Cumulative Loss Assessment

Port Maximisation Project

Mid West Ports Authority

298 Marine Terrace, Geraldton WA 6530

Prepared by:

SLR Consulting Australia

SLR Project No.: 675.072500.00007

22 July 2025

Revision: 2.0

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
0.1	15 April 2025	DZ	AW	AW
1.0	16 April 2025	DZ	AW/MWPA	AW
2.0	22 July 2025	DZ	AW	AW

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Mid West Ports Authority (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

Executive Summary

The Port Maximisation Project (PMaxP) is an infrastructure project aimed at modernising and optimising the capacity of the Mid West Ports Authority (MWPA) managed Port of Geraldton (the Port). The PMaxP involves the upgrade of existing facilities and construction of both new and replacement facilities and requires maintenance and capital dredging, reclamation and the installation of marine infrastructure, including piling activities.

The PMaxP is being assessed under Part IV of the *Environmental Protection Act 1986* (EP Act) as a significant amendment to the Geraldton Port Enhancement Project (PEP), subject of Ministerial Statement 600. The EP Act outlines the provisions for preparing an environmental impact assessment (EIA) to facilitate the Environmental Protection Authority Services (EPAS) in assessing project impacts on the environment. This report addresses impacts on the environmental factor of benthic communities and habitats (BCH) and informs the EIA (SLR Consulting Australia Pty Ltd, 2025a).

In accordance with Section 4.2 of *Technical Guidance: Protection of Benthic Communities and Habitats* (EPA, 2016b), Local Assessment Units (LAUs) are required to be defined to determine cumulative losses of BCH. The LAU considered suitable for the PMaxP has previously been defined in the O2 Marine study (2022a) for the Tourist Jetty project, based on a secondary sediment cell defined for Point Moore to Glenfield Beach (Stul, et al., 2014).

The proportion of BCH loss due to direct (irreversible) impacts from the PEP (70.00 ha) and PMaxP (18.63 ha) is 1.83% of the total pre-European extent of BCH within the LAU.

The PMaxP would also result in the reversible (recoverable) impact of approximately 74.42 ha of BCH. The implementation of the PEP resulted in a temporary impact to BCH, primarily from the dredge plume extending into Champion Bay. However, all impacts beyond the direct loss footprint were found to recover in the years following the completion of the PEP and it is reasonable to infer that the ecosystem function of BCH in Champion Bay and the wider region was not compromised by the PEP.

The PMaxP has demonstrated the application of the avoid, minimise and mitigate hierarchy in addressing impacts to BCH by avoiding areas of high quality BCH, selecting a less-impacting dredge method and the development of a Dredging Environmental Monitoring and Management Plan (DEMMP) (SLR Consulting Pty Ltd, 2025b).

The BCH that were impacted under the PEP and are expected to be irreversibly lost/modified due to PMaxP are widely distributed in the LAU, with likely higher condition areas outside the predicted impact areas. Thus, the resultant impacts to BCH of the combined PEP and PMaxP are not expected to adversely impair the ecosystem function, integrity and biodiversity.

Table of Contents

Tables in Text

Figures in Text

Acronyms and Abbreviations

Acronym/abbreviation	Definition
The Bay	Champion Bay
BC Act	Western Australia *Biodiversity Conservation Act 2016*
BCH	Benthic communities and habitats
BMT	BMT Commercial Australia
CD	Chart datum
CPMP	Port of Geraldton Coastal Processes Management Plan
DEMMP	Dredging Environmental Monitoring and Management Plan
EEC	Endangered ecological community
EP Act	*Environmental Protection Act 1986*
EPAS	Environmental Protection Authority Services
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
LAU	Local Assessment Unit
MWPA	Mid West Ports Authority
PMaxP	Geraldton Port Maximisation Project
SSC	Suspended solids concentration
SLR	SLR Consulting Pty Ltd
ZoHI	Zone of High Impact
ZoMI	Zone of Moderate Impact

1.0 Introduction

1.1 Background

The Port Maximisation Project (PMaxP) is an infrastructure project aimed at modernising and optimising the capacity of the Mid West Ports Authority (MWPA) managed Port of Geraldton (the Port) through the upgrade of existing facilities and construction of both new and replacement facilities.

The key components of the PMaxP are summarised in **Section 1.2** and described in detail in the Environmental Impact Assessment: Geraldton Port Maximisation Project (SLR Consulting Australia Pty Ltd, 2025a).

1.2 Project description

The key components of the PMaxP require maintenance and capital dredging, reclamation and the installation of marine infrastructure, including piling activities. The specifics relating to each key component are outlined in **Table 1-1**.

Table 1-1 The PMaxP key component activities

Key component	Associated activities
Replacement tug harbour	• Construction of a new breakwater extending north ~450 m into Champion Bay using a progressive rock tipping method • Capital dredging of ~31,000 m^3 to a design depth of -7.0 m chart datum (CD) using a trailing suction hopper dredge and subsequent reclamation using suitable dredged material, and • A combination of vibratory and impact piling for the construction of up to two jetties within the harbour.
Replacement Berth 1	• Maintenance dredging of ~18,000 m^3 and subsequent reclamation using suitable dredged material • Capital dredging of ~23,000 m^3 to deepen the berth pocket to -13.4 mCD using a hydro-hammer and long-arm excavator • Reclamation and construction of a causeway and new enclosed pond for future dredged materials, and • A combination of vibratory and impact piling for the construction of a wharf deck.
Extension of Berth 6	• Capital dredging of ~98,000 m^3 to a design depth of -13.4 mCD using a hydro-hammer and long-arm excavator, including the removal of the existing rock armour wall and subsequent reclamation using suitable dredged material, and • A combination of vibratory and impact piling for the extension of the wharf deck.
New Berth 8/9	• Capital dredging of ~88,000 m^3 to a design depth of -13.4 m using hydro-hammer and long-arm excavator and subsequent reclamation using suitable dredged material, and • A combination of vibratory and impact piling for the construction of a wharf deck.

1.3 Legislative context and purpose

The PMaxP is being assessed under Part IV of the *Environmental Protection Act 1986* (EP Act). The EP Act outlines the provisions for preparing an environmental impact assessment (EIA) to facilitate the Environmental Protection Authority Services (EPAS) in assessing project impacts on the environment.

The PMaxP is a significant amendment to the Port Enhancement Project (PEP) which was approved and implemented in the early 2000s. The PEP resulted in a direct (irreversible) loss to benthic communities and habitats (BCH) due to dredging and the installation of marine infrastructure. As an amended proposal, the PMaxP assessment considers BCH impacts from both the PEP and PMaxP.

This report addresses impacts on the environmental factor of BCH under the following legislation:

- Western Australia *Environmental Protection Act 1986* (EP Act)
- Western Australia *Biodiversity Conservation Act 2016* (BC Act), and
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This report has been prepared in accordance with and with reference to the following guidelines:

- *Priority Ecological Communities for Western Australia Version 35* (Department of Biodiversity, Conservation and Attractions, 2023)
- *Environmental Factor Guideline: Benthic Communities and Habitats* (EPA, 2016a)
- *Technical Guidance: Protection of Benthic Communities and Habitats* (EPA, 2016b), and
- *Technical Guidance: Environmental Impact Assessment of Marine Dredging Proposals* (EPA, 2021).

2.0 Existing environment

The Proposal Footprint lies on the coastline of the Mid West Region of Western Australia in the town of Geraldton (refer **Figure 2-1**). The Proposal Footprint would be an upgrade or an extension to some of the existing Geraldton Port infrastructure.

2.1 Local and regional context

Geraldton Port is located in Champion Bay (the Bay), approximately 420 km north of Perth. The area in and around Geraldton is considered to have a high marine and terrestrial biodiversity value.

Over the past 150 years, the Greater Geraldton landscape has undergone significant modification due to European agriculture. As such, less than 15% of the pre-European vegetation[1] remains. Critical areas of remaining local native vegetation are found in the Chapman and Greenough River catchments, which both discharge around the Geraldton township and serve as vital wildlife habitats. Additionally, the Moresby Ranges, approximately 16 km north-east of the Geraldton Port, contribute to the region's natural resources and are currently under consideration for conservation and community recreation.

