines and there are no identified haul out areas in Cockburn Sound.

7.3.2 Marine reptiles

Four (4) EPBC listed marine turtles identified as having foraging, feeding or related behaviour known to occur within 10 km of the Project site are threatened or migratory (Table 17; Annex A). No BIAs overlap the Project area. One additional marine reptile (sea snake) was listed in the PMST report under 'other protected matters' (Table 17).

7.3.2.1 Leatherback turtle

In Australia, leatherback turtles occur in tropical and temperate waters. The species has been recorded feeding in all Australian states and while no major nesting areas have been recorded, scattered isolated nesting occurs in southern Queensland and the Northern Territory (DCCEEW, 2023b). Most leatherback turtles living in Australian waters migrate to breed in neighbouring countries, particularly in Indonesia, Papua New Guinea and the Solomon Islands (DCCEEW, 2023b). The leatherback turtle forages along coastlines and in the open ocean for jellyfish and soft-bodied invertebrates and is most commonly reported from coastal waters in central eastern Australia, south-east Australia and in south-western WA. Foraging occurs throughout the water column, from close to the surface to depths of more than 1200 m. Leatherback turtles are known to feed in pelagic waters along the mid-west coast of WA. Three sightings have been reported within the 10 km buffer area (see Annex B). While no BIAs for this species exist in the vicinity of the marine DE , foraging or transient individuals may occur. However; given the limited sightings, likely species distribution, no known breeding or nesting areas and high level of existing disturbance in the Marine DE, interactions are unlikely.

7.3.2.2 Loggerhead turtle

The loggerhead turtle has a worldwide tropical and subtropical distribution and occurs in the waters throughout WA. They feed primarily on benthic invertebrates in waters ranging in depth from the nearshore zone to 55 m (CoA, 2017b). Major nesting areas for the WA population include Muiron Islands, Ningaloo Coast south to about Carnarvon and islands near Shark Bay, including Dirk Hartog Island (DCCEEW, 2023b). Loggerhead turtles are one of the most sighted turtles along the coast adjacent to the South-west Marine Region (SWMR), with resident adult and large sub-adult turtles sometimes found in the Perth region between Rottnest Island and Geographe Bay

(DCCEEW, 2023b). While no BIAs for this species exist in the vicinity of the marine DE, there have been several sightings identified through the NatureMap search (see Annex Bwithin 10 km of the Marine DE, and foraging or transient individuals may occur. However; given the limited sightings, likely species distribution, no known breeding or nesting areas and high level of existing disturbance in the Marine DE, interactions are unlikely.

7.3.2.3 Green turtle

Green turtles are the most widespread and abundant turtle species in WA waters and adults are commonly encountered in seagrass beds and in proximity to macroalgal benthic habitats. Green turtles are generally found in tropical and subtropical waters and normally remain within the northern and southern limits of the 20°C isotherms (Marquez, 1990); however, individuals may stray into temperate waters and immature green turtles have been recorded foraging in water temperatures as low as 15°C. In Australia, there are seven regional populations of green turtles that nest in different areas, the closest to the Marine DE inhabiting WA's north-west shelf, the Ashmore and Cartier Reefs and Scott Reef (DCCEEW, 2023b). One sighting has been reported within the 10 km buffer area (see Annex B), and large juveniles assumed to be foraging have also been seen on the reefs around Rottnest Island (CoA, 2012b). While no BIAs for this species exist in the vicinity of the marine DE, foraging or transient individuals may occur. However; given the limited sightings, likely species distribution, no known breeding or nesting areas and high level of existing disturbance in the Marine DE, interactions are unlikely.

7.3.2.4 Flatback turtle

The species feeds widely through the waters over the Australian continental shelf to as far north as the Gulf of Papua in Papua New Guinea and coastal waters of Indonesia (DCCEEW, 2023b). In WA, the species has been reasonably well surveyed for its nesting distribution but not for its foraging distribution. The closest major nesting areas are the Kimberley and Pilbara regions (DCCEEW, 2023b). Flatback turtles are carnivores, feeding mostly on soft bodied prey such as sea cucumbers, soft corals and jellyfish and prefer shallow, soft-bottomed seabed habitats away from reefs (DCCEEW, 2023c). Flatback turtles are not known to occur in the SWMR (CoA, 2012b) but may occur infrequently in the region.

Table 17 Listed marine reptile species potentially occurring within 10km of the marine DE (BMT 2023)

Common Name	Species Name	EPBC Act Status	BC Act Status	Type of Presence (EPBC)	Likelihood of Occurrence
Leatherback Turtle	*Dermochelys coriacea*	EN, Mi	VU	Foraging, feeding or related behaviour known to occur within area	Low
Loggerhead Turtle	*Caretta caretta*	EN, Mi	EN		Low
Green Turtle	*Chelonia mydas*	VU, Mi	VU		Low
Flatback Turtle	*Natator depressus*	VU, Mi	VU		Low
Spectacled Sea snake	*Disteira kingii*	Ma	-	Species or species habitat may occur within area	Low

7.3.2.5 Sea Snakes

One (1) species of sea snake was identified as potentially occurring in the Marine DE but is not listed as threatened (Annex A). Most sea snakes have tropical to subtropical distributions. Few sea snakes inhabit oceanic waters and most species live in shallower waters around reefs and inshore environments. Only yellow-bellied sea snakes are known to inhabit the subtropical and temperate waters of the SWMR. Other species of sea snake may be carried from warmer waters by the southward-flowing Leeuwin Current and occur as vagrants in the region (CoA, 2012b). There have been no reported sightings of the spectacled sea snake in the region.

7.3.3 Sharks, rays, and fishes

Eleven EPBC listed sharks, rays and fishes identified as potentially occurring within 10 km of the Marine DE are listed as threatened and/or migratory (Annex A). No BIAs overlap the Marine DE. Twenty-three additional species listed under the EPBC Act as 'other protected matters' were also identified (Table 18). These included pipefish, pipehorses, seadragons and seahorses, belonging to the family Syngnathidae.

7.3.3.1 Sharks and rays

7.3.3.1.1 School shark

School shark is a temperate demersal species found on the continental shelf and slope. They can be found to depths of 550 m, and often move up into the water column at night. School shark segregate into schools according to size and sex. Size generally increases from inshore to offshore. Pups and juveniles aggregate in shallower 'nursery' waters during the spring and summer. School shark undertake long migrations of up to 1400 km along the southern coast of Australia, thought to be associated with homing to natal mating and pupping grounds (AFMA, 2023). Given the lack of sightings and that the marine DE is at the northern limits of its distribution, it is unlikely that school shark will occur in the area. However; given the limited sightings, likely species distribution, no known breeding areas and high level of existing disturbance in the Marine DE, interactions are unlikely.

7.3.3.1.2 Scalloped hammerhead

The scalloped hammerhead has a circum-global distribution in tropical and sub-tropical waters (TSSC , 2018). It ranges widely over shallow coastal shelf waters. Within Australian waters the scalloped hammerhead extends from New South Wales, around the north of the continent and then south into WA to approximately Geographe Bay (TSSC, 2018). There are several records of scalloped hammerhead sharks near the marine DE (ALA, 2023). This species may occur in the area as a transient visitor however; given there area no known breeding areas and high level of existing disturbance in the Marine DE, interactions are unlikely.

Table 18 Listed shark, ray and fish species potentially occurring within 10km of the marine DE (BMT, 2023)

Common Name	Species Name	EPBC Act Status	BC Act Status[4]	Type of Presence (EPBC)	Likelihood of Occurrence
School Shark	*Galeorhinus galeus*	CD	-	Species or species habitat may occur within area	Low
Scalloped Hammerhead	*Sphyrna lewini*	CD	-	Species or species habitat known to occur within area	Low
White Shark	*Carcharodon carcharias*	VU, Mi	VU	Species or species habitat known to occur within area	Moderate
Grey Nurse Shark (west coast population)	*Carcharias taurus*	VU	VU	Species or species habitat known to occur within area	Moderate
Largetooth Sawfish	*Pristis pristis*	VU, Mi	P3, Mi	Species or species habitat may occur within area	Low
Whale Shark	*Rhincodon typus*	VU, Mi	Mi	Species or species habitat may occur within area	Low
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Mi	-	Species or species habitat may occur within area	Low
Reef Manta Ray	*Mobula alfredi*	Mi	Mi	Species or species habitat likely to occur within area	Low
Giant Manta Ray	*Mobula birostris*	Mi	Mi	Species or species habitat likely to occur within area	Low
Porbeagle	*Lamna nasus*	Mi	Mi	Species or species habitat may occur within area	Low

Common Name	Species Name	EPBC Act Status	BC Act Status[4]	Type of Presence (EPBC)	Likelihood of Occurrence
Southern Bluefin Tuna	*Thunnus maccoyii*	CD	-	Species or species habitat likely to occur within area	Low
Widebody Pipefish	*Stigmatopora nigra*	Ma	-	Species or species habitat may occur within area	Low
Spotted Pipefish	*Stigmatopora argus*	Ma	-	Species or species habitat may occur within area	Low
Gunther's Pipehorse	*Solegnathus lettiensis*	Ma	-	Species or species habitat may occur within area	Low
Gale's Pipefish	*Campichthys galei*	Ma	-	Species or species habitat may occur within area	Low
Western Crested Pipefish	*Mitotichthys meraculus*	Ma	-	Species or species habitat may occur within area	Low
Pugnose Pipefish	*Pugnaso curtirostris*	Ma	-	Species or species habitat may occur within area	Low
Common Seadragon	*Phyllopteryx taeniolatus*	Ma	-	Species or species habitat may occur within area	Low
Leafy Seadragon	*Phycodurus eques*	Ma	P2	Species or species habitat may occur within area	Low
Southern Pygmy Pipehorse	*Acentronura australe*	Ma	-	Species or species habitat may occur within area	Low
Sawtooth Pipefish	*Maroubra perserrata*	Ma	-	Species or species habitat may occur within area	Low
Bonyhead Pipefish	*Nannocampus subosseus*	Ma	-	Species or species habitat may occur within area	Low
Javelin Pipefish	*Lissocampus runa*	Ma	-	Species or species habitat may occur within area	Low
Prophet's Pipefish	*Lissocampus fatiloquus*	Ma	-	Species or species habitat may occur within area	Low
Australian Smooth Pipefish	*Lissocampus caudalis*	Ma	-	Species or species habitat may occur within area	Low
Rhino Pipefish	*Histiogamphelus cristatus*	Ma	-	Species or species habitat may occur within area	Low
Short-head Seahorse	*Hippocampus breviceps*	Ma	-	Species or species habitat may occur within area	Low
Hairy Pipefish	*Urocampus carinirostris*	Ma	-	Species or species habitat may occur within area	Low
Mother-of-pearl Pipefish	*Vanacampus margaritifer*	Ma	-	Species or species habitat may occur within area	Low
Longsnout Pipefish	*Vanacampus poecilolaemus*	Ma	-	Species or species habitat may occur within area	Low
Port Phillip Pipefish	*Vanacampus phillipi*	Ma	-	Species or species habitat may occur within area	Low
West Australian Seahorse	*Hippocampus subelongatus*	Ma	-	Species or species habitat may occur within area	Low

7.3.3.1.3 White shark

White sharks are highly mobile and move rapidly over very large ranges. The white shark is primarily an inhabitant of continental and insular shelf waters, but they are also known to inhabit the open ocean. White sharks often occur close inshore near the surf-line and may move into shallow bays. Within Australia, they can be found south of North West Cape in WA to Southern Queensland. More commonly they occur off the South and South West coasts. They display diverse migration strategies, ranging between inshore coastal habitats, to offshore open ocean (Bradford et al, 2020). White sharks are often found in regions with high prey density, such as pinniped colonies. A tagging study recorded some of the highest detections within Cockburn Sound (McAuley et al, 2016). In addition, white shark aggregations have been recorded in Cockburn Sound, with seasonal abundance coinciding with the seasonal formation of spawning aggregations of snapper (McAuley et al, 2016). This species is likely to occur in the vicinity of the marine DE.

7.3.3.1.4 Grey nurse shark (west coast population)

The grey nurse shark has a broad inshore distribution, primarily in sub-tropical to cool temperate waters (Last & Stevens, 2009). The west coast population of grey nurse shark is predominantly found in the south-west coastal waters of WA and has been recorded as far north as the North West Shelf (Stevens 1999; Pogonoski et al, 2002).

Individuals may exhibit a high degree of site fidelity, although some studies have suggested that the species exhibits some migratory characteristics moving between different habitats and localities (McAuley, 2004). The high endemism ensures that grey nurse sharks are vulnerable to localised pressures in certain areas. The status of the west coast population is poorly understood although they are reported to remain widely distributed along the WA coast and are still regularly encountered, although with low and indeterminate frequency (Chidlow et al, 2006).

The species has been recorded at varying depths but is generally found between 15–40 m (Otway & Parker, 2000). Grey nurse sharks have also been recorded in the surf zone, around coral reefs, and to depths of around 200 m on the continental shelf (Pollard et al, 1996). Grey nurse sharks may be present in the proximity of the marine DE as there may be suitable habitat, although lack of sightings suggest that there will not be significant numbers. Given the limited sightings, likely species distribution, no known breeding/feeding areas and high level of existing disturbance in the Marine DE, interactions are unlikely.

7.3.3.1.5 Whale shark

The whale shark is a large filter feeder found in tropical and warm temperate seas mainly off northern Australia. Whale sharks, occurring in both tropical and temperate waters, are known to aggregate in the waters adjacent to North West Cape in late March to early May, with the largest numbers being recorded in April (Sequeira et al, 2013). No critical habitat for whale sharks has been designated in the SWMR. There have been occasional sightings around Perth and one sighting in Cockburn Sound in 2013 but given their widespread distribution and highly migratory nature their presence in the vicinity of the marine DE is unlikely.

7.3.3.1.6 Largetooth sawfish

Largetooth sawfish (also known as Freshwater sawfish) have been recorded on the continental shelf and in river and estuarine environments, in typical depths of 0–25 m (DoE, 2014). This species is mainly found in the Kimberley and Pilbara with only a few recordings south of North West Cape (DoF, 2011a). This species is unlikely to occur in the Marine DE.

7.3.3.1.7 Porbeagle

Porbeagles are a wide-ranging, coastal oceanic shark found in temperate and cold-temperate waters worldwide. It is more common on continental shelves. No information is available on migratory timing. The Marine DE is located within a sheltered marine embayment and lacks the open ocean habitat the species prefers. Given there have been no sightings, no known breeding areas and a high level of existing disturbance in the Marine DE, interactions are unlikely.

7.3.3.1.8 Oceanic whitetip shark

Oceanic whitetip sharks are found in tropical and subtropical oceans throughout the world, but prefer waters above 20°C. They live offshore in deep water but spend most of their time in the upper part of the water column. They are considered a top predator, feeding primarily on fish and cephalopods (NOAA, 2023). In Australia the oceanic

whitetip shark is found from Cape Leeuwin (WA) through parts of the Northern Territory, down the east coast of Queensland and New South Wales to Sydney (Last and Stevens 2009) but is rarely encountered and is often released alive from pelagic longline fisheries (FRDC, 2019). This species is unlikely to occur in the area.

7.3.3.1.9 Manta rays

Giant manta rays are migratory and have a circumtropical and semi-temperate distribution through the world's oceans. However, it is believed that within this broad range the populations are distributed sparsely and are fragmented (Marshall et al, 2022). They are predominantly pelagic, found in the waters around offshore islands, and occasionally in coastal areas. The Marine DE lacks the distribution extent and open ocean habitat the species prefers.

The reef manta ray has a widespread distribution in tropical and subtropical waters of Australia having a pelagic lifestyle. They have a relatively sedentary behaviour with precise areas for cleaning and feeding within close proximity of coasts, reefs or islands. The Marine DE is located outside of the common distribution range for the species.

7.3.3.2 Fish

One EPBC listed fish was identified as potentially occurring in the Marine DE – southern bluefin tuna. Spawning takes place from September to April in warm waters south of Java and juvenile southern bluefin tuna then migrate down the coast of WA. Young southern bluefin tuna are known to migrate seasonally and may occur in the area of the marine DE.

Species within the Syngnathidae family (pipefish, pipehorses, seadragons and seahorses) generally inhabit coastal waters with diverse benthic structure (e.g. seagrasses, rocky or coral reefs). Most syngnathids live in shallow coastal waters and are especially reliant on habitats well represented in Cockburn Sound, including seagrass, filter-feeder communities, shallow detritus, reefs and artificial structures. These species are likely to occur within the vicinity of the marine DE.

7.3.4 Seabirds and shorebirds

Sixty-six EPBC listed seabird and shorebird species were identified as potentially occurring within 10 km of the Project site (Table 19). An additional 14 species that are not threatened and/or migratory were also identified as potentially occurring in the area. Nine BIA's spatially overlap the proposed Project site and buffer area (Table 20 and Figure 17). Seasonal sensitivities of these BIA's are presented in Table 21

Table 19 Listed seabird and shorebird species potentially occurring within 10km of the marine DE (BMT, 2023)

Common Name	Species Name	EPBC Act Status	BC Act Status	Type of Presence (EPBC)	Likelihood of Occurrence
Northern Siberian Bar-tailed Godwit	*Limosa lapponica menzbieri*	CE	CR	Species or species habitat known to occur within area	Low
Great Knot	*Calidris tenuirostris*	CE, Mi	CR	Species or species habitat known to occur within area	Low
Eastern Curlew	*Numenius madagascariensis*	CE, Mi	CR	Species or species habitat likely to occur within area	Low
Curlew Sandpiper	*Calidris ferruginea*	CE, Mi	CR	Species or species habitat known to occur within area	Moderate
Shy Albatross	*Thalassarche cauta*	EN, Mi	VU	Foraging, feeding or related behaviour likely to occur within area	Low
Lesser Sand Plover	*Charadrius mongolus*	EN, Mi	EN	Species or species habitat known to occur within area	Low
Southern Giant Petrel	*Macronectes giganteus*	EN, Mi	Mi	Species or species habitat may occur within area	Low
Australasian Bittern	*Botaurus poiciloptilus*	EN	EN	Species or species habitat known to occur within area	Low
Northern Royal Albatross	*Diomedea sanfordi*	EN, Mi	EN	Species or species habitat may occur within area	Low
Australian Painted Snipe	*Rostratula australis*	EN	EN	Species or species habitat known to occur within area	Low
Tristan Albatross	*Diomedea dabbenena*	EN, Mi	CR	Species or species habitat may occur within area	Low
Amsterdam Albatross	*Diomedea amsterdamensis*	EN, Mi	CR	Species or species habitat may occur within area	Low
Red Knot	*Calidris canutus*	EN, Mi	EN	Species or species habitat known to occur within area	Low
Greater Sand Plover	*Charadrius leschenaultii*	VU, Mi	VU	Species or species habitat known to occur within area	Low
Wandering Albatross	*Diomedea exulans*	VU, Mi	VU	Foraging, feeding or related behaviour likely to occur within area	Low
Southern Royal Albatross	*Diomedea epomophora*	VU, Mi	VU	Species or species habitat may occur within area	Low
Blue Petrel	*Halobaena caerulea*	VU	-	Species or species habitat may occur within area	Low
White-capped Albatross	*Thalassarche steadi*	VU, Mi	-	Species or species habitat may occur within area	Low
Indian Yellow-nosed Albatross	*Thalassarche carteri*	VU, Mi	EN	Species or species habitat likely to occur within area	Low
Black-browed Albatross	*Thalassarche melanophris*	VU, Mi	EN	Foraging, feeding or related behaviour likely to occur within area	Low
Australian Lesser Noddy	*Anous tenuirostris melanops*	VU	EN	Species or species habitat may occur within area	Low
Northern Giant Petrel	*Macronectes halli*	VU, Mi	Mi	Foraging, feeding or related behaviour likely to occur within area	Low

Common Name	Species Name	EPBC Act Status	BC Act Status	Type of Presence (EPBC)	Likelihood of Occurrence
Australian Fairy Tern	*Sternula nereis nereis*	VU	VU	Foraging, feeding or related behaviour known to occur within area	High
Sooty Albatross	*Phoebetria fusca*	VU, Mi	EN	Species or species habitat may occur within area	Low
Campbell Albatross	*Thalassarche impavida*	VU, Mi	VU	Species or species habitat may occur within area	Low
Fairy Prion (southern)	*Pachyptila turtur subantarctica*	VU	-	Species or species habitat known to occur within area	Low
Soft-plumaged Petrel	*Pterodroma mollis*	VU	-	Species or species habitat may occur within area	Low
Bar-tailed Godwit	*Limosa lapponica*	Mi	Mi	Species or species habitat known to occur within area	Low
Black-tailed Godwit	*Limosa limosa*	Mi	Mi	Roosting known to occur within area	Low
Bridled Tern	*Onychoprion anaethetus*	Mi	Mi	Breeding known to occur within area	Moderate
Broad-billed Sandpiper	*Limicola falcinellus*	Mi	Mi	Species or species habitat known to occur within area	Low
Caspian Tern	*Hydroprogne caspia*	Mi	Mi	Breeding known to occur within area	Moderate
Common Greenshank	*Tringa nebularia*	Mi	Mi	Species or species habitat known to occur within area	Moderate
Common Noddy	*Anous stolidus*	Mi	Mi	Species or species habitat likely to occur within area	Low
Common Redshank	*Tringa totanus*	Mi	Mi	Species or species habitat known to occur within area	Low
Common Sandpiper	*Actitis hypoleucos*	Mi	Mi	Species or species habitat known to occur within area	Moderate
Double-banded Plover	*Charadrius bicinctus*	Mi	Mi	Species or species habitat known to occur within area	Low
Flesh-footed Shearwater	*Ardenna carneipes*	Mi	VU	Foraging, feeding or related behaviour likely to occur within area	Moderate
Fork-tailed Swift	*Apus pacificus*	Mi	Mi	Species or species habitat likely to occur within area	
Greater Crested Tern	*Thalasseus bergii*	Mi	Mi	Breeding known to occur within area	Moderate
Grey Plover	*Pluvialis squatarola*	Mi	Mi	Species or species habitat known to occur within area	Moderate
Grey Wagtail	*Motacilla cinerea*	Mi	Mi	Species or species habitat may occur within area	Low
Grey-tailed Tattler	*Tringa brevipes*	Mi	P4, Mi	Species or species habitat known to occur within area	Low
Little Curlew	*Numenius minutus*	Mi	Mi	Roosting likely to occur within area	Low
Little Ringed Plover	*Charadrius dubius*	Mi	Mi	Roosting known to occur within area	Low
Little Tern	*Sternula albifrons*	Mi	Mi	Species or species habitat may occur within area	Low
Long-toed Stint	*Calidris subminuta*	Mi	Mi	Roosting known to occur within area	Low
Marsh Sandpiper	*Tringa stagnatilis*	Mi	Mi	Roosting known to occur within area	Low

Common Name	Species Name	EPBC Act Status	BC Act Status	Type of Presence (EPBC)	Likelihood of Occurrence
Oriental Pratincole	*Glareola maldivarum*	Mi	Mi	Species or species habitat known to occur within area	Low
Osprey	*Pandion haliaetus*	Mi	Mi	Breeding known to occur within area	Low
Pacific Golden Plover	*Pluvialis fulva*	Mi	Mi	Species or species habitat known to occur within area	Low
Pectoral Sandpiper	*Calidris melanotos*	Mi	Mi	Species or species habitat known to occur within area	Low
Pin-tailed Snipe	*Gallinago stenura*	Mi	Mi	Roosting likely to occur within area	Low
Red-necked Phalarope	*Phalaropus lobatus*	Mi	Mi	Species or species habitat known to occur within area	Low
Red-necked Stint	*Calidris ruficollis*	Mi	Mi	Roosting known to occur within area	Moderate
Roseate Tern	*Sterna dougallii*	Mi	Mi	Breeding known to occur within area	Moderate
Ruddy Turnstone	*Arenaria interpres*	Mi	Mi	Species or species habitat known to occur within area	Moderate
Ruff (Reeve)	*Philomachus pugnax*	Mi	Mi	Roosting known to occur within area	Low
Sanderling	*Calidris alba*	Mi	Mi	Species or species habitat known to occur within area	Moderate
Sharp-tailed Sandpiper	*Calidris acuminata*	Mi	Mi	Roosting known to occur within area	Moderate
Sooty Shearwater	*Ardenna grisea*	Mi	Mi	Species or species habitat may occur within area	Low
Swinhoe's Snipe	*Gallinago megala*	Mi	Mi	Roosting likely to occur within area	Low
Terek Sandpiper	*Xenus cinereus*	Mi	Mi	Species or species habitat known to occur within area	Low
Wedge-tailed Shearwater	*Ardenna pacifica*	Mi	Mi	Breeding known to occur within area	Moderate
Whimbrel	*Numenius phaeopus*	Mi	Mi	Species or species habitat known to occur within area	Low
Wood Sandpiper	*Tringa glareola*	Mi	Mi	Roosting known to occur within area	Low
Brown Skua	*Stercorarius antarcticus*	Ma	P4	Species or species habitat may occur within area	Low
White-faced Storm Petrel	*Pelagodroma marina*	Ma	-	Breeding known to occur within area	Low
Cattle Egret	*Bubulcus ibis*	OMa	-	Species or species habitat may occur within area	Low
Fairy Prion	*Pachyptila turtur*	Ma	-	Species or species habitat known to occur within area	Low
Little Penguin	*Eudyptula minor*	Ma	-	Breeding known to occur within area	High
Hooded Plover	*Thinornis cucullatus*	OMa	P4	Species or species habitat known to occur within area	Moderate
Little Shearwater	*Puffinus assimilis*	Ma	-	Breeding known to occur within area	Moderate
Sooty Tern	*Onychoprion fuscatus*	Ma	-	Breeding known to occur within area	Low
White-bellied Sea Eagle	*Haliaeetus leucogaster*	Ma	-	Species or species habitat known to occur within area	Moderate

Common Name	Species Name	EPBC Act Status	BC Act Status	Type of Presence (EPBC)	Likelihood of Occurrence
Red-capped Plover	*Charadrius ruficapillus*	OMa	-	Species or species habitat known to occur within area	Low
Silver Gull	*Chroicocephalus novaehollandiae*	Ma	-	Breeding known to occur within area	Moderate
Pacific Gull	*Larus pacificus*	Ma	-	Breeding known to occur within area	Moderate
Red-necked Avocet	*Recurvirostra novaehollandiae*	OMa	-	Species or species habitat known to occur within area	Low
Pied Stilt	*Himantopus Himantopus*	OMa	-	Species or species habitat known to occur within area	Low

Table 20 Biologically important areas for seabirds and shorebirds spatially overlapping the marine DE (BMT, 2023)

Common Name	Species Name	Behaviour	Location
Wedge-tailed Shearwater	*Ardenna pacifica*	Foraging (in high numbers)	Breeding (in hundreds of thousands) off west coast from Ashmore Reef (12°15'S) to Carnac I. (32°07'S) and ranging in western seas between 12°00'S and 33°20'S. Pelagic and offshore foraging. Foraging in seas 10 - 300 km off west coast, mostly feeding well offshore.
Roseate Tern	*Sterna dougallii*	Foraging	North-western and west coasts and islands from Sir Graham Moore Is (13°50'S), south to Mandurah (32°32'S) and as far offshore as Ashmore Reef, Bedout I. and the Houtman Abrolhos.
Pacific Gull	*Larus pacificus*	Foraging (in high numbers)	West coast and islands from Point Quobba (24°30'S) south to Wedge I. (formerly south to Warnbro Sound and at Cape Naturaliste); casual further north (Point Cloates and Lake MacLeod).
Little Shearwater	*Puffinus assimilis tunneyi*	Foraging (in high numbers)	From Kalbarri to Eucla including offshore waters. Most numerous in Houtman Abrolhos and off south coast. Usually in ones, twos or small groups up to six. Pelagic and offshore, foraging 4-200 km off coast.
Little Penguin	*Eudyptula minor*	Foraging (provisioning young)	Perth to Bunbury. Foraging mainly in inshore waters.
Fairy Tern	*Sternula nereis*	Foraging (in high numbers)	Found in the vicinity of lower north-west coast (north to Dampier Archipelago), west coast (south to Peel Inlet) and south coast (from Flinders Bay east to Israelite Bay), including islands (as far offshore as Trimouille I. and Houtman Abrolhos. Common around islands off north-west coast, at Point Quobba, Shark Bay, in the Abrolhos and around islands off lower west coast; scarce to moderately common elsewhere
Caspian Tern	*Hydroprogne caspia*	Foraging (provisioning young)	In Western Australia found on most coasts, mainly islands (as far offshore as Adele, Bedout, Trimouille and the Houtman Abrolhos) and at Lake Argyle, Lake Gregory and Lake MacLeod; accidental elsewhere in the interior.
Bridled Tern	*Onychoprion anaethetus*	Foraging (in high numbers)	West coast of Western Australia and around to Recherche Archipelago including offshore waters
Flesh-footed Shearwater	*Ardenna carneipes*	Aggregation (pre-migration)	Foraging from Cape Naturaliste to Eyre, 1-150 km offshore. Pre departure zone in some years from Rottnest Island to Bunbury.

