GOVERNMENT OF WESTERN AUSTRALIA

WESTPORT

Outer Harbour Port Development Kwinana

Environmental Protection Act 1986

Referral Supporting Document

Version control

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Executive Summary

The Westport Program will deliver a new port, integrated transport infrastructure and provide Western Australia with a competitive, efficient and world class supply chain network, to contribute to the future prosperity of the State and Australia. The Program will strategically address the efficiency, transport access and urban amenity issues facing the Port of Fremantle Inner Harbour, which is Western Australia's sole container port. A key goal of the Westport Program is to *'plan, build and operate the most sustainable port in Australia'*, which has underpinned the option selection and design process. A business case for the Westport Program is under preparation and is scheduled to be submitted to Infrastructure Australia and Infrastructure Western Australia in mid-2024.

The Proposal is for a new Outer Harbour[1] Port Development in the Kwinana Industrial Area, which comprises a new port facility, offshore breakwater, landside infrastructure and connections to the road and rail freight network, as well as a second shipping channel into Cockburn Sound. The Proposal has been strategically located within an existing heavy industrial area, which has existing buffers to sensitive land uses, to avoid land use conflicts.

Other elements of the Westport Program, including improvements to the wider metropolitan freight network (including Anketell Road), are not part of this Proposal and will be progressed as related but independent proposals. In addition, the State Government is progressing the Future of Fremantle project to identify the long-term urban infill redevelopment vision for the Inner Harbour and surrounding land, following the future transition of container trade to the proposed new port in the Outer Harbour.

The preferred design and location of the Proposal in the Port of Fremantle Outer Harbour has been subject to an extensive evaluation process using a multi-criteria analysis methodology. This assessment has been heavily weighted toward criteria that avoid and minimise environmental impacts and that maximise opportunities to enhance environmental and community values. The EPA's 2006 strategic advice (Bulletin 1230 Section 16(e) advice) has been a key consideration in this respect.

Notwithstanding this effort, it is unavoidable that implementation of a Proposal of this scale, nature and location will have environmental impacts that require careful consideration, particularly during construction, dredging and reclamation. For this reason it is appropriate and desirable that the Proposal is subject to highest level of environmental assessment through a Public Environmental Review (PER), which is requested by the Proponent.

The following preliminary key environmental factors, as defined by the EPA, are identified: *Benthic Communities and Habitats, Coastal Processes, Marine Environmental Quality, Marine Fauna, Flora and Vegetation, Terrestrial Fauna, Terrestrial Environmental Quality, Inland Waters* and *Social Surroundings. Landforms, Subterranean Fauna, Air Quality* and *Human Health* are unlikely to be considered preliminary key environmental factors.

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[1] The Port of Fremantle operates through two harbours; the Inner Harbour at Fremantle and the Outer Harbour at Kwinana within Cockburn Sound.

Following this referral process, the Proponent will prepare the draft Environmental Scoping Document (ESD), respond to submissions and finalise the ESD for EPA approval. A comprehensive Environmental Review Document (ERD) will then be prepared and publicly advertised through the PER process.

The Westport Project Office (WPO) have been delivering a comprehensive community and stakeholder engagement program since the announcement of the Westport Program in 2017. Targeted stakeholder engagement, including for environmental matters, has been a key functional input to the option selection and design development process for the Proposal. Throughout the upcoming EPA assessment, the WPO Community and Stakeholder Engagement Team will continue to work closely with the WPO Environmental Impact Assessment (EIA) Team in a coordinated and integrated manner. Together, WPO will maintain an 'open door' policy and ensure two-way communications, opportunities for engagement and information are available to the community and stakeholders at all times.

The Western Australia Marine Science Institute (WAMSI) Westport Marine Science Program (WWMSP) is a world-leading science and research initiative led by WAMSI in collaboration with WPO and its program partners. The Westport Program has contributed $13.5 million in funding to the WWMSP, which was developed with the objective of addressing knowledge gaps, defining baseline environmental conditions, improving Westport's ability to avoid, minimise, rehabilitate and offset environmental impacts and increase Government's ability to manage other pressures acting on Cockburn Sound into the future. Over the next 12 months, and before the forthcoming ERD is advertised, research papers from the WWMSP will be published and released to the public as they are finalised.

Noting the anticipated and requested PER assessment process, this referral is intended to provide sufficient information for the EPA to set the level of assessment and identify the relevant environmental factors. The referral is based on a preliminary design (15% of total design effort) and preliminary environmental information available prior to completion of the WWMSP. As such, no conclusive statements are made or intended in the referral in relation to potential impacts or the acceptability of those impacts – as these matters will be fully assessed in the future ERD. It is intended that opportunities to reduce the indicative footprints and to avoid potential impacts of the Proposal will continue to be progressively explored as further design development is undertaken and more is learnt from the progression of the WWMSP.

1 Proposal

1.1 Proposal content

1.1.1 Introduction

The State Government is delivering the Westport Program to investigate, plan, build and operate a new container port, with integrated road and rail and supply chain networks.

The proposed Outer Harbour Port Development, Kwinana (herein 'the Proposal') is the main component of the Westport Program and is the subject of this referral.

1.1.2 Proposal description

A general description of the Proposal is provided in **Table 1-1**. The location of the Proposal and its Development Envelope (DE) is shown in **Figure 1-1**. To familiarise the reader with the Proposal area, a 360º aerial image can be viewed online using this hyperlink.

All Proposal elements are defined in the Proposal Content Document (PCD) provided in **Appendix A**, including specification of indicative footprints within the DE.

Table 1-1: General proposal content description

Proposal title	**Outer Harbour Port Development, Kwinana**
Proponent	The Director General of the Department of Transport on behalf of the State of Western Australia
Short description	The Proposal is to construct and operate a new multimodal port in the Kwinana Industrial Area (KIA), approximately 30 km south of Perth (**Figure 1-1**). The Proposal includes: • A port facility. • Adjacent areas of landside development. • An offshore breakwater. • Dredging for a second main channel from the Indian Ocean to Cockburn Sound, which will be additional and parallel to the existing Success Channel. • Dredging for access channels, turning basins and berthing areas adjacent to the port facility. • Use of dredge material for beneficial re-use (primarily reclamation) and, where required, placement in approved marine placement areas. • Removal of the disused Kwinana Bulk Berth 1 (KBB1) Jetty. • Removal of the KBB2 Jetty, with replacement infrastructure to be constructed as a component of the port facility. • Connections to road and rail infrastructure up to the vicinity of Rockingham Road. • Relocation, removal or upgrade of existing infrastructure, structures and buildings. • Temporary construction infrastructure. • Maintenance of all infrastructure and assets, including maintenance dredging. The Proposal has a total development envelope (DE) of approximately 1683 hectares (ha), comprising two discrete areas; the port DE (841 ha) and the second main channel DE (842 ha). The terrestrial elements of the Proposal are located within an area of existing heavy industrial land uses within the KIA, serviced by existing road and rail infrastructure. The marine elements of the Proposal are primarily located within Cockburn Sound adjacent to the KIA, whilst the second main channel extends from the northern boundary of Cockburn Sound to the Indian Ocean.

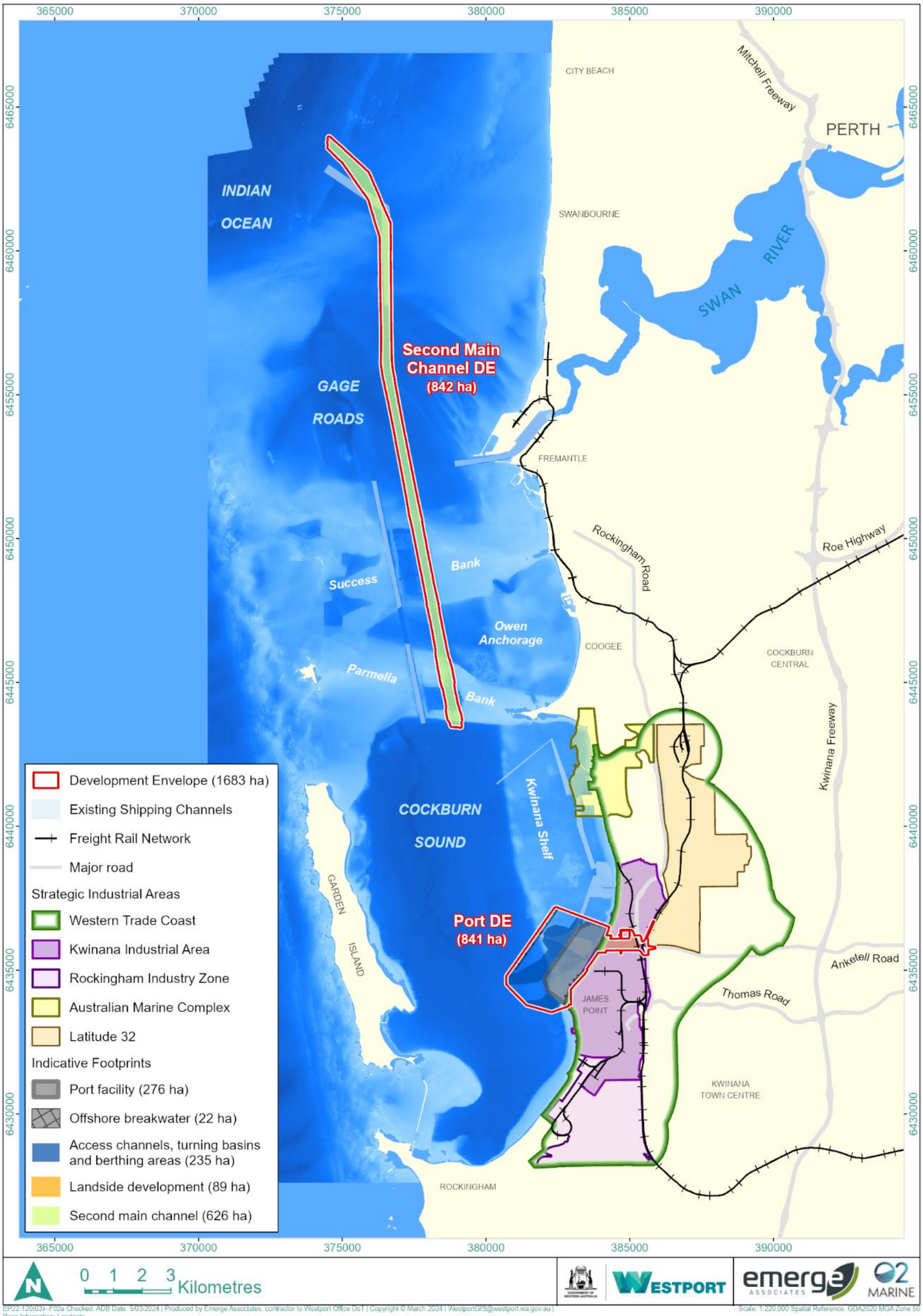

Figure 1-1: Proposal Location

1.1.2.1 Preliminary design status and artist impressions

The Proposal is currently at a preliminary design stage (15% of total design effort) and will be subject to a future detailed design process. Given the potential variability and changes that may arise as the design is further developed over time, **indicative** footprints have been specified at this stage within the DE.

Preliminary artist impressions of the Proposal are provided below, whilst a video flythrough can be viewed online using this hyperlink.

Figure 1-2: Preliminary artist impression (port facility facing east)

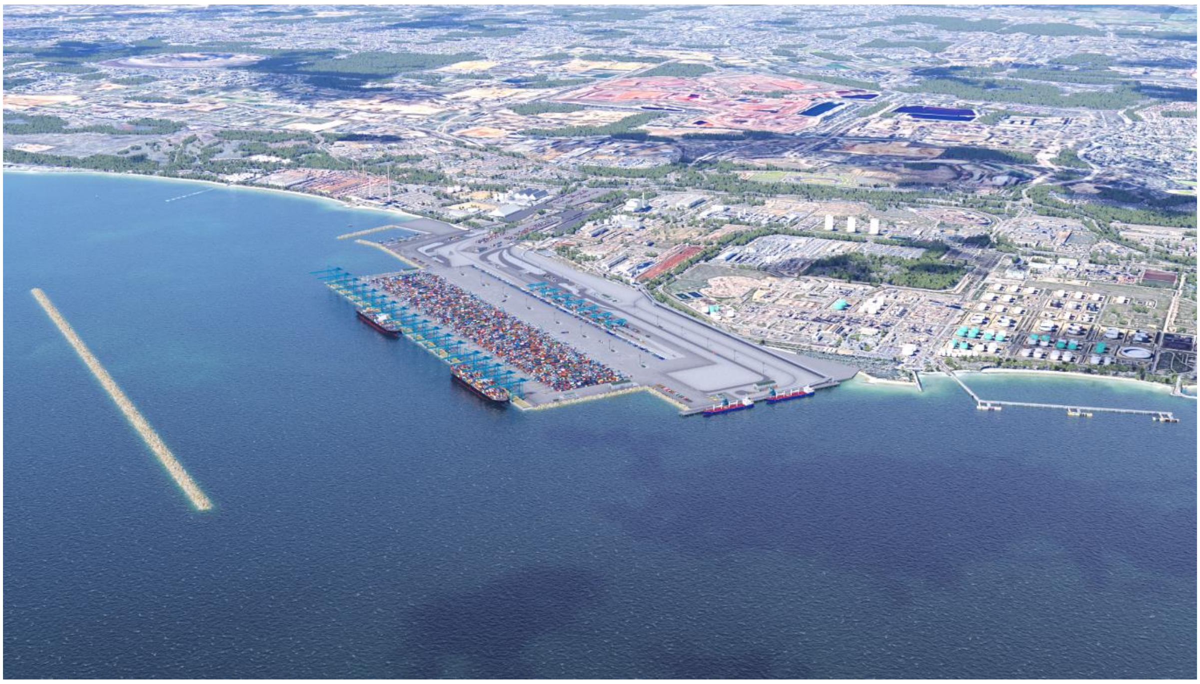

Figure 1-3: Preliminary artist impression (port facility and offshore breakwater facing east)

Figure 1-4: Preliminary artist impression (port facility facing west)

1.1.2.2 Port facility

The port facility will be used by ships to berth and then unload and load goods, primarily containers, with intermodal facilities provided for freight road and rail connectivity. The port facility will be situated on reclaimed land, to be constructed through beneficial reuse and placement of material from capital dredging.

Four container ship berths are provided along the main quay line, serviced by ship to shore cranes, with adjacent container stacking areas. The port facility has space provision for a potential future expansion of container operations to a fifth berth. The port facility is proposed to commence operations with two independent stevedore operators, each operating a minimum two-berth container terminal. Separate road (truck) access is provided for each container terminal operator, whilst a single freight rail terminal with a 900 m siding is provided for use by both operators.

Two bulk-goods ship berths are also provided on the southern quay line, which will service Fremantle Ports Kwinana Bulk Terminal (KBT), replacing the existing Kwinana Bulk Berth 2 (KBB2) Jetty. The two bulk-goods berths will be connected to the existing KBT landside facility via a service corridor along the rear port facility (behind the container terminal operations area), which will contain conveyors and utilities for transporting bulk goods.

The marine-facing edges of the port facility will comprise sloped revetments structures, whilst the container quay line and bulk-goods quay line will be constructed as vertical walls with piling. A harbour for operational support vessels (for example tug boats, small crafts and line handling boats) is also provided as part of the port facility. Provisions for a range of ancillary buildings is also provided, including for administration, truck marshalling gatehouses, battery exchanges, maintenance workshops and Border Force.

1.1.2.3 Offshore breakwater

A breakwater structure is provided approximately 1km offshore from the port facility, which will protect ships accessing the port facility from wind and waves to maximise port operability. Based on the preliminary design, the breakwater will be up to 2.6 km long, with a maximum width of up to 115 m (measured from the toe of batters). The width of the offshore breakwater will be variable along its length, in response to the variable water depth and resulting batter requirements. The Proponent is investigating opportunities to minimise environmental impacts and provide beneficial environmental and social uses of the breakwater, as the detailed design of the breakwater is progressed.

1.1.2.4 Landside development

Where the rear of the port facility meets the existing shoreline, a landside development area extends across an east-west corridor to provide connectivity to the existing road and rail networks, up to the vicinity of the intersection of Anketell Road and Rockingham Road. Allowance for direct connections to an upgraded Anketell Road (being progressed as a separate proposal by Main Roads) is provided. The landside development area will support a range of road and rail connections, empty container parks, truck marshalling areas, ancillary buildings and other infrastructure.

1.1.2.5 Access channels, turning basins and berthing areas

Ships accessing the port will navigate from the central portion of Cockburn Sound to the port facility via two separate access channels; one access channel to the four container berths and another access channel to the two bulk-goods berths. The access channel servicing the container berths will also extend to provide through-access to the existing Calista Channel. A turning basin (also known as a swing basin) is provided for each access channel, to enable ships to be turned around with tug boat assistance prior to or after berthing. Ship berthing areas are provided along the quay lines.

The access channels, turning basins and berthing areas will be constructed and maintained to variable depths, up to a maximum of -17.4 m chart datum.

1.1.2.6 Second main channel

All vessels coming into the Inner Harbour (Fremantle) and Outer Harbour (Cockburn Sound) ports transit the Deep Water access channel into Gage Roads. Ship movements associated with existing port operations within the Outer Harbour currently access Cockburn Sound via the existing Success Channel, which cuts through the relatively shallow Success Bank and Parmelia Bank. The Proposal will involve dredging for a second main channel which will require realignment of the Deep Water Channel, new dredging within Gage Roads for navigation and safety, and a second Outer Harbour access channel east of Success Channel.

The second main channel will be wider and deeper than the existing Success Channel to facilitate larger capacity ships. The second main channel will also reduce operational risk by providing a second point of access into and out of Cockburn Sound and increase operational capacity.

The preliminary design identifies the second main channel to be approximately 21 km in length from the northern Deep Water Channel to Gage Roads extending south to the southern edge of Parmelia Bank.

The preliminary design width of the second main channel is variable along its length. At a minimum, it is at least 250 m wide (including batters), with some channel sections being wider to accommodate navigational requirements, up to a maximum width of 470 m (including batters). **Figure 1-5** provides a visual representation of the variation in channel width along the length of the channel.

The minimum channel design depth is -17.9 m chart datum. Some channel sections are deeper to accommodate navigational requirements, up to a maximum channel design depth of -19.5 m chart datum in Gage Roads and the Deep Water Channel.

Further discussion of the second main channel, including the rationale for this design approach as compared to widening, deepening and/or lengthening the existing Success Channel, is provided in **Section 1.2.2.3**.

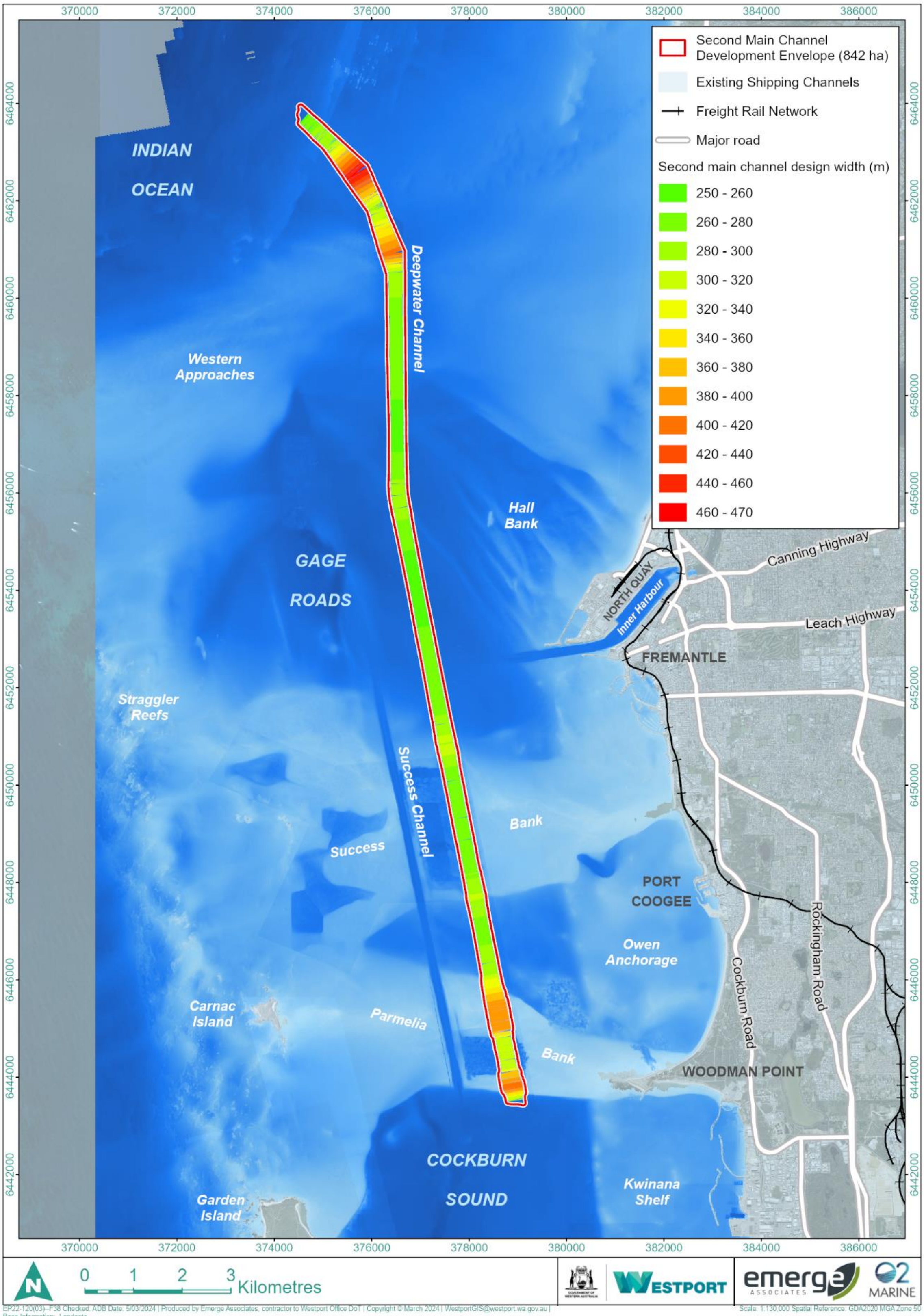

Figure 1-5: Second main channel widths

1.1.2.7 Construction elements

Timeframe

Preliminary timing estimates indicate construction of all Proposal elements may take up to 15 years in total, inclusive of commissioning. Construction of different proposal elements will be implemented concurrently over variable timeframes, meaning some elements will be completed sooner than others. Detailed construction timing estimates will be confirmed at the detailed design stage.

Capital dredging and reclamation

The primary construction element of the Proposal is the capital dredging program and associated reclamation works. Capital dredging will be required in association with the following Proposal elements:

- The offshore breakwater and portions of the port facility, to remove geotechnically unsuitable material prior to the construction of structural elements including revetments and quay walls.
- Access channels, turning basins and berthing areas, to facilitate operational ship movements.
- Second main channel, to facilitate operational ship movements.

The total capital dredge volume is estimated to be up to 35 million cubic metres (M m^3). This estimate is based on the current 15% preliminary design stage, and therefore is subject to variability which will be refined through the future detailed design stage. Dredge material will be used for beneficial re-use (primarily reclamation) and, where required, placement in approved marine placement areas. Although reclamation will be the primary use of the dredge material, the Proponent is investigating additional opportunities for other targeted beneficial re-usage, for example beach nourishment and seagrass habitat restoration.

The ERD will provide further information around the capital dredging program.

Other construction elements

Pile driving works will be required to construct the port facility quay lines. This will include a combination of sheet and tubular piles, with the exact pile driving requirements to be confirmed through detailed design.

Other construction works that will be required include:

- Terrestrial bulk earthworks, both within the port facility area (following completion of reclamation) and within the landside development area.
- Relocation, removal or upgrade of existing infrastructure, structures and buildings. This will include removal of KBB1 (disused) and KBB2, as well as existing structures within the landside development area.
- Connections to road and rail infrastructure up to the vicinity of Rockingham Road
- Establishment of temporary construction infrastructure, including staging and laydown areas.

1.1.2.8 Operational elements

Ships will access Cockburn Sound via the second main channel and then access the port facility via the access channels. Tug boats will assist ships via accessing the port facility and berthing. Following unloading and loading of goods, ships will then depart via the same access channels. Containers will be processed within the port facility, entering and leaving via road and rail connections. Bulk goods will be conveyed to and from the existing KBT facility, located adjacent to the port DE.

Timeframe

The ultimate operational lifespan of the port is not defined and will be subject to future Government decision making. The port assets have a design lifespan of at least 50 years.

Maintenance dredging

The Proposal includes maintenance dredging of the second main channel, access channels, turning basins and berthing areas. Maintenance dredging will be undertaken as required to support future port operations and maintain capital dredge widths and depths.

Maintenance dredging requirements for the Proposal are not yet known. Further information will be provided in the ERD.

1.1.3 Need for the Proposal

1.1.3.1 Context: Port of Fremantle existing operations

The Port of Fremantle is Western Australia's principal general cargo and container port, and operates through two harbours; the Inner Harbour and the Outer Harbour. The location of the Port of Fremantle and its two harbours is shown in **Figure 1-6**. Fremantle Ports is a State Government trading enterprise that manages the Port of Fremantle.

The Inner Harbour, located at the mouth of the Swan River at Fremantle, handles international container trade for the State, in addition to livestock exports, vehicle imports, general cargo, cruise ships and visiting naval vessels. Two private companies, DP World and Patrick, each operate a container terminal at North Quay, with two ship berths servicing each terminal. Both container terminals are serviced by the North Quay Rail Terminal, which provides a rail link to Perth's metropolitan intermodal sites. North Quay is also connected to the public road network which is used for truck-based container transport. North Quay accommodates empty container and staging logistics parks in proximity to the container terminals.

The Outer Harbour, located at Kwinana within Cockburn Sound, supports Western Australia's largest heavy industrial area established in the early 1950s. The Outer Harbour handles bulk cargo trade including grain, petroleum, liquid petroleum gas (LPG), alumina, mineral sands, fertilisers, coal, sulphur, iron ore and other bulk commodities, as well as substantial naval operations and infrastructure. Fremantle Ports operate two facilities within the Outer Harbour; the Kwinana Bulk Jetty and Kwinana Bulk Terminal, whilst private companies (Alcoa, BP and CBH Group) and the Department of Defence operate other jetties, as detailed in **Section 1.4.3**. No container terminals currently operate within the Outer Harbour. The geographic extent of the Outer Harbour also incorporates vessel navigation and anchorage areas within Cockburn Sound and waters to the north across Owen Anchorage and Gage Roads, including the existing Success Channel that connects Cockburn Sound to Gage Roads.

Whilst the majority of the Outer Harbour is accessible to the public, certain areas have restricted access (for example, in proximity to the major commercial jetties and berths) or anchoring restrictions (in proximity to the existing Deep Water Channel). The Outer Harbour also directly abuts naval controlled waters surrounding Garden Island. These areas are shown in **Figure 1-6**.

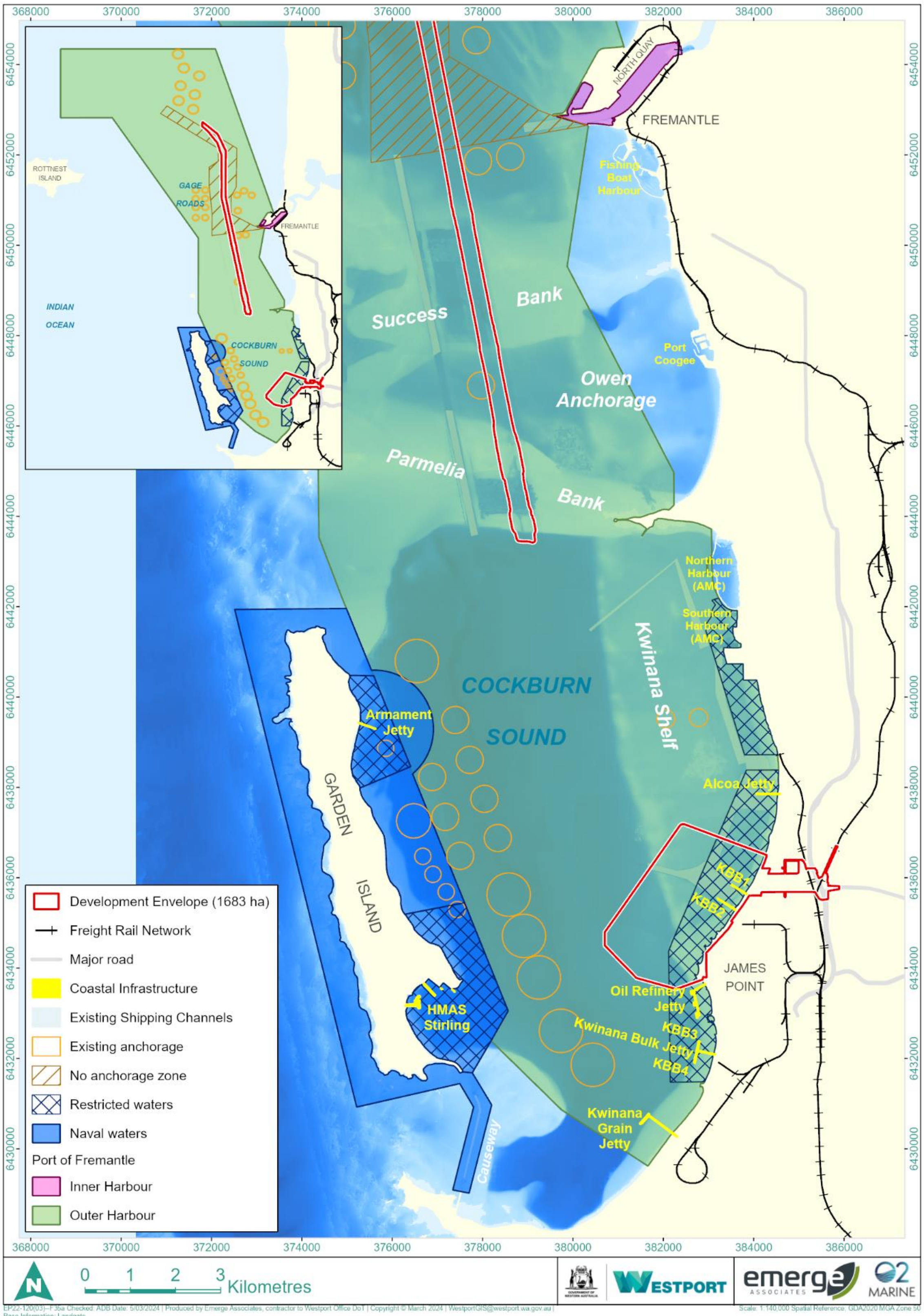

Figure 1-6: Port of Fremantle

1.1.3.2 Problem: Port of Fremantle Inner Harbour constraints

Container trade has operated at the Inner Harbour since 1969. While the current infrastructure at the Inner Harbour facilitates effective movement of container goods through the supply chain under current levels of trade, there are existing constraints which limit the ability to handle significantly higher freight volumes at the Inner Harbour:

- The quay line is constrained from extension at both ends, limiting the length of available quay to service vessels. This in turn limits the number of container gantry cranes that can operate effectively along the quay line.
- The marine basin restricts the turning of the largest vessels within the Inner Harbour and restricts vessel sizes in the future. The depth of the channel into the Inner Harbour is also anticipated to impact the ability to accommodate larger vessels into the future.
- As trade volumes increase, the number of heavy vehicles within the highly urbanised Fremantle area will continue to grow to service the freight task – increasing noise and congestion around the port. Fremantle is designated as a Strategic Metropolitan Activity Centre within the planning framework and is expected to accommodate a population increase during the same period through land use transformation.
- The freight rail infrastructure servicing the Inner Harbour is constrained in terms of capacity and has typically lower efficiency than road-based transport, resulting in additional container handing and the need for rail subsidies to increase the proportion of rail freight to the port. Additionally, curfews exist on rail operations to/from North Quay Rail Terminal and noise ('wheel squeal') is an existing issue for North Fremantle residents. This would be exacerbated with increased freight rail movements.

More generally, Western Australia has one container port on which the State relies. In contrast, eastern Australian states are serviced by four major container ports connected by strong freight networks. Western Australia's single container port gateway must operate efficiently and allow for future growth in line with the State's population and economic drivers. Not delivering increased efficiency and capacity would necessitate the need for expansion of other overland transport networks in lieu of shipping.

1.1.3.3 Solution: Westport Program Outer Harbour Port Development, Kwinana

The Westport Program is the response to the efficiency, transport access and urban amenity issues facing the Inner Harbour at Fremantle and surrounding residential community. The Westport Program will provide the State with a future-proofed and internationally competitive port to service container trade, with efficient road and rail transport links separated from housing and other sensitive receptors; strategically co-located in a heavy industrial area with available industrial land. A business case for the Westport Program is under preparation and is scheduled to be submitted to Infrastructure Australia and Infrastructure Western Australia in mid-2024.

The Proposal is a key component of the overall Westport Program and will facilitate relocation of container trade from the Inner Harbour to the proposed new port facility in the Outer Harbour. Other elements of the Westport Program, including improvements to the wider metropolitan freight network (including Anketell Road and rail upgrades), are not part of this Proposal and will be progressed as related but independent proposals, discussed further in **Section 1.1.4**.

Separate to the Westport Program, the State Government is also progressing the Future of Fremantle project to identify the long-term urban infill redevelopment vision for the Inner Harbour and surrounding land, following the future transition of container trade to the proposed new port in the Outer Harbour.

1.1.4 Proposal relationship to external road and rail infrastructure upgrades

Given the scope of the Westport Program includes the whole supply chain, it also considers future upgrades of the State's freight road and rail networks. The Proposal includes the construction and upgrades of road and rail infrastructure within the landside development area, immediately east of the proposed port facility. This includes connections to the existing road and rail networks in the vicinity of Rockingham Road. However, the Proposal does not include any road and rail infrastructure upgrades beyond these connections (outside of the DE) that may be progressed in the future independently.

Main Roads Western Australia are proposing to upgrade the Anketell Road corridor, initially between Rockingham Road and Kwinana Freeway and then a future staged upgrade between Kwinana Freeway and Tonkin Highway. This proposal forms a major component of the planned regional road network for the Perth South West corridor and will improve access, improve road safety outcomes, accommodate the predicted increased traffic demand associated with population and economic growth. Main Roads will refer, deliver and manage these upgrades as part of the State's freight road network. This Main Roads proposal is independent to the Westport Proposal. Whilst these road upgrades being progressed by Main Roads would ultimately service the Proposal's port facility, the Westport Proposal has been designed such that port operations could proceed and operate independently and connect into the existing road network, if required to do so.

Similarly, future duplication of the freight rail line between Kwinana and Cockburn, along with grade-separations to remove level-crossings, is also anticipated. These works will also be delivered separately to the Proposal and if environmental approvals are required, these will be addressed independently to the Proposal.

1.1.5 Purpose of this referral and proposed Public Environmental Review approach

The Proponent is seeking a Public Environmental Review (PER) environmental impact assessment (EIA) pathway under the *Environmental Protection Act 1986*, on the basis that:

- The Proposal is large in size, scale and complexity, with multiple project elements.
- The Proposal is likely to trigger several preliminary key environmental factors.
- The Proposal is likely to have significant effects on the environment and a detailed assessment is appropriate to assess the extent of any direct, indirect, cumulative and holistic impacts, and how such impacts could be avoided, mitigated and managed.
- The Proposal is likely to attract a high level of public interest at a local and regional scale in relation to the likely effects of the proposal on the environment.

Assessment through a PER will require the preparation of an Environmental Review Document (ERD) that will be advertised through a public consultation process. This will be informed by a range of technical investigations, studies and assessments that are currently under preparation or require scoping. This referral does not include a full environmental impact assessment of the Proposal, as this will be addressed through the subsequent PER process and documented in the future ERD. Instead, this referral provides a framework for how the future EIA process is anticipated to be undertaken in relation to each applicable environmental factor and the identified potential environmental impacts.

Noting the anticipated and requested PER assessment process, this referral is intended to provide sufficient information for the EPA to set the level of assessment and identify the relevant environmental factors. The referral is based on a preliminary design (15% of total design effort) and preliminary environmental information available prior to completion of the WAMSI Westport Marine Science Program. As such, no conclusive statements are made or intended in the referral in relation to potential impacts or the acceptability of those impacts – as these matters will be fully assessed in the future ERD. It is intended that opportunities to reduce the indicative footprints and to avoid potential impacts of the Proposal will continue to be progressively explored as further design development is undertaken and more is learnt from the progression of the WAMSI Westport Marine Science Program.

The Proposal will also be referred under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and if assessment is determined to be required, then it is proposed that this will be completed under a bilateral assessment pathway and therefore EPBC Act matters will also be considered in the future ERD.

1.2 Proposal alternatives

1.2.1 Historical container port operations and investigations in Western Australia

Internationally, maritime container trade first became established in the 1950s, with the development of container standards and intermodal infrastructure which promoted container shipping. In Western Australia, the State’s first and only container terminal was constructed at the Port of Fremantle Inner Harbour in the late-1960s, with the first container ship arriving in 1969. The Inner Harbour facilities at Fremantle have since managed maritime container trade entering and exiting the State for over 50 years.

Port facilities and operations in Cockburn Sound were first established in the 1950s and have since developed and expanded over time (existing operations are summarised in **Section 1.1.3.1** and **Section 1.4.3**). However, no historical or existing port facilities within Cockburn Sound have provided container trade services. Various studies, investigations, plans and proposals have been formulated over time to address the long-term challenges faced by container trade operations at the Inner Harbour, summarised in **Table 1-2**.

Table 1-2: Container port development investigations and initiatives

Initiative	Year	Summary
New Port Options Study	1989	Assessed five potential locations in Cockburn Sound between the Inner Harbour and the CBH grain terminal.
Future Port Options	1996	Naval Base (Kwinana) was endorsed as a preferred site for additional port facilities beyond the Inner Harbour.
Outer Harbour Strategic Plan	1997	Progressed by Fremantle Ports. Three locations in Cockburn Sound were considered, including nine options. The report identified a preferred offshore port option at Naval Base.
James Point Stage 1 (general cargo terminal)	1998	The State Government led a tender process to select a private proponent to develop a new port at James Point. James Point Pty Ltd (JPPL) was selected as the preferred proponent. JPPL referred Stage 1 of the port to the EPA in 1999, which was for a port facility handling bulk goods, general cargoes, steel, scrap metal, dangerous goods and livestock. The proposal did not include container trade, as this would form the JPPL Stage 2 port proposal (discussed below). The Stage 1 proposal was located between Kwinana Bulk Terminal and the Perth Seawater Desalination Plant. The EPA recommended the JPPL Stage 1 proposal was environmentally acceptable. Following various appeals on the EPA recommendation and subsequent further assessment by the EPA, the Minister for the Environment approved the proposal in 2004 (Ministerial Statement 669). The proposal has not been implemented and the commencement timeframes specified in Ministerial Statement 669 have lapsed.
Freight Network Review	2002	This review found additional port facilities to handle overflow freight volumes from the Inner Harbour would be needed by around 2017 and concluded that because of road and rail constraints, planning for a new facility in the Outer Harbour should be brought forward.
James Point Stage 2 (container terminal)	2005	JPPL referred Stage 2 of their port proposal to the EPA in 2005, which was for a port facility handling container trade. The Stage 2 proposal was located at James Point, south of Kwinana Bulk Terminal and north of the BP Oil Refinery Jetty. The Stage 2 facility was intended to directly compete for container trade with a separate container port proposed by Fremantle Ports (as identified in the Outer Harbour Strategic Assessment, discussed below). JPPL Stage 2 was ultimately withdrawn prior to completion of the EPA assessment process and never received environmental approval.

Initiative	Year	Summary
Fremantle Ports Outer Harbour Project Strategic Assessment	2005	Progressed by Fremantle Ports. Sought to investigate a new port facility for container trade and general cargo, to act as an overflow for the Inner Harbour at Fremantle. Using a multi criteria assessment, four potential options (all within Cockburn Sound) were assessed. The EPA provided strategic (EP Act Section 16(e)) advice and published EPA Bulletin 1230 which found "*all options would have significant adverse impacts*" and insufficient information was available to conclude any option was environmentally acceptable. Subsequent to the EPA advice, the State Government endorsed two of the port options (an island and a land-backed port at Naval Base) to enable progression to the statutory approvals phase.
Kwinana Quay Project Offshore Island Port Facility	2007	Progressed by Fremantle Ports. This involved the planning and design for an island container port at Naval Base, as identified through the 2005 Fremantle Ports Outer Harbour Project Strategic Assessment. The proposed island port facility was to be located on the Kwinana Shelf, between JPPL Stage 1 and the Australian Marine Complex. In addition to the island port, other project elements included two new shipping channels (one to access the new container port and another to service the Australian Marine Complex, from the south) and an extended and upgraded Rowley Road corridor. The proposal was referred to the EPA in 2007 who determined that it should be assessed, but ultimately the environmental impact assessment and approval process was never completed.
Perth Freight Link	2014	The State Government announced the Perth Freight Link to improve the road freight links and increase road network safety between Kewdale and Fremantle (to service the Inner Harbour) via a connection from the Roe Hwy terminus to Stock Road (Roe 8), negating the immediate need to build a new port facility in Cockburn Sound. The justification for Perth Freight Link was predicated on the need for the road network to accommodate an expected increase in throughput at the Inner Harbour along with the planned development of additional container capacity at the proposed JPPL Stage 2 container port. Additional work subsequently completed in the initial stages of the Westport Program found that the Perth Freight Link would not provide a permanent solution to the constraints at the Inner Harbour and ultimately a new port would still be required. In 2017, the Perth Freight Link was cancelled in favour of progressing a new public container port to replace the Inner Harbour, resulting in the initiation of the Westport Program in 2017.

Figure 1-7 provides a spatial summary of the key port development proposals that have been previously considered in proximity to the Proposal.

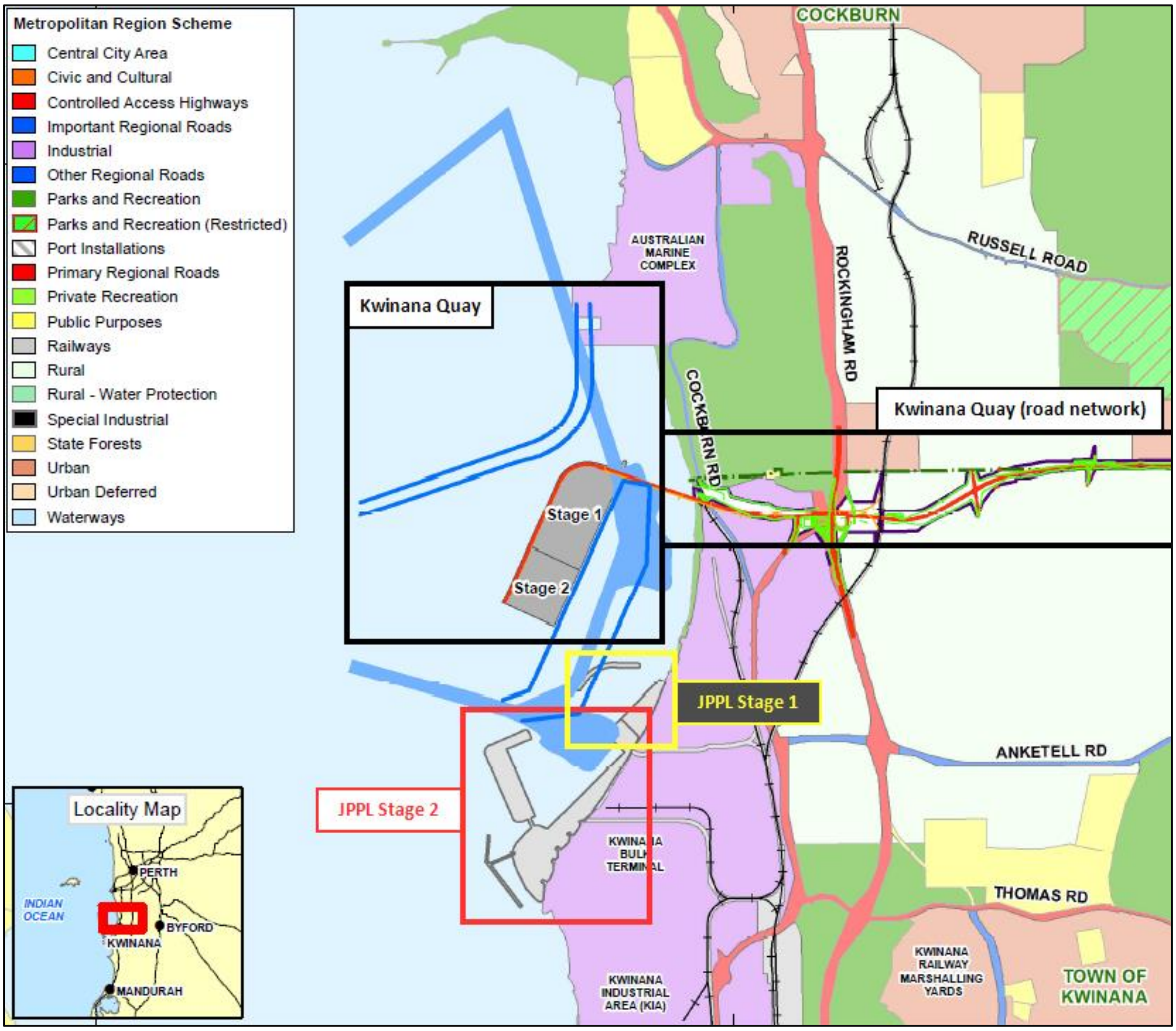

Figure 1-7: Previously considered port development options in proximity to the Proposal

1.2.2 Consideration of alternatives through Westport Program

The Westport Program is being delivered in four stages, with consideration of alternatives and strategic environmental impact avoidance as a central planning principle.

- **Stage 1 (completed 2017-2018: Problem identification and initiation)**
  Independent Westport Taskforce established, which assessed the need for the project, evaluated potentially suitable locations and culminated in the identification of eight strategic approaches to manage container trade, across three port locations (Fremantle, Kwinana and Bunbury) and various time horizons.
- **Stage 2 (completed 2018-2020: Strategic planning and optioning)**
  Independent Westport Taskforce evaluated a long-list of options, culminating in the identification of a preferred site for a new container terminal at Kwinana, which would be serviced by an upgraded freight road and rail network, including Anketell Road.
- **Stage 3 (current 2020-2024: Business case and preliminary design)**
  Westport Project Office established to coordinate preliminary (15%) design and provide advice to Government about when and how the project should be developed, to be documented in a Business Case submission, to enable decision making around project delivery. This stage also involves commencement of the statutory EIA process (EP Act and EPBC Act referrals).
- **Stage 4 (future: Detailed design, delivery and transition)**
  Future stage that will involve completion of detailed design, completion of the statutory EIA process, procurement, construction and operational commencement.

Further details on Stages 1 – 3 of the Westport Program are provided below.

1.2.2.1 Westport Stages 1 and 2 – strategic environmental impact avoidance

The Independent Westport Taskforce, established by the State Government in September 2017, assessed all possible solutions to manage the growing freight demands of Perth to future-proof Perth's freight network. With a particular focus on the existing port locations at Fremantle, Kwinana and Bunbury, this involved an assessment of the ports, associated road and rail links, and intermodal terminals to determine the best long-term integrated freight transport plan to meet the State's needs.

Environment has been a key consideration of the Westport Program since its commencement, with the establishment of the Westport Environmental Work Stream (EWS) in April 2018. The EWS included representation from government agencies, industry, port authorities, community interest groups and various environmental stakeholders (as detailed in **Section 3.3.1.2**). The overarching purpose of the Westport EWS was to identify the marine and terrestrial environmental issues associated with each potential solution to inform a multi-criteria analysis (MCA) in the selection of a preferred freight strategy.

Following completion of the Stage 1 assessment, eight options were recommended to be investigated in Stage 2 (**Table 1-3**). These were eight high-level scenarios outlining how future container trade could be allocated across three port locations at Fremantle, Kwinana and Bunbury over various time horizons.

Table 1-3: Westport Stage 1 recommended options

Option	Description
1	Theoretical base case (remain in Fremantle), as per Infrastructure Australia guidelines.
2	Optimise Fremantle and transition to Kwinana over time.
3	Optimise Fremantle and transition to Bunbury over time.
4	De-industrialise Fremantle and move containers to Kwinana in one step.
5	De-industrialise Fremantle and move containers to Bunbury in one step.
6	Fremantle and Kwinana both have containers for the long-term.
7	Fremantle and Bunbury both have containers for the long-term.
8	Only Fremantle has containers for the long-term.

Based on the eight options recommended at Stage 1, the Westport Taskforce then developed a long list of 25 diverse infrastructure scenarios, each with differing components, for assessment during Stage 2. Of the 25 options, four involved port operations at Fremantle, four involved port operations at Bunbury and 17 involved a new port at Kwinana.

Using an MCA approach, a series of facilitated workshops were conducted to compare the 25 options. 78 subject matter experts from 23 different organisations participated. The MCA incorporated weighted assessment criteria related to economic (34.6%), environmental (21.8%), land use (19.9%), social (14.6%) and governance and operation (9.1%) considerations. Seven options were shortlisted (**Table 1-4**) and all featured a new port in Kwinana, whilst no Bunbury or stand-alone Fremantle options made the shortlist.

Table 1-4: Westport stage 2 MCA 1 recommended options

Option	Location	Description
A	Kwinana	Cockburn Sound north (Rowley Road) **narrow island port** with intermodal operations at Latitude 32.
B	Kwinana	Cockburn Sound south (Anketell Road) **conventional land-backed port**.
C	Kwinana	Cockburn Sound south (vicinity Anketell Road) **conventional island port**.
D	Fremantle & Kwinana	Inner Harbour shared with Cockburn Sound south (Anketell Road) **medium conventional land-backed port**.
D2	Fremantle & Kwinana	Unmodified Inner Harbour shared with Cockburn Sound south (Anketell Road) **medium land-backed port** transitioning to Option B.
E	Fremantle & Kwinana	Modified Inner Harbour shared with Cockburn Sound south (Anketell Road) **medium conventional land-backed port** with 'Blue Highway'.
E2	Fremantle & Kwinana	Slightly modified Inner Harbour shared with Cockburn Sound south (Anketell Road) **medium land-backed port** with 'Blue Highway', transitioning to Option B.

Based on the outcomes of a second MCA, the two highest scoring options (B and D2) were recommended to be progressed to the next stage (Westport, 2020). Both options involved the construction of a new land-backed port facility at Cockburn Sound serviced by an upgraded Anketell Road, as shown in **Figure 1-8**, with option D2 also including a transition period where container trade operations would initially continue at the Inner Harbour.

Two strategic-level environmental impact avoidance outcomes were achieved through this recommendation:

- Avoidance of clearing at Mt Brown (Bush Forever site 346), which would have occurred to facilitate an extended and upgraded Rowley Road transport and infrastructure corridor servicing the port facility under Option A. The overall environmental impacts of upgrading Rowley Road and Anketell Road were compared as part of the MCA, with Anketell Road assessed to result in less overall environmental impacts.
- Avoidance of increased direct loss of benthic habitat (including seagrass on the Kwinana Shelf) that would have been required to construct an offshore island port facility (as compared to a land-backed port) under Options A and C. No such options were recommended to progress to the next stage of planning.

Figure 1-8: Westport Stage 2 conceptual port layout for Options B and D2

1.2.2.2 Westport Stage 3 – Impact avoidance through siting and design

Westport Stage 3 (Business case and preliminary design) involved the selection of a preferred port option (in proximity to the selected Stage 2 location) and development of a preliminary design (15% of total design effort to be completed), to inform the project's business case and EIA process. The Westport Project Office (WPO) was established to complete this work.

A key focus of Westport Stage 3 was to undertake detailed investigations required to answer unresolved questions from Stage 2 and to provide sufficient data to properly consider and compare potential construction and operational environmental impacts and performance. A list of investigations undertaken to inform this process is provided in **Section 1.3.2**.

To ensure the preferred option was suitable from a design, construction and operations perspective, maximised avoidance of environmental impacts, and was informed by reliable scientific information, WPO established the Design and Logistics (D&L) Workstream and Environment and Social (E&S) Workstream. A Supply Chain and Integrated Design (SCID) consultant (WSP and BMT), EIA consultant (Emerge Associates and O2 Marine) and additional technical advisors were appointed, and arrangements made to ensure a high level of integration and collaboration between workstreams.

The evaluation of project options was coordinated by SCID through a three-phase MCA approach. The E&S Workstream contributed to the development of environmental criteria and weightings and then used qualitative and quantitative assessment of impacts to score each option. The option assessment and selection process is summarised as follows (**Figure 1-9**):

- SCID Phase 1: Based on Westport Stage 2 location, 30 port configuration options and three landside logistics options were developed. From this pool of 30, a "long list" of 7 port design options and one landside option were identified.
- SCID Phase 2: Long list refined to a "short list" of 3 port options.
- SCID Phase 3: Short list of 3 options further assessed to identify the preferred option.

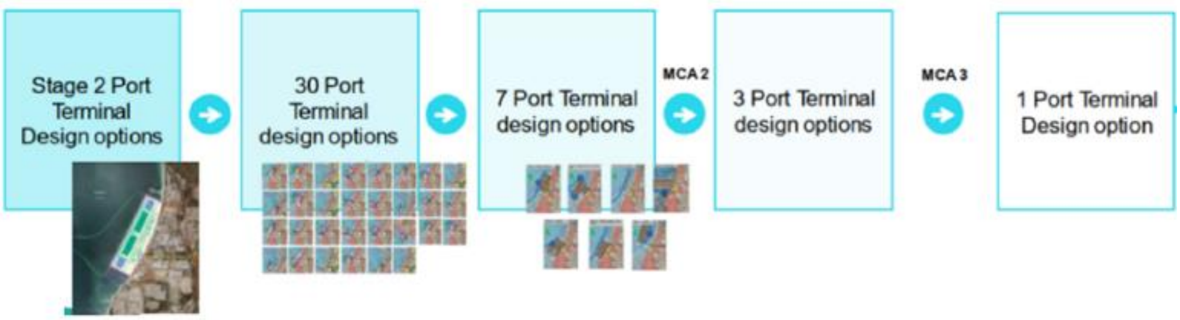

Figure 1-9: Summary of Westport Stage 3 SCID option selection process

SCID Phase 1 – Long List

To score the 30 port terminal design options to develop the 7 option long list, screening and scoring criteria were used, which were linked to the Westport Program goals, sub-goals and measures. Scoring was qualitative and each criterion was assigned a 'priority' rating based on its significance to the Westport Program. Multipliers were applied to each priority rating, the weighted score for each layout was determined, and the layouts were ranked.

With respect to the 'environmental impacts and opportunities' scoring category, three main criteria were evaluated:

- **Impacts to the benthic habitats**. Impacts to high value benthic habitats were given high priority. For each layout the criteria evaluated direct impacts on seagrass habitat, or whether it was likely to have an indirect impact. Layouts which had no (or low) adverse impact on high value benthic habitats scored favourably.
- **Dredging on Kwinana Shelf.** A criterion to minimise additional adverse impacts on Kwinana Shelf due to dredging and loss of potential sea grass habitat was designated a medium priority and options that included new channels through the Kwinana Shelf incurred a scoring penalty.
- **Changes to hydrodynamics.** Impacts due to changes in hydrodynamics were also given a high priority. Layouts that minimised the adverse environmental impacts due to hydrodynamic changes resulting from the presence of the port were ranked highly. These environmental impacts included water quality changes, disruption to coastal processes, sedimentation, and changes that could harm flora and fauna in Cockburn Sound.

SCID Phase 2 – Shortlist

The resultant long list of 7 port layouts (and 3 landside logistics options) that were recommended by SCID following Phase 1 were then evaluated through an MCA process in Phase 2. This is involved close collaboration with many stakeholders for the MCA definition, goal-weighting, sub-goal weighting, and qualitative scoring processes.

Westport Goal 4 ('Plan, build and operate the most sustainable container supply chain in Australia') was ranked 3rd highest in the MCA with a final weighting of 23.3%. Weighting of Goal 4 sub-goals included 'Cockburn Sound is protected' (13%, being the second highest weighted sub-goal in the whole MCA, only behind 'value for money' at 17%), 'The container supply chain is carbon neutral' (5%), and 'Infrastructure development and operations are sustainable' (5%).

Quantitative scoring for Phase 2 was undertaken by the SCID team using data derived largely from analysis and design, in close collaboration with WPO Workstreams and key stakeholders during qualitative scoring sessions.

Environmental scoring factors (under Goal 4) included:

- Water quality impacts (exchange time, brine and thermal dispersion, and sediment entrainment)
- Benthic habitat impacts (direct and buffer impacts on seagrass and substrates – using multipliers)
- Degree of impact on existing coastal processes, assets and new infrastructure
- Soil contamination disturbance
- Groundwater contamination disturbance
- Direct impacts on significant wetlands
- Fragmentation impacts on significant wetlands
- Impact on significant terrestrial flora
- Impact on significant ecological communities
- Impact on significant terrestrial fauna
- Impact on significant terrestrial fauna habitat
- Impact on connectivity and ecological linkages
- Recreational values impact (marine and terrestrial)
- Impact on high value indigenous heritage sites
- Impact on high value non-indigenous heritage sites
- Construction stage carbon emission.

Outcomes of the Phase 2 MCA scoring revealed the highest performing port layout options were differentiated by benthic habitat impacts as the key contributing factor, particularly reef and perennial seagrass impacts.

Based on the outcomes of the Phase 2 MCA, port Options A, C and G were progressed to Phase 3 to select a preferred option, as shown in **Figure 5-3**. A preferred landside logistics option was also selected.

Port Option G initially included a through-channel (across Kwinana Shelf), which greatly increased its benthic impact score compared to other layouts without a through-channel. Subsequent sensitivity and scenario testing was undertaken to analyse the differentiating characteristics and performance of the highest scoring five options. One of these sensitivity tests involved modifying Option G to remove the Kwinana Shelf through-channel, thereby reducing dredging and benthic habitat impact.

SCID Phase 3 – Preferred Option

In Phase 3 the shortlisted 3 options were further assessed to identify the Preferred Option through further MCA. The preferred landside logistics configuration that was decided at the end of Phase 2 was not included in the Phase 3 MCA. Broader stakeholder involvement was sought for Phase 3 MCA to ratify the criteria and weightings used, and to integrate a greater depth of modelling, analysis and data in scoring the options. Phase 2 Goals and Sub-goals were largely retained, but where stakeholders identified areas of disagreement sensitivity tests were conducted. The scoring approach remained unchanged from Phase 2 MCA. The additional modelling and input that was provided to the Phase 3 MCA included scoring factors for water quality impacts, impacts on coastal processes, benthic habitat impacts, and snapper spawning and habitat impacts.