Likewise, the marine environment surrounding Geraldton harbours valuable natural resources and notable biodiversity. The limestone substrate, which underlies the majority of Champion Bay and its surroundings, stands out as a prominent feature (AECOM, 2020). This substrate plays a crucial role in shaping the Bay's epibenthic communities. Factors such as the presence of limestone reefs, their relief and profile, and the depth of sand overlaying the reef all contribute to the ecological dynamics of the area. Additionally, exposure to prevailing south-westerly swells and seas significantly influences sand movement within the Bay. Whether sand is deposited, eroded, or frequently resuspended due to wave and tidal water action determines the specific types of epibenthic communities that thrive in different areas. Notably, habitats with similar depths, topography, and substrate slope exhibit distinct characteristics based on their varying levels of protection from swell and waves.

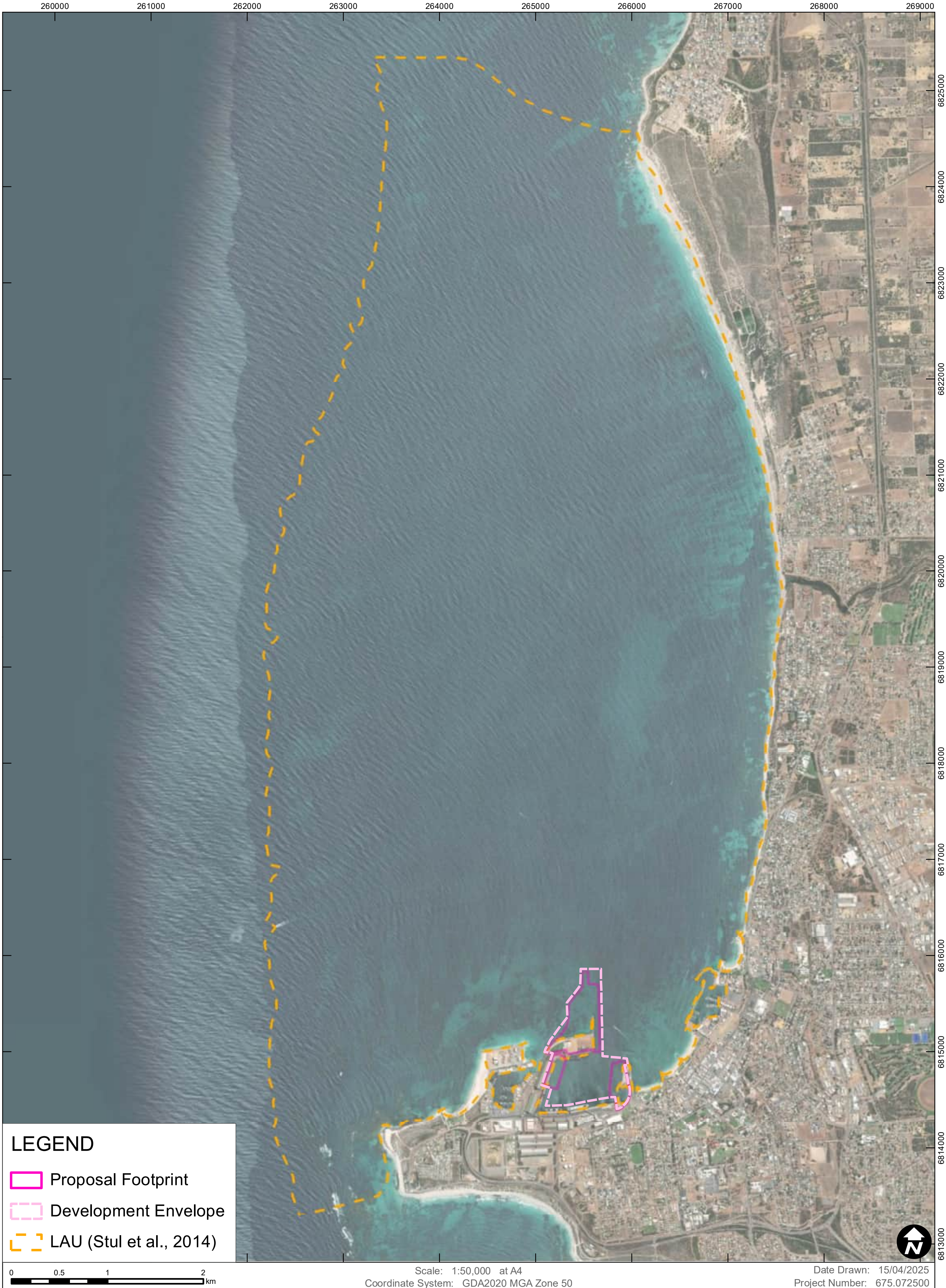
2.1.1 Local Assessment Unit

In accordance with Section 4.2 of *Technical Guidance: Protection of Benthic Communities and Habitats* (EPA, 2016b), Local Assessment Units (LAUs) are required to be defined to determine cumulative losses of BCH. Local Assessment Units (LAUs) are location specific, defined on a case-by-case basis and consider local physical and biological aspects of the marine environment and are typically 5,000 ha in size.

The LAU considered suitable for the PMaxP has previously been defined in the O2 Marine study (2022a) for the Tourist Jetty project, based on a secondary sediment cell defined for Point Moore to Glenfield Beach[2] (sediment cell R07F15) (Stul, et al., 2014). Sediment cells define natural units encompassing marine and terrestrial environments as an interactive system thus promoting integrated coastal management (O2 Marine, 2022a). The LAU is 4,832.52 ha[2] and is illustrated in **Figure 2-1**.

[1] This is likely to be an estimate of terrestrial vegetation loss.

[2] The sediment cell size is based on post-European extent while the area of BCH in the LAU was estimated for the pre-European extent hence, the pre-European area of the LAU has been adopted for the purposes of cumulative loss calculations.



Scale: 1:50,000 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 15/04/2025
Project Number: 675.072500

Data Source:
ESRI

SLR

THE LAU EMPLOYED FOR THE PMAXP

FIGURE 2-1

\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F022A_LAU.mxd

2.1.2 Tenure and areas of conservation significance

There are no areas of marine conservation significance within the LAU. The closest areas of marine biological conservation significance include:

- Abrolhos Australian Marine Park, approximately 21 km south-west of the LAU to the closest corner of the marine park extent, and
- Abrolhos Islands Fish Habitat Protection Area[3], approximately 46 km west of the LAU
- Houtman Abrolhos Islands National Park[4], approximately 51 km west of the LAU
- Hutt Lagoon System[5], approximately 61 km north-west of the LAU, and
- Forrestdale and Thompson Lakes Ramsar Site, approximately 390 km south-east of the LAU.

The closest areas of marine heritage conservation significance include:

- Zuytdorp (1712/06/09), approximately 176 km north-west of the LAU.