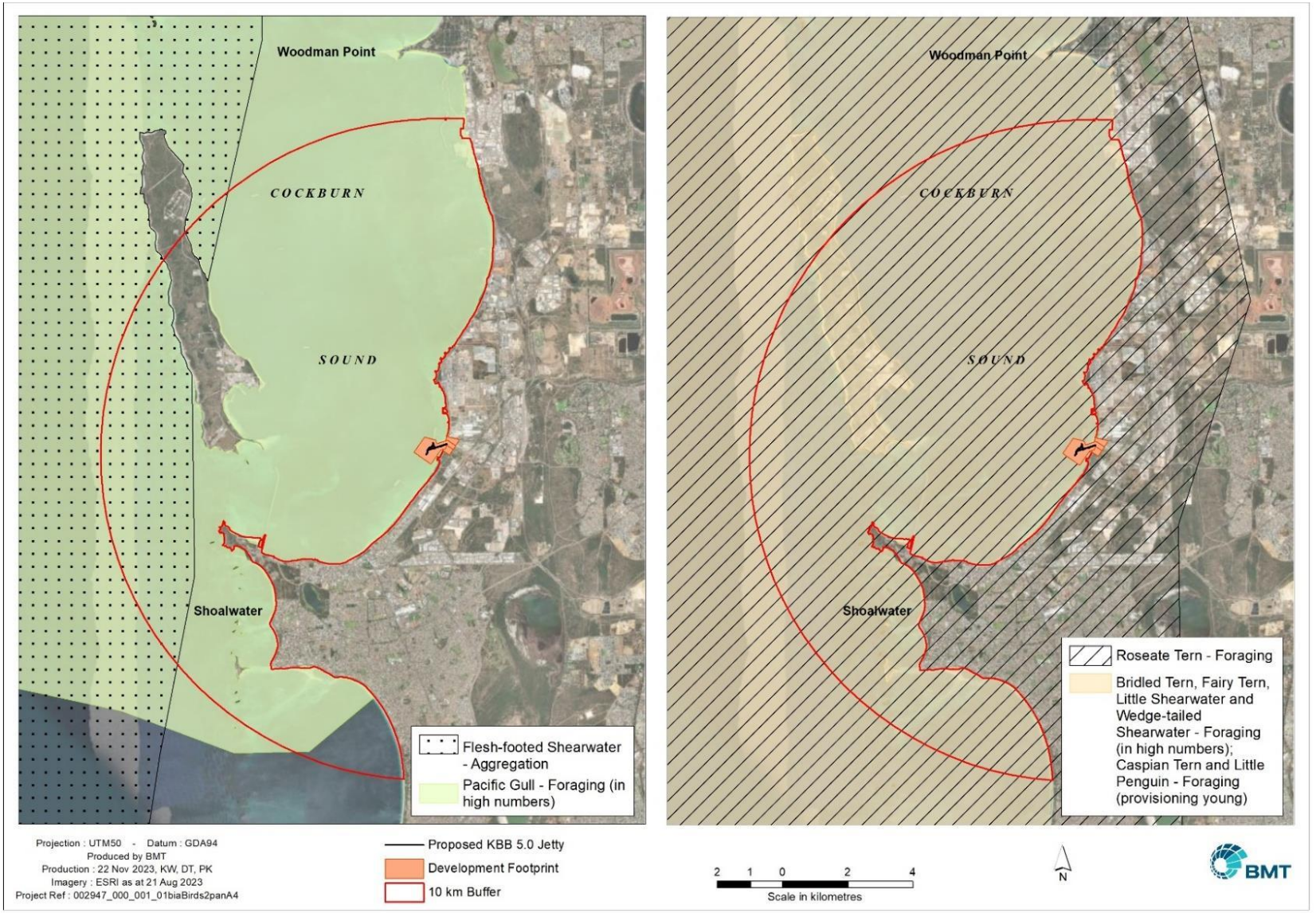


Figure 17 *Seabird biologically important areas that spatially overlap with the marine DE (BMT, 2023)*

Table 21 Seasonal sensitivities of biologically important areas that overlap the marine DE (BMT, 2023)

Species	Event	January	February	March	April	May	June	July	August	September	October	November	December
Wedge-tailed Shearwater	Foraging (in high numbers)												
Roseate Tern	Foraging												
Pacific Gull	Foraging (in high numbers)												
Little Shearwater	Foraging (in high numbers)												
Little Penguin	Foraging (provisioning young)												
Fairy Tern	Foraging (in high numbers)												
Caspian Tern	Foraging (provisioning young)												
Bridled Tern	Foraging (in high numbers)												
Flesh-footed Shearwater	Aggregation (pre-migration)												
KEY		Activity can occur											
		Lower level of abundance/activity/presence											
		Peak period of activity											

7.3.4.1 Little penguin

Penguin Island is home to the largest colony of little penguins in WA, and breeding in this region occurs between April and December. dults feed on several types of small fish including sandy sprat (*Hyperlophus vittatus*), pilchard (*Sardinops neopilchardus*) and garfish (*Hyporhamphus melanochir*). Adults mainly feed on sandy sprat when they are feeding chicks (Cannell, 2004). Parents must feed close enough to the colony to be able to return each evening with food for the chicks. During incubation, the home range is generally located within 20 km of the coastline (Cannell, 2018). Cockburn Sound has been identified as one of the core foraging areas during the incubation stage of the breeding cycle (Cannell,2018).

7.3.4.2 Fairy tern

The Australian Fairy tern is a migratory shorebird that can be found along the coast of WA. It nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation (DCCEEW 2023b). Within WA there appears to be two sub-populations. Fairy terns' nest during spring and summer around south-western Australia, and Birdlife Australia has recorded long term observations of Fairy tern roosting and nesting sites at Woodman Point in Cockburn Sound. These individuals are part of the migratory sub-population which disperses south along the coastline from Shark Bay to the Recherche Archipelago between September and May and winters north between June and August (Dunlop 2015). Further information including the management strategy for the Australian fairy tern can be found in Appendix E.

7.3.4.3 Other seabirds and migratory shorebirds

Seabird species may inhabit Cockburn Sound year-round, seasonally or as transient migrants. Breeding populations of several species occur on the offshore islands of Penguin Island and Carnac Island, with smaller populations on Garden Island at the western margin of Cockburn Sound (Finn and Calver, 2008). The Marine DE also spatially overlaps several BIA's, mostly related to foraging (Table 21).

Many species have been recorded within 10 km of the Marine DE, however; suitable habitat for species may not be present directly around the Marine DE or may be outside the common range for many species. For example, albatross species are pelagic, and the Marine DE lacks the species preferred open ocean habitat. As such, occurrence of many species within the Marine DE would likely represent passing individuals (i.e., low).

7.4 Potential impacts and risks

The potential impacts identified on marine fauna are described in Table 22

Table 22 Potential impacts to marine fauna (BMT,2023)

Potential impact	Type of impact	Context
Habitat loss and/or displacement	Direct	Construction will potentially result in the loss of habitat in the immediate marine footprint of the development, if present (Section 8.5.1)
Injured marine fauna (vessel strike):	Direct	Marine fauna may be impacted by vessel strike during the construction and operational phases of the Project. Marine fauna at most risk of vessel strikes spend a significant time at or near the sea surface, for example cetaceans, pinnipeds and dolphins for breathing between dives, resting, and/or during other key behaviours.
Underwater acoustic interferences during pilling activities	Direct	The Project is likely to generate underwater noise emissions during piling operations which has the potential to cause temporary or permanent injury to sensitive marine fauna (whales, dolphins and fish) in the vicinity of the Marine DE
Underwater acoustic interferences due to vessels	Direct	The Project is likely to generate underwater noise emissions during the construction (supporting vessels) and operational phases (engines, propellers and thrusters from vessel movement). Elevated continuous noise levels due to an increase in vessel movements have the potential result in impact to sensitive marine fauna in the vicinity of the Marine DE. These impacts include behavioural disturbances, interfering with communication systems and avoidance of the area.
Light pollution	Indirect	During construction, there may be temporary increases in light levels in and around the Marine DE from site operations and vessels. During the operational phase of the Project, lighting will be installed along the structure for navigation and driving safety. Artificial lighting has the potential to disrupt a wide array of light sensitive organisms.

7.5 Preliminary assessment of impacts

7.5.1 Habitat loss and/or displacement

The benthic footprint of the piling method of construction reduces BCH loss relative to other construction methods but BCH in the footprint of each pile would be irreversibly lost, if present. The construction of KBB 5 also has the potential to result in an irreversible or reversible loss of BCH habitat in a “halo” around each pile due to hydrodynamic effects. The extent of direct habitat loss will be small, and unlikely to physically fragment habitats to the extent of regional habitat representation that major flow-on impacts to benthic communities and the values they support will occur. It is also unlikely that habitat loss would result in significant displacement of listed threatened and/or migratory species and high value fisheries species, except at localised scales (i.e. at and directly adjacent to the wharf).

7.5.2 Injured marine fauna

Vessel movements present a potential hazard to marine fauna. Collision (vessel strike) with marine fauna has the potential to result in injury or mortality. Factors contributing to the frequency and severity of effects from collisions vary with vessel type, vessel activity, vessel speed, the physical environment (e.g., water depth), the type of animal potentially present and their behaviours. Marine fauna at most risk of vessel strikes are cetaceans, pinnipeds and dolphins, as they spend a significant time at or near the sea surface for breathing between dives, resting, and/or during other key behaviours. The National Strategy for Reducing Vessel Strike on Cetaceans and Other Marine Megafauna 2017 (DoEE, 2017) identifies that speed is a concern when considering collision risk, and that slower moving vessels provide greater opportunity for both fauna and vessel to avoid collision. The likelihood of a vessel strike during construction from vessel movements is considered low due to the slow-moving (or stationary) vessels that will be carrying heavy construction plants and materials. The offshore investigation area overlaps biologically important areas for cetaceans (Figure 14,Table 15) and there is potential for injury or

mortality to those fauna. The mobility of marine fauna such as dolphins and pinnipeds suggest avoidance of vessels is likely due to their strong swimming ability, reducing the risk of these species being injured or entrained by the slow moving and audible vessels. Avoidance of vessels may require additional energy expenditure; however; vessel speeds can be effectively managed to provide greater protection of marine fauna to the potential impacts from vessel strikes. However, because of the low likelihood of occurrence of species, already high vessel traffic in and adjacent to the Marine DE and the relatively small scale of the Marine DE, vessel strike is not expected to pose an additional risk to that already present.

7.5.3 Underwater acoustic interferences – pile driving activities

Many marine fauna rely on the production and reception of sound for critical biological functions including communication, foraging, navigation, and predator-avoidance (National Research Council, 2005) (Clark & Ellison, 2004) (Southall et al, 2007) (NOAA ,2018). Moderate to intense underwater noise and vibration generated from activities such as piling, have the potential to disturb marine fauna, as it may:

– Induce a temporary or permanent reduction of hearing sensitivity that could lead to hearing damage or death (Southall et al. 2007)
– Interfere with communication systems (echolocation), mask important biological cues (e.g., reproduction, social interactions, orientation) or cause behavioural disturbances (e.g., feeding, migration and breeding) of both marine fauna and associated prey (Southall et al. 2007; Heenehan et al. 2019)
– Cause temporary or even long-term avoidance of an area that may be important for feeding, reproduction, sheltering or migration, which could result in a greater expenditure of energy (i.e., diverting migration routes).

Underwater noise from pile driving activities during jetty construction leads to potential impacts on marine species and can result in fauna injury or death. Driving piles into sediment and potential underlying rock substrate (i.e. limestone) can generate a significant amount of impulsive noise. Noise levels that can cause auditory injury are likely to occur only in relatively close range to the pile driving. At greater distances, the intensity of noise is reduced and less likely to result in injury but may still affect the behaviour of marine species. Species display different behavioural responses to underwater noise. The frequency of the noise also affects how species respond.

Pile-driving noise has been found to influence fish behaviour by causing auditory masking and alteration of foraging patterns, social behaviour, and metabolism (Hawkins et al, 2014) (Slabbekoorn et al, 2010) (Wahlberg & Westerberg, 2005). The extent of the behavioural changes would depend on the scale and duration of the construction works, the species, the masking effect of other existing noise sources, other behavioural pressures (e.g., presence of food sources, migration routes and how used (habituated) the species would be to noise. The area is also known for a resident group of dolphins foraging in those waters, and many species likely to occur within the Marine DE. Auditory injury (temporary or permanent hearing loss) may occur at certain distances from piling works and/or when animals are continuously exposed to piling noise without mitigation.

7.5.3.1 Marine mammals

Underwater noise modelling has been undertaken and assessed against the marine mammal criteria developed by the US Mammal Criteria Group within National Oceanic and Atmospheric Administration (NOAA) (Appendix B).

For each marine mammal hearing group, estimated zones of impact were calculated for 500, 1000, 1500, 2000, 2500 and 3000 pile strikes (unmitigated) within a 24 hour period. The estimated distance at which a permanent threshold shift (PTS) and temporary threshold shift (TTS) could occur is based on the 95th percentile at which the criteria is exceeded.

The results of the modelling indicate that the TTS onset zones are predicted to range between:

– 8960 m for 500 strikes / day to 13,750 m for 3,000 strikes / day for low-frequency cetaceans (LF) / baleen whales
– 710 m for 500 strikes / day to 2,400 m for 3000 strikes / day for high-frequency cetaceans / majority of toothed whales
– 320 m for 500 strikes / day to 1,410 m for 3000 strikes per day for other Carnivores in Water (OCW) / Earless seals:

Based on the RMS SPL criteria of 160 dB re 1 µPa, the zone of potential behavioural response has been predicted to be 6,240 m for all marine mammal hearing groups.

The estimated zone of impact for a single strike is often used to determine the 'shut down zone' for piling activities. Where marine mammals are observed within this zone, piling activities would have to cease as soon as practically possible to avoid hearing injury impacts to the animal. An 'observation zone' is then determined for marine mammals approaching the 'shut-down' zone and can generally be set at a nominal distance of 250 m from the outer edge of the 'shut-down' zone. Based on the worst-case TTS onset impact zone for a single strike (for low-frequency cetaceans), the 'shut-down zone' and 'observation zone' has been determined to be 270 metres and 500 metres, respectively.

7.5.3.2 Fish species and sea turtles

Fishes, sharks, rays and pipefish

Potential effect zones have been estimated to assess the potential for PTS onset, TTS onset and tissue damage for fishes, sharks, rays and pipefish.

The results of the modelling indicate that the TTS onset zones are predicted to range between 1260 m for 500 strikes / day to 3,490 m for 3,000 strikes / day for fish with and without swim bladders.

For pile strikes up to 3,000 strikes / day, the PTS onset zones are predicted to be up to 20 metres for fish with no swim bladders and up to 290 metres for fish with swim bladders.

For pile strikes up to 3,000 strikes / day, the tissue damage zone is predicted to be:

– Up to 10 m for fish with no swim bladders
– Up to 140 m for fish with swim bladders

Marine turtles

For marine turtles, a relative risk level (high, moderate and low) has been provided based on the following impact distances for TTS onset:

– Near (N) = tens of meters from the source the relative risk is 'high'
– Intermediate (I) = hundreds of meters from the source, the relative risk is 'low'
– Far (F) = thousands of meters from the source, the relative risk is 'low'

For pile strikes up to 3,000 strikes / day, the tissue damage zone is predicted to 80 metres.

7.5.4 Underwater acoustic interferences – vessels

Vessel noise comprises a combination of continuous noise generated by engine and machinery noise, and modulated broadband noise produced by propeller rotation and cavitation. Vessel noise emissions vary with the size, speed, and engine type and the activity being undertaken. Whales and other marine species may be impacted by the noise generated by vessels, causing behavioural changes (i.e., resting, swimming times and breathing patterns, communications). Frequent vessel movement during the construction and operational phases may cause changes in behaviour, including avoidance of an area.

Gradual exposure to continuous noise sources, such as vessel engines, are generally regarded as being less harmful and less likely to startle or stress marine fauna than rapid-onset impulsive noise sources like piling (Hamernik et al, 1993) (Hamernik et al, 2003). Exposure that would result in significant alteration of behaviour is not expected.

7.5.5 Proposed future studies for impact assessment

The potential of impacts to Matters of National Significant (MNES) under the EPBC Act and Key Environmental Factor (marine fauna) as per the EP Act (Part IV), a detailed underwater noise impact assessment (UWNIA) would be required, and would need to be updated in due course with respect to draft National Anthropogenic Underwater Noise Guideline being developed by DCCEEW.

. A summary of the key tasks involved to prepare an UWNIA include:

- A review of existing ambient underwater noise monitoring data in the Cockburn Sound area to gain an understanding of the composition of the existing underwater soundscape (biological, weather and anthropogenic sounds)
- A review of the spatial and temporal distribution and abundance of key species to be assessed in the study area. This should include other marine fauna not considered in this preliminary assessment (i.e., invertebrates and seabirds)
- A review of most recent literature and guidelines to determine appropriate noise exposure thresholds for various marine fauna hearing groups
- A review of the recent available data for bathymetry, temperature/salinity profiles, geotechnical surveys
- A review of the developed construction methodology to inform the scenarios to be modelled including reasonable mitigation measures that would be feasible to implement. This could include alternative pile type selection, bubble curtains, alternative piling methods, air-filled resonators, pile sleeves, pile caps/cushion blocks etc.
- Detailed underwater noise predictions using appropriate numerical modelling of the source and environment to calculate the potential injury and behavioural impacts zones for marine fauna
- Determination of safety zones (i.e., the applicable 'shut-down zone' and 'observation zone' during piling works) for marine mammals (i.e., whales, dolphins and seals) based on the outcomes of the modelling
- Calculation or determination of potential effect zones applicable to the risk assessment of other marine fauna (e.g., fishes, marine turtles, invertebrates and seabirds) from underwater noise produced by construction activities, especially piling works
- Consideration of potential cumulative underwater noise impacts with respect to other potential projects in the Cockburn Sound area such as Westport and H2Perth
- A quantitative assessment of the increase in shipping underwater noise levels based on the forecasted trade volumes and its potential impacts on marine fauna

Further detail is provided in Appendix D Section 6.1.

7.5.6 Potential underwater noise management framework

The KBB5 project would require an underwater noise management framework that would include mitigation and management measures to be implemented during the construction phase of the project. Potential measures are summarised below, however they would be determined in the UWNIA and refined during the post-approval process once a detailed construction methodology has been developed:

- Determination of appropriate safety zones for marine mammals
- Planning of activities to implement physical mitigation measures, avoiding conducting piling during sensitive times and other management measures to avoid impacts
- Implementation of standard operational procedures during piling activities (e.g., pre-start, soft start, normal operation, stand-by operation and shut-down procedures)
- Additional mitigation measures such as increased safety zones, noise model validation, an adaptive management plan and marine mammal observation procedures

7.5.7 Light pollution

Artificial lighting has the potential to disrupt a wide array of organisms, processes, and habitats in the sea for which light cycles are critical (Marangoni et al, 2022). These can include consumer-resource interactions that are known to drive top-down structuring of marine ecosystems (Bolton et al, 2017) (Maggi et al,2020), and migrations and orientation of marine fauna that are critical for their survival (Torres et al, 2020). Vessels and other construction activities will have external lighting to facilitate navigation and safe operations. Potential impacts of lighting include disruption to behaviour and orientation of light-sensitive marine fauna (e.g., seabirds), and light glow may attract light-sensitive species (e.g. seabirds and fish), in turn affecting predator-prey dynamics. The National Light Pollution Guidelines (DCCEEW, 2023a) suggest that light mitigation may be necessary within 20 km of a BIA for a listed species. There are no sea turtle nesting grounds surrounding the Cockburn Sound region and the impact of

artificial lighting inducing disorientation of the hatchlings is not applicable. Kwinana Beach has been an industrial area for more than 70 years. Given the current artificial illumination inherent to a built-up area, the potential consequence of additional light emissions on receptors is unlikely to significantly increase impacts on the surrounding environment.

7.6 Proposed future studies for impact assessment

Based on the assessment of impacts presented in Section 7.5, the additional technical studies as detailed in Section 7.6.1 and 7.6.2 are recommended.

7.6.1 Underwater acoustic

Interferences during pilling activities and due to vessels: The Project is likely to generate underwater noise and vibration emissions during the construction (piling operations, and supporting vessels) and operational phases (engines, propellers and thrusters from vessel movement), which has the potential to cause temporary or permanent injury to sensitive marine fauna (particularly whales, dolphins and fish) in the vicinity of the Marine DE. A detailed underwater noise modelling study will be required to quantify the intensity and duration of underwater noise for assessment against species thresholds and the likelihood of occurrence of marine fauna in the Marine DE, based on final project design. This study should also consider the draft National Anthropogenic Underwater Noise Guidelines currently under development by DCCEEW.

7.6.2 Light pollution

During the construction and operational phase of the Project, lighting will be installed along the structure in support of site operations, navigation and driving safety. Artificial lighting has the potential to disrupt a wide array of light sensitive organisms. A desktop light assessment to assess the quality, quantity, and appropriateness of lighting and determine the likelihood of occurrence of marine fauna in the Marine DE that will be affected for artificial illumination.

8. Key Environmental Factor – Benthic Communities and Habitats [12]

8.1 Introduction

Benthic communities and habitat (BCH) are key ecosystems providing a myriad of ecosystem services, such as habitat provision, supporting fisheries, buffering coastal erosion by attenuating wave energies, and sequestering carbon (EPA, 2016c). In WA, BCH are paramount to sustaining many coastal food webs that would otherwise likely fail in WA's oligotrophic marine environment (EPA, 2016c). Considering the significance BCH in WA, it is important to identify the BCH present within the Marine DE and understand the potential for impacts from the Project development.

8.2 Relevant legislation, policy and guidance

8.2.1 EPA Objective

To protect benthic communities and habitats BCH so that biological diversity and ecological integrity are maintained (EPA, 2023).

8.2.2 Relevant legislation

Following legislation that were considered relevant for BCH includes:

– *Environmental Protection Act (1986)*
– *Biodiversity Conservation Act 2016 and Biodiversity Conservation Regulations 2018.*

8.2.3 EPA policy and guidance

The EQMF for the SEP is based on the EVs outlined in Table 23 (EPA, 2015) (refer to Section 6.2). For BCH, the EV of “Ecosystem Health” and the EQO “Maintenance of Ecosystem Integrity” apply for this PEIA. KBB 5 is located within an area assigned a Moderate level of ecological protection (EPA 2015).

Additional EPA policies and guidance that were considered relevant for BCH include:

– Statement of Environmental Principles, Factors and Objectives (EPA, 2023)
– Technical Guidance – Protection of Benthic Communities and Habitats (EPA, 2016a)
– Environmental Factor Guideline – Benthic Communities and Habitats (EPA, 2016d).

8.2.4 Other policy and guidance

Other policies and guidance that were considered relevant for BCH include:

– Fremantle Ports MEMF (BMT 2020)
– Guide for Applying Working with Nature to Navigation Infrastructure Projects (PIANC 2018).

[12] This section is entirely sourced from the KBB 5 Business Case – Preliminary Environmental Impact Assessment (BMT, 2023) (See appendix A)

8.3 Receiving environment

8.3.1 General description

The nearshore marine environment of Perth's coastal waters predominantly comprises a thin sand veneer overlying limestone pavement, which supports a diversity of benthic primary producers including seagrasses, macroalgae, and corals. Its protected embayment configuration, marine water and coastal sediment movements, and groundwater inputs are responsible for the Sound's ecological significance (BMT, 2018 in BMT, 2023). Seagrasses form the dominant benthic primary producers within Cockburn Sound, where they support fisheries, attenuate wave energies, promote sediment stabilisation, and are therefore, ecologically significant.

8.3.2 Benthic ecology

The substrate of Cockburn Sound primarily comprises sand and reef promoting diversity for BCH, supporting mono- and multi-specific stands of seagrass (e.g., Amphibolis antarctica, A. griffithii, Posidonia australis, P. sinuosa, P. angustifolia, P. coriacea, and Halophila and Halodule spp.), kelp (Ecklonia radiata) and some Faviidae corals (BMT, 2018 in BMT, 2023). The KBB 5 proposed marine footprint encompasses ~43.1 ha, excluding the marine disturbance footprint as this has not yet been defined. Mapping suggests that the KBB 5 development area consists of unvegetated sediments with little BCH present (Oceanica, 2009 in BMT, 2023) (BMT, 2018 in BMT, 2023) (Figure 18). BCH type and extent within the Project's marine footprint derived from the previous mapping (BMT, 2018 in BMT, 2023) relative to the entire Local Assessment Unit (LAU) is presented in Table 23. However, a time series of Nearmap satellite imagery shows dark areas accumulated between 2008 and 2023 which may be seagrasses or mobile wrack and there is the potential for unidentified BCH occurring within the marine footprint (Figure 19) (Nearmap 2023 in BMT, 2023).

Table 23 Habitat coverage in the KBB 5 marine footprint and the local assessment unit (BMT, 2023)

Habitat	Project Footprint	Local Assessment Unit (ha[13])		
	(ha)	Pre-European Development	Now	Post-Development
Seagrass	0[14]	4000[315]	860.02[13]	860.02[13]
Sand	43.1[13]	5686.58[416]	9686.58[13]	9686.56[13]
Low relief reef	0 [13]	16.5[2]	16.5[13]	16.5[13]
Total	**43.1**	**9703.08**	**10,563.1**	**10,563.08**

[13] Ha = hectare

[14] Data sourced from DPSIR 2018 (BMT 2018 in BMT, 2023)
[15] Data sourced from Cockburn Sound Environmental Study: Technical Report on Seagrass (Cambridge, 1979 in BMT, 2023).
[16] Sand pre-European development calculated by subtracting the area of seagrass in Cambridge (1979 in BMT, 2023) from the area of sand identified in DPSIR (BMT 2018 in BMT, 2023).