Modifications that removed the through-channel and dredging requirements for port Option G following the sensitivity testing in Phase 2 greatly reduced its benthic habitat impacts and improved the water quality score.

Of the three assessed options, Option G ranked highest for the environmental scoring factors, largely due to minimal impact on coastal processes, snapper spawning and lowest loss of seagrass and limestone reefs on Kwinana Shelf compared to options A and C. SCID advised that *“Whilst Option G is not the lowest cost port solution, it performs better than Options A or C with respect to environmental impacts and performs similar to if not better than these Options for all other criteria”*. Given the weighting of environment in scoring, Option G thereby outperformed the other shortlisted options and was recommended to WPO as the preferred option.

Overall, environment was a key consideration throughout Westport Stage 3 and each of the MCA processes undertaken to inform the Preferred Option decision making process, with criteria heavily weighted toward marine matters of greatest concern to the EPA and the community. This process resulted in the avoidance of a range of potential environmental impacts that may otherwise result from the implementation of alternative port options instead of Option G. For example, the removal of the shipping channel north onto the Kwinana Shelf resulted in the preferred Option G moving from fifth to highest performing from an environmental perspective. Further discussion of impact avoidance outcomes achieved through this process is provided for each environmental factor chapter in this referral.

1.2.2.3 Shipping channel

In addition to selecting a preferred port location, layout, and associated landside logistics arrangement, an additional decision point is how ships will enter and exit Cockburn Sound.

Currently, vessels visiting the Outer Harbour enter and exit Cockburn Sound through a single existing shipping channel; Success Channel. Fremantle Ports maintain Success Channel to a dredged depth of 14.7 m.

As part of Westport Stage 2, Success Channel was identified as a constraint to any potential future container port development within Cockburn Sound, given it is not sufficiently deep or wide to enable passage of larger, deeper-draught vessels that are anticipated to service the State based on future trade forecasts.

To address this issue, two options were considered during Westport Stage 2:

1. Deepen and widen the existing main channel to 18.76 m depth and 220 m width.
2. Construct a second main channel parallel to the existing Success Channel, dredged and maintained to 18.76 m depth and 220 m width. The proposed location of the second channel was selected to align with historical Cockburn Cement dredge footprints to minimise the quantum of dredging required and to reduce loss of seagrass habitat. This option would involve no modification to the existing Success Channel.

As part of Westport Stage 2, each channel option was investigated with respect to their potential environmental impacts, both in terms of potential seagrass habitat loss on Success and Parmelia Banks and influences on Cockburn Sound hydrodynamics. With respect to seagrass, spatial analysis (using available seagrass habitat mapping at the time) determined little difference in direct seagrass loss between the two options, but a greater loss of shallow sandy habitat (representing potential future seagrass habitat) from widening the existing channel. Furthermore, based on the results of hydrodynamic modelling undertaken for each option, the following conclusions were made at that time (Westport, 2020):

- A wider, deeper channel improves the flushing of Cockburn Sound most of the year and across most of the deep basin.
- Dredging a second channel in addition to the existing channel improves flushing rates in Cockburn Sound.
- Seasonal medium-scale and broadscale water circulation regimes in Cockburn Sound were not affected.

Given a second main channel would also reduce operational risk by providing a second point of access into and out of Cockburn Sound (whilst also increasing operational capacity), and in consideration of the assessment findings related to seagrass loss and hydrodynamic changes, this option was selected as part of the Westport Stage 2 process and subsequently formed a base-assumption for assessment of individual port options thereafter.

As part of Westport Stage 3, WPO internally reassessed the two channel options in relation to benthic habitat (seagrass) impacts to validate the channel decision from Westport Stage 2. This was done given the availability of refinements in the channel design from vessel simulations undertaken during SCID Phase 3 and the availability of updated benthic habitat mapping from the WAMSI Westport Marine Science Program in October 2023.

The validation process was undertaken for the optimised design of the proposed new second channel versus the widened and deepened existing S&P channel, under the same design requirements. These channel parameters were based on a greater level of design progression compared to the higher-level design assumptions that informed the initial analysis in Westport Stage 2.

The validation results (**Table 1-5**) reconfirmed that potential impacts on seagrasses (both direct and indirect) would be lower under a new second channel scenario versus widening and deepening of the existing Success Channel. This is largely due to the location of the new second channel aligning with historically dredged areas, as opposed to the existing Success Channel which abuts shallow seagrass beds that would be impacted by widening.

Table 1-5: Benthic habitat impacts of channel design options

Benthic habitat impacts	Existing channel improvements	New second channel
Direct seagrass loss[1]	42.3 ha	31.8 ha
Indirect seagrass impacts[2]	19.3 ha	14.2 ha

[1] Existing seagrass areas, which are of the highest relative importance.

[2] Existing seagrass areas within 50 m of 'direct seagrass loss', being potential zones of chronic indirect impacts.

The decision for the Proposal to include a new second channel, as opposed to including widening and deepening of Success Channel, has resulted in avoidance of direct and indirect impacts to additional areas of seagrass.

1.3 Proponent initiatives to inform the environmental impact assessment process

1.3.1 WAMSI Westport Marine Science Program

The WAMSI Westport Maring Science Program (WWMSP) is a world-leading science and research initiative led by WAMSI in collaboration with Westport and its program partners, which aims to address environmental and social knowledge gaps surrounding Cockburn Sound. Westport has contributed $13.5 million in funding to the WWMSP, which was developed with the objective of defining baseline environmental conditions, improving Westport's ability to avoid, mitigate and offset environmental impacts and increase Government's ability to manage other pressures acting on Cockburn Sound into the future.

The scope of the WWMSP was developed based on:

- A knowledge gap assessment, undertaken in consultation with various stakeholders (including DWER, DPIRD and DBCA), based on:
  - A risk assessment of potential environmental impacts associated with port construction and operation against all EPA environmental factors. This included consideration of EPA advice on previous port proposals within Cockburn Sound, including Bulletin 1230 Section 16(e) advice on the *Fremantle Ports Outer Harbour Project*.
  - An assessment of the current state of knowledge against these risks and associated information requirements for statutory EIA processes, as well as for informing the design process and development of impact mitigation strategies.
- Consultation with DWER EPA Services on the above to refine priorities for science projects.
- Development of project scopes and review of science proposals in consultation with DWER, DPIRD and DBCA.

The objective of the WWMSP is to enhance knowledge and understanding of Cockburn Sound that will:

- Establish environmental baselines for important environmental and social values and improve understanding of key ecological processes in Cockburn Sound, including addressing knowledge gaps.
- Provide a broad scientific basis informing the design of the Proposal and underpinning impact prediction and assessment of the Proposal.
- Inform mitigation and offset strategies to maximise environmental and social outcomes and assist in building environmental resilience of Cockburn Sound in the medium to long-term.
- Provide information on community values and uses of Cockburn Sound and aspirations for the future through consultation with the community.

The WWMSP is comprehensive and has been planned and designed to address the information requirements for EIA. Notwithstanding this, it remains possible that some additional and further investigations may be required to inform the future PER, which will be confirmed at the future ESD stage.

The WWMSP is also tasked with delivering on key knowledge gaps and likely community & stakeholder concerns that are not typically part of the EIA process, but which may be of interest or concern to the community.

The WWMSP includes nine research themes, established through a series of 16 expert workshops involving scientists, key stakeholders and community representatives (WAMSI, 2022). More than 30 research projects are being undertaken across the nine themes (**Table 1-6**). As the WWMSP has been implemented over time, some changes to the original scope of projects has occurred in response to challenges that have arisen, which is reflected in project list included in the below table. The WWMSP is currently scheduled to be complete by the end of 2024 and all studies will be published in the public domain once complete.

Table 1-6: WWMSP themes, objectives and projects (WAMSI, 2022)

Theme	Objective	Projects
1. Ecosystem modelling	Develop an ecosystem model to understand how water quality and habitats may change under various possible future scenarios.	1.1 Integrated ecosystem model platform. 1.2 Pathway to productivity: development of a water quality response model for Cockburn Sound. 1.3 Characterise the trophic structure, ecosystem attributes and functioning of Cockburn Sound, using conceptual, qualitative, and quantitative ecosystem models.
2. Benthic habitats and communities	Improve our understanding of benthic communities and processes, with a focus on seagrass rehabilitation and restoration.	2.1 Benthic habitat mapping. 2.2 Pressure-response relationships, building resilience and future proofing seagrass meadows (including seagrass tolerance thresholds). 2.3 Seagrass restoration program. 2.4 Benthic communities in soft-sediment and hard substrates, and mitigation strategies for artificial reefs.

Theme	Objective	Projects
3. Water and sediment quality	Develop a comprehensive environmental baseline and understand contaminants, nutrient sources and recycling.	3.1 Water and sediment quality monitoring. *3.2 Processes governing nutrient and contaminant cycling in Cockburn Sound* (project 3.2 discontinued and replaced by new projects 3.4 and 3.5). 3.3 Key elements of the groundwater/surface water flux into Cockburn Sound. 3.4 Sediment sulphides, oxygen flux and seagrass health 3.5 Cockburn Sound benthic nutrient flux dynamics.
4. Fisheries and aquatic resources	Understand seasonal movements of key species, the habitats they seek out and the food they rely on.	4.1 Snapper connectivity and evaluation of juvenile stocking. 4.2.1 Spatial distribution and temporal variability in life stages of key fish species in Cockburn Sound. 4.2.2 Zooplankton in Cockburn Sound. 4.2.3 Trophic pathways and food web structure of Cockburn Sound and Owen Anchorage. 4.3 Investigating effects of climate change on biota in Cockburn Sound. 4.4 Effects of total suspended solids on key fish species. 4.5 Seafood safety and quality. *4.6 Effect of Westport development on invasive species risks to Cockburn Sound* (project 4.6 discontinued and replaced by new project 4.7). 4.7 Marine invasive species literature review.
5. Hydrodynamic modelling	Understand how water quality and circulation in Cockburn Sound may change due to Westport and climate change.	5.1 Hydrodynamic modelling data inputs. 5.2 Surface gravity wave modelling data inputs.
6. Social	Identify and understand the community values connected to Cockburn Sound.	6.1 Community values for changes in environmental conditions. 6.2 Opportunities and impacts for recreational fishing from the Westport development. 6.3 Recreation, amenity and aesthetic values. 6.4 Benefit-cost framework for environmental port design features.
7. Noise	Develop current and future underwater ‘soundscapes’ of Cockburn Sound to understand, and manage, the potential effects of underwater noise.	7.1 Baseline soundscape, sound sources and transmission. 7.2 Hearing sensitivity of Australian sea lions, little penguins, and fish. 7.3 Behavioural response of fish to noise.

Theme	Objective	Projects
8. Apex predators and iconic species	Improve our understanding of the distribution and seasonal movements of conservation significant and iconic species, the habitats they seek out and the food sources they rely on.	8.1 Determining the diet, causes of mortality, foraging habitat and home range of little penguins using Cockburn Sound. 8.2 Investigate the abundance, movement, habitat use and diet of Australian sea lions in the Perth Metropolitan area. 8.3 Spatio-temporal distribution of key habitat-uses and key prey species for Indo-Pacific bottlenose dolphins in Owen Anchorage and Cockburn Sound, including a fine-scale understanding of the use of the habitats in the Kwinana Shelf. 8.4 Spatio-temporal distribution of syngnathids (e.g. seahorses) in Cockburn Sound.
9. Coastal processes	To better understand patterns and drivers of sediment transport and the processes of beach accretion and erosion in Cockburn Sound and Owen Anchorage.	9.1 Coastal processes and sediment movement in Cockburn Sound and Owen Anchorage.

1.3.2 Westport Supply Chain and Integrated Design

WPO established the SCID engineering program to develop the various port, container terminal, road and rail infrastructure layout options, which were then assessed to determine the preferred option. As part of assessing different options (**Section 1.2.2.2**), various technical studies were commissioned through the SCID program to compare the potential environmental impacts of each. This has included investigations in relation but not limited to:

- Hydrodynamic modelling exercises for Cockburn Sound related to:
  - Flushing
  - Brine dispersal (from Perth Seawater Desalination Plant)
  - Snapper larvae dispersal
  - Tug propellor wash resuspension
  - Sediment fate modelling for dredging and reclamation.
- Geotechnical conditions
- Sediment sampling and analysis
- Dredging strategies.

The preferred layout option determined through the SCID program is reflected in the content of this Proposal. The SCID program is currently progressing the preferred option to a preliminary (15% of total design effort) engineering design that will inform the forthcoming business case submission to Infrastructure Australia and Infrastructure Western Australia.

1.3.3 Westport Marine and Terrestrial Mitigation Working Groups

WPO have established a Marine Mitigation Working Group (MMWG) and a Terrestrial Mitigation Working Group (TMWG), the objectives of which are to co-design and evaluate measures that aim to:

- Mitigate the environmental impacts of the Proposal.
- Improve the long-term ecosystem health, resiliency, and biodiversity within Cockburn Sound and its terrestrial surrounds.

Members of the MMWG and the TMWG include:

- Marine Mitigation Working Group:
  - Department of Primary Industries and Regional Development
  - Department of Biodiversity, Conservations and Attractions
  - Department of Water and Environmental Regulation
  - Fremantle Ports
  - Recfishwest
  - University of Western Australia
  - WAMSI
  - Water Corporation
  - Westport EIA Consultancy (Emerge Associates & O2 Marine)
- Terrestrial Mitigation Working Group:
  - Beeliar Regional Park Community Advisory Committee
  - Bushland Perth
  - City of Canning
  - City of Kwinana
  - Greening Australia
  - Perth NRM
  - Shire of Serpentine Jarrahdale
  - Westport EIA Consultancy (Emerge Associates).

Mitigation and resilience building measures developed through the MMWG and TWMG will be incorporated into the future ERD, where applicable to the EIA mitigation hierarchy.

The MMWG and TWMG are not limited to developing only those measures which fit within the EIA mitigation hierarchy for the Proposal, with many of the measures, particularly those related to resilience building in the local area likely to be progressed and implemented outside of the EIA process.

Other stakeholder reference groups for the Westport Program are discussed in **Section 3.3**.

1.4 Local and regional context

1.4.1 Introduction

The Proposal is located within the southern portion of the Perth metropolitan area, situated in the south-west of Western Australia.

The terrestrial components of the Proposal, associated with the areas of landside development and supporting infrastructure, are situated within the Kwinana Industrial Area (KIA) of the Western Trade Coast, that is located on the western coastline of the Swan Coastal Plain and adjacent to Cockburn Sound, which is also known by its Aboriginal name of Derbal Nara.

The KIA was first established in the early 1950s and has since been the primary strategic heavy industrial area servicing the Perth metropolitan region. The KIA has been strategically separated from sensitive land uses (such as urban areas) to avoid potential land use conflicts. The land use zoning of the area and surrounds, as defined by the Metropolitan Region Scheme, is shown in **Figure 1-10**.

The majority of the marine components of the Proposal, including the port facility, access channels, turning basins, berthing areas and offshore breakwater are situated in the eastern portion of Cockburn Sound, on the Kwinana Shelf. Cockburn Sound has been intensively utilised and considerably altered from its natural state since European settlement in the 1800s.

The proposed second main channel extends from the northern edge of Cockburn Sound across Owen Anchorage and Gage Roads, connecting with the Indian Ocean to the north. The location of the proposal development envelope in relation to nautical charts is shown in **Figure 1-11**.

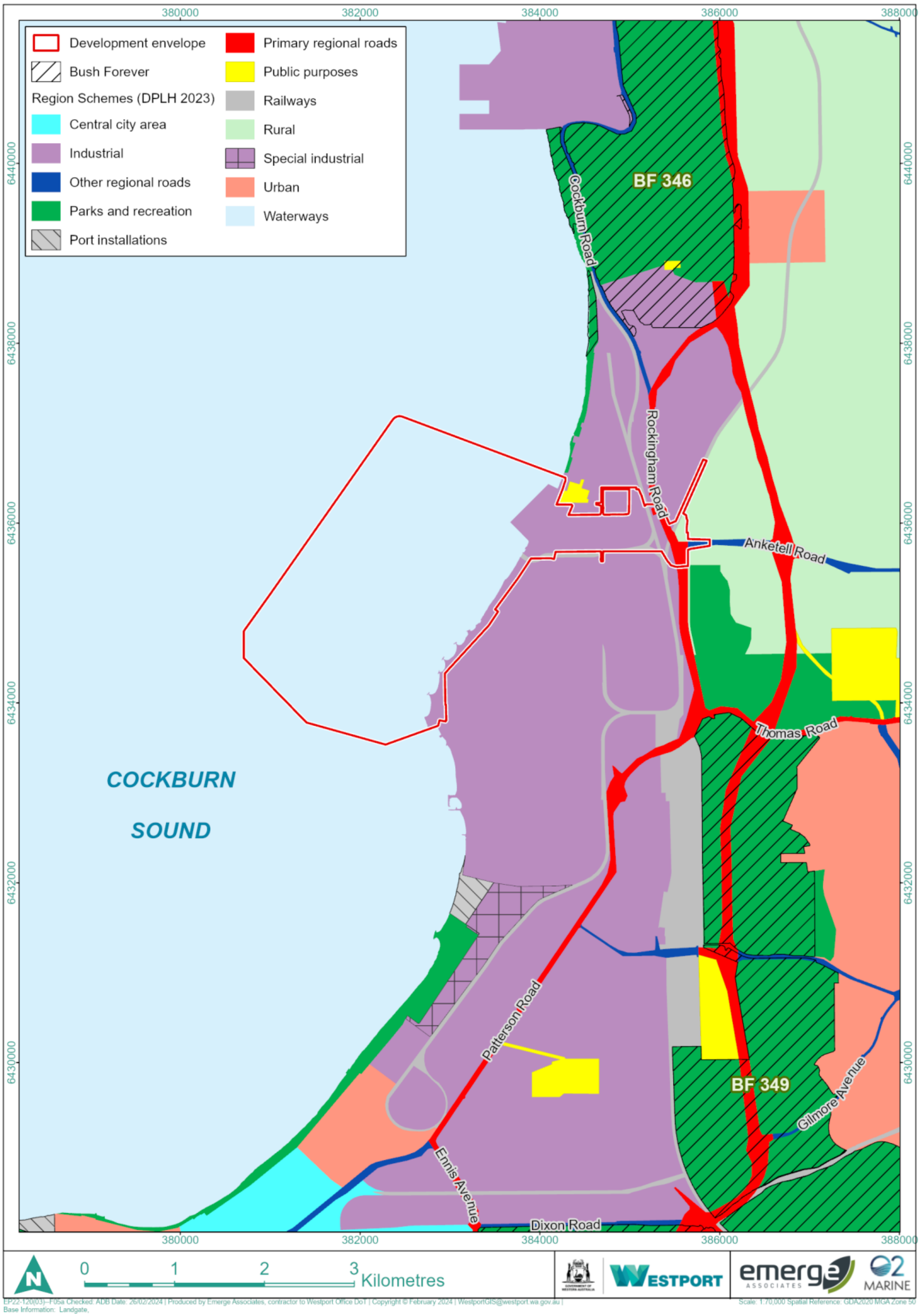

Figure 1-10: Metropolitan Region Scheme land use zones and reserves

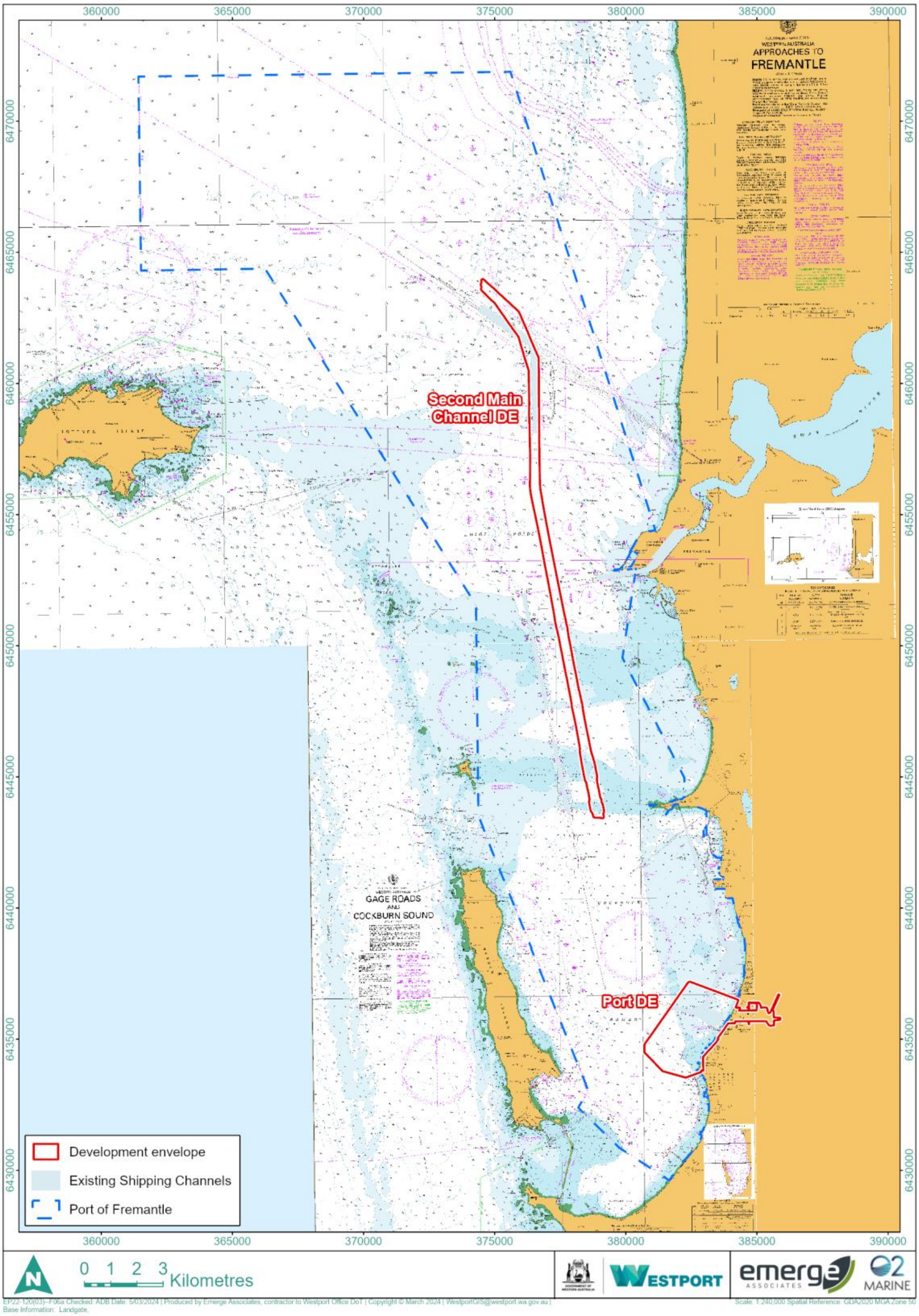

Figure 1-11: Proposal extent in relation to nautical charts

1.4.2 Cockburn Sound

Cockburn Sound is a semi-enclosed marine embayment (covering approximately 110 km2) within a matrix of submerged natural and anthropogenic features. To the south and east Cockburn Sound is bound by the coastline, to the north by Woodman Point and relatively shallow Parmelia Bank, and to the west by Garden Island, which is a barrier island approximately 10 km long, that provides protection from incoming oceanic swell.

The primary entrance to Cockburn Sound from the north is an opening between the north-east of Garden Island and Woodman Point. The southern end of Cockburn Sound is connected to the adjacent Indian Ocean via a natural opening between the southern end of Garden Island and the western tip of Point Peron, which was bridged by a causeway in 1973 (discussed in **Section 1.4.5**).

1.4.2.1 Bathymetry

The bathymetry of Cockburn Sound is characterised by a relatively deep central basin with a depth varying between 15-20 m, with shallower surrounding areas including:

- Kwinana Shelf in the eastern portion north of James Point, which experiences a variable depth up to 10m.
- Southern Flats in proximity to the Garden Island causeway, which experiences a depth of around 2-3m.
- Nearshore beaches along the mainland and Garden Island.

To the north, the shallow Parmelia Bank and Success Bank bound the deeper Owen Anchorage.

1.4.2.2 Circulation and mixing

Cockburn Sound has complex hydrodynamics that are seasonally variable. Perth coastal waters, including Cockburn Sound, are micro-tidal, with low tidal amplitudes up to 0.8 m and negligible tidal currents compared with more dominant wind-driven forcing (Steedman and Craig, 1983; Masselink and Pattiaratchi, 2001a). Cockburn Sound is effectively protected from the open ocean swell by Garden Island, with limited exchange (flushing) through the shallow openings.

In winter, storm fronts with strong winds from the north-west and south-west completely mix the full depth of the waters in the Sound. Rainfall contributes a buoyant freshwater surface layer originating from the Swan-Canning river system, which is transported toward Cockburn Sound from Fremantle by wind and the natural rotation of the earth. Storm winds mix the freshwater vertically and result in lower salinity water in the Sound compared to adjacent oceanic waters, generating a salinity-driven exchange flow through the northern opening (D'Adamo, 2002).

In autumn, there are often periods of several weeks of very low wind speeds, resulting in reduced wind-driven forcing and a stable vertical water column (stratification). As such, evaporation is the dominant hydrodynamic mechanism driving circulation and mixing during this period. Horizontal gradients in temperature also contribute to the reduction (and reversal) of the exchange flow through the northern entrance (D'Adamo, 2002). Lower flushing rates and less wind mixing in autumn can lead to poorer water quality and lower dissolved oxygen (which would normally enter the system via oxygenated oceanic water entering from the northern opening and via wind-mixing of the surface water layer). When these conditions are combined with higher nutrient levels this can result in algal blooms and sometimes fish kill events.

During summer, the diurnal sea breeze system dominates the hydrodynamic forcing with low offshore (easterly) wind speeds in the morning and a period of high solar radiation heating the surface layer. The sudden onset of intense onshore (south-westerly) wind speeds in the early afternoon vertically mixes the water column (Pattiaratchi et al., 1997; Masselink and Pattiaratchi, 2001a; Verspecht and Pattiaratchi, 2010; Zaker et al., 2007). Additional vertical mixing also occurs through heat loss to the atmosphere at night (penetrative convection). Collectively, summer conditions result in a well-mixed water column that encourages outflow through the northern opening.

Within the Sound, basin-scale circulation is also wind-driven and typically follows the direction of the wind at the margins of the basin and exhibits a return reverse flow through the middle of the Sound. During sea breezes and storms, circulation cells develop in response to the wind stress on the surface, and the northern and southern parts of the Sound develop independent circulation cells separated by the topography west of James Point. Storm fronts typically drive a southward current on Kwinana Shelf and in the surface waters with a resultant northward flow in the deeper water of the basin. In summer, when the wind is strongest from a south-westerly direction, a northwards current is induced over Kwinana Shelf and in the margins with a return flow southward through the deeper centre of the Sound.

1.4.2.3 Marine environmental quality

Water quality in Cockburn Sound is at present significantly improved from a state of contamination and peak nutrient loading in the 1960s (as discussed in **Section 1.4.2.6**). Annual monitoring of the marine water quality has reinforced ongoing concerns about poor water quality in some areas of Cockburn Sound (CSMC, 2023; EPA, 2017), such as southern areas that experience reduced flushing.

Of greatest concern in Cockburn Sound, particularly in the poorly flushed southern section, is the situation when water quality becomes so poor that it results in algal blooms and fish kills. The scenario leading to this condition is the reduction of wind forcing in autumn, exacerbated by the hydrodynamics. Dissolved oxygen is decreased in the water column due to the reduction in entrainment and mixing and is also consumed through biological oxygen demand from the sediments in the near-bed layer. Low dissolved oxygen levels can be harmful to marine life and can contribute directly to fish kill events (ANZECC/ARMCANZ, 2000).

1.4.2.4 Coastal processes

Changes to the Cockburn Sound shoreline are controlled by coastal processes that act to move the sediments and cause erosion and accretion. Sediment is transported primarily via nearshore currents, which includes alongshore currents, cross-shore currents, and circulation cells. In Cockburn Sound the nearshore currents are constrained by the bathymetry, reefs, islands and headlands, resulting in circulation cells (alongshore and cross-shore currents) that drive the sediment transport. Sea-breezes drive alongshore currents that are generally northward in summer, resulting in a cumulative net northward sediment transport. Winter storm systems drive southward longshore currents, resulting in net southward sediment transport (Masselink and Pattiaratchi, 2001b).

1.4.2.5 Marine ecology

Cockburn Sound lies within a region of marine "biogeographical overlap" that stretches from Augusta to Exmouth. The coastal waters of Perth provide a temperate environment for marine flora and fauna, but the influence of the Leeuwin Current allows tropical species from the north to persist. In Perth's coastal waters, endemic species unique to Western Australia typically account for 10-25% of the total species, depending on the organism type such as crustaceans, shellfish and worms (BMT, 2018a).

The biodiversity of seagrass species in Perth's coastal waters is high. Habitats for marine fauna mostly found in Cockburn Sound are extensive soft sediment areas, seagrass meadows and limestone reefs. These habitats are used for feeding, resting and breeding (spawning and nursery). The marine fauna within these habitats comprises fishes, crustaceans, molluscs, and marine mammals, including bottlenose dolphins, Australian sea lions, little penguins and seabirds (Johnston, et al., 2008). Cockburn Sound, Owen Anchorage and Warnbro Sound are important spawning and nursery areas for recreationally and/or commercially targeted fish and invertebrate species, including snapper, blue swimmer crabs, western king prawns, white bait and King George whiting.

1.4.2.6 Seagrass coverage trends

A key natural feature of Cockburn Sound is seagrass, including both perennial seagrasses which grow all year round (including *Amphibolis griffithii* and *Posidonia Australis*) and ephemeral seagrasses that grow seasonally (including *Halophila ovalis*). Early accounts in 1954, prior to the introduction of industrial land uses, recorded up to 4200 ha of seagrass within Cockburn Sound (Cambridge and McComb, 1984; Kendrick et al., 2002).

The Water Corporation’s Woodman Point waste water treatment plant began discharging primary waste water directly into the Sound in the early 1960s. By 1967, seagrass coverage in Cockburn Sound had declined to approximately 2929 ha. Between the 1960s and early 1980s, approximately 80% of the seagrass cover was lost. In 1984, the Sepia Depression Ocean Outlet Landline (SDOOL) pipeline became operational at Cape Peron, which was constructed to discharge treated wastewater to the deeper waters west of Garden Island, rather than into Cockburn Sound, curbing the flow of contaminants and nutrients into the Sound (Kendrick et al., 2002). Seagrass meadows stabilised over the following decade with only a minor increase from 721 ha to 948 ha (Hovey and Fraser, 2018) since 1999.

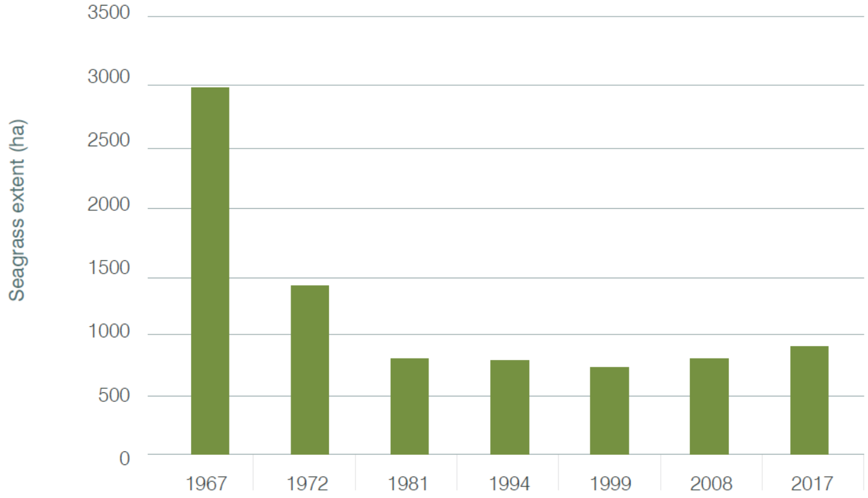

Figure 1-12: Change in seagrass coverage in Cockburn Sound over time (BMT, 2018)

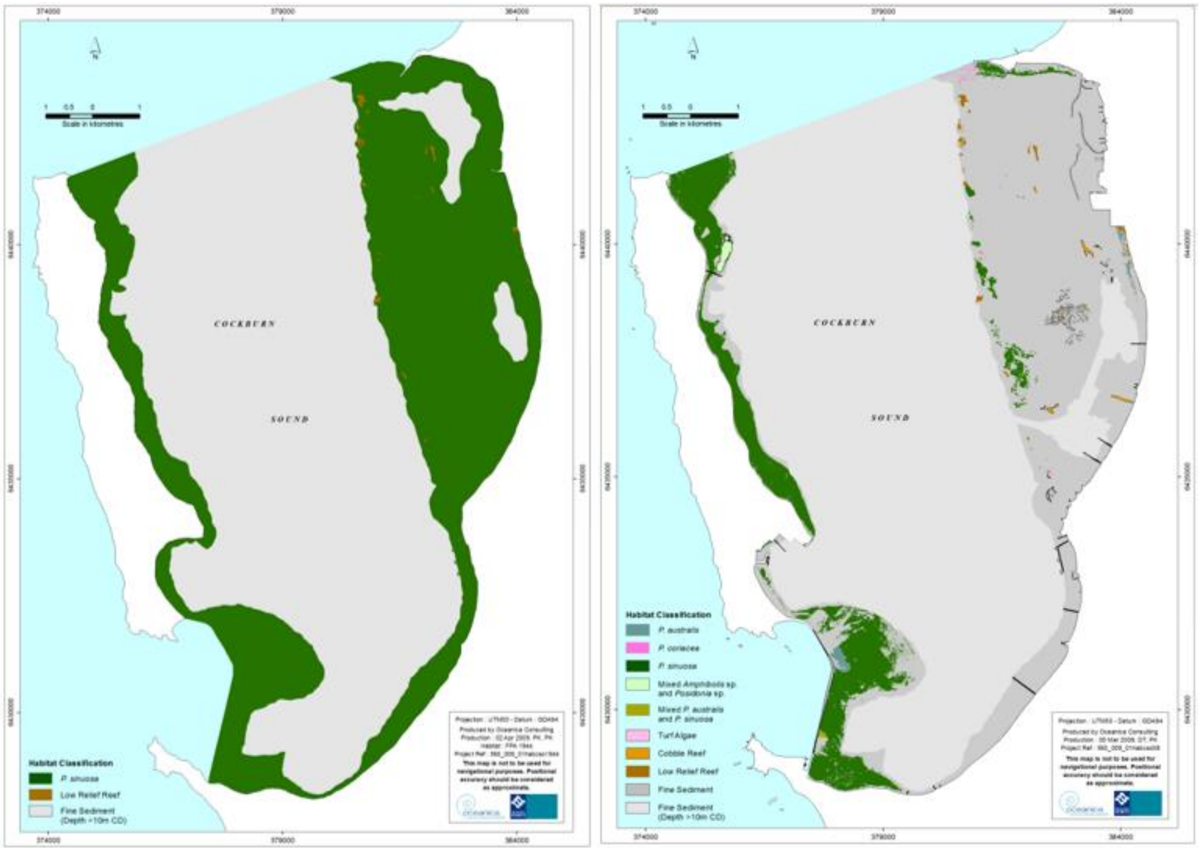

Figure 1-13: Cockburn Sound seagrass cover in 1944 (left) and 2008 (right) (BMT 2018a)

Like Cockburn Sound, the benthic habitats of Owen Anchorage are dominated by seagrasses. Much of the offshore area of Owen Anchorage is dominated by *Amphibolis* spp., while inshore is represented by a mosaic of meadow forming species from the genera *Posidonia* and *Amphibolis*. Coloniser species that have been reported in the area include *Zostera*, *Halophila* and *Syringodium* (BMT Oceanica, 2017). The overall extent of seagrass in Owen Anchorage appears relatively stable, although localised changes are common from both natural processes and long term shellsand dredging activities (BMT Oceanica, 2017). Detailed historical seagrass coverage data is unavailable for Owen Anchorage.

1.4.2.7 Commercial uses

Cockburn Sound supports a range of commercial activities in the marine environment including existing port operations, tourism and fisheries. Resident populations of dolphins and little penguins use the sound for foraging, attracting tourism to the region and activities such as diving and dolphin encounters (WAMSI, 2018). Cockburn Sound supports commercially and recreationally fished species such as blue swimmer crabs and pink snapper. Mussel aquaculture is also a commercial industry operating in Cockburn Sound but has been in decline in recent years (CSMC, 2023).

1.4.2.8 Recreational uses

Cockburn Sound is the State's most intensively used embayment in view of its many concurrent recreational, industrial, and commercial uses. Recreational uses of Cockburn Sound are numerous and varied, as summarised in **Table 1-7**.

Table 1-7: Summary of recreational uses of Cockburn Sound

Land-based activities	Water-based activities
- Beach activities - Birdwatching - Café/bar - Camping/caravan - Community volunteering - Cycling - Dog beach activities - E-scootering - Fishing - Horse exercising - Photography - Picnicking - School camps - Community camps - Sightseeing - Skateboarding - Walking/running - Yoga	- Boating - Community volunteering - Fishing - Freediving - Hoverboarding - Hydro-foiling - Jet-skiing - Kayaking - Kite boarding - Kite surfing - Motor boating - Photography - Sailing - Scuba diving - Snorkelling - Stand-up paddle boarding - Swimming - Swimming with horses - Wake boarding - Water skiing - Windsurfing

The port DE is situated within the KIA and is less frequented by the public for most of the above recreational activities compared to other more popular recreational locations such Woodman Point, the Rockingham Foreshore and Point Peron. However, the local area does support two recreational attractions; the Naval Base Horse Beach and diving and snorkelling at the disused KBB1 jetty, both of which are frequently used by the public.

The second main channel DE is offshore and not accessible for land-based activities. Most recreational activities in this area are likely to be associated with fishing and other boat-based activities.

1.4.3 Existing Outer Harbour port facilities and operations

As discussed in **Section 1.1.3.1**, Cockburn Sound is actively used for significant commercial port operations. Port facilities and operations in the Outer Harbour were first established in the 1950s, with the construction of the BP Kwinana oil refinery and jetty as part of the *Oil Refinery (Kwinana) Agreement Act 1952*. Since this time, various other port facilities have been established in Cockburn Sound, as summarised in **Table 1-8**.

The Outer Harbour forms part of the Port of Fremantle waters and therefore ship movements are controlled by Fremantle Ports. Areas in proximity to some operational jetties and wharfs along the eastern shore of Cockburn Sound are access-restricted to authorised vessels only, as shown in **Figure 1-6**. Vessels utilising existing Outer Harbour port facilities transit into Cockburn Sound via Success Channel, with designated anchorage areas located along the western portion of Cockburn Sound (in addition to Gage Roads to the north).

Areas surrounding Garden Island are naval waters controlled by the Royal Australian Navy and do not form part of the Outer Harbour. Waters in proximity to Careening Bay and the Armament Jetty are access-restricted to authorised vessels only. Approximately two-thirds of Garden Island remains open to the public (only during daylight hours and when visiting by private vessel).

Table 1-8: Existing port facilities and associated jetties and wharfs within Cockburn Sound

Facility	Jetties/wharfs	Description
Australian Marine Complex (AMC)	Various within Northern Harbour and Southern Harbour.	Shipbuilding and sustainment industrial precinct, split across two (Northern and Southern) Harbours. First construction stage in 1980, with ongoing staged development progressing since this time.
Alcoa Alumina Refinery	Alcoa Jetty	Constructed in the early 1960s and operated by Alcoa, the jetty accommodates ships importing bulk caustic soda and exporting refined alumina, associated with the Alcoa alumina refinery. The jetty is equipped with a conveyor belt system. In January 2024, Alcoa announced it plans to fully curtail production in 2024, but continue port operations to import raw materials and export alumina produced at Alcoa's Pinjarra Alumina Refinery.
Fremantle Ports Kwinana Bulk Terminal (KBT)	KBB1 (disused) KBB2	Operated by Fremantle Ports, the facility imports and exports dry bulk goods, in addition to bulk LPG exports (discussed in **Section 1.4.6.2**). KBB1, constructed in the 1950s, is no longer used and is in a state of disrepair. KBB2, constructed in the late 1960s, remains an operational jetty, with bulk goods transported to the jetty from landside stockpiles via conveyor belt. The KBT is also serviced by a freight railway connection adjacent to the landside stockpiles.

Facility	Jetties/wharfs	Description
BP Kwinana Terminal	Oil Refinery Jetty (three berths)	Constructed in the 1950s and operated by BP, the three-berth jetty accommodates bulk tankers loading and unloading bulk petroleum products. The BP Kwinana Terminal formerly operated as an oil refinery until production ceased in early 2021.
Fremantle Ports Kwinana Bulk Jetty	KBB3 KBB4	Operated by Fremantle Ports, the facility supports two common user berths (KBB3 constructed in the late-1960s and KBB4 constructed in the late-1970s), which accommodate vessels unloading dry and liquid bulk cargoes, including recent increases in fuel imports since the BP oil refinery operations ceased in 2021.
CBH Kwinana Grain Terminal	Kwinana Grain Jetty	Constructed in the mid-1970s and operated by CBH Group, the facility accommodates ships loading bulk grain exports.
Department of Defence HMAS Stirling	Various at Careening Bay Armament Jetty	A naval base located on Garden Island, commissioned in 1978 and operated by the Commonwealth Department of Defence. It's primary wharfs and berths are located at Careening Bay at the southern end of Garden Island, with a separate Armament Jetty at the north-east of Garden Island.

1.4.4 Previous dredging activities

Cockburn Sound and surrounding waters to the north have been subject to various historical and ongoing dredging campaigns. This has included dredging to establish and maintain various navigational channels, including (from north to south):

- Deep Water Channel, used by vessels accessing Port of Fremantle when transiting between the Indian Ocean and Gage Roads.
- Success Channel across the Success and Parmelia Banks, which is used by vessels when transiting between Gage Roads and Cockburn Sound.
- Stirling, Calista and Medina Channels on the Kwinana Shelf, used by vessels accessing KBT, Alcoa and AMC.

Various other historical dredging activities have been undertaken within and surrounding Cockburn Sound. This includes ongoing shell-sand dredging undertaken by Cockburn Cement Limited (CCL) across the Pamelia and Success Banks since 1972. These dredging activities are undertaken pursuant to the *Cement Works (Cockburn Cement Limited) Agreement Act 1971* State Agreement and existing environmental approvals that allow impacts to and removal of seagrass. CCL operate an unloading wharf and wash-plant on the northern side of Woodman Point. Dredge material is initially unloaded from dredge vessels at the wharf and placed on the seabed by the jetty. It is then re-collected and pumped to the wash plant facility onshore, with output material pumped to CCL's cement production facility in Munster.

1.4.5 Garden Island causeway

A 4.2 km causeway was constructed in 1973 to link Garden Island to the mainland, as part of the construction of the HMAS Stirling naval base which was subsequently commissioned in 1978. The causeway is predominantly a solid rock revetment, with two openings spanned by bridges (northern opening is 600 m wide, southern opening is 300 m wide) that allow limited exchange between Cockburn Sound and the Indian Ocean. Modification of natural flow regimes within Cockburn Sound as a result of the causeway exacerbated the trapping of nutrient-rich water, contributing to water quality issues.

The WAMSI Garden Island Causeway Workshop was held in 2018, to investigate whether modification of the causeway would improve the ecological health of southern Cockburn Sound. Although there was considerable environmental uncertainty, the workshop recommended that the risk to social amenity, ecological stability, and highly valued infrastructure would outweigh any ecological gain from potentially improved flushing associated with modification of the causeway (WAMSI, 2018). Subsequent critique provided by CSIRO water and sediment experts highlighted the possibility that removal of the Causeway would improve water exchange and water quality, but the extent of the improvement was uncertain (WAMSI, 2018).

1.4.6 Western Trade Coast industrial areas, adjacent to Cockburn Sound

The Western Trade Coast (WTC) is Perth's primary strategic industrial area, comprising four different areas, as outlined in **Table 1-9** and shown in **Figure 1-1**.

Table 1-9: Industrial areas within the Western Trade Coast

WTC area	Description
Kwinana Industrial Area	The KIA was first established in 1955 with the commissioning of the then BP oil refinery. It supports heavy industrial land uses, including petroleum and mineral refineries, power stations, chemical plants, cement works, port facilities and supporting industries.
Rockingham Industry Zone (RIZ)	South of KIA, the RIZ is a heavy and light industrial area which provides additional industrial land given land availability issues within the KIA. It transitions between heavy industry, light industry and commercial land uses in closer proximity to urban areas.
Australian Marine Complex	North of KIA, AMC is a specialist ship building and sustainment industrial precinct supporting the manufacturing, fabrication, assembly & maintenance requirements of the marine, defence, energy and resource industries. It is one of only two naval ship-building locations in Australia.
Latitude 32	East of the KIA, Latitude 32 is an extensive general industrial area, approximately 1,400 ha in size. Currently, much of the lands remains undeveloped, with land use planning ongoing across many precincts to enable future industrial land use. The area is a designated redevelopment area and as such DevelopmentWA is the responsible authority.

The Proposal is situated within the core of the KIA. Key surrounding heavy industrial land uses include, but are not limited to:

- BP Kwinana Terminal (formerly an oil refinery until 2021)
- Fremantle Ports Kwinana Bulk Terminal
- Water Corporation Perth Seawater Desalination Plant
- Synergy Kwinana Power Station
- Synergy Cockburn Power Station
- NewGen Power Station (privately owned)
- Cockburn Cement Kwinana
- Steel Mains Kwinana (water pipeline manufacturer).

1.4.6.1 Perth Seawater Desalination Plant

Water Corporation operate the Perth Seawater Desalination Plan (PSDP), which is located adjacent to the Proposal area and currently produces up to 18% of the drinking water for the Perth metropolitan area. The PSDP intakes seawater from Cockburn Sound for the desalination process and then discharges the brine (highly saline water) back into Cockburn Sound, on the Kwinana Shelf at a depth of approximately 10 m (BMT, 2018b).

The PSDP received environmental approval, pursuant to Part IV of the EP Act in May 2003. An amendment to this approval was approved to increase the capacity of the plant from 30 GL to 45GL per year in July 2004. In May 2005 the Minister for the Environment requested the EPA review a number of conditions relating to brine discharge from the PSDP. The EPA advised the Minister that the significance of impacts to the marine environment from the discharge of brine were still uncertain and the marine environment of Cockburn Sound continues to be under stress. As a result, the EPA recommended that a change to the implementation conditions should be made to ensure the objectives of the *State Environmental (Cockburn Sound) Policy 2005* are met. The Water Corporation constructed the plant in 2006.

In 2010 the Minister for Environment approved amendments to the project's environmental conditions to ensure increases in the intensity and/or duration of density stratification does not cause declines in dissolved oxygen of bottom waters, defined as less than or equal to 0.5 metres above the seabed, to 60% saturation (24 hour running median) or less in the high and/or moderate protection areas of Cockburn Sound, as defined by the *State Environmental (Cockburn Sound) Policy 2015* (EPA, 2015), also known as the Cockburn Sound SEP, as discussed in **Section 7.3.2** and shown in **Figure 7-2**. In April 2014, the EPA advised that the additional stratification and dissolved oxygen marine monitoring was completed appropriately, and a revised operational marine monitoring program then commenced.

The Water Corporation PSDP has an existing licence (L4476/1984/12) to operate pursuant to Part V of the EP Act, the boundary of which is shown in **Figure 1-14**. One prescribed premise category is licenced:

- **Category 54A:** Water desalination plant: premises at which salt is extracted from water if
  - waste water is discharged into marine waters; and
  - the discharged waste water has a density greater than the average ambient density of the marine water at the discharge site.

Water Corporation has a licenced production capacity of not more than 45 gigalitres per year, with a desalination brine volume limit of not more than 68 gigalitres per year at the underwater outfall diffuser. The licence includes a range of conditions, controls and a monitoring program, primarily in relation to desalination brine disposal.

The Water Corporation is implementing an Operational Environmental Management Plan to ensure the Low Ecological Protection Area (LEPA) (**Figure 1-15**) boundary is maintained and key Environmental Quality Objectives (EQO) are achieved. Monitoring under the Operational Environmental Management Plan includes:

- Total dissolved solids (TDS), temperature, and dissolved oxygen (DO) of seawater at locations near the discharge site, LEPA boundary sites, reference sites, and a site in the deeper waters of Cockburn Sound.
- Monitoring of seawater intake and desalination brine for pH, conductivity, turbidity, DO, and temperature.
- Discharge diffuser performance analysis via marine monitoring of TDS at locations along the LEPA boundary.
- Groundwater monitoring upgradient and downgradient of evaporation pond (as well as the interstitial space between liners) for total nitrogen (TN), total phosphorus (TP), TDS, total suspended solids (TSS), DO, pH, conductivity, BTEX and hydrocarbons.
- Volumes of sludge removed from site.
- Analysis of sludge cake composition and ingredients including nitrogen content.

Based on public compliance reports the WPO understands the PSDP is meeting Part IV and Part V environmental approval conditions and no complaints have been received during the most recent reporting period (2021-2022).

Water Corporation has proposed a second desalination plant adjacent to the PSDP (and the Proposal DE) with the intention to be operational by 2032.

The Proposal has the potential to influence the mixing of brine in the vicinity of the PSDP diffuser and in turn affect the Water Corporation's ability to achieve EQO within the LEPA. WPO is actively engaging collaboratively with Water Corporation regarding this issue, including specific hydrodynamic and dispersion modelling. This matter will be addressed further in the ESD and ERD.

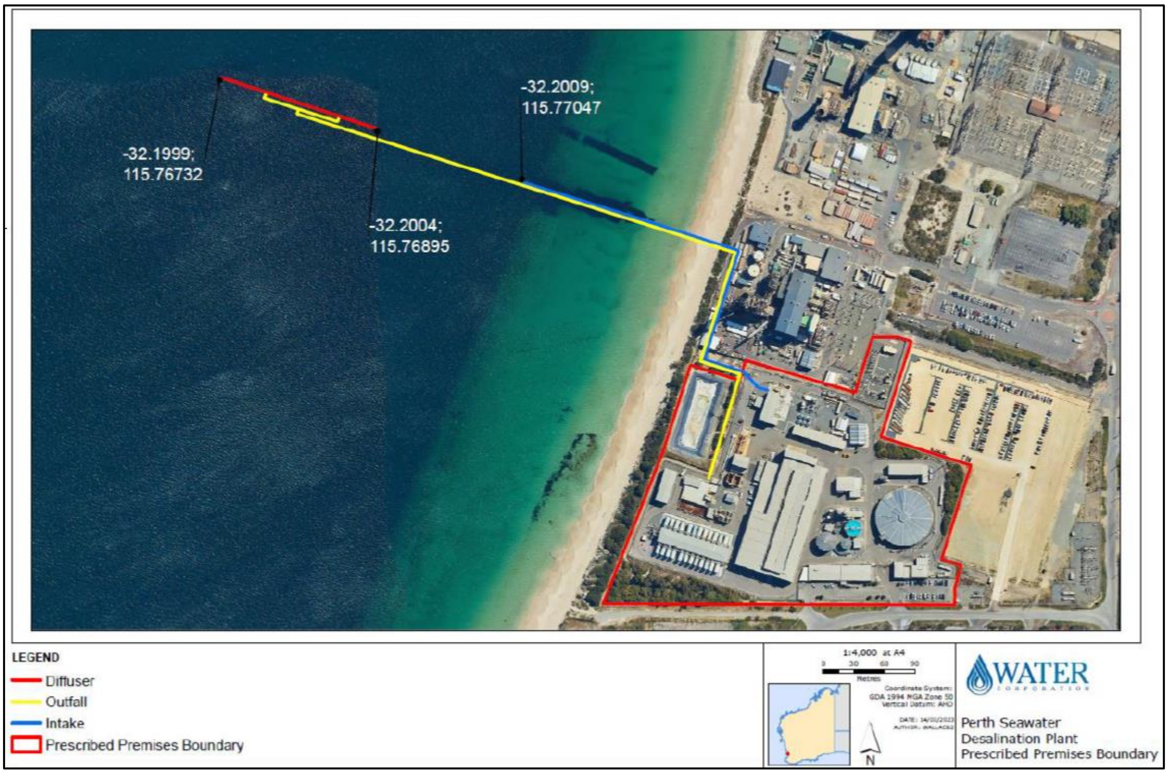

Figure 1-14: PSDP prescribed premise boundary (DWER 2023)

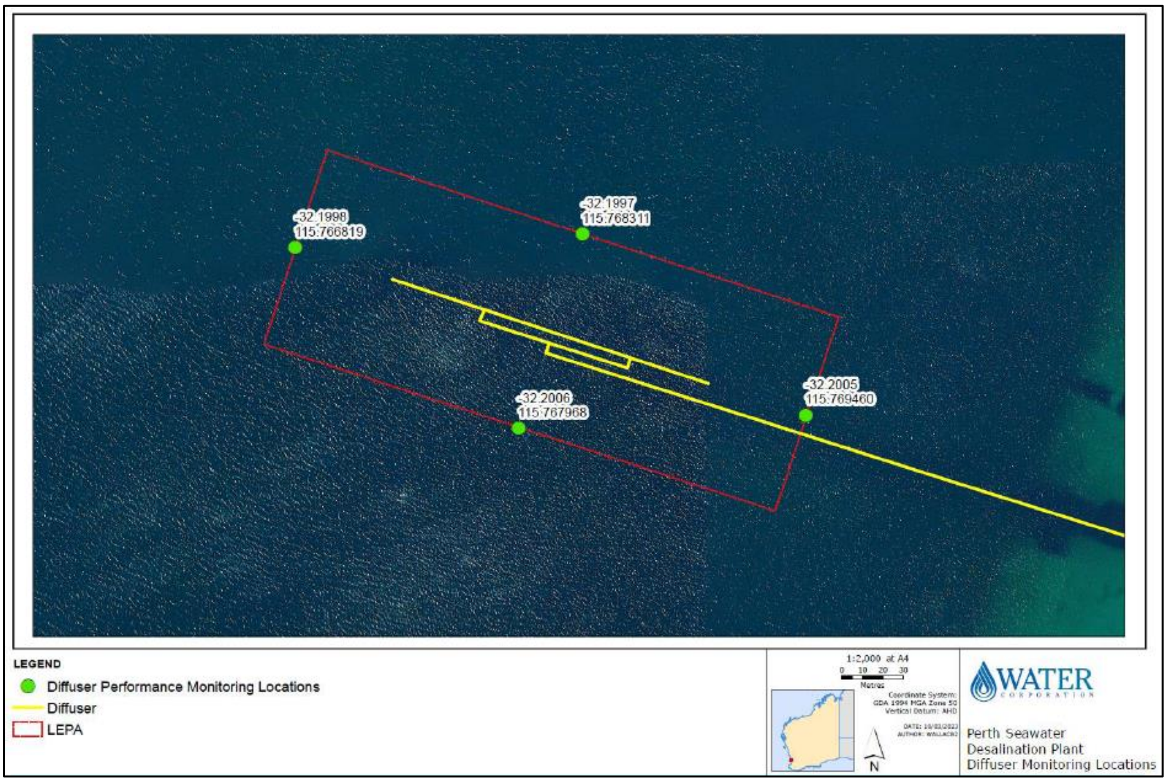

Figure 1-15: PSDP Low Ecological Protection Area (LEPA) (DWER 2023)

1.4.6.2 Kwinana Bulk Terminal

The Fremantle Ports KBT operates from KBB2 and an adjacent landside facility under an existing licence (L4476/1984/12) pursuant to Part V of the EP Act, the boundary of which is shown in **Figure 1-16**. Two prescribed premise categories are licenced:

- **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.
- **Category 58A:** Bulk material loading or unloading: premises on which salt is loaded onto or unloaded from vessels by an open materials loading system.

Table 1-10 summarises the bulk materials which are exported and imported at the facility, include the volumes assessed by DWER when determining licence conditions.

Table 1-10: Bulk materials approved for export and import at the KBT facility

Commodity	Import/export	Volume (tonnes)
Iron ore, Bauxite	Export	5,000,000
Silica sands	Export	2,600,000
Cement clinker	Import	1,400,000
Gypsum, granulated slag, nut coke (combined)	Export and import	550,000
Spodumene	Export	400,000
Total tonnage		**9,950,000**

KBT is primarily a dry bulk import and export facility, but also supports the export of around 60,000 tonnes of LPG and associated products as liquid bulk.

KBT has a licenced production capacity of not more than 50,000 tonnes per day (cumulative across both prescribed premise categories), equivalent to a maximum of 18,250,000 tonnes per year. **Table 1-11** summarises the reported actual annual production quantities at KBT for the past three years. Average annual production over this time period is approximately 16% of maximum licenced production capacity.

Table 1-11: Actual annual production quantities at KBT

Reporting period	Annual production quantity (Category 58 & 58A combined)
01/08/2019 – 31/07/2020	3,079,812 tonnes
01/07/2020 – 20/06/2021	3,333,502 tonnes
01/07/2021 – 30/06/2022	2,218,901 tonnes

The licence includes a range of conditions, controls and a monitoring program pertaining to emissions (dust, wash water discharges and spills to marine environment, stormwater discharges, general emissions from primary activities).