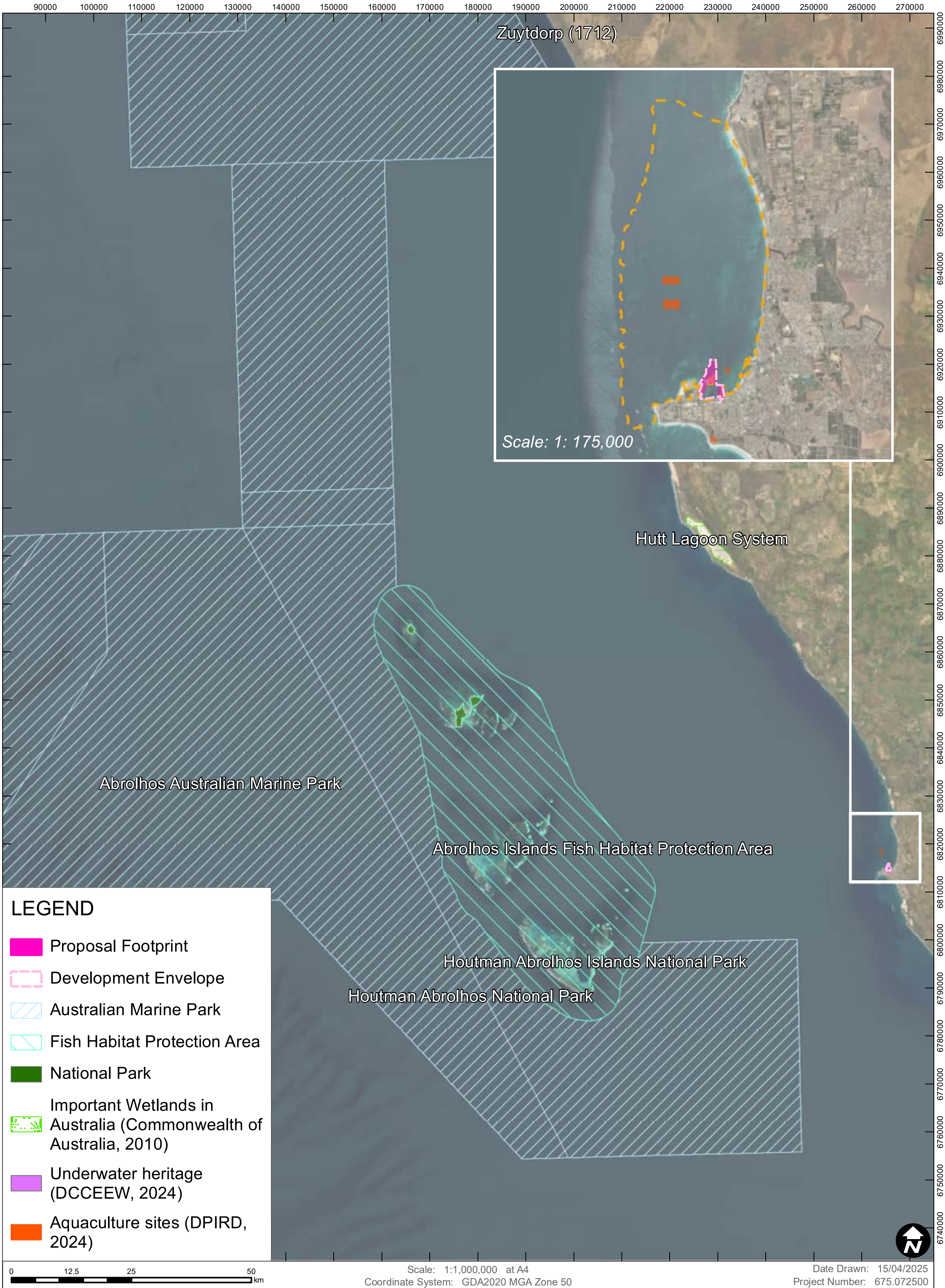
These areas are illustrated in **Figure 2-2**.

There are also three licensed aquaculture sites, two in Champion Bay, operated by Indian Ocean Fresh Australia Pty Ltd for a number of finfish species, and Batavia Coast Maritime Institute at Separation Point (land-based) on the southern side of the peninsula (**Figure 2-2**).

[3] Under the Western Australian *Fisheries Resources Management Act 1994*.

[4] Under the Western Australian *Reserves (National Parks and Conservation Parks) Act 2004*.

[5] Listed on the Directory of Important Wetlands in Australia.



\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F023_ConservationTenure.mxd

Data Source:
ESRI

SLR

TENURE AND AREAS OF MARINE CONSERVATION SIGNIFICANCE

FIGURE 2-2

2.2 Benthic communities and habitats

2.2.1 Historical mapping

Since 2020, the BCH in Champion Bay have been surveyed in four studies. These studies include:

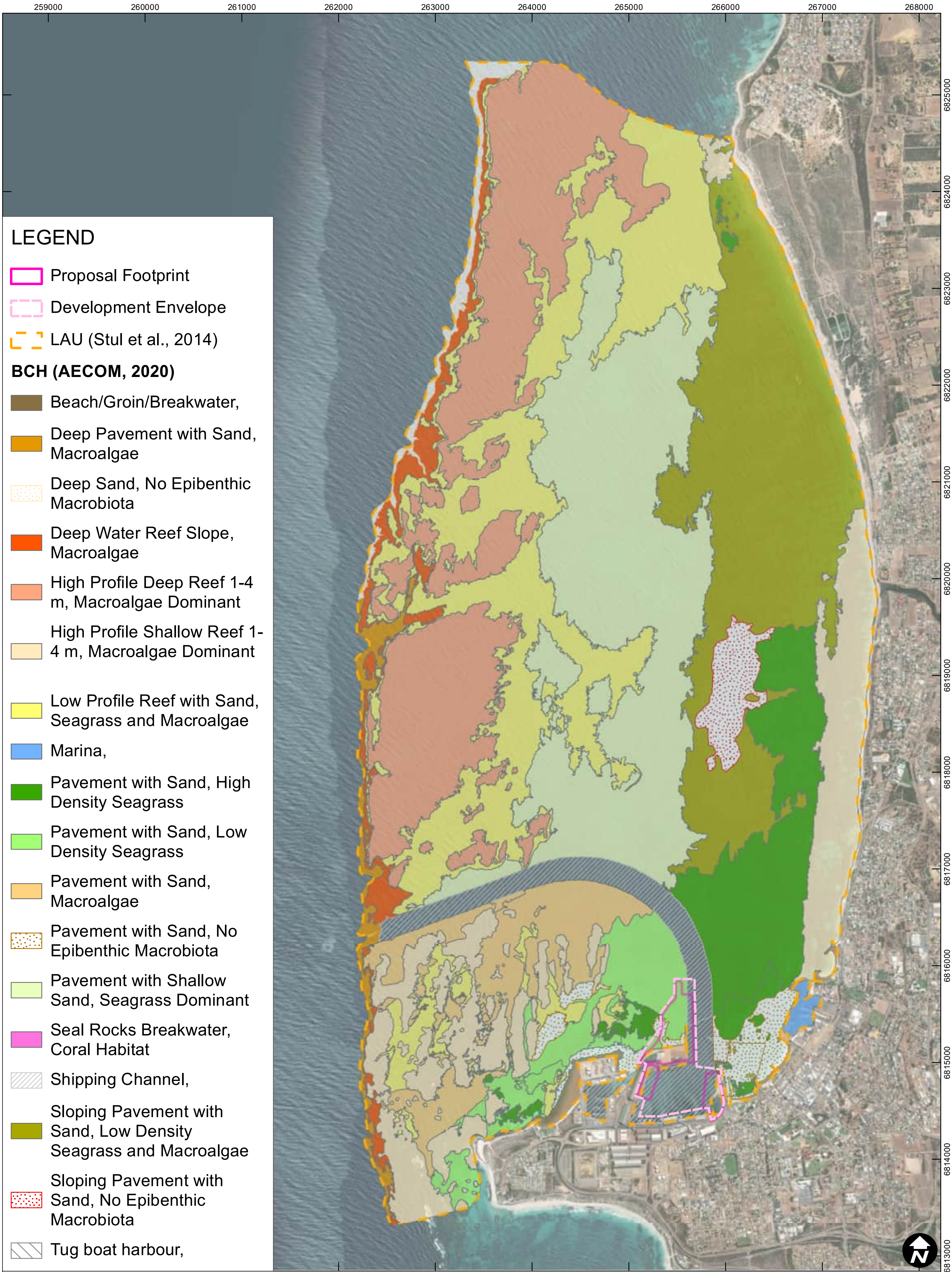
- Benthic Habitat Mapping Report – Champion Bay and Surrounds (AECOM, 2020)
- Seagrass Health Survey Report – Seagrass Communities in Champion Bay and Surroundings (BMT, 2021)
- Long Term Resilience of Seagrass Communities in Champion Bay (BMT, 2022), and
- Benthic Communities and Habitat Assessment: MWPA Tourist Jetty (O2 Marine, 2022b).

Previous broadscale benthic mapping undertaken within Champion Bay suggests a diverse range of habitats and benthic communities, such as seagrasses, macroalgae and filter-feeding organisms, exist throughout the Bay and surrounding areas (AECOM, 2020). Within the area to the south of the shipping channel and north of Fishing Boat Harbour, where the current Proposal Footprint is situated, the substratum has been described by AECOM (2020) as a mixture of reef and soft sediments with mostly seagrass and macroalgae dominated benthic communities (**Figure 2-3**). Seagrass within this area consisted of low- and high-density patches of *Halophila* spp., *Posidonia* spp., *Amphibolis* spp.and *Syringodium* sp., whilst macroalgae assemblages tended to be dominated by *Sargassum* spp. and *Ecklonia* sp. Depths in this area generally range between 4 m and 12 m.

In 2021, BMT Commercial Australia (BMT) completed routine seagrass monitoring at select sites in Champion Bay. The most abundant seagrass species in the Bay were *A. antarctica* and *P. sinuosa* and the survey reported evidence of recovery, in the form of increased shoot density and decreased bare sand areas, since the 2003 capital dredging activities (BMT, 2021).