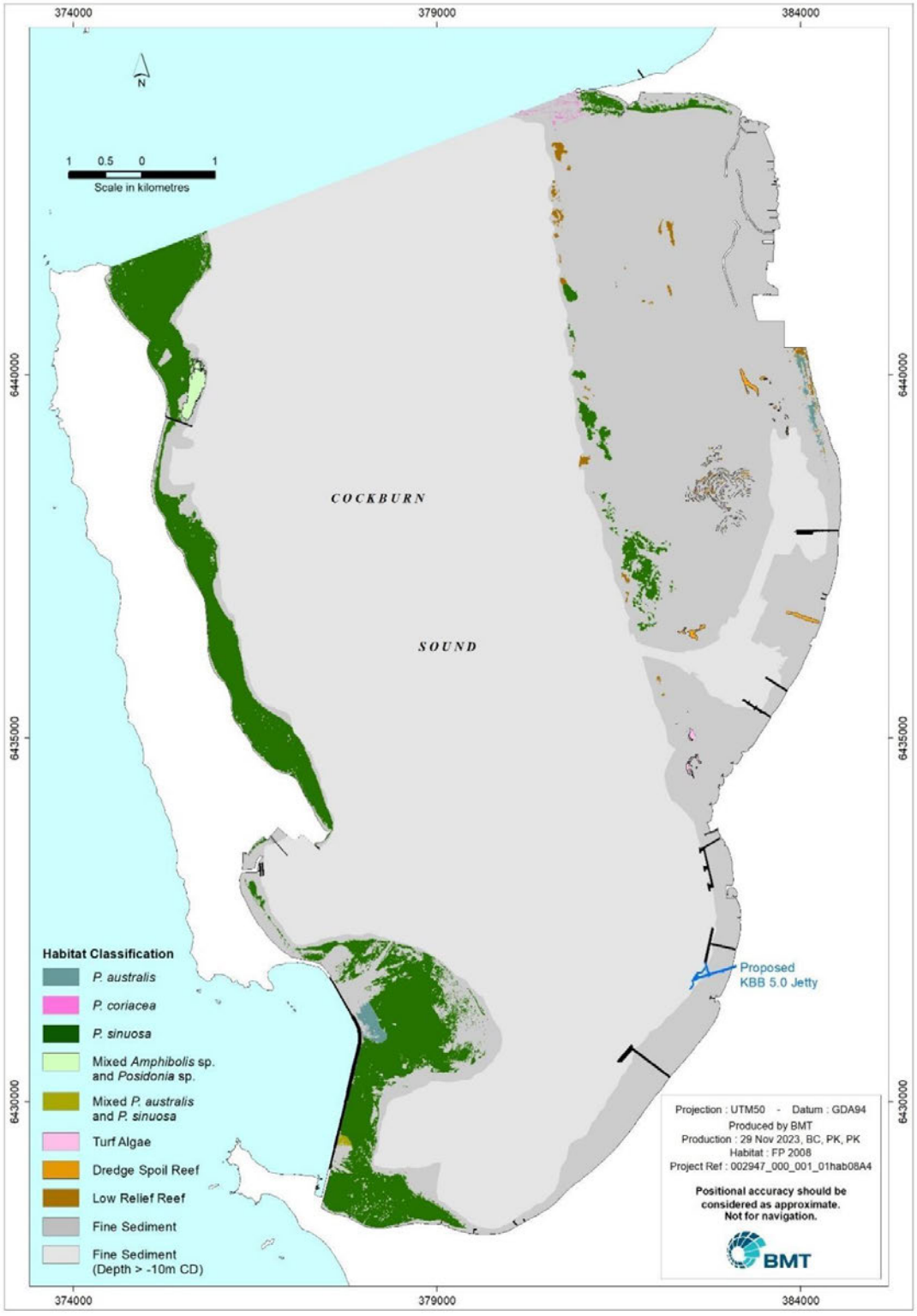


Figure 18 KBB 5 proposed marine footprint in Cockburn Sound and mapped habitat classifications (BMT, 2023)

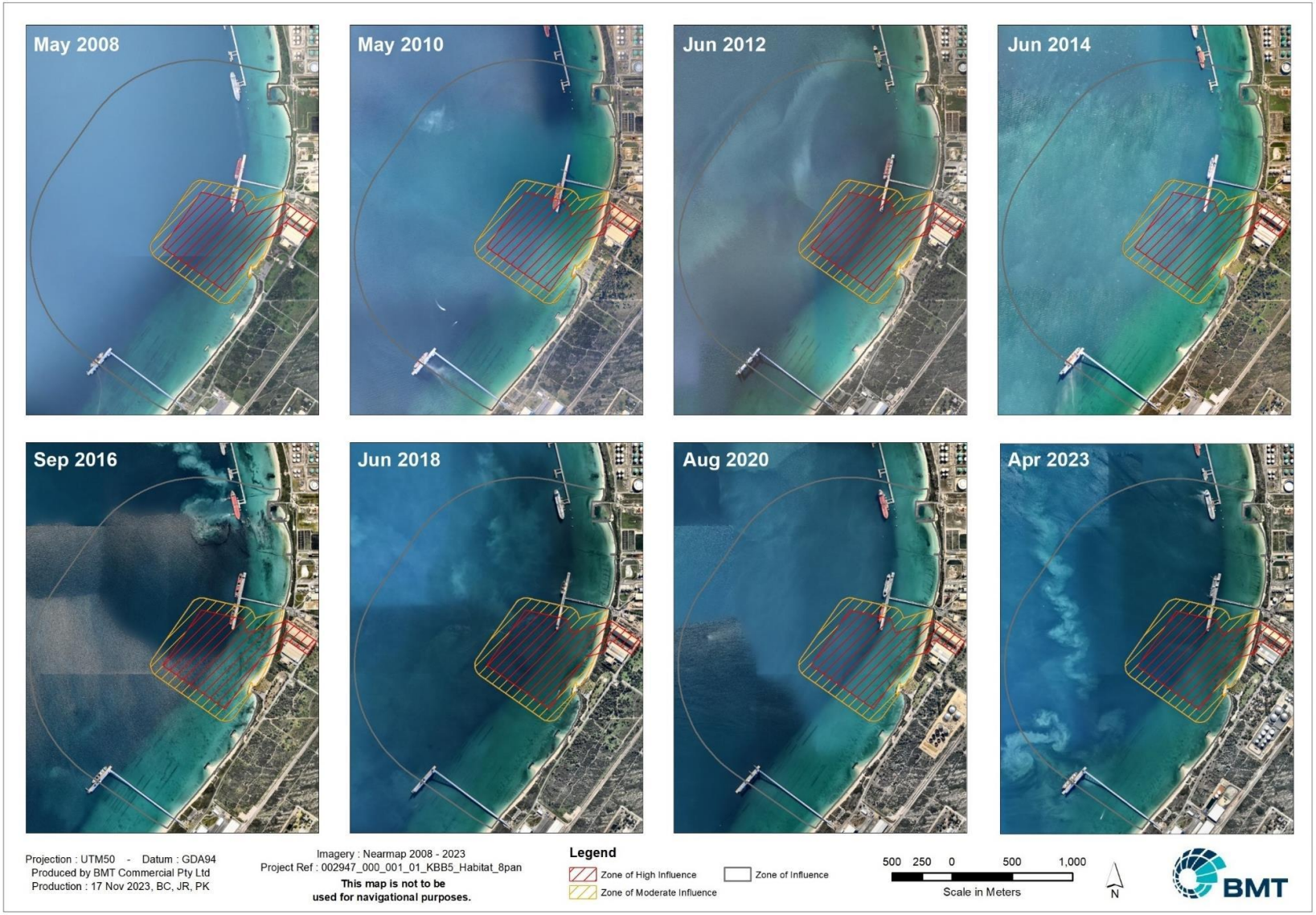


Figure 19 *Nearmap satellite imagery timeseries of the marine DE (BMT, 2023)*

8.4 Potential impacts and risks

The potential impacts identified on benthic communities and habitats are described in Table 24.

Table 24 Potential impacts to benthic communities and habitats (BMT 2023)

Potential impact	Type of impact	Context
Loss of habitat	Direct	Construction will potentially result in the loss of BCH in the immediate footprint of the development, if present.
Shading and burial	Direct	The piling method of construction will likely cause a localised increase in suspended sediment and has the potential to shade or bury nearby BCH.

8.5 Preliminary assessment of impacts

8.5.1 Habitat loss and/or displacement

The benthic footprint of the piling method of construction reduces BCH loss relative to other construction methods but BCH in the footprint of each pile would be irreversibly lost if present. The construction of KBB 5 also has the potential to result in an irreversible or reversible loss of BCH habitat in a “halo” around each pile due to hydrodynamic effects. Preliminary BCH loss has been calculated using the methods provided in EPA’s Technical Guidance – Protection of Benthic Communities and Habitats (EPA, 2016c). These methods include eight steps to calculate BCH loss.

Step 1: What is the ‘local assessment unit’?

The local assessment unit (LAU) has been defined as Cockburn Sound, which equates to 12,400 ha.

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

Historical BCH mapping (2008) was used to determine the distribution and extent of BCH in the LAU (Table 23).

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

The KBB 5 Project builds on an active berth for Kwinana Bulk industries, and the nearby offshore area comprises a disturbed environment with steep, natural slope of areas routinely dredged for shipping channel maintenance. Mapping suggests the area is exclusively sand, but the proposed KBB 5 marine footprint potentially includes an area of ephemeral BCH (likely colonising seagrasses) and presents a low risk to ecological and social values in the area.

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

Cockburn Sound has historically supported large areas of BCH, comprising primarily of seagrasses; however; significant losses in BCH have occurred since the late 1960s (BMT, 2018 in BMT, 2023). Seagrass extent was estimated at ~4000 ha in 1979 (Cambridge, 1979 in BMT, 2023), while sand was assumed to occupy ~5686 ha and low relief reef ~16 ha (Table 23).

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

BCH mapping undertaken in 2018 estimates 860 ha of seagrass, 9686 ha of sand, and 16 ha of low-relief reef present within the LAU (Table 23). To adequately assess the risk to BCH, contemporary benthic mapping is required.

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

Contemporary mapping of BCH within the Marine DE is required to predict the BCH losses associated with the Project; however; a worst-case loss of 0.02 ha of sand and potentially ephemeral vegetation may be directly impacted from the introduction of piles into the environment.

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

Contemporary mapping of BCH within the Marine DE is required to predict the BCH losses associated with the Project; however; a worst-case loss of 0.02 ha of sand and potentially ephemeral vegetation may be directly impacted from the introduction of piles into the environment.

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

Where historical losses are already significant, the EPA encourages Proponents consider strategies to achieve no net additional loss, or where possible, to generate a net increase (EPA, 2016c). Considering the information presented in addressing steps 1—7, the loss of 0.02 ha of potential sand and ephemeral vegetation in a previously disturbed area presents a low ecological consequence for the biological diversity and ecological integrity of the Marine DE.

8.5.2 Shading and burial effects

The piling method of construction will likely cause a localised increase in suspended sediment and has the potential to shade or bury nearby BCH. Benthic invertebrate communities or associated epibenthic fauna (e.g., crustaceans, filter feeders) may be impacted, with the potential for altered growth or reproductive regimes, or mortality. Shading may reduce the photosynthetic capacity of BCH, such as seagrasses, and potentially contribute to losses. The KBB 5 structure itself also has the potential to cause shading of a small area of BCH. The scale of sediment resuspension is expected to temporary over short term duration and dissipate rapidly; it is not likely that BCH will be shaded or buried by suspended sediments over the 20-month construction period.

8.6 Proposed future studies for impact assessment

Based on the assessment of impacts presented in Section 8.4, surveys are recommended as detailed in Section 8.6.1.

8.6.1 Benthic habitat mapping[17].

Construction will potentially result in the loss of BCH (if present) in the immediate footprint of the development. The previous mapping is dated and satellite imagery suggests that confirmation of BCH is required. A survey of the seafloor within the Marine DE to identify and map the BCH is required to quantify the amount and type of BCH at risk of loss.

[17] Clarification from BMT being sought to further define study, area required to be assessed and likely duration.

9. Key Environmental Factor - Coastal processes[18]

9.1 Introduction

The coastal zone is highly valued for its aesthetic, cultural, social and recreational values; as well as being important for commercial infrastructure and facilities (EPA, 2016f). Disruptions to the energy of waves and currents in the Marine DE may pose a risk of shoreline erosion and sedimentation around the marine infrastructure. The potential impacts to coastal processes were assessed for the placement of KBB 5 infrastructure.

9.2 Relevant legislation, policy and guidance

9.2.1 EPA Objective

To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected (EPA, 2023).

9.2.2 Relevant legislation

Following legislation that were considered relevant for coastal processes include:

– *Environmental Protection Act 1986*

9.2.3 EPA policy and guidance

Following EPA policy and guidance that were considered relevant for coastal processes include:

– Statement of Environmental Principles, Factors and Objectives (EPA, 2023)
– State Environmental (Cockburn Sound) Policy 2015 (EPA, 2015)
– Environmental Factor Guideline – Coastal Processes (EPA, 2016f)

9.2.4 Other policy and guidance

Other policy and guidance that were considered relevant for coastal processes include:

– WA Coastal Zone Strategy (DPLH, 2017)
– State Planning Policy No. 2.6: State Coastal Planning Policy (WAPC, 2013)
– State Coastal Planning Policy Guidelines (WAPC, 2020)
– Coastal Hazard Risk Management and Adaptation Planning Guidelines (WAPC, 2019)
– Sea Level Change in Western Australia - Application of Coastal Planning (DOT, 2010)

9.3 Receiving environment

The proposed KBB 5 infrastructure is comprised of a concrete deck supported by piles. The section of coastline adjacent to the structure is generally considered to be a low energy coastal environment (Section 6). The coastline at Kwinana Beach is exposed to locally generated wind waves from the southwest and northwest, with a limited fetch of less than 10 km.

Numerous coastal management and protection structures have been constructed between James Point south and East Rockingham Beach resulting in Kwinana Beach being compartmentalised by cross-shore structures to the

[18] This section is entirely sourced from the KBB 5 Business Case – Preliminary Environmental Impact Assessment (BMT, 2023) (See appendix A)

north and south of the Marine DE. Historical data indicates accretion in the central zone of Kwinana Beach, and erosion at the north and south, as evidenced by the protective seawalls along the foredune.

9.3.1 Nearshore sediment transport

The beach where the Project is situated is within a curved embayment formed by wave refraction processes between the existing KBB 3 and KBB 4 jetties to the north and the Kwinana Jetty/Beach seawall to the south. The primary source of sediment for this beach is local, and given its proximity to these structures the correlation between grain size and wave intensity is weak (Klein et al. 2010). The construction of the Garden Island Causeway from 1971 to 1973 reduced south-westerly wave energy at James Point by up to 75% (Woods & Associates,1988). This change in energy distribution reinforced southerly sediment movement. Since the construction of the Causeway, the shoreline at Kwinana Beach has generally exhibited stability with occasional local changes, primarily due to the relatively higher wave energy associated with storms.

Sediment accumulation occurs on the northern sides of these structures, with the most prominent example being around the wreck of the SS Kwinana. This accumulation led to the installation of two detached groynes to mitigate downdrift erosion (DPI, 2004) and the construction of a seawall on the southern side of the SS Kwinana headland. The reduction in seagrass meadows along the eastern margin of Cockburn Sound between 1967 and 1973 has impacted the net sediment supply in the area. Analysis of aerial photographs (DOT, 2023) (Figure 20) suggests that the shoreline to the north (KBJ infrastructure connecting to the land) and south (Kwinana Jetty) of the proposed KBB 5 location experienced accretion from 1942 to 2016, and slight erosion from 2016 to 2019. The construction of KBB 3 and KBB 4 to the north of the Project has had minimal impact on shoreline position.

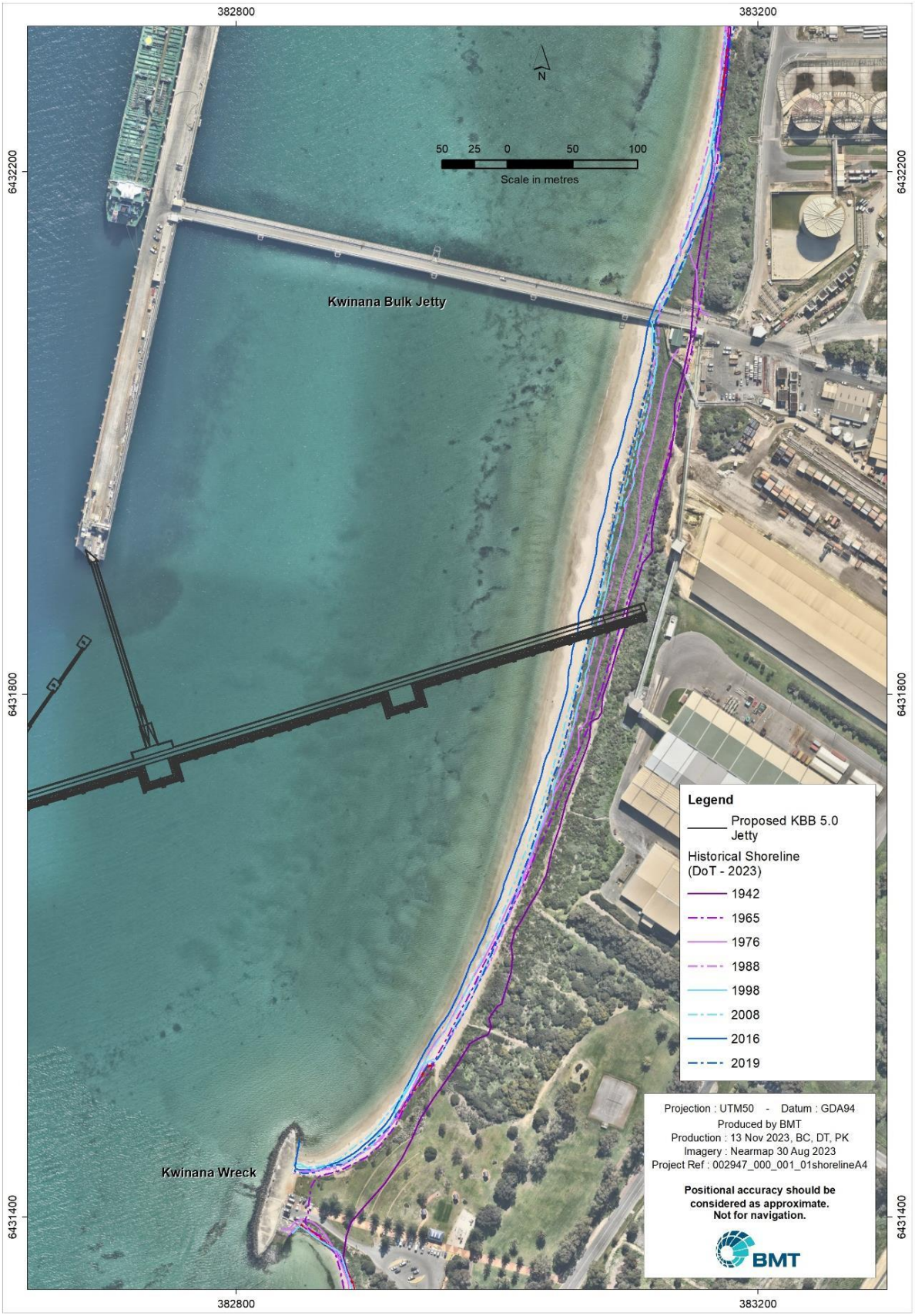


Figure 20 Shoreline analyses from 1942 to 2019 in the marine DE (BMT, 2023)

The intersection of Kwinana Beach, where the KBB 5 jetty abutment is proposed for installation, is sheltered by vessels moored at KBJ. Attenuation of waves by moored vessels at KBJ results sediment deposition in the sheltered area (Figure 21). Depletion of sediments occurs in the areas where there is no wave by vessels (Figure 21).

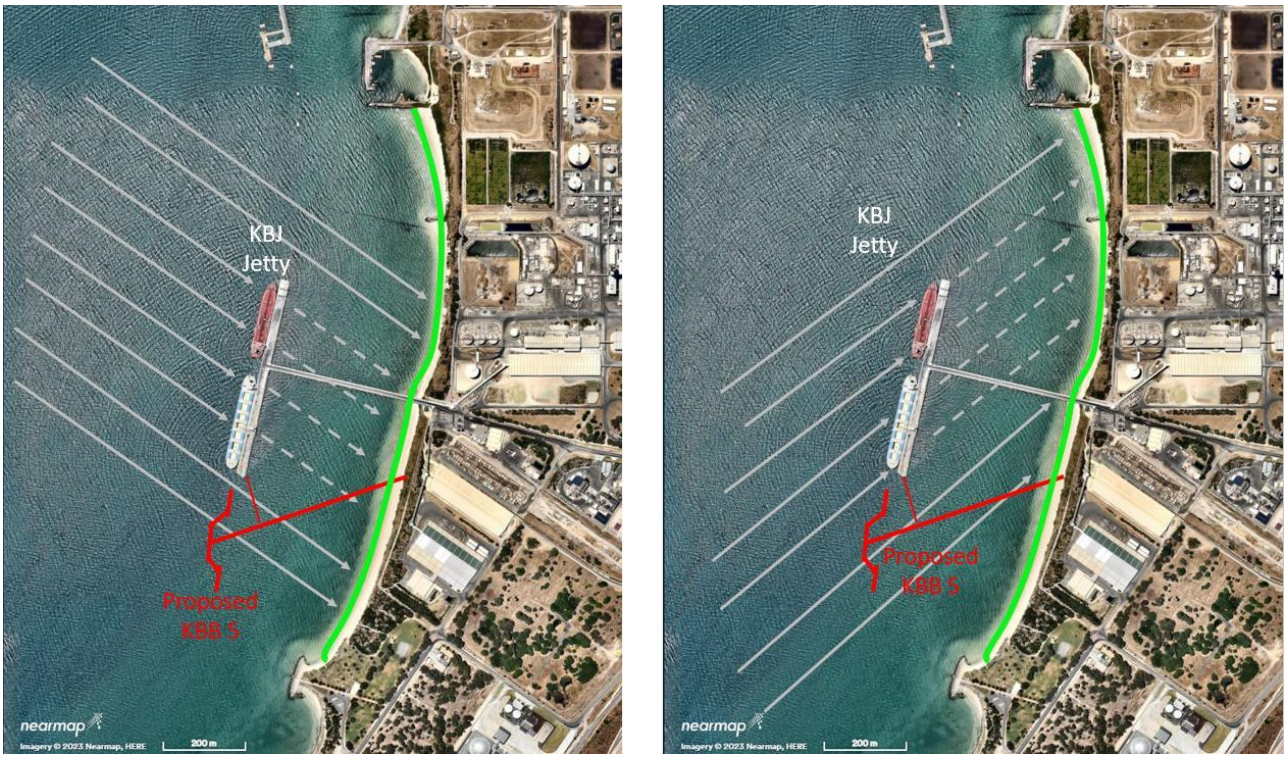


Figure 21 *Nearshore wind-generated waves being reflected by vessels moored at KBJ from northwest (left) and southwest (right) wind direction (BMT, 2023)*

9.4 Potential impacts and risks

The potential impacts identified on coastal processes are described in Table 25.

Table 25 *Potential impacts to marine environmental quality (BMT, 2023)*

Potential impact	Type of impact	Context
Coastal modifications	Indirect	Port construction can have impact on hydrodynamics and sediment transportation influencing coastal processes and beach morphology.
Temperature variability	Direct	The structure may shade the surrounding water mass reducing absorption of solar heat by surface water and diminishing stratification.
Restricted nearshore current and buoyancy effects	Direct	Water passing near or under the structure may experience restricted flow due to the structure's presence. This restricted flow and reduced mixing may contribute to stratification.
Sheltering and reduced turbulence	Indirect	Vessels moored at the existing Kwinana Bulk Jetty act as a wave barrier sheltering a section of the beach from waves. The addition of KBB 5 is expected to expand the length of sheltered beach when the new berth is occupied potentially altering patterns of erosion and accretion.

9.5 Preliminary assessment of impacts

The identified potential environmental impacts to coastal processes are: (1) coastal modifications, and (2) hazards due to climate change assessed below.

9.5.1 Coastal modifications

The piling technique used in port construction can have several impacts on hydrodynamics and sediment transportation influencing coastal processes and beach morphology. Some of the impacts include:

- **Sediment disturbance and settlement**: Interaction between piles and water currents can lead to local scour of seabed sediments around the base of the piles. If the currents are strong enough, a local increase in nearbed turbidity and modification of local seabed morphology can result. For most of the structure, the water depth exceeds 10 m. Coastal currents strong enough to cause scour around the piles is expected to be limited to the piles in the shallow shore crossing area, and only during storm events.
- **Changes in local hydrodynamics**: The installation of piles can disrupt natural water flow patterns and tidal currents. Changes to current flow can affect sediment transport, causing changes in sediment deposition and erosion patterns along the coastline. This effect is expected to be minimal for KBB 5.
- **Redirection of wave energy**: Piles can redirect wave energy, potentially changing the way waves interact with the shoreline. This can impact sediment movement and beach morphology, influencing erosion and accretion processes. This effect is expected to be minimal for KBB 5 as indicated from historical shoreline analyses (Table 25). However, moored vessels at KBB 5 are expected to shelter sections of the shoreline from wave energy and may make a more important contribution to coastal processes (Table 25).
- **Impact on beach morphology**: Changes in sediment transport and redistribution can affect beach morphology, leading to alterations in the alignment, profile and width of the beach, and potential erosion or accretion of the foredunes and vegetation behind the beach. This effect is expected to be minimal for KBB 5 as indicated from historical shoreline analyses (Table 25).
- **Potential beach erosion**: Construction of the KBB 5 structure is not expected to directly disrupt wind, water and sediment movement. Wave sheltering of parts of the beach by moored vessels is expected to result in small-scale amplification of erosion and accretion at the site (Figure 21).
- **Habitat disruption**: Alterations in sediment transport and beach morphology can impact coastal habitats, such as dune vegetation, intertidal zones, and seagrass beds, affecting the fauna that depends on these areas. For KBB 5 such impacts are expected to be limited with slow changes in beach width, decreasing at the north and south ends and increasing in the middle (Figure 20).
- Accretionary areas may see gradual building of the foredune structures and seaward movement of the vegetation line, although this process is typically dominated by infrequent storms generating elevated water levels. Erosion areas may see gradual reduction in beach width seaward of the existing seawalls at the south end of Kwinana Beach and the unprotected beach may experience dune erosion and vegetation line retreat over time.

The infrastructure for KBB 5 will be mounted on pilling foundations. Pile-supported structures offer advantages for sediment transport compared to other structural support methods, although their direct benefit specifically for sediment transport may not be a primary reason for their use. Compared to solid structures, such as breakwaters or seawalls, piles allow relatively unimpeded wave transmission through the structure, reducing their energy absorption and potentially lessening the disturbance to hydrodynamics and sediment movement. Piles create minimal contact with seabed compared to larger surface structures like concrete bulkheads or embankments and allows natural sediment transport processes to continue relatively unimpeded compared to larger structures that might obstruct sediment movement. Water passing freely between the piles, should have little impact on sediment movement and coastal dynamics.

9.5.2 Temperature variability

The KBB 5 may potentially shade the surrounding water mass. This shading could reduce absorption of solar heat by surface water, diminishing stratification. However, due to the open aspect of the Marine DE, general circulation, depth of water and movement of vessels is expected that any potential temperature effects from shading by the jetty would be rapidly dissipated.

9.5.3 Restricted nearshore current and buoyancy effects

Water passing near or under the KBB 5 structure may experience restricted flow due to the structure's presence. This restricted flow and reduced mixing may contribute to stratification. The piling construction method ensures that water can freely flow beneath the facility. The limited surface area of the piles reduces the area available for heat exchange between the structure and the water. There are no known restricted flow environmental impacts arising from existing KBJ or CBH jetty's.

9.5.4 Sheltered areas and reduced turbulence

The primary indirect impact from the new infrastructure is expected to be due to the ships berthing at the structure. Vessels moored at the existing KBJ act as a wave barrier sheltering a 400 m (for two moored vessels) section of the nearshore and beach from north-westerly through to south-westerly wind driven waves. The addition of KBB 5 is expected to expand the length of sheltered beach by ~200 m when the new berth is occupied. The length of shoreline sheltered by vessels will increase toward the north of Kwinana Beach during south-westerly winds/waves and increase toward the south during north-westerly winds/waves. The sheltering of sections of the beach will reduce nearshore wave action compared to unsheltered areas and will reduce wave-driven alongshore current, resuspension of sediment and alongshore sediment transport. The difference in alongshore transport between unsheltered and sheltered sections is expected to result in accretion in the sheltered area and erosion in the unsheltered areas. The net impact of sheltering by moored vessels is expected to result in net accretion at the shoreline directly east of the structures, and net erosion at the northern and southern extents of the beach (adjacent to the coastal management structures). This effect is already evident for the existing jetty infrastructure and the accretion area is expected to expand southward and exacerbate erosion at the north and south of the beach.

9.6 Proposed future studies for impact assessment

Port construction can have impact on hydrodynamics and sediment transportation influencing coastal processes and beach morphology. In particular, vessels moored at the existing KBJ act as a wave barrier sheltering a section of the beach from waves. Based on the assessment of impacts presented in Section 9.5, surveys are recommended as detailed in Sections 9.6.1 to 9.6.3.

9.6.1 Sediment transport studies

An understanding of sediment dynamics and transport patterns is required to assess how construction may impact sediment movement, erosion, and deposition in the coastal zone. The calculation of sediment transport can be calibrated against local sediment budgets and inform effective coastal planning.

9.6.2 Coastal hydrodynamics analysis

An understanding of potential changes to the natural water flow patterns, tidal currents, and wave characteristics in the area is required to identify critical changes in hydrodynamics due to port construction.

9.6.3 Beach morphology studies

An evaluation of potential changes in erosion and accretion patterns along the coastline as a result of port construction activities and impacts on beach characteristics, including shape, profile, and sediment distribution requires assessment.