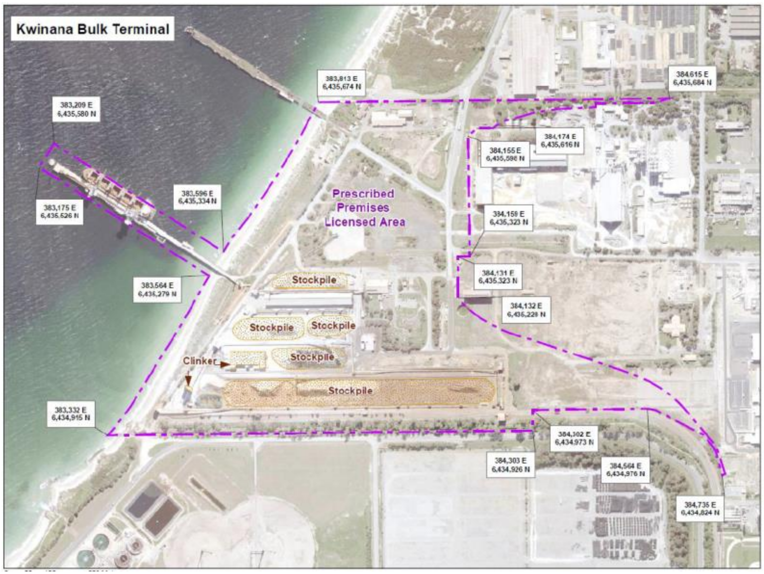

Figure 1-16: Kwinana Bulk Terminal prescribed premises boundary (DWER, 2022)

1.4.7 Aboriginal cultural heritage

Noongar people are the Traditional Owners of the south-west of Western Australia, within which the Proposal area is located. The Proposal occurs across two Native Title areas, being the Gnaala Karla Booja (WC1998/058) and the Whadjuk (WC2011/009) (**Figure 1-17**).

Traditional Owners have previously expressed the significance of the coastal system to Aboriginal people, and their concern regarding impacts to these values (Fisher, 2005). The following excerpt is from a Noongar dreaming story describing the creation of Cockburn Sound (Landscope Magazine, 2003):

Gumbar Yondock Ancestral Crocodile travelled down from the north and pushed himself onto the land, where his tail cut a deep channel in Cockburn Sound (now known as Gage Roads) and pushed up Rottnest (Wadjemup). The sound of rushing water woke the rainbow sea serpent (Waugal). Waugal smelled the salt and went out to investigate. A battle between the two pushed up Carnac (Ngooloormayp) Island. At Woodman Point, the Waugal manoeuvred and carved out Jervois Bay with his tail. Waugal bit the tail of crocodile, who then gave up, Waugal heard the sea water come rushing into the Swan River (stirred up because of all the fighting) and anchored the severed tail across the entrance, using the hair from his chin and armpit and the crocodile's toenails to anchor the tail down. This formed a reef across the Swan River mouth, and it was jagged like the tail of a crocodile (this reef once blocked the mouth of the Swan River at Fremantle, before it was removed to create Fremantle Harbour). Waugal then made crocodile walk back up north whilst his spirit remained as Garden Island. Hence, Garden Island is known as Meeandip Yondock (Yondock with tail missing).

Noongar Traditional Owners are a key stakeholder for the project. The *Kapi Biddi (Water Pathways), The Westport Aboriginal Engagement Strategy* was prepared in 2019 as a guide for Westport's future planning, delivery and operational phases, and established the Westport Noongar Advisory Group (NAG), as discussed in **Section 3.3.1.5**.

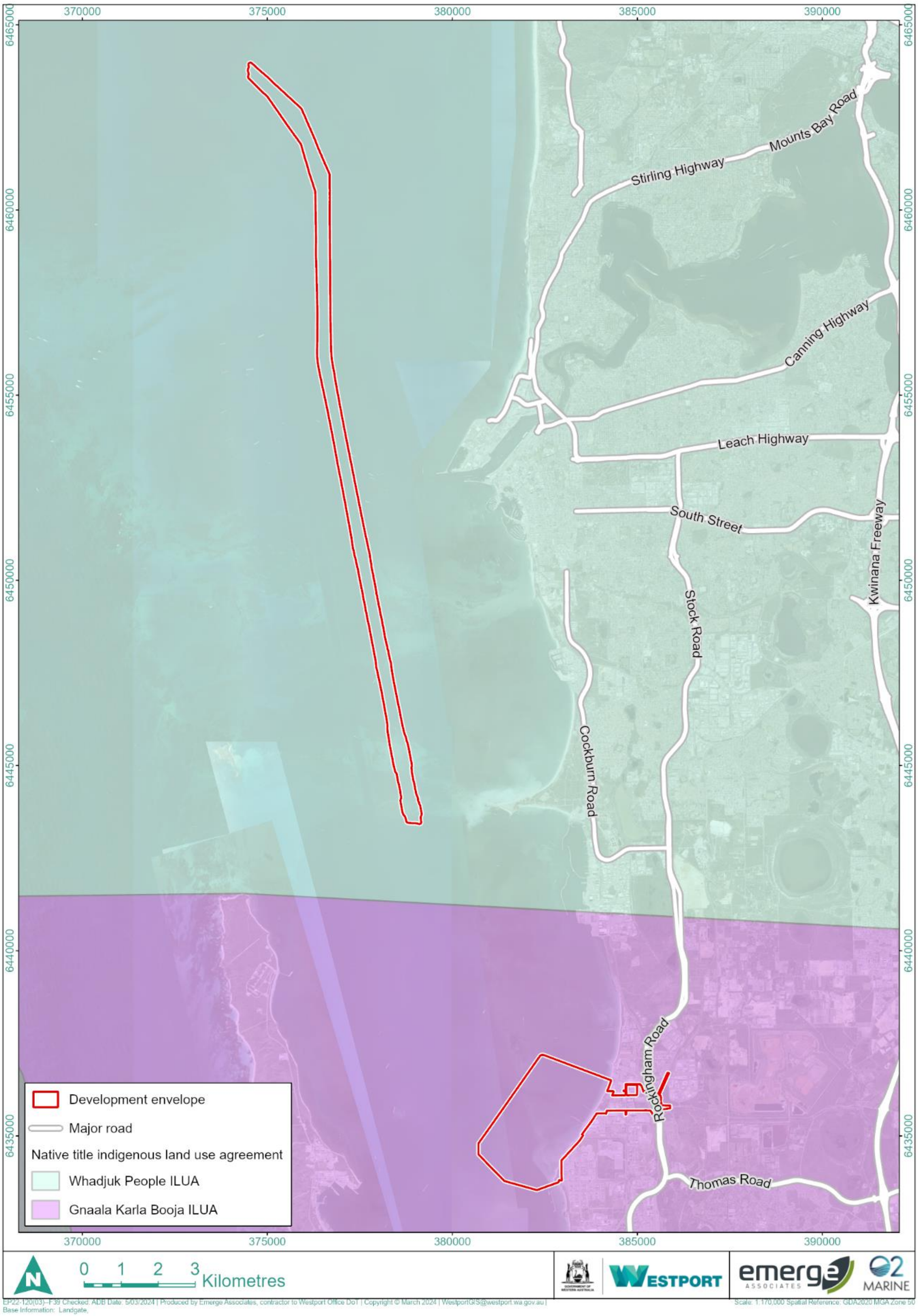

Figure 1-17: Native Title Claim Areas

1.4.8 Climate

The south-west of Western Australia experiences a Mediterranean climate of hot dry summers and cool wet winters. The KIA area receives a mean annual rainfall of around 745 mm, mean annual minimum temperature of 14.5ºC and a mean annual maximum temperature of 23.1ºC (BoM, 2023), as shown in **Figure 1-18**. This is based on climate data recorded between 1955 and 2012 at the Kwinana BP Refinery weather station (BoM station 9064, which was located directly adjacent to the Proposal prior to its closure in 2012).

The south-west of Western Australia experiences three typical wind seasons, including low pressure system storms in winter, afternoon sea-breezes in summer, and high-pressure system calm periods exhibiting low wind speeds in autumn (Steedman and Craig, 1983). Storms occur all year but are most frequent between June and August, with an average of 15 to 30 storm events of 1-5 day duration occurring annually (Lemm et al., 1999). Between September and February the sea-breeze cycle contributes approximately 35% of all wind patterns with strong and persistent south south-westerly onshore winds (Pattiaratchi et al., 1997). Typical wind speed vs direction plots from Medina Research Station (being the nearest available weather station with available wind data) are provided in **Figure 1-19**.

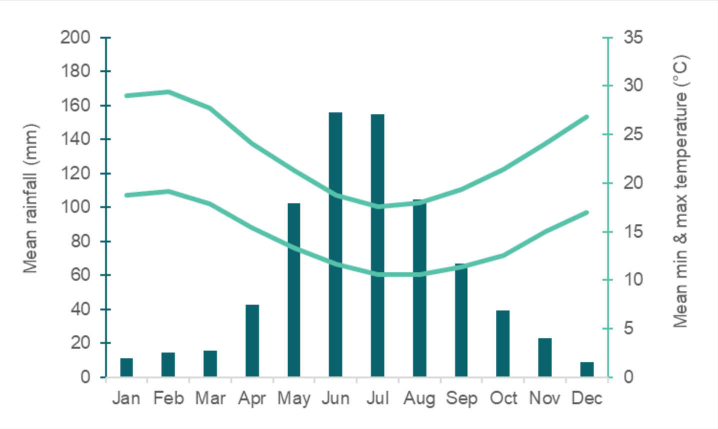

Figure 1-18: Mean rainfall and temperature, Kwinana 1955-2012

The south-west of Western Australia is experiencing a long-term decline in annual rainfall. Since 1970, there has been an approximate 10-20% drop in winter rainfall, which has occurred as a series of step-changes, as opposed to a gradual decline (BoM, 2015). High rainfall years, which were common prior to 1970, have been absent since this time. The south-west of Western Australia is also experiencing a long-term increase in the annual mean temperature anomaly (being the difference between the long-term average temperature and the actual recorded temperature). Based on these long-term trends and the continued impacts of climate change, it is expected that the annual rainfall in the south-west of Western Australia will continue to decline, whilst temperatures will continue to increase. The marine environment is also expected be impacted by climate change, with Intergovernmental Panel on Climate Change (IPCC) modelling indicating that waters around Perth will see long-term trends of increased sea surface temperatures and rising sea levels.

Climate change will need to be considered as part of the EIA process for the Proposal. A Climate Adaptation Strategy is also currently under development for the Westport Program.

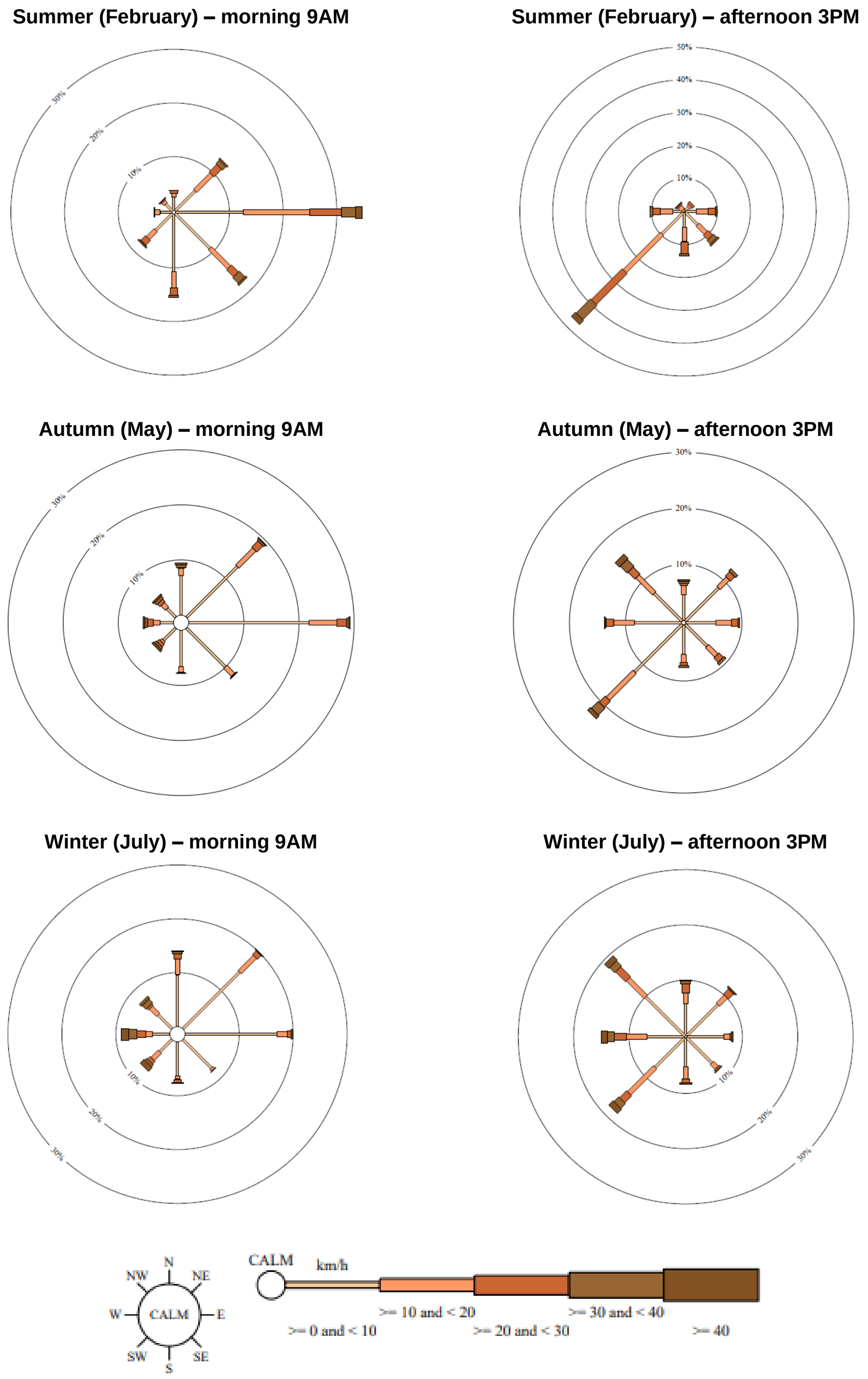

Figure 1-19: Wind speed vs direction plots, Medina 1983-2018

1.4.9 Terrestrial environmental context

1.4.9.1 Conservation areas

The Proposal area does not intersect or adjoin any existing conservation areas. Mt Brown is situated approximately 3km north of the Proposal area, which comprises Bush Forever site 346. Bush Forever sites are areas that have been identified by the State government as comprising regionally significant bushland on the Swan Coastal Plain (WAPC, 2000).

1.4.9.2 Geomorphology and landforms

The Proposal area is located on the western edge of the Swan Coastal Plain, which is the geomorphic unit that characterises much of the Perth metropolitan area. The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Escarpment to the east. Broadly, the Swan Coastal Plain consists of two sedimentary belts of different origin; the western side consisting of three dune systems (Quindalup, Spearwood and Bassendean) composed of wind-deposited soils and the eastern side consisting of alluvial material washed down from the adjacent Darling Escarpment (Seddon, 2004).

The Proposal area is situated on the Quindalup Dune system, which is characterised by uniform pale calcareous sands that are well- to rapidly-drained and consist of wind-blown lime and quartz beach sand. The eastern-most portion of the Proposal area extends into the Spearwood dune system which is characterised by yellow-brown siliceous sands over limestone, with hilly to gently undulating terrain (Seddon, 2004).

The natural foredune landforms typical of the Perth coastline have been heavily modified along the eastern edge of Cockburn Sound within the KIA as a result of industrial development, with limited natural landform remaining within the Proposal area.

1.4.9.3 Terrestrial ecology

Terrestrial ecological values within the Proposal area have been subject to high levels of historical disturbance and clearing as a result of the development and expansion of industrial land uses across the KIA since the early 1950s. Limited remnant vegetation and associated fauna habitat remains in the local area. Given the extensive historical disturbance, the native fauna assemblages utilising the site would be reduced compared to what would be expected in similar environments that had not been subject to such disturbances.

1.4.9.4 Hydrology

There are no watercourses, inland surface water features or wetlands present within the Proposal area or adjacent areas, and the site has a gentle slope from east to west toward Cockburn Sound but is generally flat. Rainfall typically infiltrates freely at the source in undeveloped areas, and in developed areas the surface water flows are driven by anthropogenic features including hardstand runoff and constructed drainage infrastructure.

1.5 Cumulative environmental impact assessment framework

For the purpose of EIA, cumulative environmental impacts are the successive, incremental and interactive impacts on the environment of a proposal with one or more past, present and reasonably foreseeable future activities. Given the cumulative pressures of historical, existing and anticipated future land uses and development in proximity to the Proposal area, it will be important that the Proposal considers cumulative environmental impacts.

A cumulative impact assessment for the Proposal will be completed as part of the future PER. Notwithstanding this, preliminary consideration has been afforded as to which past, present and reasonably foreseeable future activities are likely to be considered as part of the future cumulative environmental impact assessment.

Past and present activities that are likely to be considered include:

- Existing industrial land uses within the KIA, RIZ, AMC and other industrial areas immediately adjacent to Cockburn Sound. For example, including but not limited to:
  - Perth Seawater Desalination Plant
  - Electricity generation plants
  - Alcoa alumina refinery (noting refinery operations are planned to be curtailed)
  - Concrete plants
  - Steel manufacturing
  - Waste incineration
  - Cement production
  - Lithium refining
  - BP oil terminal
  - General industry (e.g. AMC)
  - Fremantle Ports facilities (Kwinana Bulk Terminal and Kwinana Bulk Jetty)
  - Chemical and fertiliser production
  - CBH grain terminal.
- Existing naval operations at HMAS Stirling, subject to the extent to which any required information is non-sensitive and is able to be publicly shared.
- Existing and ongoing maintenance dredging operations for existing channels.
- Existing commercial and recreational fishing activities.

Reasonably foreseeable future activities that are likely to be considered include:

- Main Roads Anketell Road/Thomas Road upgrades, which is anticipated to undertake an environmental impact assessment process at a similar timeframe to this Proposal. These upgrades to the freight road network, whilst independent of the Proposal, would ultimately be used by freight traffic entering and exiting the Proposal's port facility.

- Perth Seawater Desalination Plant 2, which is currently subject to an EPA assessment process (EPA assessment number 2227). This project is located directly adjacent to this Proposal, with some spatially overlapping proposal elements. As such, the proponent is currently working with Water Corporation (the proponent of PSDP2) to coordinate how this should be best addressed. This is expected to involve a redefinition of the PSDP2 proposal that considers and responds to the design of the Westport Proposal.
- Australian Naval Infrastructure (a Commonwealth Government business enterprise whose primary objective is to support the Commonwealth's continuous naval shipbuilding program by being the owner, developer and manager of infrastructure and related facilities) is anticipated to propose an expansion of the Henderson maritime precinct at AMC to include a large vessel dry-dock. Whilst the Proposal has not been referred, an announcement of committed federal funding has been made and referral during the assessment is reasonably foreseeable.
- Other new or upgraded naval infrastructure projects, subject to whether any such projects are proposed or are reasonably foreseeable at the time of the assessment. This will also depend on the extent to which any required information is non-sensitive and is able to be shared with the Proponent.
- BP's proposed Kwinana Renewable Fuels Project within the existing BP Kwinana Terminal site. This proposal seeks to establish a biofuels processing facility, to process vegetable oils, animal fats and other biowaste products to produce biofuels. The proposal has been assessed by the EPA (assessment number 2377), who have recommended that the proposal may be implemented subject to conditions.

Other activities that are not likely to be considered include:

- JPPL Stage 1 (general cargo), as this project did not move forward and its environmental approval has lapsed.
- JPPL Stage 2 (container trade), as this project did not move forward. Whilst the project was referred to the EPA, the environmental impact assessment process was not completed and no environmental approval was granted.
- Fremantle Ports Kwinana Quay Project (Fremantle Ports Outer Harbour Project), as this project did not move forward. The project was referred to the EPA, but was ultimately withdrawn without completing an assessment and attaining approval.

The State Government, through the Department of Jobs, Tourism, Science and Innovation (JTSI), have commissioned WAMSI to investigate cumulative pressures of current and proposed development on the environmental values of Cockburn Sound and Owen Anchorage. The outcomes of the investigation are anticipated to be published in 2024 and will be considered as part of the Proposal's cumulative environmental impact assessment.

The approach and methodology of the cumulative environmental impact assessment, including which past, present and reasonably foreseeable future activities will be considered, will be confirmed as part of future stages of the EIA process, noting that the EPA is currently in the process of development guidance on cumulative environmental impact assessment.

2 Legislative Context

2.1 Enabling legislation and responsible Minster

The Proposal is being developed and referred by the Department of Transport (through the Westport Project Office) and will be under the lawful jurisdiction of the Director General of the Department of Transport on behalf of the State of Western Australia (the Proponent). Once constructed, the port will be a public asset to be managed by an existing or to be determined port authority.

The marine infrastructure components will fall under the:

- *Port Authorities Act 1999*
- *Marine and Harbours Act 1981*
- *Public Works Act 1902*
- *Shipping and Pilotage Act 1967*
- *Navigation Act 2012.*

Landside State transport assets will fall under the:

- *Main Roads Act 1930*
- *Public Transport Authority Act 2003*
- *Government Railways Act 1904*
- *Rail Freight System Act 2000*
- *Rail Safety National Law (WA) Act 2015*
- *Railways (Access) Act 1998.*

2.2 Environmental impact assessment and approval

While more than 50 approvals may be necessary for the Westport Program to proceed, there are two primary environment approvals granted under the State *Environmental Protection Act 1986* (Part IV – Environmental Impact Assessment) and *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (Chapter 4 – Environmental Assessments and Approvals).

Following consideration of this referral, it anticipated and requested that the EPA will assess the proposal at a PER level (see **Section 1.1.5**). The Proponent will then prepare the Environmental Scoping Document (ESD) to define the scope of the forthcoming PER. The assessment and approval will occur in five stages, as per **Figure 2-1**.

It has also been conservatively assumed that following referral of the Proposal under the EPBC Act, that the Commonwealth Minister for Environment will decide the proposed action (the Proposal) is a controlled action. An accredited bilateral assessment process is then proposed to be undertaken, and State and Commonwealth Ministers will ultimately consider the environmental approval of the Proposal and any conditions.

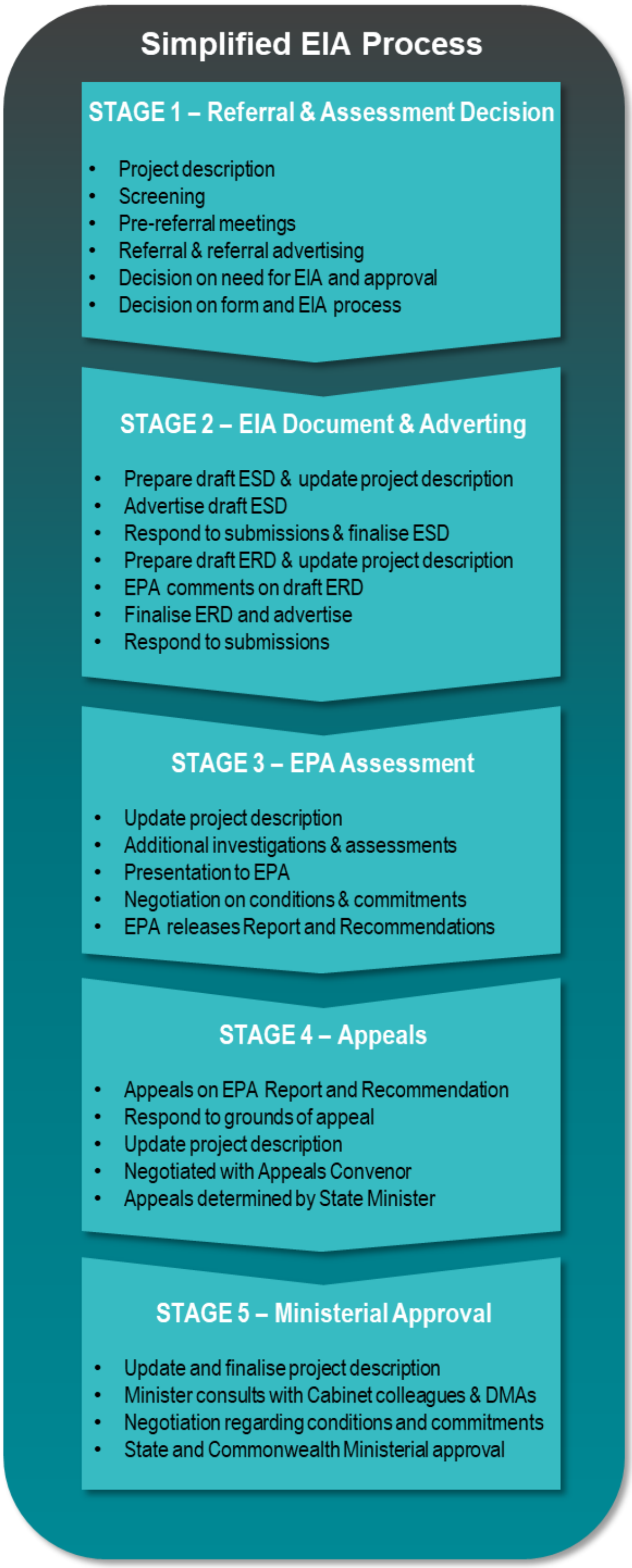

Figure 2-1: Simplified EIA process

2.3 Other approvals and regulation

In addition to the primary approvals under the EP Act and EPBC Act, the proposal is likely to require various secondary approvals and consents outlined in **Table 2-1**. The future PER document will expand on this legislation further.

Table 2-1: Other approvals and regulation

Legislation	Objective	Agency	Can address environmental impacts?
Aboriginal Heritage Act 1972.	Provides a framework for the recognition, protection, conservation and preservation of Aboriginal cultural heritage. Incorporates amendments made in November 2023 following repeal of the *Aboriginal Cultural Heritage Act 2021*.	Department of Planning, Lands and Heritage (DPLH)	Yes
Environmental Protection Act 1986 (Part V)	Part V *Environmental Regulation* of the EP Act provides a framework for the licencing of operations for prescribed premises. The KBT is currently operating under an existing Part V licence. Whilst the relocation of KBB2 jetty (i.e. the construction element) is considered as part of this Proposal, ongoing operation of the jetty and KBT as a bulk import and export facility is expected to be managed under an amended version of the existing KBT Part V operating licence.	DWER	Yes
Planning and Development Act 2005	Provides for a land-use planning system, to promote the sustainable use and development of land, establishes the Western Australian Planning Commission (WAPC) and the role of local government in planning decisions.	DPLH WAPC	Yes
Main Roads Act 1930	Provides for the construction, maintenance, and supervision of highways, main and secondary roads, and other roads, the control of access to roads and for other relative purposes.	Main Roads WA	Yes
Commonwealth *Environment Protection (Sea Dumping) Act 1981*	Provides for the regulation the loading and dumping of waste at sea and the placement of artificial reefs within Australian waters.	DCCEEW	Yes

Legislation	Objective	Agency	Can address environmental impacts?
Contaminated Sites Act 2003	Potential contamination will be investigated, assessed, managed and if necessary remediated consistent with the DWER Guideline: *Assessment and management of contaminated sites*.	DWER	Yes
Government Railways Act 1904	Provides for the maintenance and management of government railways.	Public Transport Authority	Yes
Rail Freight System Act 2000	Provides for the identification and management of railway land corridors.	PTA	Yes
Public Works Act 1902	Provides for public work, which includes railways, harbours and ports, and roads.	Department of Finance	Yes
Rights in Water and Irrigation Act 1914	Regulates the use and protection of water resources, taking water and activities that may damage, obstruct or interfere with water flow or the beds and banks of watercourses and wetlands in proclaimed areas.	DWER	Yes
Biodiversity Conservation Act 2016 *Biodiversity Conservation Regulations 2018*	Provides for protection for biodiversity, particularly threatened species and threatened ecological communities.	DBCA	Yes
Dangerous Goods Safety Act 2004	Regulates the manufacture, storage, handling and transport of dangerous goods and the operation of major hazard facilities, to ensure risk of harm to health of persons and harm to property or the environment is minimised.	Department of Mines, Industry Regulation and Safety (DMIRS)	Yes
Port Authorities Act 1999	Provides for port authorities, their functions, responsibilities, operations and related matters.	Department of Transport	Yes
Fish Resource Management Act 1994	Provides for the regulation of fishing, aquaculture and other aquatic resources.	DPIRD	Yes
Aquatic Resources Management Act 2016	Provides for the management of fisheries and aquatic resource management.	DPIRD	Yes

3 Stakeholder Engagement

3.1 Stakeholder engagement objectives and principles

Extensive stakeholder engagement has been undertaken across all stages of the Westport Program to date, guided by the objectives and principles outlined below.

Objectives:

1. Establish and maintain trust between stakeholders and Westport.
2. Ensure impacted stakeholders are involved and believe the Westport engagement process is considered, transparent and fair.
3. Ensure stakeholder inputs contribute to positive outcomes for their high priority issues.

Principles:

- Respectful treatment of all stakeholders
- Open and clear communication
- Early and proactive engagement
- Inclusivity, to ensure the needs of all stakeholders are heard and acknowledged.
- Collaboration, to harness stakeholder input and expertise.

Westport defines stakeholders as any individual or organisation who have an interest or are impacted by the decision-making process and outcome of Westport. Westport includes the community as a key stakeholder group.

Westport has a large and diverse range of stakeholders, such as academics and thought leaders, industry groups and associations, local governments, marine service providers, other national and international ports, rail and intermodal terminal operators, recreational and environmental groups, shipping lines, stevedores, and Traditional Owners. Residents in the City of Kwinana and adjoining local government areas (LGAs) are considered key stakeholders, while the broader Western Australian public are also stakeholders, given the scale of the proposed Westport supply chain.

Figure 3-1 summarises the different types of stakeholders who have been engaged for Westport. Specific stakeholders are listed in **Section 3.3**.

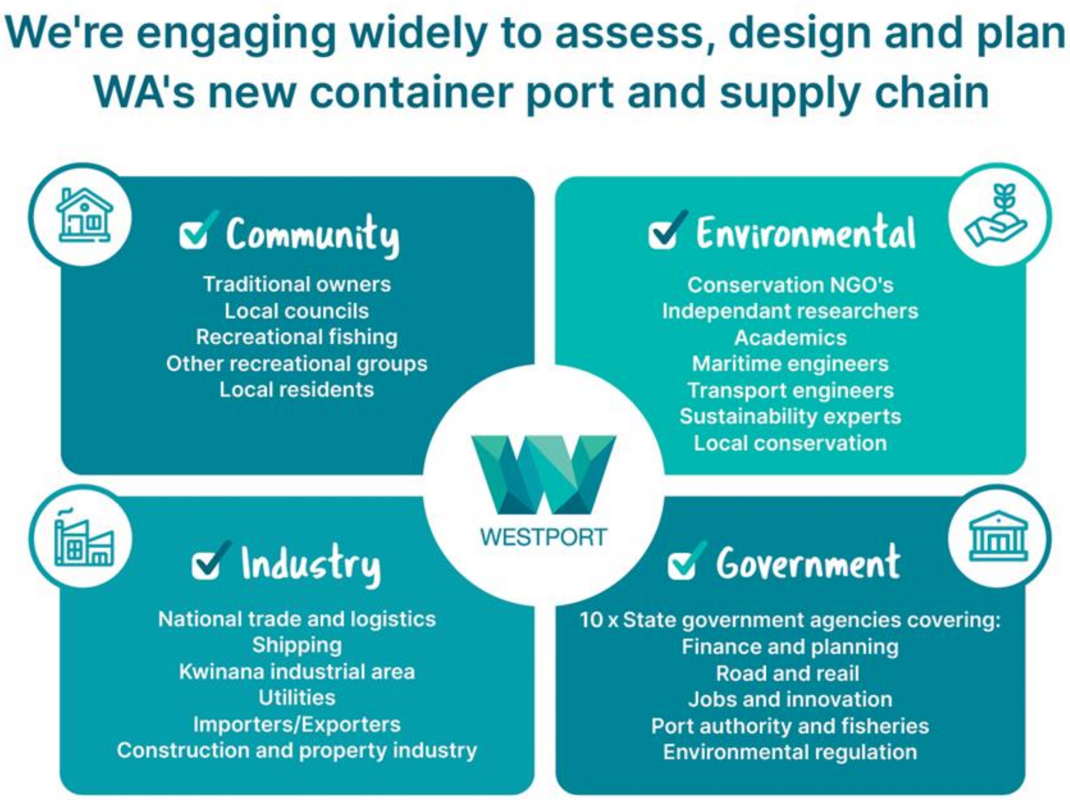

Figure 3-1: Summary of stakeholders engaged for Westport

3.2 Governance stakeholders and structure

The Westport Program is a whole of government planning program with many State Government departments involved in design and development. The current governance structure consists of:

- Major Project Expenditure Review Sub-Committee
  - Run by the Department of Premier and Cabinet and contains Ministers representing different portfolios for the State Government
- Westport Steering Committee
  - Westport
  - Director General – Department of Transport
  - Infrastructure Western Australia
  - Department of Water and Environmental Regulation
  - Western Australian Planning Commission
  - Main Roads Western Australia

- Department of Primary Industries and Regional Development
- Department of Treasury
- Fremantle Ports
- Department of Premier and Cabinet
- Public Transport Authority
- Department of Planning, Lands and Heritage

* Westport Project Control Group
  - Westport (Managing Director, General Manager, Principal Project Director)
  - Fremantle Ports
  - Department of Premier and Cabinet
  - Director Department of Treasury
  - State Solicitors Office
  - Department of Jobs, Tourism, Science and Innovation
  - Department of Transport
  - Department of Planning Lands and Heritage
  - Public Transport Authority.

3.3 Stakeholder engagement process

3.3.1 Westport Stages 1 and 2 (2017-2020)

Stakeholder engagement has been a key component of the Westport Program since the Westport Taskforce was first established in 2017.

3.3.1.1 Westport Reference Group

The Westport Reference Group was first convened in December 2017, following establishment of the Westport Taskforce, to ensure industry, peak bodies and private operators had a voice throughout the planning process and would help to inform Westport's methodology, act as a sounding board for ideas and feedback, and gather diverse input.

The Westport Reference Group had over 90 organisations including:

- Community groups
- Industry
- Peak bodies, unions and member organisations
- State, Federal and Local Government agencies
- Universities and research institutions.

The reference group engaged the following stakeholders to identify eight strategic options for how container trade could be allocated or transitioned across the three port locations of Fremantle, Kwinana and Bunbury:

- Arc Infrastructure
- Australian Marine Complex Common User Facility
- Bunbury Geographe Growth Plan Partnership
- CBH
- Chamber of Commerce and Industry
- Chamber of Minerals and Energy
- Cockburn Sound Management Council
- Cockburn Power Boat Association
- Committee for Perth
- Conservation Council of WA
- Curtin University Sustainability Policy Unit
- Department of Agriculture and Food
- DP World
- Eastern Metropolitan Region Council
- Freight and Logistics Council
- Kwinana Industries Council
- Latitude 32 Community Group
- Livestock and Rural Transport Association
- Local Government (10 LGAs)
- Maritime Union of Australia
- Mediterranean Shipping Company
- Member for Bunbury
- Member for Cockburn
- Member for Fremantle
- Member for Kwinana
- Pastoralists & Graziers Association
- Planning and Transport Research Centre
- Patrick Stevedores
- Peel Development Commission
- Property Council of Australia
- Rail Tram and Bus Union
- Recfishwest
- Sirona Capital
- Southwest Development Commission
- Southwest Group
- Southern Ports Authority
- Transport Workers’ Union
- Urban Development Institute of Australia
- WA Fishing Industry Council
- WA Livestock Exporters Association
- WA Marine Science Institute
- WA Port Operations Taskforce
- Water Corporation
- Western Harbours Alliance
- Western Roads Federation.

The Reference Group played an active role in shaping and contributing to Westport’s process and methodology in the formative phase. As the project progressed into more technical and sensitive investigations in Stage 2, the Reference Group was engaged to provide different perspectives, views and feedback, and communicate information about the project to their networks and members.

3.3.1.2 Environmental Work Stream Working Group

The Environmental Work Stream (EWS) Working Group comprised a number of stakeholder groups, including non-government EWS members self-nominated from organisations represented at the Westport Taskforce Reference Group. The working group provided high level environmental advice, which informed the *Westport Work Stream 2: Constraints and Opportunities Report* and the Westport Taskforce report *Westport: What We Have Found So Far*. These Reports, along with the EWS Working Group were then used to inform Westport Stage 3, particularly to identify potential environmental challenges for port-related development in Kwinana, Fremantle and Bunbury, and formed a basis for more detailed assessment to inform the Westport process.

EWS Working Group Membership and representation:

- DWER
- Westport
- DPIRD
- City of Kwinana
- DBCA
- Fremantle Ports
- JTSI
- Kwinana Industries Council
- Pastoralists and Graziers Association
- Recfishwest
- Southern Ports
- South West Development Corporation
- Western Australian Fishery Industry Council
- WAMSI
- Water Corporation
- Department of Planning
- Department of Transport
- Maritime Union of Australia
- Western Harbours Alliance
- City of Cockburn.

Additional preliminary advice was provided by the external experts from:

- DPIRD
- DPLH
- DWER
- Murdoch University
- University of Western Australia
- Western Australian Museum.

Key outputs of the EWS Working Group include:

- Identification of key environmental and social values that are supported by the terrestrial and marine environments within each area of interest.
- Identification and mapping of potential future sources of pressure in each area (including pressures not associated with potential port development).
- Preliminary assessment of the possible implications of the identified sources of pressures on each value.

3.3.1.3 WAMSI Westport Marine Science Program

The EWS Working Group formed in Stage 1 was the start of the stakeholder engagement process for the WWMSP, discussed in **Section 1.3.1**. The WWMSP has developed over the following timeline:

- April 2018: The Westport EWS Working Group is established with 30 plus members (listed above).
- August 2018: Preliminary risk assessment identified 33 key marine values to be investigated by Westport's science program.
- December 2019: Westport and its partner agencies develop Westport's environmental work plan and budget.
- Early 2020: Westport's environmental work plan refined based on discussions with key stakeholders.
- Mid 2020: Draft WWMSP scope developed.
- March 2021: Westport and WAMSI formalise collaborative agreement.
- May 2021: WAMSI workshops commence to develop the science program for nine key themes.
- September 2021: Westport funds $13.5 million WWMSP.
- November/December 2021: First science projects commence.
- July 2022: WWMSP Science Plan released.

The WWMSP is anticipated to be completed by the end of 2024, with all reports to be published online and be publicly accessible.

3.3.1.4 Community engagement

Community engagement in Stage 2 was targeted at the following key community groups:

- Fremantle, Kwinana and Bunbury communities
- Communities along freight routes (roads and rail)
- Wider Western Australian community
- Interest groups.

These groups were engaged on a number of environmental themes including environmental and social values of Cockburn Sound, PIANC's (World Association for Waterborne Transport Infrastructure) Working with Nature approach [2] and how it is being applied to Westport, the Westport and WAMSI partnership, and environmental constraints.

[2] PIANC Working with Nature "promotes a proactive, integrated philosophy which focuses on achieving the project objectives in an ecosystem context rather than assessing the consequences of a predefined project design and focuses on identifying win-win solutions rather than simply minimising ecological harm" (PIANC, 2023)

Community engagement was completed through the following methods:

- Digital platforms (website, social media, MySay, digital media advertisements)
- Traditional print media (newspapers, television, radio)
- Free community events with paper feedback surveys
- Telephone interviews (two rounds in 2019)
- UWA social values research for community in Fremantle, Kwinana, Bunbury and Greater Perth to determine social and environmental preferences.
- Presentations at 102 external events (a combination of paid and free events)
- Direct mail was sent to a subscriber list of more than 2200 recipients
- Targeted focus groups:
  - Recreational fishers (27 June 2019)
  - Residents living along the freight rail line (8 July 2019)
  - Latitude 32 landowners (13 August 2019)
  - Fremantle Inner Harbour industries (16 September 2019)
  - Kwinana industries (23 September 2019)
  - Local Government authorities (25 September 2019).

Community engagement throughout Stage 2 identified that the environment is one of the most important community values. The PIANC Working with Nature philosophy was adopted for the planning process to ensure that the project objectives were from the perspective of the natural system, and environmental considerations were embedded into the Westport process at each stage. Additionally, environmental criteria used in the MCA were given higher weightings. The key environmental topics based on community and stakeholder feedback for Westport Stage 1 and Stage 2 were:

- Westport should allow for sustainable development of the port industry.
- The Infrastructure Sustainability Council (ISC) rating system should be considered.
- A strategic environmental assessment would allow for feedback on the environmental health of the port location in response to dredging requirements.
- The idea that Cockburn Sound is recovering needs further scientific investigation about likely environmental impacts associated with construction, operation, and maintenance.
- Further Westport publications should expand on the diverse and significant environmental values of the study area.
- Aboriginal heritage and the important history of the First Nations Gnaala Karla Booja people need to be recognised.
- Extend Westport Reference Group to include representation of Indigenous interests.

- Westport should recognise the existing industrial uses of seawater within Cockburn Sound, which include use as cooling water for industrial premises, desalination intake water and outfall of industrial process water (including desalination brine).

3.3.1.5 Aboriginal engagement

In Stage 2, Westport worked with Noongar consultancy Aboriginal Productions and Promotions (APP), led by Dr Richard Walley AO, to engage with relevant Aboriginal stakeholder groups on Westport's behalf. This involved engagement with the South West Aboriginal Land and Sea Council (SWALSC) and other key Aboriginal stakeholder groups in the Fremantle and Kwinana areas. In addition, APP participated in the heritage criteria workshops conducted during the Stage 1 and 2 MCAs to ensure Aboriginal cultural and sacred sites were considered during the assessments.

APP has produced an Aboriginal economic and cultural development plan for future stages of the Westport project, *Kapi Biddi: The Westport Aboriginal Engagement Strategy*. This document will steer Westport's Aboriginal engagement through any future planning, delivery and operational phases.

Westport and APP worked with SWALSC to establish the Westport Noongar Advisory Group that has been initiated for Stage 3.

3.3.2 Westport Stage 3 (2020-2024)

Stakeholder engagement for Westport Stage 3 was underpinned by categories of key stakeholders, as summarised in **Figure 3-2**.

Figure 3-2: Westport Stage 3 key stakeholder groups

3.3.2.1 Stakeholder reference groups

In response to priorities identified through the previous stages of Westport, a number of reference groups were formed for Stage 3, including:

- Supply Chain Industry Reference Group
- Government Trading Enterprise Working Group
- Noongar Advisory Group
- Local Government Reference Group, including members of:
  - City of Armadale
  - City of Belmont
  - City of Canning
  - City of Cockburn
  - City of East Fremantle
  - City of Kalamunda
  - City of Kwinana
  - City of Melville
  - City of Rockingham
  - City of Swan
  - PEEL Alliance
  - Shire of Serpentine Jarrahdale
  - Southwest Group.

Key working groups were also established to address specific environmental themes, as listed below. In addition to formal working group involvement, ongoing and ad-hoc engagement with key stakeholders was undertaken throughout Westport Stage 3 as and when required. For example, a close working relationship with WAMSI scientists delivering the WWMSP has been maintained to seek information inputs and preliminary results for the science program to inform the design process where possible and applicable.

Members from these working groups were invited to the Stage 3 MCA workshops held from July-September 2023 to determine the preferred design option for the container port.

- **Environmental, Social and Governance Reference Group**
  This group is a mechanism for the environmental, social, and governance fields to provide Westport with expertise, experience, and sentiment, and assist Westport decision making. Representatives include:
  - City of Kwinana
  - Curtin University
  - Infrastructure WA

- Murdoch University
  - Road Safety Commission
  - South Metro Tafe.
- **Dredging Working Group**
  This group generates and explores options for a Westport capital dredging campaign (including spoil use and disposal) that maximises environmental outcomes – for input into the port and supply chain planning process. Representatives in:
  - Department of Primary Industries and Regional Development
  - DBCA
  - DWER
  - JTSI
  - Fremantle Ports
  - WAMSI
  - Westport SCID Consultancy (WSP and BMT)
  - Westport EIA Consultancy (Emerge Associates and O2 Marine)
  - Damco Consulting
  - Boskalis
  - In2Dredging
  - Van Oord.
- **Marine Mitigation Working Group**
  This group evaluates and recommends priority resilience-building measures to mitigate the direct and indirect impacts from the proposed Westport development, and improve the long term marine ecosystem health and biodiversity within Cockburn Sound and it's surrounds. Representatives include:
  - Department of Primary Industries and Regional Development
  - DBCA
  - DWER
  - Fremantle Ports
  - Recfishwest
  - University of Western Australia
  - WAMSI
  - Water Corporation
  - Westport EIA Consultancy (Emerge Associates & O2 Marine).

- **Terrestrial Mitigation Working Group**
  This group evaluates and recommend priority resilience-building measures to mitigate the direct and indirect impacts from the proposed Westport development, and improve long term terrestrial ecosystems health and biodiversity within Cockburn Sound and its surrounds. Representatives include:
  - Beeliar Regional Park Community Advisory Committee
  - Bushland Perth
  - City of Canning
  - City of Kwinana
  - Emerge Associates
  - Greening Australia
  - Perth NRM
  - Shire of Serpentine Jarrahdale
  - Westport EIA Consultancy (Emerge Associates).

3.3.2.2 Community engagement

Community engagement during Stage 3 is summarised in **Table 3-1**.

Table 3-1: Summary of Stage 3 community consultation

Audience/Stakeholders	Engagement Medium	Timing
All community and stakeholders	Website updates	2021 onwards
Email subscribers	Monthly project newsletter updates	November 2021 onwards
City of Kwinana and Shire of Serpentine-Jarrahdale local government areas	Letterbox drop – Westport Navigate newsletter with project information	2022
Shire of Serpentine-Jarrahdale and City of Cockburn, targeting people near Anketell Road	Community pop-up events at shopping centres and local markets	March 2022
All community and stakeholders	Community Survey on the Anketell-Thomas Road Freight Corridor, via My Say Transport.	July 2022
All community and stakeholders	Social media advertising via Department of Transport Facebook page	2022 onwards
Sample of 805 residents from Perth and Peel metropolitan area (including Kwinana and Fremantle)	Biannual community perceptions surveys to determine sentiment / understanding of Westport and preferences for engagement.	March 2022 July 2022 May 2023

Audience/Stakeholders	Engagement Medium	Timing
Residents in Kwinana and Cockburn	Community pop-up events at local shopping centres to provide project information and answer questions.	September and October 2023
110,000 residents in City of Cockburn, City of Kwinana, City of Rockingham, and Shire of Serpentine-Jarrahdale	Letterbox drop – letter and flyer outlining Westport preferred design.	December 2023
All community and stakeholders	Community survey seeking broad feedback on the Westport project, via My Say Transport	September 2023 – January 2024
Horse owners who visit the Naval Base horse beach	Community pop-up events at the Naval Base horse beach to provide project information and answer questions	December 2023
Recreational fishers who access Cockburn Sound	Community pop-up events at various fishing locations to provide project information and answer questions	January – March 2024
Community in Cockburn and surrounding areas	Westport marquee at Coogee Live community event	March 2023

Responses to the community survey that ran from September 2023 – January 2024 highlighted that the environment is a key area of interest. The primary environmental themes that have emerged to date include:

- Protection and future health of Cockburn Sound.
- Preserve recreational values of Cockburn Sound.
- Preserve cultural heritage of the Proposal area.
- Inform and consult with community on environmental issues.
- Transition to carbon neutrality and meeting net zero targets.
- Impacts on people living near proposed freight corridor.
- Infrastructure design to improve the environment.

3.3.2.3 Targeted stakeholder engagement on environmental matters

Face to face briefings with specific environmental groups have been ongoing throughout Westport Stage 3, with a number of stakeholders carried over from the Stakeholder Reference Group in Stage 2 (Westport Taskforce).

One of the key environmental groups that have been engaged in a recurring manner is the Cockburn Sound Management Council and its member organisations, including:

- DWER
- Department of Primary Industries and Regional Development

- Department of Health
- Fremantle Ports
- Water Corporation
- Australian Department of Defence
- City of Cockburn
- City of Kwinana
- City of Rockingham
- Kwinana Industries Council
- WA Fishing Industry Council
- Cockburn Power Boats Association.

The Cockburn Sound Management Council has met with Westport regularly throughout Stage 3, addressing a range of information, including:

- General Westport progress updates
- WWMSP updates
- MCA process and inclusion as a key environmental stakeholder
- Ship movements around Cockburn Sound once the port is operational.

Members of the Cockburn Sound Management Council, and other key marine stakeholder groups were invited to a Recreational User Roundtable Briefing at the Westport Office in October 2023. The briefing covered content on the WWMSP, Westport's Mitigation Strategy, and the EIA process. Attendees included the Fremantle Sailing Club, Recfishwest, Cockburn Power Boats and the City of Cockburn.

Stakeholder engagement increased following the Premier's announcement of the Westport preferred design on 29 November 2023. This included a letter and flyer sent to 110,000 residents and businesses near the project area in December 2023, to provide information on the preferred design for the port and freight network, along with targeted engagement with horse owners who access the Naval Base horse beach and recreational fishers accessing Cockburn Sound (**Table 3-1**).

3.3.3 Future engagement (2024 onward)

Westport will continue to engage stakeholders including the community throughout 2024 and beyond, as the projects transitions into business case submission, detailed design and construction.

The EP Act assessment process will involve targeted opportunities for stakeholders and the community to provide direct submissions at each stage of the EIA process, including:

- **Referral** (current stage), where submissions can be made in relation to the level of assessment for the Proposal. The Proponent is requesting the highest level of assessment.
- **Scoping**, where submissions can be made on the Environmental Scoping Document to determine the information to be provided in the future Public Environmental Review.
- **Assessment**, where submissions can be made on the Environmental Review Document advertised through the Public Environmental Review process.

Stakeholder consultation outcomes

The stakeholder engagement process has and will continue to be guided by the Westport engagement objectives outline in **Section 3.1**.

Table 3-2 outlines examples of environmental considerations that have been influenced by stakeholder engagement to date.

Table 3-2: Examples of environmental considerations influenced by stakeholders

Issue/Theme	Key stakeholder/s	Input and Outcome
Protecting recreational fishing in Cockburn Sound	Recfishwest	Input: • Provided ongoing feedback (since Stage 1) that fish species in Cockburn Sound rely on the seagrass nursery meadows for their survival. • Outlined that seagrass beds are home to one of the largest spawning aggregations of Pink Snapper in Western Australia. • Outlined concern about the quantum of Cockburn Sound that may be lost for recreational uses (fishing, boating etc.) due to increased navigational restrictions. Outcome: • Influenced development of the WWMSP with specific studies in relation to seagrass and pink snapper funded. • Informed the various MCAs and associated environmental criteria scoring to date. This included completion of technical investigations and modelling of potential impacts to snapper spawning to inform option selection process and design development.

Issue/Theme	Key stakeholder/s	Input and Outcome
Cumulative impacts on seagrass	Environmental groups, academic institutions	Input • Stakeholders identified a knowledge gap concerning the impact of cumulative pressures on tolerance thresholds for seagrass. Outcome • Knowledge gap was incorporated into the WWMSP as a new area of research.
Avoiding Mount Brown	Environmental groups	Input • The use of Rowley Road as the main freight corridor was expected to result in significant impacts on flora, fauna, wetlands and Aboriginal heritage in the vicinity of Mount Brown. Outcome • Mount Brown, and associated conservation significant environmental and heritage values, avoided by selecting a port option that did not rely on an upgraded Rowley Road corridor.
Protection of seagrass	Terrestrial Mitigation Working Group Marine Mitigation Working Group	Input • Members of both working groups were invited to MCA workshops in July-September 2023. • Areas of seagrass and reef on the Kwinana Shelf were identified as significant environmental assets. Outcome • Environmental values were weighted heavily within the MCA process. • The design option that was subsequently selected avoided these areas of seagrass and reef.

4 Environmental Principles and Factors

4.1 Principles

Table 4-1 provides a summary of the application of the EP Act principles to the Proposal.

Table 4-1: Application of EP Act principles

Principle	Consideration
1. The precautionary principle *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by:* *a. Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* *b. An assessment of the risk-weighted consequences of various options.*	Significant engagement through all stages of the Westport Program has been undertaken with key stakeholders to identify and consider all social, cultural and environmental risks of the Proposal. This will continue to occur throughout the forthcoming assessment process. This enables the identification of key risks, information gaps, monitoring and management requirements and also consideration of any appropriate alternatives to those aspects of the Proposal that may pose most significant risk. The State Government has invested significantly in the WWMSP to address environmental knowledge gaps in relation to Cockburn Sound, which is discussed in **Section 1.3.1**. The WWMSP studies will provide a comprehensive basis of scientific information which is guiding the development of the Proposal to enable known areas of environmental, social and cultural sensitivity and importance to be avoided. The State Government, via JTSI, has also commissioned WAMSI to investigative cumulative pressures of current and proposed development on the environmental values of Cockburn Sound and Owen Anchorage, to develop a whole of system framework for cumulative impact assessment. These studies will be incorporated into the Proposal's EIA.
2. The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.*	The Proposal will future-proof Perth's freight network over the next 50 years and will lead to new jobs and economic diversification, that will benefit future generations. Stages 1 and 2 of the Westport Program have been guided by a supply chain and network-wide approach to decision making, to ensure long-term trade solutions are realised at a whole-of-system level, as discussed in **Section 1.2.2.1**. The Proposal has been designed to avoid and maintain sensitive environmental values, to ensure their health, function and productivity are maintained for future generations. In particular, Cockburn Sound represents a significant environmental and social asset to Western Australians' which is a key consideration of the Proposal. Intergenerational equity is also a key tenant of sustainability. Development of the Proposal is being guided by the Westport *Environmental, Social and Governance Strategy* and the Proponent is also seeking *Infrastructure Sustainability Rating* by the Infrastructure Sustainability Council, which evaluates economical, social and environmental performance of infrastructure across the planning, design, construction and operational phases of infrastructure assets.

Principle	Consideration
3. The principle of the conservation of biological diversity and ecological integrity *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	As outlined above, significant investment has been made in the WWMSP to address environmental knowledge gaps within Cockburn Sound and to attain a strong basis of understanding of the biological diversity and ecological integrity of the system as a whole. This includes WWMSP Theme 1 *Ecosystem Modelling*, which intends to develop a whole of ecosystem model to assess potential impacts of the Proposal at an ecosystem level. The Proposal has been designed with consideration to the *State Environmental (Cockburn Sound) Policy 2015*, which provides a robust and cumulative environmental quality and management framework for Cockburn Sound, to ensure its ongoing protection, including conservation of its biological diversity and ecological integrity.
4. Principles relating to improved valuation, pricing and incentive mechanisms *a. Environmental factors should be included in the valuation of assets and services.* *b. The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.* *c. The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.* *d. Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.*	The Proponent will be responsible for implementing and funding the cost of environmental avoidance, mitigation and management measures. Avoiding and minimising impacts to environmental factors has been a critical consideration informing the Proposal location and design, as outlined in this referral. Where possible, the Proposal will: • Ensure leading best practice standards during construction to minimise emissions and discharges as far as reasonably possible • Source goods and services that have the least environmental impact. The Westport Program has been developed based on the principle of integrated supply chain planning. All elements of the supply chain have been considered to maximise efficiency and minimise waste. As a component of the Westport Program, the Proposal is also based on these principles. Concurrent with the Proposal's EIA process, a business case for the Westport Program will be lodged with Infrastructure Australia to inform decision making around its implementation. The business case includes consideration of environmental opportunities, risks and costs associated with the Proposal.

Principle	Consideration
5. The principle of waste minimisation *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	The Westport Program has been developed based on the principle of integrated supply chain planning. All elements of the supply chain have been considered to maximise efficiency and minimise waste. Where waste is unavoidable, the Proposal has been developed to adhere to the hierarchy of waste controls. A key element of this is the Proposal seeking to re-use dredge material for beneficial uses. This includes reusing dredge material for the port facility reclamation works, amongst other potential beneficial uses that will continue to be explored as the Proposal design progresses and is informed by the outcomes of the WWMSP. A *Resource Use (Circular Economy) Strategy* is currently under development for the Westport Program.

4.2 Preliminary key environmental factors

The EPA defines 14 environmental factors under five themes as the basis for assessing the environmental impacts of a proposal. Environmental factors are those elements of the environment that may be impacted by a proposal and provide a systematic approach to organising environmental information for the purpose of EIA. For each environmental factor, the EPA defines an environmental objective.

Table 4-2 provides an overview of the environmental factors that the EPA may determine to be preliminary key environmental factors requiring further assessment for the Proposal.

Table 4-2: Preliminary key environmental factors

Theme	Environmental factor	Preliminary key environmental factor	Referral chapter
Sea	Benthic communities and habitats	Likely	**Section 5**
	Coastal processes	Likely	**Section 6**
	Marine environmental quality	Likely	**Section 7**
	Marine fauna	Likely	**Section 8**
Land	Flora and vegetation	Likely	**Section 9**
	Terrestrial fauna	Likely	**Section 10**
	Landforms	Unlikely (**Table 4-3**)	N/A
	Subterranean fauna	Unlikely (**Table 4-3**)	N/A
	Terrestrial environmental quality	Likely	**Section 11**
Water	Inland waters	Likely	**Section 12**
Air	Air quality	Unlikely (**Table 4-3**)	N/A
	Greenhouse gas emissions	Unlikely (**Table 4-3**)	N/A

Theme	Environmental factor	Preliminary key environmental factor	Referral chapter
People	Human health	Unlikely (**Table 4-3**)	N/A
	Social surroundings	Likely	**Section 13**

Table 4-3 provides a preliminary assessment of the environmental factors that may not be considered preliminary key environmental factors for the Proposal, on the basis of:

- An absence of relevant and/or sensitive environmental values or considerations applicable to the Proposal, or
- A low level of predicted impact, or
- Application of standard controls can address predicted impacts, or
- Being suitably addressed through other regulatory and statutory mechanisms.

Table 4-3: Other environmental factors

Environmental factor	Preliminary assessment
Landforms	Potential landforms that may be of relevance include coastal foredunes adjacent to Cockburn Sound and potential karst features, which have some potential to occur in the eastern portion of the Proposal area. As discussed in **Section 1.4.9.2**, the natural foredune landforms typical of the wider Perth coastline have been heavily modified along the eastern edge of Cockburn Sound within the KIA as a result of industrial development, with limited natural landform remaining within the Proposal area. The residual coastal foredune landform that intersects the Proposal area is unlikely to be considered a significant landform given: • It is in a highly disturbed condition as a result of historical and existing industrial land uses and development. • Similar foredune landforms are common along the Perth coastline and typically occur in less disturbed condition. • The landform is not a particularly good or important example of its type. On the Swan Coastal Plain, karst features are generally limited to areas comprising a limestone geology, generally being coastal areas. Two distinct areas of south-west Western Australia are known to be prone to development of karstic landforms: Yanchep-Wanneroo north of Perth and Leeuwin-Naturaliste between Dunsborough and Augusta, both of which are not in proximity to the Proposal area. A Preliminary Site Investigation (WSP, 2023) of the terrestrial portions of the DE identified the deeper aquifer (beneath the superficial sandy aquifer) to occur in areas of karstic limestone geology, however these occur at a relatively deep depth of beyond 26 m. Given the nature and extent of historical industrial development across the proposal area, and the surficial geological conditions of the areas, it is unlikely that significant karst and associated cave features occur and remain unknown in surficial layers immediately beneath the Proposal area.