In 2022, BMT surveyed select sites in Champion Bay to gain an understanding of the impacts of the 2021 maintenance dredging activities by measuring indicators of health. A decline in shoot density and height and an increase in sand were recorded, although it was noted that these changes may also be attributed to other environmental pressures such as marine heatwaves, hydrodynamics, terrestrial input and local perturbations (BMT, 2022).

A more targeted mapping exercise in 2022 by O2 Marine for the Tourist Jetty project identified sparse to high-density meadows of *P. sinuosa* and *Halophila* spp. between the Eastern Breakwater and the Geraldton Town Beach.



0 0.5 1 2 km

Scale: 1:50,000 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 15/04/2025
Project Number: 675.072500

Data Source:
Nearmap, 23 February 2024

\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F043_LAUBCH.mxd

SLR

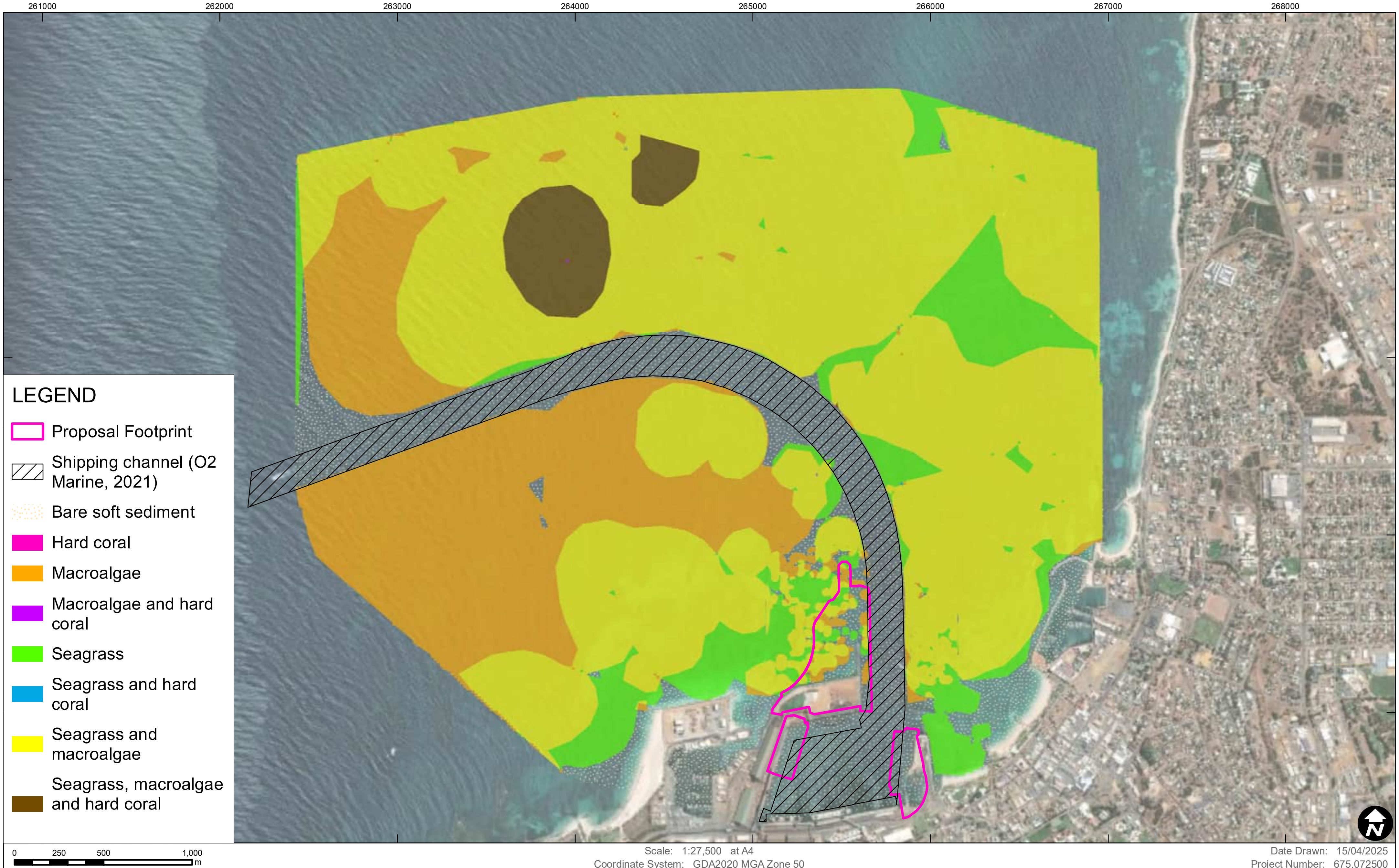
HISTORICAL BCH MAPPED IN THE LAU

FIGURE 2-3

2.2.2 Contemporary mapping

Benthic communities and habitats (BCH) were surveyed and mapped by SLR Consulting Pty Ltd (SLR) in the southern portion of the LAU in 2024 at locations 1, 2 and 3 (**Figure 2-4**). Location 1 is located along the northern breakwater. Location 2 is located north of Seal Rocks and Location 3 encompasses the southern portion of Champion Bay from around Elphick Ave to the Port. Data from SLR's 2024 field campaign and data from AECOM's (2020) survey[6] were used to generate an interpolated map predicting the distribution and extent of BCH in the southern portion of the LAU (SLR Consulting Pty Ltd, 2024).

[6] AECOM's (2020) data was only incorporated into the interpolation model for Location 3.



Scale: 1:27,500 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 15/04/2025
Project Number: 675.072500

Data Source:
ESRI

SLR

AN OVERVIEW OF INTERPOLATED BCH AT LOCATIONS 1, 2 AND 3

FIGURE 2-4

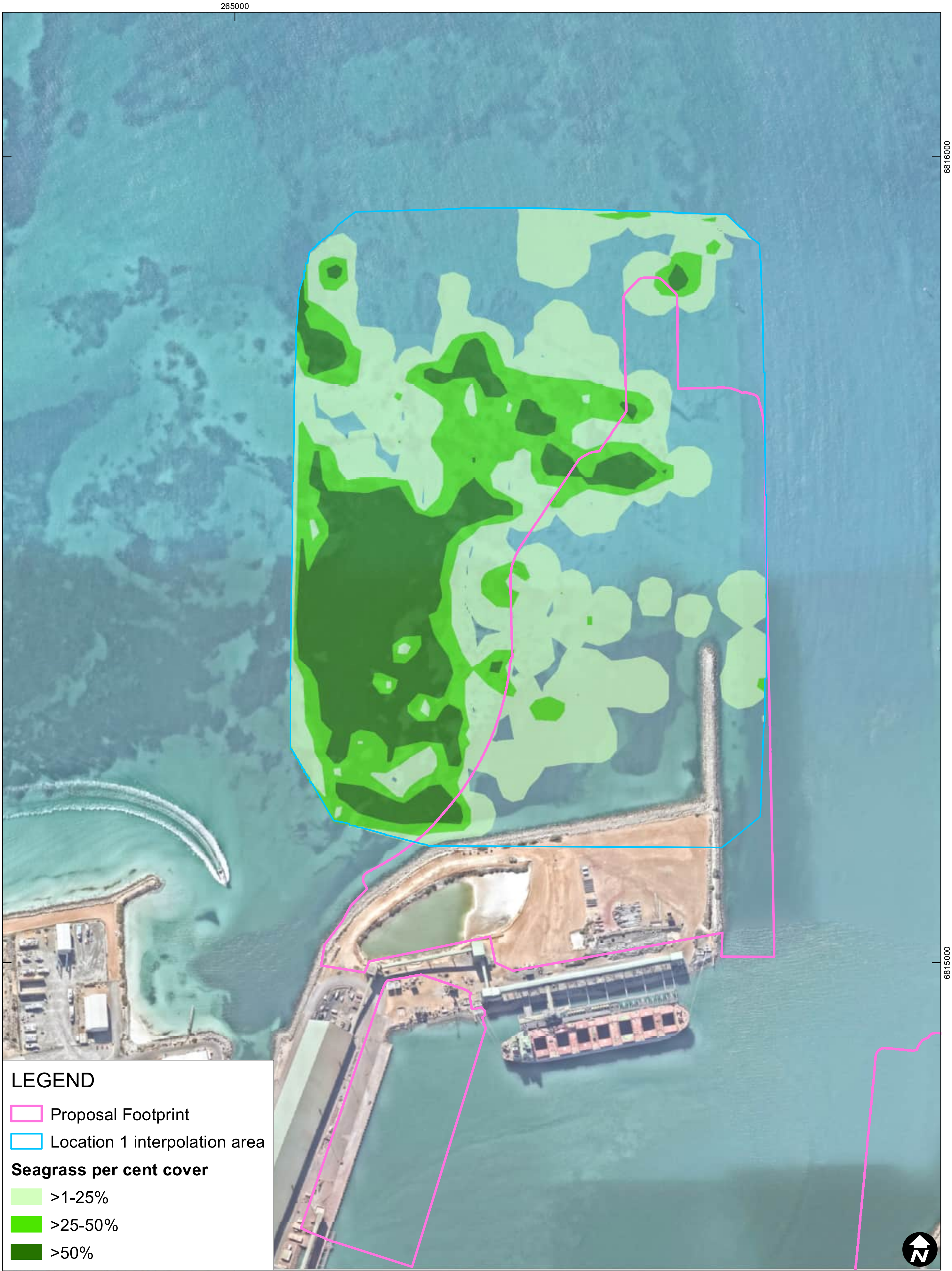
\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F026A_BCHOverview.mxd