10. Key Environmental Factor - Flora and Vegetation

10.1 Introduction

Vegetation is defined as groupings of different flora patterned across the landscape that occur in response to environmental conditions. The EPA is of the view that vegetation can be an effective surrogate for ecological processes and the diversity of interactions in terrestrial ecosystems (EPA, 2016c).

10.2 Relevant legislation, policy and guidance

10.2.1 EPA Objective

The EPA's objective for flora and vegetation is "to protect flora and vegetation so that biological diversity and ecological integrity are maintained" (EPA, 2016c). In the context of this objective, ecological integrity is the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements.

10.2.2 Relevant legislation

Following legislation that were considered relevant for flora and vegetation include:

- *Environmental Protection Act 1986* (WA)
- *Biodiversity Conservation Act 2016* (WA) (BC Act)
- *Biosecurity and Agriculture Management Act 2007* (WA)
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

10.2.3 EPA policy and guidance

Following EPA policy and guidance that were considered relevant for flora and vegetation include:

- Environmental Factor Guideline – Flora and Vegetation (EPA, 2016c).
- Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans (EPA, 2021e)
- Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016g)
- Environmental Guidance for Planning and Development. Guidance Statement No. 33 (EPA, 2008)
- Protection of Naturally Vegetated Areas Through Planning and Development (EPA, 2021h)
- Instruction: How to prepare an Environmental Review Document (EPA, 2021d)

10.2.4 Other policy and guidance

Other policy and guidance documents that were considered relevant for flora and vegetation include:

- Matters of National Environmental Significance Significant Impact: Guidelines 1.1 (DotE, 2013)
- Approved Conservation Advice for the Tuart *(Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain Ecological Community (Threatened Species Scientific Committee (TSSC), 2019)
- EPBC Referral Guidance – Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (DoEE, n.d.)
- Guidance Note – Modification of an Occurrence of a Threatened Ecological Community (DBCA, 2019a)
- Department of Biodiversity Conservation and Attractions (DBCA) Priority lists for flora and ecological communities. (DBCA, 2023)

10.3 Receiving environment

10.3.1 Regional context

The Interim Biogeographic Regionalisation of Australia classifies Australia into 89 bioregions and 419 subregions, utilizing biological, geological, and geographical characteristics as criteria (Thackway and Cresswell, 1995).

The landside DE is located within the Swan Coastal Plain bioregion and the Perth (SWA2) subregion. The Perth subregion comprises a flat coastal plain primarily covered in woodlands. This area is characterized by the prevalence of Banksia and Tuart trees on sandy soils, *Casuarina obesa* on outwash plains, and paperbark trees in swampy regions. Moving eastward, the plain gradually transitions to Mesozoic sediments dominated by Jarrah woodlands. The subregion is represented by heath and Tuart woodlands on limestone terrain, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, and Marri vegetation on colluvial and alluvial soils (Thackway and Cresswell, 1995).

10.3.2 Soil and land systems

The soil landscape and land system mapping in Western Australia provide a comprehensive depiction of soil and landscape attributes, encompassing regional to local scales, with map scales ranging from 1:20,000 to 1:125,000 (DPIRD, 2018).

The landside DE is situated within the Quindalup South System, defined as 'Coastal dunes of the Swan Coastal Plain, characterized by calcareous deep sands and yellow sands adorned with coastal scrub.'(GoWA 2023; DPIRD-064).

10.3.3 Regional vegetation

Broad scale (1:250,000) pre-European vegetation mapping completed by Beard (1979) shows that the landside DE is entirely located within the Rockingham vegetation association (3048) comprising mixed heath with scattered tall shrubs (e.g. Acacia, Proteaceae and Myrtaceae species).

Regional vegetation complex mapping by Heddle et al. (1980) with updates from Webb et al (2016) geomorphic units on the Swan Coastal Plain (SCP) identified the landside DE within the Quindalup complex (System 6 mapping unit n. 55), characterized by coastal dune complex with low closed forest and shrubland.

The DBCA has conducted mapping of native vegetation on the Swan Coastal Plain, categorizing it by association and complex. According to the latest data available, it is estimated that the Rockingham (3048) vegetation association retains approximately 29.2% of its original extent on the Swan Coastal Plain In the case of the Quindalup Complex, it still contains 60.49% of its native vegetation compared to its pre-European extent on the Swan Coastal Plain (GoWA 2023; DPIRD-006).

10.3.4 Site vegetation

A site investigation was undertaken as described in section 4.2. Based on observations, preliminary vegetation units were mapped and described across the landside DE, summarised in Table 26, and shown in Figure 22. The mapped vegetation is consistent with the regional Beard (1979) vegetation association and Heddle et al. (1980) vegetation complex mapping described in section 10.3.3.

Vegetation was largely Degraded in condition (EPA 2016), with both native and planted vegetation present. Native vegetation was confined to the fore dune with mixed coastal heath / *Acacia rostellifera* low shrubland the dominant vegetation present within the landside DE. A small patch of *Melaleuca lanceolata* woodland was present within the north of the Project Area.

The *Eucalyptus gomphocephala* woodland was recorded along the southern boundary of the landside DE and may comprise part of a large patch meeting the diagnostic criteria for the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community, listed as Critically Endangered under the EPBC Act and as a Priority Ecological Community by DBCA. Additional field survey work is required should definition of this ecological community be required.

The remainder of vegetated areas within the landside DE were mapped as 'planted'. This determination was made based on:

– The presence of reticulation and tree trunk protection
– Review of historical aerial imagery that demonstrates historical clearing within these mapped areas.

Of note is the areas of planted *Callitris preissii*, which are present as both a mono-culture and a mixed planted shrubland. Occurrence of *Callitris preissii* within calcareous sandy soils of the Quindalup Dunes can indicate the presence of the *Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands of the Swan Coastal Plain TEC, listed as Critically Endangered under the BC Act. However, give the *Callitris preissii* individuals are not naturally occurring (planted), the vegetation is not considered to represent the TEC (DBCA 2023).

Table 26 Preliminary vegetation units within landside DE

Desription		Condition	Area (ha)
Native	*Eucalyptus gomphocephala* woodland	Degraded	0.34
	Melaleuca lanceolata low open woodland	Degraded	0.27
	Mixed coastal heath / *Acacia rostellifera* low shrubland	Good	1.66
		Degraded	0.32
Planted	*Allocasuarina* species	Completely Degraded - Not Assessed	0.03
	Callitris preissii	Completely Degraded - Not Assessed	0.53
	Grevillea shrubs	Completely Degraded - Not Assessed	0.07
	Mixed wetland species	Completely Degraded - Not Assessed	0.13
Cleared		n/a	0.60
Grand Total			**3.95**

10.3.5 Bush Forever, conservation and environmentally sensitive areas

No Bush Forever sites fall within the landside DE. The nearest Bush Forever sites, identified one site (site 349) situated approximately 2.4 km to the east of the landside DE (GoWA 2023; DPLH-022)

Within the landside DE, there are no designated conservation areas. The closest conservation areas are unnamed reserves dedicated for conservation and recreation, administered by the Conservation Commission WA. These reserves are situated approximately 4 km to the south-east of the landside DE (GoWA 2023; DBCA-011).

Environmentally sensitive areas are declared by DWER to prevent the degradation of important environmental values such as threatened flora, Threatened Ecological Communities or significant wetlands. The landside DE intersects with one environmentally sensitive area (GoWA 2023; DWER-046).

10.3.6 Ecological linkages

Ecological linkages are broadly mapped to represent a link between patches of remnant vegetation judged to be a regional significance in the Perth Metropolitan Region (PMR) Scheme Area.

The landside DE does not intersect ecological linkages. The closest ecological linkage (ID:76) is approximately 2.5 km east of the landside DE (GoWA 2023; DWER-046).

10.3.7 Significant flora

A search of the EPBC Act PMST and the NatureMap search identified 28 significant flora species listed under the EPBC Act and BC Act with potential to occur within the landside DE (see Table 27).

Table 27 Conservation significant flora with potential to occur within the landside DE

Scientific Name	EPBC Act	BC Act / DBCA listing	Likelihood of Occurrence
Acacia sp. Binningup (G. Cockerton et al . WB 37784)	Not listed	Priority 1	Unlikely to occur
Andersonia gracilis	Endangered	Vulnerable	Highly unlikely to occur
Aponogeton hexatepalus	Not listed	Priority 4	Highly unlikely to occur
Austrostipa mundula	Not listed	Priority 3	Unlikely to occur
Banksia mimica	Endangered	Vulnerable	May occur
Caladenia huegelii	Endangered	Not listed	Likely to occur
Cyathochaeta teretifolia	Not listed	Priority 3	Highly unlikely to occur
Diuris drummondii	Vulnerable	Endangered	Unlikely to occur
Diuris micrantha	Vulnerable	Not listed	Unlikely to occur
Diuris purdiei	Endangered	Not listed	Highly unlikely to occur
Dodonaea hackettiana	Not listed	Priority 4	Highly unlikely to occur
Drakaea elastica	Endangered	Not listed	Highly unlikely to occur
Drakaea micrantha	Vulnerable	Not listed	Highly unlikely to occur
Eleocharis keigheryi	Vulnerable	Vulnerable	Highly unlikely to occur
Eucalyptus foecunda subsp. foecunda	Not listed	Priority 4	Unlikely to occur
Eucalyptus x balanites	Endangered	Not listed	Highly unlikely to occur
Jacksonia gracillima	Not listed	Priority 3	May occur
Jacksonia sericea	Not listed	Priority 4	May occur
Lachnagrostis nesomytica subsp. paralia	Not listed	Priority 1	May occur
Lepidium puberulum	Not listed	Priority 4	Highly unlikely to occur
Myosotis australis subsp. australis	Not listed	Priority 4	Highly unlikely to occur
Netrostylis sp. Chandala (G.J. Keighery 17055)	Not listed	Priority 2	Highly unlikely to occur
Pimelea calcicola	Not listed	Priority 3	May occur

Scientific Name	EPBC Act	BC Act / DBCA listing	Likelihood of Occurrence
Sphaerolobium calcicola	Not listed	Priority 3	May occur
Stylidium ireneae	Not listed	Priority 4	Unlikely to occur
Synaphea sp. Fairbridge Farm (Papenfuss 696)	Critically Endangered	Priority 1	Highly unlikely to occur
Synaphea sp. Serpentine (G. Brand 103)	Critically Endangered	Priority 2	Highly unlikely to occur
Thelymitra variegata	Not listed	Critically Endangered	Unlikely to occur

10.3.8 Significant ecological communities

A search of the EPBC Act PMST identified the potential occurrence of five threatened ecological communities listed as Matters of National Environmental Significance under the EPBC Act (Table 28).

Table 28 Conservation significant ecological communities with potential to occur within the landside DE

Threatened Ecological Community	EPBC Act	BC Act / DBCA listing	Likelihood of occurrence
Thrombolite (microbial) community of coastal freshwater lakes of the Swan Coastal Plain (Lake Richmond)	Endangered	Not listed	Community known to occur within local area, however specific habitat not present within landside DE.
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	Endangered	Critically Endangered	Community known to occur within local area, however specific habitat not present within landside DE.
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Critically Endangered	Community known to occur within local area, however specific habitat not present within landside DE.
Empodisma peatlands of southwestern Australia	Endangered	Not listed	Community known to occur within local area, however specific habitat not present within landside DE.
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Not listed	Community likely to occur within area. Potential present along southern boundary as part of a larger patch extending to the south and east.

10.4 Potential impacts and risks

Construction-related activities that have the potential to impact flora and vegetation are:

– Clearing of native and non-native vegetation
– Spills or leaks of hydrocarbons or hazardous materials
– Construction vehicle movements

Potential direct impacts to flora and vegetation are:

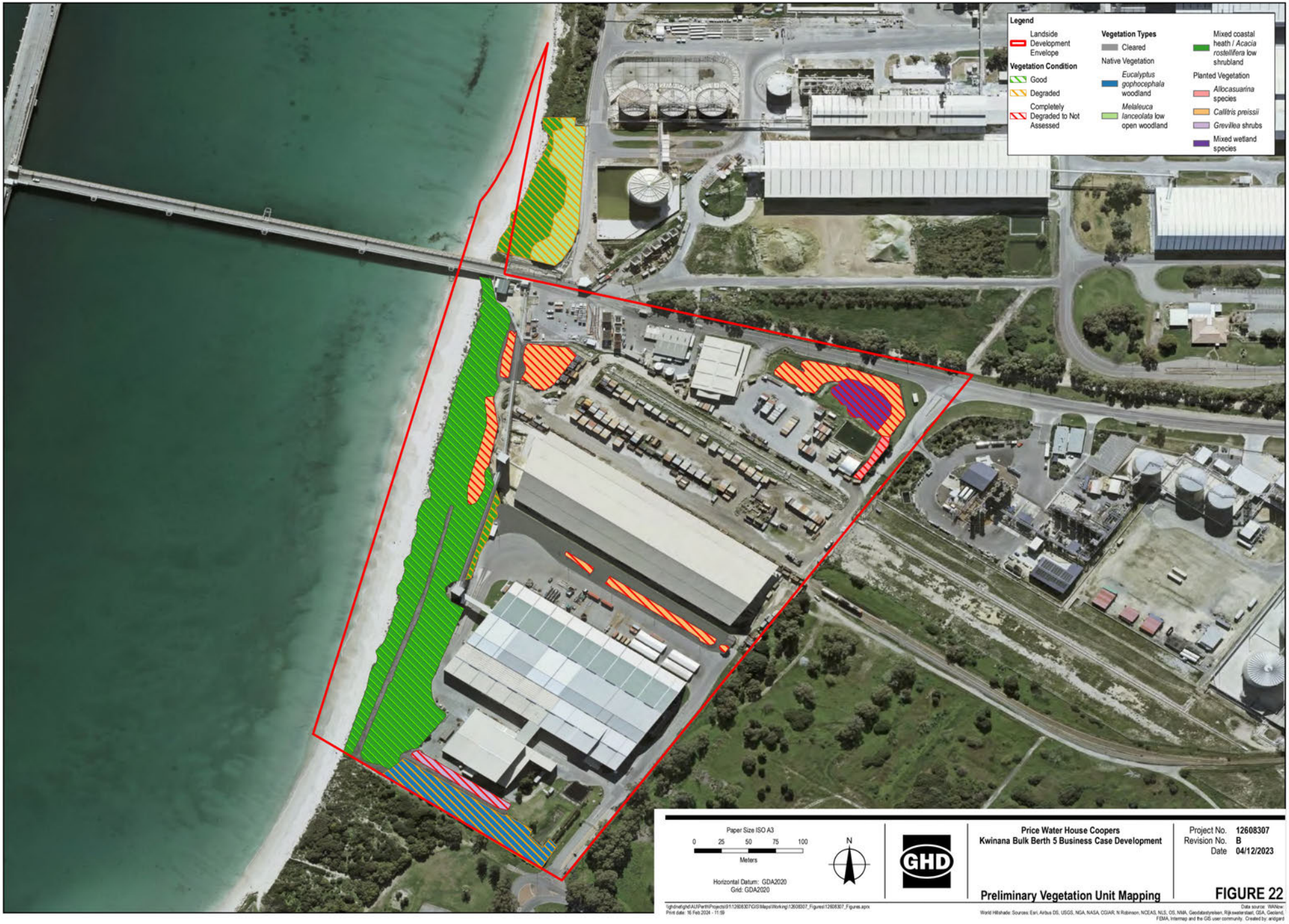
– Clearing of up to 0.20 ha of native vegetation
– Clearing up to 0.09 ha of planted vegetation

Potential indirect impacts to flora and vegetation include:

– Introduction and spread of weeds and generation and deposition of dust

Operations-related activities that have the potential to impact flora and vegetation are:

– Introduction and spread of weeds and generation and deposition of dust


Legend
Landside Development Envelope
Vegetation Condition
Good
Degraded
Completely Degraded to Not Assessed
Vegetation Types
Cleared
Native Vegetation
Eucalyptus gophocephala woodland
Melaleuca lanceolata low open woodland
Mixed coastal heath / Acacia rostellifera low shrubland
Planted Vegetation
Allocasuarina species
Callitris preissii
Grevillea shrubs
Mixed wetland species
Paper Size ISO A3
0 25 50 75 100
Meters
Horizontal Datum: GDA2020
Grid: GDA2020
N
GHD
Price Water House Coopers
Kwinana Bulk Berth 5 Business Case Development
Preliminary Vegetation Unit Mapping
Project No. 12608307
Revision No. B
Date 04/12/2023
FIGURE 22
Data source: WANlw
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community. Created by: aridgard

10.5 Preliminary assessment of impacts

10.5.1 Direct impacts

Clearing of native vegetation

The project is anticipated to result in clearing of up to approximately 0.20 ha of native vegetation during construction. The remaining disturbance areas are planted vegetation or cleared areas.

10.5.2 Indirect impacts

Introduction and spread of weeds and generation and deposition of dust

Vehicle and equipment movements during construction and operation of the project have the potential to introduce spread weeds throughout areas of native vegetation adjacent to the landside DE.

Vehicle movements to and from site during construction and operation of the project have the potential to generate and deposit dust on vegetation adjacent to the landside DE. Dust deposition has the potential to smother and kill flora and vegetation, as well as leading and increase in the occurrence of invasive plant species and diseases.

10.6 Proposed future studies for impact assessment

Based on the assessment of impacts presented in Section 10.5, the following survey is recommended:

- A **Reconnaissance flora and vegetation survey** should be undertaken to support Environmental Impact Assessment, specifically, the clearing of native vegetation within the landside DE.

11. Key Environmental Factor - Terrestrial Environmental Quality

11.1 Introduction

In the context of Environmental Impact Assessment (EIA), the EPA defines terrestrial environmental quality as encompassing "the chemical, physical, biological, and aesthetic attributes of soils." (EPA, 2016d).

11.2 Relevant legislation, policy and guidance

11.2.1 EPA Objective

The EPA's environmental objective regarding Terrestrial Environmental Quality is "to maintain the quality of land and soils so that environmental values are protected". The objective recognises the fundamental link between soil quality and the protection of ecological and social values that good soil quality supports. Therefore, the focus of this factor and its associated objective is how changes to soil quality impact environmental values (EPA, 2016d).

11.2.2 Relevant legislation

Following legislation that were considered relevant for terrestrial environmental quality include:

- *Environmental Protection Act 1986 (WA)*
- *Contaminated Sites Act 2003 (WA)*
- *Soil and Land Conservation Act 1945 (WA)* •
- *Dangerous Goods Safety Act 2004 (WA)* •
- *Waste Avoidance and Recovery Act 2007 (WA).*

11.2.3 EPA policy and guidance

Following EPA policy and guidance that were considered relevant for terrestrial environmental quality include:

- Environmental Factor Guideline – Terrestrial Environmental Quality (EPA, 2016d).

11.2.4 Other policy and guidance

Other policy and guidance documents that were considered relevant for terrestrial environmental quality include:

- Assessment and management of contaminated sites (DER, 2014)
- Identification and investigation of acid sulfate soils and acidic landscapes (DER, 2015a)
- Treatment and management of soil and water in the acid sulfate soil landscapes (DER, 2015b).

11.3 Receiving environment

11.3.1 Geology and soils

Refer to Section 10.3.2 for a summary of the soil and land systems within the landside DE.

The landside DE lies within the Cretaceous Warnbro Group bedrock geology within the Perth coastal zone which is characterised by calcareous sand (white, medium-grained, rounded quartz and shell debris, well sorted, of eolian origin) (GoWA 2023; DMIRS-014).

Previous site investigations have identified three geological units that underlay the landside DE as described below:

– Superficial Formation:
  - Safety Bay Sand – white, unlithified, calcareous fine to medium grained quartz sand and shell fragments originating from stable and mobile aeolian dunes (Davidson, 1995).
  - Becher Sand/Becher Clay – grey, fine grained, quartz and skeletal sand with lenses of silty calcareous clay rich in shell fragments and seagrass peat and mud layers (Davidson, 1995)..
  - Tamala Limestone – creamy, white to yellow aeolian calcarenite, varying from limestone to calcareous sand (fine to medium grained shell fragments), with minor siltstone and marl with various proportions of predominantly medium-grained quartz and sand (Davidson, 1995).
  - Rockingham Sand: brown to pale grey, silty and slightly feldspathic, medium to coarse grained subangular quartz sand. It is of shallow marine origin and occupies a deep eroded channel incised into the underlying Wanneroo member of the Leederville Formation.
– Leederville Formation:
  - Wanneroo Member – interbedded sandstones, siltstones and shales. The siltstones are typically dark grey, micaceous and the sandstone interbeds are weakly consolidated pale grey and fine to very coarse grained (Davidson, 1995)..
  - Pinjar Member – grey and olive green discontinuous interbedded sandstones, siltstones and shales of both marine and non-marine origin (Davidson, 1995).

11.3.2 Acid sulfate soils

Acid sulfate soils (ASS) are naturally occurring soil types containing iron sulfides, primarily in the form of pyrite materials. To assess the potential presence of ASS within the landside DE, a review of the ASS risk mapping for the Swan Coastal Plain was conducted (GoWA 2023; DWER-055). This mapping aims to evaluate the likelihood of ASS disturbance by activities penetrating more than 3 meters below the ground surface. The disturbance risk is categorized into three classes:

1. **High to moderate risk of ASS** within 3 meters of the natural soil surface, susceptible to disturbance by most land development activities.
2. **Moderate to low risk of ASS** within 3 meters of the natural soil surface, potentially disturbed by most land development activities (activities involving soil disturbance beyond 3 meters carry a high to moderate ASS disturbance risk).
3. **No known risk of ASS occurring** within 3 meters of the natural surface (or deeper), immune to disturbance by most land development activities.

There are no potential ASS sites within the landside DE. The closest site category high to moderate risk is approximately 2.6 km east from the landside DE (GoWA 2023; DWER-055).

11.3.3 Contaminated sites

The DWER Contaminated Sites Database only presents information on known or suspected contaminated sites that have been classified by the DWER within the following categories:

– *Contaminated - remediation required (CRR)*
– *Contaminated - restricted use (CRU)*

The sites identified are summarised in Table .

– *Remediated for restricted use (RRU)*

The database does not provide details of sites that are awaiting classification or “Potentially contaminated – investigation required”, “Decontaminated” or sites that have been reported and classified as “Report not substantiated”.

A review of the DWER Contaminated Sites Database (DWER, 2023a) was undertaken on the 22 November 2023, and revealed that four sites are located within the landside DE and/ or within a 250 m radius of the landside DE, which are predominately relevant to the assumed and proposed construction activities. These sites are summarised in Table 29.

Table 29 Contaminated sites within the landside DE or within a 250 m radius

Site number	Classification	Classification date[19]	Summary	Location
69249	*Contaminated – remediation required*	23/10/2019	Nutrients (such as from fertilisers) are present in groundwater beneath the Site which discharges to Cockburn Sound.	Landside DE Lot 497 (Site C)
69250	*Contaminated – remediation required*	28/09/2022	Nutrients (such as from fertilisers) are present in groundwater beneath the Site which discharges to Cockburn Sound.	Landside DE Lot 497 (Site B)
69251	*Contaminated – restricted use*	29/05/2018	Ammonia, nitrogen and phosphorous are present in groundwater beneath the Site. Copper is also present in groundwater in the northern portion of the site.	Landside DE Lot 497 (Site A)
75308	*Remediated for restricted use*	29/03/2019	Asbestos-impacted soil may be present on the site below the top 10 cm of soil, which was remediated and validated to be free of visible asbestos.	Located approximately 200m east of the landside DE

11.4 Potential impacts and risks

Construction related activities that have the potential to impact terrestrial environmental quality (and human health) are presented in the preliminary construction conceptual site model (Table 30) and summarised below:

- Earthworks and re-use of spoil on-site (without appropriate characterisation and placement)
- Piling activities creating preferential flow paths between Superficial and Leederville aquifers
- Alteration of local flow paths due to drainage design leading to localised flow and/ or groundwater mounding within the landside
- Dewatering (abstraction of groundwater) and disposal of effluent
- Spills or leaks of hydrocarbons or hazardous materials
- Construction vehicle movements

Operational activities that have the potential to impact terrestrial environmental quality are:

- Management and design of drainage systems within the landside DE, which have the potential to amend local flow paths (surface water and/ or groundwater)

Potential direct impacts to terrestrial environmental quality due to development within the landside DE:

- Further and/ or contamination of soils and groundwater within the landside DE and potentially off-site

11.5 Preliminary assessment of direct impacts

Further and/ or contamination of soils and groundwater within the landside DE and potentially off-site

Existing contamination and potential contamination due to land use history, as presented in the contamination data gap analysis is unlikely to present a significant risk to the construction and operational activities provided that appropriate investigation, assessment and management of soils (including spoil), surface water and groundwater is completed within the landside DE.

11.6 Proposed future studies for impact assessment

Proposed future investigations and assessments to inform the management of construction within the landside DE is provided in Table 30.

[19] Classification date as per on the BSR information provided as the formal record provided by DWER.

Table 30 Preliminary construction conceptual site model

Construction aspect	CoPCs	Potential source media/ location	Pathway status and risk discussion	Receptor	Residual Data Gaps
Demolition activities					
Demolition / upgrade activities associated with northern portion of the landside DE	Asbestos - Asbestos Containing Materials (ACM) fibrous asbestos and asbestos fines	Asbestos within historical assets potentially disturbed or upgraded during the development	Aspects of the landside DE typically northern portion were constructed as early as 1970's whilst asbestos containing materials and products were still available and utilised in construction/ maintenance. An asbestos risk register has not been provided to date for the landside DE and there is a risk that assets may contain asbestos products.	On-site: Construction workers/ FPA personnel and off-site works (airborne only)	**Data Gap**: Review the asbestos register for the landside DE. Areas un-assessed or not recently and adequately inspected will require a suitable qualified asbestos assessor prior to disturbance. Additional more recent reports by Macrofertile and Bis (such as site management plans and further reports available from DWER on this matter) will need to be considered.
Demolition of the fertiliser shed (Subject Site C) and associated infrastructure such as conveyor	Ammonia, nitrate, nitrite, sulfate, total nitrogen, total phosphorus. Metals	Residual fertilisers within shed (roof eaves, concrete, walls)	Decontamination and removal of residual fertiliser product within fertiliser shed during demolition.	Ecological: Cockburn Sound Aquifers: Superficial On-site: Construction workers	**Data Gap:** Review demolition approach and methodology to reduce and mitigate mobilisation of residual fertiliser within the landside DE. Additional more recent reports by Macrofertile and Bis (such as site management plans and further reports available from DWER on this matter) will need to be considered.
Demolition of impermeable surfaces (shed, hard standing) and drainage infrastructure	Ammonia, nitrate, nitrite, sulfate, total nitrogen, total phosphorus. Metals PFAS	Residual fertilisers within shed (roof eaves, concrete, walls) Residual CoPC within soils surrounding and beneath impermeable surface and drainage infrastructure	Mobilisation of residual CoPC during demolition and/ or long-term status of the land side DE (for example demolition of existing assets) leading to an increase in permeability of the soils and increase in infiltration on-site either due to rainfall (temporal changes) and/ or drainage design leading to changes within existing known or potential groundwater plumes.	Ecological: Cockburn Sound Aquifers: Superficial	**Data Gap:** Review demolition approach and methodology to reduce and mitigate mobilisation of residual CoPC within the landside DE. Additional more recent reports by Macrofertile and Bis (such as site management plans and further reports available from DWER on this matter) will need to be considered.