Environmental factor	Preliminary assessment
Subterranean fauna	Troglofauna (air-breathing fauna that live in caves and voids) are most likely to be present in areas that support geological features such as karst, channel iron deposits, banded iron formations, alluvium/colluviums in valley-fill areas and weather or fractured sandstone. No such landforms are known or considered likely to occur within the Proposal area, or in underlying surficial geological layers, and as such it is unlikely that preferred habitat for troglofauna occurs. Stygofauna (aquatic fauna that live in groundwater) are most likely to be present in areas that support geological features such as calcretes, alluvial formations, fractured rock aquifers and karst limestone. No such landforms are known or considered likely to occur within the Proposal area at accessible depths and as such it is unlikely that preferred habitat for stygofauna occurs. Whilst the site is underlain by the superficial Swan groundwater aquifer, which could potentially provide habitat for stygofauna, the potential for significant impacts to stygofauna as a result of implementation of the proposal are generally limited to dewatering during construction (if required) and/or abstraction of groundwater (if required), which are common practices and are regulated through licencing administered under the *Rights in Water and Irrigation Act 1914*. A range of existing industrial land uses within the KIA are licenced to and currently abstract groundwater from the superficial aquifer.
Air quality	Consideration of air quality for EIA relates to air emissions of hazardous, toxic and dangerous pollutants that pose a risk to human health and might otherwise be regulated and licenced under Part V of the EP Act (Environmental Regulation). The Proposal does not include any elements that would result in emissions of this nature, as emissions from construction and operation of the Proposal are generally limited to greenhouse gas emissions (GHG), which are considered in relation to the GHG environmental factor, discussed below. The KIA, within which part of the Proposal area is located, is subject to the *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999* and associated Regulations, which sets ambient standards and limits for sulphur dioxide and total suspended particulate concentrations within the KIA and surrounding areas. Application of the policy provides a regulatory tool to manage the cumulative impacts to air quality from industrial land uses and processes within the KIA that produce these emissions. The majority of sulphur dioxide emissions from KIA are produced as a waste product of heavy industrial processes licenced under Part V of the EP Act. However, operation of vehicles and vessels using fossil fuels also produces sulphur dioxide. As such, trucks, ships and cars that utilise the local area as a result of the Proposal's implementation will therefore produce such emissions, but this is unlikely to significantly contribute to the KIA sulphur dioxide airshed and are separately regulated under Australian Design Rules. The existing regulatory and statutory framework administered under the Kwinana Atmospheric Wastes EPP and associated Regulations can suitably address any potential air quality impacts, which are considered in a cumulative context for the KIA. Air emissions related to dust and odour are considered under the Social Surroundings environmental factor (**Section 13**), as they relate to amenity impacts rather than human health impacts.

Environmental factor	Preliminary assessment
Greenhouse gas emissions	Generally, the EPA considers GHG emissions from a proposal in EIA where they are reasonably likely to exceed: • 100,000 tonnes CO_2-e of scope 1 emissions in any year; or • 100,000 tonnes CO_2-e of scope 2 emissions in any year. Preliminary estimates of GHG emissions for the Proposal during construction and operation phases have been calculated, which indicate that the maximum scope 1 or scope 2 emissions in any given year will not exceed 20,160 tonnes CO_2-e. On this basis, the above threshold values are unlikely to be exceeded. Independent of the EIA process, the Westport Program is committed to ambitious and industry leading climate change impact reductions, with a public commitment to 'Design and catalyse a net zero port and local container supply chain by 2050'. The Proponent is committed to meeting this objective and is preparing a *Net Zero Management Plan*, in accordance with the Westport *Environmental, Social and Governance Strategy*, to be implemented as part of the Proposal.
Human health	Consideration of this environmental factor for EIA relates to potential impacts to human health arising from radioactive sources. The Proposal itself does not include the use or production of any materials or processes that represent a significant radioactive source. Given the nature of the Proposal being to enable container trade via the port, there is potential for the Proposal to facilitate the movement of traded goods entering or exiting the port within containers that contain radioactive sources. Any such potential radioactive sources that would pass through the future port would be transient sources of emissions, as opposed to a static and ongoing source of emissions that have the potential to have prolonged impacts to the human health of workers and operational personnel. This is similar to existing trade operations at the Inner Harbour, which manage risks associated with radioactive material in accordance with the requirements of the Australian Radiation Protection and Nuclear Safety Agency and the *Australian Radiation Protection and Nuclear Safety Act 1998*.

5 Benthic Communities and Habitats

5.1 EPA environmental factor and objective

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

5.2 Relevant policy and guidance

- Environmental Factor Guideline: Benthic Communities and Habitats, EPA, Western Australia (EPA, 2016a)
- Technical Guidance – Protection of Benthic Communities and Habitats, EPA, Western Australia (EPA, 2016b)
- Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals, EPA, Western Australia (EPA, 2021)
- State Environmental (Cockburn Sound) Policy 2015 (EPA, 2015)
- Environmental Quality Criteria Reference Document for Cockburn Sound (EPA, 2017)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)
- National Assessment Guidelines for Dredging (CA, 2009)

5.3 Receiving environment

5.3.1 Studies and investigations

- WWMSP Theme 1: Ecosystem modelling
- WWMSP Theme 2: Benthic habitats and communities
- WWMSP Theme 3: Water and sediment quality
- WWMSP Theme 5: Hydrodynamic modelling
- RPS Sediment Sampling and Analysis
- Westport Geotechnical Study
- Hydrodynamic and Sediment Fate Modelling for Dredging and Reclamation
- BCH Cumulative Loss Assessment
- Westport Numerical Modelling of Sediment Resuspension of Tug Propeller Wash
- 2017 survey of selected seagrass meadows in Cockburn Sound, Owen Anchorage and Warnbro Sound (Fraser and Kendrick, 2017)
- Benthic Habitat Mapping of Cockburn Sound (UWA, 2018)

- Cockburn Sound-Drivers-Pressures State-Impacts-Responses Assessment 2017 Final Report (BMT, 2018a)
- Benthic Macroinvertebrate Fauna Assessment (Oceanica, 2007; 2009; 2013b)

5.3.2 Environmental values

Perth coastal waters support a diverse range of BCH including mixed assemblages of tropical and temperate species from the influence of the Leeuwin Current. Cockburn Sound and Owen Anchorage hold significant environmental, social, and economic values that are of high importance. The Proposal is considered to pose a potential risk to the environmental value of 'Ecosystem Health', and the associated 'Maintenance of Ecosystem Integrity' environmental quality objective specifically developed for Cockburn Sound. In particular the Proposal has the potential to significantly impact the structure and function of important components of the Cockburn Sound marine ecosystem including seagrass (a key indicator of Ecosystem Health), and benthic macroinvertebrate communities.

5.3.3 Local Assessment Units

The EPA provides a risk-based spatial assessment framework for evaluating cumulative irreversible loss of and/or serious damage to BCH (EPA, 2016b), which has been applied to determine potential impacts to BCH as a result of the Proposal. The EPA's technical guidance for BCH, as well as existing defined Local Assessment Units (LAUs) that can be applied to this Proposal, provide a common framework for new assessments and applies an approach that is consistent with the EIA of previous infrastructure projects.

For the EPA to determine if potential losses to BCH are acceptable, the following calculations of the spatial extent of BCH will be required:

- Prior to all human-induced disturbance
- Existing at the time of the Proposal
- Remaining after implementation of the Proposal.

The EPA has previously accepted a defined LAU of area 105.7 km^2 (10 570 ha) for Cockburn Sound (EPA, 2013) which includes the region bounded by the east coast of Garden Island, a line drawn from the north end of Garden Island across to Woodman Point, along the eastern shore of Cockburn Sound and the causeway linking Rockingham to Garden Island. The EPA has also previously accepted defined LAUs for areas north of Cockburn Sound likely to be impacted by the Proposal including Owen Anchorage, Gage Roads and Deep Water Channel (EPA, 2009).

The proposed loss and previous habitat losses within these LAUs will be totalled to determine a cumulative impact that will be assessed against the EPA Objective as well as the overall policy objective for Cockburn Sound, which is to ensure that water quality of the Sound is maintained and where possible improved so that there is no further net loss and preferably a net gain in seagrass areas.

The defined LAUs for the Proposal are presented in **Figure 5-1**.

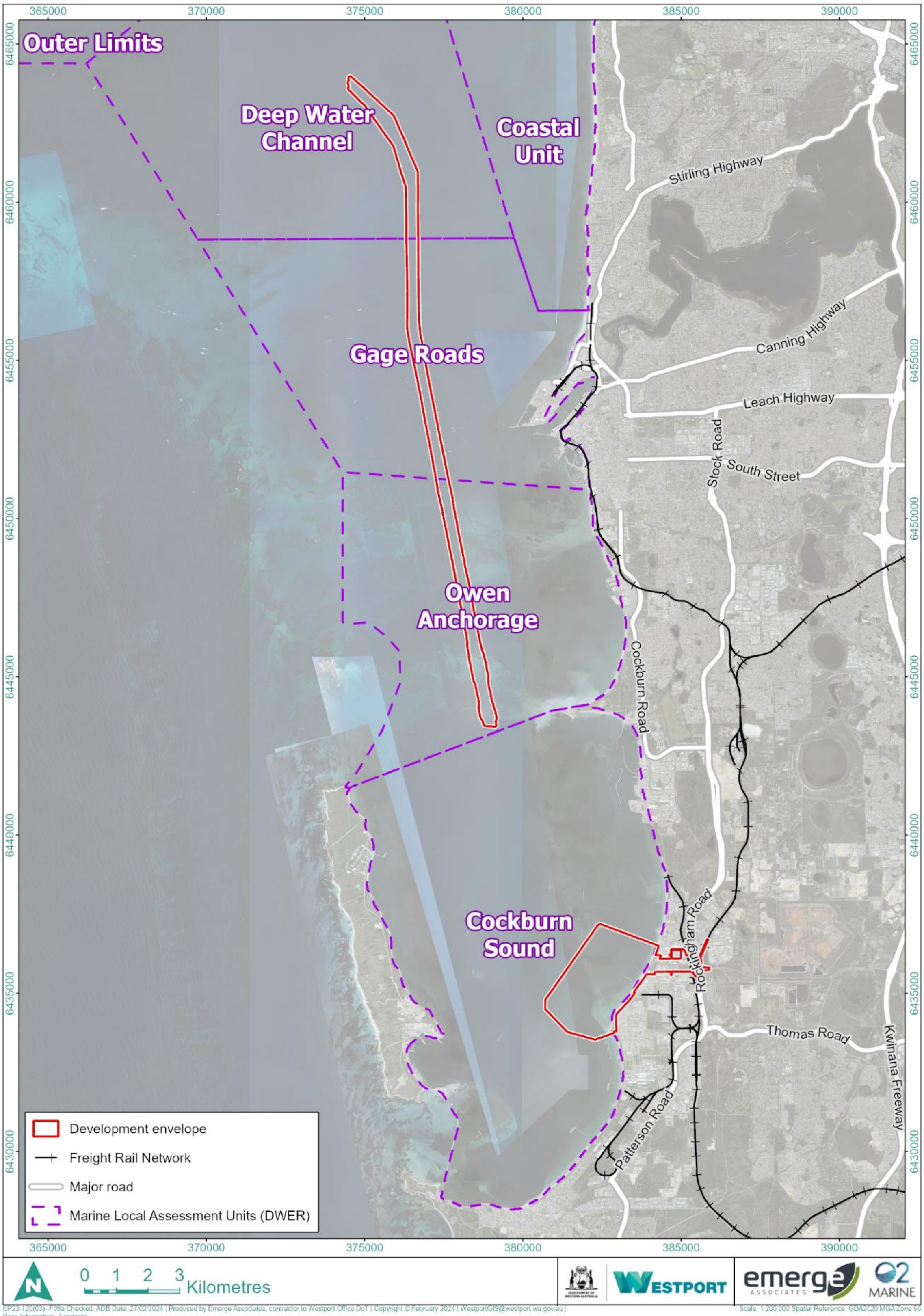

Figure 5-1: Defined Local Assessment Units for the Proposal

5.3.4 General description – BCH

Benthic communities are crucial for maintaining marine ecosystem integrity and providing ecological services. They support biological diversity by offering diverse and structurally complex habitats, acting as a refuge for vulnerable life stages, and providing a varied food supply. These communities also provide significant direct and indirect benefits to humans. In the Western Australian context, benthic primary producer habitats are particularly important due to the nutrient-poor nature of coastal waters. Unlike pelagic primary producers, such as phytoplankton, which depend on consistent nutrient supply such as through upwelling, benthic primary producer communities are able to rapidly assimilate and store nutrients if and when they become available. Benthic primary producers form the foundation of coastal food webs that support recreationally and commercially important fisheries. Additionally, certain benthic communities form three-dimensional structures that attenuate wave and current energy, offering seabed and shoreline protection. By maintaining healthy and viable benthic communities, the resilience of marine and coastal environments may be enhanced despite increasing human use and climate change challenges.

The assessment of environmental impacts to BCH from proposals should consider their fundamental ecological function and importance, particularly benthic primary producers, and the potential consequences of their loss for marine ecological integrity and biological diversity at local and regional scales.

5.3.5 Benthic primary producer habitat

Benthic primary producers (BPPs) are predominantly marine plants, for example seagrasses and macroalgae, but include invertebrates like hard corals and some sponges that host symbiotic photosynthetic organisms. BPPs and associated organisms grow attached to the seabed and play a crucial role in ecosystem structure and function within intertidal and subtidal areas that receive sufficient sunlight for photosynthesis.

The temperate coastal waters of Western Australia are recognised for containing one of the world’s most diverse seagrass floras. Seagrasses are flowering plants and important primary producers in the Western Australian context. These plants support numerous food chains and highly productive ecosystems in a nutrient poor environment. They provide food and shelter for many organisms and are a nursery ground for commercially important prawn and fish species. The primary production rates of seagrasses are closely linked to production rates of associated fisheries.

Seagrass in Cockburn Sound has historically been considered to grow in areas with a depth of 10 m or less. This defined 10 m depth limit has been used previously for both management and assessment of impacts to seagrass in the Sound and is strongly correlated to availability of benthic light which is attenuated to about 90-95% of surface values within 8-10 m water depth, which is still enough light to allow seagrasses to grow (BMT, 2018a). However, it is noted that in the right conditions, seagrasses across the Proposal area (particularly in Owen Anchorage and further north) can be found at deeper than 10 m at reduced densities. For the Proposal EIA, seagrass loss calculations will be undertaken using the latest mapping of BCH extent. Potential seagrass habitat (on bare substrate/sand) has been assumed down to a depth of 12 m.

5.3.5.1 Cockburn Sound

Seagrasses are the dominant BPP of Cockburn Sound in terms of primary productivity (BMT, 2018a). There are only 72 seagrass species worldwide, 13 of which are found in the local region. The six main meadow-forming seagrass species are *Amphibolis griffithii*, *A. antarctica*, *Posidonia australis*, *P. sinuosa*, *P. angustifolia* and *P. coriacea*. In Cockburn Sound, seagrasses mainly comprise species from the genera *Posidonia* and *Amphibolis* (Hovey and Fraser, 2018) with the densest meadows of *P. sinuosa* or *P. australis* occurring in shallow sheltered areas of the Sound. Cockburn Sound had extensive areas of these species before broad-scale seagrass loss occurred in the late 1960s to early 1970s. Although the areal extent has decreased significantly, particularly on the eastern margin of the Sound, most species persist in the remaining stands of seagrass.

Microphytobenthos (MPB; microscopic algae that reside on the surficial layer of sediments) also play an important role in the provision of primary production to Cockburn Sound but remains poorly studied and understood. Algal epiphytes, which grow on the leaves and stems of seagrasses, and macroalgae (e.g. *Ecklonia radiata*) growing on reef substrates are also contributors to primary production in Cockburn Sound. Some corals of the Faviidae family also occur in the Sound but their contribution to primary production is considered minor.

Given their ecological importance and dominant role in primary production in Cockburn Sound, seagrasses have drawn the most attention of the BPP groups in Cockburn Sound where it was estimated that seagrass meadows originally occupied more than 4000 hectares, covering most of the seabed at depths of 10 metres or less (BMT, 2018a).

During the late 1970s, an environmental study identified significant industrial discharge as the primary cause of poor water quality and the widespread loss of seagrass. In response, industry reduced its contaminant and nutrient discharges such that by the early 1980s water quality had improved. However, almost 80% of the seagrass habitat (mainly *Posidonia sinuosa*, *Posidonia australis*, and *Amphibolis*) was lost in the Sound between the 1960s and early 2000s before measures were established to curb the flow of contaminants and nutrients into the Sound (Kendrick et al., 2002).

Historical anthropogenic loss of seagrass extent includes localised impacts from scouring around coastal infrastructure as well as direct loss from dredging and spoil disposal activities. However, the primary cause of seagrass loss in the Sound has been long-term changes in marine environmental quality due to nutrient enrichment (eutrophication) from industrial development and associated effluents.

Water quality declined again in the late 1980s triggering another investigation, the Southern Metropolitan Coastal Waters Study (1991-94). This study determined that although seagrass dieback had slowed, nutrient related water quality was deteriorating again and only marginally better than it was in the late 1970s. Wastewater was subsequently diverted to Sepia Depression, and since the 1980s the water quality conditions have improved significantly and seagrass distribution has stabilised.

More recent observations of seagrass meadows' 'lower depth limit' present encouraging signs of their improving vitality in certain areas. Notably, the seagrasses at Garden Island south and Woodman Point appear to be expanding their depth range (Fraser et al., 2016; Rule, 2015). This pattern implies there has been an increase in water clarity and light reaching the seabed which is crucial for seagrass growth. These plants are now found near their natural depth limits in Cockburn Sound (Collier et al., 2007).

Although water quality has improved and seagrass losses appear to have stabilised, the increase in seagrass extent has been minimal (approximately 132 ha gained between 2008 and 2017), and long-term monitoring sites have shown a decline in seagrass condition based on shoot density at certain locations (Hovey and Fraser, 2018).

Despite positive signs of seagrass extent recovery, the decline in seagrass health (shoot density) in certain areas within Cockburn Sound remains a concern (BMT, 2018a). While it is evident that seagrass health can no longer be regarded solely as a nutrient related water quality issue, the reasons for these declines remain unclear.

The results of more recent studies suggest that sediment stressors (sulfide intrusion) may contribute to declining *Posidonia sinuosa* shoot densities in Cockburn Sound (Fraser and Kendrick, 2017). Recent studies suggest that toxic sulfide intrusion, via the sediments, is also likely to be implicated in changes in seagrass health and is now considered a potential driver of seagrass decline in Cockburn Sound. It is also probable that long-term monitoring of seagrass health at fixed locations may have introduced a level of sampling disturbance, possibly contributing to the measured declines in seagrass shoot densities (BMT, 2018a).

The WWMSP Project 2.3 Seagrass Restoration is investigating the environmental conditions and processes which are important to seagrass and how this information can be used to improve seagrass restoration outcomes.

5.3.5.2 Owen Anchorage

Like Cockburn Sound, the BPP habitats of Owen Anchorage are dominated by seagrasses. Much of the offshore area of Owen Anchorage is dominated by Amphibolis spp., while inshore is represented by a mosaic of meadow forming species from the genus Posidonia and Amphibolis, including *P. coriacea*, *P. sinousa*, *P. australis* and A. Griffithi (BMT Oceanica, 2017). Coloniser species that have been reported in the area include Zostera sp., Halophila sp. and Syringodium sp. (BMT Oceanica, 2017).

The overall extent of seagrass in Owen Anchorage appears relatively stable, although localised changes are common (BMT Oceanica, 2017). Studies in support of the EIA for a previous dredging project established that seagrass meadows on Success and Parmelia Banks are dynamic, with continuous active colonisation, recession and changes in seagrass cover and species composition (DAL and PHC, 2000).

Long term shellsand dredging activity on Parmelia and Success Banks, operating since 1972, is required as part of its approval to obtain aerial photography annually, and to undertake detailed ground truth surveys of benthic habitats every 5 years, to track changes (losses and gains) in seagrass cover due to natural causes, dredging and other anthropogenic impacts.

The 2004 mapping exercise examined changes in benthic habitat cover since 1999 and found the overall proportion of vegetated habitat in the study area had not changed, although losses and gains were observed in various regions (Oceanica and CRC, 2005). The greatest gains in vegetated cover occurred as edge growth along existing seagrass meadows. Most declines of vegetated habitat outside of the dredging footprint were considered natural, although losses in Parmelia Bank East appeared to be associated with approved dredging activity in the area (Oceanica and CRC, 2005).

Vegetated habitat occupied ~2175 ha of the Owen Anchorage study area in 2004 compared with ~3193 ha in 2009. The mapping methods used suggested that between 2004 and 2009 the percentage of seagrass habitat in the study area increased by ~15% (~1018 ha) as a proportion of overall area. Gains in seagrass cover appeared to occur predominantly in areas of sparse vegetation and were determined to be partly a consequence of improved technology and capacity to capture better resolution images of seagrass cover, as well as real increases in seagrass extent (BMT Oceanica, 2017).

Preliminary WWMSP Project 2.1 BCH mapping of Owen Anchorage provided in **Figure 5-2** indicates that seagrass extent across Owen Anchorage has not changed significantly since 2009, again with losses and gains observed in various regions and across species. In summary, the extent of BCH across Owen Anchorage has remained relatively stable since at least 1999 when detailed contemporary mapping studies commenced.

Additionally, increases in estimated ecological value between 1972 and 2004 have been largely attributed to a considerable increase in seagrass cover that has occurred in the region since 1972 (Kendrick et al., 2002; Oceanica and CRC, 2005), which has helped offset some of the losses due to maritime and commercial dredging.

5.3.5.3 Gage Roads and Deep Water Channel

The marine environment north of Cockburn Sound and Owen Anchorage near Fremantle (described in this document as Gage Roads and Deep Water Channel) is primarily characterised by sand covering limestone pavement. Seagrasses, both perennial (such as *Amphibolis griffithii* or *Posidonia australis*) and ephemeral (like *Halophila ovalis*), are the dominant primary producers on the sandy areas (Kendrick et al., 2002; Kirkman and Kirkman, 2000; SKM, 2009). Amphibolis spp. and Posidonia spp. are the dominant seagrass genera within the Gage Roads and Deep Water Channel areas (Kirkman and Kirkman, 2000).

Coral can also be found in the nearshore and offshore areas of Gage Roads and Deep Water Channel, with the highest percentage of coverage observed at Hall Bank, located ~3 km northwest of the Swan River entrance in Fremantle. Hall Bank stretches about 250 m in length and 50-100 m in width, with a maximum depth of around 6 m and surrounding waters reaching depths of about 15 m (BMT, 2021). A comprehensive study conducted by Thomson and Frisch (2010) documented the presence of fourteen coral species from eleven genera belonging to ten families at Hall Bank. The average coral cover across seven transects was 52.6%, with one transect reporting the maximum coral cover of 72.5%, which is the highest ever recorded coral coverage at or beyond 32°S (Thomson and Frisch, 2010).

There have been anecdotal observations of a potential decline in coral cover at Hall Bank since the study conducted by Thomson and Frisch (2010), possibly associated with the marine heatwave event that occurred during the summer of 2010-2011 and resulted in widespread coral declines along the Western Australian coastline (DEC 2012). Nevertheless, Hall Bank remains one of the few known areas in the vicinity of the Proposal that exhibits a significantly high abundance and coverage of coral in the marine environment.

The current extent of BCH using the latest WWMSP Project 2.1 BCH mapping for Cockburn Sound, Owen Anchorage, Gage Roads and Deep Water Channel is provided in **Figure 5-2**. It is important to note that the WWMSP Project 2.1 BCH mapping is not complete so **Figure 5-2** is preliminary and does not present the final BCH mapping to be used in the Proposal EIA.

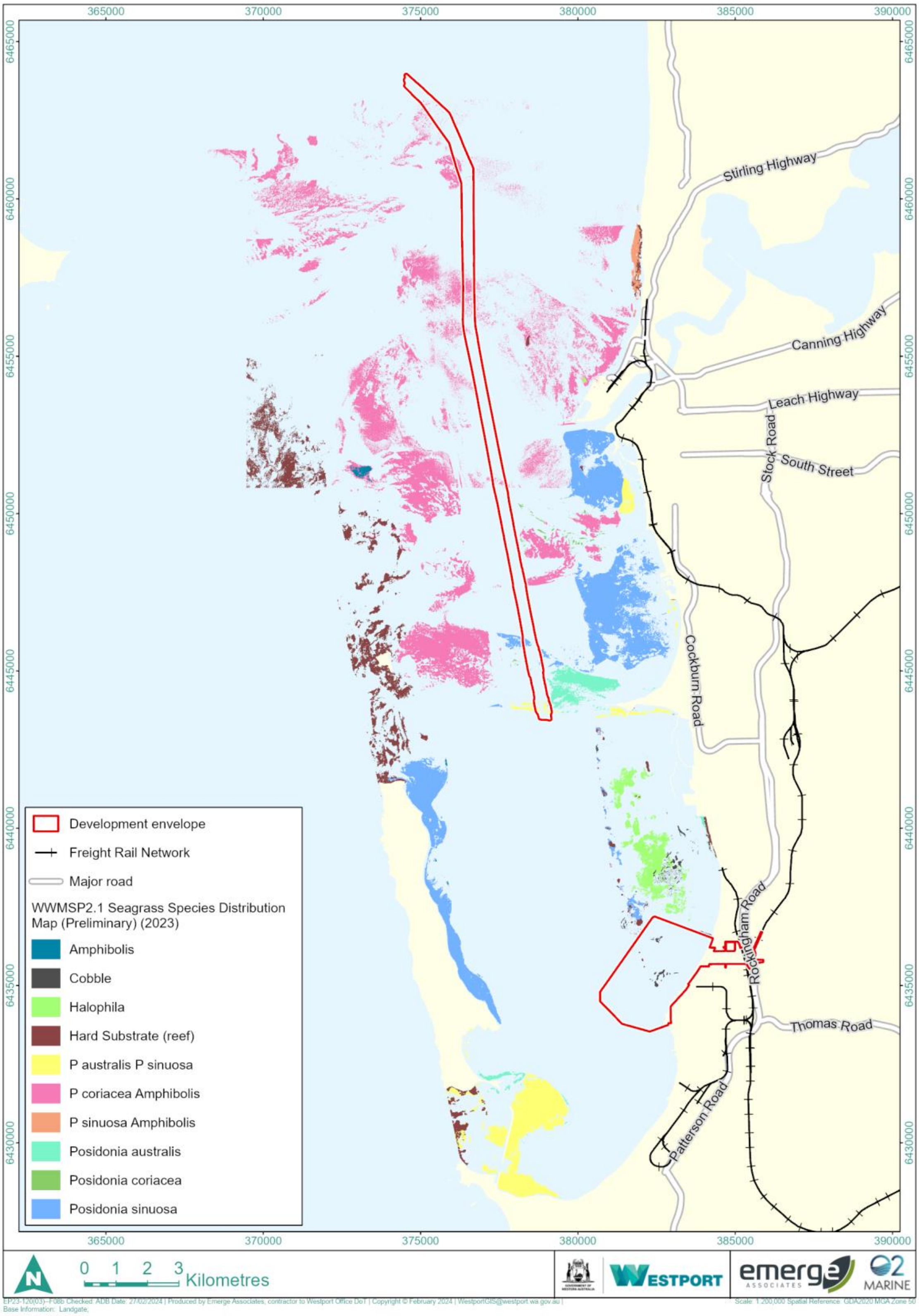

Figure 5-2: BCH mapping (WAMSI, unpub.)

5.3.6 Benthic communities

Benthic macroinvertebrates (infauna associated with soft sediments and epifauna associated with soft sediments and hard substrates) provide a range of key ecological functions, including providing direct and important food sources for a range of marine fauna (e.g. pink snapper and blue swimmer crabs), as well as higher trophic levels including dolphins. They also play important roles in detrital and nutrient cycling through bioturbation altering biogeochemical conditions and filter feeding particles from the water column.

Various environmental factors and ecological interactions significantly influence the abundance and composition of benthic communities. These factors include changes in seagrass canopy, reduced primary productivity, predation, and competition (Jernakoff et al., 1996). Furthermore, macroinvertebrate assemblages have shown sensitivity to sudden changes in physical conditions such as salinity, temperature, and dissolved oxygen (Bath et al., 2004).

Over the past four decades, three comprehensive investigations have been conducted on benthic communities in the deep basin of Cockburn Sound. While earlier studies differ in sampling sites, methods, and taxonomic identifications, it was evident that substantial changes in benthic macrofauna communities have occurred between the 1970s and recent years (Oceanica, 2013a). These changes include shifts in species abundances, distribution, and community indices, including species diversity (Oceanica, 2013a). It is likely that modifications to the benthic marine environment, at least in part, account for these shifts in the benthic macroinvertebrate assemblage structure in parts of Cockburn Sound, however, it is difficult to confirm if the functional and ecological role of the present community has experienced a similar shift.

More recently the WWMSP Project 2.4 seeks to characterise and improve our understanding of benthic communities in the soft sediments of shallow waters (< 10 m) on Parmelia Bank and Kwinana Shelf and soft sediments of deeper waters (> 10 m) in the basin of Cockburn Sound. This research project aims to provide critical data on benthic systems for the EIA of the Proposal, and underpin future mitigation plans for large-scale artificial reef projects. The project aims to:

- Provide baseline data on benthic communities in soft-sediment and on natural hard substrates.
- Determine the pressure-response relationships of key benthic macroinvertebrates to suspended sediment and sedimentation.
- Determine the feasibility of artificial reef substrates for the settlement of native biota.

The key benthic macrofauna within the main habitats of Cockburn Sound are provided in **Table 5-1**.

Table 5-1: Key benthic macrofauna within the main habitats of Cockburn Sound

Habitat type	Infauna or epifauna	Taxa
Fine sediments	Infauna	Polychaetes, crustaceans, bivalves
	Epifauna	Echinoderms, anemones, ascidians, gastropods, decapods
Seagrass beds	Infauna	Polychaetes, crustaceans, bivalves
	Epifauna	Crustaceans, sponges, echinoderms, gastropods, decapods
Reef	Epifauna	Echinoderms (holothurians and ophiuroids), crustaceans (barnacles, crabs), sponges, ascidians

5.4 Potential environmental impacts

The risks and potential impacts on BCH and related values arising from the Proposal will be assessed in the context of EPA technical guidance for protecting BCH and for assessing dredging impacts. Predicted impacts will include cumulative impacts associated with past, present and reasonably foreseeable future activities (see **Section 1.5**). Impacts to BCH will be assessed by considering the following key impact pathways.

5.4.1 Direct impacts

During the construction phase of the Proposal the following key activities and resulting impacts have the potential to adversely impact on BCH:

- Direct loss (removal and burial) of BCH due to dredging within the indicative footprints and the burial of habitat within the port facility, offshore breakwater, and reclamation area.

5.4.2 Indirect impacts

During the construction phase of the Proposal the following key activities and resulting impacts have the potential to adversely impact on BCH:

- Indirect loss or impact to BCH caused by:
  - reduced benthic light availability due to increased light attenuation by turbidity generated through dredging and reclamation/disposal.
  - smothering due to settlement of sediments released by dredging, disposal and resuspension.
  - Release of toxicants and/or nutrients to the water column due to disturbance of sediments.

During the operations phase of the Proposal the following activities and resulting impacts have the potential to adversely affect BCH:

- Indirect loss of BCH caused by altered patterns of longshore sediment transport, and/or bottom shear stresses due to wave shoaling and reflection in front of the port infrastructure, resulting in erosion or smothering of seagrass, creating a 'halo' effect of bare sand.
- Indirect loss or impact to BCH caused by chronic turbidity generated through operations at the port, increased vessel traffic and tug propellor wash.
- Indirect loss of BCH caused by altered groundwater flows.
- Indirect loss or impacts to BCH as a result of sediment plumes caused by maintenance dredging.
- Loss of BCH caused by release of hydrocarbons or other chemical toxicants from vessel or onshore spills.
- Loss or displacement of BCH caused by the introduction of marine invasive species.

5.5 Mitigation

The Proposal has been developed through an extensive MCA of a range of port design options (~30 options) and main channel locations (2 options: upgraded existing channel or new second channel), leading to a short-list of preferred options and then the final preferred option. The MCA process was based on quantitative assumptions of the pressures, and qualitative scoring of potential impacts to BCH, for different port facility and main channel options/configurations. Opportunities for reducing the probable extent and severity of potential BCH impacts are also being considered in refining the final design of the reclamation areas, the offshore breakwater and dredge/disposal requirements and methods. A full description of the MCA process is provided in **Section 1.2.2**, however, a summary of the relevant BCH mitigation hierarchy considerations and outcomes are provided below.

5.5.1 Avoid

The final preferred port facility option (Option G in **Figure 5-3**) which this Proposal represents, scored higher (better) for environmental criteria relating to BCH with the configuration (parallel to shore) and location of proposed infrastructure (slightly further south on the Kwinana Shelf) avoiding any direct seagrass loss when compared to the other options (**Figure 5-3**). This includes the proposed offshore breakwater which, compared with some other port options considered through the MCA process, avoids seagrass habitat (**Figure 5-3**).

Earlier plans for Option G also included a through channel which extended north along the Kwinana Shelf, rather than the proposed single entry/exit channel with a turning basin. Removal of this through channel from the final design has significantly reduced dredging volumes and avoided direct loss of seagrass in this area.

Option G also represents the lowest in-situ dredge volume of the three shortlisted options (~5Mm^3 less than Option C and ~7Mm^3 less than Option A). This lower dredge volume for the port facility will result in less dredging pressure overall on BCH during the construction phase which can be managed more effectively.

The preferred new second main channel option impacts less seagrass (see **Section 1.2.2.3**) compared with the alternative of widening the existing channel (see **Figure 5-4**), and is also predicted to improve flushing within Cockburn Sound. The second main channel also runs through large areas of Parmelia and Success Banks that have been previously dredged by CCL's shellsand dredging operations, therefore avoiding undisturbed seagrass habitat. Given a second main channel would also reduce operational risk by providing a second point of access into and out of Cockburn Sound (whilst also increasing operational capacity), this was selected as the preferred option.

The second main channel depth has also been optimised (and reduced) over the preliminary design process, which has reduced dredge volumes and the extent of direct impacts to BCH through dredging as far as possible. For example, the current required dredging depths of -19.5 metres chart datum (mCD) in the second main channel and -17.4 mCD in the access channel are a significant reduction from the values originally identified in early stages of the preliminary design process; which ranged from -22.7 to -21.1 mCD in the second main channel and from -19.5 to -17.8 mCD in the access channel.

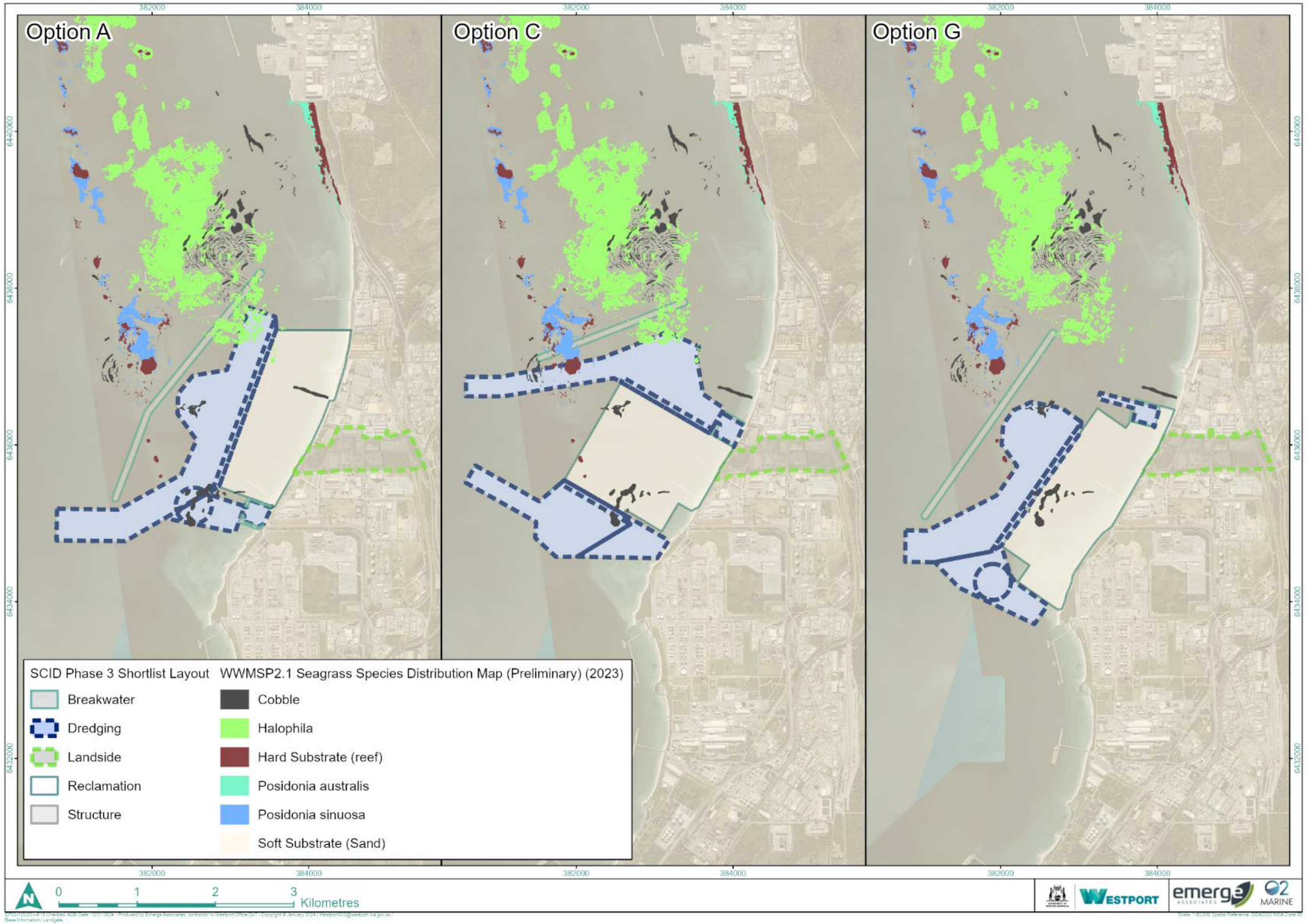

Figure 5-3: Three shortlisted port options

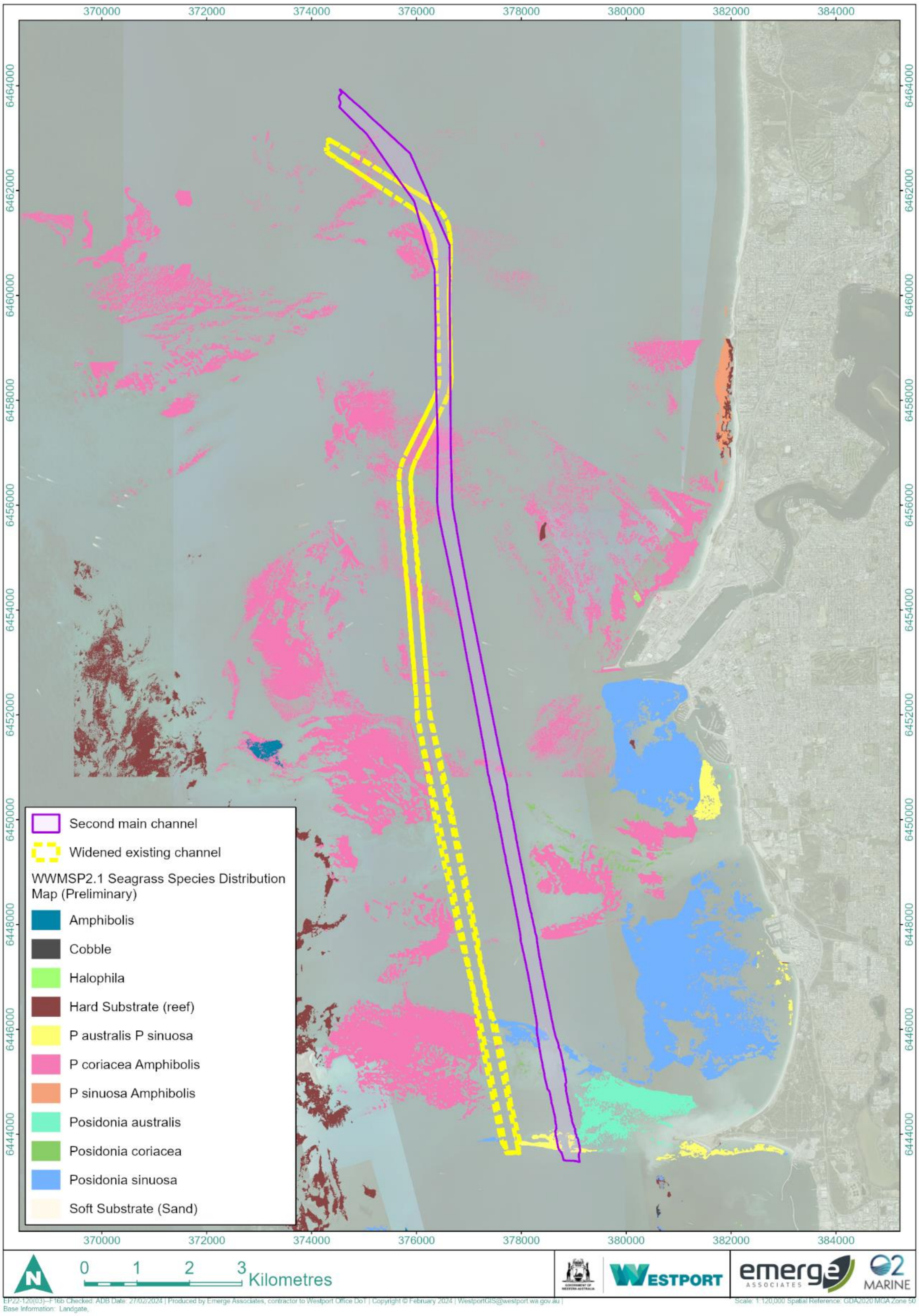

Figure 5-4: Second main channel and widened existing channel options

5.5.2 Minimise

The WWMSP Theme 2 seeks to address the key knowledge gaps in relation to the factors that control/influence the extent and health of seagrass in Cockburn Sound and Owen Anchorage as well as deliver the BCH information required for EIA of the Proposal.

The information that this research will provide (to inform the EIA of the Proposal) includes:

- Contemporary BCH mapping of Cockburn Sound, Owen Anchorage, Gage Roads and Deep Water Channel to understand the current extent of seagrass meadows to compare with previous estimates and trends.
- Improving the understanding of tolerance thresholds (to key stressors) for seagrass, causes of long-term decline of seagrass condition in Cockburn Sound.
- Methods to reverse this decline and build resilience in seagrass meadows.
- Methods to undertake enduring seagrass restoration at the Kwinana Shelf and Owen Anchorage area at a scale commensurate with historic loss, and potential loss associated with the Proposal.

Another objective of WWMSP Theme 2 is to better understand and refine the thresholds for dredging pressures and temperature (thermal stress) for seagrass species in Cockburn Sound (WWMSP Project 2.2). An assessment conducted by BMT (2018a) identified dredging and increasing water temperatures as high-impact pressures. It is reasonable to assume that the cumulative effect of these pressures in combination could significantly impact the environmental and social values of the area. Therefore, it is crucial for the EIA of this Proposal to also understand the cumulative effects of these pressures, such as how ongoing elevated seawater temperatures (caused by ocean-warming events and exacerbated by climate change) may influence the tolerance of seagrasses to dredge-related pressures such as light reduction or sediment burial. This information will be important for predicting and minimising Proposal construction impacts but more importantly to manage any longer term cumulative operational impacts of the Proposal on seagrass cover and health in Cockburn Sound.

The seagrass pressure-response relationships and guideline values are currently being developed through WWMSP Project 2.2. This work aims to predict the impact of dredging on seagrass and will be adopted for the future dredge plume modelling and the development of a dredge management plan. Additionally, it will be used to inform strategies for the monitoring and management of impacts during dredging and disposal, as well as by chronic turbidity generated through operations at the port, increased vessel traffic and tug propellor wash. Applying the best available science to the prediction and management of indirect impacts, combined with best practice dredging/reclamation methods and strategies, will significantly minimise the extent, severity and duration of dredging pressures such as reduced light availability/shading on seagrass.

Additionally up-to-date benthic habitat mapping (**Figure 5-2**) defining the location and extent of BCH in Cockburn Sound and adjacent to the second main channel (such as Owen Anchorage) will inform the location of dredge and disposal environmental monitoring and management such that impacts are further minimised.

Further work to identify dredging environmental management strategies to minimise impacts to BCH will be required through the future environmental scoping and assessment phases and these strategies will be applied wherever possible when more details of the dredging design are known. There is ongoing, close coordination between the Proposal dredging and environmental streams to optimise and establish the most appropriate mitigation measures to minimise impacts to BCH.

Key considerations are seagrass habitat loss in addition to dredging equipment choice, operational settings (e.g. overflow duration), dredging schedule (e.g. staging) and application of other mitigation measures (e.g. sedimentation ponds and silt screens).

Simple dredging strategies that could be applied during dredging and disposal to avoid/minimise impacts on seagrass include seasonal restrictions, to ensure start to finish dredging of high fines content areas occurs during winter months only (March – August), to avoid release of fines during peak seagrass growth period of summer months.

The careful staging of capital dredging is known to have benefits for mitigation purposes – with the increased length of the interval between phases of dredging allowing more recovery time for sensitive BCH receptors. This applies to seasonal intervals within a single capital dredging campaign and to a multi-year interval between dredging campaigns that reflects the operational needs of the port. The Proponent accepts that for a proposed dredging campaign of this size in a marine environment as sensitive as Cockburn Sound, where practicable, dredging volumes should be minimised, and breaks between dredging maximised, to reduce pressure and allow more recovery time for key sensitive receptors such as seagrass. Further assessment, feasibility and selection of strategies to stage the proposed dredging will need to occur following completion of dredging EIA studies and during the EPA's assessment of the Proposal.

5.5.3 Rehabilitate/Offset

The Proponent (via WWMSP Project 2.3) is researching and developing methods to undertake enduring seagrass restoration in the Kwinana Shelf and Owen Anchorage area at a scale commensurate with historic loss, and potential loss associated with the Proposal. The project is developing guidelines for seagrass restoration to inform resilience building and rehabilitation options that will likely be required to offset the Proposal's residual impacts on BCH. The Proponent is already planning an offset strategy that will utilise this information and address the likely significant residual impacts to BCH from the Proposal.

5.6 Assessment and significance of residual impact

As discussed in **Section 1.1.5**, this referral does not include a full environmental impact assessment of the Proposal, as this will be addressed through the subsequent PER process and documented in the future ERD. As such, the following sections provide an overview of how potential impacts of the Proposal will be assessed through the future EIA stages.

5.6.1 Construction impacts

The Proposal will apply the EPA Technical Guidance: Environmental Impact Assessment of Marine Dredging Proposals (EPA, 2021) which provides guidance for predicting and managing the impacts of dredging in Western Australia.

An assessment of construction impacts to BCH, including a cumulative loss assessment, will be undertaken to evaluate the extent, severity and duration of the potential direct and indirect impacts of the Proposal on BCH. The predicted irreversible losses and recoverable impacts on seagrass habitat will be the primary focus of assessment as it is the dominant BCH in Cockburn Sound and a key sensitive receptor. All predicted losses of BCH will use the WWMSP Project 2.1 mapped extent of BCH (WAMSI, unpub.) and the established LAUs for the Proposal (see **Section 5.3.3**) for consistency with ongoing BCH cumulative loss assessments across Cockburn Sound, Owen Anchorage, Gage Roads and Deep Water Channel.

5.6.2 Zones of impact

The Proposal EIA involves predicting pressure fields and assessing their impact on key receptors. Considering the extent, duration, timing and intensity of these pressure fields provides a better understanding of the potential effects. To enhance the accuracy of these predictions and establish management trigger levels, tolerance thresholds and recovery timescales for the key sensitive receptors are being developed.

Baseline surveys and investigations are being undertaken to define the system in which dredging will occur. The EIA will then require a thorough understanding of the spatial extent, severity, timing and duration of dredging pressure, as well as the predicted effects on sensitive environmental receptors. Following the EIA, monitoring and management will be implemented at reference and impact assessment sites based on the spatial extent of predicted impacts to inform adaptive management and demonstrate compliance with conditions of approval.

This spatial assessment of impacts helps classify the indicative footprints into three distinct zones of potential impact (EPA, 2021):

- **Zone of High Impact (ZoHI):** The area where serious damage to benthic communities is predicted or where impacts are considered irreversible. Serious damage is defined as damage that is irreversible or damage that is unlikely to recover for at least five years following the completion of dredging activities.
- **Zone of Moderate Impact (ZoMI):** The area within which predicted impacts on benthic organisms are sub-lethal, and/or the impacts are recoverable within a period of five years.
- **Zone of Influence (ZoI):** The area within which changes in environmental quality associated with dredge plumes are predicted and anticipated during the dredging operations, but where these changes would not result in a detectible impact on benthic biota. This area can be very large, but at any point in time the dredge plume is likely to be restricted to a relatively small portion of the ZoI.

In accordance with EPA (2021), hydrodynamic and sediment fate modelling (including dredge plume modelling) will be undertaken to predict and define the ZoHI, ZoMI and ZoI in the vicinity of the Proposal. These zones of impact will also inform the BCH cumulative loss assessment.

The development of accurate BCH mapping and zones of impact based on best available science, modelling, best practice EIA and expert professional judgement will be critical to the EPA's assessment of the Proposal as well as the design and management of the Proposal's physical marine infrastructure and proposed dredging, reclamation and spoil disposal activities.

5.6.3 Direct impacts

5.6.3.1 Loss (removal and burial) of BCH

Direct impacts to BCH typically involve irreversible loss and are located within the ZoHI. The ZoHI represents the area where impacts on BCH are predicted to be irreversible within a timeframe of five years. Direct impacts from excavation or burial are certain to occur within and immediately adjacent to the indicative footprints of the Proposal's marine elements.

Port DE

It is assumed that all BCH (or potential BCH such as bare sand) within the port DE will be permanently lost (or seriously damaged) such that the impact is irreversible. BCH within this area primarily consists of bare sediment, potentially inhabited by sparsely populated benthic communities. The assumed direct loss of seagrass BCH within the Port DE is considered conservative as none of the indicative footprints (port facility, offshore breakwater or access channels, turning basins and berthing areas) intersect with mapped seagrass habitat. Although approximately 732 ha of BCH is assumed to be directly lost within the DE (see **Table 5-2**), there is no perennial seagrass meadows and only a small amount (0.034 ha) of mapped ephemeral seagrass (halophila spp.) within the DE, based on the preliminary WWMSP Project 2.1 BCH mapping.

Second main channel DE

It is similarly assumed that all BCH (or potential BCH such as bare sand) within the second main channel DE will be permanently lost (or seriously damaged) such that the impact is irreversible. The BCH within the DE is dominated by bare sand potentially inhabited by sparsely populated macroinvertebrate communities, with other areas intersecting mapped seagrass habitat (see **Figure 5-4**). Therefore, in addition to approximately 750 hectares of bare sand being directly impacted, there will also be direct and permanent loss of up to approximately 60 ha of seagrass habitat within the DE, specifically within the LAUs that intersect the second main channel DE (see **Table 5-2** and **Figure 5-5**). However, similar benthic macroinvertebrate communities and species, and possibly new seagrass, may recolonise the dredged slopes of the second main channel after dredging is completed.

Preliminary estimates of the direct and irreversible impact to each BCH type from the Proposal DE within defined LAUs, and how this corresponds to a permanent percentage loss of each BCH type, are presented numerically in **Table 5-2** and shown spatially in **Figure 5-5.**

Table 5-2: BCH extent within defined LAUs with estimated direct loss for each BCH type from Proposal DE

LAU	Deep Water Channel				Gage Roads				Owen Anchorage				Cockburn Sound			
	Extent		Direct loss (DE)		Extent		Direct loss (DE)		Extent		Direct loss (DE)		Extent		Direct loss (DE)	
Habitat	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Bare substrate / sand	4275	91.7	190.5	4.5	5766	82.3	253.9	4.4	4660	74.1	304.1	6.5	10394	90.4	722.5	6.9
Seagrass (perennial spp.)	386	8.3	12.5	3.2	1232	17.6	27.8	2.3	1619	25.8	18.3	1.1	795	6.9	0.0	0.0
Seagrass (ephemeral spp.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	245	2.1	0.03	0.01
Hard substrate (reef)	0.0	0.0	0.0	0.0	4.1	0.1	0.0	0.0	7.3	0.1	0.0	0.0	32.5	0.3	0.8	2.5
Cobble	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.7	0.3	8.2	23
Total	**4660**	**100.0**	**203.0**	**4.4**	**7002**	**100.0**	**282**	**4.0**	**6286**	**100.0**	**322**	**5.1**	**11502**	**100.0**	**731.5**	**6.7**

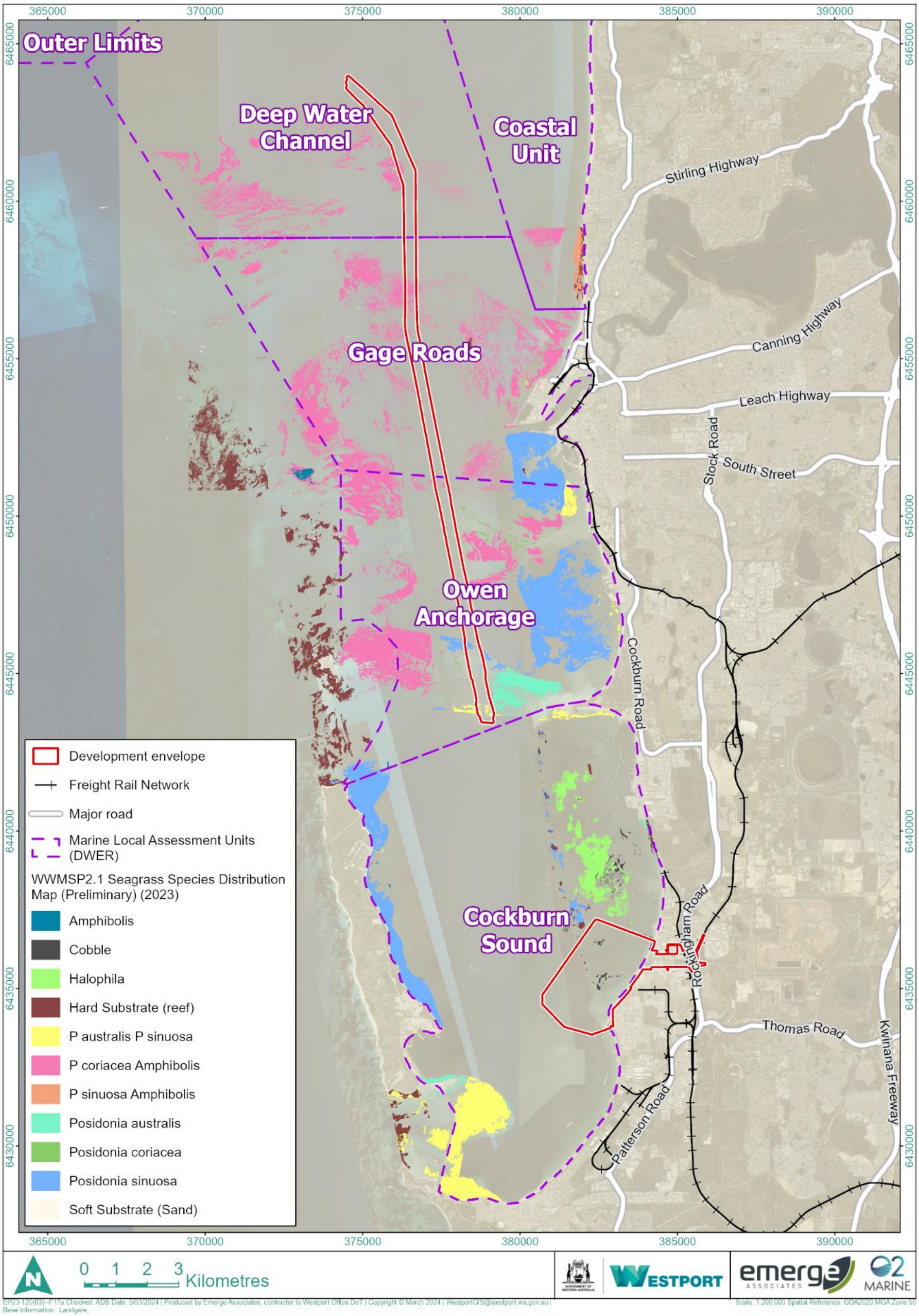

Figure 5-5: BCH extent within Proposal DE and LAUs

5.6.4 Indirect impacts (irreversible and recoverable)

Dredging can result in elevated levels of suspended sediment in the water column, which in turn can have negative impacts on seagrass ecosystems upstream and downstream of the dredging activity. In addition to direct physical removal, EPA (2021) states that the critical indicators of dredging pressure on seagrass are reduction in benthic light availability (Photosynthetic Active Radiation) due to light attenuation caused by the sediment suspended through the water column and burial caused by increased sedimentation. The resulting indirect impacts to BCH are described as either irreversible, located within the ZoHI, or recoverable (within 5 years), located within the ZoMI (EPA, 2021).

EPA (2021) recommends that only 'realistic' impact scenarios are presented for EIA of dredging proposals. For this assessment it is particularly important to present zones of impact that are as commensurate as possible with the actual size of the dredging Proposal (which is significant by Australian standards) and documented effects associated with other campaigns of similar magnitude (of which there are few). While there is a broad understanding of how seagrasses react to environmental changes caused by dredging activities, it is important to note that the resilience and recovery of seagrass greatly differs among species. Consequently, relying on generic thresholds limits the confidence in predicting and managing seagrass ecosystems under dredging pressures.