2.2.2.1 Location 1 benthic communities and habitats

Location 1 was characterised by soft sediment and moderately dense patchy seagrass, with sparse macroalgae interspersed throughout. No hard substrate was recorded at any of the sampled sites. Bare unconsolidated sediment was observed at 36% of these sites, with the remaining 64% having seagrass and/or macroalgae coverage. *Posidonia* sp. was the most abundant seagrass species albeit *Halophila* sp., *Syringodium* sp. and *Amphibolis* sp., were also recorded. *Sargassum* sp. was the most abundant macroalgae and it co-occurred with unidentified filamentous brown algae.

Seagrass meadows were more contiguous with a higher per cent cover in the southwest portion of Location 1 (**Figure 2-5**). Very little seagrass was observed around the existing breakwater and shipping channel, and mostly sparse cover of seagrass was observed within the Proposed Footprint for the Tug Harbour and Berth 8 and 9. Similarly, seagrass was absent or observed at low density in the northern portion of Location 1.

Macroalgae was observed at sparser densities compared to seagrass within Location 1 (**Figure 2-6**). Macroalgae cover was mostly less than 25% throughout Location 1 with several small high per cent cover patches dispersed throughout Location 1. Some areas of macroalgae throughout Location 1 were present as ‘drift’ algae that was not attached to the seabed, although it was often difficult to discern between attached and drift macroalgae from the some of the images collected. Only macroalgae that was deemed to be attached to the seabed was included in the analyses, where possible.



0 50 100 200 m

Scale: 1:6,000 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 15/04/2025
Project Number: 675.072500

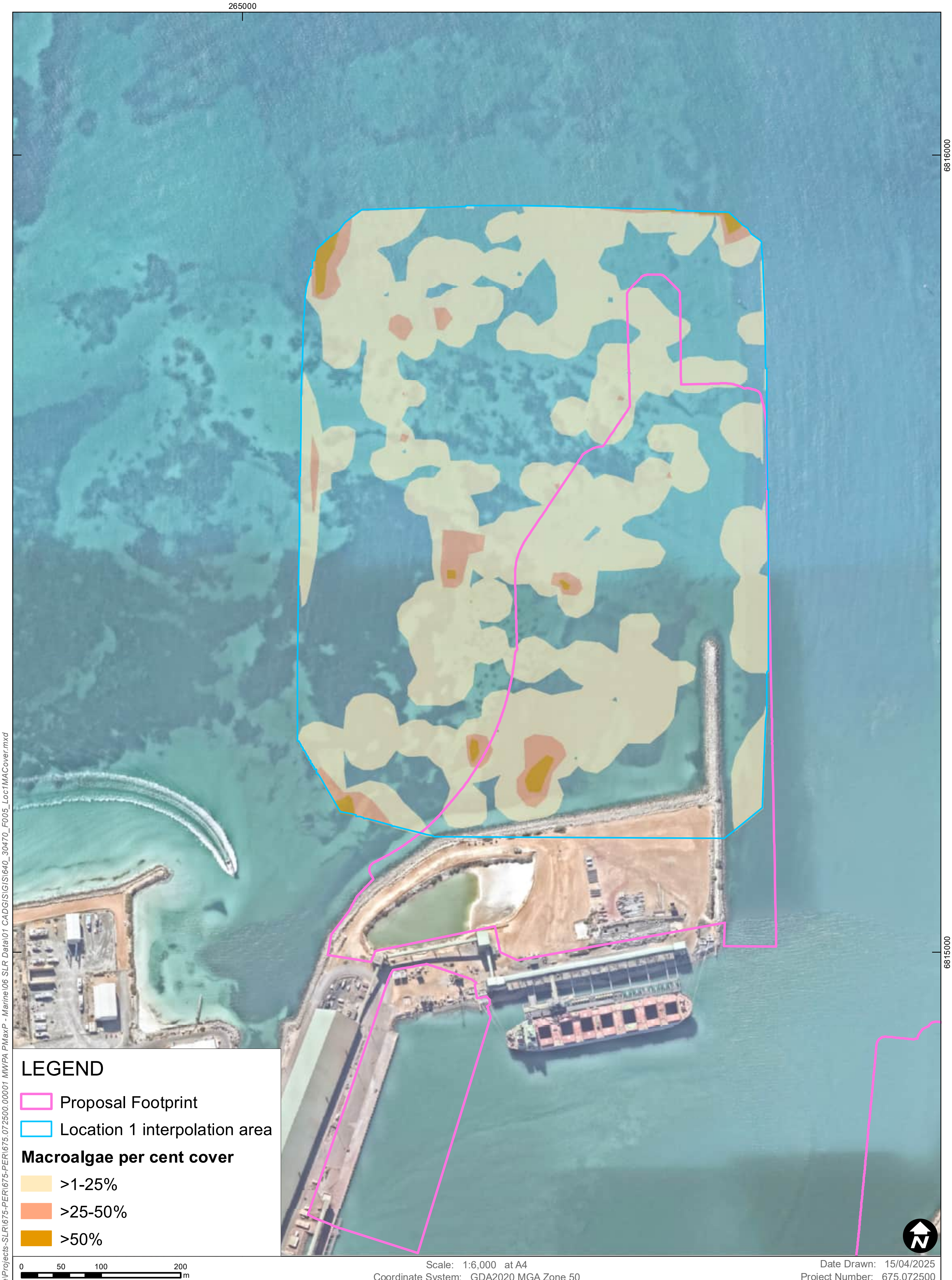
Data Source:
Nearmap, 2 May 2023

SLR

INTERPOLATED DISTRIBUTION AND PER CENT COVER OF SEAGRASSES WITHIN LOCATION 1

FIGURE 2-5

\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F006_Loc1SGCover.mxd



Scale: 1:6,000 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 15/04/2025
Project Number: 675.072500