Construction aspect	CoPCs	Potential source media/ location	Pathway status and risk discussion	Receptor	Residual Data Gaps
Spoil/ soil management during construction					
Excavations and/ or spoil characterisation (re-use on-site and/ or disposal off-site to landfill facility)	Ammonia, nitrate, nitrite, sulfate, total nitrogen, total phosphorus. Sulfur Metals	Onsite soils potentially impacted due conveyor spillages, soak well sediment accumulation, washdown areas and infiltration basin	Elevated soil nutrient concentrations (nitrogen, phosphorus) and elevated metal concentrations (copper, metals) were identified in the sediments of the soak wells/drains (Coffey, 2017). The PDSI indicated that anecdotal evidence from Fremantle Ports Authority suggests that the soak wells are pumped and cleaned approximately once per year (Coffey, 2017). Spills associated with conveyor use are visible, including the presence of bulk sulfur material however, are expected to be superficial (limited to surface). Spills are monitored and cleaned by Fremantle Port authority. The GHD Bis industry DSI identified nitrogen and nitrate concentrations above the background concentration levels within the former washdown areas and beneath the conveyors (GHD, 2017a). Nickel was elevated above the adopted assessment criteria within the infiltration basin and was detected above background concentrations former washdown bay and evaporation and infiltration basins. The residual presence within the surficial soil profile is not a significant source itself in comparison to the raw conveyor materials (ammonium sulfate) and its management (GHD, 2018a). Therefore, it is concluded that the soil impacts present a low risk to the Cockburn sound.	Ecological: Cockburn Sound	An initial review of concept design and further progressed detailed design to ascertain the overall development plan and placement/ excavation of potentially impacted materials, which have the potential to increase concentrations of particularly nutrients within groundwater, surface water and ultimately the Cockburn Sound. Soils (spoil) within areas proposed to be excavated will require to be managed in accordance with a Construction Environmental Management Plan (CEMP) or equivalent associated management plan. **Data Gap:** Additional investigations within areas of proposed disturbance may be required to inform the above management plan(s) depending on the areas excavated. Additional more recent reports by Macrofertile and Bis (such as site management plans and further reports available from DWER on this matter) will need to be considered.

Construction aspect	CoPCs	Potential source media/ location	Pathway status and risk discussion	Receptor	Residual Data Gaps
			The occupational exposure to the CoPCs is thought to be greater than what would occur with contact with potentially impacted soil. However, the risk to construction workers and those with direct contact to soils will need to be considered.	On-site: Construction workers	**Data Gap:** Additional investigations within areas of proposed disturbance may be required to inform the below management plan(s) depending on the areas excavated. Soils (spoil) within areas proposed to be excavated will require to be managed in accordance with a Construction Environmental Management Plan (CEMP) or equivalent associated management plan. Additional more recent reports by Macrofertile and Bis (such as site management plans and further reports available from DWER on this matter) will need to be considered.
Excavations and/ or spoil characterisation (re-use on-site and/ or disposal off-site to landfill facility)	PFAS	Onsite soils particularly within Subject B and C – central and northern portions of the landside DE (vicinity of the manifold building)	The GHD baseline PFAS Assessment identified PFAS concentrations above the LOR but below the adopted assessment criteria in soils on Subject A on Lot 497 On Plan 35196 (GHD, 2018b). The review of PFAS sources within the inner and outer harbour identified that there were no records of use of AFFF for the Subject A, and that there has been no significant land reclamation or fill importation historically for the Site. Records for use of AFFF for Subject B and C are not available. Diffuse PFAS source zones are not expected to be present however, no known PFAS investigations have been undertaken Subject B and Subject C on Lot 497 On Plan 35196, and potential PFAS sources have been identified (GHD, 2018c).	On-site: Construction workers	**Data Gap:** No known PFAS soil investigations have been undertaken at subject B and subject C on Lot 497 On Plan 35196 that were reviewed during this data gap assessment. Additional more recent reports by Macrofertile and Bis (such as site management plans and further reports available from DWER on this matter) will need to be considered.

Construction aspect	CoPCs	Potential source media/ location	Pathway status and risk discussion	Receptor	Residual Data Gaps
Piling activities within landside DE	Ammonia, nitrate, nitrite, sulfate, total nitrogen, total phosphorus Sulfur Metals PFAS	Superficial Aquifer and/ or surface water	Piling activities during the construction of pipe trestle and roadway connecting landside aspects to marine facilities and potentially buildings which are not able to be constructed on shallow foundations.	Aquifers: Leederville and Superficial	**Data Gap:** Piling design and implementation will need to be reviewed and assessed during detailed design to ensure preferential pathways via piling activities are not created. Currently the Leederville Aquifer (deeper) is reported to be isolated from the Superficial Aquifer. Preferential pathways may incite migration of contamination plumes on-site laterally and vertically. Additional more recent reports by Macrofertile and Bis (such as site management plans and further reports available from DWER on this matter) will need to be considered.
Groundwater/ surface water during construction					
Ground disturbance leading to mobilisation of contaminants within superficial aquifer	Ammonia, nitrate, nitrite, sulfate, total nitrogen, total phosphorus. Sulfur (acidity) Metals PFAS	Residual contamination within soils or spoil	CoPCs within soils either located below the groundwater table and/ or placed below the groundwater table have the potential to leach contaminants within superficial aquifer and/ or surface water (infiltration basins during dewatering activities). A risk also exists for changes or amendment to the drainage design with the potential to alter localised groundwater regime (post- construction, however, requires to be addressed during design aspects of the development).	Aquifer: Superficial Ecological: Cockburn Sound On-site: Construction workers	An initial review of concept design and further progressed detailed design to ascertain the overall development plan. Groundwater within areas to be dewatered or groundwater regime altered due to changes within drainage design will require to be managed in accordance with a Construction Environmental Management Plan (CEMP) or equivalent associated management plan. Additional more recent reports by Macrofertile and Bis (such as site management plans and further reports available from DWER on this matter) will need to be considered.

Construction aspect	CoPCs	Potential source media/ location	Pathway status and risk discussion	Receptor	Residual Data Gaps
Dewatering activities including abstraction and disposal within superficial aquifer	Ammonia, nitrate, nitrite, sulfate, total nitrogen, total phosphorus. Sulfur Metals PFAS	Groundwater from superficial aquifer	CoPCs within soils either located below the groundwater table and/ or placed below the groundwater table have the potential to leach contaminants within superficial aquifer and/ or surface water (infiltration basins during dewatering activities). A risk also exist for changes or amendment to the drainage design with the potential to alter localised groundwater regime (post- construction, however requires to be addressed during design aspects of the development).	Aquifer: Superficial Ecological: Cockburn Sound On-site: Construction workers	An initial review of concept design and further progressed detailed design to ascertain the overall development plan. Groundwater within areas to be dewatered or groundwater regime altered due to changes within drainage design will require to be managed in accordance with a Construction Environmental Management Plan (CEMP) or equivalent associated management plan. **Data Gap:** Additional investigations within areas of proposed disturbance may be required to inform the above management plan(s) depending on the areas excavated. Additional more recent reports by Macrofertile and Bis (such as site management plans and further reports available from DWER on this matter) will need to be considered.

12. Key Environmental Factor - Terrestrial Fauna

12.1 Introduction

In the context of EIA, terrestrial fauna refers to animals that inhabit or utilize land at some point in their life cycle. Terrestrial fauna encompasses both vertebrate (such as birds, mammals, including bats, reptiles, amphibians and freshwater fish) (EPA, 2016e).

12.2 Relevant legislation, policy and guidance

12.2.1 EPA Objective

The EPA's objective for Terrestrial Fauna is "To protect terrestrial fauna so that biological diversity and ecological integrity are maintained". In the context of this objective, ecological integrity is the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements (EPA, 2016e).

12.2.2 Relevant legislation

The ollowing legislation that were considered relevant for terrestrial fauna include:

- *Environmental Protection Act 1986 (WA)*
- *Biodiversity Conservation Act 2016 (WA)*
- *Environment Protection and Biodiversity Conservation Act 1999 (Cth).*

12.2.3 EPA policy and guidance

The following EPA policy and guidance that were considered relevant for terrestrial fauna include:

- Environmental Factor Guideline – Terrestrial Fauna (EPA, 2016e).
- Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans (EPA, 2021e)
- Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2016h)
- Instruction: How to prepare and Environmental Review Document (EPA, 2021d).

12.2.4 Other policy and guidance

Other policy and guidance documents that were considered relevant for terrestrial fauna include:

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan (Department of Parks and Wildlife (DPAW), 2013)
- Survey Guidelines for Australia's Threatened Mammals (DSEWPaC, 2011a)
- Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC, 2011b)
- Survey Guidelines for Australia's Threatened Birds Under the Environment Protection and Biodiversity Conservation Act 1999 (Department of the Environment, Water, Heritage and the Arts, 2010)
- EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species (DSEWPaC, 2012c)
- Referral Guideline for 3 WA Threatened Black Cockatoo Species (Department of Agriculture, Water and Environment, 2022)

12.3 Receiving environment

12.3.1 Fauna diversity

The NatureMap search tool identified the presence/potential presence of 539 fauna species recorded within 10 km of the landside DE. This comprised:

- 6 amphibian species
- 310 bird species
- 85 invertebrate species
- 49 mammal species
- 89 reptile species

12.3.2 Significant fauna

A search of the EPBC Act PMST identified 65 significant fauna species listed under the EPBC Act within a 10 km radius of the landside DE. Including 53 birds, 8 mammals, 2 reptiles and 2 invertebrates (see Table 31).

Table 31 Significant fauna species listed under the EPBC and BC Act that are likely or potentially likely to occur within 10km of the landside DE

Scientific Name	Common Name	EPBC Act	BC Act/ DBCA listing	Likelihood of Occurrence
Birds				
Actitis hypoleucos	common sandpiper	Migratory	Migratory	May occur
Anous tenuirostris melanops	Australian Lesser Noddy	Vulnerable	Endangered	May occur
Apus pacificus	Fork-tailed swift	Migratory	Migratory	May occur
Arenaria interpres	Ruddy turnstone	Migratory	Migratory	May occur
Botaurus poiciloptilus	Australasian Bittern	Endangered	Endangered	May occur
Calidris acuminata	Sharp-tailed sandpiper	Migratory	Migratory	May occur
Calidris alba	Sanderling	Migratory	Migratory	May occur
Calidris canutus	Red Knot, Knot	Endangered & Migratory	Endangered	May occur
Calidris ferruginea	Curlew Sandpiper	Critically Endangered & Migratory	Critically Endangered	May occur
Calidris ruficollis	Red-necked stint	Migratory	Migratory	May occur
Calidris subminuta	Long-toed stint	Migratory	Migratory	May occur
Calidris tenuirostris	Great Knot	Critically Endangered & Migratory	Critically Endangered	May occur
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo, Karrak	Vulnerable	Vulnerable	May occur
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	Vulnerable & Migratory	Vulnerable	May occur
Charadrius mongolus	Lesser Sand Plover, Mongolian Plover	Endangered &	Endangered	May occur
Diomedea amsterdamensis	Amsterdam Albatross	Endangered & Migratory	Critically Endangered	May occur
Diomedea dabbenena	Tristan Albatross	Endangered & Migratory	Critically Endangered	May occur

Scientific Name	Common Name	EPBC Act	BC Act/ DBCA listing	Likelihood of Occurrence
Diomedea epomophora	Southern Royal Albatross	Vulnerable & Migratory	Vulnerable	May occur
Diomedea exulans	Wandering Albatross	Vulnerable & Migratory	Vulnerable	May occur
Diomedea sanfordi	Northern Royal Albatross	Endangered & Migratory	Endangered	May occur
Falco peregrinus	Peregrine falcon	Not listed	other specially protected	May occur
Halobaena caerulea	Blue Petrel	Vulnerable	Not listed	May occur
Hydroprogne caspia	Caspian tern	Migratory	Migratory	May occur
Ixobrychus dubius	Australian little bittern	Not listed	Priority 4	May occur
Leipoa ocellata	Malleefowl	Vulnerable	Vulnerable	Unlikley to occur
Limosa lapponica	Bar-tailed godwit	Migratory	Migratory	May occur
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit	Critically Endangered	Critically Endangered	May occur
Macronectes giganteus	Southern Giant-Petrel, Southern Giant Petrel	Endangered & Migratory	Migratory	May occur
Macronectes giganteus	Red Knot, Knot	Endangered	Endangered	May occur
Macronectes halli	Northern Giant Petrel	Vulnerable & Migratory	Migratory	May occur
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Critically Endangered & Migratory	Critically Endangered	May occur
Onychoprion anaethetus	Bridled tern	Migratory	Migratory	May occur
Oxyura australis	Blue-billed duck	Not listed	Priority 4	May occur
Pachyptila turtur subantarctica	Fairy Prion (southern)	Vulnerable	Not listed	May occur
Pandion haliaetus	Osprey	Migratory	Migratory	May occur
Phoebetria fusca	Sooty Albatross	Vulnerable & Migratory	Endangered	May occur
Plegadis falcinellus	Glossy ibis	Migratory	Migratory	May occur
Pterodroma mollis	Soft-plumaged Petrel	Vulnerable	Not listed	May occur
Rostratula australis	Australian Painted Snipe	Endangered	Endangered	May occur
Sterna dougallii	Roseate tern	Migratory	Migratory	May occur
Sternula nereis nereis	Australian Fairy Tern	Vulnerable	Vulnerable	May occur
Thalassarche carteri	Indian Yellow-nosed Albatross	Vulnerable & Migratory	Endangered	May occur
Thalassarche cauta	Shy Albatross	Endangered & Migratory	Vulnerable	May occur
Thalassarche impavida	Campbell Albatross, Campbell Black-browed Albatross	Vulnerable & Migratory	Vulnerable	May occur
Thalassarche melanophris	Black-browed Albatross	Vulnerable & Migratory	Endangered	May occur

Scientific Name	Common Name	EPBC Act	BC Act/ DBCA listing	Likelihood of Occurrence
Thalassarche steadi	White-capped Albatross	Vulnerable	Not listed	May occur
Thalasseus bergii	Crested tern	Migratory	Migratory	May occur
Thinornis rubricollis	Hooded plover, hooded dotterel	Vulnerable	Not listed	May occur
Tringa glareola	Wood sandpiper	Migratory	Migratory	May occur
Tringa nebularia	Common greenshank	Migratory	Migratory	May occur
Tyto novaehollandiae novaehollandiae	Masked owl (southwest)	Not listed	P3	May occur
Zanda baudinii	Baudin's Cockatoo, Baudin's Black-Cockatoo, Long-billed Black-cockatoo	Endangered (listed as Calyptorhynchus baudinii)	Endangered	May occur
Zanda latirostris	Carnaby's Black Cockatoo, Short-billed Black-cockatoo	Endangered (listed as Calyptorhynchus latirostris)	Endangered	May occur
Mammals				
Pseudocheirus occidentalis	Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit	Critically Endangered	Critically Endangered	Unlikley to occur
Bettongia penicillata ogilbyi	Woylie	Endangered	Critically Endangered	Unlikley to occur
Dasyurus geoffroii	Chuditch, Western Quoll	Vulnerable	Vulnerable	Unlikley to occur
Isoodon fusciventer	quenda, southwestern brown bandicoot	Not listed	Priority 4	Known to occur
Phascogale tapoatafa wambenger	south-western brush-tailed phascogale, wambenger	Not listed	Critically Dependant	Unlikley to occur
Notamacropus eugenii derbianus	Tammar wallaby	Not listed	Priority 4	Unlikley to occur
Hydromys chrysogaster	Water-rat, rakali	Not listed	Priority 4	Unlikley to occur
Notamacropus irma	Western brush wallaby	Not listed	Priority 4	Unlikley to occur
Reptiles				
Neelaps calonotos	Black-striped snake, black-striped burrowing snake	Not listed	Priority 3	May occur
Lerista lineata	Perth slider, lined skink	Not listed	Priority 3	May occur
Invertebrates				
Synemon gratiosa	Graceful sunmoth	Not listed	Priority 4	May occur
Idiosoma sigillatum	Swan Coastal Plain shield-backed trapdoor spider	Not listed	Priority 3	Unlikley to occur

12.3.3 Habitat value

A site investigation was undertaken as described in section 4.2. Based on observations, fauna habitat values were low, given the vegetation present within the landside DE was largely Degraded in condition (EPA 2016). The habitat is highly fragmented and has been subject to significant historical disturbance. However, two conservation significant fauna species, quenda (P4) and Perth slider (P3), may use the habitat present within the native vegetation areas.

Black cockatoo foraging habitat

Habitat suitable for foraging by Black Cockatoos, including Carnaby's Cockatoo (classified as Threatened under the EPBC Act and the BC Act) and the Forest Red-tailed Black Cockatoo (classified as Vulnerable under the EPBC Act and the BC Act), is present within the landside DE. Approximately 0.34 ha of Tuart woodland, present along the southern boundary of the landside DE (Figure 22), represents suitable foraging habitat for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo.

12.4 Potential impacts and risks

Construction related activities that have the potential to impact terrestrial fauna are:

– Construction vehicle and machinery movements
– Clearing of native and non-native vegetation within the limited clearing extent
– Installation of infrastructure posing collision and entrapment hazard
– Introduction and spread of weeds and generation and deposition of dust

Potential direct impacts to terrestrial fauna:

– Loss of fauna habitat
– Fauna injury or mortality from entrapment, collision and entanglement with infrastructure, vehicles and machinery

Potential indirect impacts to terrestrial fauna are:

– Noise and light emissions
– Introduction and spread of weeds and generation of deposition of dust

12.5 Preliminary assessment of impacts

12.5.1 Construction related impacts

12.5.2 Direct impacts

Loss of fauna habitat

The project is anticipated to result in the clearing of approximately 0.30 ha of low value habitat.

The habitat proposed to be cleared is of limited value to terrestrial vertebrate fauna due to its condition, highly-fragmented nature and location within an industrial area that has undergone significant historical disturbance. Two conservation-significant species may use the native vegetation habitat: the quenda (P4) and Perth slider (P3). Neither species range is restricted to the proposal area, with the quenda distributed throughout the southwest of WA (Valentine et al., 2018) and the Perth slider throughout the Swan Coastal Plain, centred around the southern Perth metropolitan area (Maryan et al., 2015). A third species, the Pacific swift (P4), may also use the airspace above the Introduced Grasses with Sparse Shrubs and Garden/Non-Native Plants habitat types. The Pacific swift has a broad distribution throughout Australia, occurring in all states and territories (Higgins, 1999). The habitat proposed to be cleared is unlikely to represent key habitat for any conservation-significant species

Fauna injury or mortality from entrapment, collision and entanglement with infrastructure, vehicles and machinery

Construction activities and vehicle and machinery movements in areas adjacent to fauna habitat have the potential to result in injury or mortality of terrestrial fauna that may be present within the DE. Construction activities such as excavating have the potential to result in entrapment or entanglement of terrestrial fauna.

12.5.3 Indirect impacts

Noise and light emissions

Construction activities are anticipated to generate localised and temporary noise emissions. Primary noise emissions are anticipated to be those created by construction vehicles and machinery. Construction activities are intended to be limited to occurring within daylight hours; however, security lighting may be required around the construction compound. However, the surrounding industrial area is already relatively well-lit at night, and the addition of security lighting is unlikely to increase impacts from light emissions.

Artificial light is known to impact seabirds with a nocturnal component to their lifecycle. This is restricted to species within the order Procellariform when they return to land to breed. There are no significant breeding rookeries of any Procellariform species known to occur within 20 km of the Proposal area. During commissioning and operations, occasional venting and flaring is anticipated to produce short term noise emissions.

Introduction and spread of weeds and generation of deposition of dust

Vehicle and equipment movements during construction of the Proposal have the potential to introduce and spread weeds throughout terrestrial fauna habitat adjacent to the DE.

Potential sources of construction-related dust generation include clearing, earthworks and vehicle movements. These activities have the potential to smother and kill flora and vegetation, as well as lead to an increase in the occurrence of invasive plant species and diseases.

12.6 Proposed future studies for impact assessment

Based on the assessment of impacts presented in Section 10.5 the following survey is recommended:.

– A basic **Terrestrial fauna survey** should be undertaken to support Environmental Impact Assessment, specifically, the clearing of potential conservation significant fauna habitat within the landside DE.

13. Key Environmental Factor - Social surroundings

13.1 Introduction

This section provides an overview of all the social surroundings and heritage surveys undertaken to date and ongoing consultation that is anticipated to occur to ensure heritage and social surroundings considerations are incorporated by Fremantle Ports over the life of the Project.

In accordance with the EP Act, the term “environment” includes social surroundings. As per Section 3(1) the definition of environment includes living organisms, their physical, biological and social context, along with the interactions among all these elements (EPA, 2016a).

13.2 Relevant legislation, policy and guidance

13.2.1 EPA objective

The EPA’s environmental objective for social surroundings is: “To protect social surroundings from significant harm”. The objective recognises the importance of ensuring that social surroundings are not significantly affected as a result of implementation of a Project or scheme (EPA, 2016a).

13.2.2 Relevant legislation

Following legislation that was considered relevant for social surroundings include:

- *Environmental Protection Act 1986* (WA)
- Environmental Protection (Noise) Regulations 1997 (WA)
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth)
- *Native Title Act 1993* (Cth)
- *Aboriginal Heritage Act 1972* (WA)
- *Aboriginal Cultural Heritage Act 2021* (WA)
- *Aboriginal Heritage and Torres Straight Islanders Heritage Protection Act 1984* (Cth)
- *Heritage Act 2018* (WA).

13.2.3 EPA policy and guidance

Following EPA policy and guidance that were considered relevant for social surroundings include:

- Environmental Factor Guideline – Social Surroundings (EPA, 2016a).
- Interim Technical Guidance Environmental impact assessment of Social Surrounds – Aboriginal cultural heritage (EPA, 2023).
- Guidance Statement No. 3 – Separation Distance Between Industrial and Sensitive Land Uses (EPA, 2005b).

13.2.4 Other policy and guidance

Other policy and guidance documents that were considered relevant for social surroundings include:

- Draft Guidance Note 8 Guideline on Environmental Noise for Prescribed Premises (Department of Environmental Regulation (DER), 2016)
- Visual Landscape Planning in Western Australia: A manual for evaluation, assessment, siting and design (Western Australian Planning Commission (WAPC), 2007)
- WAPC Transport Impact Assessment Guidelines (2016)

13.3 Receiving environment

This section identifies the technical elements of the receiving environment that are directly and indirectly related to the social surroundings considerations of aesthetic, cultural, economic, and other social surroundings to the extent in which they directly affect or are affected by physical or biological surroundings (EPA, 2016). The receiving environment for social surroundings of the project and surrounding areas consists of:

– Sensitive receptors including residents, workers, recreational users, and tourists
– Recreational areas, marine areas and islands
– Industrial areas and urban areas, including residential precincts
– Aboriginal cultural values.

13.3.1 Social and economic location

The project area is located within the traditional land and sea of the Whadjuk people of the Noongar nation, approximately 40 km south of Perth central business district within the southern extent of the City of Kwinana local government boundary. The City of Kwinana covers 118 km2, and shares borders with the City of Rockingham to the south, the City of Cockburn to the north, and the Shire of Serpentine-Jarrahdale to the east.

Based on the 2021 Census, Kwinana had a population of 45,867 people, and it is currently witnessing significant population expansion (ABS, 2021). In 2021, 4.4% of the population (2,016 people) in Kwinana identified as Aboriginal or Torres Strait Islander, which is higher than WA (3.3%).

The project area is located approximately 600m south of the City of Kwinana / City of Rockingham boundary. The City of Rockingham encompasses a total land area of about 260 km2 and has a population of 135,678 (ABS, 2021). Similar to Kwinana the residential areas within the City of Rockingham are rapidly expanding. In 2021, 2.7% of the population (3,605 people) in Rockingham identified as Aboriginal or Torres Strait Islander.

The nearest residential suburb to the project is in Rockingham, approximately 2km to the south. It is separated by Rockingham Industry Zone, CBH Group Kwinana Grain Jetty and Terminal in addition to Cee & See Caravan Park, all of which are located in East Rockingham. Rockingham town centre is located approximately 4.5km southwest of the project area.

Recreational areas in the immediate vicinity of the project include Wells Park, Kwinana Beach, Kwinana Jetty fishing spot, Kwinana Grain Terminal dive site and Kwinana Dog Beach. The coastline adjacent to the project area is used for swimming, diving, snorkelling, walking and horse riding by local residents and tourists.

The project area is directly adjacent to the Port Precinct Zone within the Kwinana SIA. Kwinana SIA is one of Western Australia's most important strategic industrial areas and is part of the State's premier heavy industrial zone, the Western Trade Coast. Current operations, under management and operation of Fremantle Ports, include the Kwinana Bulk Terminal and Kwinana Bulk Jetty. The Bulk Terminal, located north of the project area includes one berth referred to as KBB2. KBB2 is primarily used for export and import of bulk cargoes such as coal, gypsum and cement clinker.

Associated Projects of relevance to the project area include the Government of Western Australia Westport Program. The Westport Program supports growth and better management of Cockburn Sound through the establishment of a future container terminal to the north of the marine DE and KBB2. This would include supporting logistics and associated integrated road and rail transport corridors. This facility would facilitate transition from the inner harbour at Fremantle to the outer harbour at Kwinana as the major container port for WA.

Table 32 presents social and economic receptors located within 6 km of the project area, detailing the relevant distances of the receptors from the project area.

Table 32 Approximate distances to social and economic receptors

Receptor	Approximate distance (km) and direction from project area
Residential	
Kwinana town centre	5.1 km east of the project area
Rockingham town centre	4.2 km southwest of the project area

Receptor	Approximate distance (km) and direction from project area
Education facilities	
Medina Primary School	4.4 km northeast of the project area
Calista Primary School	4.9 km east of the project area
Orelia Primary School	5.4 km northeast of the project area
Gilmore College	5.4 km northeast of the project area
Health facilities	
Kwinana Community Health and Development Centre	5.3 km east of the project area
Rockingham General Hospital	5.3 km southeast of the project area
Recreational and Reserve areas	
Wells Park	0.3 km south of the project area
Kwinana Beach	Directly adjacent to project area
Kwinana Dog Beach	0.9 km south of project area
Rockingham Beach	3.3 km southwest of project area
Lake Richmond	5.9 km southwest of project area
Bulk Jetty Dive Site	4 km northeast of the project area
Naval Base Horse Beach	4.5 km northeast of the project area
Mike Barnett Sports Complex	3.9 km southwest of the project area
Perth Motorplex	4.1 km northeast of the project area
Thomas Oval	3.8 km northeast of the project area
Kwinana Golf Course	3.5 km east of the project area
Rockingham Golf Course	5.6 km southeast of the project area
Lake Cooloongup	5.1 km southeast of the project area
Leda Nature Reserve	4.6 km southeast of the project area

13.3.2 Aboriginal heritage

The project area is located within the South West Native Title Settlement (Settlement) area, traditional lands of the Noongar language group of the Whadjuk people. The Settlement, which formally commenced on 25 February 2021 is made up of six individual indigenous land use agreements (WA Government, 2023). This project area is within the Gnaala Karla Booja land use agreement area. The Traditional Custodians of these lands and seas are represented by Gnaala Karla Booja Aboriginal Corporation (GKB AC).

The project area is located within Cockburn Sound, known as Derbal Nara (Noongar name for Cockburn Sound). Noongar people attribute creation mythology associated with Rottnest Island, Garden Island, Carnac Island (Brown, Fisher in Goode, 2018) and Cockburn Sound. The reported myths involve a Waugal (Armstrong in Goode, 2018) and a great fire that burned with intensity (Moore in Goode, 2018) that resulted in the ground splitting and offshore islands separating from the mainland, creating Cockburn Sound. Another myth relates to the story of a battle between an Ancestral Crocodile and Waugal (rainbow sea serpent) that resulted in the spirit of the crocodile remaining at garden Island (Landscape Magazine in Goode, 2018).

Fremantle Ports, within their Reconciliation Action Plan - Reflect (RAP), specify their RAP journey as a reflection of their genuine desire to engage and support Aboriginal and Torres Strait Islander peoples. Recognising that historical and current works and operations continue to impact the physical environment of the lands and waters of Kwinana / Cockburn Sound (Derbal Nara) (Fremantle Ports, 2023).

The land and seas surrounding the project area contains a diverse array of registered and lodged cultural heritage including dreaming and ceremonial sites, camps, ritual, plant resources and mission sites as drawn from the

Aboriginal Heritage Inquiry System (AHIS) (Table 33). Sites listed have been included due to potential impacts to Aboriginal Cultural Heritage (ACH) values through physical ground disturbance, changes to culturally significant ground or surface water resources, significant dust emissions, ecological impacts to culturally significant flora and fauna or significant visual impacts on landscapes with culturally significant values.