Seagrasses exhibit various life history strategies and can be broadly classified as colonising, opportunistic, or persistent species, depending on their capacity to withstand and recover from environmental pressures. The smaller, fast-growing colonising genera, such as *Halophila*, exhibit low physiological resistance to pressures like dredging, however, they possess an ability to recover rapidly. Larger and persistent genera like *Posidonia* demonstrate greater resilience to pressures but have a slower recovery rate. Seagrasses can make various physiological and morphological adjustments to partially withstand pressures, including leaf shedding, slowed growth, utilising stored carbohydrates in their rhizomes to maintain metabolism and increased photosynthetic efficiency (Ralph et al., 2007).

Understanding the thresholds of different pressures at which seagrass meadows start to decline allows for greater confidence in predicting EIA to pressures and optimising management (McMahon et al., 2013).

The pressure-response relationships and guideline values developed through the WWMSP Project 2.2 for the impact of dredging on seagrass will be adopted for the dredge plume impact assessment as that is the primary BCH type mapped through numerous studies in the vicinity of the Proposal. The new guideline values for seagrass (which will be specific for local species) will be used to define realistic ZoMIs and ZoHIs for the proposed dredging activity. This will result in predictions that are neither conservative nor underestimated so that an assessment of the acceptability of impacts to BCH can be adequately made. For each zone of impact, possible and probable effects will be given, outlining two confidence levels in the spatial extent of each zone, as stipulated in EPA (2021), which represent the worst- and best-case extent, respectively, for each zone.

5.6.4.1 Light reduction and shading

The impact of reduced light availability on seagrass is one of the most well-understood pressure-response pathways. Seagrasses have relatively high photosynthetic light requirements to maintain a positive carbon balance, crucial for growth and reproduction. When light availability falls below the minimum requirements, seagrass growth is decreased. Under reduced light conditions, seagrasses make morphological and physiological adjustments to maintain a positive carbon balance, which can lead to a decline in seagrass shoot density, seagrass condition and eventual mortality if light reduction continues. The ability of seagrasses to persist under reduced light and the duration they can endure vary greatly among species (Ralph et al., 2007).

At present, comprehensive data exists regarding tolerance thresholds for light reduction in specific seagrass species (such as *Posidonia sinuosa* and *Amphibolis griffithii*) within the temperate region of Australia. WWMSP Project 2.2 encompasses all species, including those found in Cockburn Sound, and will also increase knowledge on recovery timeframes and the role of seed banks in facilitating recovery of colonising and opportunistic species which is required to accurately assess recoverable impacts and define the ZoMI.

5.6.4.2 Sedimentation and burial

While previous studies have predominantly focused on the effects of changes in light availability on seagrasses due to dredging activities, there has been less research on the consequences of sediment burial, although it is important to note that burial is a natural process with recurrent events caused by storms, riverine inputs or bioturbating fauna (Cabaço et al., 2008). As such, seagrasses living in systems that are prone to burial have developed adaptations to persist with the prevailing environmental conditions like vertical growth, leaf elongation, and flowering (Ooi et al., 2011).

Sediments naturally resuspend and settle based on various factors such as particle size, density, bottom velocity and shear stress and burial can occur either through direct settling of suspended particles or through secondary deposition due to natural sediment dynamics.

The impacts of burial on seagrasses depend on several factors including the species, presence of vertical rhizomes, burial depth, duration, and spatial extent (Cabaço et al., 2008). Generally, larger species exhibit greater resilience to burial compared to smaller species (Duarte et al., 1997). Seagrasses can respond to burial by undergoing morphological changes to increase the amount of photosynthetic tissue above ground (Vermaat et al., 1997; Duarte et al., 1997; Mills and Fonseca, 2003). However, if the energy requirements exceed the supply, shoot density declines and shoot mortality may occur (Cabaço et al., 2008). Moderate burial can even stimulate vertical leaf growth in species capable of such responses, like *Syringodium isoetifolium* (Duarte et al., 1997). Alternatively, deeper burial depths often result in adverse effects on seagrasses, including light inhibition and increased sediment anoxia (Eldridge et al., 2004).

Many previous studies have not examined the threshold levels for burial for seagrass species which dominate the Proposal area. WWMSP Project 2.2 involves a review of current knowledge and gaps of pressures and thresholds for managing seagrass in temperate regions to dredging and ocean warming pressures. Project 2.2 seeks to improve understanding of burial pressures on local species, including level and duration, as well as recovery times.

The level of burial that species can cope with has been studied for 8 out of 10 species that occur in Cockburn Sound, however, most of these studies were done outside of Western Australia and there is an absence of locally-derived thresholds. Taking into consideration the species size, growth form, life history and drawing on work undertaken on tropical and related species, it might be expected that burial treatments in the range of 2 – 60 cm may induce effects in local seagrass species ranging from the lowest observable to sub-lethal and lethal effects. The number of days it took for effects to be observed varied between species and ranged between 14 – 120 days. Only one local species (Halophila ovalis) has information on recovery times (4-10 months). For all other local species there is no recovery data making it very difficult to assign ZoMI or ZoHI with confidence. However, where ≤4 cm of burial was tested there were no impacts, and therefore this value could be applied conservatively for the ZoMI and ZoHI for all other local species assessed. Seven local seagrass species that have been studies have sufficient data to define a potential ZoI in relation to burial (WAMSI, unpub.).

While the recommended sediment burial thresholds will be derived from the best available scientific knowledge, WWMSP Project 2.2 provides further considerations for dredge plume modelling being undertaken for the Proposal:

- A potential disturbance should be managed for the most sensitive species present.
- Locally-specific guidelines are highly recommended where available as these capture inherent site conditions.
- There may be a need for seasonally varying burial thresholds, although this is largely unquantified.
- Effects of interactive factors on thresholds are largely unquantified (in situ experiments capture naturally changing site conditions).
- Influence of sediment biogeochemical characteristics on seagrasses may vary thresholds (e.g., organic matter).

5.6.5 Zone of Influence

The extent of the ZoI will be calculated by including any region where suspended sediment concentration (SSC) (at any height in the water column) exceeds background concentrations by a defined value at any time. This is a highly conservative threshold in which the plume would not be visually discernible, yet the influence may be detected in monitoring with appropriately selected control sites, and where detectible impacts to stable benthic habitat would be highly improbable. The predicted combined ZoI for dredging is expected to be large but at any point in time the dredge plume is likely to be restricted to a relatively small portion of it. The intent of the predicted ZoI is to indicate to regulators and the public that visible plumes may be present in this zone from time to time if the Proposal is implemented, but importantly any BCH in these areas will not experience any measurable adverse effects.

5.6.6 Intersection of zones of impact and mapped BCH

Following determination of the zones of impact it will be determined if they overlap with mapped BCH to allow for spatial extent analysis and impact/loss calculations which will be used to assess the significance of impacts and inform the BCH cumulative loss assessment.

5.6.7 Operational impacts

During Proposal operations which is expected to be >50 years, potential erosion or smothering of BCH may result from altered patterns of sediment movement and water flow around the proposed port facility infrastructure (including potentially the offshore breakwater) resulting in a ‘halo’ effect. The Proposal DE includes a 50 m ‘halo’ around the port facility indicative footprint that captures these potential indirect impacts. Based on observable halo effects around other structures in Perth coastal waters this predicted 50 m halo is considered conservative.

The seabed within this predicted 50 m halo around the port facility does not contain any mapped seagrass or other significant BPP habitat (see **Figure 5-2**). Therefore, although approximately 664.5 hectares of bare sediment will be indirectly impacted, there is no loss of BCH expected. Although the proposed offshore breakwater at certain points is close to mapped seagrass habitat it is expected that detailed design and construction measures will be thoroughly investigated and implemented so that any ‘halo’ effect or permanent loss of seagrass is avoided to the fullest extent possible.

A potential indirect loss or impact to BCH is chronic turbidity (i.e. water clarity which can affect light attenuation) generated through increased vessel traffic and tug propellor wash within shallower waters in the Sound. Seagrass could be exposed to slight (but chronic) elevations of turbidity above natural levels from vessel propellor wash that is typically associated with ship and tugboat passages through dredged channels. This issue has been highlighted by the EPA in its dredging guidance and encourages proponents to assess this pressure using a similar approach to the assessment of shading impacts on seagrass from dredging activities. Vessel propellor wash can also remobilise contaminants within sediments when they are disturbed.

These issues can be exacerbated by deposition of dredge-generated suspended sediments altering particle size distribution (PSD) in surface sediments in the vicinity of the port facility due to, with higher proportion of finer particles in the system, meaning that higher resuspension rates under naturally occurring events.

A Tug Sediment Resuspension study (using field measurements and hydrodynamic modelling of concentration of sediment resuspend by tug activity at an existing project site adjacent to the Proposal) was undertaken to inform assessment of the Westport SCID Phase 3 short list marine infrastructure options. However, a larger more targeted sediment dispersion study for the Proposal is anticipated to be required to inform the EIA.

Realistic Proposal operational scenarios including vessel and channel simulations, utilisation projections and tug usage requirements and locations will be used to inform sediment plume modelling to predict the extent, severity, frequency and duration of ongoing resuspended sediment plumes in Cockburn Sound that are generated by operational vessel activity associated with the Proposal (in combination with existing and approved port activities). This approach will provide a clearer understanding of possible changes to ambient turbidity/SSC and benthic light conditions and the subsequent ecological response of impacted seagrass communities.

It is anticipated that this work will be supported by the integrated ecosystem modelling framework for Cockburn Sound being delivered by WWMSP Theme 1 and the pressure-response relationships and guideline values developed through WWMSP Project 2.2. The model will be developed to explore dredge plume dispersion effects on seagrass meadows and to support understanding and management of the effect of pressures on the marine environment during the development and subsequent operation of the Proposal.

Understanding operational pressures such as chronic light reduction is critical for predicting the longer term cumulative operational impacts of the Proposal on seagrass cover and health in Cockburn Sound, as well as impacts on ecosystem integrity and function, which may be compounded by thermal stress from ongoing elevated seawater temperatures (caused by ocean-warming events and exacerbated by climate change).

The Proposal includes maintenance dredging of the second main channel, access channels, turning basins and berthing areas. Maintenance dredging will be undertaken as required to support future port operations and maintain capital dredge widths and depths. Future maintenance dredging will likely be managed in accordance with a port long term dredge management plan, which will incorporate environmental mitigation strategies. Impacts will be assessed in the PER.

5.6.8 Cumulative impacts

The EPA's technical guidance for BCH (EPA, 2016b), as well as existing defined LAUs that have been applied to this Proposal, provide a common framework for new assessments and a consistent approach with the EIA of previous infrastructure projects.

This guidance also provides a risk-based spatial assessment framework for evaluating cumulative irreversible loss of and/or serious damage to BCH, which is being applied to determine impacts to BCH as a result of Proposal activities and other existing or future proposals.

5.7 Environmental outcomes

This Proposal has the potential to result in direct and indirect impacts to seagrass habitat and benthic communities that exist in the defined LAUs for Cockburn Sound and areas to the north (adjacent to the proposed second main channel). While the Proposal indicative footprints avoid direct impacts to seagrass within the Cockburn Sound LAU (**Table 5-2**), residual impacts to BCH are still predicted and will assessment. The extent, severity and duration of impacts to BCH, both irreversible and recoverable, will not be accurately predicted until the mitigation hierarchy has been further applied during the final planning and design process and the required information is available during the PER phase, such as contemporary pressure-response seagrass thresholds, benthic habitat mapping and dredge plume modelling.

The Proponent will need to demonstrate how these potential environmental impacts have been mitigated to the fullest practicable extent and present predictions that are realistic so that an assessment of the acceptability of predicted residual impacts to BCH can be adequately made. These predictions will also inform the BCH cumulative loss assessment which will determine the predicted permanent and recoverable loss of BCH as a percentage of that which existed prior to European habitation. Considered within this context, the overall irreversible impact to BCH and cumulative loss from the Proposal will be assessed together with the potential consequences of the losses for marine ecological integrity and biological diversity within the LAUs and the broader marine environment.

The Proponent's assessment of impacts to BCH for the Proposal will involve the following aspects:

- Marine studies used to inform the assessment of impacts to BCH.
- Use of contemporary and locally relevant science for predicting impacts to BCH, including outputs of the WWMSP.
- Review of actual BCH impacts from previous projects in the area.
- Defined LAUs and historical loss values.
- Assumption that best practice port design and impact mitigation will be applied.
- Seagrass rehabilitation and offsets.
- Consistency with EPA Technical Guidance.

Incorporation of these aspects during the EIA will be required to ensure sufficient confidence in the predicted environmental outcomes that are used to assess the consequences of the cumulative losses resulting from implementation of the Proposal for biological diversity and ecological integrity and whether the EPA's objective for BCH can be achieved.

6 Coastal Processes

6.1 EPA environmental factor and objective

To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.

6.2 Relevant policy and guidance

- EPA (2016c). Environmental Factor Guideline: Coastal Processes, EPA, Western Australia
- EPA (2016d). Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals, EPA, Western Australia
- State Environmental (Cockburn Sound) Policy 2015 (EPA, 2015)
- Environmental Quality Criteria Reference Document for Cockburn Sound (EPA, 2017)

6.3 Receiving environment

6.3.1 Studies and investigations

- WWMSP Theme 9: Coastal processes
- WWMSP Theme 5: Hydrodynamic modelling
- Long List Coastal Impact Desktop Study
- Westport Geotechnical Study
- Hydrodynamic and Sediment Fate Modelling for Dredging and Reclamation
- BMT Oceanica (2018a) Cockburn Sound – Drivers-Pressures-State-Impacts-Responses Assessment 2017 final report.
- BMT Oceanica (2014) Cockburn Sound Coastal Vulnerability Values and Risk Assessment Study

6.3.2 Environmental values

Coastal processes change over time and alter the physical environment which can affect the availability of habitat, as well as hydrodynamics which influences the ecological communities that occur in each part of the coast. EPA (2016c) identifies the environmentally significant coastal values which may be affected by changes to coastal processes. These values are relevant to Cockburn Sound and include (but are not limited to):

- Benthic communities and habitats such as seagrass meadows.
- Conservation significant marine fauna and iconic species, as well as critical habitat such as nesting, breeding or foraging habitat.
- Conservation significant flora and vegetation and terrestrial fauna species.

- Unique landforms.
- Significant cultural and aesthetic values.
- Active or passive recreation values.

The Cockburn Sound SEP (2015), which is discussed in **Section 7.3.2**, has established Environmental Values (EVs) for the Cockburn Sound marine area. While these EVs are not directly related to coastal processes, changes to coastal processes within the marine environment related to the Proposal may indirectly affect these EVs. In particular, the Proposal has the potential to impact coastal hydrodynamics, sediment transport, and coastal morphology which could lead to impacts to the following:

- Ecosystem health (seagrasses, benthic macroinvertebrate communities and fish communities)
- Recreation and aesthetics
- Fishing and aquaculture
- Cultural and spiritual values.

6.3.3 General description – coastal processes

The geology of Cockburn Sound and Owen Anchorage comprises several key features (**Figure 6-1**), overlaid and interacting with a highly variable veneer of sedimentary features including sand banks and sheets, perched beaches and terraces.

There are four main ridges (generally long and narrow elevated geomorphological features with steep sides) that have impacted the long-term sediment transport within the area (CZM et al., 2013). Five Fathom Bank and Garden Island Ridge are two outer ridges (both located south and inland of Rottnest Island) and act as a boundary from the offshore sediments. The Jervoise Bank Ridge is within Cockburn Sound, parallel to and between Garden Island and the mainland, and aids the retention of the Kwinana Shelf in the Sound. The Spearwood Ridge includes a series of cliffs and perched beaches between Spearwood and Henderson on the mainland, providing stability for the modern coastline. Success and Parmelia Banks provide additional sediment to the coast, with the ridges and other geological features controlling the sediment availability (CZM et al., 2013).

Anthropogenic modifications to the coast that have previously been undertaken within Owen Anchorage and Cockburn Sound include groynes, jetties, breakwaters, boat ramps and intakes/outfalls (**Figure 6-2**). Such structures can alter the natural sediment transport, and due to the low energy of the system, these alterations may not be evident immediately (BMT Oceanica, 2017).

Figure 6-1: Key geomorphological features of Cockburn Sound and Owen Anchorage

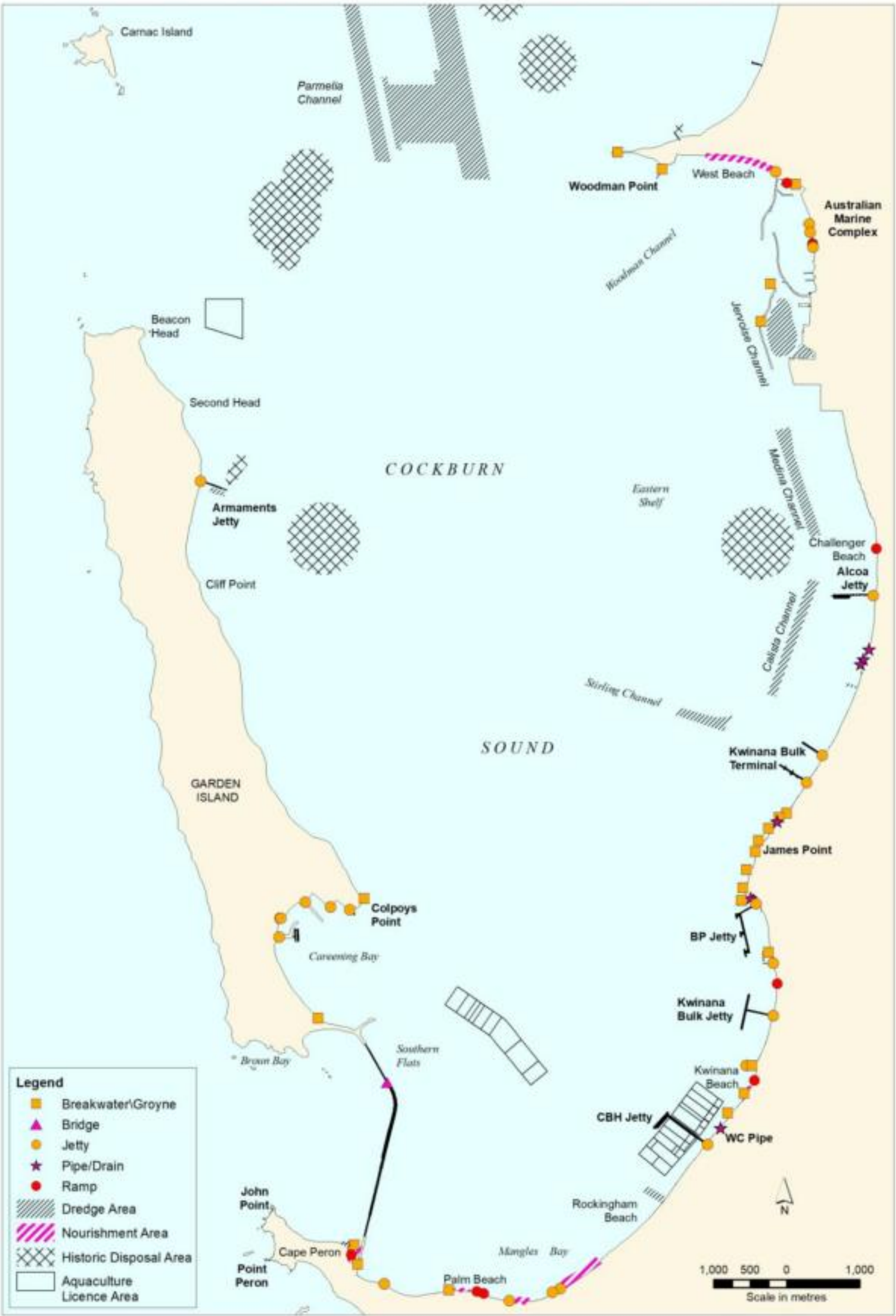

Figure 6-2: Coastal modification in Cockburn Sound (BMT 2018)

A significant modification to the system was the installation of the Garden Island Causeway in 1972 which altered the swell and sea wave energy causing modifications to the shoreline at James Point. Following its installation, seven small offshore breakwaters or headlands were constructed in the 1970s near James Point to minimise and stabilise the sediment transport southwards (CZM et al., 2013).

There are many areas along the Perth metropolitan coast, including some areas of Cockburn Sound, that are currently at risk of beach erosion. CY O'Connor beach is replenished yearly to maintain a usable beach and prevent the loss of land for recreational, aesthetics and commercial values. In the future it is predicted that other beaches within the City of Cockburn including Coogee Beach will require beach replenishment due to sea level rise.

Water levels within Owen Anchorage and Cockburn Sound are influenced by seasonal and inter-annual mean sea level variations, storm surge, continental shelf waves, seiches, and interannual tidal modulations (CZM et al., 2013). The area is microtidal with small amplitude diurnal tides. Water levels along the coast, including the Sound, are also strongly influenced by barometric pressure and wind direction. Strong persistent easterly winds can result in reduced coastal water levels, particularly when coupled with a high-pressure system.

External drivers of coastal change include waves, water level, winds, and currents. The frequency, magnitude and character of this incident energy translates into the force required to shift the sediment and ultimately reshape the shoreline. Nearshore currents are generated when swell and locally generated wind waves break, and energy is then transferred to sediment transport. The resultant erosion and accretion on Cockburn Sound shorelines is controlled by the alongshore and cross-shore currents and circulation cells, constrained by the bathymetry and topography.

Storms, climate variability, and anthropogenic pressures, including coastal development and dredging, contribute to coastal change at different timescales. Global climate change and geological processes (including sea level rise) are long-term drivers. Ongoing coastal processes include the supply of sediments from rivers, shoreline erosion or offshore sources, and sediment transport by ocean currents. Short-term forcing includes extreme events such as winter storm fronts and less frequent severe tropical cyclones.

Sediment cells of the Western Australian coastline are defined in Stul et al. (2015), comprising self-contained spatially discrete areas that can be described using sediment budgets. Within sediment cells are areas of sediment supply (sources), sediment loss (sinks), and the along- and cross-shore processes (pathways) linking them. Cockburn Sound region sediment cells (primary, secondary, and tertiary) have been defined in Stul et al. (2015) (see **Figure 6-3**). Any changes to the sediment budget of a cell may result in erosion or accretion of sediment, rotation of the shoreline, or creation of new sediment cells. New infrastructure has the potential to interrupt longshore and cross-shore sediment pathways and alter the configuration of the sediment cells.

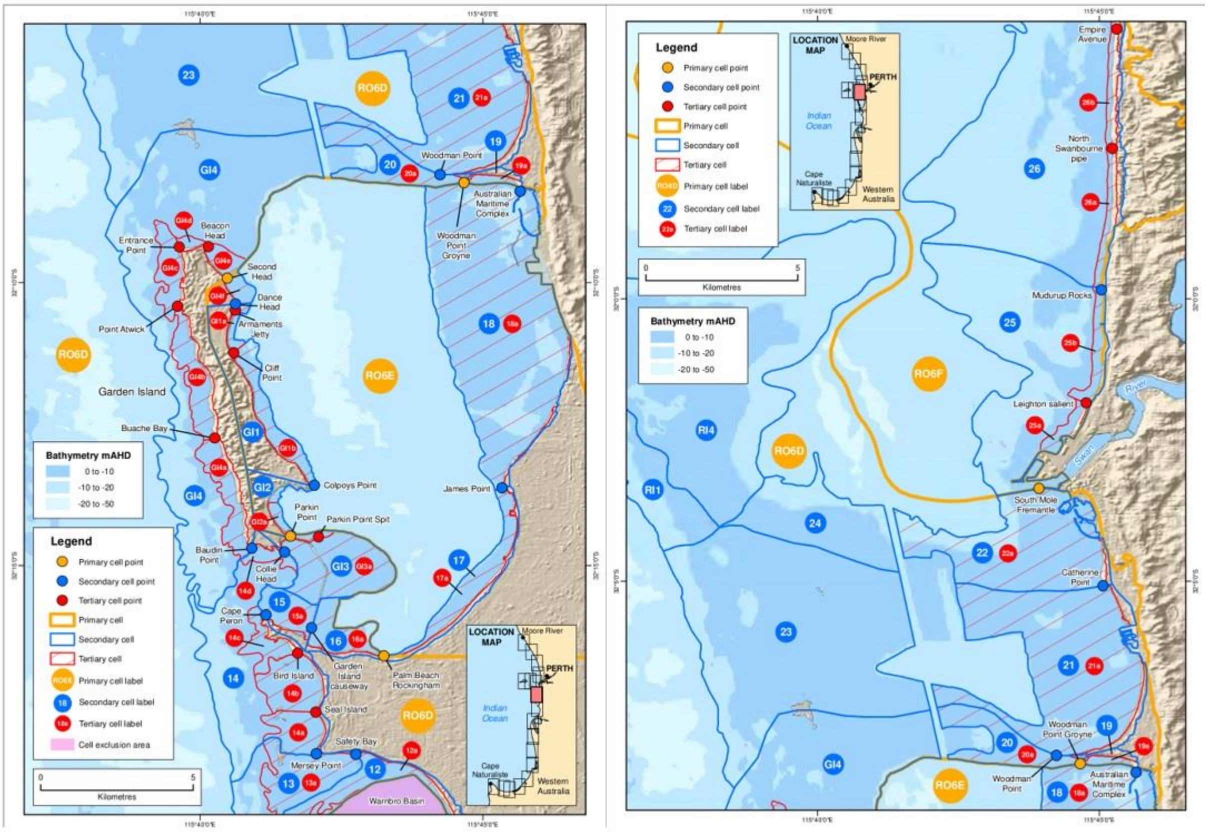

Figure 6-3: Sediment cells of Perth coastal waters (Stul et al., 2015)

The Proposal is located on an already heavily modified coastline during a period when global coastlines are under stress by rising sea levels. Even without the Proposal being implemented, some adjacent areas will face erosion and inundation in the future, with coastal erosion 'hotspots' already having been identified. To undertake and manage the potential impacts from the Proposal, a clear understanding of baseline coastal trends, sediment transport sources and rates, coastal variability time scales, and the main drivers of coastal processes and changes is required.

WWMSP Project 9.1 aims to provide the necessary knowledge of coastal processes and trends to predict and mitigate the potential impacts of the Proposal on coastal areas. Without a strong understanding of baseline coastal variability before the Proposal is implemented, it will be difficult to quantify and attribute any potential impacts of the Proposal itself. This could result in unrelated erosion at nearby beaches being mistakenly attributed to the Proposal. Considering the overall stress on coastal areas due to rising sea levels, it is crucial to establish this baseline understanding to ensure that the Proposal does not have long-term detrimental effects on the surrounding areas and infrastructure.

The WWMSP Project 9.1 2023 Annual Report (WAMSI, 2023) summarised the work done to date to understand the historic shoreline positions. Between 1987 and 2022, there has been considerable variability across the study area (Cockburn Sound and Owen Anchorage) though as a whole most areas have exhibited relatively stable shorelines.

The largest changes have generally been associated with the construction of coastal engineering structures, though when the net shoreline position is calculated across the sediment cells, sediment seems to be redistributing rather than being lost or gained. It was noted that the analysis did not take into account the volume of sand which could impact the results due to nourishment or reclamation. The data is still being analysed and will be presented in the final report in mid-2024. Sediment transport monitoring is also currently being undertaken, and results of this will also be available in mid-2024.

6.4 Potential environmental impacts

The potential impacts of the Proposal on coastal processes include:

- Permanent alteration of coastal process due to the reclamation and construction of the port facility.
- Alteration of direction and magnitude of wave energy and dynamics, current patterns and interruption to longshore sediment transport caused by Proposal construction across the nearshore zone and along adjacent shoreline.
- Construction of the offshore breakwater structure having the potential to trap sediment and causing changes to the morphology of the coastal zone and potentially impacting near-shore BCH.
- Dredging of the second main channel having the potential to create further interruption of onshore sediment transport from Success and Parmelia Banks.
- Potential impacts from the Proposal being exacerbated by sea level rise.

6.5 Mitigation

6.5.1 Avoid

A Long List Coastal Impact Desktop Study was completed to inform the MCA selection process for the preferred option, which had the objective of providing a comparative assessment based on a nested wave modelling approach to assess how the wave climate would be affected by the selected long list layout options under selected storm conditions and how that would be reflected on the local coastal processes. This study provides useful insights on beach changes, especially when suggesting the management approach that will be needed for each of the layouts. Although all long list port options were found to impact coastal processes, the results identified that for the preferred option (the Proposal) the position on the shelf at James Point and use of a straight parallel offshore breakwater leads to lower impact on Cockburn Sound hydrodynamics and results in less alteration to existing coastal processes compared with other design options.

6.5.2 Minimise

The environmental studies undertaken as part of the Westport Program include consideration of how construction and operational impacts of the Proposal can be minimised. These include hydrodynamic modelling to inform final port design, coastal process modelling, dredge plume modelling, flushing modelling and the marine environmental management plans to be prepared to minimise impacts from the Proposal.

The measures to be undertaken to minimise impacts will be further developed and opportunities identified as the detailed design progresses. These will be documented within the PER.

6.5.3 Rehabilitate

Efforts to rehabilitate the coastline and associated coastal processes, through approaches such as beach nourishment and construction of headlands and breakwaters, are already commonly undertaken along the Perth coast (including within Cockburn Sound), independent of the Proposal. Opportunities for further contribution to coastal rehabilitation, including potential additional beach nourishment, are being considered as part of the Proposal. This will be further addressed at the PER stage and will be informed by the outcomes of the WWMSP, which will help to gain a clear understanding of the baseline coastal sediment transport processes.

6.6 Assessment and significance of residual impact

The significance of residual impacts to coastal processes as a result of the Proposal will be assessed at the PER stage, and will be informed by WWMSP Theme 5 and 9 research, which is yet to be published. In relation to impacts to coastal processes it is important to note that the extent and severity of indirect impacts has uncertainty, whereas direct impacts do not.

6.6.1 Direct impacts

A key element of the Proposal is the proposed port facility, the indicative footprint of which intersects the marine and terrestrial interface, as well as the offshore breakwater. The indicative port facility footprint requires the construction of an approximately 2.5 km of parallel structure over the nearshore area within which all coastal processes will be permanently altered. The indicative port facility footprint will cover existing sandy beach. Burial of this beach material will remove this well-graded beach sand from the coastal system.

6.6.2 Indirect impacts

Construction of the port facility and second main channel and the associated dredging will have an impact on the coastal processes within the region. Potential impacts including disruption to natural sediment transport pathways and rates will require further assessment, based upon the results of WWMSP Project 9.1.

The physical structures of the Proposal also have the potential to affect the local flow velocity, particularly during extreme events, with implications for design of structures and potential sedimentation processes.

Further erosion and changes in sediment transport may also occur due to existing structures. BMT Oceanica (2014) predicted that if modifications to the area were to occur, low-lying newer material being added to the shoreline coastal plain from the system may be more susceptible to changes.

6.6.3 Cumulative impacts

The cumulative impacts to coastal processes due to the Proposal and other existing or future proposals will be investigated at the PER stage. The Proponent will assess the direct and indirect impacts as a consequence of the Proposal, as well as the cumulative effect of increasing physical infrastructure within Cockburn Sound.

6.7 Environmental outcomes

The Proposal has the potential to impact coastal processes within and around Cockburn Sound. Studies will be undertaken to determine the magnitude and significance of any impacts, to be documented through the future PER, to determine whether the EPA objective can be met and what potential future management in relation to coastal processes may be required.

7 Marine Environmental Quality

7.1 EPA Environmental factor and objective

To maintain the quality of water, sediment and biota so that environmental values are protected.

7.2 Relevant policy and guidance

- Environmental Factor Guideline: Marine Environmental Quality, EPA, Western Australia EPA (2016e)
- Technical Guidance – Protecting the Quality of Western Australia's Marine Environment, EPA, Western Australia EPA (2016f)
- Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals, EPA, Western Australia EPA (2021).
- State Environmental (Cockburn Sound) Policy 2015 (EPA, 2015)
- Environmental Quality Criteria Reference Document for Cockburn Sound (EPA, 2017)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)
- National Assessment Guidelines for Dredging (CA, 2009)
- Contaminated Sites Guidelines (DWER, 2021)
- Managing urban development in acid sulphate soil areas DWER (2015a)
- Treatment and management of soil and water in acid sulphate soil landscapes (DWER, 2015b)

7.3 Receiving environment

7.3.1 Studies and Investigations

- WWMSP Theme 1: Ecosystem modelling
- WWMSP Theme 3: Water and Sediment Quality
- WWMSP Theme 5: Hydrodynamic modelling
- WWMSP Theme 6: Social values
- RPS Sediment Sampling and Analysis Plan Implementation
- Westport Geotechnical Study
- Hydrodynamic and Sediment Fate Modelling for Dredging and Reclamation
- Westport SCID Phase 3 Short List Flushing and Plume Dispersion Modelling Study

- Westport SCID Phase 3 Numerical Modelling of Sediment Resuspension of Tug Propeller Wash
- Cockburn Sound-Drivers-Pressures State-Impacts-Responses Assessment 2017 Final Report (BMT, 2018a)

7.3.2 Cockburn Sound Environmental Quality Management Framework

The EPA has established an environmental quality management framework (EQMF) for Cockburn Sound (see **Figure 7-1**), which has been given effect through the *State Environmental (Cockburn Sound) Policy 2015* (EPA, 2015) also known as the Cockburn Sound SEP.

The approach to establishing an EQMF, including identification of Environmental Values (EVs), Environmental Quality Objectives (EQOs), Levels of Ecological Protection (LEPs) and Environmental Quality Criteria (EQC) is described in EPA (2017). The approach is based on the principles and guidelines of the National Water Quality Management Strategy (NWQMS), with particular regard to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018), representing an agreed, Australia-wide approach to protecting water quality and associated EVs.

It is important to note that EVs, EQOs and LEPs are not defined by short term impacts but are intended to represent long-term objectives for marine environmental quality (MEQ). The EQMF therefore provides a basis for considering cumulative effects from all the different pressures on the Sound as well as the EIA of the Proposal in the long-term.

The objectives of the SEP were developed in consultation with the community and are intended to reflect the values held by the community for the marine environment of Cockburn Sound. The overall objective of the SEP is to ensure that the water quality of the Sound is maintained and, where possible, improved so that there is no further net loss and preferably a net gain in seagrass areas, and that other environmental values and uses are maintained.

Implementation of the EQMF is through the Cockburn Sound Management Council (CSMC) and requires a cooperative approach that involves all relevant stakeholders. EQC play an important role in the EQMF by providing the quantitative benchmarks for measuring success in achieving the environmental quality objectives. The goal of environmental management is therefore to ensure that direct and indirect sources of nutrients and contaminants are managed such that the EQC are met and the environmental quality objectives achieved. If the EQC are exceeded, then the regulator, manager and discharger must cooperatively develop and implement management strategies, with timelines, and interim objectives if necessary, to restore environmental quality to the levels defined by the EQC.

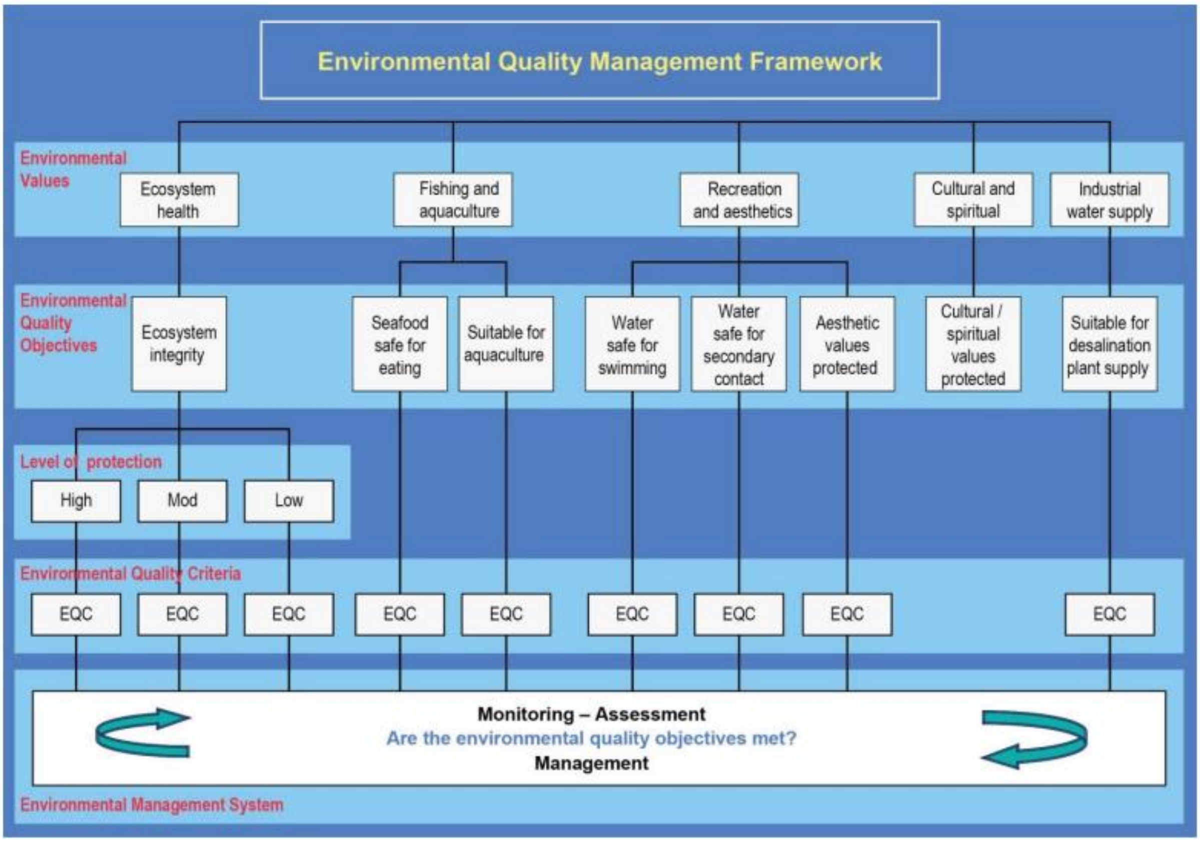

Figure 7-1: Cockburn Sound environmental quality management framework

7.3.3 Environmental Values and Environmental Objectives

The Cockburn Sound SEP establishes five EVs for Cockburn Sound, all of which are relevant to MEQ and this Proposal:

- Ecosystem health
- Fishing and aquaculture
- Recreation and aesthetics
- Cultural and spiritual
- Industrial water supply.

EVs are defined as values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits (ANZG, 2018). EQOs are high level management objectives that describe what must be achieved to protect each EV (EPA, 2016f).

The EVs and associated EQOs for the local marine environment are established in the Cockburn Sound SEP. Five EVs and eight corresponding EQOs apply to Cockburn Sound and surrounding waters (see **Table 7-1**).

Table 7-1: Environmental Values and Environmental Quality Objectives applicable to Cockburn Sound and surrounding waters (EPA, 2017)

Environmental Values	Environmental Quality Objectives
Ecosystem Health	EQO1: Maintenance of ecosystem integrity. EQO1 is split into four sub-objectives, being: Maximum, High, Moderate and Low Levels of Ecological Protection (LEPs) (refer **Section 7.3.4**).
Fishing & Aquaculture	EQO2: Seafood (caught) is of a quality safe for human consumption. EQO3: Water quality is suitable for aquaculture purposes
Recreation & Aesthetics	EQO4: Water quality is safe for primary contact recreation (e.g. swimming and diving). EQO5: Water quality is safe for secondary contact recreation (e.g. fishing and boating). EQO6: Aesthetic values of the marine environment are protected.
Cultural & Spiritual	EQO7: Cultural and spiritual values of the marine environment are protected
Industrial Water Supply	EQO8: Water quality is suitable for industrial supply purposes

7.3.4 Levels of Ecological Protection

In accordance with EPA (2016f), the 'Ecosystem Health' EQOs are spatially allocated into four LEPs: Maximum, High, Moderate and Low. Each LEP area is assigned an acceptable limit of change, allowing for areas important for conservation to be maintained within the limits of natural variation, whilst recognising that societal uses may preclude a 'Maximum' LEP limit from being achieved within some areas.

An area assigned as a High LEP (HEPA) means to allow small changes in the quality of water, sediment or biota (i.e. small changes in contaminant concentrations with no resultant detectable changes beyond natural variation in the diversity of species and biological communities, ecosystem processes and abundance/biomass of marine life).

An area assigned as Moderate LEP (MEPA) means to allow moderate changes in the quality of water, sediment and biota (i.e. moderate changes in contaminant concentrations that could cause small changes beyond natural variation in ecosystem processes and abundance/biomass of marine life, but no detectable changes from the natural diversity of species and biological communities).

An area assigned as Low LEP (LEPA) means to allow for large changes in the quality of water, sediment and biota (i.e. large changes in contaminant concentrations that could cause significant changes beyond natural variation in the natural diversity of species and biological communities, rates of ecosystem processes and abundance/biomass of marine life, but which do not result in bioaccumulation/biomagnification in nearby High ecological protection areas).

There is an existing approved Environmental Quality Plan (EQP) provided by the Cockburn Sound SEP which spatially present the established LEPs for the Sound. **Figure 7-2** provides the EQP for Cockburn Sound (with the indicative port facility footprint overlaid for context), with the MEPA assigned along most of the eastern margin of Cockburn Sound adjacent to the industrial area and the HEPA which is assigned to most of the remainder of Cockburn Sound. The Proposal indicative port facility footprint is within the current MEPA and HEPA.

The Cockburn Sound SEP allows for minor new coastal development within the existing MEPAs, however, a significant development such as this Proposal will require modifications to the current EQP.

For example, the EQP in **Figure 7-2** does not include any temporary changes to LEPs that may need to be defined spatially and made publicly available by the Proponent during the Proposal construction phase (e.g. to inform the community of the short term loss of environmental or social values such as fishing and recreation). Any temporary changes to LEPs will return to defined long-term LEPs following completion of dredging/reclamation activities.

The EQP in **Figure 7-2** also doesn’t include permanent changes that may be required for Proposal operational impacts. The Proposal operation phase will likely require an extension of the eastern Cockburn Sound MEPA (into and reducing the HEPA) around the indicative port facility footprint but this will be defined later in the Proposal planning and EIA process and addressed in the PER document.

Figure 7-2: EQP for Cockburn Sound

7.3.5 Cockburn Sound SEP environmental monitoring

Under the Cockburn Sound SEP, responsibility for monitoring against the EQC is shared across several public authorities, based on their roles and responsibilities. Not all parameters for all EQC are, or need to be, monitored on a regular basis. The relevant public authorities determine what monitoring should be undertaken based on an assessment of risks and impacts. To facilitate the compilation and reporting of data and the adoption of appropriate responses, each year the public authorities provide the results of that monitoring to the CSMC. The results are compared against the relevant EQC, summarised and discussed in the context of meeting the environmental quality objectives for Cockburn Sound.

The CSMC reports annually to the Minister for Environment and the community on the results of environmental monitoring of the Cockburn Sound marine area and the extent to which the monitoring results demonstrate the environmental quality objectives set in the Cockburn Sound SEP are met. These reports are published on the Council's website. Every three years, the Council reports on the overall state of the Cockburn Sound marine area, including trends in water quality and associated environmental values. Recent monitoring data and trends from the monitoring programs are summarised below.

7.3.6 General description of marine environmental quality in Cockburn Sound

Cockburn Sound is a unique marine environment that experiences natural fluctuations in water quality due to seasonal forcings, synoptic and daily weather patterns, barotropic and baroclinic mixing processes and flushing, rainfall, river flow and biological events. Human activities such as wastewater discharges, inputs from contaminated land and groundwater, and coastal modifications have had adverse effects on the marine environment of Cockburn Sound previously, resulting in a decline in marine environmental quality (BMT, 2018a).

Collaborative efforts of government, industry, and the community over the past two decades have significantly improved the marine water and sediment quality in Cockburn Sound which is now considered acceptable compared with relevant guidelines (BMT, 2018a). High water quality is expected from a social perspective to support aesthetic, cultural and spiritual values, and for active pursuits such as water-based tourism and recreation. High water quality is also required to maintain high seafood quality, support recreational and commercial fisheries, and aquaculture farming. Suitable water quality is also required to facilitate some industrial uses such as desalination.

A Water Quality Index that is used in Cockburn Sound for reporting the overall results of monitoring is calculated from five indicators: total nitrogen concentration, total phosphorous concentration, chlorophyll a concentrations, light attenuation coefficients, and dissolved oxygen concentrations in the water just above the seafloor (CSMC, 2023). The Water Quality Index is reported for every year for each of the ecological protection areas in Cockburn Sound. The CSMC (2023) reporting provided the trend in Water Quality Index in each of the ecological protection areas since 2010.

In summary, trends suggest that most indicators of environmental health continue to be met and that the Sound is in a reasonably stable condition. However, although levels of toxicants appear to be relatively low, seafood is safe to eat and water quality is safe for swimming, there still appear to be some water quality impacts related to excessive nutrients in the southern end of the Sound and this may be impacting on seagrass health in the area.

The water quality in Cockburn Sound is being maintained for its environmental values and uses (such as recreational, shellfish harvesting, and industrial water supply). There are ongoing concerns about poor water quality in some areas of Cockburn Sound (CSMC, 2023). Poor water quality (such as in the MEPA in Northern Harbour) may exhibit low water clarity due to enhanced phytoplankton growth (elevated chlorophyll a concentrations). This can limit light reaching seagrasses that require sufficient light for growth (EPA, 2017). Legacy groundwater discharges from the KIA contribute nutrients that build up within the sediment and are implicated as the likely cause of sediment sulphide accumulation, adding to seagrass decline (Fraser and Kendrick, 2017; Greenwood et al., 2016). There are observed declines in seagrass shoot density at some sites (Jervoise Bay, Woodman Point and northern Garden Island) and a decline in productivity of some commercial fisheries (including aquaculture) and recreational fisheries. New threats such as plastic pollution and climate change have also emerged.

7.3.7 Water quality – physio-chemical

Water quality responses in Cockburn Sound manifest as a consequence of the combination of the seasonal hydrodynamic setting (mixing, stratification, circulation and flushing) and nutrient and contaminant loads. Cockburn Sound is a semi-enclosed basin with limited oceanic exchange. The hydrodynamic processes in the basin respond primarily to local wind forcing and atmospheric processes that generate and erode salinity and temperature gradients seasonally. Wind acts directly on the sea surface to induce motion, but also acts indirectly by mixing the water column and eroding the vertical density structure (stratification). In this setting, wind driven circulation and mixing dominate all other physical forcing mechanisms.

In autumn the Cockburn Sound system is characterised by stable vertical water column structure (stratification) in the absence of sustained wind mixing from sea breezes or storms (D'Adamo, 2002). Additionally, in autumn, the waters in Cockburn Sound cool more quickly than the oceanic waters, setting up a horizontal temperature (density) gradient. The overall mean density of the Sound water is therefore greater than the adjacent open ocean during autumn. The more buoyant ocean water flows in through the shallow sills at the northern entrance, preventing the outflow of Cockburn Sound waters, hence less exchange and flushing occurs in autumn. Continental shelf waves, generated by tropical cyclones in the northwest (Elliot and Pattiaratchi, 2010), are common in autumn and also contribute to the inflow of oceanic water over the northern sill that suppresses exchange.

This hydrodynamic backdrop reduces the mixing of DO to the bottom waters in the deeper basin of the Sound due the lack of wind forcing, and due to the barrier set up by the resultant vertical structure. Combined with the biological oxygen demand from the sediments, DO in the near-bed layer can be consumed intermittently to low levels. This situation is more common in the poorly flushed southern section of Cockburn Sound, particularly in Mangles Bay where nutrients are often elevated. Nuisance algal blooms (often diatom species) are a consequence of reduced vertical mixing and low dissolved oxygen, in combination with higher surface temperatures and nutrient loading unable to dissipate through flushing. Algal blooms reduce the water clarity, then exacerbate the situation as they expire and sink, and bacterial decomposition consumes oxygen which also contributes to the lower DO levels. Diatoms with hook-like barbs can kill fish directly by triggering irritation to the gills and causing respiratory stress and mortality. This is the likely cause of the 2015 fish kill incident in Cockburn Sound (DoF, 2015).

DO levels in Cockburn Sound are generally well mixed and well oxygenated, but exhibit pronounced seasonal and short-term fluctuations (Rose et al., 2012; CSMC, 2023). Summer monitoring in 2021 of 118 sites in the Sound reported dissolved oxygen saturation levels that were generally above 80-90% saturation for most sites (CSMC, 2023). This is still comparable to the EQC for a Moderate LEP (80%) and High LEP (90%). Short periods of dissolved oxygen depletion occur mostly during late summer and autumn (or associated with extreme weather events) in the stratified bottom waters in the southern end of Cockburn Sound (CSMC, 2023). DO levels as low as 2 mg/L have been recorded historically in the southern end of Cockburn Sound during periods of light easterly winds and high water temperature. Healthy dissolved oxygen concentrations tend to range from 7-8 mg/L.

There is more recent evidence that the waters from the deeper basin, depleted in oxygen during autumn, may be driven by the anticlockwise circulation and conveyed onto Kwinana Shelf through the conduit created by the Stirling Channel north of James Point. This scenario becomes important for water quality on Kwinana shelf when considering the consequence of mixing the low dissolved oxygen into shallower regions with higher nutrient influx, and possibly inducing algal blooms and subsequent fish kills (WAMSI, unpub).

7.3.8 Water and sediment quality – toxicants

7.3.8.1 Contaminants of potential concern

In Cockburn Sound, previous and ongoing monitoring of water and sediment quality has shown that environmental quality criteria are generally met for the majority of contaminants.

The primary pathways for contaminants from contaminated land to enter Cockburn Sound are as surface run-off that enters directly via drains or indirectly via recharge to groundwater from the various land uses in the catchment (GHD, 2013). However, with no rivers or creeks flowing directly into Cockburn Sound, groundwater has been identified as the primary pathway for contaminant loads into Cockburn Sound (although it is noted that contaminant load data from stormwater drains is limited). Large groundwater flows to Cockburn Sound have the potential to serve as a conduit for contamination, with between 13.6GL and 27.5 GL of groundwater discharged each year through permeable soils (GHD, 2013). Historical groundwater investigations reported multiple impacts across the Proposal area from hydrocarbons, metals, nutrients and excess alkalinity with the expected groundwater flow towards Cockburn Sound, however, despite the variable quality of groundwater beneath the Proposal area, it is not expected to be a significant driver of risk to the proposal (WSP, 2023). This is due to the assumption that no groundwater abstraction or deep excavations (that would contact groundwater) will be required for the proposed landside development area construction or operation of the Proposal (WSP, 2023).

Other sources of potential contamination include direct industry inputs from nearby infrastructure and activities such as naval operations, harbours, and jetties, as well as atmospheric deposition.

Previous monitoring of marine water column contaminants (e.g. metals, organometallics, non metallic inorganics, organics and pesticides) has not been routinely undertaken in Cockburn Sound. Concentrations of potential water column contaminants were last comprehensively assessed in 2008 although some site specific targeted surveys have been undertaken since that time (CSMC, 2023). Water column contaminant concentrations were below the guidelines, below their respective detection limits or the Limits of Reporting where no guidelines were available, or present in low concentrations. Contaminants at concentrations above the Limits of Reporting but with no guidelines were within accepted international standards where these are available (CSMC, 2023).

Regarding sediment quality, contamination exposure in Cockburn Sound is primarily attributed to industrial operations, shipping, and other boating activities, which are similar to the pressures affecting marine water quality.

Three sediment quality sample locations visited annually during the Cockburn Sound annual environmental monitoring program are located within the vicinity of the Proposal. Results from the Cockburn Sound annual environmental monitoring report 2021-22 show that environmental quality guidelines (EQG) were exceeded at Kwinana Bulk Jetty for some metals (arsenic, mercury and copper), some Polycyclic Aromatic Hydrocarbons (PAH) and vessel anti-fouling agent tributyltin (TBT) but none were above resampling trigger values.

Limited historical sampling locations were identified with sediment quality data in the Proposal area, and although most of these samples were collected more than five years ago, the data is important context for historical contamination. Based on the available historical information, concentrations of most contaminants (e.g. metals, hydrocarbons, organochlorine pesticides) were generally below the guidelines, where these were available, or the Limits of Reporting. Concentrations of most metals (i.e. copper, zinc, aluminium, cobalt, lead, mercury, nickel) are generally higher in the southern area of Cockburn Sound.

The monitoring of sediment quality in the past has shown that the EQC are generally met for the majority of contaminants. However, biofouling control contaminants are regularly detected, albeit in specific areas (BMT, 2018a).

More recent sediment data is available from the following recent studies:

- CSMC Annual Environmental Monitoring Report (2023).
- the RPS Sampling and Analysis Plan Implementation Report (RPS, 2023) which has been undertaken for the Proposal.
- WWMSP Project 3.1: Baseline Sediment Quality Survey of Cockburn Sound and Owen Anchorage (April 2023)

The CSMC report presents three sampling locations in vicinity of the Proposal with some metals (arsenic, mercury and copper), some PAH and TBT above Cockburn Sound EQG. Oceanica and RPS sampling data did not report any exceedances of trigger levels. The WWMSP survey for all protection areas found the median concentration for each contaminant (metals/metalloids, hydrocarbons (TPH and PAH), tributyltin, herbicides (diuron and irgarol) and PFAS) did not exceed the EQG A, and the individual sites total contaminant concentrations did not exceed the EQG B. The individual sites concentrations did not exceed the lower EQG A value for any contaminant (where there were EQG values available).

These recent findings strongly suggest that the material would be suitable for disposal offshore. Further, initial screening of Western Australian waste classification values by WSP where data was available are indicative of the material being appropriate for onshore disposal/reclamation, with the notable exception of elevated PAH in one sample. Another key consideration for onshore disposal is the exceedance of some acid sulphate soil (ASS) action criteria in the RPS results although the sediment is considered to contain sufficient buffering capacity to neutralise any acid released during dredging (RPS, 2023).

Given the proposed volume of material to be dredged and the limited nature of the RPS assessment to date, further detailed and targeted investigations are required to better assess potential reuse or disposal options for the dredged material.

7.3.8.2 Nutrients

Recent trends identified through various monitoring programs show that industrial point source discharges of nutrients are decreasing, which suggests that overall management of these emissions by industry and regulatory agencies has been effective.

Cockburn Sound has historically received nutrients from various sources such as industrial and wastewater discharge, groundwater discharge, and surface run-off from urban and rural horticultural areas. In the past, the main concern was nitrogen input from industrial sources, which was believed to be the primary cause of seagrass die-off due to the growth of algae on seagrass and high levels of phytoplankton in the 1970s and 1980s.

Since the 2000s, the management and diversion of wastewater discharges to the ocean through the Sepia Depression Ocean Outlet Line has resulted in a decline in nitrogen inputs from industrial discharges. Point source industrial discharges are now considered insignificant in terms of nutrient and contaminant loads (BMT, 2018a). Overall, the total nutrient and contaminant inputs from point source discharges have reduced and stabilized, leading to improvements in water quality. However, it is important to note that nutrient release from sediments may still play a significant role in maintaining and varying phytoplankton biomass in certain areas of Cockburn Sound (BMT, 2018a).

The contribution of groundwater inputs remains uncertain but could potentially be significant. Generalised groundwater contours of total nitrogen (TN) concentration based on more than 500 bores in the Perth region suggest that TN concentrations increase from around 2 mg/L in the south to about 8 mg/L near Woodman Point (Sarukkalige, 2011). TN concentrations in porewater from Cockburn Sound in nearshore holes measured by Smith et al. (2003) ranged from <1 to 739 mg/L, and were generally <3 mg/L.

The highest concentrations were centred north and south of James Point, down-gradient of industries in that area. In 2003, TN loads in groundwater discharging to the Sound were estimated at 234 ±88 t N/yr, depending on groundwater recharge rates, and were dominated by ammonium (Smith et al., 2003). A more recent estimate suggests that the total groundwater nitrogen supply could be higher (655 tN/yr) depending on annual rainfall (McFarlane, 2015). The large differences between estimates over time, however, were potentially due to technical changes to the model so it is very difficult to determine temporal variations in groundwater nitrogen fluxes. However, it is unlikely that the groundwater nitrogen load has significantly increased between the 2003 and 2016 studies.

In the more recent RPS sediment sampling (RPS, 2023), elutriate total phosphorous (TP) concentrations exceeded the guideline limits at all sites, nitrates and TN exceeded the guidelines at most sites, and ammonia and nOx exceeded guideline limits at James Point. Elutriate nutrients were typically higher in the indicative port facility footprint than in the indicative second main channel footprint, particularly at the James Point sites. The maximum dilution requirement to reach the guideline concentrations was 1:4 in the indicative port facility footprint and 1:2 in the indicative second main channel. As stated in previous reports (BMT, 2018a; Greenwood et al., 2016), some nutrient loading still occurs within sediments in both Kwinana Shelf and Owen Anchorage.

7.3.8.3 Metals and metalloids

In Cockburn Sound, previous and ongoing studies have shown that environmental quality criteria are generally met for the majority of metals.

Elevated concentrations of heavy metals and metalloids in the sediments of partially enclosed embayments, like Cockburn Sound, are often linked to human activities in the surrounding catchment area. These activities include land use practices, such as jetties and harbours, shipping, vessel construction and maintenance, urban run-off, contaminated groundwater, industrial effluents, and accumulation from permanent mooring locations. Contaminants can be found in either particulate or dissolved forms, with historically higher concentrations in the southern area of Cockburn Sound. This is likely due to a higher content of silt and clay, which have a larger surface area for adsorption, rather than a contamination source in the vicinity (BMT, 2018a).

Metal concentrations from sediments sampled within the development envelope were below all relevant guidelines although sites near the existing Kwinana Shelf channel and jetty infrastructure, with higher TOC and smaller grain size (which are known to increase metal binding in the sediment), had higher metal concentrations (RPS, 2023). These results are consistent with those of previous studies (BMT, 2018a), which found elevated metal concentrations surrounding the Kwinana Bulk Jetty, but still below guideline limits.

The vessel biofouling control agent TBT and its degradation products dibutyltin (DBT) and monobutyltin (MBT) are often found in areas where historical contamination is expected, such as port infrastructure, jetties, and vessel mooring locations. Within offshore areas, such as the deep basin of the Sound, away from direct source inputs, these contaminants are mostly at or near the limit of reporting (LoR) (BMT, 2018a). TBT was banned in 2008 by the International Convention on the Control of Harmful Anti-fouling Systems on Ships but can still be present in older vessels with exposed historic coatings and in sediments containing flakes of contaminated paint that has come off historical vessels. While TBT has been replaced by antifouling technologies that predominantly use copper as the active ingredient, paints may also contain additional biocides like zinc pyrithione or organic algaecides. Concentrations of copper in sediments around shipping-related infrastructure are occasionally elevated but vary spatially among different areas, similar to TBT.