Data Source:
Nearmap, 2 May 2023

SLR

INTERPOLATED DISTRIBUTION AND PER CENT COVER OF MACROALGAE WITHIN LOCATION 1

FIGURE 2-6

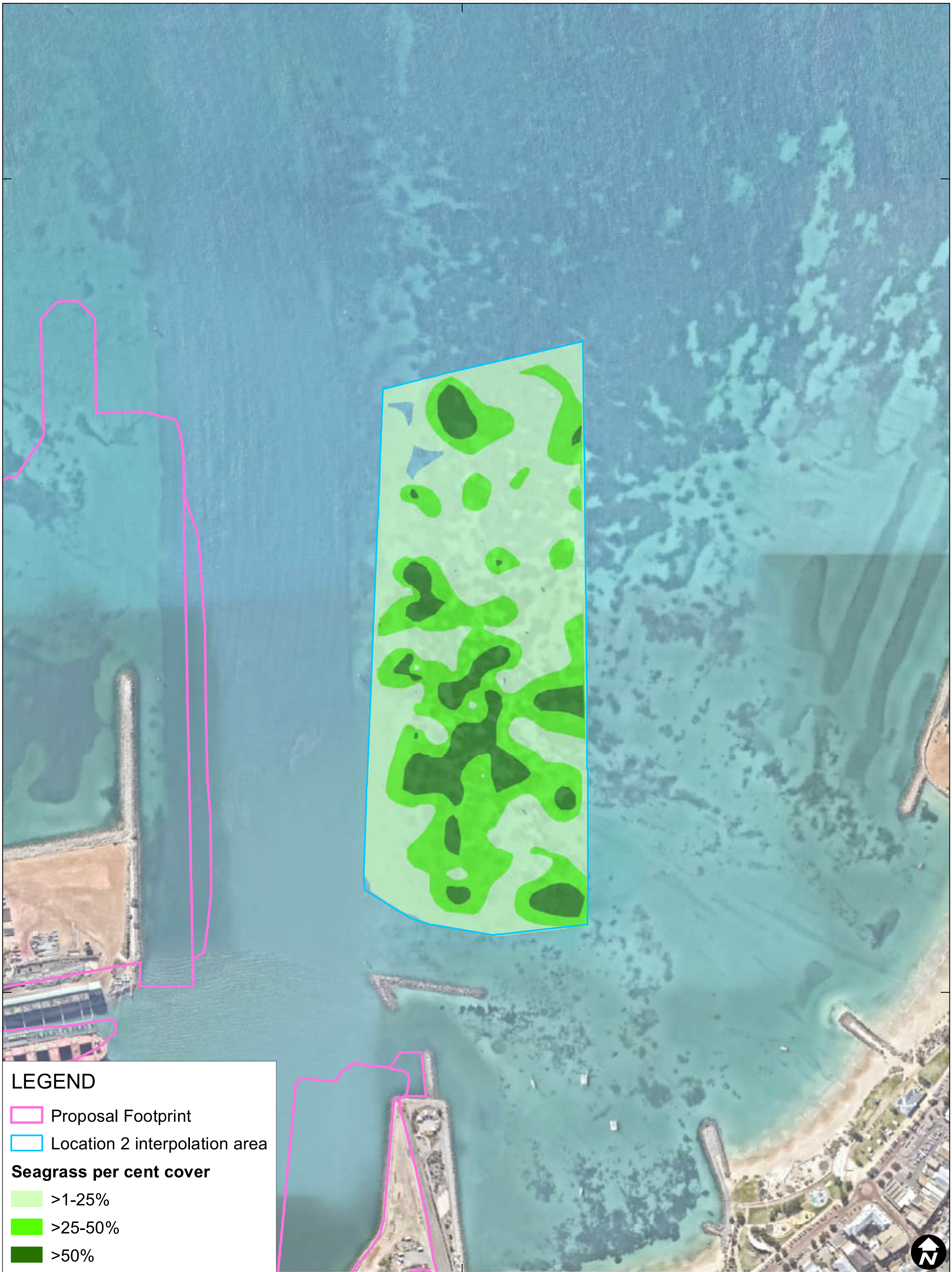
\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F005_Loc1MACover.mxd

2.2.2.2 Location 2 benthic communities and habitats

Location 2 was characterised by a mosaic of low to moderate profile reef and unconsolidated sediment associated with mostly low to medium per cent cover macroalgae and seagrass. Soft sediment was recorded at almost all sites, whilst rocky reef occurred at 37% of sampled sites. Bare unconsolidated sediment was observed at only 6% of sites throughout Location 2. Where rocky reef was observed it was always associated with the presence of macroalgae. Seagrass was present at 83% of sites sampled whilst macroalgae was observed at 69% of sampled sites. All four seagrass species recorded in Location 1 occur in Location 2. Macroalgae in Location 2 was more diverse than Location 1 and consisted of *Ecklonia* sp., *Sargassum* sp., *Padina* sp., coralline algae and unidentified filamentous brown and green algae.

Seagrass and macroalgae co-occurred across most of Location 2 (**Figure 2-7** and **Figure 2-8**). Low per cent cover (i.e. <25%) seagrass was distributed throughout most of Location 2 with higher per cent cover patches located in the southern portion (**Figure 2-7**).

The per cent cover of macroalgae was similar to seagrass throughout Location 2. Contrary to seagrass, higher per cent cover patches were recorded in the northern portion (**Figure 2-8**). Also, unlike Location 1, macroalgae were generally attached to the seabed in Location 2.



0 50 100 200 m

Scale: 1:6,000 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 15/04/2025
Project Number: 675.072500

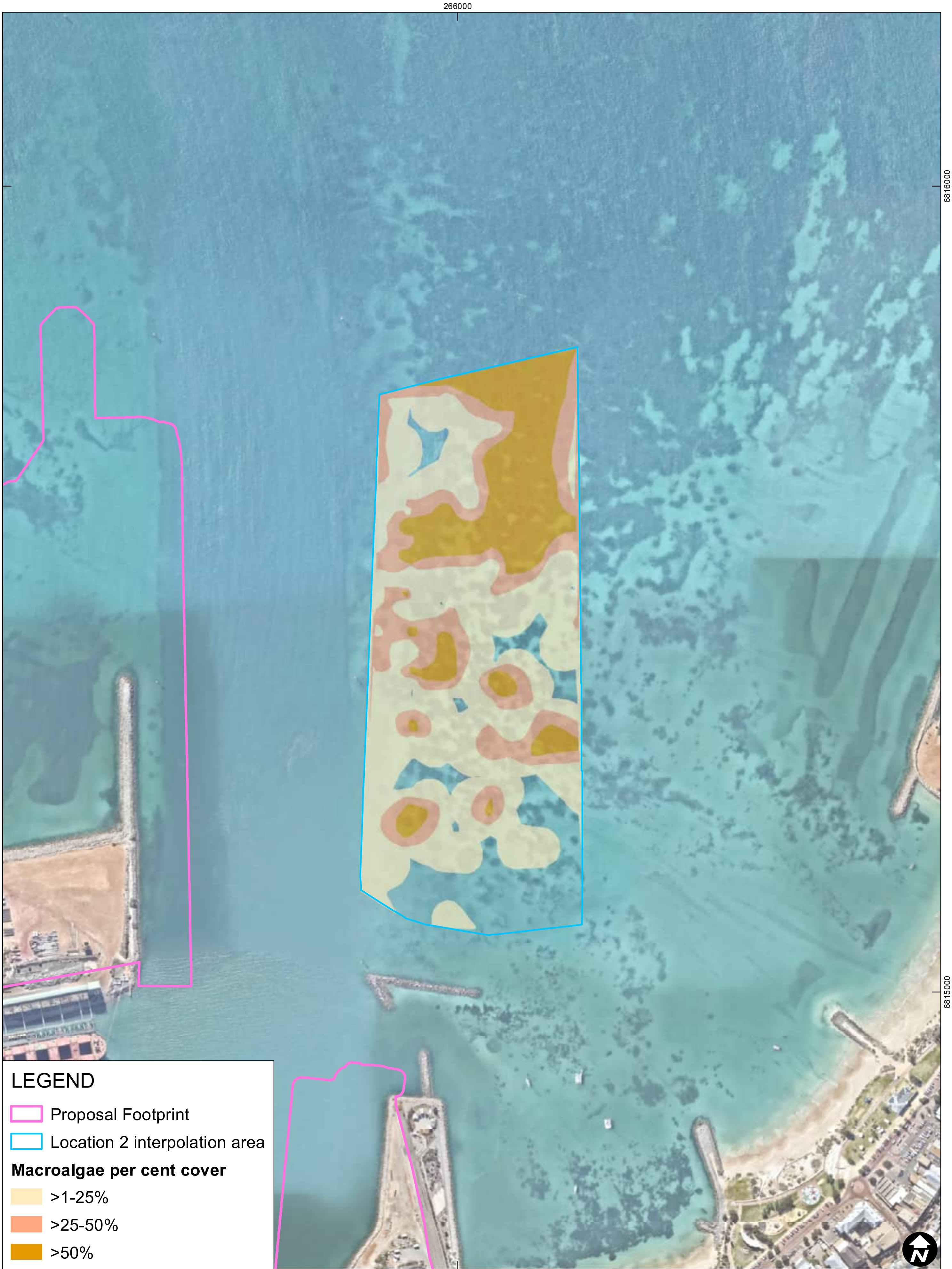
Data Source:
Nearmap, 2 May 2023

SLR

INTERPOLATED DISTRIBUTION AND PER CENT COVER OF SEAGRASSES WITHIN LOCATION 2

FIGURE 2-7

\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F010_Loc2SGCover.mxd



0 50 100 200 m

Scale: 1:6,000 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 15/04/2025
Project Number: 675.072500

Data Source:
Nearmap, 2 May 2023

SLR

INTERPOLATED DISTRIBUTION AND PER CENT COVER OF MACROALGAE WITHIN LOCATION 2

FIGURE 2-8

\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F009_Loc2MACover.mxd

2.2.2.3 Location 3 benthic communities and habitats

The BCH north of the shipping channel in Location 3 were mostly characterised by seagrass meadows on soft sediment habitat and co-occurring macroalgae and seagrass on low to moderate relief rocky reef (consolidated substratum) with associated unconsolidated sediment. Unconsolidated sediment was observed at 62% of sampled sites[7], whilst low to moderate relief rocky reef occurred at 3% of sampled sites. The remaining 35% of sites contained a mixture of both unconsolidated sediment and rocky reef habitat. Rocky reef was always observed with macroalgae present. *Posidonia* sp. and/or *Amphibolis* sp. were observed mostly in areas where rocky reef was absent. Macroalgae across Location 3 were more diverse than locations 1 and 2 and consisted of all the species recorded in Location 2 and a variety of unidentified filamentous brown and green algae.