Table 33 Registered Aboriginal sites close to the project area

Place	Distance to project area	ID	Restriction	Place type
Mooribirdup Ceremonial Grounds	6.2 km	22888	No gender restrictions	Camp; ritual / ceremonial; plant resource
Sister Kate's Childrens Home (Summer Camp)	6.5 km	31265	No gender restrictions	Camp; historical; mission; water source
Rotary Park	5.6 km	3471	No gender restrictions	Creation / dreaming narrative
Lake Richmond	6.0 km	15974	No gender / initiation restrictions	Camp; ritual / ceremonial
Woodman Point	12.4 km	15841	No gender restrictions	Creation / dreaming narrative

Fremantle Ports is required to enter into a Noongar Standard Heritage Agreement with SWALSC, for and on behalf of the people represented by the GKB AC, as required under the Indigenous Land Use Agreement. The Noongar Standard Heritage Agreement establishes the process by which Fremantle Ports and the people represented by the GKB AC are likely to consult about cultural heritage protection and management, including how Fremantle Ports is anticipated to seek cultural heritage surveys and how the people represented by the GKB AC are anticipated to undertake those surveys.

13.3.3 Aboriginal cultural heritage values

Engagement and collaboration with GKB AC are required to determine Aboriginal cultural heritage values and social surroundings factors of importance to Traditional Custodians. Potential areas of relevance could include:

- Access
- Flora and fauna retention
- Water use
- Visual impact and aesthetic
- Cultural values
- Isolated artifacts within the project area

There should be ongoing consultation to allow GKB AC to participate in the project, make decisions about and monitor project impacts on an ongoing basis.

13.3.4 European heritage

Kwinana's European settlement history spans from the early days of the Swan River Colony in the early 1800s. Thomas Peel brought a population of around 400 people from the United Kingdom in 1830, aiming to find a settlement in Cockburn Sound. Although the attempt failed, some people chose to stay in Kwinana.

The second noticeable wave of immigration to the area occurred in 1920, when the WA government provided financial support to British migrants, encouraging them to come to WA in exchange of their participation in a primary production scheme in undeveloped areas, including Kwinana (Price, 2016).

In the 1950s, Kwinana's transformation into an industrial centre began when the WA government partnered with the Anglo-Persian Oil Company (now BP) to construct an oil refinery and develop Kwinana as an industrial hub (MacLachlan, 2013). Margaret Feilman, the first female town planner in Perth, was commissioned to plan the layout of the new town. Medina became the first neighbourhood to be established as part of this development (Russell, 1979).

The project area and its social surrounds encompass several European heritage sites. Some heritage sites (e.g., Smirk's cottage and Sloan's cottage heritage site) within the City of Kwinana sit in the inland areas and at a

distance to the project area and are unlikely to directly or indirectly be impacted by the Project. There are four European heritages sites (Wells Park, SS Kwinana, Cliff Point Historic Site, and Cape Peron K Battery Complex) that are near the project area or may have a view of project area (Table 34).

SS Kwinana is a shipwreck and one of the European heritages in the project area. Originally named 'Darius' in 1892, the vessel was renamed to 'Kwinana' in 1912 when purchased by the WA government. The vessel served various roles, from transporting horses to India to moving cattle in WA. After several incidents, it became derelict as Kwinana Beach in 1922. The place features a steel vessel hull rusting in the water, cut to water level and filled with concrete to create a platform. The hull's shape is visible with concrete and stone, extending about 5 m into Kwinana Beach's Bay. In 1966, Kwinana Councillor proposed that the beachfront reserve next to the wreck should be named Wells Park. This area has been a popular holiday spot since the 1950s and has been developed gradually over the past decades. The park is surrounded by heavy industrial land uses. According to the Town of Kwinana Local Planning Scheme No. 2 (p.25), the industrial development in that area should safeguard public access to Wells Park Recreation Reserve and it should be properly buffered from industrial sites and any future development (DPLH, 2023).

Cape Peron K Battery Complex is another heritage site located within Rockingham LGA boundary, with the approximately 8.5 km inland distance to the project area. It is a remnant of infrastructure that was used during WW2. It sits in a landscape setting consisting of a large public open space which features sand dunes covered with native vegetation.

Garden Island, located on the eastern side of project area, encompasses historic sites, and contains European heritage values. The Cliff Point Historical Site (also known as Sulphur Town), located on this island holds historical importance as the European's early settlement in WA. Governor Stirling's party established it in 1829, marking WA's inaugural non-convict settlement. This site is culturally significant to the community (DPLH, 2023b).

There are other European state registered heritage sites in a distance of approximately 4-5 km from the project area. These sites include Mead Homestead (within the City of Kwinana LGA), Day Cottage, Chesterfield Inn, Hymus House and Outbuildings, and Bell Cottage within the City of Rockingham. These sites are less likely to be impacted by the project area due to the inland distance which is buffered by remnant native vegetation, urban setting and industrial sites.

The direct and indirect impact of the construction of KBB5 on the European heritage need to be considered and reflected in the design and decision-making for the location and design of the berth.

Table 34 European Heritage

Heritage Site	Site type	Place number	Location	Management category
Wells Park	Urban Park	12101	Kwinana Beach Rd, East Rockingham	B (considerable) - High level of protection
SS Kwinana	Historic Site	12109	Kwinana Jetty, Kwinana Beach Road	A (exceptional) - Highest level of protection possible
Cliff Point Historic Site	Historic Site	18184	Sulphur Bay Garden Island, Rockingham	A - The place has historic and research value
Cape Peron K Battery Complex	Historic Site	03365	End of Point Peron Rd, Cape Peron, Rockingham	A - The place has aesthetic and historic value.

13.3.5 Amenity

The EPA Social Surroundings Factor Guideline (EPA, 2016) identifies that:

"both visual amenity, and the ability for people to live and recreate within their surroundings without any unreasonable interference with their health, welfare, convenience and comfort. Noise, odour and dust all have the potential to unreasonably interfere with the health, welfare, convenience and comfort of people. Natural landscapes and views often contribute to visual amenity, such as areas of high heritage, cultural or social significance due to their natural features or scenic quality."

The amenity value refers to the use and enjoyment of public and private properties which can be negatively impacted by changes to the characteristics of an environment. These changes include noise, light, traffic, odour,

dust, views and scenic quality. Therefore, any changes to the human-made and natural landscape may lead to a significant impact on the amenity values associated with a landscape and the way people experience a landscape and space. A range of studies proposed in Section 13.6, can identify the potential changes and impacts a project can pose to social context, visual landscape, and cultural aspects, to assist with the prevention or mitigation of the negative impacts on the sensitive area, amenities, and cultural values of the existing characters.

13.3.6 Landscape and visual

Figure 23 represents a modelled visual impact of KBB5 with view to the coast.

Figure 23 Modelled visual impact of KBB5 with view to the coast (FPA, 2023).

A Landscape and Visual Impact Assessment (LVIA) desktop appraisal was conducted within the project area to identify the landscape characteristics, key visual receptors, and the scenic quality of the project area. Based on a desktop study of the existing landscape context, five main Landscape Character Units (LCUs) are identified.

Due to the close distance of the project area to the identified LCUs, other than LCU1 and LCU2 which would have a direct impact from the Project, the project area would interact with LCU3, LCU4, and LCU5.

In general, visual receptors that may be affected by the Project are identified as:

- Residents of Garden Island
- Garden Island Navy Base staff
- Users of Rockingham Beach Road
- Recreational ocean users (Boat, swimmers, divers etc.)
- Recreational inland users (walkers, beach users etc.)
- Tourists

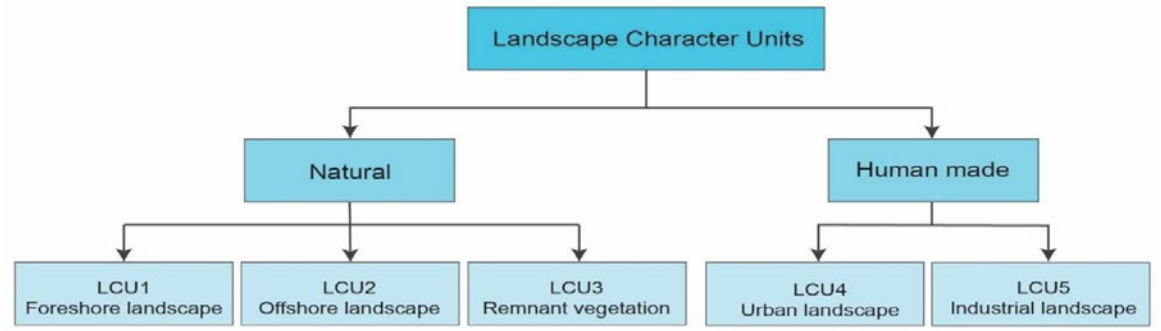


Figure 24 Identified landscape character units

A description of each LCU is provided below:

LCU1: Foreshore landscape

LCU1 is the interface of land and water and encompasses coastline areas within the project area and the surroundings at the bay. The foreshore landscape includes a variety of coastline features dominated by sandy coasts (Table 35). Sandy dunes on the foreshore are covered and stabilised with vegetation cover, providing habitat for fauna and mitigating soil erosion and heat. This LCU also includes green spaces such as Wells Park, Bell Park, Churchill Park, Herbert Park, Naval Memorial Reserve, and Peron Park. The foreshore around the project area accommodates other land uses such as CBH Group Kwinana Port and Kwinana Grain Terminal.

LCU1 provides a variety of aesthetic and recreational benefits and offers residents the opportunity to enjoy the landscape of coral reefs, watching the specific fauna such as birds and whales, hiking and fishing. The views of this LCU would be impacted by the Project. Although the project area is adjacent to an industrial site and there are several berths in the surroundings, the addition of KBB5, its related infrastructure and more vessels traffic would be a visual disruption.

Table 35 The main coastal features. Source: State Planning Policy No. 2.6. p12-14

Coastal landscape feature	Description
Sandy coasts	A foreshore area that is dominant with sand and lacks solid rock formations. Exhibit fluctuating erosion and accretion patterns and are susceptible to sea level rise-induced retreats.
Rocky coasts	Rocky coasts are classified based on their continuous rocky substrate and elevation (at least 1 m above the higher spring tide). Those with a low of discontinuous rocky areas would be classified as mixed sandy and rocky coasts. Rocky coasts were classified into three categories: Hard rock coast, soft sedimentary rock coast, and weakly lithified sedimentary rock coast,
Mixed sandy and rocky coasts	Mix of sandy and rocky coasts includes fringing reefs, rocky platforms, and discontinuous rocky shorelines.
Coastal lowland	Coastal lowlands, formed by geological processes like deltas, typically have gently sloping shores with fine sediments, featuring tidal flats, salt marshes, and sometimes chenier plains or storm ridges, influenced by tidal and inundation dynamics.
Tidal reaches of inland waters	Tidal reaches in inland waters, like river mouths and estuaries, are shaped by coastal forces, with flat shores and fine sediments, influenced by tides and inundation.
Islands	Islands comprise a combination of sandy and rocky coasts

LCU2: Offshore landscape

LCU2 presents the offshore landscape, or seascape within the Project surroundings. LCU2 encompasses jetties, coastal platforms, and islands including Garden Island and Carnac Island. This landscape unit offers a range of recreational activities such as scuba diving, fishing, boating and birdwatching. The views of the foreshore from LCU2, are critical in people's recreational experiences. Although the project area is adjacent to an industrial site and there are several berths in the surroundings, the addition of KBB5, its related infrastructure and more vessel traffic would be considered as a disruption to the visual experience of the users of LCU2.

LCU3: Remnant vegetation

The City of Kwinana encompasses more than 27 natural reserves, including coastal, woodland, and wetland environments, collectively covering an area of approximately 300 ha. These reserves have diverse tenure arrangements, including Crown reserves, freehold land, and parks (City of Kwinana, 2023). Preserving the cultural heritage of these areas with the particular attention to the Aboriginal heritage sites is a key management priority (City of Kwinana, n/a; p.4). The City of Rockingham has an area of approximately 1,230 ha of natural assets which are managed by the City council and an additional 3,260 ha private natural landscapes with environmental values.

It is unlikely that Project would affect the characteristics of the Remnant vegetation areas (LCU3), especially the areas which are situated further inland and at a distance.

There are some patches of LCU3 (e.g., Lewington Reserve) adjacent to the industrial landscape and the project area. Due to the dense vegetation, the views are limited. The views are likely to be intervened by vegetation, unless the Project is visible from elevated areas and outlooks.

LCU4: Urban landscape

LCU4 characterises the urban area including residential settlements, commercial land uses (shopping centres, shops etc), recreational land uses (such as parks, ovals, Cee and Sea Caravan Park) and public open spaces (public parks, streetscapes, etc). This LCU have been shaped by cultural activities and influenced by the way the land is utilised. It includes a blend of human-made structures and natural elements. This LCU encompasses the urban setting within Kwinana, East Rockingham, Rockingham and Peron localities. The view of the project area from this LCU would be intervened by buildings and trees. The residents and users of LCU4 may experience indirect impacts from Project, such as potential alteration to the traffic patterns and changes in the foreshore areas (e.g., visibility of more vessels and infrastructures) where people used to recreate. The properties facing the foreshore and offshore landscapes may visually be impacted by the changes that happen as a result of construction and operation of KBB5.

LCU5: Industrial landscape

Industrial sites include Western Trade Coast (WTC) which encompasses both the Kwinana Industrial Complex, with its southern segment situated within the City of Rockingham. The southern section of the WTC features heavy industries like petroleum refineries, power plants, chemical facilities, cement works, and related industries. Near the heavy industrial complex, the Rockingham Industrial Zone and East Naval Base factory area contain established fabrication facilities, transport depots, warehouses, and construction supply operation (Syme and McLeod, 2019 p27). This LCU is unlikely to be impacted significantly by the Project since the features and changes occurring as result of construction and operation of KBB5 is not uncharacteristic to the LCU5 character.

13.3.7 Key viewpoints

Based on the desktop study and the examination of available resources, the key viewpoints were identified (Table 36). The identified potential viewpoints are located within LCU1 and LCU2.

Table 36 Key viewpoints

Viewpoint	Description
Cape Peron Loop Trail	This trail is 2.4 km long and is located in a landscape consisting of rugged limestone cliffs covered by native vegetation, sandy beaches, and offshore beaches. It is a popular trail that offers a range of recreational activities such as walking, swimming, diving, and picnicking.
Carnac Island	Carnac Island is situated south of Fremantle and serves as a fully protected nature reserve which is crucial for the conservation of the rare Australian sea lion. This island is a renowned and favoured location for fishing, particularly on its eastern side which features a sheltered bay ideal for anchoring boats. This island is also popular for bird watchers.
Garden Island	Garden Island is a slender island located 50 km south of Perth and is connected to the mainland by a bridge and causeway. It is historically significant as the site of WA's first settlement. It holds national heritage value, notably at the Cliff Point Heritage Site, associated with Governor Stirling and Captain Charles Fremantle. Primarily a naval base, approximately two-thirds of the island is open to the public during daytime hours only. It is accessible by private boat and monitored by the Department of Conservation and Land Management Rangers. Cliff Point Historic Site can be a key viewpoint within the island.

Viewpoint	Description
Kwinana Beach	Kwinana Beach is located adjacent to the south of the Project site. It is a popular beach that includes a diving wreck and has picnic/play facilities at Wellis Park. It also has a jetty at this location.
Rockingham Beach	Rockingham Beach is located on the south of the project and provides a scenic beaty of white sandy beach bordered by sand dunes covered by native vegetation.
Point Peron	Point Peron is a popular location with a lookout structure that may allow views of north towards Project site. It includes Cape Peron Loop Trail which is a coastal walk. Cape Peron K Battery Complex and Cape Peron Loop Trail are two key viewpoints within the area.
Wells Park	Wells Park has been a popular beachside park since the 1950s. Located adjacent to Kwinana Beach, Wells Park includes a playground, public amenities, picnic shelters and BBQs.

13.3.8 Traffic

There is the potential for increased traffic on the roads within the Project proximity during both the construction and operation of the Project. The development may result in additional traffic on the road network, with the potential for associated reduction in road safety. A more detailed assessment is required to determine the extent of the impact of an increase in traffic from the Project.

13.3.9 Airborne noise and vibration

A preliminary noise impact assessment study is detailed in Appendix D, its purpose is to assess:

– Airborne noise from construction activities
– Airborne noise from stationary vessel at KBB 5
– Airborne noise from a vessel movement to KBB 5

The outcome of the noise modelling study indicates that:

– Airborne noise from piling is initially deemed unlikely to be exceeding the assigned levels, however consideration is to be given to the fact that a Construction Noise and Vibration Management Plan (CNVMP) may need to be prepared and submitted by the contractor a minimum of 14 days prior to the commencement of construction. The purpose of the CNVMP is to undertake all preliminary work, predict noise and vibration impact based on contractor's list of equipment and provide a path for management of noise/vibration complaints should these arise.
– Complaints due to airborne noise emissions from stationary vessels at KBB 5 are thought to be unlikely.
– Complaints due to airborne noise emissions from vessel movements to and from at KBB 5 are thought to be unlikely.

It is recommended that as the design progresses all noise and vibration sources are assessed and captured in the noise impact assessment.

13.4 Potential impacts and risks

Construction related activities that have the potential to impact social surroundings are:

– Construction vehicle movements and excavation activities.
– Construction of Project infrastructure

Operational activities that have the potential to impact social surroundings are plant operations and associated noise emissions Potential direct impacts to are:

– Disturbance to land or areas used for cultural heritage purposes or known to have cultural heritage values.
– Restriction of access to country, including Aboriginal heritage sites or places of interest.
– Altered visual amenity as a result of constructed Project infrastructure from sensitive receptors including Wells Park.
– Routine and non-routine noise emissions.

Potential indirect impacts to social surroundings are:

- Impacts on amenity – including places of cultural significance – due to dust and light.
- Increased traffic in the Project area.

13.5 Preliminary assessment of impacts

13.5.1 Direct impacts

The direct impacts of construction of KBB 5 include:

- Construction-related activities are likely to have an impact on the view of the users of Wells Park and Kwinana Beach.
- Construction-related activities may be visible from Rockingham Beach and Point Peron and may impact the views of recreational users.
- Likely disturbance to land or areas used for cultural heritage purposes or known to have cultural heritage values
- Restriction of access to Country, including Noongar cultural places of interest
- Routine and non-routine noise emissions
- Altered visual amenity because of Project infrastructure, including disrupting the view from the foreshore (LCU1) to seascape (LCU2) and from the seascape (LCU2) being the eastern side of Garden Island towards the foreshore (LCU1). The change to visual amenity includes change of skyline, horizon line, and night light.

13.5.2 Indirect impact

Indirect impacts that may occur because of the Project consist of:

- Impacts on amenity, including places of Noongar cultural significance due to dust and light.
- Increase traffic within and adjacent to the project area.
- Increase industrial marine traffic within and adjacent to the project area.

13.6 Proposed future studies for impact assessment

A range of products will be imported via KBB5 which includes Petroleum with a tonnage of about 2,433,010 in 2034 and it is forecasted to be approximately 2,072,496 tonnage in 2054. While the resistance against fossil fuel continues to rise, it is likely to experience a backlash from the stakeholders. To comprehensively assess the social surrounds impacts of the Project, it is recommended that the client undertake a range of technical studies to inform the environmental impact assessment and associated approval applications for the Project. The recommended studies are outlined in Table 37.

Table 37 Proposed studies for impact assessment

Technical element	Report to date	Proposed study for impact assessment
Aboriginal Heritage and Social Surrounds	Desktop analysis (this Section)	On-ground Aboriginal Heritage Surveys – Aboriginal Archaeological and Ethnographic Heritage
Aboriginal Cultural Heritage	Desktop analysis (this Section)	
European Heritage	Desktop analysis (this Section)	European Heritage Assessment
Landscape and Visual	Desktop Landscape and Visual Appraisal (this Section)	Landscape and Visual Impact Assessment
Traffic	Desktop analysis (this Section)	Traffic and Transport Assessment
Airborne noise	Desktop analysis ()	Environmental Noise Assessment

14. Key environmental factor - Inland waters

14.1 Introduction

Inland waters encompass both groundwater, comprising superficial and confined aquifers, and surface water features like waterways, wetlands, and estuaries. A "waterway" refers to any natural channel such as a river, creek, stream, or brook, along with its associated floodplain, estuary, or inlet. This encompasses systems with continuous flow, seasonal flow, intermittent flow, and segments of waterways that have been subject to human-induced modifications (EPA, 2018)

For the purpose of EIA, the EPA defines Inland waters as “The occurrence, distribution, connectivity, movement, and quantity (hydrological regimes) of inland water including its chemical, physical, biological and aesthetic characteristics (quality) (EPA, 2018).

14.2 Relevant legislation, policy and guidance

14.2.1 EPA objective

The EPA’s objective for Inland Waters is: “To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected”. This objective acknowledges the vital connection between the hydrological patterns and the quality of inland waters, as well as the environmental values associated with or reliant upon them. These environmental values encompass water-dependent ecosystems, aesthetic appeal, cultural significance, recreational opportunities, public drinking water sources, and the utilization of water for agricultural and industrial purposes. Additionally, this objective aligns with the waste minimization principle outlined in the *Environmental Protection Act of 1986* (EPA, 2018).

14.2.2 Relevant legislation

Following relevant legislation that were considered for inland waters include:

– Environment Protection Act 1986 (WA)
– Environment Protection and Biodiversity Conservation Act 1999 (Cth)
– Rights in Water and Irrigation Act 1914 (WA).

14.2.3 EPA policy and guidance

Following EPA policy and guidance that were considered relevant for inland waters include:

– Environmental Factor Guideline: Inland Waters (EPA, 2018).

14.2.4 Other policy and guidance

Other policy and guidance documents that were considered relevant for inland waters include:

– Geomorphic Wetlands of the Swan Coastal Plain – geographic information system (GIS) dataset (DBCA, 2021a)
– Water quality protection note 4, Sensitive water resources (Department of Water (DoW), 2016)
– Water quality protection note 10, Contaminant spills emergency response (DWER, 2020b)
– Water quality protection note 56, Tanks for fuel and chemical storage near sensitive water resources (DWER, 2018)
– Water quality protection note 65, Toxic and hazardous substances (DoW, 2015)
– Draft State Planning Policy 2.9 Planning for Water 2021. Western Australian Planning Commission 2021 (DPLH, 2021)

14.3 Receiving environment

14.3.1 Regional context

The project area is located in the Swan Coastal Plain bioregion which experiences an Mediterranean climate, with hot dry summers and cool wet winters (BOM, 2023). The closest Bureau of Meteorology station (Garden Island, reference: 9256) is situated approximately 7 km west of the project site. This station has maintained daily records since 2001 and records an average annual rainfall of 614 mm (see Figure 25). July stands out as the wettest month, receiving an average rainfall of 123 mm, while December emerges as the driest, with an average of only 10 mm of rainfall. Notably, evaporation rates peak during the summer months, specifically from December to February, and are at their lowest between June and August (see Figure 25). Monthly evaporation consistently surpasses the mean monthly rainfall, with the exception of July, highlighting a predominantly water-scarce environment throughout most of the year.

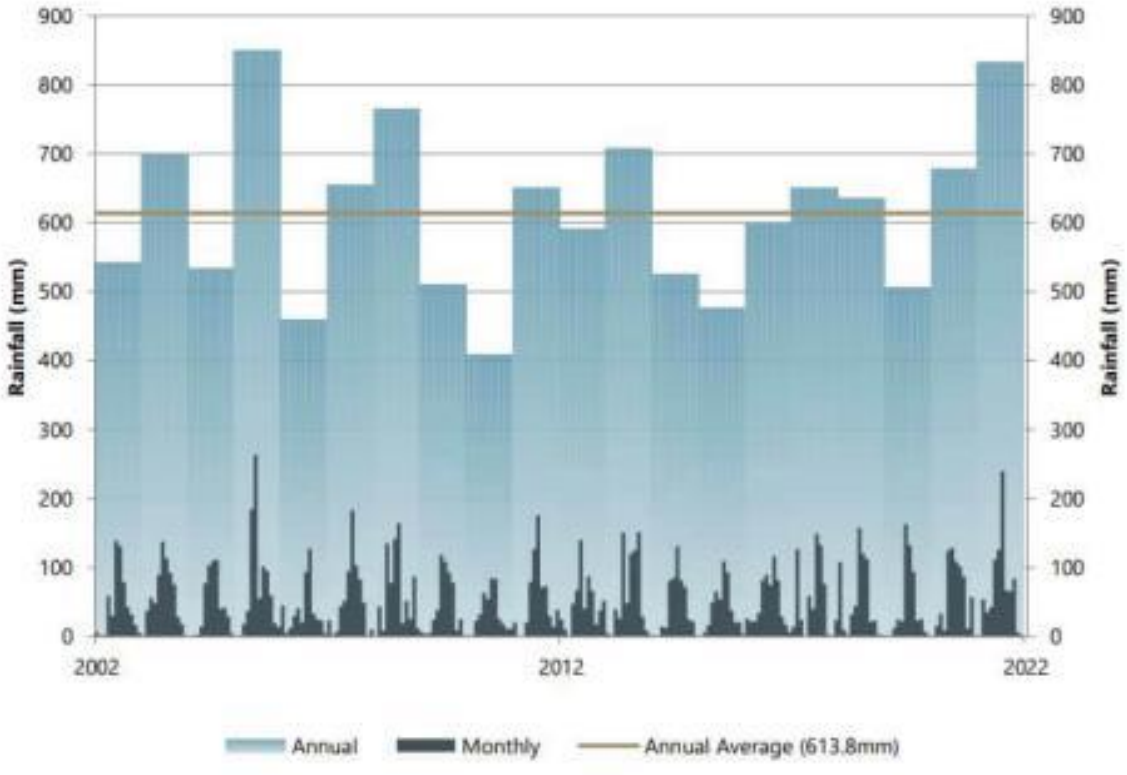


Figure 25 Average annual rainfall – Garden Island (Advisian, 2023)

14.3.2 Surface Water

14.3.2.1 Wetlands

The Geomorphic Wetlands of the Swan Coastal Plain, as documented in DPAW (2016), provide information about the position, boundaries, geomorphic classification (wetland type), and management categorization of wetlands within the Swan Coastal Plain region. These wetlands are categorized into one of three management groups: Conservation, Resource Enhancement, or Multiple Use. Spatial information analysis has identified the closest wetland falling under resource enhancement (Sumpland – unknown name – ID 6375) located approximately 2.3km east from the landside DE, and under conservation (Sumpland – unknown name – ID 6389) located approximately 2.5 km east from the landside DE (GoWA 2023; DBCA-019).

No wetlands of international importance (Ramsar wetland sites) are within or adjacent to the landside DE (GoWA 2023; DBCA-010).

14.3.2.2 Features

Within the landside DE, there are no water bodies such as rivers, watercourses, drains, or creeks, and no external catchment areas that discharge into the proposed site.

14.3.3 Groundwater

14.3.3.1 Groundwater use

The landside DE is located within the Cockburn Groundwater area (GoWA; DWER-034). The nearest public drinking water source area is the Jandakot Underground Water Pollution Area located approximately 10km east of the landside DE GoWA; DWER-033).

A search of the DWER Water Register (DWER, 2019b) identified two groundwater licences within the landside DE. These include licence number 163607, held by Fremantle Port Authority, and licence number 208270 held by Mary Donald Nominees Pty Ltd. All the licence draw groundwater from the Perth – Superficial Swan Aquifer (Superficial Formation).

14.3.3.2 Local hydrogeology

The superficial aquifer is the major, unconfined aquifer beneath the Project area and is divided into three units: Safety Bay/Becher Sand (unconfined), Becher Clay aquitard (discontinuous), and Tamala Limestone (unconfined or semi-confined). The Safety Bay/Becher Sand layer is in hydraulic continuity, except where Becher Clay is present. The Rockingham Sand layer underlying the Tamala Limestone is a semi-unconfined aquifer and is in hydraulic continuity with the overlying Tamala Limestone. The siltstone and shales of the upper members of the Leederville Formation (Wanneroo and Pinjar Members) act as an aquitard, isolating the deeper, confined Leederville Aquifer from the formations above. A local hydrogeological cross section is presented in Figure 26– the centre of the Plant Area Development Envelope is located approximately 0.5 km from the coast.

14.3.3.3 Groundwater quality

Elevated concentrations of ammonia, total nitrogen and phosphorus have been reported down-gradient of the hopper storage area and associated soak wells within the bulk material handling facility (Coffey 2017). Ammonia and Nitrogen species were also found to be mobile and form a groundwater plume within the BIS site, with the highest concentrations associated with the evaporation basin and infiltration basin (GHD 2017a).