More recent results (RPS, 2023) found TBT was below the LoR at all sites other than three within the indicative port facility footprint, which were near to the existing Kwinana Shelf channel and jetty infrastructure. One site near the Kwinana Shelf channel had the highest TBT concentration found (though still below guideline limits) which was in both the surface and bottom of the core, indicating long-term contamination. These findings reflect previous survey results, which suggest TBT may be observed near shipping channels (DoW, 2006).

7.3.8.4 Hydrocarbons

Hydrocarbons found in sediments are also typically linked to anthropogenic sources in areas with heavy industrial activities (such as refineries, above and below ground storage tanks), groundwater influx, vessel operations (including accidental spills, refuelling, loading/unloading), and general port activities. Over time, there have been gradual improvements in industrial discharge and land management practices, resulting in significant reductions of hydrocarbon contaminants entering Cockburn Sound from specific points (BMT, 2017). Despite the potential risks, there is limited evidence to suggest that hydrocarbon contamination poses a significant threat to Cockburn Sound, as historical monitoring of marine sediments shows hydrocarbon concentrations well below the available environmental protection criteria (BMT, 2018a).

More recent results (RPS, 2023) found hydrocarbon concentrations were below LoR at most sites, and below relevant guidelines at all sites. Higher concentrations were observed within the indicative port facility footprint than in the indicative second main channel footprint, particularly around the existing Kwinana Shelf channel and jetty infrastructure, similar to the metal concentrations. These results reflect the previous findings, which found elevated hydrocarbons near the Kwinana Bulk Jetty, though still below guideline limits (BMT, 2018a; DoW, 2006).

7.3.8.5 Pesticides, herbicides and polychlorinated biphenyls

Pesticides, herbicides, and polychlorinated biphenyls (PCBs) are persistent bioaccumulating chemicals in the environment. These substances originate from horticultural and industrial sources in the surrounding catchment area and pose a risk to the marine environmental quality of Cockburn Sound.

In the past, organochlorine pesticides (OC pesticides) such as DDT and dieldrin were found in sediments at sites near marinas, harbors, and industrial or wastewater outfalls (DEP, 1996). Low-level concentrations of PCBs were also observed in certain areas of the deeper basin (DEP, 1996). More recent sediment quality sampling indicates that the levels of pesticides, herbicides, and PCBs are now below LoRs, posing a low risk to biota in Cockburn Sound sediments (BMT, 2018a; RPS, 2023).

The decline in pesticide concentrations can be attributed to a nationwide ban on the use of OC pesticides in Australia since 1995, as well as improvements in managing point source inputs, such as industrial and domestic wastewater and stormwater drains. Diffuse sources, like contaminated groundwater and surface runoff, may still present some risk, but the overall situation has improved.

7.3.8.6 Other compounds and new contaminants

Concentrations of other potential contaminants in sediments are generally low. Per- and poly-fluoroalkyl substances (PFAS) have been detected in localised areas of soil and groundwater on Garden Island and Point Peron. PFAS present a new contaminant of potential concern (COPC) for the Sound (BMT, 2018a). PFAS, widely used for decades in household products like non-stick cookware, stain protection, and food packaging, as well as industrial and commercial applications such as firefighting foams and coatings, are persistent and highly resistant to degradation. These emerging contaminants pose a risk to the marine environmental quality of Cockburn Sound due to industrial practices and the proximity to HMAS Stirling, Australia's largest naval base. Historical storage and use of aqueous film forming foams for firefighting and training, as well as waste burial, are the likely sources of PFAS detected on Garden Island and adjacent mainland areas.

Perfluorobutane sulfonic acid (PFBS) found in groundwater in the vicinity of the Proposal area (at one site) is potentially an indication of other PFAS, present at levels below the standard laboratory LOR. The laboratory LOR reported were considered appropriate for the assessment criteria chosen, however, investigation of PFAS at a lower detection limit may be warranted for future investigation in sediment and groundwater (WSP, 2023).

There is also now raised awareness of potential issues related to other parameters not previously tested, including microplastics, pharmaceuticals, personal care products, methy tert-butyl ether (MTBE) and anti-foulant biocides. RPS (2023) found that MTBE and anti-foulant biocides were all below LoR and therefore below relevant guidelines. These contaminants have not previously been observed above guideline limits in the port facility footprint and second main channel footprint (RPS, 2023; BMT, 2018a; CSMC, 2023; DoW, 2006).

Given Cockburn Sound’s location and heavy use, there is a likelihood of elevated plastic contamination compared to other embayments in Western Australia. However, there is currently no commercial laboratory test available to assess potential microplastics in marine sediments. Further research and development programs may therefore consider testing as part of their efforts. The link between microplastics and potential negative ecological impacts is still being studied. The industrial use and oil refining history in Kwinana may result in detectable levels of MTBE. Treated wastewater is not directly discharged into Cockburn Sound, so there is no direct pathway for pharmaceuticals and chemicals from personal care products to enter the Sound.

7.4 Potential environmental impacts

7.4.1 Construction phase impacts

Construction impacts from the Proposal are predicted to be temporary and mostly related to the impacts to water quality from dredging activities during the construction period or presence of construction vessels. These would also likely result in modification and changes to the sediment particle size and distribution in the direct vicinity of the Proposal.

During the construction phase of the Proposal the following activities and resulting impacts have the potential to adversely affect MEQ near the Proposal:

- Dredging, reclamation and disposal activities have the potential to:
  - Increase turbidity, SSC and deposition rates.
  - Alter the physical characteristics of adjacent sediments.
  - Mobilise contaminants contained within the sediments.
  - Reduce water clarity and light over quite large areas.
- There is potential for a hydrocarbon release into the marine environment from a vessel spill and/or bunkering operations during construction.

7.4.2 Operational phase impacts

The following post-construction or operational phase impacts have the potential to adversely impact on MEQ near the Proposal:

- Chronic turbidity and remobilised contaminants generated through operation of the port, increased vessel traffic and tug propellor wash.
- Sediment plumes caused by maintenance dredging.
- Release of hydrocarbons or other chemical toxicants from vessel or onshore spills.

Each of these potential impacts could compromise the existing EVs within Cockburn Sound.

7.5 Mitigation

7.5.1 Avoid

The Proposal has been through an extensive and rigorous MCA process, with scoring weighted heavily towards environmental criteria, including comparing predicted changes to flushing and plume dispersion (thermal, saline and sediment). The weighting assigned to environmental criteria relating to MEQ (described in more detail in **Section 1.2.2**) favoured the final preferred port and channel option, which this Proposal represents. This includes the proposed offshore breakwater which compared with some other port options considered through the MCA process avoids significant changes to local hydrodynamics due to being parallel to the shoreline.

The preferred new second channel option is also predicted to avoid impacts related to reduced water circulation in the Sound with modelling showing that it is the best option for improving flushing rates within the northern area of Cockburn Sound and seasonal medium-scale and broadscale water circulation regimes in Cockburn Sound being unimpacted.

7.5.2 Minimise

There is potential that the Proposal results in operational impacts to environmental and social EVs, including established LEPs, caused by chronic turbidity generated through operation of the port, increased vessel traffic and tug propellor wash. In this regard a Tug Sediment Resuspension study (using field measurements and hydrodynamic modelling of concentration of sediment resuspended by tug activity at an existing project adjacent to the Proposal) was undertaken to inform assessment of the Westport SCID Phase 3 short list marine infrastructure options. However, a larger more targeted study for the Proposal will be required to inform the EIA.

It is proposed that sediment plume modelling is undertaken to predict the extent, severity, frequency and duration of ongoing resuspended sediment plumes in Cockburn Sound that are expected to be generated by operational vessel activity associated with the Proposal. This approach will provide a clearer understanding of possible changes to ambient turbidity/SSC and the subsequent consequences to the five EVs and relevant corresponding EQOs that apply to Cockburn Sound and surrounding waters. It is anticipated that this work will be supported by the integrated ecosystem modelling framework for Cockburn Sound being delivered by WWMSP Theme 1 as well as baseline information and knowledge delivered by Theme 3. The model will be developed to explore dredge plume dispersion effects on MEQ, the ability of Cockburn Sound to meet established LEPs and EQOs and to support understanding and management of the effect of pressures on the marine environment during the development and subsequent operation of the Proposal.

In relation to construction impacts to MEQ, further work to identify dredging environmental management strategies to minimise impacts will be required through the EPA’s environmental scoping and assessment phase. Key considerations are dredging volume, in addition to dredging equipment choice, operational settings (e.g. overflow duration), dredging schedule (e.g. staging) and dredge spoil disposal/re-use strategies, application of other mitigation measures (e.g. sedimentation ponds and silt screens).

7.5.3 Rehabilitate

The overall objective of the Cockburn Sound SEP is to ensure that the water quality of the Sound is maintained and, where possible, improved so that there is no further net loss and preferably a net gain in seagrass areas, and that other environmental values and uses are maintained. Achieving this objective is an important priority across the Westport Program. Using a science-based approach, the WWMSP is being completed to identify opportunities to improve management of Cockburn Sound for this generation, and future generations.

7.6 Assessment and significance of residual impact

7.6.1 Construction phase impacts

EVs, EQOs and LEPs aren't defined by short term impacts but are intended to represent long-term objectives for MEQ. The EQMF therefore provides a basis for considering cumulative effects and the EIA of Port developments in the long-term. Construction impacts from the Proposal are predicted to be temporary and mostly related to the temporary impacts to water quality from dredging activities during the construction period or presence of construction vessels within the Proposal DE.

7.6.1.1 Dredging: increase turbidity, suspended sediment concentration and deposition rates

Dredging and disposal activities are expected to result in temporary and localised increases to turbidity, SSC and deposition rates as well as loss of ecosystem integrity/function due to the direct and indirect loss of shallow sandy habitat, seagrass, reefs and algae. This potential impact on the established EVs in Cockburn Sound will be temporary, so will mostly be assessed in the context of the extent, duration and severity of the potential impact on BCH and marine fauna in **Section 5** and **Section 8** respectively. A temporary modification to the established long-term LEP boundaries within Cockburn Sound and also along the second main channel will need to be spatially defined and made publicly available during construction (to reflect the short-term impact to EVs) but these will return to normal following completion of the dredging and disposal. This is likely to require a reduction in some impacted areas from a HEPA to a MEPA, however, the extent and duration of these temporary LEPs will be determined later following completion of dredge plume modelling and other relevant EIA studies and presented in the PER.

7.6.1.2 Dredging: alteration of the physical characteristics of adjacent sediments

Dredging can alter the composition of nearby *in-situ* sediments due to deposition of dredge-generated suspended sediments. This effect has been previously observed during other similar sized dredging programs to the Proposal, including Woodside's Pluto Project and Chevron's Wheatstone Project.

For the Pluto Project dredging, pre- and post-dredging surface sediment PSD surveys (MScience, 2011) indicated a significant increase in silt in surface sediments adjacent to areas dredged in the southern portion of Mermaid Sound, which persisted over time. The fine content decreased with distance from the dredge footprint which allowed the magnitude and spatial scale of impact to sediment PSD to be determined.

A larger dredge volume is proposed for this Proposal than for Pluto or Wheatstone, so the predicted magnitude of changes to the physical characteristics of the sediment adjacent to the Proposal are likely to be significant.

7.6.1.3 Dredging: mobilisation of contaminants in sediments

The sediment SAP implemented by the Proponent for the Proposal (RPS, 2023) indicates that the concentration of COPC (i.e. total metals, hydrocarbons and organotins) in the material to be dredged are below the relevant screening levels for reclamation purposes or unconfined ocean disposal. The results indicate dredging or disturbance of the sediments is not likely to result in adverse effects on MEQ and that EQO1 for the EV 'Ecosystem Health' is likely to be achieved in the Moderate or High LEP areas shown in **Figure 7-2**.

7.6.1.4 Dredging: reduce water clarity and light

Reduction in water clarity and available light as a result of increased SSC, poses a risk to BCH and marine fauna and associated ecosystem integrity and function. This potential impact on EVs via this pathway is not expected to be long-term so will mostly be assessed in the context of the extent, duration and severity of the potential impact on BCH and marine fauna in **Section 5** and **Section 8** respectively.

7.6.1.5 Construction vessels: potential hydrocarbon spill

There will be a broad range of marine based construction vessels and related equipment which will each have a risk of hydrocarbon spillage (e.g. dredge vessels, crew transfer vessel, support vessels, drilling/piling plant). There is potential for a hydrocarbon release into the marine environment from these vessels during construction. However, this risk is inherent in all dredging operations and can be effectively managed through application of standard operating procedures. All vessels will be required to have a Shipboard Oil Pollution Emergency Plan (SOPEP) and SOPEP equipment to prevent release of hazardous materials into the marine environment, and to respond if such releases do happen. The construction environmental management plans will include proposed monitoring and management strategies to mitigate this risk.

7.6.2 Operational phase impacts

7.6.2.1 Chronic turbidity generated and remobilised contaminants through operation of the port, increased vessel traffic and tug propellor wash

Reduction in water clarity and light as a result of increased SSC, poses a risk to BCH and marine fauna as well as causing long term changes to the turbidity regime of Kwinana Shelf and a risk to some aspects loss of ecosystem function. Physical contaminants such as suspended sediments and turbidity can affect ecosystem processes such as respiration and photosynthesis and can also affect social uses of marine waters by altering the clarity of the water or aesthetic characteristics. The extent, duration, frequency and severity of the potential impact on EVs will need further assessment.

The Proposal operations at the terminal facility will likely require an extension of the eastern Cockburn Sound MEPA (into and reducing the HEPA). For example MEPAs are often applied to relatively small areas within inner ports to accommodate any accumulation or remobilising of contaminants from anti-foulant paints or spillages, typically extending up to 250 m from ship turning basins and berths (EPA, 2016f).

7.6.2.2 Sediment plumes caused by maintenance dredging

Reduction in water clarity and light as a result of increased turbidity during maintenance dredging, poses a risk to MEQ. The potential impact on EVs and EQOs will be infrequent, minor and temporary and will be managed in accordance with a port long term dredge management plan.

7.6.2.3 Operational vessels: potential hydrocarbon spill

Increased vessel traffic associated with the Proposal (including larger and more frequent vessel arrivals) has the potential to increase the risk of vessel collision and associated accidental hydrocarbon spill. Hydrocarbon spills are possible however the risk of a significant hydrocarbon spill is considered to be very low, with the risk inherent in all operational port facilities. Standard operational management practices will be regulated by the port and response measures will be in place to effectively mitigate this risk.

7.6.3 Cumulative impacts

The EQMF being applied for the assessment of impacts to MEQ from the Proposal already provides a basis for considering cumulative effects from all the different pressures on the Sound as well as the EIA of the Proposal in the long-term. This will be further considered in the PER.

7.7 Environmental outcomes

The Proposal has the potential to result in construction (short-term) and operational (long-term) impacts to MEQ. The Proponent will need to demonstrate how these potential environmental impacts have been mitigated to the fullest practicable extent. Assessment of impacts to MEQ for the Proposal will involve the following aspects:

- Contemporary marine studies and best available science (including from the WWMSP) used to inform the assessment of impacts to MEQ.
- Assessment against the SEP established EQMF, EVs and EQOs across Cockburn Sound and surrounding waters
- Consistency with EPA Technical Guidance.

Incorporation of these aspects during the EIA will be required to ensure sufficient confidence in the predicted impacts to MEQ that are used to assess whether the objectives for Cockburn Sound as set out in the SEP, and the EPA's objectives for MEQ, can be achieved.

8 Marine Fauna

8.1 EPA environmental factor and objective

To protect marine fauna so that biological diversity and ecological integrity are maintained.

8.2 Relevant policy and guidance

- Environmental Factor Guideline: Marine Fauna, EPA, Western Australia EPA (2016g)
- Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals, EPA, Western Australia EPA (2021)
- State Environmental (Cockburn Sound) Policy 2015 (EPA, 2015)
- Environmental Quality Criteria Reference Document for Cockburn Sound (EPA, 2017).

8.3 Receiving environment

8.3.1 Studies and investigations

- WWMSP Theme 1: Ecosystem modelling
- WWMSP Theme 4: Fisheries and aquatic resources
- WWMSP Theme 7: Noise
- WWMSP Theme 8: Apex Predators and iconic species
- O2 Marine (2023a) Marine fauna desktop study: Westport. Report number R220380.
- O2 Marine (2023b) Fisheries desktop study: Westport. Report number R220380.
- BMT (2018a) Cockburn Sound – Drivers-Pressures-State-Impacts-Responses Assessment 2017 final report
- BMT Oceanica (2014) Cockburn Sound Coastal Vulnerability Values and Risk Assessment Study.

8.3.2 General description – marine fauna

Cockburn Sound supports spawning aggregations and juveniles of fish (e.g. pink snapper) and invertebrates (e.g. blue swimmer crabs), specially protected migratory species (e.g. JAMBA/CAMBA listed migratory birds and whales) and supports primary food resources for threatened marine fauna listed under State and Commonwealth legislation (e.g. little penguins and Australian sea lions). Many of these species have critical windows of time during the year where they are particularly sensitive to impacts within the Sound. These critical windows of marine environmental sensitivity must be considered during the EIA process for the Proposal.

Bottlenose dolphins utilise all the main habitats of Cockburn Sound, with Kwinana Shelf and the deep basin most intensively used (Calver and Finn, 2001). Australian sea lions can be found at haul out sites throughout the year, including regular sightings around Garden Island (Orsini, 2004). A colony of little penguins occurs on Penguin Island (outside and south of Cockburn Sound), which is the largest in Western Australia and represents the northern most breeding limit of the species. Little penguins have an unusually lengthy breeding season on Penguin Island, lasting from April to January (Nicholson, 1994) and the species also forages within Cockburn Sound. Several major seabird species have been documented to use the coastal waters in the region, including terns, cormorants, oystercatchers, shearwaters, pelicans, ospreys, and sea eagles. The Garden Island coast also plays host to a suite of waders in the summer.

The WWMSP has a number of marine fauna projects that will provide insights into these receptors within Cockburn Sound and Owen Anchorage. The following sections briefly describe the key species or biologically important areas. The species and their uses of Cockburn Sound and Owen Anchorage will be investigated further and presented in the PER and supporting documentation.

8.3.2.1 Key marine fauna species

Table 8-1 lists conservation significant marine fauna species that are listed under the EPBC Act or BC Act and may potentially to occur within or in proximity to the Proposal area (O2 Marine, 2023a), including any relevant biologically important areas (BIAs) applicable to each species.

Whilst not listed under the EPBC Act or BC Act, the little penguin (*Eudyptula minor*) is an iconic species known to occur in proximity to the Proposal area. Cockburn Sound is also a biologically important area for the species with respect to foraging (provisioning young).

Table 8-1: Conservation significant marine fauna with potential to occur

Common name	Species	Class	EPBC Act	BC Act	BIA
Grey nurse shark	*Carcharias taurus*	Shark	VU	VU	-
Scalloped hammerhead	*Sphyrna lewini*	Shark	CD	-	-
Southern right whale	*Eubalaena australis*	Mammal	EN & MI	VU	Seasonal calving habitat
Humpback whale	*Megaptera novaeangliae*	Mammal	MI	CD & MI	Migration (north and south)
Australian sea-lion	*Neophoca cinerea*	Mammal	EN	EN	Foraging (male)
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	Mammal	-	MI	
Common sandpiper	*Actitis hypoleucos*	Bird	MI	MI	

Common name	Species	Class	EPBC Act	BC Act	BIA
Wedge-tailed shearwater	*Ardenna pacifica*	Bird	MI	MI	Foraging (in high numbers)
Ruddy turnstone	*Arenaria interpres*	Bird	MI	MI	
Wandering albatross	*Diomedea exulans*	Bird	VU & MI	VU	
Caspian tern	*Hydroprogne caspia*	Bird	MI	MI	Foraging (provisioning young)
Northern giant petrel	*Macronectes halli*	Bird	VU & MI	MI	-
Bridled tern	*Onychoprion anaethetus*	Bird	MI	MI	Foraging (in high numbers)
Fairy prion (southern)	*Pachyptila turtur subantarctica*	Bird	VU	-	-
Roseate tern	*Sterna dougallii*	Bird	MI	MI	Foraging
Australian fairy tern	*Sternula nereis nereis*	Bird	VU	VU	Foraging (in high numbers)
Greater crested tern	*Thalasseus bergii*	Bird	MI	MI	
Threatened species are listed as 'critically endangered' (CR), 'endangered' (EN) or 'vulnerable' (VU). *MI are listed migratory species.* *CD are listed conservation dependent species.*					

8.3.2.2 Key fish species

Cockburn Sound and Owen Anchorage support a large variety of fish species and fisheries, provides spawning and nursery habitats, and are important areas for commercial and recreational species in Western Australia including the pink snapper (*Chrysophrys auratus*) which is a major recreational species and is commercially important in WA. The only locations on the lower-west coast where snapper aggregate to spawn are Cockburn Sound, Owen Anchorage and Warnbro Sound. Results from a study by Wakefield et al. (2011) found that these areas are important spawning sites and nursery areas for the species and are thus critical for sustaining stocks of the species. The Sound is also an important location for other fish species such as blue swimmer crabs, western king prawns, white bait and King George whiting.

The Proposal is situated in a local area that supports important habitats with high abundances of some species. As such, individual fish species, commercial and recreational fisheries, aquaculture, and flow on effects to other marine fauna in the local marine environment are all relevant considerations to the Proposal.

The key fish species that are present and relevant to the Proposal, and have important habitat within Cockburn Sound, are described in **Table 8-2** (O2 Marine, 2023b).

Table 8-2: Key fish species relevant to the Proposal and local area

Species	Relevance to Proposal and local area
Pink snapper	Spawning habitat, egg retention, and nursery habitat, Proposal DE overlaps November spawning location, Proposal DE overlaps with high abundance of juvenile snapper and larvae, however, final preferred port facility option avoids D9 which is a key spawning aggregation site and has less impact on snapper larvae than other port options studied through MCA process (these locations are presented in **Figure 8-1**).
Blue swimmer crab	Nursery habitat, seagrass is an important habitat, Proposal DE overlaps important nursery area.
Southern garfish	Spawning and nursery habitat, species is seagrass dependent.
Australian herring	Widely distributed through Cockburn Sound, spawning occurs from Perth to Cape Leeuwin.
Whitebait	Nursery habitat, key prey species for the little penguin and Australian fairy tern, high larvae abundance overlaps Proposal DE and species distribution higher around Proposal DE.
King George whiting	Nursery located at Mangles Bay.
Yellow fin whiting	Widely distributed through Cockburn Sound, stock is classified as sustainable-adequate.
Blue mussels	Important aquaculture species, spawning occurs from May to August.
Squid (or southern calamari)	Important recreational species, abundant in Cockburn Sound and Owen Anchorage, investigation into fine-scale spatial distribution in Cockburn Sound suggests preference for seagrass habitats.
Syngnathidae	Important commercial aquarium species, seagrass dependent, Cockburn Sound breeding habitat for endemic West Australian seahorse. Syngnathidae species are also flagship species for seagrass habitats.

Other species present in Cockburn Sound that are fished by commercial and recreational fishers but Cockburn Sound does not represent important nursery or spawning habitat include Australian sardines and scaly mackerel, which are key prey species for little penguin and Indo-pacific bottlenose dolphin.

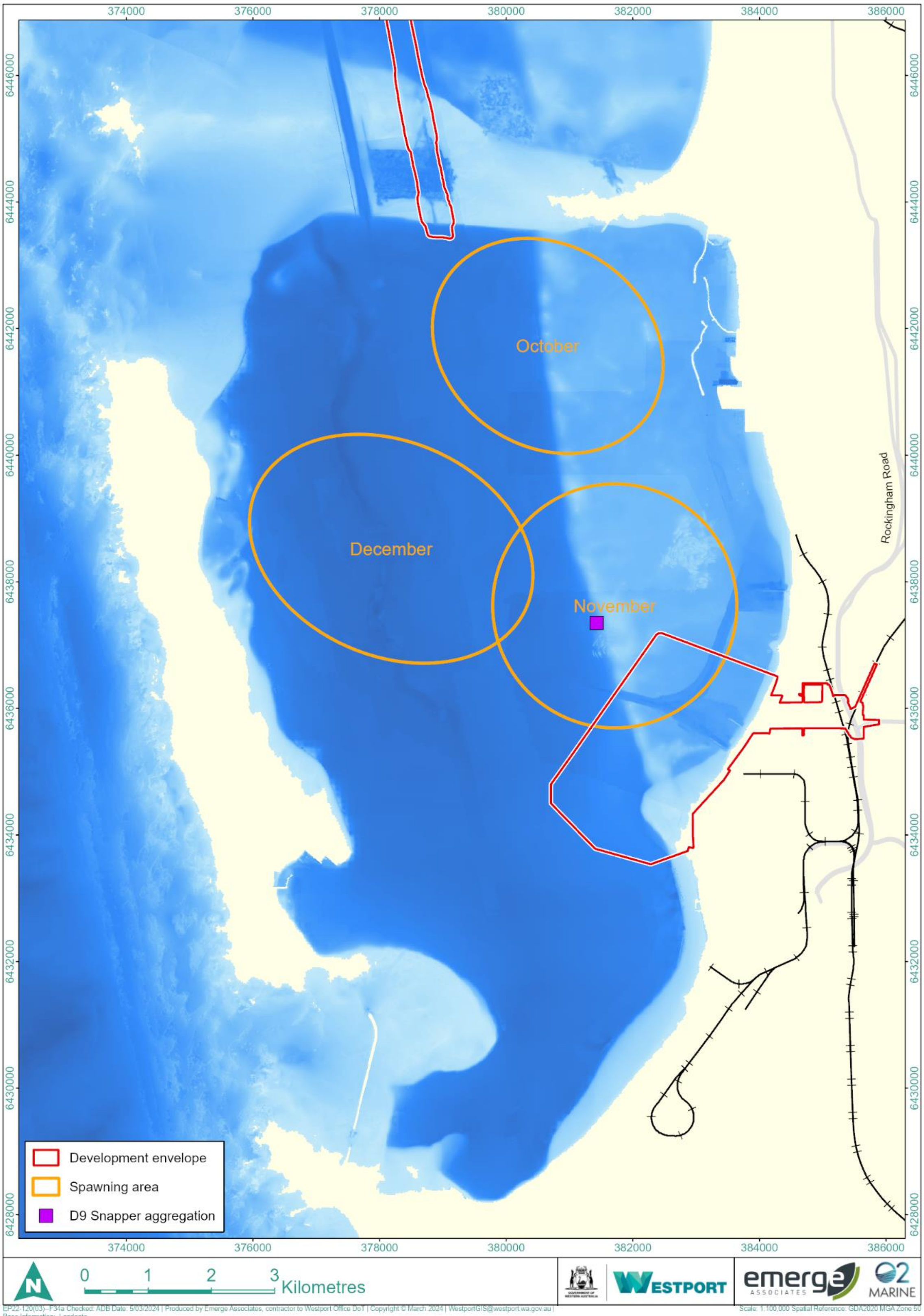

Figure 8-1: Snapper spawning aggregations

8.4 Potential environmental impacts

8.4.1 Construction phase impacts

During the construction phase, the following activities have the potential to adversely affect marine fauna in the vicinity of the Proposal.

- Injury from vessel strike during dredging and disposal activities.
- Underwater noise and vibration impacts from dredging and piling.
- Artificial light emissions originating from construction vessels including those associated with dredging altering behaviours.
- Loss of marine fauna habitat due to direct removal or disturbance of benthic habitat from dredging.
- Increases in turbidity from dredging and reclamation impacting on foraging fauna, behaviour and/or spawning success.
- Entrainment of marine fauna by dredge.
- Threats to biosecurity due to the introduction of marine pest species from construction vessels resulting in decline in local marine fauna populations.
- Alteration of spawning habitat or reduced spawning success due to changes in hydrodynamics for snapper in Cockburn Sound.

8.4.2 Operational phase impacts

During the operational phase, the following activities have the potential to adversely affect the marine fauna in the vicinity of the Proposal.

- Injury from operational vessel strike.
- Underwater noise impacts from maintenance dredging and increased vessel traffic.
- Threats to biosecurity due to the introduction of marine pest species from operational vessels.
- Artificial light emissions originating from vessels altering behaviours.
- Increases in turbidity from vessel movements impacting on foraging fauna, behaviour and/or spawning success.

8.5 Mitigation

8.5.1 Avoid

It is likely that there will be some impacts to marine fauna or their habitat that will not be able to be avoided. However, avoiding known critical spatial and temporal windows of marine environmental sensitivity, such as snapper spawning locations and seasons, has been a key mitigation strategy during the planning phase and will continue to be applied during construction works. For example through the MCA process, the selected preferred port option avoids key snapper spawning aggregation site 'D9' and was modelled to have the least impact on dispersal and density of snapper larvae during the November spawning period (which is most proximal to the port DE) across the three short-listed options.

Other mitigation measures to avoid impacts will be investigated during the impact assessment process and presented in the PER documentation.

8.5.2 Minimise

The following mitigation measures may be used to minimise impacts of the Proposal:

- Continuing and possibly increasing the State-wide Array Surveillance (SWASP) monitoring to ensure introduced pests are detected as soon as possible and measures can be taken to control and eradicate.
- Offshore breakwater and structure design options are being considered to minimise the impact on hydrodynamics, as it is understood that circulation affects the transport of snapper larvae.
- To minimise the impacts of dredging on coastal fish, sediment concentrations should be kept below critical thresholds. This in turn would also aid in minimising impacts to little penguins that rely on forage fish populations for food.
- Reducing noise can be most effectively achieved through selection of quieter construction methods. Vibration piling for example could be used as a preference to hammer piling and mechanical dredging could be selected over hydraulic dredging where possible.
- Where temporal or spatial overlap between noise at a potentially harmful level with sensitive species is unavoidable, mitigation should involve trained and/or dedicated marine fauna observers (MFOs) and the use of management (observation and exclusion) zones.

8.5.3 Rehabilitate

- Options are being considered for the offshore breakwater to be designed to maximise marine fauna habitat.
- Rehabilitation of benthic communities where possible may also aid in supporting the marine fauna in the area.

8.6 Assessment and significance of residual impact

8.6.1 Direct impacts

8.6.1.1 Injury from vessel strike

Increased vessel movements increase the potential risk for vessel strikes, especially for airbreathing species and species that spend prolonged periods of time at the water's surface. In the south-west bioregional plan, vessel strikes are a potential concern for cetaceans, Australian sea lion and the little penguin. Collisions with recreational vessels are the major contributor to little penguin deaths. Resting or milling whales, in particular calving females, are likely to be most at risk of vessel effects and can demonstrate a lack of adequate avoidance behaviour to approaching vessels (Nowaeck et al., 2004).

Marine fauna may be impacted by vessel strike during the construction phase due to vessel movements, with the potential impact resulting in injury or fatality. The risk from the Proposal however is very low as all of the project vessels involved will be slow moving. The dredge vessels and any piling vessel operate very slowly and within the Proposal DE only. Barges (which are used in tandem with the dredge vessel) are also generally slow moving. En route between the second main channel and reclamation area, it is unlikely these barges will be travelling faster than 6-8 knots.

The risk of vessel strike is also very low for the operational phase as commercial vessels will be generally slow moving within port waters (unlikely to be travelling faster than 6-8 knots), particularly when they are approaching restricted waters. The future manager of the port will be responsible for continuously monitoring all commercial vessel traffic in vicinity of port operations, including locations, routes and speed, using a vessel tracking system.

8.6.1.2 Underwater noise impacts from dredging, piling and increased vessel traffic

Increased underwater noise due to dredging and piling during construction works and increased vessel movements during the Proposal operational phase have the potential to impact marine fauna.

Sound travels faster through water than air with low frequencies travelling further than high frequencies (DoE, 2015). Impacts from underwater noise can include reduced hearing sensitivity, through shifting the hearing threshold permanently or temporarily for marine species. Loud noises or long exposure may lead to physical damage, including permanent or temporary hearing loss (DSEWPaC, 2012). If the noise exposure exceeds the critical sound energy level the hair cells of marine mammals become permanently damaged and tissue rupture occurs, leading to hearing loss and permanent threshold shift (PTS) (DoE, 2015; DPTI, 2012). When the auditory system is exposed to a high level of sound for a specific duration, sensory hair cells begin to fatigue and change shape. If the noise exposure is below some critical sound energy level, the hair cells will eventually return to their normal shape, representing temporary threshold shift (TTS). Therefore, the assessment criteria for each marine fauna type are divided into noise levels that may result in TTS, PTS, masking (communication interference) and behavioural and energetic consequences.

Underwater noise modelling has not yet been conducted for the Proposal, though a study is currently underway to capture the ambient underwater soundscape to understand and inform management of the potential effects of increased underwater noise (WAMSI, 2021). Sound propagation associated with the Proposal will be modelled and the susceptibility of key species to the range of frequencies emitted by vessels and port operations investigated (WAMSI, 2021). The findings will be used to develop mitigation methods to reduce the potential effects of underwater noise on marine species (WAMSI, 2021).

Another mechanism noise can affect wildlife is by masking acoustic signals that animals rely on and, in doing so, hindering communication between individuals. Masking by anthropogenic noise can become a concern for a particular cetacean species when the frequency band of the noise overlaps with the species' vocal frequency range or hearing range (DoE, 2015). The hearing sensitivity of marine mammals varies with frequency of the noise source and between species (DPTI, 2012). Hearing is most sensitive at frequencies ranging from 8-90 kHz for toothed whales and below 1 kHz for baleen whales (DPTI, 2012).

The impact of low-level anthropogenic noise that is received continuously can also include changes in behavioural responses. Noise generated by construction activities has the potential to disturb marine fauna including threatened and listed migratory species (e.g. humpback whale, little penguin, Australian sea lion). Impacts include causing temporary or even long-term avoidance of an area that would otherwise be important for feeding, reproduction or sheltering (DSEWPaC, 2012). These impacts may affect critical behaviours and functions, such as feeding, migration, breeding and response to predators, all of which may ultimately affect an individual animal's survival.

An increase in underwater noise can also affect fish species and their behaviours, including pink snapper potentially avoiding critical spawning habitats (Popper and Hawkins 2018). Fish larvae also rely on sound as an orientation cue and rely on sensory organs to actively disperse and locate suitable habitats (Simpson et al. 2004; Montgomery et al. 2006; Caiger et al. 2012). Fish egg and larvae exposed to underwater noise for pile driving are at risk from potential impacts such as mortality and injury to internal organs, especially if near the noise source.

Implementation of appropriate underwater noise management strategies, informed by modelling, will ensure that impacts from underwater noise will not cause significant impacts to individuals or have population level consequences. Further mitigation will be adopted where avoidance cannot be achieved. The use of MFOs will further facilitate the protection of marine fauna.

8.6.1.3 Light pollution originating from vessels

The construction and operation of the Proposal will result in the increase of light sources and light pollution. Bright lighting can disorient flying birds and subsequently cause injury or mortality through collision with infrastructure or starvation due to disruptions in the ability to forage at sea (DSEWPaC, 2012). Artificial lighting can also cause congregations of foraging fish species leading to altered behaviours of predator species.

8.6.1.4 Loss of marine fauna habitat due to direct removal or disturbance of benthic habitat from dredging

Marine fauna present within the disturbance area are well represented within the local (i.e., Cockburn Sound) and broader region (i.e., Perth's coastal waters) (O2 Marine, 2023a). Although seagrass habitat is widely represented across the region, it is only the seagrass habitat within Cockburn Sound that supports spawning aggregations and juveniles of fish (e.g. pink snapper) and invertebrates (e.g. blue swimmer crabs). Cockburn Sound also supports primary food resources for threatened marine fauna listed under State and Commonwealth legislation (e.g. little penguins and Australian sea lions). An assessment of impacts to marine fauna from the loss of key habitat will be required once and will need to consider the anticipated impacts to BCH as a result of the Proposal.

8.6.1.5 Entrainment of marine fauna by dredgers

Entrainment of marine fauna and collision with dredging infrastructure is a risk presented by dredging operations (Whittock et al., 2017; Todd et al., 2014). The highest potential for marine fauna entrainment by dredge is for marine reptiles, particularly sea turtles, which are not frequently found in Cockburn Sound. Dredging operations is only likely to affect individual turtles rather than cause a population level impact, particularly as turtles are rarely present within the Proposal area.

Dredge vessels pose different risk profiles to marine fauna, for example, a backhoe dredge does not pose a high risk (no viable/probable pathway for entrainment). In the context of a cutter-suction dredge, it is also difficult for a turtle (or other significant marine fauna) to be entrained due to the very slow moving (anchored) position of the dredge and the position of the dredge pump near the sea floor behind the rotating cutter head. Trailer suction hopper dredges pose a greater risk if used and would require management measures to minimise this risk, which may include the use of Turtle Exclusion Devices on dragheads, generally used for reducing bycatch in fisheries but has also been used on these dredge types (Lank and Roberts, 2022).

8.6.1.6 Threats to biosecurity due to the introduction of marine pest species from construction vessels resulting in decline in local marine fauna populations

Invasive species are also a key pressure associated with shipping activities in Cockburn Sound. There are 45 introduced marine species known in Cockburn Sound, four of which are considered pests. Some examples of the impacts of introduced marine pests in relation to fish and fisheries value in Cockburn Sound may include:

- Loss of commercial and recreational fisheries harvest.
- Competition with native species for habitats (e.g. important spawning and nursery habitats,), food and/or habitat potentially leading to the displacement of native species.
- Predation on native species.
- Alteration of trophic interactions and food-webs.
- Alteration of ecosystem processes (e.g. nutrient cycling and sedimentation).

The SWASP for introduced marine pests has been implemented in Fremantle since 2010 and reports are completed twice a year, presenting the results of monitoring conducted by DPIRD, Fremantle Ports and Department of Defence. The Proposal will lead to increased shipping and therefore increased risk of further invasive species being introduced to the Sound. Marine pests may be introduced during construction and/or operations through ballast water exchange or via biofouling. Dredge vessels, trading vessels, barges and tugs are among the vessels considered high-risk for the introduction of pest species (O2 Marine, 2021a). Where appropriate mitigation measures are adopted, the risk of introduced marine pests becoming established and affecting the biodiversity values and/or ecological integrity of the local environment is low.

Mitigation measures consistent with the National System for the Prevention and Management of Marine Pest Incursions, the Australian Ballast Water Management Requirements and the National Biofouling Management Guidelines for Commercial Vessels reduce the risk that Proposal activities will result in the introduction of marine pests in the proposal area and surrounding marine environment.

8.6.2 Cumulative impacts

The cumulative impacts to marine fauna due to the Proposal and other existing or future proposals will be investigated during the PER process. The Proponent will ensure all direct and indirect impacts as a consequence of the Proposal, including the cumulative effect of additional shipping movements, and any third party users of the infrastructure, will be assessed as required under both the State EP Act and/or the Commonwealth EPBC Act. This will include relevant EPBC Act controlled action triggers for listed marine species, such as whales and other migratory species, and their application to shipping movements associated with the Proposal.

8.7 Environmental outcomes

Consideration of the potential for significant impacts to marine fauna is based on the nature and magnitude of potential impacts, considering the criteria as defined within the EPA and MNES significant impact guidelines (DoE, 2013). The nature and magnitude of impacts to marine fauna will not be fully understood until the mitigation hierarchy has been further applied during the final planning and design process and the required information is available (during the formal assessment phase of the Proposal), such as the extent of impacts to seagrass habitat and critical windows of environmental sensitivity.

Cockburn Sound's social importance to the Western Australian community is largely due to it supporting the previously identified significant marine fauna (including listed Threatened and Migratory species under the EPBC Act and key fish and fisheries). Potential impacts of the Proposal on marine fauna will be further assessed at the PER stage, including consideration of:

- Baseline studies used to inform the assessment of impacts to marine fauna
- Use of contemporary and locally relevant science for predicting impacts to marine fauna, including outputs of the WWMSP

- Review of actual marine fauna habitat impacts (including BCH) from previous projects in the area
- Assumption that best practice port design and impact mitigation will be applied
- Consistency with EPA Technical Guidance.

Incorporation of these aspects during the EIA will be required to ensure sufficient confidence in the predicted environmental outcomes that are used to assess the consequences of the potential impacts resulting from implementation of the Proposal, to confirm whether the EPA's objective for marine fauna can be achieved.

9 Flora and Vegetation

9.1 EPA environmental factor and objective

To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

9.2 Relevant policy and guidance

- EPA Environmental Factor Guideline – Flora and Vegetation
- EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment
- Conservation advice for applicable threatened ecological communities and flora (various)
- DCCEEW Survey guidelines for Australia's threatened species.

9.3 Receiving environment

9.3.1 Studies and investigations

A desktop study of flora and vegetation values within the terrestrial portion of the Proposal area was completed in August 2023 (Biota, 2023). This study involved a literature review, database searches and a likelihood of occurrence assessment for conservation significant flora and vegetation.

Building on the outcomes of the August 2023 desktop study, a 'detailed' and 'targeted' flora and vegetation assessment was undertaken in Spring 2023. The assessment adopted a methodology that addresses the requirements of the *EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*. The results of the assessment are currently being analysed to inform preparation of the survey report. Preliminary results of the assessment are presented below, where relevant. The full survey outcomes and report will be available to support the future stages of the EIA process.

9.3.2 General values

As discussed in **Section 1.4**, the terrestrial portion of the Proposal area is situated within the KIA which has been subject to high levels of disturbance and vegetation clearing as a result of the development and expansion of industrial land uses since the early 1950s.

Regional native vegetation extent data (DPIRD, 2023) indicates that approximately 28 ha of native vegetation occurs within the terrestrial portion of the DE, of which approximately 11 ha is identified as regrowth vegetation. The remainder of the terrestrial portion of the DE (approximately 80% of its extent) has been historically cleared and no longer supports native vegetation.

Vegetation complex mapping for the Swan Coastal Plain (DBCA, 2018) identifies the Quindalup Complex and Cottesloe Complex – Central and South as occurring across the terrestrial portion of the DE. Where remnant native vegetation does remain and is relatively undisturbed, the vegetation composition and structure may align with the mapped vegetation complex. The details of both vegetation complexes are summarised in **Table 9-1**.

Table 9-1: Vegetation complex descriptions and statistics (DBCA, 2018)

	Quindalup Complex	Cottesloe Complex – Central and South
Complex description	Coastal dune complex consisting mainly of two alliances - the strand and fore-dune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of *Melaleuca lanceolata* (Rottnest teatree) - *Callitris preissii* (Rottnest Island pine), the closed scrub of *Acacia rostellifera* (summer-scented wattle) and the low closed *Agonis flexuosa* (peppermint) forest of Geographe Bay.	Mosaic of woodland of *Eucalyptus gomphocephala* (tuart) and open forest of *Eucalyptus gomphocephala* (tuart) - *Eucalyptus marginata* (jarrah) - *Corymbia calophylla* (marri); closed heath on the limestone outcrops.
Structural formation	Coastal dunes, low closed forest and closed scrub.	Woodland, open forest and closed heath.
Swan Coastal Plain pre-European extent	54,574 ha	45,300 ha
Current extent (2018 data)	33,012 ha (60.5% of pre-European extent)	14,658 ha (32.2% of pre-European extent)
Current extent (2018 data), protected for conservation	4,918 ha (9.0% of pre-European extent)	4,308 ha (9.5% of pre-European extent)
Native vegetation extent within DE (DPIRD 2023)	14.6 ha, of which 5.7 ha is identified as regrowth vegetation.	13.3 ha, of which 5.5 ha is identified as regrowth vegetation.

Figure 9-1 shows the extent of native vegetation and boundaries of vegetation complexes in proximity to the Proposal. Given the extensive historical disturbance across the KIA and within the terrestrial portion of the DE, it is likely that the local area supports a range of introduced (weed) species, which can out-compete native flora and reduce the vegetation condition of native communities. Similarly, the presence of plant diseases such as dieback (*phytophthora cinnamomi*) is common across south-west Western Australia where areas are subject to high degrees of disturbance and human activity, indicating such disease have potential to exist within the Proposal area.

The results of the Spring 2023 flora and vegetation assessment, once available, will provide further information on the flora and vegetation values within the site.

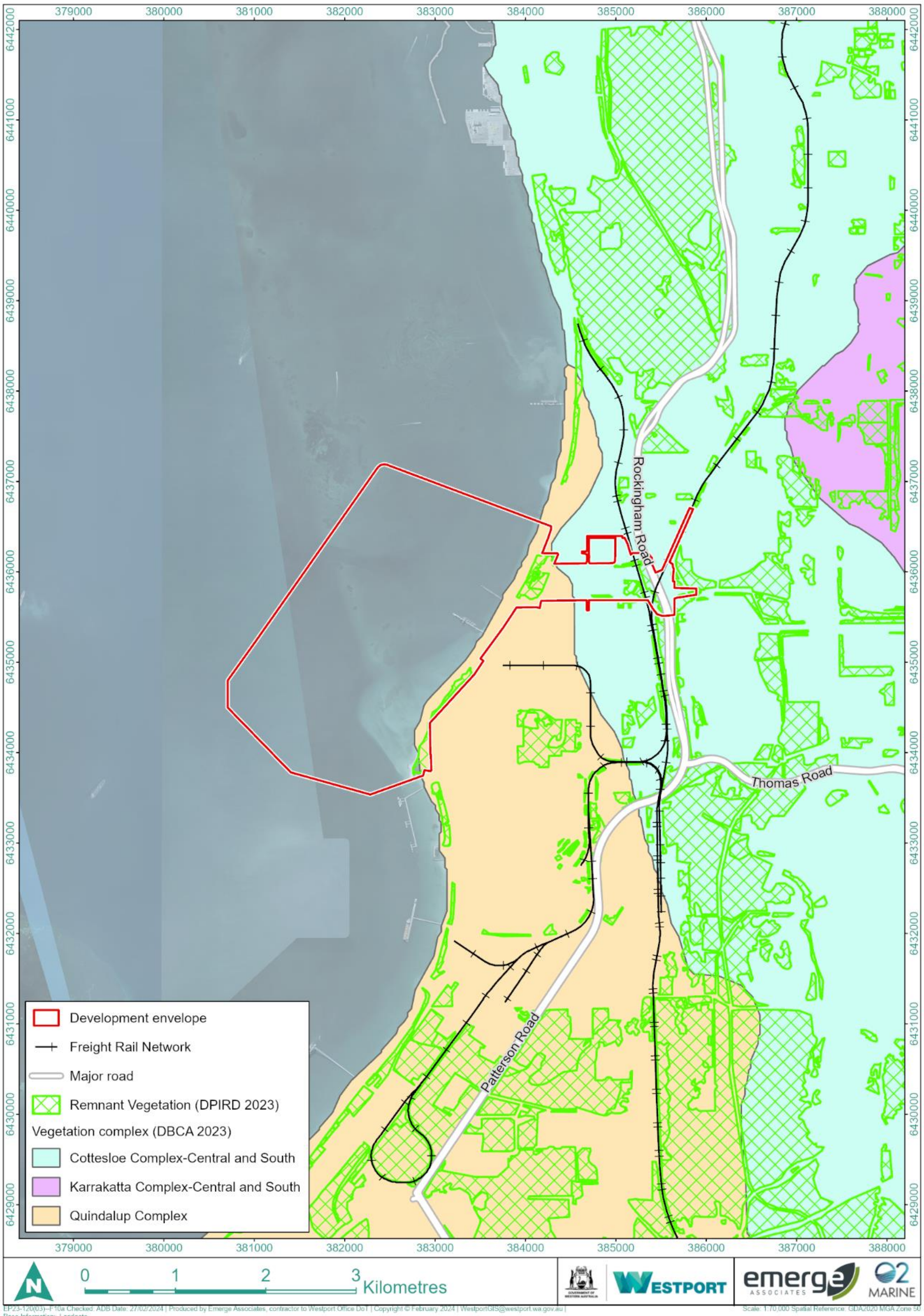

Figure 9-1: Native vegetation complexes and extent

9.3.3 Conservation significant flora

Based on the results of the desktop flora and vegetation study (Biota, 2023), one threatened flora species and eight priority flora species may potentially occur within the DE, as summarised in **Table 9-2**.

Table 9-2: Conservation significant flora with potential to occur

Species	Common name	EPBC Act	BC Act	DBCA
Caladenia huegelii	Grand spider orchid	EN	CR	-
Poranthera moorakatta	-	-	-	P2
Austrostipa mundula	-	-	-	P3
Eryngium pinnatifidum subsp. *Palustre* (G.J. Keighery 13459)	-	-	-	P3
Jacksonia gracillima	-	-	-	P3
Pimelea calcicola	Coastal banjine	-	-	P3
Caladenia speciosa	Sandplain white spider orchid	-	-	P4
Dodonaea hackettiana	Hackett's hopbush	-	-	P4
Eucalyptus foecunda subsp. *foecunda*	Fremantle mallee	-	-	P4
Threatened species are listed as 'critically endangered' (CR), 'endangered' (EN) or 'vulnerable' (VU). Priority species are defined by DBCA as Priority 1, 2, 3 or 4.				

A targeted assessment for conservation significant flora within the DE was completed in Spring 2023. The results of this survey are currently being processed and will be available at the future assessment phases, which will enable confirmation of presence or absence of conservation significant flora species at the future ESD and PER stage.

Preliminary findings indicate that no threatened or priority flora species were identified during the Spring 2023 field surveys. However, potential for priority species and/or taxa of interest remain, pending confirmation of collected specimen identifications.

9.3.4 Conservation significant ecological communities

Based on the results of the August 2023 desktop assessment (Biota, 2023), three threatened ecological communities (TECs) and two priority ecological communities (PECs) have the potential to occur within the DE, as summarised in **Table 9-3**.

Table 9-3: Conservation significant ecological communities with potential to occur

Species	Likelihood of occurrence (Biota, 2023)	EPBC Act	BC Act	DBCA
Sedgelands in Holocene Dune Systems of the southern Swan Coastal Plain	May occur	EN	CR	-
Banksia woodlands of the Swan Coastal Plain	May occur	EN	-	P3
Tuart (*Eucalyptus gomphocephala*) forests and woodlands of the Swan Coastal Plain	Unlikely to occur	CR	-	P3
Northern Spearwood shrublands and woodlands (FCT 24)	Likely to occur	-	-	P3
Acacia shrublands on taller dunes, southern Swan Coastal Plain (FCT 29b)	May occur	-	-	P3
Threatened species are listed as 'critically endangered' (CR), 'endangered' (EN) or 'vulnerable' (VU). Priority species are defined by DBCA as Priority 1, 2, 3 or 4.				

A detailed assessment for conservation significant ecological communities within the terrestrial DE was completed in Spring 2023. The results of this survey are currently being processed and will be available at the future assessment phases, which will enable confirmation of presence or absence of conservation significant ecological communities at the future ESD and PER stage.

Preliminary findings from the Spring 2023 field survey indicate that, pending completion of detailed floristics analysis, the following conservation significant ecological communities may occur:

- Banksia woodlands of the Swan Coastal Plain
- Tuart (Eucalyptus gomphocephala) forests and woodlands of the Swan Coastal Plain
- Callitris preissii (or Melaleuca lanceolata) forests and woodlands of the Swan Coastal Plain (FCT 30a) (BC Act – CR)
- Coastal shrublands on shallow sands, southern Swan Coastal Plain (FCT 29a) (P3).

9.4 Potential environmental impacts

Potential environmental impacts of the Proposal on flora and vegetation values are outlined below and will be confirmed and considered at the future assessment stage, to be documented in the future PER.

9.4.1 Direct impacts

During the construction phase of the Proposal the following key activities and resulting impacts have the potential to adversely impact on flora and vegetation:

- Direct loss, degradation and fragmentation of flora and vegetation through clearing and bulk earthworks of the landside development area.

9.4.2 Indirect impacts

During the construction and operations phase of the Proposal the following key activities and resulting impacts have the potential to adversely impact on flora and vegetation:

- Indirect loss or impact to flora and vegetation as a result of the introduction or spread of invasive species (pests and weeds) due to construction or operational machinery and vehicles.
- Indirect loss or impact to flora and vegetation as a result of the introduction or spread of disease (for example, dieback) due to construction or operational machinery and vehicles.

9.4.3 Cumulative impacts

As discussed in **Section 9.3.2**, at a local scale the KIA has been subject to extensive historical clearing of native vegetation to facilitate strategic industrial development. At a regional scale, the Swan Coastal Plain has also been subject to extensive historical clearing of native vegetation to facilitate the growth of the Perth metropolitan area. The Proposal will also contribute to these cumulative impacts to flora and vegetation, as will other future projects to be developed within the KIA and across Perth.

There may also be impacts on native communities into the KIA buffer zone associated with Anketell Rd improvements and upgrades. These impacts may not be significant for the Proposal in isolation, but may be significant in a cumulative context.

9.5 Mitigation

9.5.1 Avoid

Throughout the port location selection process (discussed in **Section 1.2.2**), various port layouts with different terrestrial footprints were considered. A small marine footprint port option was considered, whereby the bulk of the container logistics and storage infrastructure was separately located inland, east of Rockingham Road, and connected to the marine terminal by automated transport routes. This option would have resulted in extensive impacts to native vegetation and associated conservation significant TEC vegetation, due to its large inland terrestrial footprint. Potential impacts to conservation significant flora were also considered. The high quantum of terrestrial vegetation impacts was a key reason this port option scored poorly in the MCA process when compared to other options. This option was not further progressed, providing a strategic impact avoidance outcome.

Where possible the DE has been spatially limited to avoid areas supporting native vegetation, to avoid potential impacts of loss and fragmentation through clearing. However, given the large scale of the Proposal and the needs for large, cleared areas to support landside port infrastructure, such impact avoidance opportunities are limited. Avoidance opportunities will continue to be considered as the design of the Proposal develops.

9.5.2 Minimise

There are a range of opportunities available to minimise potential impacts on flora and vegetation as part of implementing the Proposal. Impact minimisation measures will be further assessed and confirmed at the future assessment stage.

The risk of potential impacts associated with the spread or introduction of weeds and disease can be minimised through the implementation of best-practice construction environmental management protocols (typically through a construction environmental management plan). This typically involves the implementation of management actions related to the use of clean machinery and vehicles, washdown facilities and stockpile management. Further controls to reduce the risk of exceeding any approved vegetation clearing limits can also be applied.

9.5.3 Rehabilitate

There is potential for the Proposal to include areas of temporary impact, for example to facilitate construction staging, laydown areas or other construction infrastructure. If this results in temporary impacts to flora and vegetation values, then there may be opportunities to rehabilitate these areas after construction is completed. This will be further investigated and confirmed at the future PER stage.

9.6 Assessment and significance of residual impact

Residual impacts to flora and vegetation will be confirmed and considered at the future assessment stage, based on the results of site-specific surveys completed in Spring 2023. This will be documented in the PER.

9.6.1 Direct impacts

The Proposal may result in the direct loss of up to 29 ha of native vegetation that occurs within the terrestrial DE as a result of clearing during construction. This vegetation has the potential to contain conservation significant flora and vegetation. The specific flora and vegetation values and area of impact will be confirmed through the assessment stage, which will inform the assessment of these impacts and their potential significance.

9.6.2 Indirect impacts

With respect to the potential introduction and spread of weeds and disease, it is likely that such threats already apply to vegetation within the Proposal area. Notwithstanding, there are a range of impact minimisation measures (discussed above) that can be implemented.

9.6.3 Cumulative impacts

The potential cumulative impacts of the Proposal on flora and vegetation will be assessed at the future PER stage, as discussed in **Section 1.5**. It is expected that cumulative impacts will be assessed in the context of the loss of native vegetation generally and in consideration of regional vegetation complexes, relative to pre-European extent. Sufficient information and data will be available to undertake this assessment as to how cumulative impacts to these values have occurred over time. This can be considered in both a local and regional context.

9.7 Environmental outcomes

There is potential for significant impacts to flora and vegetation as a result of implementing the Proposal. Currently, gaps in knowledge (particularly with respect to TEC occurrence within the Proposal area) represents a limitation that will be resolved through targeted onsite survey currently being undertaken within the terrestrial portion of the port DE. The survey results will enable confirmation of presence or absence of conservation significant flora and ecological communities. These potential impacts will need to be considered and assessed at the future PER stage to determine whether the EPA objective can be met.

10 Terrestrial Fauna

10.1 EPA environmental factor and objective

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

10.2 Relevant policy and guidance

- EPA Environmental Factor Guideline – Terrestrial Fauna
- EPA Technical Guidance – Sampling methods for terrestrial vertebrate fauna
- EPA Technical Guidance – Terrestrial fauna surveys
- EPBC Act Referral guidelines for three WA threatened black cockatoo species: Carnaby's cockatoo, Baudin's cockatoo and Forest red-tailed black cockatoo
- Survey guidelines for Australia's threatened reptiles.
- Survey guidelines for migratory shorebirds.

10.3 Receiving environment

10.3.1 Studies and investigations

To inform the Proposal, an initial desktop study of terrestrial fauna species (vertebrate and invertebrate, including short-range endemic (SRE) species) within the Proposal area was completed in August 2023 (Biota, 2023). This study involved a literature review, database searches and a likelihood of occurrence assessment for conservation significant fauna.

Building on the outcomes of the August 2023 desktop study, the following field surveys have subsequently been undertaken:

- Basic fauna survey
- Targeted survey – black cockatoos
- Targeted survey – migratory shorebirds
- SRE sampling.

The surveys have been undertaken in accordance with relevant EPA and DCCEEW guidance (**Section 10.2**) to ensure suitability for use in EIA, including consideration of optimal survey timing and frequency.

The results of the field surveys are currently being analysed to inform preparation of the associated report. The survey findings and associated report will be available to support the future stages of the EIA process.

10.3.2 General values

Terrestrial fauna habitat values within the DE have been subject to significant disturbance due to the construction and operation of historical and existing industrial land uses across the KIA.

In this context, the fauna assemblages utilising the terrestrial DE are expected to be reduced compared to what would typically occur in comparative coastal environments that had not been subject to such disturbance. Notwithstanding, the DE is still likely to provide habitat of varying composition, condition and extent for native terrestrial fauna. This is likely to be primarily associated with areas supporting vegetation.

In addition, the coastal beach area and intertidal zone has the potential to be used by migratory or marine bird species during southward or northward migration periods. However, the DE area is not a known important area for shorebirds (Cannell, 2004).

Preliminary results of the field surveys indicate:

- Eight mammal species were detected, seven introduced and one native (quenda)
- Five reptile species were recorded, three skinks and two elapids. All are common
- 37 bird species from 23 families were recorded.