Seagrass distribution and per cent cover tended to be higher in the soft sediment habitat closer to shore and further to the north and east of Location 3 (**Figure 2-9**), whilst rocky reef and macroalgae was more prevalent further from shore throughout the centre and western areas of Location 3 (**Figure 2-10**). Seagrass was present at 90% of sites sampled and macroalgae observed at 68% of sampled sites. Seagrass and macroalgae were recorded together at 63% of sampled sites. There was very little bare soft sediment observed throughout Location 3 (2% of sampled sites).

The per cent cover of macroalgae was similar to seagrass throughout Location 3. Very few drift macroalgae were observed throughout Location 3, with most observations being attached to the substratum.

Some areas of low per cent cover (<25%) hard coral were also observed within Location 3 (**Figure 2-11**) and generally occurred as small, isolated colonies within seagrass and macroalgae communities. These occurred to the north and north-east of Location 1 and the shipping channel (**Figure 2-11**). From the video footage collected, it was difficult to discern the species of coral, although they appear to be from the genus *Montipora* and/or *Acropora*.

[7] Based on sampled sites by SLR (2024).

Scale: 1:27,500 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 15/04/2025
Project Number: 675.072500

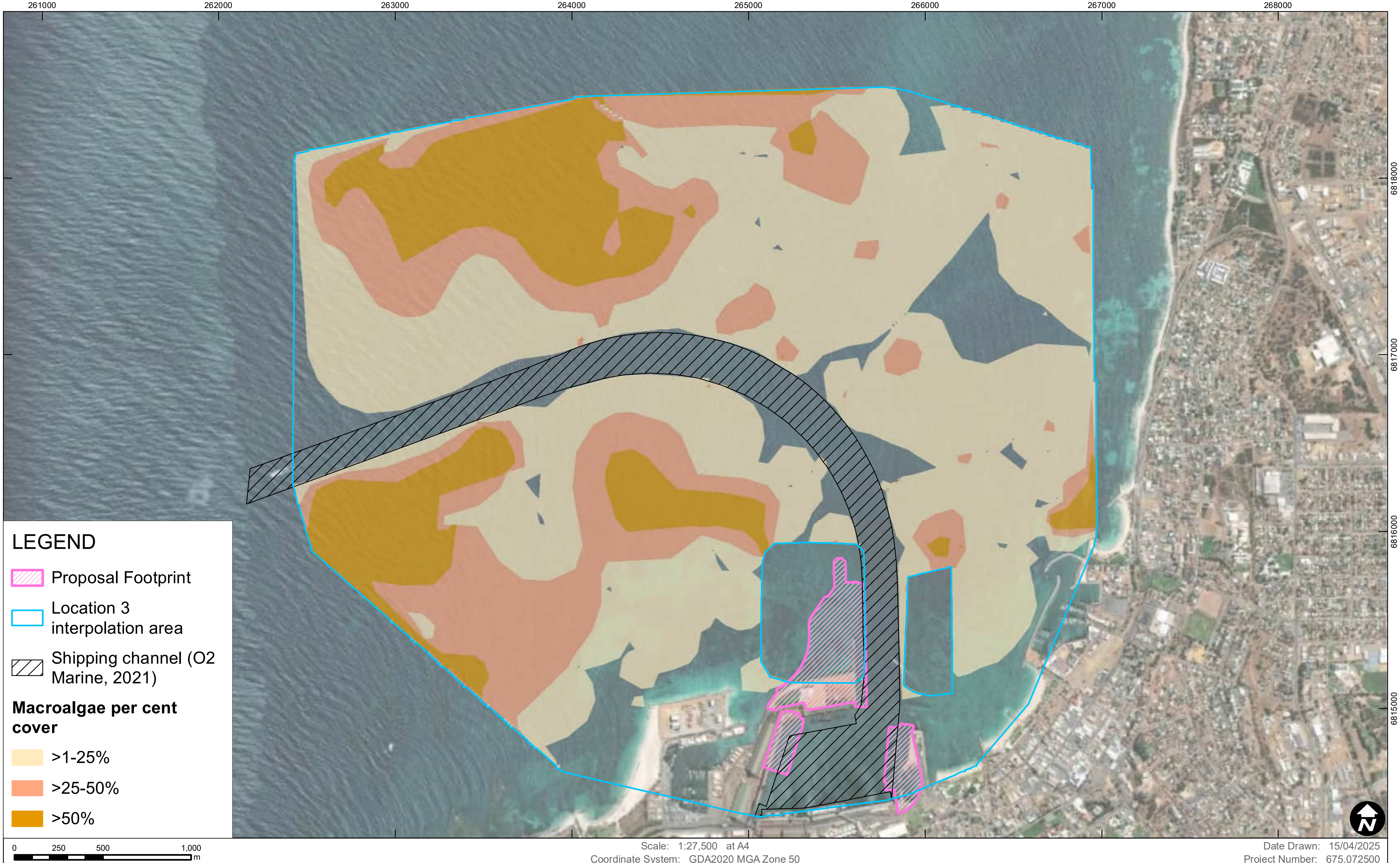
Data Source:
Esri, Maxar, Earthstar Geographics, and the GIS User Community