Copper, nickel and zinc exceeded the adopted assessment criteria, within the bulk material handling facility (GHD 2018). Cobalt, copper, nickel and total iron are present at concentrations exceeding adopted health and ecological guideline levels at the BIS site. Nickel and cobalt form a part of the plume core. The highest groundwater concentrations are associated with the evaporation basin, infiltration basin and washdown bay (GHD 2017a).

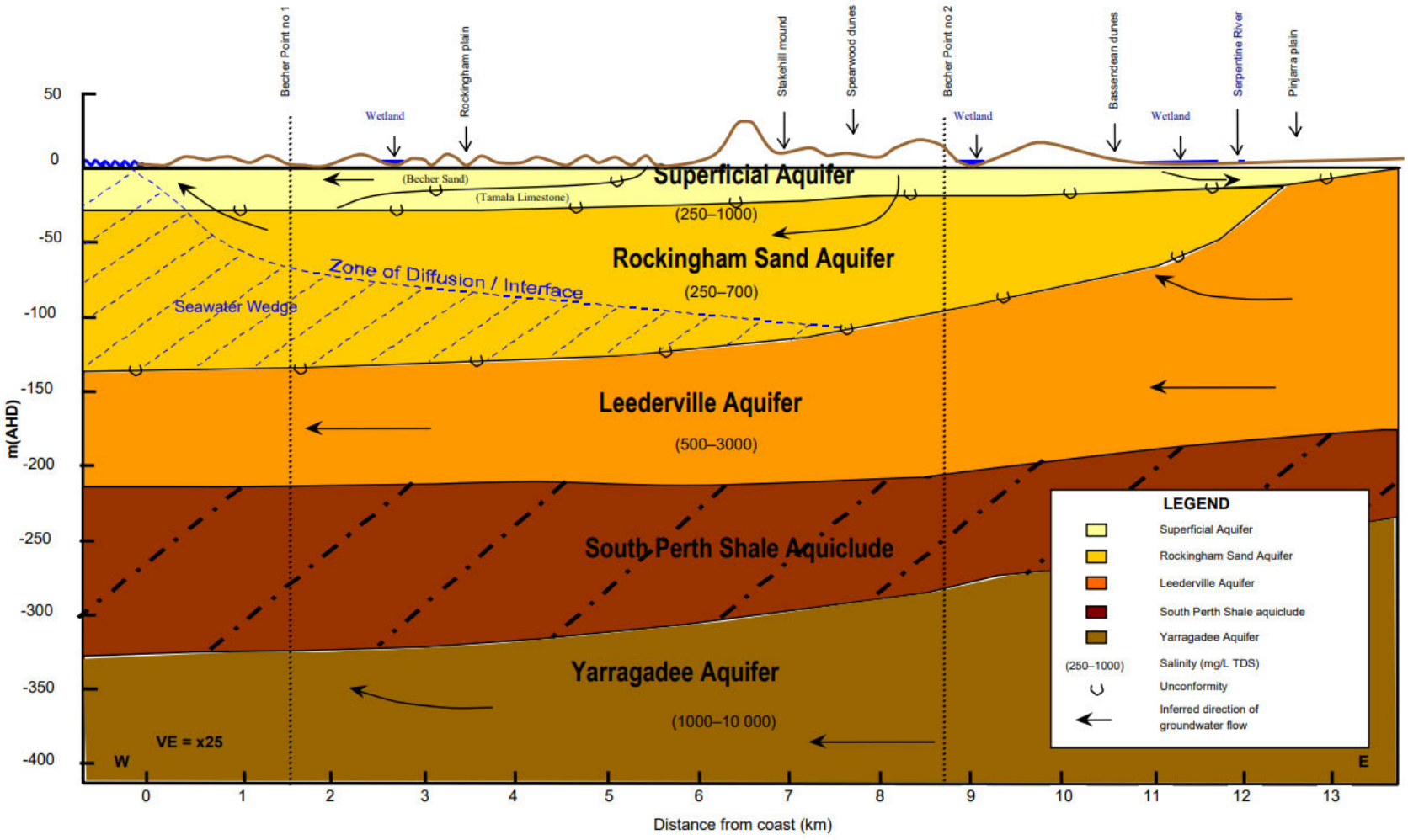


Figure 26 *Hydrogeological cross section (DoW 2008)*

14.4 Potential impacts and risks

Construction related activities that have the potential to impact inland waters are presented in the preliminary construction conceptual site model (

Table 38) and summarised below:

- Piling activities creating preferential flow paths between Superficial and Leederville aquifers
- Alteration of local flow paths due to drainage design leading to localised flow and/ or groundwater mounding within the landside
- Dewatering (abstraction of groundwater) and disposal of effluent
- Spills or leaks of hydrocarbons or hazardous materials

Operational activities that have the potential to impact inland waters are:

- Management and design of drainage systems within the landside DE, which have the potential to amend local flow paths (surface water and/ or groundwater)

Potential direct impacts to inland waters due to development within the landside DE:

- Further and/ or contamination of groundwater within the landside DE and potentially off-site

14.5 Preliminary assessment of impacts

14.5.1 Direct impacts

Further and/ or contamination of groundwater within the landside DE and potentially off-site

Existing contamination and potential contamination due to land use history, as presented in the contamination data gap analysis is unlikely to present a significant risk to the construction and operational activities provided that appropriate investigation, assessment and management surface water and groundwater is completed within the landside DE.

14.6 Proposed future studies for impact assessment

Proposed future investigations and assessments to inform the management of construction within the landside DE is provided in Table 38.

Table 38 Preliminary construction conceptual site model

Construction aspect	CoPCs	Potential source media/ location	Pathway status and risk discussion	Receptor	Residual Data Gaps
Spoil/ soil management during construction					
Piling activities within landside DE	Ammonia, nitrate, nitrite, sulfate, total nitrogen, total phosphorus Sulfur Metals PFAS	Superficial Aquifer and/ or surface water	Piling activities during the construction of pipe trestle and roadway connecting landside aspects to marine facilities and potentially buildings which are not able to be constructed on shallow foundations.	Aquifers: Leederville and Superficial	**Data Gap:** Piling design and implementation will need to be reviewed and assessed during detailed design to ensure preferential pathways via piling activities are not created. Currently the Leederville Aquifer (deeper) is reported to be isolated from the Superficial Aquifer. Preferential pathways may incite migration of

Construction aspect	CoPCs	Potential source media/ location	Pathway status and risk discussion	Receptor	Residual Data Gaps
					contamination plumes on-site laterally and vertically.
Groundwater/ surface water during construction					
Ground disturbance leading to mobilisation of contaminants within superficial aquifer	Ammonia, nitrate, nitrite, sulfate, total nitrogen, total phosphorus. Sulfur (acidity) Metals PFAS	Residual contamination within soils or spoil	CoPCs within soils either located below the groundwater table and/ or placed below the groundwater table have the potential to leach contaminants within superficial aquifer and/ or surface water (infiltration basins during dewatering activities). A risk also exists for changes or amendment to the drainage design with the potential to alter localised groundwater regime (post-construction, however, requires to be addressed during design aspects of the development).	Aquifer: Superficial Ecological: Cockburn Sound On-site: Construction workers	An initial review of concept design and further progressed detailed design to ascertain the overall development plan. Groundwater within areas to be dewatered or groundwater regime altered due to changes within drainage design will require to be managed in accordance with a Construction Environmental Management Plan (CEMP) or equivalent associated management plan.
Dewatering activities including abstraction and disposal within superficial aquifer	Ammonia, nitrate, nitrite, sulfate, total nitrogen, total phosphorus. Sulfur Metals PFAS	Groundwater from superficial aquifer	CoPCs within soils either located below the groundwater table and/ or placed below the groundwater table have the potential to leach contaminants within superficial aquifer and/ or surface water (infiltration basins during dewatering activities). A risk also exist for changes or amendment to the drainage design with the potential to alter localised groundwater regime (post-construction, however requires to be addressed during design aspects of the development).	Aquifer: Superficial Ecological: Cockburn Sound On-site: Construction workers	An initial review of concept design and further progressed detailed design to ascertain the overall development plan. Groundwater within areas to be dewatered or groundwater regime altered due to changes within drainage design will require to be managed in accordance with a Construction Environmental Management Plan (CEMP) or equivalent associated management plan. **Data Gap:** Additional investigations within areas of proposed disturbance may be required to inform the above management plan(s) depending on the areas excavated.

15. Environmental impacts and management – Other environmental factors

15.1 Greenhouse gas

15.1.1 Relevant legislation, policy and guidance

15.1.1.1 EPA Objective

The EPA's objective for Greenhouse Gas Emissions (GHG) is to "minimise the risk of environmental harm associated with climate change by reducing greenhouse gas emissions as far as practicable". For the purpose of EIA, the EPA defines GHG emissions as 'carbon dioxide, methane, nitrous oxide, sulphur hexafluorides, hydrofluorocarbons, perfluorocarbons and nitrogen trifluoride' (EPA, 2023).

15.1.1.2 Relevant legislation

Following legislation that were considered relevant for greenhouse gas emissions include:

- *Environmental Protection Act 1986 (WA)*
- *National Greenhouse and Energy Reporting Act 2007 (Cth)*
- *Carbon Credits (Carbon Farming Initiative) Act 2001 (Cth)*
- *National Greenhouse and Energy Reporting (Measurement Determination) 2008 (Cth)*
- *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (Cth)*
- *Safeguard Mechanism (Crediting) Amendment Bill 2023 (Cth)*

15.1.1.3 EPA policy and guidance

Following EPA policy and guidance that were considered relevant for greenhouse gas emissions include:

- Environmental Factor Guideline: Greenhouse Gas Emissions (EPA, 2023).

15.1.1.3.1 EPA GHG Guidance

Generally (EPA, 2023), GHG emissions from a proposal will be considered (a threshold for assessment that would require GHG emissions to be considered as key environmental factor) where they are reasonably likely to exceed:

– 100,000 tonnes CO2-e of scope 1 emissions in any year; or
– 100,000 tonnes CO2-e of scope 2 emissions in any year.

15.1.1.4 Other policy and guidance

Other policy and guidance documents that were considered relevant for greenhouse gas emissions include:

- Western Australian Climate Policy (GoWA, 2020)
- Greenhouse Gas Emissions for Major Projects (GoWA, 2019)
- Australia's Guarantee of Origin Scheme Policy Position Paper (DCCEEW, 2022).

15.1.2 Receiving environment and potential impacts

Australia's climate is evolving in response to the broader global warming trend. Since the commencement of national records in 1910, Australia has experienced an average temperature increase of 1.44 ± 0.24°C. Most of this warming has transpired since 1950, with each successive decade surpassing the previous one in warmth. Notably, 2019 marked Australia's hottest year on record, and the years spanning from 2013 to 2019 all occupy

spots among the nine warmest years. This prolonged warming trend signifies that today's temperatures surpass those observed for the most part of the 20th century (CSIRO, 2020).

Specific impacts of climate change experienced in WA (CSIRO, 2020) include:

– an increase in average temperatures of 1.3°C since 1910
– a decline of around 16% in April to October rainfall in the southwest of Australia since 1970, larger than anywhere else in Australia
– a decrease in the number of tropical cyclones observed since 1982
– fire seasons with an increasing number of days with high fire danger.

Predicted future climate change impacts for WA (GoWA, 2021), if greenhouse gas emissions remain

unabated, include:

– Temperatures are expected to increase by around 2oC.
– Weather extremes in all regions are very likely to increase into the future.
– Fire seasons are expected to be longer, with an approximately 40% increase in days of very high fire danger.
– There is a continuing significant declining rainfall trend.
– Tropical cyclones are projected to decrease in frequency; however, it is expected a greater proportion will have higher intensity.

The Intergovernmental Panel on Climate Change has affirmed that there is indisputable evidence of human influence causing warming in the atmosphere, ocean, and on land. A key aim of the Paris Agreement is to restrict the rise in the global average temperature to a level significantly below 2.0°C above pre-industrial levels, with additional efforts made to limit the increase to 1.5°C.

15.1.3 Proposed future studies for impact assessment

Throughout both construction and operations, scope 1 and scope 2 emissions are unlikely to exceed 100,000 t CO_{2-} e per year[20]. Project definition is not currently at a sufficiently advanced stage to provide an estimate of scope 3 emissions for the project. However, FPA will be required to provide an emissions assessment (Refer Section 15.1.4) to demonstrate that the scope 1 and 2 emissions assessment thresholds (EPA, 2023) have not be exceeded, which would likely require the consideration of Greenhouse gas emissions as a key environmental factor.

15.1.4 Greenhouse gas emissions assessment

A greenhouse gas assessment will be required to provide credible estimates of the proposed annual CO_{2-} e scope 1,2 and 3 emissions for the project during construction and operation phases to support the environmental impact assessment.

[20] Scope 1 and 2 emissions associated with KBB5 does not include visiting trade vessels and is expected to only include vessels, equipment and vehicles on site required for construction and vessels, equipment and vehicles required for operations of the facility.

16. Consideration of cumulative impacts

Cumulative impacts of the project need to be considered for each key environmental factor. The boundaries and values relevant for the cumulative impact assessment in relation to each relevant Key Environmental factor are summarised in Table 39.

Table 39 Cumulative impact assessment considerations

Key Environmental Factor	Environmental Value	Boundaries
Marine Environmental Quality	Water, biotic and recreational values	Cumulative impacts on water, biotic and recreational values to be assessed in consideration of proposed Westport development to the north.
Marine Fauna	Protected marine biodiversity	Cumulative impacts on marine fauna to be assessed in consideration of proposed Westport development to the north.
Benthic Communities and Habitat	Marine habitat	Cumulative impacts on marine habitat to be assessed in consideration of proposed Westport development to the north.
Coastal Processes	Physical and biological	Cumulative impacts on coastline to be assessed in consideration of proposed Westport development to the north.
Flora and Vegetation	Native Vegetation	Cumulative impacts on native vegetation to be assessed by reviewing the remaining extent of each impacted pre-European vegetation association and vegetation complex across the broader IBRA sub-region. In addition, the remaining native vegetation extents within various buffers from the Proposal boundary (10 km, 15 km, and 20 km) will be reviewed.
Terrestrial Environmental Quality	Surface water and groundwater	A review of impacts from other users within local area will be conducted.
Terrestrial Fauna	Conservation significant fauna habitat	Cumulative impacts on fauna habitat to be assessed by reviewing the remaining extent of each impacted relevant pre-European vegetation association and vegetation complex across the broader IBRA sub-region. In addition, the remaining native vegetation extents within various buffers from the Proposal boundary (10 km, 15 km, and 20 km) will be reviewed.
Social Surroundings	Amenity	If the Proposal is likely to result in air pollution, noise, or light pollution above background levels at the nearest sensitive receptors then an assessment will be conducted to determine what other air pollution, noise or light impacts could be affecting that receptor. The Project's contribution to those cumulative impacts will then be assessed.
Inland Waters	Surface water and groundwater	A review of impacts from other users within local catchments and groundwater units will be conducted.

17. Approval strategy

Table 40 below outlines the key environmental approvals that are likely relevant to enable the construction and operation of the KBB5 and associated infrastructure. The construction and operation of the proposed facility could potentially impact a number of Key Environmental Factors. It follows then that referral under the EP Act and EPBC Act would likely be required.

Table 40 Key environmental-related approvals relevant to the Project

Legislation	Responsible agency	Aspect	Approval required?
EPBC Act	DCCEEW	Protection of Matters of National Environmental Significance	**Yes, significance of potential impacts likely to trigger referral.** A referral under the EPBC Act is expected to be required. This is based on the potential impacts to MNES.
EP Act (Part IV)	EPA, with assistance from the DWER EPA Services Unit	Environmental impact assessment and management of Key Environmental Factors	**Yes, significance of potential impacts likely to trigger referral.** A s.38 referral is expected to be required. This is based on the potential impacts

Assessment of the Approvals pathway

GHD considers that the most likely pathway for primary approvals to be adopted by the regulators is through the following:

– EP Act s.38 - Assessment on Referral Information (with or without additional information) – with public review
  - Potential timeframe - 17 to 24 months
– EPBC Act – Impact assessment via Bilateral Agreement, Project considered a Controlled Action following referral.

18. Studies and approvals schedule

This section outlines the required studies and estimated timeframe for each key environmental factors (see Table 41)

Table 41 Required studies and estimated timeline for key environmental factors

Key Environmental Factor	Studies required	Indicative timeframe
Marine environmental quality	Spill risk assessment and modelling studies	~6 weeks
	Water and sediment quality baseline studies	Likely 1 year (13 months to capture full season). Engagement with EPA, and consideration of existing FPA MQMP data required to determine duration. Sediment sampling likely on-off sampling
	Baseline sediment survey of potential contaminants	
Marine fauna	Underwater acoustic studies	~10 weeks
	Light pollution studies	~ 4 weeks
Benthic communities and habitat	Benthic habitat mapping	~ 16 weeks
Coastal processes	Sediment transport studies	~12–16 weeks
	Coastal hydrodynamics analysis	~8–10 weeks
	Beach morphology studies	~8-10 weeks
Flora and vegetation	Reconnaissance flora and vegetation survey	6 weeks
Terrestrial environmental quality	Review of concept design and further progressed detailed design to ascertain the overall development plan.	6 weeks
Terrestrial fauna	Basic fauna survey	6 weeks
Social surroundings	Aboriginal Heritage Surveys – Aboriginal Archaeological and Ethnographic Heritage	10-12 weeks
	European Heritage Assessment	8-10 weeks
	Landscape and Visual Impact Assessment	8-10 weeks
	Traffic and Transport Assessment	8-10 weeks
	Environmental Noise Assessment	4 weeks
Inland waters	Review of concept design and further progressed detailed design to ascertain the overall development plan.	6 weeks
Greenhouse gas	Greenhouse gas Assessment	4 weeks

19. References

ABS, 2021. 2021 Rockingham, Census All persons QuickStats |Australian Bureau of Statistics. Available at <https://abs.gov.au/census/find-census-data/quickstats/2021/SAL51301>

ABS, 2021. 2021 Kwinana, Census All persons QuickStats |Australian Bureau of Statistics. Available at <https://abs.gov.au/census/find-census-data/quickstats/2021/LGA54830>

Advisian, 2023. Water Management Report: Woodside H2Perth.

AFMA (2023) Southern and Eastern Scalefish and Shark Fishery (SESSF). Species summaries 2023: School Shark. Australian Government, Canberra, ACT. p.152

ALA (2023) Caperea marginata (J.E. Gray, 1846): Pygmy Right Whale. NCRIS, CSIRO and GBIF. Available at <https://bie.ala.org.au/species/https://biodiversity.org.au/afd/taxa/62a8fd85-8ec4-4d57-96cf-355c363cece9> [Accessed 02 November 2023]

Antenucci JP, Mills R, Botelho DA (2009) Kwinana Quays: Hydrodynamic Modelling of Cockburn Sound. Prepared for Oceanica Consulting Pty Ltd (acting for Fremantle Ports) by the University of Western Australia Centre for Water Research, Perth Western Australia, May 2009

ANZECC, ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1: The Guidelines. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT, October 2000

ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Available at <http://www.waterquality.gov.au/anz-guidelines> [Accessed 07 November 2023]

Baylis AM, Page B, Goldsworthy SD (2008) Colony-specific foraging areas of lactating New Zealand fur seals. Marine Ecology Progress Series, 361:279–290

Beard, J., 1976. Vegetation survey of Western Australia. Western Australia 1:1,000,000 vegetation series.

BMT (2018) Cockburn Sound – Drivers, Pressures, State, Impacts, Responses Assessment 2017: Final Report. Report prepared for Department of Water and Environmental Regulation, the Kwinana Industries Council, the City of Rockingham and the City of Kwinana on behalf of the Cockburn Sound Management Council. Report No. 1362_001/Rev1, Perth, Western Australia, July 2018

BMT (2020) Fremantle Ports Marine Environmental Management Framework. Prepared for Fremantle Ports by BMT, Report No. R-1608_00-1, Perth, Western Australia, March 2020

BMT (2020a). Fremantle Ports Marine Environmental Management Framework. Prepared for Fremantle Ports by BMT, Report No. R-1608_00-1, Perth, Western Australia, March 2020

BMT (2022) Fremantle Ports Marine Quality Monitoring Program (MQMP) Database. BMT Deep Platform. Data from 2001 to 2022

BMT (2023) Kwinana Bulk Berth 5 Business Case Preliminary Environmental Impact Assessment

BMT Oceanica (2019) Cockburn Sound Coastal Vulnerability Values and Risk Assessment. Prepared for Cockburn Sound Coastal Alliance by BMT Oceanica Pty Ltd and BMT WBM Pty Ltd, Coastal Zone Management Pty Ltd, SGS Economics and Planning Pty Ltd and Damara WA Pty Ltd, Report No. 1033_001/2_Rev1, Perth, Western Australia, Version 2, October 2019

Bolton D, Mayer-Pinto M, Clark GF, Dafforn KA, Brassil WA, Becker A, Johnston EL (2017) Coastal urban lighting has ecological consequences for multiple trophic levels under the sea. Science of the Total Environment, 576:1-9

Bradford R, Patterson TA, Rogers PJ, McAuley R, Mountford S, Huveneers C, Bruce BD (2020) Evidence of diverse movement strategies and habitat use by white sharks, Carcharodon carcharias, off southern Australia. Marine Biology, 167(7), 1-12

Cambridge ML (1979) Cockburn Sound Environmental Study: technical report on seagrass. DCE, Report no. 7, Perth, Western Australia. June 1979

Cannell BL (2004) Distributions of the major marine fauna found in the Perth Metropolitan area (Yanchep To Mandurah). Technical Report No. MMS/CWC,LNE/MMP,SEMP,SIMP - 79/2004, Perth, Western Australia. December 2004

Cannell BL (2017) Understanding the toll of consecutive years of warm waters on Little Penguins and refining their capacity as bioindicators of the marine coastal ecosystem. Prepared for City of Rockingham and Fremantle Ports by Murdoch University. Report Year 2 April 2018, Perth, Western Australia. April 2017

Chidlow J, Gaughan D and McAuley RB (2006) Identification of Western Australian Grey Nurse Shark aggregation sites. Final report to the Australian Government, Department of the Environment and Heritage. Fisheries research report No. 155. Department of Fisheries, Perth, Western Australia, 48p

Chiffings AW (1979) Cockburn Sound Study 1976-1979: technical report on nutrient enrichment & phytoplankton. Prepared by Cockburn Sound Study Group, Perth, Western Australia, Report No. 3, June 1979

City of Kwinana, (n/a). Natural Areas Management Plan 2014-2024. Available at https://www.kwinana.wa.gov.au/council/documents,-publications-and-forms/publications-and-forms-(all)/plans-and-strategies/2020/natural-areas-management-plan-2014-2024 (Accessed on 04 Sep 2023)

City of Kwinana, 2023. Environmental Conservation and Management. Accessible at https://www.kwinana.wa.gov.au/city-life/protecting-our-environment/environmental-conservation-and-management

City of Rockingham, 2023. Planning Strategy – Environmental Protection. Accessible at https://rockingham.wa.gov.au/your-city/news/2023/may/new-environmental-protection-strategy

Clark CW, Ellison WT (2004) Potential use of low-frequency sounds by baleen whales for probing the environment evidence from models and empirical measurements. In: Thomas, J.A., Moss, C.F., Valetr, M (eds) Advances in the study of echolocation in bats and dolphins. University of Chicago Press, Chicago, IL, p. 564-589

CoA (2012a) Conservation Management Plan for the Southern Right Whale. A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2011–2021. Australian Government, Canberra. Available at <https://www.dcceew.gov.au/environment/biodiversity/ threatened/recovery-plans/conservation-management-plan-southern-right-whale-recovery-plan-2011-2021> [Accessed 07 November 2023]

CoA (2012b) Species group report card - marine reptiles. Supporting the marine bioregional plan for the South-west Marine Region. Australian Government, Canberra, ACT. 2012

CoA (2013a) Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*). Australian Government, Canberra. Available at <https://www.dcceew.gov.au/environment/biodiversity/threatened/recovery-plans/recovery-plan-australian-sea-lion-neophoca-cinerea-2013> [Accessed 08 November 2023]

CoA (2013b) Issues Paper for the Australian Sea Lion (*Neophoca cinerea*). Australian Government, Canberra, ACT. 2013

CoA (2014). Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*). Australian Government, Canberra. Available at <https://www.dcceew.gov.au/environment/biodiversity/threatened/recovery-plans/recovery-plan-grey-nurse-shark-carcharias-taurus-2014> [Accessed 07 November 2023]

CoA (2017a) National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna 2017. Australian Government, Canberra, ACT. 2017

CoA (2017b) Recovery Plan for Marine Turtles in Australia: 2017 - 2027. Australian Government, Canberra, ACT. 2017

CoA (2018) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018). Australian Government, Canberra, ACT. 2018

Commonwealth of Australia (CoA), National Assessment Guidelines for Dredging. Commonwealth of Australia, Canberra, ACT. Accessible at: https://www.dcceew.gov.au/sites/default/files/documents/guidelines09.pdf

Commonwealth Scientific and Industrial Research Organisation (CSIRO), 2020. Climate change in Australia. Available at https://www.csiro.au/en/research/environmental-impacts/climatechange/climate-change-information.

CSMC (2013) State of Cockburn Sound Report – 2013. Cockburn Sound Management Council, Rockinghan Beach, Western Australia.

CSMC (2023) State of Cockburn Sound Marine Area Report 2022. Cockburn Sound Management Council, Government of Western Australia, July 2023

CZM, Damara, UWA, Oceanica (2013) Cockburn Sound Coastal Alliance Vulnerability Study – Erosion and Inundation Hazard Assessment Report. Coastal Zone Management Pty Ltd, Damara WA Pty Ltd, University of Western Australia School of Environmental Systems Engineering and Oceanica Consulting Pty Ltd, Perth, Western Australia, March 2013

CZM, UWA, Damara WA & Oceanica (2019). Coastal Vulnerability Study: erosion and inundation hazard assessment report. Prepared for the Cockburn Sound Coastal Alliance, Document Set ID: 8780128, Version 2, October 2019

D'Adamo N (2002) Exchange and Mixing in Cockburn Sound, Western Australia: A Seasonally Stratified, Microtidal, Semi-Enclosed Coastal Embayment. PhD thesis, University of Canterbury, Christchurch, New Zealand. May, 2002

DAFF (2015) Anti-fouling and In-water Cleaning Guidelines. Department of Agriculture, Fisheries and Forestry. Available at <https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/ animal-plant/pests-diseases/marine-pests/antifouling-consultation/antifouling-guidelines.pdf> [Accessed 29 March 2023]

DAL & PPK (2001) The State of Cockburn Sound: A Pressure-State-Response Report, Prepared for Cockburn Sound Management Council by D.A. Lord & Associates Pty Ltd and PPK Environment & Infrastructure Pty Ltd, Report no. 01/187/1, Perth, Western Australia, June 2001

DAL (1998) Sedimentology of Success and Parmelia Banks, Owen Anchorage, (Western Australia) - Summary Report, Prepared for Cockburn Cement Limited by D.A. Lord & Associates Pty Ltd, Report no. 95/008/6, Perth, Western Australia, October 1998

Dames & Moore (1999) Consultative Environmental Review: Kwinana Export Facility. Prepared for Koolyanobbing Iron Pty Ltd, February 1999, Perth, Western Australia

Davidson, W.A., 1995. Hydrogeology and groundwater resources of the Perth Region, Western Australia: Western Australia Geological Survey, Bulletin 142, 257p.

DAWE (2022) Australian Biofouling Management Requirements. Department of Agriculture, Water and the Environment. Available at <https://www.agriculture.gov.au/sites/default/files/documents/ Australian-biofouling-management-requirements.pdf> [Accessed 28 November 2023]

DCCEEW (2023a) National Light Pollution Guidelines for Wildlife. Australian Government, Canberra. Version 2.0. May, 2023

DCCEEW (2023b) Species Profile and Threats Database. Australian Government, Canberra. Available at <https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl> [Accessed 03 November 2023]

DCE (1979) A study for Sound Management: a summary of the findings of the Cockburn Sound Environmental Study. Bulletin No. 73, Perth, Western Australia, December 1979

DEP (1996) Southern Metropolitan Coastal Waters Study (1991-1994): summary report. Prepared by the Department of Environmental Protection, Perth, Western Australia. Report 17. 1996

Department of Agriculture, Water and Environment (DAWE), 2022. Referral guideline for 3 threatened black cockatoo species: Carnaby's cockatoo, Baudin's cockatoo and Forest red-tailed black cockatoo..