10.3.3 Conservation significant vertebrate fauna

Based on the results of the August 2023 desktop assessment (Biota, 2023), two threatened, four priority and one 'other protected' vertebrate fauna species may potentially occur, as summarised in **Table 10-1**.

Table 10-1: Conservation significant vertebrate terrestrial fauna with potential to occur

Common name	Species	Class	EPBC Act	BC Act	DBCA
Carnaby's cockatoo	*Zanda latirostris*	Bird	EN	EN	-
forest red-tailed black cockatoo	*Calyptorhynchus banksii* subsp. *naso*	Bird	VU	VU	-
peregrine falcon	*Falco peregrinus*	Bird	-	OS	-
Perth slider / lined skink	*Lerista lineata*	Reptile	-	-	P3
jewelled ctenotus	*Ctenotus gemmula*	Reptile	-	-	P3
quenda / southern brown bandicoot	*Isoodon fusciventer*	Mammal	-	-	P4
western brush wallaby	*Notamacropus irma*	Mammal	-	-	P4
Threatened species are listed as 'critically endangered' (CR), 'endangered' (EN) or 'vulnerable' (VU). Priority species are defined by DBCA as Priority 1, 2, 3 or 4. OS are species otherwise in need of special protection to ensure their conservation.					

With respect to the two black cockatoo species that may potentially occur, the desktop assessment also considered the potential for breeding, roosting and foraging habitat to occur, as summarised in **Table 10-2**.

Table 10-2: Black cockatoo habitat types

	Carnaby's cockatoo	Forest red-tailed black cockatoo
Breeding habitat	Species would not breed within the DE, as it is outside of the known breeding range and available habitat is suboptimal.	Species could potentially breed within the DE, as it is within known breeding range however available habitat is suboptimal.
Foraging habitat	Species could forage within the DE, as suitable foraging habitat may occur.	Species could forage within the DE, as suitable foraging habitat may occur.
Roosting habitat	Species unlikely to night roost within the DE, as it prefers roosting locations in riparian areas or near permanent sources of fresh water.	Species could potentially night roost within the DE, as suitable night roosting habitat (tall trees) may occur.

Confirmation of whether any conservation significant vertebrate fauna species are known or likely to occur within the DE has subsequently been further assessed during the field surveys completed in late 2023 and early 2024. This has included targeted assessments to confirm suitability of black cockatoo habitats.

Preliminary findings from the field survey indicate:

- Individuals and secondary evidence (diggings) of quenda were seen across the majority of the survey area, using motion sensor camera recordings.
- No other conservation significant vertebrate fauna were recorded.
- With respect to black cockatoos:
  - No individuals or secondary evidence of any black cockatoo species were recorded.
  - 99 trees were assessed as potential habitat trees for black cockatoos within the survey area (which is larger than the DE and therefore a lower number may apply), with none having hollows present. No evidence of breeding activity was recorded.
  - The survey area is unlikely to support roosting habitat for Carnaby's cockatoo, whilst suitable roosting habitat for forest red-tailed black cockatoos, which have more general habitat preferences, may occur in small portions of the survey area.

The results of these field surveys are currently being processed and will be available at the future assessment phase, which will enable confirmation of presence or absence of conservation significant species at the future ESD and PER stage.

10.3.4 Conservation significant migratory fauna

Based on the results of the August 2023 desktop assessment (Biota, 2023), 13 listed migratory fauna species (all birds) were considered to potentially occur within the terrestrial DE (**Table 10-3**). Some migratory species are also listed as threatened in Australia.

Table 10-3: Conservation significant vertebrate terrestrial migratory fauna with potential to occur

Common name	Species	Class	EPBC Act	BC Act	DBCA
Pacific swift	*Apus pacificus*	Bird	MI	MI	-
ruddy turnstone	*Arenaria interpres*	Bird	MI	MI	-
curlew sandpiper	*Calidris ferruginea*	Bird	CR & MI	CR	-
greater sand plover	*Charadrius leschenaultia*	Bird	VU & MI	VU	-
Caspian tern	*Hydroprogne caspi*	Bird	MI	MI	-
Northern Siberian bar-tailed godwit	*Limosa lapponica menzbieri*	Bird	MI	MI	-
Eurasian whimbrel	*Numenius phaeopus*	Bird	MI	MI	-
grey plover	*Pluvialis squatarola*	Bird	MI	MI	-
roseate tern	*Sterna dougallii*	Bird	MI	MI	-
fairy tern	*Sternula nereis*	Bird	VU	VU	-
parasitic jaeger	*Stercorarius parasiticus*	Bird	MI	MI	-
crested tern	*Thalasseus bergii*	Bird	MI	MI	-
common greenshank	*Tringa nebularia*	Bird	MI	MI	-
Threatened species are listed as 'critically endangered' (CR), 'endangered' (EN) or 'vulnerable' (VU). MI are listed migratory species.					

Field surveys completed in late 2023 and early 2024 have further assessed whether conservation significant migratory fauna species are known or likely to occur within the DE. Based on the shorebirds counts completed in November 2023, shorebird numbers recorded were low overall, with four listed migratory species observed:

- Actitis hypoleucos (common sandpiper)
- Calidris canutus (red knot)
- Hydroprogne caspi (Caspian tern)
- Thalasseus bergii (crested tern)

The field survey results (including from subsequent January and February 2024 counts) are currently being processed and will be made available at future assessment stages.

10.3.5 Conservation significant invertebrate fauna

Based on the results of the August 2023 desktop assessment (Biota, 2023), no threatened and two priority invertebrate fauna were considered to potentially occur within the terrestrial DE, as summarised in **Table 10-4**.

Table 10-4: Conservation significant invertebrate terrestrial fauna with potential to occur

Common name	Species	Class	EPBC Act	BC Act	DBCA
Swan Coastal Plain shield-backed trapdoor spider	*Idiosoma sigillatum*	Invertebrate	-	-	P3
Graceful sunmoth	*Synemon gratiosa*	Invertebrate	-	-	P4

Further assessment during field surveys completed in Q4 2023/Q1 2024 will confirm whether any conservation significant invertebrate fauna species are known or likely to occur within the DE. The results of these field surveys are currently being processed and will be available at the future assessment phase.

10.3.6 Conservation significant SRE invertebrate fauna

Based on the results of the August 2023 desktop assessment (Biota, 2023), it was concluded that SRE invertebrate fauna have not been well sampled within the terrestrial portion of the DE, which is common across the Swan Coastal Plain.

Three invertebrate groups predisposed to short-range endemism were identified to potentially occur within the site including mygalomorph spiders, millipedes and land snails. Four known SRE species and 13 potential SRE conservation significant invertebrate fauna species may potentially occur within the terrestrial DE, as summarised in **Table 10-5**.

Table 10-5: Conservation significant SRE invertebrate fauna with potential to occur

Group	Species	SRE status
Mygalomorph spiders	*Aname* 'mainae'	Potential SRE
	Aname 'MYG405'	Potential SRE
	Aname 'MYG496'	Potential SRE
	Aname sp.	Potential SRE
	Eucyrtops sp.	Potential SRE
	Idiommata sp.	Potential SRE
	Idiosoma sigillatum	**Known SRE (also P3 species)**
	Kwonkan sp.	Potential SRE
	Missulena sp.	Potential SRE
	Missulena 'hoggi spp. group'	Potential SRE

Group	Species	SRE status
	Proshermacha sp.	Potential SRE
	Synothele sp.	Potential SRE
	Teyl 'waldockae'	Potential SRE
Millipedes	*Antichiropus* 'DIP078'	**Known SRE**
	Antichiropus 'DIP082'	**Known SRE**
	Antichiropus 'DIP126'	**Known SRE**
Land snails	*Bothriembryon kendricki*	Potential SRE

Confirmation of whether any conservation significant SRE invertebrate fauna species are known or likely to occur within the DE has subsequently been further assessed during the field surveys completed in Q4 2023/Q1 2024.

Preliminary survey results indicate that common land snails and introduced millipedes were the predominant finds of the SRE invertebrate searches. No specimens representing potential SRE species were found or retained for analysis.

10.4 Potential environmental impacts

Potential environmental impacts of the Proposal on terrestrial fauna values are outlined below and will be confirmed and considered at the future assessment stage, to be documented in the future PER.

10.4.1 Direct impacts

During the construction phase of the Proposal the following key activities and resulting impacts have the potential to adversely impact on terrestrial fauna:

- Direct loss, degradation and fragmentation of fauna habitat through clearing and bulk earthworks of the landside development area.
- Mortality of fauna due to interaction with construction equipment.

During the operation phase of the Proposal the following key activities and resulting impacts have the potential to adversely impact on terrestrial fauna:

- Mortality of fauna due to interaction with operational equipment.

10.4.2 Indirect impacts

During the construction and operations phase of the Proposal the following key activities and resulting impacts have the potential to adversely impact on terrestrial fauna:

- Altered fauna behaviour due to increased or altered noise emissions, light emissions and human presence
- Increase in feral animal abundance and/or movement around the Proposal area.

10.4.3 Cumulative impacts

As discussed in **Section 9.3.2**, at a local scale the KIA has been subject to extensive historical clearing of native vegetation and associated fauna habitat, including the coastal beach area and intertidal zone that has the potential to be used by migratory or marine bird species. At a regional scale, the Swan Coastal Plain has also been subject to extensive historical clearing of native vegetation and associated fauna habitat to facilitate the growth of the Perth metropolitan area. The Proposal will also contribute to these cumulative impacts to terrestrial fauna habitat availability, as will other future projects to be developed within the KIA and across Perth.

10.5 Mitigation

10.5.1 Avoid

Throughout the port location selection process (discussed in **Section 1.2.2**), various port layouts with different terrestrial footprints were considered. A small marine footprint port was considered, whereby the bulk of the container logistics and storage infrastructure was separately located inland, east of Rockingham Road, and connected to the marine terminal by automated transport routes. This option would have resulted in extensive impacts to native vegetation and associated fauna habitat, habitat connectivity and ecological linkages (including for conservation significant species such as black cockatoos), due to its large inland terrestrial footprint. The high quantum of terrestrial vegetation and fauna habitat impacts was a key reason this port option scored poorly in the MCA process when compared to other options. This option was not further progressed, providing a strategic impact avoidance outcome.

Where possible the DE has been spatially limited to avoid areas supporting native vegetation and associated terrestrial fauna habitat, to avoid potential impacts of loss and fragmentation through clearing. However, given the large scale of the Proposal and the needs for large, cleared areas to support landside port infrastructure, such impact avoidance opportunities are limited. Avoidance opportunities will continue to be considered during detailed design.

10.5.2 Minimise

There are a range of opportunities available to minimise potential impacts on terrestrial fauna as part of implementing the Proposal, including but not limited to:

- Implementation of best-practice construction environmental management protocols (typically through a construction environmental management plan), for example pre-clearing fauna relocation, fauna spotting during construction, construction site speed limits and relocation of suitable habitats (for example, black cockatoo hollows).
- Specification of lighting with reduced spread and intensity.
- Operational protocols around native fauna interactions
- Operational protocols around feral animal control.

Impact minimisation measures will be further assessed and confirmed during assessment.

10.5.3 Rehabilitate

There is potential for the Proposal to include areas of temporary impact, for example to facilitate construction staging, laydown areas or other construction related infrastructure. If this results in temporary impacts to terrestrial fauna habitat values, then there may be opportunities to rehabilitate these areas after construction is completed. This will be confirmed at the future PER stage.

10.6 Assessment and significance of residual impact

Residual impacts to flora and vegetation will be confirmed and considered at the future assessment stage, based on the results of site-specific surveys completed in late 2023 and early 2024. This will be documented in the PER.

10.6.1 Direct impacts

The Proposal may result in the direct loss of up to 29 ha of native vegetation that provides terrestrial fauna habitat as a result of clearing during construction. This habitat has the potential to support conservation significant terrestrial fauna species. The specific terrestrial fauna values in this area will be confirmed through the assessment stage, which will inform the assessment of these impacts and their potential significance.

10.6.2 Indirect impacts

Indirect impacts associated with noise, light, human presence and feral animal abundance is possible, acknowledging that it is likely that such threats already apply to terrestrial fauna values within the Proposal area given historical and existing industrial land uses. There are various impact minimisation measures available to mitigate potential impacts.

10.6.3 Cumulative impacts

The potential cumulative impacts of the Proposal on terrestrial fauna will be assessed at the future PER stage, as discussed in **Section 1.5**. It is anticipated that cumulative impacts will be assessed in the context of the loss of native vegetation and associated terrestrial fauna habitat, relative to pre-European extent. Cumulative impacts to specific fauna habitat types (based on structure and composition) may also be considered, if sufficient data is available. This can be considered in both a local and regional context, subject to data availability.

10.7 Environmental outcomes

There is potential for significant impacts to terrestrial fauna as a result of implementing the Proposal. Currently, gaps in knowledge represents a limitation that will be resolved through targeted onsite survey currently being undertaken within the terrestrial portion of the port DE. The survey results will enable confirmation of presence or absence of conservation significant fauna and associated habitat. These potential impacts will need to be considered and assessed at the future PER stage to determine whether the EPA objective can be met.

11 Terrestrial Environmental Quality

11.1 EPA environmental factor and objective

To maintain the quality of land and soils so that environmental values are protected.

11.2 Relevant policy and guidance

- Contaminated Sites Act 2006
- Environmental Factor Guideline – Terrestrial Environmental Quality (EPA, 2016h)
- Planning Bulletin No. 64: Acid Sulfate Soils (WAPC, 2009)
- Managing urban development in acid sulfate soil areas (DWER, 2015a)
- Identification and investigation of acid sulfate soils and acidic landscapes (DER, 2015)
- Treatment and management of soil and water in acid sulfate soil landscapes (DWER, 2015b)
- Assessment and management of contaminated sites: Contaminated sites guidelines (DWER, 2021).

11.3 Receiving environment

11.3.1 Studies and investigations

The Proponent is undertaking the following site-specific investigations which consider soil quality and potential contamination within the terrestrial DE:

- Preliminary Site Investigation (PSI) (WSP, 2023)
- Detailed Site Investigation (DSI).

The PSI has been completed, whilst the DSI is currently being undertaken and is anticipated to be available to input into the future assessment stage.

11.3.2 Geology

The site is situated within a dunal landform that primarily comprises calcareous sand with smaller areas of limestone and sand formations in eastern areas, as described in **Table 11-1**. The deeper geology is a patchy clay unit, consisting of marine mud separating the Becher Sands and Tamala limestone units to the north of the DE (WSP, 2023).

Table 11-1: Surface geology

Surface geology	Description
Calcareous sand	white medium grained rounded quartz and shell debris well sorted of eolian origin
Limestone	pale yellow-brown fine-grained angular and medium-grained rounded quartz and calcite cross-bedding minor heavy minerals
Sand	pale and olive-yellow medium to coarse-grained sub-angular quartz moderately sorted of residual origin modified by marine inundation

11.3.3 Historical and existing land uses and potential contamination sources

As discussed in **Section 1.4.5**, the KIA has supported industrial land uses and development since the early 1950s. Many existing heavy industrial land uses throughout the KIA are potential sources of contamination, which has the potential to impact natural soil quality in the area.

A review of the publicly available Contaminated Sites Database (DWER, 2023) indicates that various sites within the KIA are known to be comminated, some of which require remediation, as shown in **Figure 11-1**.

The PSI conducted for the Proposal identified soil impacts across much of the terrestrial portions of the DE, based on the results of various historical investigations completed over the past 30 years. Metal and hydrocarbon soil impacts were documented in some areas but have been subject to remediation. A range of data gaps were identified, which will be addressed through the future DSI.

Overall, there is potential for soil contamination within the terrestrial portions of the DE which requires further investigation to accurately characterise.

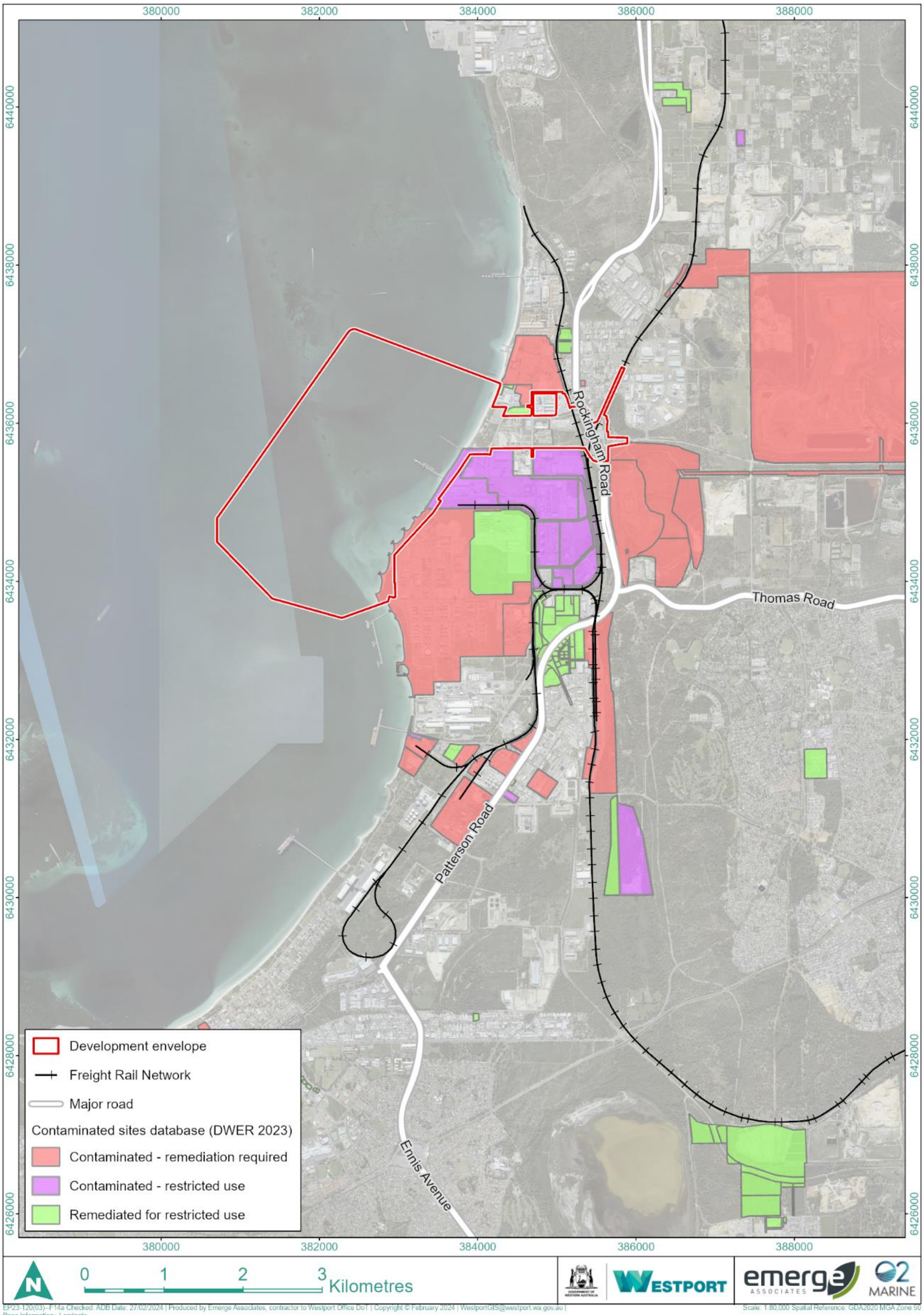

Figure 11-1: Contaminated Sites Database (DWER, 2023)

11.3.4 Acid sulfate soils

DWER regional acid sulfate soils (ASS) risk mapping indicates the terrestrial portion of the DE and surrounding area has no known risk of ASS occurring.

11.4 Potential environmental impacts

Potential environmental impacts of the Proposal on terrestrial environmental quality are outlined below. These will be further considered at the future assessment stage, to be documented in the future PER.

During the construction phase of the Proposal the following key activities and resulting impacts have the potential to adversely impact on terrestrial environmental quality:

- Disturbance, spread and environmental exposure to existing contaminants within excavated soils during construction.
- Introduction of new contaminants into the soil as a result of accidental spills of fuels and other materials used during construction.

During the operation phase of the Proposal the following key activities and resulting impacts have the potential to adversely impact on terrestrial environmental quality:

- Introduction of new contaminants into the soil as a result of accidental spills of fuels and other materials used during operations.

11.5 Mitigation

Many of the terrestrial environmental quality considerations related to contaminated issues are typically dealt with through statutory processes under the Contaminated Sites Act 2006. As such, the extent to which this will be applicable to the EIA will need to be further considered at the scoping stage.

11.5.1 Avoid

As part of the MCA process undertaken to select the preferred location for the port facility, consideration was afforded to avoiding known contaminated sites, to avoid potential disturbance of contaminated soil or groundwater. The majority of the terrestrial portions of the DE (the east-west connection component) is located in a portion of the KIA that contains less known contamination than some adjacent areas to the north and south. This provides avoidance outcomes with respect to potential impacts to terrestrial environmental quality as a result of disturbance, spread and environmental exposure to existing soil contaminants.

11.5.2 Minimise

There are a range of opportunities available to minimise potential impacts on terrestrial environmental quality as part of implementing the Proposal, including but not limited to:

- In accordance with the Contaminated Sites Act 2006 process; prepare and implement a Sampling and Analysis Plan (SAP) and subsequent Remediation Action Plan (RAP) to address known soil contamination prior to or as part of construction activities.

- Where possible, earthworks design should limit excavation in areas known to contain contaminated soils.
- Where contaminated soils are excavated, suitably remediate for re-use or dispose at an appropriate class of landfill facility. This can include application of the following management principles:
  - Prioritising destruction of contaminated material where possible
  - Maximising separation of contaminated material and clean fraction
  - Reducing materials to landfill where options exist for practicable treatment to enable reuse of soil and/or groundwater.
- Implementation of standard operating procedures and environmental best practice to minimise the risk of introducing new soil contaminants during construction and port operations.

Impact minimisation measures will be further considered at the future assessment stage.

11.5.3 Rehabilitate

The construction process provides an opportunity to rehabilitate (remediate) existing impacts to terrestrial environmental quality associated with soil contamination. Any such opportunities are being investigated as part of the DSI and will be further considered in detail through the subsequent SAP and RAP being prepared under the *Contaminated Sites Act 2006* process.

11.6 Assessment and significance of residual impact

Residual impacts to terrestrial environmental quality will be confirmed at the future assessment stage, based on the results of the DSI and other documentation prepared through the *Contaminated Sites Act 2006* process. This will be documented in the PER.

It is anticipated there is the potential for significant environmental impacts if suitable impact mitigation measures are not applied, due to potential for historical soil contamination to become exposed during construction and impact environmental values.

11.7 Environmental outcomes

There is potential for significant impacts to terrestrial environmental quality as a result of the Proposal, which will need to be considered and assessed at the future PER stage to determine whether the EPA objective can be met.

12 Inland Waters

12.1 EPA environmental factor and objective

To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

12.2 Relevant policy and guidance

- Environmental Factor Guideline – Inland Waters (EPA, 2018)
- State Planning Policy 2.9: Water Resources (WAPC, 2006)
- Better Urban Water Management (WAPC, 2008)
- Decision Process for Stormwater Management in Western Australia (DWER, 2017)
- Australian Runoff Quality: A guide to Water Sensitive Urban Design (Engineers Australia, 2006)
- Stormwater Management Manual for Western Australia (DoW, 2007).

12.3 Receiving environment

12.3.1 Studies and investigations

WWMSP Project 3.3 *Elements of the groundwater/surface water flux into Cockburn Sound* is currently being progressed to assess the terrestrial inputs into Cockburn Sound through quantifying groundwater nutrient discharges. It will assess the relative difference between groundwater discharges and surface water discharges. This will provide further scientific knowledge regarding groundwater and surface water quality within the terrestrial portion of the DE, which inputs to Cockburn Sound.

The Proponent is undertaking the following site-specific investigations which consider water resources (with respect to water quality) within the terrestrial portion of the DE:

- Preliminary Site Investigation (WSP, 2023)
- Detailed Site Investigation.

As outlined above, the PSI has been completed, whilst the DSI is currently being undertaken and is anticipated to be available to input into the future assessment stage.

12.3.2 Groundwater

Based on the results of the PSI, groundwater underlying the terrestrial DE is expected to be contained within the following aquifers:

- Superficial aquifer located in the unconsolidated dune sands, recharged by local rainfall. This sandy aquifer generally exhibits high hydraulic conductivities and extends to a depth of approximately 26m.
- A lower, semiconfined aquifer contained in the karstic limestone where a non-continuous clay layer acts as an aquitard. The karstic nature of the aquifer containing limestone results in variable hydraulic conductivities and preferential flow pathways. Due to the non-continuous nature of the aquitard this aquifer is connected to portions of the superficial aquifer.
- Deeper aquifers including the Leederville and Yarragadee aquifers which are separated from the shallow aquifers and each other by thick, impermeable layers.

Groundwater within the DE is expected to be encountered between 3 to 4 m below ground level and flow in a west to north westerly direction (DWER, 2023). Regional groundwater contours are shown in **Figure 12-1**.

The PSI concluded that due to the proximity of Cockburn Sound, underlying groundwater is expected to be tidally influenced, with the magnitude of the influence greater in areas closer to the coast. Additionally, a saline water wedge has been documented to be present in excess of 1km inland from the coast.

Various existing groundwater bores occur across the DE, the majority of which access the superficial aquifer. Existing bores are used for a variety of purposes, including commercial, industrial, water supply, monitoring and other unspecified uses. Various groundwater abstraction licences also exist within the DE of varying quantities.

The PSI concluded that groundwater quality across the DE is of variable quality, with historical groundwater investigations reporting impacts from hydrocarbons, metals, nutrients and excess alkalinity, which was expected to flow towards Cockburn Sound.

Existing vegetation within the site may uptake or be dependent upon groundwater from the underlying superficial aquifer which underlies the site. BoM maintain a groundwater dependent ecosystem (GDE) Atlas, which shows there is potential for terrestrial GDEs to occur within the DE. The GDE Atlas presents a national level assessment, as opposed to being based on more targeted regional or site-specific studies. The PSI concluded that is it considered unlikely that there are any GDEs of significance within the DE.

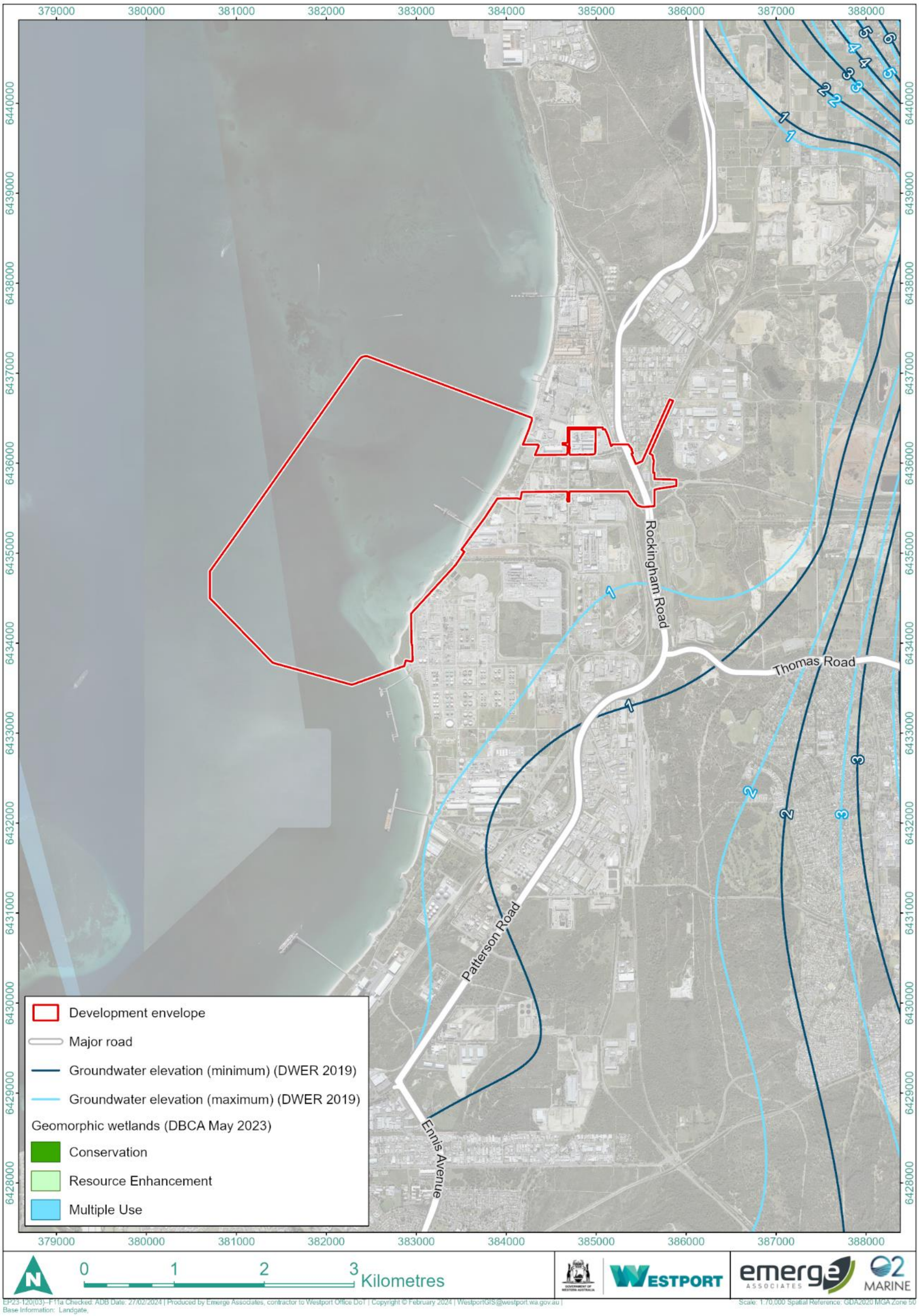

Figure 12-1: Hydrology

12.3.3 Surface water

The site is generally flat, with a slight slope from east to west, towards Cockburn Sound. No surface water features, such as rivers, creeks, drains or flow paths, are mapped within or passing through the DE. Based on the topography of the DE, Cockburn Sound is considered to be the primary downstream sensitive environmental receptor.

The underlying sandy soils are characterised by high permeability, meaning that rainfall is typically expected to freely infiltrate at source in undeveloped areas. Surface water flows in developed areas are likely driven by anthropogenic features such as hardstand runoff and constructed drainage areas.

Given most existing land uses within the KIA (and therefore within the DE) were constructed some time ago, there is generally an absence of contemporary stormwater infrastructure that incorporates Water Sensitive Urban Design (WSUD) principles that would contribute to managing the quality of any surface water runoff, with the exception of more recently constructed developments and land uses.

12.3.4 Wetlands

Geomorphic wetland mapping for the Swan Coastal Plain (DBCA, 2023) does not identify any wetland features as occurring within the DE. The closest mapped wetland is a 2.12 ha Resource Enhancement Wetland (REW) to the north-east of the Rockingham Road and Anketell Road intersection, as shown in **Figure 12-1**.

12.4 Potential environmental impacts

It is anticipated that implementation of the Proposal has the potential to cause the following environmental impacts on inland waters:

- Alteration of groundwater flushing and residence time at the point of contaminated groundwater marine discharge and associated risk of adverse water quality.
- Temporary modification of groundwater levels as a result of terrestrial dewatering during construction (if required) to undertake deep excavation.
- Impacts to current surface and ground water cycles (alteration of hydrological regimes) resulting in impacts to water dependent values.
- Abstraction of groundwater for construction and operational uses (if required), if water quality is confirmed to be suitable for such uses.
- Interruption of current groundwater flows into Cockburn Sound due to presence of port facility infrastructure.

The potential environmental impacts of the Proposal on inland waters will be confirmed and considered at the future assessment stage, to be documented in the future PER.

12.5 Mitigation

12.5.1 Avoid

As part of the port location selection process (discussed in **Section 1.2.2**), inland waters values were considered through the MCA stages. This included assessment of potential direct impacts of each option on significant wetlands, as well as fragmentation impacts to these values. The selected port location avoids all significant wetlands in the local area and will not fragment any such values. Other port options with larger terrestrial footprints had a greater potential for such impacts, but these potential impacts have been strategically avoided through the site selection process.

Within the terrestrial portion of the DE, there are no wetlands or surface water features that require further consideration of impact avoidance. Potential impacts to inland waters values (such as groundwater and surface runoff) will be further addressed through impact minimisation measures.

12.5.2 Minimise

There are a range of opportunities available to minimise potential impacts on inland waters as part of implementing the Proposal, including but not limited to:

- Detailed design of the Proposal to incorporate stormwater management infrastructure that adopts WSUD principles to manage and treat runoff, in order to minimise impacts to water dependent ecosystems (such as Cockburn Sound). This may be implemented through preparation and implementation of a Stormwater Management Plan.
- Implementation of an environmental monitoring program for surface water runoff (flows and quality) and groundwater (levels and quality) during construction and operation, including adaptive management measures, to ensure impacts to water dependent ecosystems (such as Cockburn Sound) are minimised and adaptively managed.
- If terrestrial dewatering is required for deep excavation; implementation of a Dewatering Environmental Management Plan to minimise any potential environmental impacts.

Impact minimisation measures will be further considered at the future assessment stage.

12.6 Assessment and significance of residual impact

Residual impacts to inland waters will be confirmed at the PER stage and will be informed by the results of the DSI and WWMSP Project 3.3. It is anticipated there is the potential for significant environmental impacts if suitable impact mitigation is not applied, due to potential for historical groundwater contamination and nutrient loads and their interaction with Cockburn Sound to be altered as a result of the installation of significant port infrastructure.

12.7 Environmental outcomes

There is potential for significant impacts to inland waters as a result of the Proposal, which will need to be considered and assessed at the future PER stage to determine whether the EPA objective can be met.

13 Social Surroundings

13.1 EPA environmental factor and objective

To protect social surroundings from significant harm.

13.2 Relevant policy and guidance

- Environmental Factor Guideline – Social Surroundings (EPA, 2023a)
- Environmental Factor Guideline: Air Quality (EPA, 2020)
- Interim Technical Guidance EIA of Social Surroundings – Aboriginal Cultural Heritage (EPA, 2023b)
- Aboriginal Heritage Due Diligence Guidelines (DAA, 2013)
- State Planning Policy 2.4 Basic Raw Materials (DPLH, 2019a)
- State Planning Policy 5.4 Road and Rail Noise (DPLH, 2019b)
- Environmental Protection (Kwinana) (Atmospheric wastes) Policy 1999 (Kwinana EPP)
- EPA Guidance for the Assessment of Environmental factors. Separation distances between industrial and sensitive land uses, No.3 (EPA, 2005)
- 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)
- Western Australian Planning Commission Transport Impact Assessment Guidelines (WAPC, 2016)

13.3 Receiving environment

13.3.1 Overview

Social surroundings of the Proposal have been considered with respect to the marine context (Cockburn Sound and areas further north; Owen Anchorage and Gage Roads) and the terrestrial context (KIA).

Cockburn Sound is a unique environment utilised for a range of activities including shipping and bulk transport associated with industrial land uses, commercial fishing and aquaculture as well as recreational activities including, fishing, swimming, diving, water sports and boating (Sutton and Shaw, 2019). Given its use by the broader community, the Proposal has the potential to impact these social surroundings.

The KIA is one of Western Australia's largest industrial areas, supporting various highly visible major industrial facilities and is therefore subject to elevated noise levels and light pollution (Water Corporation, 2019). The KIA is well buffered from the nearest residential areas, located over 3 km away in the suburb of Medina. Approximately 64% of people directly employed within the KIA reside locally in either Cockburn, Kwinana or Rockingham (Sutton and Shaw, 2019).

The nearest sensitive receptors within a 5 km radius of the Proposal are shown in **Table 13-1** and **Figure 13-1**. Additionally, Cockburn Sound and the land in the vicinity of the Proposal are heavily utilised by the community for a range of recreational activities as further described in **Section 1.4.2.8**.

Table 13-1: Closest sensitive receptors to the Proposal

Sensitive receptors	Type	Distance from DE (km)
Perth Motorplex	Recreation	0.71
Wells Park	Recreation	2.27
Residences - Medina	Residential	2.70
Medina Primary School	School	2.77
Amanda's Family Daycare - Medina	Childcare	2.96
Thomas Oval	Recreation	3.14
Kwinana Golf Course/Club	Recreation	3.65

Figure 13-1: Sensitive receptors in proximity to the Proposal

13.3.2 Aboriginal cultural heritage

Aboriginal heritage in Western Australia is managed under the *Aboriginal Heritage Act 1972* (AH Act), which provides a framework for the recognition, protection, preservation and management of Aboriginal heritage.

A search of the DPLH Aboriginal Cultural Heritage Inquiry System (ACHIS) was undertaken to identify previously recorded Aboriginal sites. The search indicated no registered Aboriginal heritage sites recorded within 1 km of the Proposal. The closest registered Aboriginal heritage site to the Proposal is Thomas Oval, approximately 2 km southeast as shown in **Figure 13-2**.

The search of the ACHIS identified one other heritage place within the DE namely, 'Indian Ocean' mythological Aboriginal heritage site (S02169/3776), which includes Cockburn Sound and the waters north to Fremantle and west to Rottnest Island. The site relates to the creation of Cockburn Sound and the surrounding islands, which comes from a Noongar dreaming story about the Gumbar Yondock Ancestral Crocodile and the Waugal, as described in **Section 1.4.7**. The status of this site is 'Stored Data/Not a Site', and as such it is not a protected area under the Act.

Table 13-2 summarises the registered and other heritage places that occur within 5 km of Proposal DE, and their extents are shown in **Figure 13-2**.

Table 13-2: Aboriginal heritage places within 5 km of the Proposal (DPLH, 2023)

Name	Listing status	Site ID	Marine or Terrestrial	Significance	Distance from DE (km)
Thomas Oval	Registered	3710	Terrestrial	Camp	2.36
Woodman Point	Registered	15841	Terrestrial	Mythological	2.65
Cockburn Road	Registered	15840	Terrestrial	Mythological	4.62
Lake Coogee	Registered	20866	Terrestrial	Mythological	5.18
Indian Ocean	Other – Stored Data / Not a Site	S02169/ 3776	Marine	Mythological	Located within DE
Garden Island	Other - Lodged	18417	Marine	Artefacts / Scatter, Historical, Midden / Scatter, Mythological	3.32
Carnac Island	Other - Lodged	20863	Marine	Mythological	3.55
Mount Brown - Booyeeanup	Other - Lodged	20865	Terrestrial	Mythological	1.38

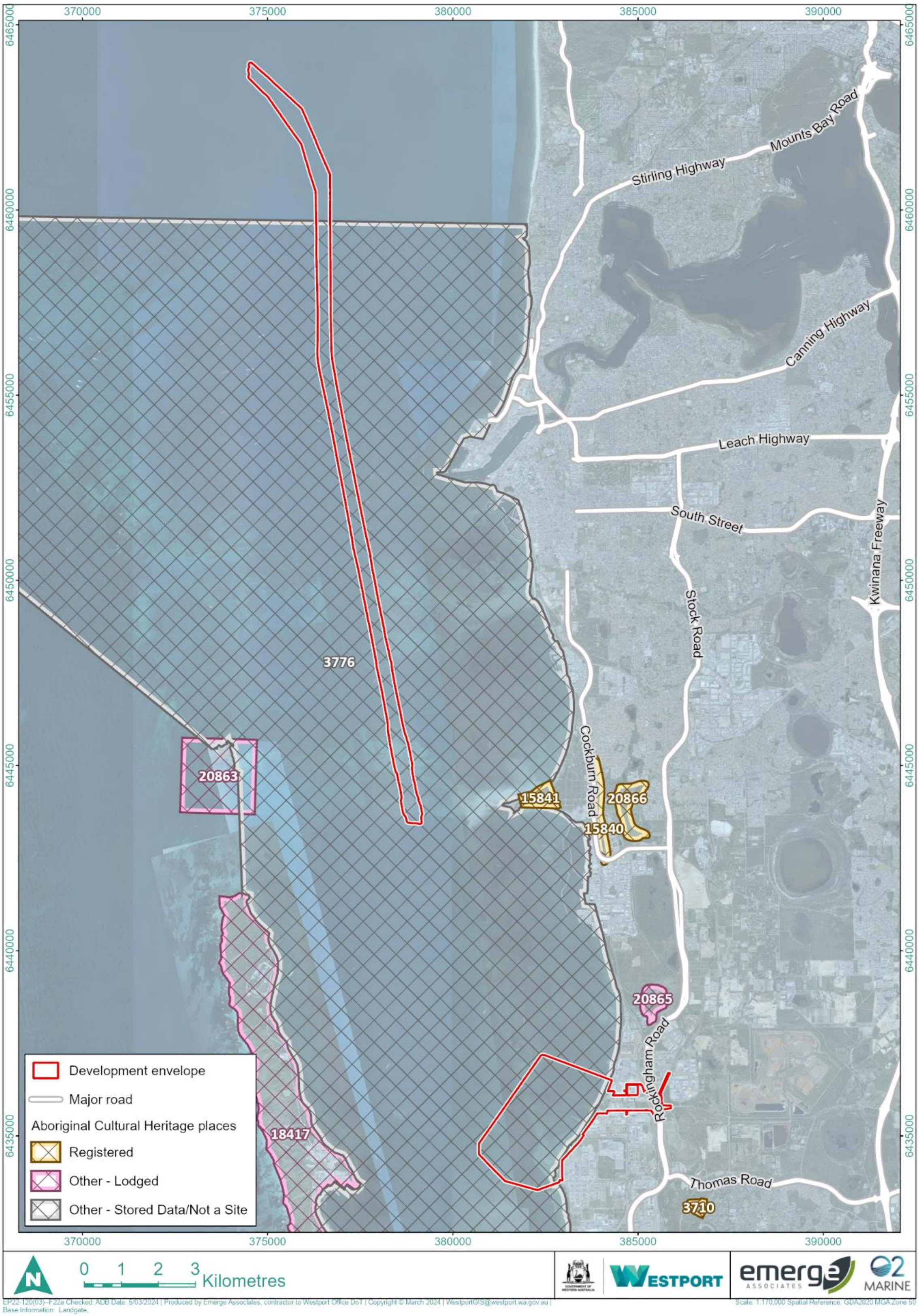

Figure 13-2: Aboriginal heritage places relevant to the Proposal

The Proponent has undertaken focused engagement with Aboriginal stakeholders, including representatives of the applicable Aboriginal Corporations to identify cultural sites of importance and develop a cultural and spiritual values map. The sites identified were used to inform the MCA process and the port design process, by highlighting the important cultural and spiritual sites of relevance. It is noted that the information provided to develop the cultural and spiritual mapping was provided to WPO in confidence and is not yet publicly available. Further assessment of Aboriginal cultural heritage will be undertaken during the next assessment stage of the Proposal within both the marine DE and the terrestrial DE, in accordance with the relevant guidance.

Kapi Biddi: The Westport Aboriginal Engagement Strategy was prepared in 2019 to effectively integrate Aboriginal culture into all stages of the Project. It sets out Westport's vision for Aboriginal heritage engagement and opportunities for involving Aboriginal people into the decision-making process.

The strategy is based on seven pillars that aim to acknowledge, consult, protect, develop, design and advance the Aboriginal cultural connection with Westport. These include:

1. **Noongar Cultural Acknowledgement, Recognition and Education** – based around promoting cultural awareness to all Westport staff and the broader community and integrating this knowledge into Westport's future planning, delivery, and operational phases;
2. **Noongar Community Consultation Process** – reflects the importance of ongoing future engagement with the Noongar community and establishment of the Westport Noongar Advisory Group (NAG), as discussed in **Section 3.3.1.5**.
3. **Protection of Aboriginal Heritage** – describes the spiritual importance of the traditional lands to the Noongar community and the levels of protection both under Federal and State legislation;
4. **Economic Development** – based on creating opportunities for Aboriginal people and businesses to be involved in the Project through employment and procurement avenues, consistent with the State Government's targets;
5. **Recognition of Noongar Culture in Design and Construction** – aims to strengthen the sense of place connected to the Westport development by embedding Aboriginal stories, culture and heritage into the design;
6. **The Six South West Native Title Settlement Indigenous Land Use Agreements** - acknowledges the importance of the six Indigenous Land Use Agreements (ILUAs) established as part of the South West Native Title Settlement (Settlement) and the link to the corresponding Regional Corporations; and
7. **Assessment** – highlights the importance of a clear review and assessment process for the Westport Aboriginal Engagement Strategy to measure its effectiveness and need for modification.

The importance of Strategy in the current phase of the Proposal is providing a pathway for engagement to further understand the receiving environment in the context of Aboriginal culture and embed this within the Proposal's future planning, delivery, and operational phases.

13.3.3 Natural and historic heritage

The Commonwealth maintains various lists and registers of natural, historic and indigenous heritage places throughout Australia, including the World Heritage List, National Heritage List and Commonwealth Heritage List (DCCEEW, 2023a). Places identified on these lists are protected under the Commonwealth EPBC Act.

The World Heritage List is associated with Australia's obligations under the World Heritage Convention and includes 20 listings. The National Heritage List is Australia's list of natural, historic and Indigenous places of outstanding significance to the nation. The list is maintained by the Australian Heritage Council (AHC). The Commonwealth Heritage List is a list of Indigenous, historic and natural heritage places owned or controlled by the Commonwealth Government which are of significant heritage value. There are no World, National or Commonwealth heritage places within 2 km of the Proposal.

The Heritage Council of Western Australia maintains a State Register of Heritage Places under the Heritage Act 2018 for places of State cultural heritage significance. No known heritage places are State listed on land within the KIA. The closest registered heritage place is the Kwinana Signal Box (Place ID: 3112), located approximately 2 km to the south-east. The Peel Town Archaeological Sites (Place ID: 17868) is the closest listed site on the State Heritage register, approximately 0.7 km north of the Proposal near Mount Brown and Beeliar Regional Park. Beeliar Regional Park is in the Places Database maintained by the Heritage Council of Western Australia (Place Number 09198) but is not in the Heritage Council of WA's Assessment Program, nor on the State Register of Heritage Places (Fremantle Ports, 2012).

Local Governments are required to compile a Local Government Inventory that identifies the places and areas that are of cultural heritage significance in the local area, referred to as Local Heritage Surveys. These inventories are non-statutory lists that provide a record of the places that are an important part of the history of an area, and the type of management that should be undertaken. The Naval Base Holiday Park (Place ID: 16994) located opposite the Peel Town Archaeological Sites, is included in the City of Cockburn local heritage survey (non-statutory listing). The listing includes the Naval Base caravan park and holiday shacks on the Henderson Cliffs (Fremantle Ports, 2012). Wells Park and the SS Kwinana shipwreck are both listed on the City of Kwinana local heritage survey (non-statutory listing). Natural and historic heritage sites relevant to the Proposal are shown in **Figure 13-3**.

Australia protects its shipwrecks, sunken aircraft and other types of underwater heritage and their associated artefacts through the *Underwater Cultural Heritage Act 2018*. A search of the Australasian Underwater Cultural Heritage Database (DCCEEW, 2023b) identified no historic shipwrecks listed under the Commonwealth *Underwater Cultural Heritage Act 2018* occurring within 1-km of the Proposal. Based on the shipwreck data held by the Western Australian Museum, no shipwrecks occur within the DE. Two shipwreck sites are located within close proximity of the DE, the Camilla lost in 1903 (approximately 100 m north of the Alcoa jetty) and a D9 Dredge ex Parmelia, sunk in 1962 (approximately 2.5 km south-west of the Alcoa jetty), as shown in **Figure 13-4**.

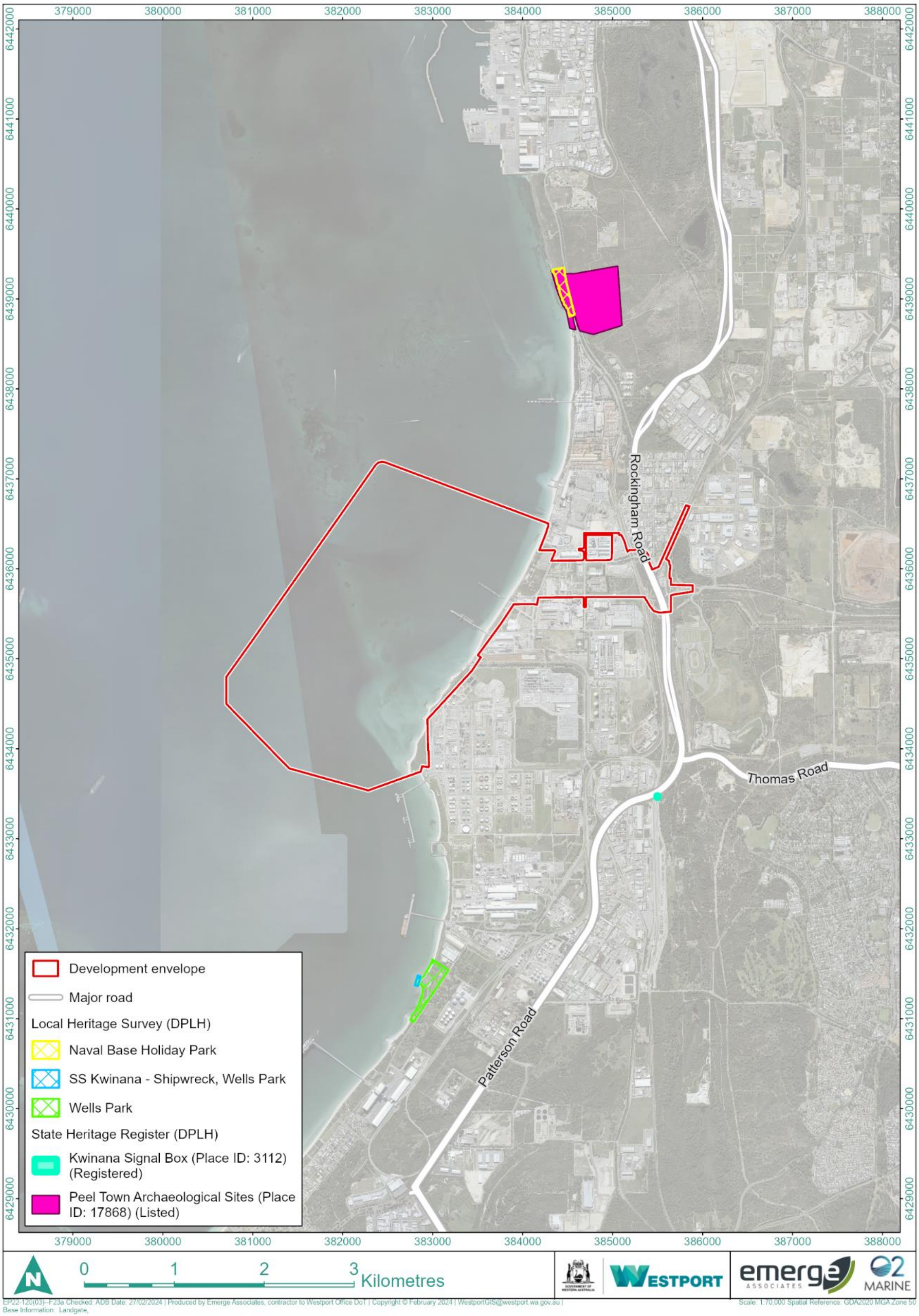

Figure 13-3: Natural and historic heritage places relevant to the Proposal

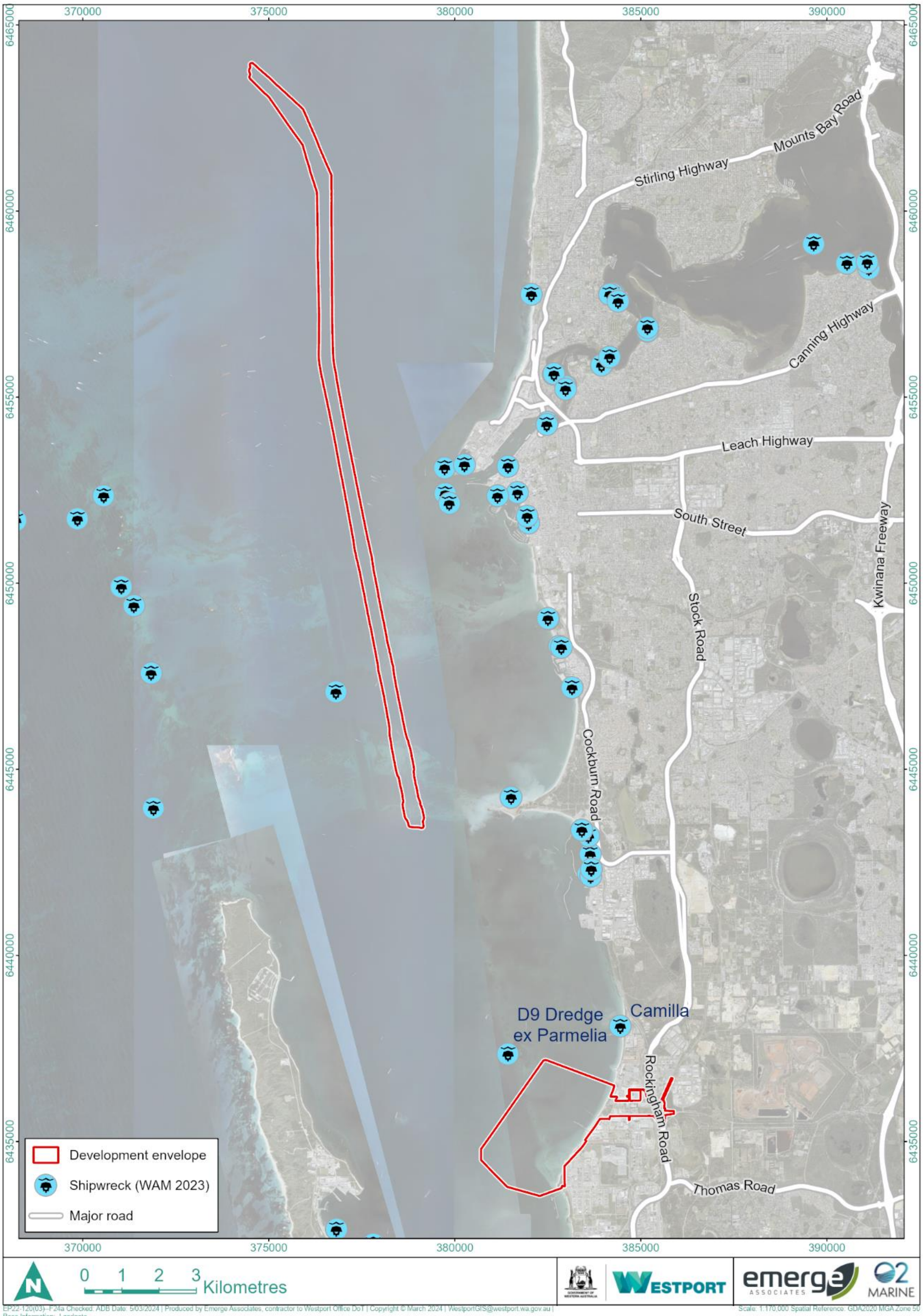

Figure 13-4: Shipwrecks surrounding the Proposal

13.3.4 Amenity

13.3.4.1 Landscape character and visual amenity

Given the location of the Proposal within the existing KIA, the development of a port facility and land-based infrastructure is largely consistent with the current visual landscape. The proposed second main channel will not have new surface infrastructure (beyond navigational channel markings), however will enable an increase in ship traffic volumes beyond that currently entering and exiting Cockburn Sound via Success Channel.

A mix of landscape character zones surround the Proposal, including those with both high and low scenic characteristics. Natural features including Cockburn Sound, surrounding beaches, Beeliar Regional Park and Mount Brown, provide high aesthetic and landscape value, while the KIA immediately surrounding the Proposal area has low scenic characteristics.

The Cockburn Sound shoreline retains most of the natural configuration between AMC and the northern extent of the KIA, with extensive modifications within the KIA for port facilities and small groynes (Fremantle Ports, 2012). Although Cockburn Sound is considered to have a high amenity value due to its recreational value, it is heavily utilised for shipping and other boating activities which makes it a very diverse landscape unit (Fremantle Ports, 2012).

The KIA consists of low lying and flat topography making it highly visible from the areas of higher elevation to the north and east. The key line of sight features to the Proposal are those areas of higher elevation at Mt Brown and highly utilised recreational areas at Woodman Point and the northern Rockingham foreshore, as well as Cockburn Sound itself which is a popular marine recreational area.

Woodman Point is located approximately 9.4 km north of the Proposal and marks the northern most extent of Cockburn Sound. It consists of a relatively narrow beach-ridge plain that extends to a peninsula formed as a result of sediment accumulation (DEC et al., 2010). Woodman Point Regional Park is an area of mixed scenic landscape units combining high conservation value coastal bushland which supports various migratory bird species, whilst it is also known for its heritage values (DEC et al., 2010). Woodman Point provides access to Cockburn Sound for the local community at West Beach and the recreational boating precinct which has public boat ramps and jetties (Fremantle Ports, 2012). Views looking south from the Woodman Point area would include the Proposal.

Mount Brown is a key feature of Beeliar Regional Park with its peak reaching approximately 66 m and offering panoramic views of Cockburn Sound including the Proposal area. Mount Brown is regularly accessed by the broader community for its scenic bushwalking trails.

An Urban Design and Landscape Framework will be developed for the Proposal, which will outline how planning, engineering and landscape project design is integrated and has responded to the various social, cultural, land use, urban, planning and environmental values applicable to the Proposal area. As part of the UDLF process, a landscape character and visual impact assessment will be undertaken to assess the potential visual impacts of the Proposal and define appropriate management strategies.

13.3.4.2 Noise

The KIA contains many heavy industrial land uses that contribute significant noise emissions, resulting in elevated noise levels across the local area. Noise levels are regulated under the *Environmental Protection (Noise) Regulations 1997* which provide assigned noise levels for particular premises based on their noise sensitivity and surrounding land uses, defined as 'assigned limits'. The regulations contain specific provisions for the KIA, whereby the residential areas in proximity to the KIA are subject to a lower recommended maximum design noise emission level of 5dB below the assigned levels, to avoid significantly contributing to an exceedance. Construction activities are not subject to regulations prescribing adherence to Assigned Levels.