Department of Biodiversity, Conservation and Attractions (DBCA) 2023. List of threatened and priority flora. Accessible at: List of threatened and priority flora | Department of Biodiversity, Conservation and Attractions (dbca.wa.gov.au)

Department of Biodiversity, Conservation and Attractions (DBCA), 2019a. Guidance Note – Modification of an Occurrence of a Threatened Ecological Community. Western Australia.

Department of Biodiversity, Conservation and Attractions (DBCA), 2019b. 2018 State-wide Vegetation Statistics – Full Report. March 2019. Perth, Australia.

Department of Biodiversity, Conservation and Attractions (DBCA), 2019c. 2018 South West Vegetation Complex Statistics. March 2019. Perth, Australia

Department of Biodiversity, Conservation and Attractions (DBCA), 2021a. Geomorphic Wetlands of the Swan Coastal Plain (DBCA-019) – GIS dataset. Perth, Australia.

Department of Biodiversity, Conservation and Attractions (DBCA), 2023. Methods for survey and identification of Western Australian threatened ecological communities. July 2023, Accessible at: https://www.dbca.wa.gov.au/media/2284/download

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2022. Australia's Guarantee of Origin scheme. Consultation Summary.

Department of Environmental Regulation (DER), 2014. Guideline: Assessment and management of contaminated sites. Perth: Department of Environment Regulation

Department of Environmental Regulation (DER), 2015a. Guideline: Identification and investigation of acid sulfate soils and acidic landscapes. Perth: Department of Environment Regulation.

Department of Environmental Regulation (DER), 2015b. Guideline: Treatment and management of soil and water in the acid sulfate soil landscapes. Perth: Department of Environment Regulation.

Department of Environmental Regulation (DER), 2016. Draft Guidance on Environmental Noise for Prescribed Premises. Available at https://www.der.wa.gov.au/images/documents/ourwork/consultation/guideline-environmentalnoise/draft_Guideline_on_Environmental_Noise_for_Prescribed_Premises.pd

Department of Parks and Wildlife (DPAW), 2013. Carnaby's Cockatoo (Calyptorhynchus latirostris) Recovery Plan. Perth, Australia. Accessible at http://www.environment.gov.au/system/files/resources/94138936-bd46-490e-821db71d3ee6dd04/files/carnabys-cockatoo-recovery-plan.pdf

Department of Planning, Lands and Heritage (DPLH) 2021. Draft State Planning Policy 2.9. Planning for Water.

Department of Planning, Lands and Heritage (DPLH) 2023. Town of Kwinana. Local Planning Scheme No. 2. Available at: https://www.wa.gov.au/system/files/2023-11/kwinana2-schemetext.pdf

Department of Planning, Lands and Heritage (DPLH) 2023b. Available at: https://inherit.dplh.wa.gov.au/

Department of Primary Industries and Regional Development (DPIRD), 2018. Soil Landscape Mapping – Systems (DPIRD-064) – GIS dataset. Perth, Australia

Department of Primary Industries and Regional Development (DPIRD), 2018. Soil Landscape Mapping – Systems (DPIRD-064) – GIS dataset. Perth, Australia.

Department of Primary Industries and Regional Development (DPIRD), 2019. Pre-European Vegetation (DPIRD-006) – GIS dataset. Perth, Australia.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2011a. Survey guidelines for Australia's threatened mammals. Guidelines for detecting mammals listed as threatened under the EPBC Act. Commonwealth of Australia. Accessible at https://www.awe.gov.au/sites/default/files/documents/survey-guidelines-mammals.pdf.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2011b. Survey guidelines for Australia's threatened reptiles. Guidelines for detecting reptiles listed as threatened under the EPBC Act. Commonwealth of Australia. Accessible at https://www.awe.gov.au/sites/default/files/documents/survey-guidelines-reptiles.pdf

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2012c. EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species.

Department of the Environment (DotE), 2013. Matters of National Environmental Significance. Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia.

Department of the Environment and Energy (DoEE), n.d. EPBC Referral Guidance. Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community

Department of the Environment, Water, Heritage and the Arts, 2010. Survey guidelines for Australia's threatened birds. Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act. Commonwealth of Australia

Department of Water (DoW) 2015. Water quality protection note 65: Toxic and Hazardous substances

Department of Water (DoW), 2016. Water quality protection note 4. Sensitive water resources. January 2016. Perth, Australia.

Department of Water and Environmental Regulation (DWER), 2018. Water quality protection note 56. Tanks for fuel and chemical storage near sensitive water resources. December 2018. Perth, Australia

Department of Water and Environmental Regulation (DWER), 2019 Decision Report: Application for Licence Amendment(L4476/1984/12). Fremantle Port Authority

Department of Water and Environmental Regulation (DWER), 2019b. Water Register. Accessed April 2022. Available at https://maps.water.wa.gov.au/#/webmap/register.

Department of Water and Environmental Regulation (DWER), 2020b. Water quality protection note 10. Contaminant spills – emergency response plan. May 2020. Perth, Australia.

Department of Water and Environmental Regulation (DWER), 2023. Environmental Protection Act 1986. April 2023

DEWHA (2008). Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle). Government of Australia, Canberra, ACT. December 2008

DoE (2014a) Approved Conservation Advice for *Pristis pristis* (Largetooth Sawfish). Australian Government, Canberra, ACT. April 2014

DoE (2015a) Conservation Management Plan for Blue Whale – A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 (2015-2025). Australian Government, Canberra, ACT. Commonwealth of Australia, 2015

DoE (2015b) Sawfish and River Sharks Multispecies Recovery Plan. Commonwealth of Australia, Canberra, ACT. 2015

DoE (2015c) Approved Conservation Advice *Calidris ferruginea* curlew sandpiper. Australian Government, Canberra, ACT. 2015

DoEE (2017) National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna. Commonwealth of Australia, Canberra, ACT. 2017

DoF (2011a). Fisheries Fact Sheet: Sawfish. Available at: <https://www.fish.wa.gov.au/Documents /recreational_fishing/fact_sheets/fact_sheet_sawfish.pdf> [Accessed 10 November 2023]

DOT (2009) Shoreline Movement Study, Point Peron Rockingham. Prepared by the Department of Transport for the Department of Environment and Conservation, Perth, Western Australia, December 2009

DOT (2010) Sea Level Change in Western Australia: application to coastal planning. Prepared by Department of Transport, Coastal Infrastructure, Coastal Engineering Group. Version 0, Final Report, Perth, Western Australia. February 2010

DOT (2023) Coastline Movements – Vegetation Lines (DOT-023). Geospatial data. Available at <https: //catalogue.data.wa.gov.au/dataset/coastline-movements> [Accessed 12 November 2023]

Double MC, Gales N, Jenner KCS & Jenner M-N (2010) Satellite tracking of south-bound humpback whales in the Kimberley region of Western Australia, Final report. Australian Marine Mammal Centre, Tasmania 1-30.

DPI (2004) Kwinana Beach: Erosion Protection and Ongoing Management Works. DPI Report No. 149, New Coastal Assets Branch, Department of Planning and Infrastructure, Perth, Western Australia

DPIRD (2022) Biofouling management tools and guidelines. Department of Primary Industries and Regional Development, Perth, Western Australia. Available at <https://www.fish.wa.gov.au/Sustainability-and-Environment/Aquatic-Biosecurity/Vessels-And-Ports/Pages/Biofouling-management-tools-and-guidelines.aspx> [Accessed 28 November 2023]

DPLH (2017) WA Coastal Zone Strategy. Western Australian Planning Commission. Perth Western Australia

DSEWPAC (2012) Conservation Management Plan for the Southern Right Whale: a recovery plan under the Environment Protection and Biodiversity Conservation Act 1999 (2011-2021). Australian Government, Canberra, ACT. 2012

DSEWPAC (2013) Recovery Plan for the White Shark (*Carcharodon carcharias*). Australian Government, Canberra, ACT. 2013

DSEWPC (2011) Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern). Australian Government, Canberra, ACT. February 2021

DWER (2021a) Licence Number L4474/1976/14. Amendment date 11 March 2021. Perth, Western Australia, March 2011.

DWER (2021b) Assessment and management of contaminated sites: guideline. Government of Western Australia, Joondalup, Western Australia. November 2021

Environmental Protection Authority (EPA) Victoria, 2021. Environmental Protection Regulations 2021.

Environmental Protection Authority (EPA) Victoria, 2022. Guideline for Assessing and Minimising Air Pollution in Victoria.

Environmental Protection Authority (EPA), 2005b. Guidance Statement No. 3 – Separation Distance Between Industrial and Sensitive Land Uses.

Environmental Protection Authority (EPA), 2008. Environmental Guidance for Planning and Development. Guidance Statement No. 33. May 2008. Perth: Environmental Protection Authority

Environmental Protection Authority (EPA), 2016a. Environmental Factor Guideline: Social Surroundings. Perth: Environmental Protection Authority

Environmental Protection Authority (EPA), 2016c. Environmental Factor Guideline: Flora and Vegetation, Perth: Environmental Protection Authority.

Environmental Protection Authority (EPA), 2016d. Environmental Factor Guideline: Terrestrial Environmental Quality. Perth: Environmental Protection Authority.

Environmental Protection Authority (EPA), 2016e. Environmental Factor Guideline: Terrestrial Fauna. Perth: Environmental Protection Authority.

Environmental Protection Authority (EPA), 2016g. Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment. Perth: Environmental Protection Authority.

Environmental Protection Authority (EPA), 2016h. Technical Guidance – Terrestrial Fauna Surveys. December 2016. Perth: Environmental Protection Authority

Environmental Protection Authority (EPA), 2016i. Environmental Factor Guideline: Marine Environmental Quality Perth: Environmental Protection Authority.

Environmental Protection Authority (EPA), 2018. Environmental Factor Guideline: Inland Waters Perth: Environmental Protection Authority.

Environmental Protection Authority (EPA), 2020b. Environmental Factor Guideline: Air Quality. Perth: Environmental Protection Authority.

Environmental Protection Authority (EPA), 2021c. Instructions: Referral of a proposal under section 38 of the Environmental Protection Act 1986. October 2021.

Environmental Protection Authority (EPA), 2021d. Instructions: How to Prepare an Environmental Review Document. Perth: Environmental Protection Authority. October 2021

Environmental Protection Authority (EPA), 2021d. Instructions: How to Prepare an Environmental Review Document. Perth: Environmental Protection Authority. October 2021.

Environmental Protection Authority (EPA), 2021e. Instructions on How to Prepare Environmental Protection Act 1986 Part IV Environmental Management Plans. Perth: Environmental Protection Authority

Environmental Protection Authority (EPA), 2021h. Guidance for planning and development: Protection of naturally vegetated areas in urban and peri-urban areas. In accordance with Section 16(k) of the Environmental Protection Act 1986.

Environmental Protection Authority (EPA), 2023. Environmental Factor Guideline: Greenhouse Gas Emissions. Perth: Environmental Protection Authority.

EPA (2015) State Environmental (Cockburn Sound) Policy 2015. Perth, Western Australia. 2015

EPA (2016a) Environmental Factor Guideline – Marine Environmental Quality. Environmental Protection Authority, Perth, Western Australia, December 2016

EPA (2016b) Technical Guidance: Protecting the Quality of Western Australia's Marine Environment. Environmental Protection Authority. Perth, Western Australia, December 2016

EPA (2016c) Technical Guidance – Protection of Benthic Communities and Habitats. Environmental Protection Authority, Perth, Western Australia, December 2016

EPA (2016d) Environmental Factor Guideline – Benthic Communities and Habitats. Environmental Protection Authority, Perth, Western Australia, December 2016

EPA (2016e) Environmental Factor Guideline – Marine Fauna. Environmental Protection Authority, Perth, Western Australia, December 2016

EPA (2016f) Factor guideline: coastal processes. Environmental Protection Authority, Perth, Western Australia, December 2016

EPA (2017) Environmental quality criteria reference document for Cockburn Sound: a supporting document to the State Environmental (Cockburn Sound) Policy 2015. Environmental Protection Authority, Joondalup, Western Australia. April 2017

EPA (2023) Statement of Environmental Principles, Factors, Objectives and Aims of EIA. Environmental Protection Authority, Joondalup, Western Australia. October 2021

Ersts P, Rosenbaun HC (2003) Habitat preference reflects social organization of humpback whales (*Megaptera novaeangliae*) on a wintering ground. Journal of Zoology. 260: 337–345.

ESD Steering Committee (1992) National Strategy for Ecologically Sustainable Development. December 1992. Commonwealth of Australia, Canberra

Finn H, and Calver MC (2008) Feeding aggregation of bottlenose dolphins and seabirds in Cockburn Sound, Western Australia. The Western Australian Naturalist, 26(3), 157–172

FRDC (2019) A Report Card for Australia`s Sharks: Oceanic Whitetip Shark, *Carcharhinus longimanus*. March 2019

Fremantle Port Authority (FPA), 2018. *Port of Fremantle 2018: Port Information Guide*. Accessible at: https://www.fremantleports.com.au/docs/default-source/shipping-docs/port-information-guide-2018.pdf

Fremantle Port Authority (FPA), 2020. Port of Fremantle: Dangerous Cargoes Standard. Available at: https://www.fremantleports.com.au/docs/default-source/port-safety/dangerous-cargoes-standard-april-2020.pdf?sfvrsn=9a033220_4

Fremantle Port Authority (FPA), 2023. Port Facilities. Accessible at: https://www.fremantleports.com.au/the-port/port-facilities

Fremantle Ports (2018) Port Information Guide: Port of Fremantle 2018. Available at: <https://www.fremantleports.com.au/docs/default-source/shipping-docs/port-information-guide-2018.pdf>. [Accessed 28 November 2023]

Fremantle Ports (2022) Annual Report 2022. Prepared by Fremantle Ports, Perth, Western Australia. May 2022.

Fremantle Ports (2023) Port Facilities: Kwinana Bulk Jetty. Available at: <https://www.fremantleports.com.au/the-port/port-facilities>. [Accessed in: 29 November 2023]

Fremantle Ports, 2022. Scope of Works – KBB 2.5 and 5 Business Case Development V1.0

Fremantle Ports, 2022. Scope of Works – KBB 2.5 and 5 Business Case Development V1.0

Gentilli J (1971). Climates of Australia and New Zealand: volume 13 of World survey of climatology. The University of Michigan. Amsterdam: New York; Elsevier, 1971. 405 p.

Goode B (2018). Report of an Aboriginal Heritage Survey of the Perth Seawater Desalination Plant IWSS Stage 2 Expansion: Kwinana, Western Australia. Prepared for Water Corporation by Brad Goode & Associates Consulting Anthropologists & Archaeologists, Dunsborough, Western Australia, February 2018.

Government of Western Australia (GoWA), 2019. Greenhouse Gas Emissions Policy for Major Projects

Government of Western Australia (GoWA), 2020. Western Australia Climate Policy.

Government of Western Australia (GoWA), 2023. Data WA, accessible at https://www.data.wa.gov.au/.

Greenwood J, Keesing J, Donn M, McFarlane D (2016) Nitrogen Budget for Cockburn Sound, Western Australia. Prepared for Cockburn Sound Management Council and the Western Australian Department of Water by CSIRO, Perth, Western Australia, September 2016

Hamernik RP, Ahroon WA, Hsueh KD, Lei SF, and Davis RI (1993) Audiometric and histological differences between the effects of continuous and impulsive noise exposures. Journal of the Acoustical Society of America, 93(4):2088–2095

Hamernik RP, Qiu W and Davis B (2003) The effects of the amplitude distribution of equal energy exposures on noise-induced hearing loss: The kurtosis metric. Journal of the Acoustical Society of America, 114:386–395

Harris JE, Antenucci JP (2009) Kwinana Quays: Offshore Development Scenario Modelling. Prepared for Oceanica Consulting Pty Ltd (acting for Fremantle Ports) by University of Western Australia Centre for Water Research, Perth, Western Australia, August 2009

Hawkins AD, Roberts L and Cheesman S (2014) Responses of free-living coastal pelagic fish to impulsive sounds. The Journal of the Acoustical Society of America, 135: 3101– 3116

Heenehan H, Stanistreet JE, Corkeron PJ, Bouveret L, Chalifour J, Davis GE, et al. (2019) Caribbean sea soundscapes: monitoring humpback whales, biological sounds, geological events, and anthropogenic impacts of vessel noise. Front. Mar. Sci. 6:347

Irvine L, and Salgado Kent C (2017) The Distribution and Relative Abundance of Humpback Whale (Megaptera novaeangliae) Calves Within the Ningaloo Marine Park, Western Australia Between June and August 2016. Report to the Department of Parks and Wildlife, Western Australia. (Exmouth: Curtin University), 49 p.

Jenner KCS, Jenner M-N.M, McCabe KA (2001) Geographical and temporal movements of humpback whales in Western Australian Waters. Appea Journal. 2001, p. 749-765

Keesing JK, Greenwood J, Donn M, McFarlane D (2016) Spatial and temporal analysis of water quality monitoring data collected from Cockburn Sound Management Council and the Western Australian Department of Water by CSIRO, Perth, Western Australia, February 2016

Klein AH, Ferreira O, Dias J, Tessler M, Silveira L, Benedet L, Menezes JT and Abreu J (2010) Morpho dynamics of structurally controlled headland-bay beaches in southeastern Brazil: A review. Coastal Engineering 57: 98–111

Last PR, Stevens JD (2009) Sharks and Rays of Australia. CSIRO Publishing, Melbourne, pp. 550

Lourey MJ, Dunn JR, Waring J (2006) A mixed-layer nutrient climatology of Leeuwin Current and Western Australian shelf waters: Seasonal nutrient dynamics and biomass. Journal of Marine Systems 59:25–51

MacLachlan, Ian, 2013. Kwinana Industrial Area: agglomeration economies and industrial symbiosis on Western Australia's Cockburn Sound, Australian Geographer, 44:4, 383-400, DOI: 10.1080/00049182.2013.852505

MAFRL (2017) Water Quality of Cockburn and Warnbro Sounds (December 2016 to March 2017). Prepared by Marine and Freshwater Research Laboratory for the Department of Environment Regulation on behalf of the Cockburn Sound Management Council, Perth, Western Australia, May 2017

Maggi E, Bongiorni L, Fontanini D, Capocchi A, Dal Bello M, Giacomelli A, Benedetti-Cecchi L (2020) Artificial light at night erases positive interactions across trophic levels. Functional Ecology 34:694–706

Marangoni LFB, Davies T, Smyth T, Rodriguez A, Hamann M, Duarte C, Pendoley K, Berge J, Maggi E, Levy O (2022) Impacts of artificial light at night in marine ecosystems – a review. Global Change Biology. 2022; 28:5346-5367.

Marquez MR (1990) FAO Species catalogue, vol. 11, Sea turtles of the world: an annotated and illustrated catalogue of sea turtle species known to date. Food and Agriculture Organization Fisheries Synopsis no. 125, Volume 11, Rome, 1990

Marsh H, Corkeron PJ, Limpus CJ, Shaughnessy PD and Ward T (1995) The reptiles and mammals in Australian seas: status and management. In Zann, L and Kailola, P. The State of the Marine Environment Report for Australia: Technical Annex 1: The Marine Environment, Department of Environment, Sport and Territories, Canberra, pp 151-166

Marshall A, Barreto R, Carlson J, Fernando D, Fordham S, Francis MP, Herman K, Jabado RW, Liu KM, Pacoureau N, Rigby CL, Romanov E & Sherley RB (2022) Mobula alfredi (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2022: e.T195459A214395983. Available at <https://dx.doi.org/10.2305/IUCN.UK.2022-1.RLTS.T195459A214395983.en> [Accessed 12 November 2023]

Masselink G, Pattiaratchi C (2001) Seasonal changes in beach morphology along the sheltered coastline of Perth, Western Australia. Marine Geology 172(3-4):243-263

McAuley R (2004) Western Australian Grey Nurse Shark Pop Up Archival Tag Project. Final Report to Department of Environment and Heritage. Perth, Western Australia. 55pp.

McAuley R, Bruce B, Keay I, Mountford S and Pinnell T (2016) Evaluation of passive acoustic telemetry approaches for monitoring and mitigating shark hazards off the coast of Western Australia. Fisheries Research Report No. 273, Department of Fisheries, Western Australia. 84pp

Mohring M, Rule M (2013) Long-term Trends in the Condition of Seagrass Meadows in Cockburn and Warnbro Sounds. Prepared for Cockburn Sound Management Council by Department of Parks and Wildlife, Perth, Western Australia, October 2013

National Environmental Protection Council, 2016. National Environmental Protection (Ambient Air Quality) Measure.

National Research Council (2005) Marine mammal populations and ocean noise: determining when noise causes biologically significant effects. The National Academies Press, Washigton, DC. 2005

Nearmap (2023). Map browser. Available at <https://www.nearmap.com/au/en> [Accessed 24 November 2023]

NOAA (2018) Marine Mammal Acoustic Technical Guidance: Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (Version 2.0). Office of Protected Resources, National Marine Fisheries Service, Silver Spring, MD 20910. NOAA Technical Memorandum NMFS-OPR-59. April 2018.

NOAA (2023) Species Directory: Oceanic Whitetip Shark. US Department of Commerce. Available at <https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark> [Accessed 07 November 2023]

Oceanica (2007) Perth Metropolitan Desalination Plant – Cockburn Sound Benthic Macrofauna Community and Sediment Habitat – Comprehensive Baseline Survey. Prepared for Water Corporation by Oceanica Consulting Pty Ltd. Report No. 500/1, Perth, Western Australia, March 2007

Otway NM and Parker PC (2000) The Biology, Ecology, Distribution, Abundance and Identification of Marine Protected Areas for the Conservation of Threatened Grey Nurse Sharks in South-east Australian Waters. NSW Fisheries Research Institute, Cronulla, NSW. 1440-3544, no 19. February 2000

PIANC (2018). Guide for Applying Working with Nature to Navigation Infrastructure Projects. EnviCom WG Report n 176. September 2018

PIANC (2018). Guide for Applying Working with Nature to Navigation Infrastructure Projects. EnviCom WG Report n 176. September 2018

Pogonoski JJ, Pollard DA and Paxton JR (2002) Conservation Overview and Action Plan for Australian Threatened and Potentially Threatened Marine and Estuarine Fishes. Environment Australia, Canberra, ACT. 375 p.

Pollard DA, Lincoln-Smith MP and Smith AK (1996) The biology and conservation of the grey nurse shark (*Carcharias taurus* Rafinesque 1810) in New South Wales, Australia. Aquatic Conservation: Marine and Freshwater Ecosystems. Volume 6, Issue 1, 20 p. March 1996.

Price, Amy. Kwinana 1918-2018. Available at: https://htawa.net.au/WA-100-years/files/community/Kwinana-snapshot-e.pdf (Access 04 Sep 2023)

Rose TH, Smale DA, Botting G (2012) The 2011 marine heat wave in Cockburn Sound, south-west Australia. Ocean Science 8:545–550

Ruiz-Montoya L, Lowe RJ (2014) Summer circulation dynamics within the Perth coastal waters of south-western Australia. Continental Shelf Research 77:81–95

Russell, Laurie. Kwinana, 1979. "third time lucky". s.n.

Seashore (2019) Assessment of coastal erosion hotspots in Western Australia. Prepared by Seashore Engineering Pty Ltd for the Department of Transport and Department of Planning, Lands and Heritage. Report SE052-01-Rev1, Perth, Western Australia

Sequeira AM, Mellin C, Meekan MG, Sims DW, and Bradshaw CJ (2013. Inferred global connectivity of whale shark Rhincodon typus populations. J. Fish Biol. 82: 367–389

Shaughnessy PD, McIntosh RR, Goldsworthy SD, Dennis TE, & Berris M (2006) Trends in abundance of Australian sea lions, *Neophoca cinerea*, at Seal Bay, Kangaroo Island, South Australia. In Trites AW, Atkinson SK, De Master DP, Fritz LW, Gelatt TS, Rea LD & Wynne KM (eds) Sea Lions of the World, pp. 325–351. Alaska Sea Grant College Program, University of Alaska: Fairbanks, Alaska, 2006.

Skene D, Ryan D, Brooke B, Smith J, Radke L (2005) The Geomorphology and Sediments of Cockburn Sound. Report No. 2005/10. Geoscience Australia, Australian Government, Canberra, ACT. 88pp.

Slabbekoorn H, Bouton N, van Opzeeland I, Coers A, ten Cate C and Popper AN (2010) A noisy spring: the impact of globally rising underwater sound levels on fish. Trends in Ecology & Evolution, 25, 419–427.

Southall BL, Bowles AE, Ellison WT, Finneran JJ, Gentry RL, Greene Jr CR, Kastak D, Ketten DR, Miller JH, Nachtigall PE, Richardson WJ, Thomas JA, Tyack PL (2007) Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals 33:411–520

Steedman R, Craig P (1979) Numerical Model Study of Circulation and Other Oceanic Aspects of Cockburn Sound. Prepared for Cockburn Sound Study Group by the Department of Conservation and Environment, Perth, Western Australia

Stevens JD (1999) Management of shark fisheries in northern Australia; Part 1. In: Shotton R (ed) Case studies of the management of elasmobranch fisheries. FAO Fisheries Technical Paper. 378, 456–479. FAO, Rome, 1999

Sutton AL, Shaw JL (2019) Literature Review and Preliminary Risk Assessment of the Marine Environment for the Westport Port and Environs Strategy. Prepared by Western Australian Marine Science Institution, Perth, Western Australia, 268 pp.

Syme and McLeod, (2019) Employment and Economic Development Study. Economic Analysis for Local Planning Strategy. Accessible at https://www.kwinana.wa.gov.au/council/documents,-publications-and-forms/publications-and-forms-(all)/information-sheets-and-guides/2021/employment-and-economic-development-study

Thackway, R. and Creswell, I.D., 1995. An Interim Biogeographic Regionalisation for Australia: a framework for establishing the national system of reserves. Version 4.0. Australian Nature Conservation Agency. Canberra

Threatened Species Scientific Committee (TSSC), 2019. Approved Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community.

Thums M, Ferreira LC, Jenner C, Jenner M, Harris D, Davenport A, Andrews-Goff V, Double M, Möller L, Attard CRM, Bilgmann K, Thomson PG and McCauley R (2022) Pygmy blue whale movement, distribution and important areas in the Eastern Indian Ocean. Global Ecology and Conservation, Volume 35, e02054, ISSN 2351-9894., June 2022

Torres D, Tidau S, Jenkins S, Davies T (2020) Artificial skyglow disrupts celestial migration at night. Current Biology 30:R696–R697

TSSC (2015a) Approved Conservation Advice for *Megaptera novaeangliae* (Humpback Whale). Australian Government, Canberra, ACT. October 2015

TSSC (2015b) Approved Conservation Advice for *Rhincodon typus* (whale shark). Australian Government, Canberra, ACT. October 2015

TSSC (2018) Listing Advice *Sphyrna lewini* scalloped hammerhead. Australian Government, Canberra ACT. March 2018

Van Senden D & Miller B (2005) Stratification and Dissolved Oxygen Issues in Cockburn Sound Pertaining to Discharge of Brine from Desalination. Technical Report 2005-03by Water Research Laboratory (WRL), University of New South Wales for WA Water Corporation, Syndey, NSW, Australia. April 2005

Wahlberg, M. and Westerberg, H. (2005) Hearing in fish and their reactions to sounds from offshore wind farms. Marine Ecology Progress Series, 288, 295–309

WAMSI (2019) Literature Review and Preliminary Risk Assessment of the Marine Environment for the Westport Port and Environs Strategy. Prepared by Western Australia Marine Science Institution

WAPC (2013) State Planning Policy No 2.6 – State Coastal Planning Policy. Western Australian Planning Commission, Perth, Western Australia

WAPC (2019) Coastal hazard risk management and adaptation planning guidelines. Government of Western Australia, Perth, Western Australia. July 2019

WAPC (2020) State Coastal Planning Policy Guidelines. Western Australian Planning Commission, Perth, Western Australia

Water Corporation (2013) Perth Seawater Desalination Plant Marine Monitoring & Management Plan. Final Report, August 2013. Water Corporation, Perth, Western Australia

Western Australian Planning Commission, 2007. Visual Landscape Planning in Western Australia: A manual for evaluation, assessment, siting and design.

Woods P & Associates (1988) Rockingham coastal study. State Planning Commission, Perth, WA