The construction and operation of the Proposal will generate noise emissions. This will result in a reduction of amenity in the immediate area of the source. It is anticipated this will be of low impact considering the industrial location of the Proposal. During operations, the predominant noise emissions are likely to be vessel-based and not significantly different from other vessel activity currently within Cockburn Sound, noting vessel noise is considered in relation to Marine Fauna in **Section 8**.

An airborne noise and vibration impact assessment will be undertaken during the assessment stage of the Proposal and will be consistent with the Environmental Protection (Noise) Regulations 1997. The assessment will consider:

- Potential noise and vibration sources associated with Proposal's port operations.
- Proposal terrestrial vibration impacts.
- Proposal (only) noise emissions to receptors such as Medina residential area.
- Cumulative noise impact at sensitive receptors (proposed in addition to the KIC acoustic model predicted emissions).
- EPA guidance including but not limited to the Environmental Factor Guideline regarding existing and Proposal noise (landside and vessel noise emissions).
- Identification of broad measures to achieve compliance with the Noise Regulations.

Existing cumulative noise emissions from the KIA are known to exceed 'assigned levels' at noise sensitive receptors under some wind conditions. As such, the assessment to residential areas near the KIA must consider 'significantly contributing' noise in accordance with regulation 7.

13.3.4.3 Dust

The generation of dust emissions has the potential to negatively impact on local amenity of nearby sensitive receptors. Dust will be generated during construction through the operation of construction machinery, equipment and vehicle movements, and potentially via wind erosion of exposed surfaces from high wind speeds. Construction equipment and vehicle dust emissions would however be marginal and localised, and given the Proposal is located within an existing industrial area, the contribution of short-term construction activities generating dust will be minimal.

During operations, emissions will be generated by shipping activities and road and rail transport (i.e. heavy vehicles and light passenger vehicles). Wind-borne dust emissions may be generated due to large expanses of hardstand areas (emissions will be diffuse rather than point sources for container port operations). Overall, operation of the Proposal is unlikely to be a significant source of dust. Standard dust control measures are considered effective in mitigating potential impacts and can be implemented to suitably manage any dust impacts.

An important consideration in this respect is that the Proposal does not involve trade of bulk materials. Whilst the Proposal includes relocation of the KBB2 jetty and associated construction activities, the Proposal does not include operation of the relocated jetty (which will involve the import and export of bulk materials). These operations and any associated environmental emissions (including dust) will be managed under an amended version of the existing Part V operating licence for the KBT facility (L4476/1984/12, as detailed in **Section 1.4.6.2**).

13.3.4.4 Odour

The generation of odour emissions has the potential to negatively impact on local amenity of nearby sensitive receptors. A range of existing heavy industrial land uses within the KIA produce odour emissions that are associated with existing prevailing odour impacts to the local area, including various refineries (alumina and nickel), agricultural chemical production and power generation, amongst others.

Construction and operation of the Proposal is unlikely to produce odour emissions that would impact on surrounding sensitive receptors, particularly beyond odour impacts that already occur in the local area as a result of existing land uses within the KIA.

The Proposal does not involve the import or export of bulk materials or live export, which have the potential to produce significant odour emissions. As outlined in **Section 13.3.4.3**, any potential odour impacts associated with the operation of KBT using the relocated KBB2 jetty will be managed under an amended version of the existing Part V operating licence for the KBT facility (L4476/1984/12), given the operation of KBT is not part of the Proposal.

It is also noted that BP are currently progressing a separate proposal to transition its former oil refinery to an energy hub capable of processing renewable feedstocks such as vegetable oils, animal fats and other waste products for use in the production of renewable diesel and sustainable aviation fuel. Odour emissions are expected to be released from the renewable feedstocks storage, processing and treatment facilities.

13.3.5 Social values associated with physical or biological values

In accordance with the EPA guidance (EPA, 2023a), there must be a clear link between the Proposal's impact on the physical or biological surroundings and the subsequent impact on a person's aesthetic, cultural, economic or other social surroundings, for these social surroundings to warrant assessment in EIA. This includes changes to a person's and/or a community's sense of place and enjoyment of their natural surroundings.

The WWMSP includes multiple projects that will further characterise the community values within and surrounding Cockburn Sound, including:

- Project 6.1 *Community values for changes in environmental conditions*, which aims to provide an understanding of what environmental qualities, attributes and functions of Cockburn Sound are prioritised by the Perth community.
- Project 6.3 *Recreation, amenity and aesthetic values report on Spatial mapping of non-fishing recreational activities and associated values in Cockburn Sound*, which aims to identify the range and spatial extent of non-fishing recreational activities and associated values.

13.3.5.1 Existing terrestrial social values

Some of the popular land-based activities are beach activities (including dog and horse beach use), cycling, walking/running, birdwatching, camping and caravanning and picnicking (CSMC, 2023; Hughes et al., 2023). WWMSP Project 6.3 has identified three key areas of the Cockburn Sound coastline that have a higher activity concentration including; the northern and southern ends of the Sound and an aggregation in the central area (Hughes et al., 2023).

Popular recreational areas in the immediate vicinity of the Proposal include Naval Base Horse beach and Challenger beach, both utilised on a regular basis by the local community for various recreational purposes including fishing, horse riding and exercising, swimming and diving (Sutton and Shaw, 2019). Naval Base Holiday Park is an accommodation area for holiday goers who typically utilise these local beaches and fishing areas and provides for camping and caravanning facilities (Sutton and Shaw, 2019).

West Beach at Woodman Point, Kwinana Beach, Rockingham Beach and Palm Beach are the most popular for swimming (Fremantle Ports, 2012). Cycling activities tend to be more popular in the northern end of Cockburn Sound (Hughes et al., 2023).

The Mangles Bay area including Cape Peron, Palm Beach, Rockingham Waterfront is a popular recreational spot, offering boat launching facilities at both Cape Peron and Palm Beach (Fremantle Ports, 2012). Palm beach is also one of six beaches with public access in Cockburn Sound (Fremantle Ports, 2012). Camping and Caravanning is provided for in the area at the Cee & CEE Caravan Park and Rockingham Holiday Village (Hughes et al., 2023).

Woodman Point located at the northern end of Cockburn Sound is frequently visited for both land and water-based recreational activities (Hughes et al., 2023). It is an important recreational area with camping and caravanning facilities located at the Woodman Point Holiday and Caravan Park and providing access to Cockburn Sound for swimming and boating activities (Fremantle Ports, 2012). Both Woodman Point and Mount Brown, located in Beeliar Regional Park, offer scenic bushwalking trails and bird watching utilised by the broader community attracting local, interstate and international visitors (Fremantle Ports, 2012; Sutton and Shaw, 2019).

13.3.5.2 Existing marine social values

Cockburn Sound has significant ecological value with the presence of a wide range of marine fauna (Water Corporation, 2019). Some key marine fauna permanently reside in the Sound, including bottlenose dolphins, little penguins, sea lions and fish species (Water Corporation, 2019). A resident sub-population of bottlenose dolphins (*Tursiops sp.*) occurs within the Sound (Water Corporation, 2019). Swimming with dolphins in Cockburn Sound has long been a popular tourism activity, relying heavily on the resident sub-population (Fremantle Ports, 2012; CSMC, 2023). A population of little penguins also utilise the Sound but are more concentrated in the southern area adjacent to their known roosting habitat at Garden Island (Water Corporation, 2019).

The conditions of Cockburn Sound support several recreational activities including fishing, diving (scuba and freediving), sailing, kayaking, waterskiing, swimming and wind/kite surfing (Sutton and Shaw, 2019). The majority of these activities typically operate within the southern region of Cockburn Sound around Mangels Bay and at Woodman Point in the north where access to the sound is more prevalent (Sutton and Shaw, 2019).

Recreational boating occurs across the entirety of Cockburn Sound, however many of the boat launching and mooring facilities are located in the southern section around Mangles Bay and boat usage is more concentrated in this area (Water Corporation, 2019). Typically, recreational boating is highest during the summer months with Mangles Bay heavily used as a mooring area (Strategen, 2012). Several recreational sailing clubs operate in and around Cockburn Sound (Hughes et al., 2023). The sailing/yachting season covers a similar period to recreation boating running from October to April (Strategen, 2012). Certain areas of Cockburn Sound are restricted to unauthorised vessels, primarily in proximity to existing port facilities and wharfs along the eastern shores, as well as in proximity to naval infrastructure on Garden Island, as shown in **Figure 1-6**.

Over the years, Cockburn Sound has developed a strong reputation for recreational divers who regularly utilise the offshore shipwrecks and other maritime artefacts which act as artificial habitat for a diversity range of fish species (Sutton and Shaw, 2019). The main attractions for divers to the area include the Kwinana Grain Terminal, numerous Cape Peron dive sites and the D9 shipwreck (Hughes et al., 2023). Popular snorkelling locations include Little Penguin Trail, Cape Peron Trail, and Churchill Park Dive Trail (Hughes et al., 2023). The disused KBB1 jetty is also a popular location for diving and snorkelling as its easily accessible directly adjacent to the shoreline.

<u>Recreational fishing</u>

Recreational fishing in Cockburn Sound is among its most important social and community values (EPA, 2015). Recreational fishing is managed by DPIRD, with input from the Western Australian recreational fishing body (Recfishwest), to implement area-specific rules and regulations relating to species and fishing activities. Recfishwest is the peak recreational fishing body in WA, which works to represent the 750,000 recreational fishers in WA. Cockburn Sound plays an important role in the total recreational fishing effort in WA, providing spawning and nursery habitats and supporting a large variety of fish (Wakefield et al., 2013). In WA, 50% of the total finfish catch (excluding baitfish) and 60% of the blue swimmer crab catch is taken by recreational fishers (Sutton and Shaw, 2019). **Section 8.3.2.2** presents the existing environment for recreational fishing in terms of fish species, while this section focuses on social, community and economic aspects of recreational fishing.

Shore based fishing typically occurs around the local jetties and northern Cockburn Sound (Tate et al., 2022). Boat-based fishing occurs across the entire Sound but is more concentrated in Mangles Bay, with key target species including pink snapper, Australian herring, Australian octopus, King George whiting and southern calamari (Sutton and Shaw, 2019).

Blue swimmer crabs are the most important nearshore recreationally fished species in the south-west of Western Australia (Ryan et al., 2022; Johnston et al., 2023). Most of the recreational crab catch in Cockburn Sound occurs around Mangles Bay, Southern Flats, Woodman Point and other shallow margins (Sutton and Shaw, 2019).

In the west coast bioregion pink snapper was the second highest kept recreational species in the West Coast Demersal Scalefish Fishery in 2020/21, with an estimated catch of 20,956 fish (Ryan et al., 2022). Cockburn Sound is the largest known aggregation for pink snapper with recreational fishing closures for spawning occurring from 1 August to 31 January each year (DPIRD, 2023).

Another popular recreational fishing species is the rock lobster, with fishing of this species running all year long. Recreational fishers who hold rock lobster licences can catch rock lobsters using a maximum of 2 baited pots or by hand collection when diving.

Abalone are considered a delicacy, and recreational fishing of Roe’s abalone provides high social benefit. There are 17,255 recreational abalone fishing licences (Strain et al., 2023). Although this species is found in Cockburn Sound (southern section), high concentrations are found in other areas of Western Australia (O2 Marine, 2023b).

Additional species caught and retained as by-products include octopus and calamari squid (Strategen, 2012).

Surveys are currently underway as part of the WWSMP to understand how the key fish species use Cockburn Sound during different lifecycle stages. The baseline data collected will inform further detailed impact assessment for the next stage of the Proposal including opportunities and impacts for recreational fishing arising from the Proposal.

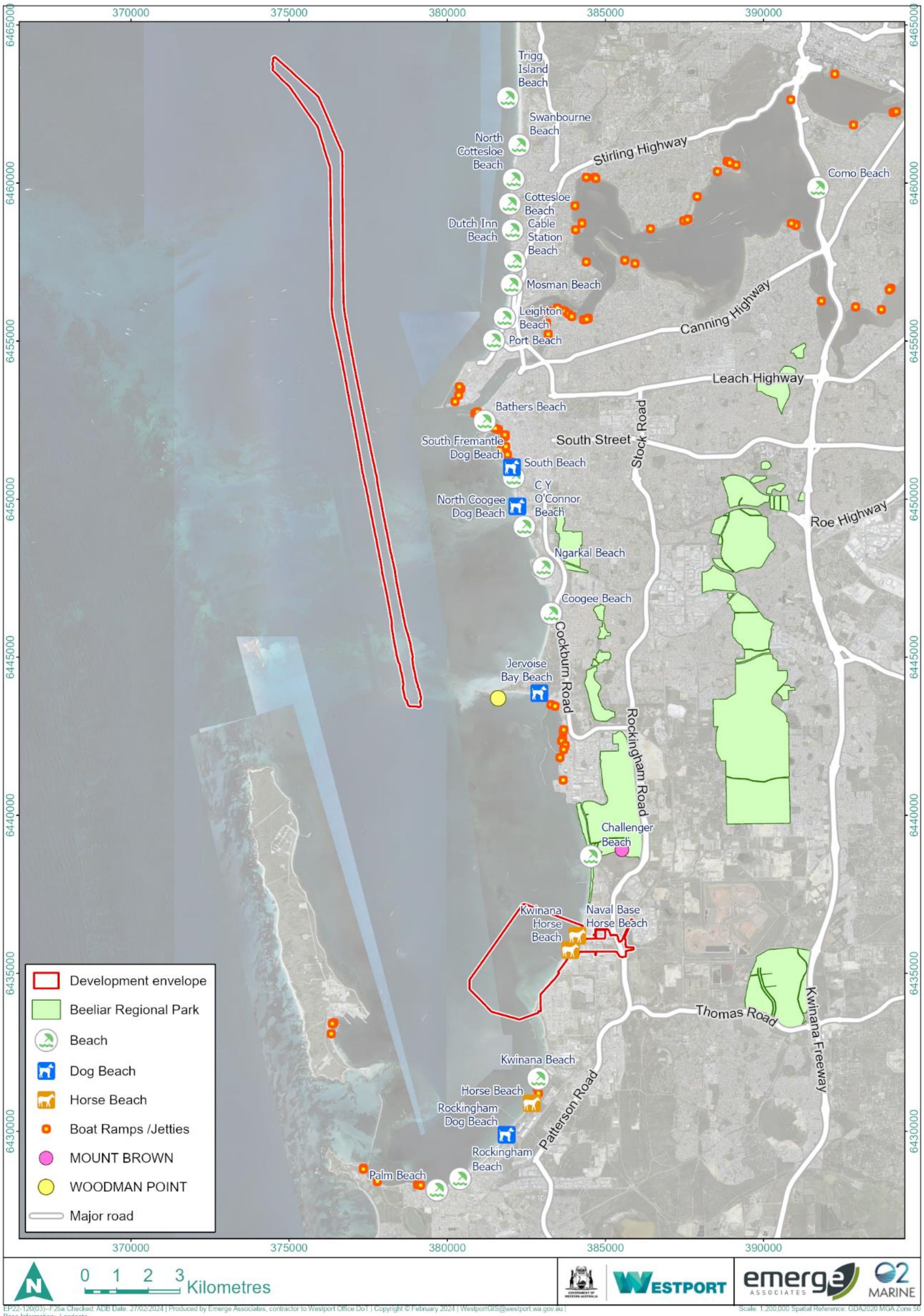

Figure 13-5: Recreational uses in the vicinity of Cockburn Sound

13.3.6 Economic values associated with physical or biological values

Cockburn Sound supports significant commercial shipping activity, with the number of ships entering in any one year typically between 1,000 to 2,000 (BMT 2018a). The existing shipping channel into the northern end of the Sound transects Success and Parmelia Banks (BMT 2018a). Commercial shipping activities within Cockburn Sound include those associated with bulk trade industries located on the eastern shore of Cockburn Sound within the KIA, as well as the facilities at HMAS Stirling Naval Base at Garden Island (HGM 1998). Fremantle Ports operates the Kwinana Bulk Jetty and Kwinana Bulk Terminal, which handles commodities such as cement, grains, petroleum, silica, bitumen, fertilisers and sulphur. Separate facilities are also operated by Alcoa, BP and CBH Group.

The use of Cockburn Sound for tourism is of high economic and social importance to the Western Australian community (CSMC, 2023). Some popular tourist attractions include numerous adventure and wildlife packages, along with fishing charters and other tourism activities which contribute to local jobs and the local community (Sutton and Shaw, 2019). Rockingham Wild Encounters offer swimming with dolphins packages that depart from the Rockingham beach foreshore. Other charter fishing and ecotourism initiatives also run within the Sound. Other tourist activities occurring within and around Cockburn Sound include; Penguin Island/ferry/wildlife cruise, glass bottom boats, adventure cruises, sea kayak tours, stand up paddle boarding, kite boarding, diving, jet skiing tours (Sutton and Shaw, 2019). The Mangles Bay foreshore includes a local yacht club, fishing club and accommodation facilities.

The WWMSP Project 6.3 identified several businesses associated with motor-boat training that utilise Cockburn Sound including; Easy Learn Boat School, Perth Boat School, Rockingham Boating, Skippers Tickets Rockingham, Skippers Tickets Woodman Point (Hughes et al., 2023). Western Australia Surf utilises Cockburn Sound teaching windsurfing and hydrofoiling (Hughes et al., 2023).

<u>Commercial fishing</u>

Cockburn Sound is also used for commercial fishing and commercial aquaculture (HGM, 1998). Fishing tourism is important to the State economy, and there are several ‘groups’ that utilise the sound.

Cockburn Sound and Owen Anchorage support a large variety of fish species and is an important area for commercial fishing in Western Australia (O2 Marine, 2023b). There are currently four commercial fisheries that operate wholly within Cockburn Sound:

- Cockburn Sound (Line and Pot) Managed Fishery (CSLPMF), which the Cockburn Sound Mussel Managed fishery operates within.
- Cockburn Sound (Fish Net) Managed Fishery (CSFNMF).
- West Coast Beach Bait Fish Net Managed Fishery (WCBBFNMF).
- South West Coast Salmon Managed Fishery (SWCSMF).

In addition, there are managed fisheries that operate partly within Cockburn Sound. All relevant commercial fisheries are described in **Table 13-3** and are shown in **Figure 13-6**.

GOVERNMENT OF WESTERN AUSTRALIA

WESTPORT

Aquaculture

Cockburn Sound has historically supported a significant blue mussel (Mytilus galloprovincialis planulatus) aquaculture industry (O2 Marine, 2023b). The industry operates wholly within Cockburn Sound but is concentrated around the southern section, with three leases including north Garden Island (not active), Kwinana Grain Jetty and Southern Flats, as shown in **Figure 13-7** (Sutton and Shaw, 2019). Mussel production has declined and is likely a combined result of a decrease in phytoplankton and predation by snapper (Sutton and Shaw, 2019). There are currently no active mussel aquaculture operations within Cockburn Sound.

There is growing interest in seaweed aquaculture in the south coast bioregion for extraction of bromophores for use in ruminant feed for methane reduction in cattle livestock (DPIRD, 2023). Fremantle Seaweed has secured approval for a 32-hectare (ha) seaweed farm, located on the easternmost limit of Success Bank in the Owen Anchorage.

Table 13-3: Commercial fisheries operating within Cockburn Sound

Fishery	Key Resource	Description
Cockburn Sound Crab Managed Fishery	Blue swimmer crab (*Portunus armatus*)	The Cockburn Sound Crab Managed Fishery overlaps the Proposal area operating wholly within Cockburn Sound as shown in Figure 13 6. It supports important blue swimmer crab nursery habitat (O2 Marine, 2023). This fishery typically operates in shallow waters less than 50 m deep and the crabs are caught using pots rather than gill nets. This fishery has been closed to commercial and recreational fishing since 2014 to allow stocks to recover (Newman et al., 2023a).
Cockburn Sound Line and Pot Managed Fishery (CSLPMF)	Finfish (whitebait, Australian herring, Southern garfish, yellowfin whiting); and West coast Octopus (*Octopus djinda*)	The CSLPMF operates wholly within Cockburn Sound as shown in Figure 13 6. The CSLPMF landed 0.5 tonnes of demersal scalefish in 2021 (Newman et al., 2023a). This fishery captures and retains octopus as a by-product which are usually captured in unbaited pots (O2 Marine, 2023b).
West Coast Beach and Bait Fish Net Managed Fishery (WCBBFNMF)	Finfish (i.e. whitebait, Australian herring, yellowfin whiting)	The WCBBFNMF operates partly within Cockburn Sound from various beaches utilising beach seine nets.
West Coast Rock Lobster Fishery	Rock lobster (*Panulirus cygnus*).	The Proposal overlaps with Zone C of the fishery, extending from Green Head (30° S) to Cape Leeuwin (O2 Marine, 2023b). Bycatch of the WCRLMF includes octopus, champagne crabs and baldchin grouper (O2 Marine, 2023b).
Roe's Abalone Fishery	Abalone	The Proposal overlaps with Area 7 of the Abalone Managed Fishery in WA.

Fishery	Key Resource	Description
Cockburn Sound Fish Net Managed Fishery (CSFNMF)	Finfish (i.e. whitebait, Australian herring, Southern garfish, yellowfin whiting)	A range of finfish species are caught by commercial fishers within Cockburn Sound (CSMC, 2023). This fishery operates wholly within Cockburn Sound but predominantly around Mangles Bay and Garden Island. Cockburn Sound represents important spawning grounds and nursery habitat for the target species of this fishery (Fisher et al., 2023). Cockburn Sound is closed to commercial, charter, and recreational fishing of pink snapper (*Chrysophrys auratus*) from 1 August to 31 January each year (O2 Marine, 2023b). The CSFNMF predominately targets southern garfish and Australian herring, however, due to depleted southern garfish stocks, the commercial and recreational catch in the metropolitan area has been closed since 2017 (Smith et al., 2017; Duffy et al., 2023).
South West Coast Salmon Managed Fishery	Western Australian Salmon (*Arripis truttaceus*)	Western Australian salmon are not considered a key species in the area (Johnston et al., 2022). The commercial catch of Western Australian salmon in the west coast bioregion was 89 tonnes in 2021 (Duffy et al., 2023). In 2021 there were eight licenses which recorded salmon catch in the South Coast bioregion (DPIRD, 2023).
West Coast Purse Seine Managed Fishery	Small pelagic scalefish (i.e. Australian sardines and scaly mackerel, Australian anchovy, yellowtail scad and maray)	The scaly mackerel and Australian sardine are the indicator species and dominate the catch for this fishery (Newman et al., 2023a). Purse seine nets are pelagic in nature, with little impact on benthic habitats during normal operations (Newman et al., 2023a).
Specimen Shell Managed Fishery (SSMF)	Shells (i.e. cowries, cones, murexes, and volutes)	The SSMF fishery harvests shells for display, collection, cataloguing, classification, and sale. In order of 200 species are collected annually State-wide (O2 Marine, 2023b).
Marine Aquarium Fish Managed Fishery (MAFMF)	Coral, live rock, algae, seagrass, and invertebrates	The MAFMF supplies aquarium species to domestic and international markets and the live pet trade (Newman et al., 2023b). The MAFMF operates throughout all State waters and extends to the 200 NM limit (Exclusive Economic Zone), with majority of its activity around the Capes regions, Perth, Geraldton, Exmouth, Dampier, and Broome (Newman et al., 2023b).

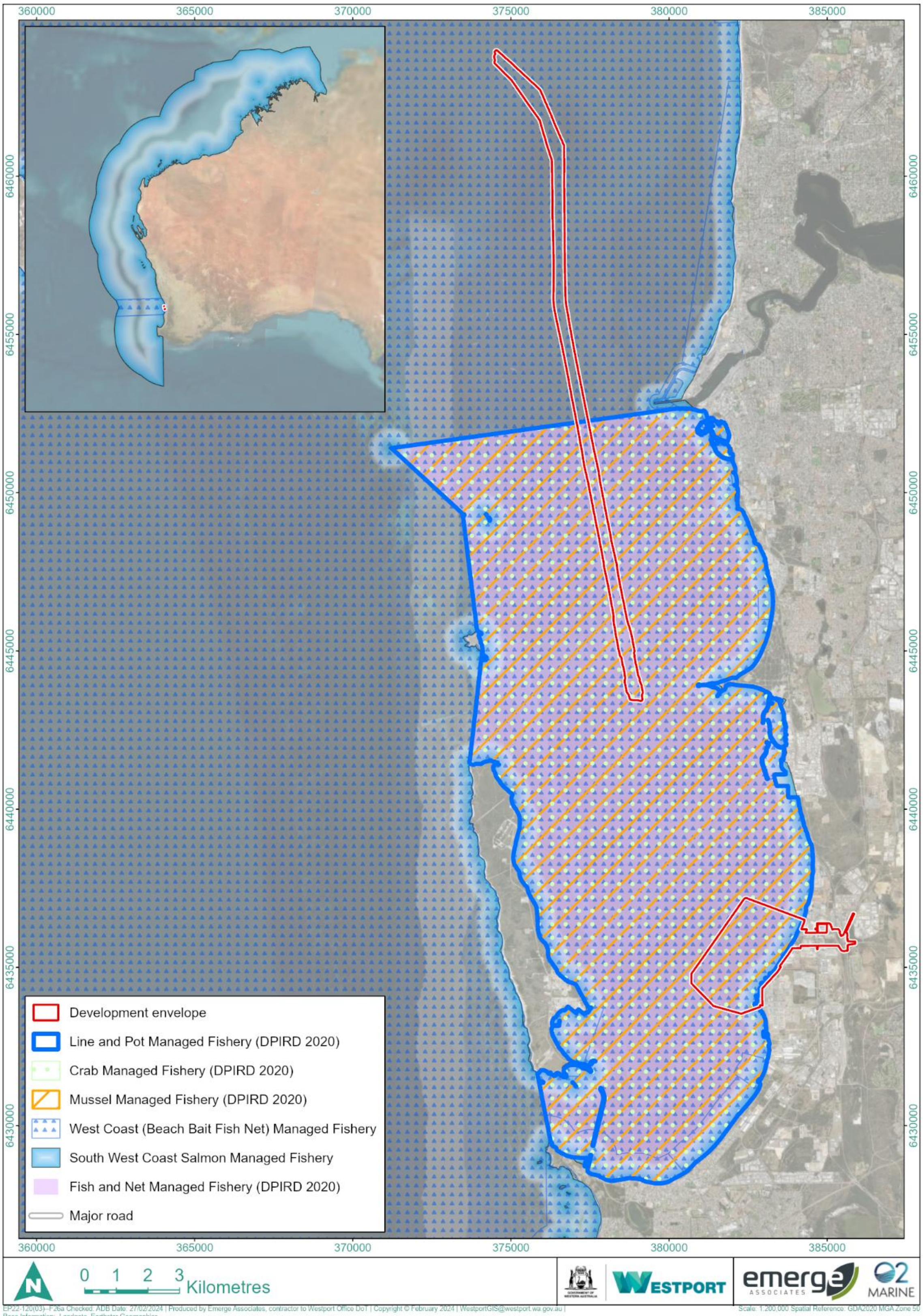

Figure 13-6: Commercial fishery area (DPIRD, 2023)

Figure 13-7: Aquaculture leases (DPIRD, 2022)

13.4 Potential environmental impacts

It is anticipated that implementation of the Proposal has the potential to cause the following environmental impacts on social surroundings.

The potential environmental impacts of the Proposal on social surroundings will be further considered at the future assessment stage, to be documented in the future PER.

13.4.1 Direct impacts

Aboriginal cultural heritage

- Disturbance to unidentified Aboriginal heritage sites caused by dredging and construction of the Proposal.
- Disturbance to culturally significant mythological sites (Indian Ocean).

Natural and historic heritage

- Disturbance to unidentified non-Aboriginal heritage sites caused by dredging and construction of the Proposal.

Amenity

- Disturbance to visual amenity due to the presence of port related infrastructure.
- Disturbance to visual amenity due to construction activities and infrastructure.
- Disturbance to visual amenity due to increases in traffic volumes.
- Disturbance to visual amenity from clearing of vegetation.
- Disturbance to the amenity, or living environment, of nearby sensitive receptor locations, including air quality, noise, odours and traffic congestion.

Social values

- Permanent loss of public access caused by physical presence of infrastructure.
- Temporary loss of public access and recreation caused by construction activities.
- Disturbance to water based recreational activities within Cockburn Sound due to increase in vessel movements.
- Disturbance to water based recreational activities within Cockburn Sound during construction dredging activities.
- Reduction in aesthetic value of Cockburn Sound waters for recreational activities due to increased turbidity during construction.
- Disturbance to commercial and recreational fishing values within Cockburn Sound during dredging activities.

Economic values

- Interference with existing commercial activities by the Proposal.

13.4.2 Indirect impacts

Aboriginal heritage

- Potential impacts to Aboriginal cultural heritage.

Natural and historic heritage

- Potential impacts to shipwrecks sites from changes to ocean currents.

Amenity

- Reduction in visitation to Cockburn Sound due to increased development and construction nuisances negatively impacting on the landscape and visual amenity.

Social values

- Decrease in recreational fishing due to restrictions around the Proposal area.
- Displacement of Naval Base Horse Beach as a result of the Proposal.
- Reduction in the use of Cockburn Sound for tourism and recreational activities from introduced species associated with increased shipping activities from the Proposal.
- Reduction in the use of Cockburn Sound for recreational activities due to elevated TSS during construction dredging.
- Increased safety concerns for primary and secondary contact with water due to decreased water quality.
- Increase in introduced species due to the increase in foreign vessels negatively impacting on commercial and recreational fisheries.

Economic values

- Reduction in tourism and commercial fishing due to loss of habitat and marine life.
- Displacement of penguins from feeding areas due to increased vessel movements resulting in a loss in tourism.
- Reduction in resident dolphin population because of the potential loss of marine life and habitat and then the flow on impacts to tourism businesses.
- Reduced mussel production and economic profitability due to introduced species and elevated turbidity levels.

13.4.3 Cumulative impacts

- Increased number of vessels utilising Cockburn Sound cumulatively increasing turbidity levels.
- Accumulated pressures and industrialisation may permanently deter marine fauna species from Cockburn Sound, impacting the value being present.
- Further industrialisation of Cockburn Sound resulting in cumulative impacts to the social values of the area (i.e. recreational use).

13.5 Mitigation

13.5.1 Avoid

The key impact avoidance outcome for the Proposal with respect to social surroundings is the strategic location of the Proposal within an existing heavy industrial area at KIA. This limits the extent to which the amenity of sensitive land uses and receptors will be impacted by the Proposal beyond existing impacts from the KIA.

As part of the MCA process undertaken to select the preferred location for the port facility, consideration was afforded to avoiding impact on Aboriginal cultural heritage sites and natural and historic heritage sites. The Proposal area does not intersect any registered Aboriginal heritage sites, nor any natural and historic sites. As discussed in **Section 13.3.2**, Aboriginal cultural and spiritual values mapping has been undertaken and was incorporating into the MCA process, to maximise impact avoidance to such values. Similarly, natural and historical heritage values were also considered as part of the MCA process, with options that avoided impacts to such values scored higher than those with potential impacts.

Consideration was also afforded to protecting and enhancing community and recreational values as part of the MCA process. This included assessment of options with respect to potential impacts to specific locations and features (marine and terrestrial) that provided recreational value. Notwithstanding this, given Cockburn Sound and its associated environmental values support a variety of social and economic values, avoidance of all impacts to such values as a result of the Proposal is not possible. Where able, construction and operation of the Proposal will be designed to avoid such impacts. Further impact avoidance opportunities will be considered as part of the assessment process.

13.5.2 Minimise

A range of impact minimisation opportunities will be investigated and considered as part of the assessment process. These may include, but are not limited to, the following:

- Engaging suitably qualified archaeologists to monitor construction works.
- Ongoing consultation with Traditional Owners to determine additional Aboriginal heritage information about potential sites.
- Management of the Proposal to comply with *the Environmental Protection (Noise) Regulations 1987*.
- Managing timing of key impacting activities such as dredging to minimise impact during sensitive periods for species that have social or economic values.
- Preparation and implementation of management plans, such as:
  - Aboriginal Cultural Heritage Management Plan
  - Natural and Historic Heritage Management Plan
  - Construction Environmental Management Plan (including dust and noise emissions, amongst other considerations).

- Ongoing stakeholder consultation with the local community regarding integration of the Proposal into the local and regional community and associated social values.
- Ongoing consultation with Aboriginal heritage groups to ensure values are considered throughout the Proposal's development.
- Advise public of any major planned disturbances to boating traffic, via public media, notices to boating clubs and temporary signs at public boat ramps.
- Preparation and implementation of an Urban Design and Landscape Framework.

13.6 Assessment and significance of residual impact

Residual impacts to social surroundings will be confirmed at the future assessment stage, based on the results of investigations currently underway. This will be documented in the PER.

There is potential for impacts to social surroundings including impacts to Aboriginal and historic heritage values and more broadly, impacts to the social and economic values of Cockburn Sound and the surrounding coastline. However, there are various mitigation and management strategies that can be implemented to minimise these impacts. The extent to which these potential impacts are significant will require further assessment at the PER stage.

13.7 Environmental outcomes

The Proposal is located in an area that supports significant environmental values associated with its social surroundings. There is potential for significant impacts to these social surroundings as a result of the Proposal, which will need to be considered and assessed at the future PER stage to determine whether the EPA objective can be met.

14 Offsets

The Western Australian Environmental Offsets Policy (2011) and Western Australian Environmental Offsets Guidelines (2014) defines an environmental offset as *'an offsite action or actions to address significant residual environmental impacts of a development or activity'*.

The residual environmental impacts of the Proposal are not yet known and will be determined at the future assessment stage. If any residual environmental impacts are found to be significant, then offsets may be proposed to address these. In accordance with the Western Australian Environmental Offsets Policy:

- Environmental offsets for the Proposal will only be considered after impact avoidance and mitigations options have been exhausted. Significant steps have been taken through strategic site selection, siting and design development to achieve environmental impact avoidance to date, as discussed in **Section 1.1.5** and each environmental factor chapter in this document.
- Environmental offsets will be based on sound environmental information and knowledge. Westport has invested significantly in the WWSMP to undertake relevant research that will inform any future offset proposals.

Given the extent of the Proposal, its potential environmental impacts and the current understanding of existing environmental values within the Development Envelope, it is anticipated that the Proposal may result in significant environmental residual impacts and therefore offsets are expected to be required. A key consideration in this respect is seagrass rehabilitation, which is being heavily investigated as part of the WWMSP to establish the feasibility and potential methodologies for such programs to be implemented at scale.

Offsets will be further considered in greater detail as part of future stages of the EIA process. Opportunities for synergies between environmental offsets and carbon offsetting will also be explored.

15 Matters of National Environmental Significance

Matters of National Environmental Significance (MNES) that are protected under the Commonwealth EPBC Act include:

- listed threatened species and communities
- listed migratory species
- Ramsar wetlands of international importance
- Commonwealth marine environment
- world heritage properties
- national heritage places
- the Great Barrier Reef Marine Park
- nuclear actions
- a water resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, the Proposal (also referred to as the 'Proposed Action' with respect to EPBC Act matters) will require approval from the Commonwealth Minister if it has, will have, or is likely to have, a significant impact on an MNES.

The following groups of MNES are likely to be relevant to the Proposal:

- listed threatened species and communities
- listed migratory species.

Given the potential for the Proposal to impact on MNES, the Proponent intends to submit an EPBC Act referral. If the Commonwealth Minister determines that the Proposal (Proposed Action) is a Controlled Action, then assessment and approval under the EPBC Act will be required.

Should such an outcome arise, the Proponent will request that impacts of the Proposal on MNES be assessed through an accredited assessment by the EPA under the existing Bilateral Agreement. As such, MNES considerations are proposed to be addressed within the future PER.

16 Holistic Impact Assessment

Holistic impact assessment considers the connections and interactions between impacts, and the overall impact of the Proposal on the environment as a whole. Where the combination of the environmental effect of two or more environmental factors or values has the potential to result in a significant impact, a holistic impact assessment of the Proposal on the environment is required.

Given the high degree of connections and interactions between environmental factors and values (both marine and terrestrial) applicable to the Proposal, a holistic impact assessment will be required. This will be undertaken at the future assessment stage and documented in the future PER.

Work is being undertaken by WWMSP Project 1.2 *Pathways to Productivity: Development of a water quality response model for Cockburn Sound* to develop a water quality model that will be able to link hydrodynamics, biogeochemistry and essential ecosystem processes. The coupled model will be capable of bringing together the diversity of data collected over many years, and that being collected within the science program. The integrated modelling will allow quantification of the links between water quality and benthic communities such as seagrass in Cockburn Sound. The model will be used in collaboration with other projects to assess scenarios relevant to holistic and cumulative impact assessment.

The framework to consider holistic impact assessment will be further considered at the scoping and assessment stages.

17 Additional Information

17.1 Appendices

Appendix A – Proposal Content Document

17.2 Abbreviations list

Table 17-1: Abbreviation list

ACHIS	Aboriginal Cultural Heritage Inquiry System
AHC	Australian Heritage Council
AMC	Australian Marine Complex
APP	Aboriginal Productions and Promotions
ASS	Acid sulfate soils
BCH	Benthic communities and habitats
BIA	Biological important area
BPP	Benthic primary producer
CCL	Cockburn Cement Limited
COPC	Contaminant of potential concern
CR	Critically endangered
CSFNMF	Cockburn Sound Fish Net Managed Fishery
CSLPMF	Cockburn Sound Line and Pot Managed Fishery
CSMC	Cockburn Sound Management Council
D&L	Westport (Stage 3) Design and Logistics Workstream
DBCA	Department of Biodiversity, Conservation and Attractions
DBT	Dibutyltin
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
DDT	Dichlorodiphenyltrichloroethane
DE	Development envelope

DO	Dissolved oxygen
DPLH	Department of Planning, Lands and Heritage
DSI	Detailed Site Investigation
DWER	Department of Water and Environmental Regulation
E&S	Westport (Stage 3) Environmental and Social Workstream
EIA	Environmental impact assessment
EN	Endangered
EP Act	*Environmental Protection Act 1986* (WA)
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EQC	Environmental Quality Criteria
EQG	Environmental quality guidelines
EQMF	Environmental quality management framework
EQO	Environmental Quality Objective
EQP	Environmental Quality Plan
ERD	Environmental Review Document
ESD	Environmental Scoping Document
EV	Environmental Value, for the purpose of the Cockburn Sound SEP
EWS	Westport (Stage 1 & 2) Environmental Work Stream
FCT	Floristic community type
GDE	Groundwater dependent ecosystem
GHG	Greenhouse gas
HEPA	High Ecological Protection Area
ISC	Infrastructure Sustainability Council
JPPL	James Point Pty Ltd
JTSI	Department of Jobs, Tourism, Science and Innovation

KBB	Kwinana Bulk Berth
KBT	Kwinana Bulk Terminal
KIA	Kwinana Industrial Area
LAU	Local assessment unit
LEP	Level of Ecological Protection
LEPA	Low Ecological Protection Area
LGA	Local government area
LoR	Limit of reporting
LPG	Liquified petroleum gas
MAFMF	Marine Aquarium Fish Managed Fishery
MBT	Monobutyltin
MCA	Multi-criteria analysis
MEPA	Moderate Ecological Protection Area
MEQ	Marine environmental quality
MFO	Marine fauna observer
MMWG	Westport Marine Mitigation Working Group
MNES	Matters of National Environmental Significance
MTBE	Methy tert-butyl ether
NAG	Westport Noongar Advisory Group
NWQMS	National Water Quality Management Strategy
OC	Organochlorine
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
PAH	Polycyclic Aromatic Hydrocarbons

PCB	Polychlorinated biphenyl
PCD	Proposal Content Document
PEC	Priority ecological community
PER	Public Environmental Review
PFAS	Per- and poly-fluoroalkyl substances
PIANC	World Association for Waterborne Transport Infrastructure
PSD	Particle size distribution
PSDP	Perth Seawater Desalination Plant
PSI	Preliminary Site Investigation
PTS	Permanent threshold shift
RAP	Remediation Action Plan
RIZ	Rockingham Industrial Zone
SAP	Sampling and Analysis Plan
SCID	Supply Chain and Integrated Design
SDOOL	Sepia Depression Ocean Outlet Landline
SEP	State Environmental (Cockburn Sound) Policy 2015
SOPEP	Shipboard Oil Pollution Emergency Plan
SRE	Short-range endemic
SSC	Suspended sediment concentration
SSMF	Specimen Shell Managed Fishery
SWALSC	South West Aboriginal Land and Sea Council
SWASP	State-wide Array Surveillance
TBT	Tributyltin
TDS	Total dissolved solids
TEC	Threatened ecological community
TMWG	Westport Terrestrial Mitigation Working Group

TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids
TTS	Temporary threshold shift
VU	Vulnerable
WAMSI	Western Australian Marine Science Institute
WAPC	Western Australian Planning Commission
WCBBFNMF	West Coast Beach and Bait Fish Net Managed Fishery
WPO	Westport Project Office
WSUD	Water Sensitive Urban Design
WTC	Western Trade Coast
WWMSP	WAMSI Westport Marine Science Program
ZoHI	Zone of high impact
ZoI	Zone of influence
ZoMI	Zone of moderate impact

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Appendix A

Proposal Content Document

Outer Harbour Port Development, Kwinana

Proposal Content Document

Table 1: General proposal content description

Proposal title	**Outer Harbour Port Development, Kwinana**
Proponent name	The Director General of the Department of Transport on behalf of the State of Western Australia
Short description	The Proposal is to construct and operate a new multimodal port in the Kwinana Industrial Area (KIA), approximately 30 km south of Perth (**Figure 1**). The Proposal includes: • A port facility. • Adjacent areas of landside development. • An offshore breakwater. • Dredging for a second main channel from the Indian Ocean to Cockburn Sound, which will be additional and parallel to the existing Success Channel. • Dredging for access channels, turning basins and berthing areas adjacent to the port facility. • Use of dredge material for beneficial re-use (primarily reclamation) and, where required, placement in approved marine placement areas. • Removal of the disused Kwinana Bulk Berth 1 (KBB1) Jetty. • Removal of the KBB2 Jetty, with replacement infrastructure to be constructed as a component of the port facility. • Connections to road and rail infrastructure up to the vicinity of Rockingham Road. • Relocation, removal or upgrade of existing infrastructure, structures and buildings. • Temporary construction infrastructure. • Maintenance of all infrastructure and assets, including maintenance dredging. The Proposal has a total development envelope (DE) of approximately 1683 hectares (ha), comprising two discrete areas; the port DE (841 ha) and the second main channel DE (842 ha). The terrestrial elements of the Proposal are located within an area of existing heavy industrial land uses within the KIA, serviced by existing road and rail infrastructure. The marine elements of the Proposal are primarily located within Cockburn Sound adjacent to the KIA, whilst the second main channel extends from the northern boundary of Cockburn Sound to the Indian Ocean.

Table 2A: Proposal content – physical elements

Proposal element	Location / description	Maximum extent, capacity or range
Physical elements		
Port facility	Reclamation area adjacent to KIA, refer **Figure 2**.	Indicative footprint of up to 276 ha. Area to be reclaimed using material from the Proposal's capital dredging program.
Offshore breakwater	Adjacent to port facility, refer **Figure 2**.	Indicative footprint of up to 22 ha, length up to 2.6 km and width up to 115 m.
Landside development	Within KIA, refer **Figure 2**.	Indicative footprint of up to 89 ha.
Access channels, turning basins and berthing areas, including navigational aids	Adjacent to port facility, refer **Figure 2**.	Indicative footprint of up to 235 ha, with a variable depth up to a maximum of -17.4 m chart datum.
Second main channel, including navigational aids	From Indian Ocean to Cockburn Sound, refer **Figure 3**.	Indicative footprint of up to 626 ha, length up to 21 km. The minimum channel width is 250 m along its entire length (including batters). Some channel sections are wider to accommodate navigational requirements, up to a maximum width of 470 m (including batters). The minimum channel depth is -17.9 m chart datum. Some channel sections are deeper to accommodate navigational requirements, up to a maximum depth of -19.5 m chart datum.

Table 2B: Proposal content – construction elements

Proposal element	Location / description	Maximum extent, capacity or range
Construction elements		
Capital dredging	Within indicative footprints. Dredge material placement at port facility and approved marine placement area/s.	Up to 35 million cubic metres (M m^3) of material to be dredged (including vertical and horizontal over-dredging allowances). Beneficial re-use of dredge material primarily through placement within the port facility reclamation area and, where required, placement within approved marine placement area/s.
Port facility reclamation works	Port facility	Indicative footprint of up to 276 ha.
Offshore breakwater reclamation works	Offshore breakwater	Indicative footprint of up to 22 ha.
Terrestrial bulk earthworks	Port facility (following reclamation) and landside development area	Indicative footprint of up to 365 ha.
Pile driving works	Port facility quay lines	Combination of sheet and tubular piles.
Relocation, removal or upgrade of existing infrastructure, structures and buildings	Where required within the port development envelope	-
Temporary construction infrastructure	Where required within the port development envelope	-

Table 2C: Proposal content – operational elements

Proposal element	Location / description	Maximum extent, capacity or range
Operational elements		
Maintenance dredging	Second main channel, access channels, turning basins and berthing areas. Beneficial re-use of dredge material or placement at approved marine placement area/s.	As required to support future port operations and maintain capital dredge depths.

Table 2D: Proposal content – GHG elements

Proposal element	
Proposal elements with greenhouse gas emissions	
Construction elements:	
Scope 1	Estimated annual GHG emissions, during construction: **18,832** tCO2-e/year Estimated total GHG emissions, during construction: **207,151** tCO2-e
Scope 2	Estimated annual GHG emissions, during construction: **0** tCO2-e/year Estimated total GHG emissions, during construction: **0** tCO2-e
Scope 3	Estimated annual GHG emissions, during construction: **105,454** tCO2-e/year Estimated total GHG emissions, during construction: **1,159,992** tCO2-e
Operation elements:	
Scope 1	Estimated annual GHG emissions, during operations: **1,092** tCO2-e/year Estimated total GHG emissions, over lifetime of operations: **58,111** tCO2-e
Scope 2	Estimated annual GHG emissions, during operations: **3,617** tCO2-e/year Estimated total GHG emissions, over lifetime of operations: **217,019** tCO2-e
Scope 3	Estimated annual GHG emissions, during operations: **10,501** tCO2-e/year Estimated total GHG emissions, over lifetime of operations: **524,211** tCO2-e

Table 2E: Proposal content – other elements

Proposal element		
Rehabilitation		
Where areas of the development envelope are impacted by temporary construction works only, opportunities for rehabilitation after construction activities have ceased will be considered.		
Commissioning		
Functional testing, performance and integration testing, documentation generation, operator training, and official handover.		
Decommissioning		
Given the long and ultimately uncertain operational timeframe (refer below), decommissioning elements of the Proposal are not able to be reasonably foreseen and considered.		
Other elements which affect extent of effects on the environment		
Proposal time	Maximum project life	The ultimate lifespan of the port is not defined and will be subject to future Government decision making. The port assets have a design lifespan of at least 50 years.
	Construction phase	The total capital works construction period will be approximately 15 years, inclusive of commissioning. Construction of different proposal elements will be implemented concurrently over variable timeframes, meaning some elements will be completed sooner than others.
	Operations phase	The port assets have a design lifespan of at least 50 years.
	Decommissioning phase	Not applicable, refer above.

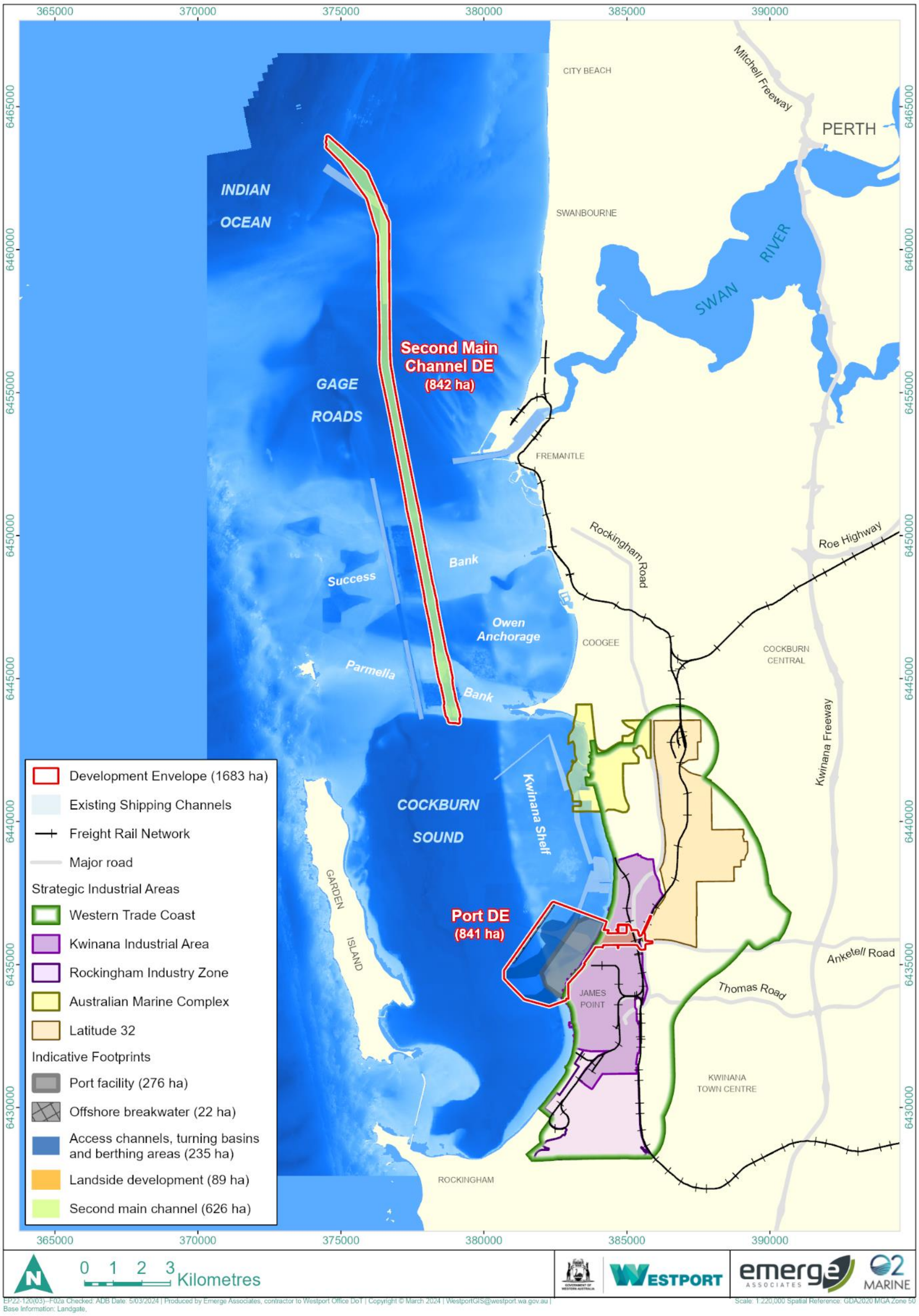

Figure 1: Proposal Location

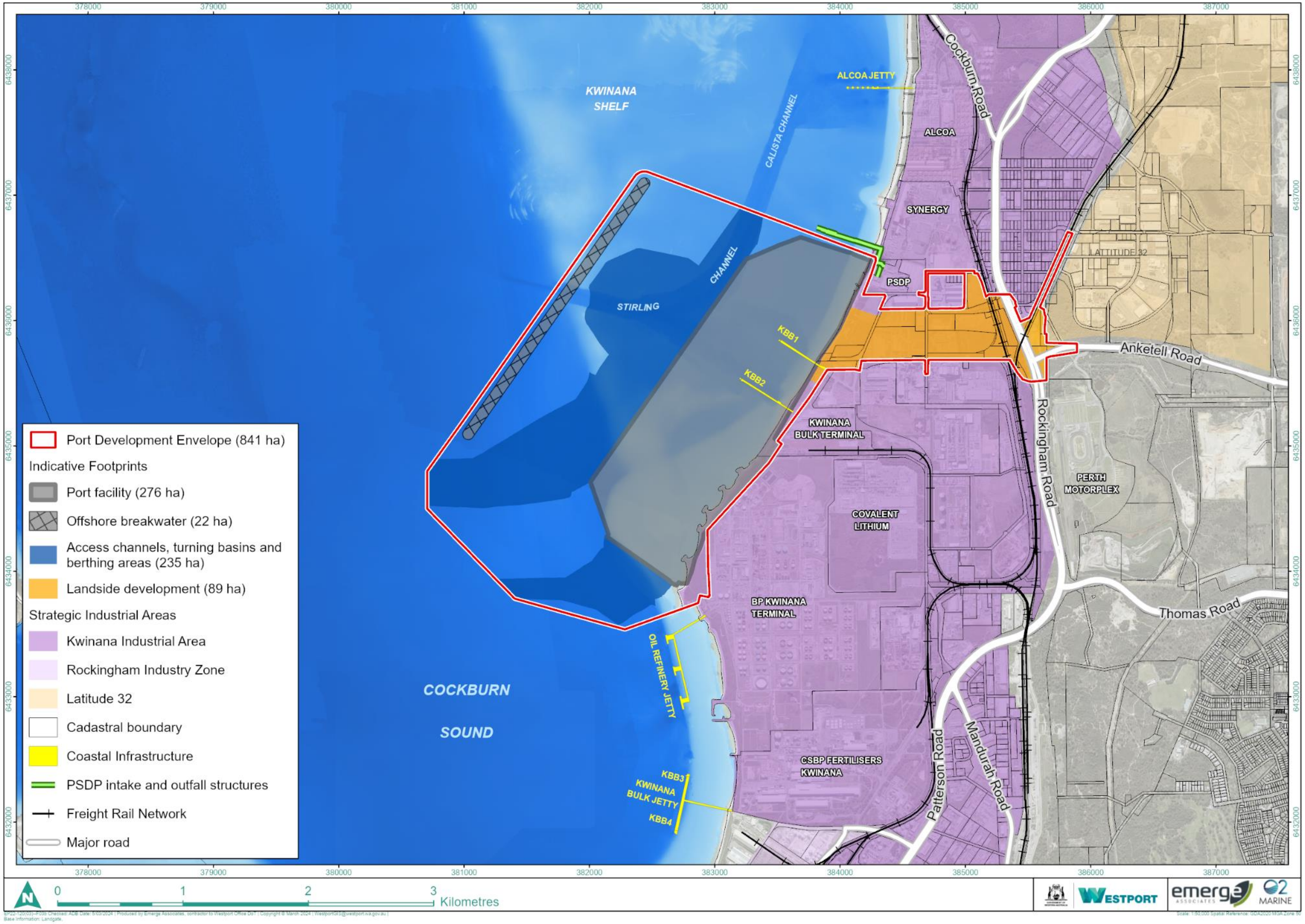

Figure 2: Port Development Envelope

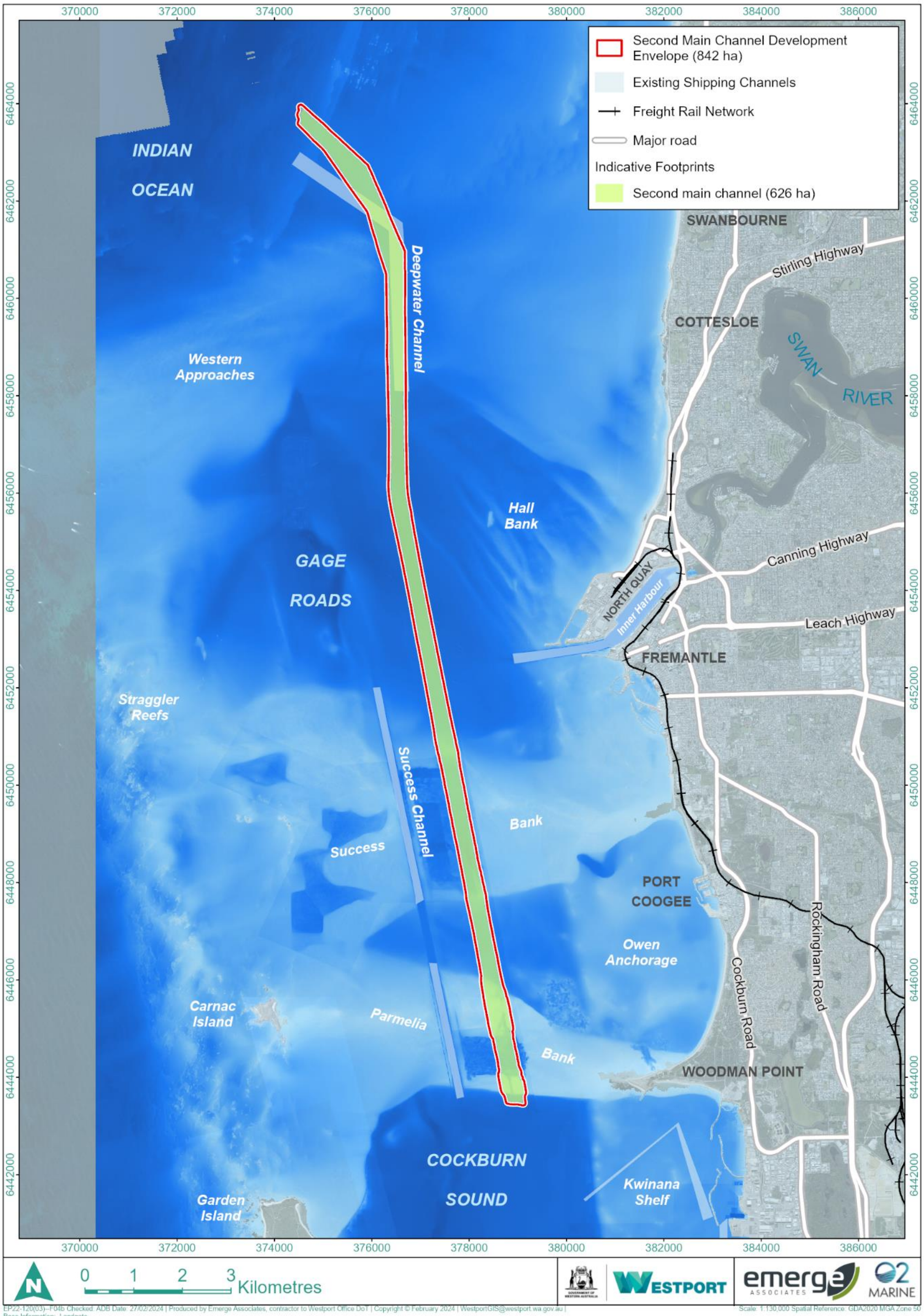

Figure 3: Second Main Channel Development Envelope