SLR

INTERPOLATED DISTRIBUTION AND PER CENT COVER OF SEAGRASSES WITHIN LOCATION 3

FIGURE 2-9

\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F014_Loc3SGCover.mxd



Scale: 1:27,500 at A4
Coordinate System: GDA2020 MGA Zone 50

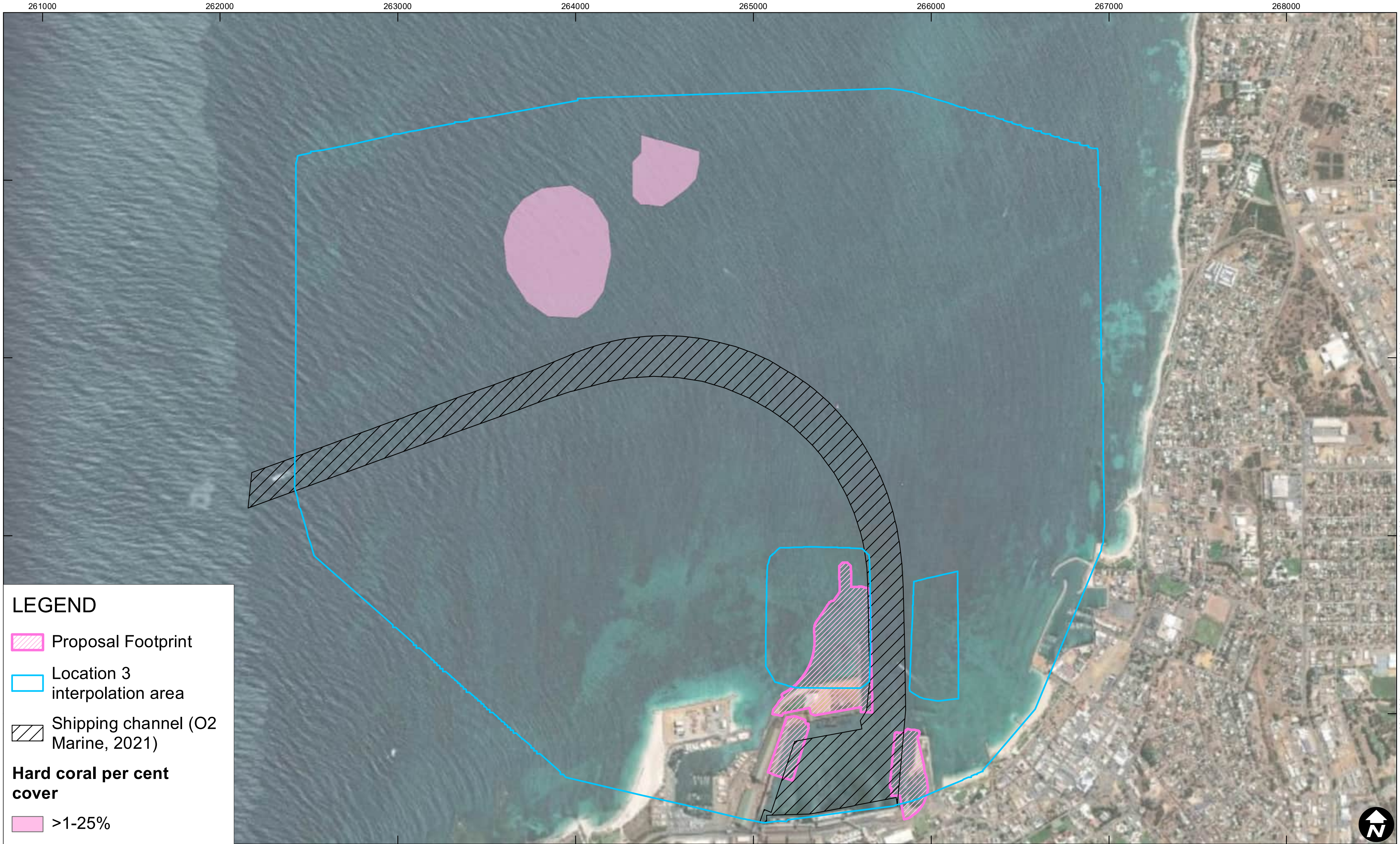
Date Drawn: 15/04/2025
Project Number: 675.072500

Data Source:
Esri, Maxar, Earthstar Geographics, and the GIS User Community

SLR

INTERPOLATED DISTRIBUTION AND PER CENT COVER OF MACROALGAE WITHIN LOCATION 3

FIGURE 2-10



0 250 500 1,000 m

Scale: 1:27,500 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 15/04/2025
Project Number: 675.072500

Data Source:
Esri, Maxar, Earthstar Geographics, and the GIS User Community

SLR

INTERPOLATED DISTRIBUTION AND PER CENT COVER OF HARD CORAL WITHIN LOCATION 3

FIGURE 2-11

\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F015_Loc3HCCover.mxd

2.2.3 Local and regional values

2.2.3.1 Conservation values

Posidonia australis complex seagrass meadows is a Priority 3(i) ecological community under the Western Australia BC Act. Under regulations 170, 171 and 172 of the BC Act, Priority 3 communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or not well defined, and known threatened processes exist that could affect them.

Posidonia australis complex seagrass meadows ecological community has also been nominated for listing as an endangered ecological community (EEC) under the EPBC Act in 2011. Public consultation was undertaken for the ecological community in 2014. This process resulted in the *Posidonia australis* seagrass meadows of the Manning-Hawkesbury ecoregion being listed as endangered. However, the wider *Posidonia australis* complex was not listed under the EPBC Act.

2.2.3.2 Regional significance

The BCH recently mapped by SLR (2024) is similar to those identified by O2 Marine (2022b) and AECOM (2020). The mapping produced from the latter two studies were also comparable to historical BCH mapping in the broader region completed by URS in 2001 in preparation for the capital dredging project (O2 Marine, 2022a). The 2001 study by URS indicated that the BCH described in the above sections are ubiquitous throughout the Central West Region of Western Australia (URS, 2001). Thus, it is unlikely that the BCH in Champion Bay are unique or geographically confined.

2.2.3.3 Local significance

The BCH identified in locations 1, 2 and 3 were relatively similar in composition (SLR Consulting Pty Ltd, 2024). Seagrass and macroalgae diversity may vary between locations, with Location 1 being the least diverse of the three. However, the species observed in Location 1 were also observed in Location 2 and the broader Location 3. Thus, it is unlikely that the BCH in Location 1 is unique or geographically confined.

2.2.3.4 Functional ecological values

The seagrass meadows in the LAU are likely to form part of the *Posidonia australis* complex ecological community which occurs mostly in the temperate regions of Australia from Shark Bay on the west coast across southern Australia to Wallis Lake on the east coast (Department of Climate Change, Energy, the Environment and Water, 2013). This community includes *P. australis*, *P. angustifolia* and *P. sinuosa* as the most abundant species and is a climax community of a successional process that occurs over decades to centuries. *Amphibolis* spp., *Cymodocea* sp., *Halophila* spp., *Heterozostera* sp. and *Syringodium* sp. may also occur within this community along with a diverse assemblage of epiphytes, macroalgae and periphyton. It generally persists in sheltered and low energy environments and can form large meadows or small fragmented patches. This ecological community is highly productive and provides habitat, shelter and food for many transient or resident fauna species albeit does not have an associated characteristic fauna assemblage. *Posidonia* spp. are not usually a direct food source for most grazers but rather stabilise the substratum for the establishment of other primary producers and sessile fauna that might support high food chains. It is also known to provide nursery habitat for some fish and crustaceans, including the Western Rock Lobster (*Panulirus cygnus*). Along with providing habitat resources for marine primary producers and fauna, seagrass meadows also remove nutrients from the water, oxygenate the water and sediment and reduce sediment resuspension and is a natural carbon sink (Duarte, et al., 2010; Government of Western Australia, 2023).

The same ecological values that seagrass meadows provide are also associated with hard corals where they form reefs. However, the records of corals in Location 2 and 3 were isolated, small colonies that did not form viable coral reef habitat. Thus, the ecological values of hard corals in locations 2 and 3 are unlikely to be high. These isolated, small colonies may provide temporary shelter or a foraging resource for small, mobile fauna but are unlikely to sustain populations or diverse communities.

Macroalgae reefs can also provide some of the same values as seagrass meadows but can also play critical roles in habitat degradation (Diaz-Pulido, 2008). Environmental stressors, such as eutrophication and overfishing, can manifest in an overabundance of macroalgae, out-competing hard corals and reducing the value reef habitats.

Based on these values and the BCH expected to occur in locations 1, 2 and 3, the *Posidonia australis* complex is considered to be of the highest ecological value and play a vital role in ecosystem processes.

2.2.3.5 Social values

The foreshore of Geraldton and the water quality and marine environment contributes to the health and wellbeing of the residents, as well as supports local tourism. Seagrasses of Champion Bay help to support snorkelling, diving, fishing, and other water based recreational activities.

Seagrass meadows may correspond to country and have cultural significance to several indigenous groups of the Yamatji Southern Region, including the Wilunyu, Nhanagardi and Naaguja peoples. The seagrass species identified have been widely mapped in their distribution, not only within Champion Bay, but widely throughout the Central West Coast Region (DBCA, 2022) and based on the small scale and location of the Proposed Footprint, unlikely to represent any social impacts by the Project.

2.2.4 Pre-European extent

The pre-European extent of the subtidal BCH types in the LAU was outlined in *Benthic Communities and Habitat Cumulative Loss Assessment: MPWA Tourist Jetty* (O2 Marine, 2022a). The pre-European extent was estimated using historical photographs and interpretation of current BCH assemblages occurring adjacent to existing disturbed areas.

O2 Marine (2022a) describes the dynamic nature of existing BCH in the Bay resulting in annual variabilities. Thus, the pre-European extent is a spatial estimation that does not account for ecosystem condition, species health or seasonal variabilities. This data should be interpreted with caution and considered an approximation.

The pre-European extent of subtidal BCH in LAU was estimated at 4,832.52 ha and is detailed in **Table 2-1**.

Table 2-1 The estimated pre-European extent of BCH in the LAU (source: O2 Marine, 2022a)

BCH category	Approximation of area prior to European settlement (ha)	Proportion of approximate area in the LAU (%)
Deep pavement with sand, macroalgae	48.81	1.01
Deep sand, no epibenthic macrobiota	37.56	0.78
Deep water reef slope, macroalgae	110.71	2.29
High profile deep reef 1-4 m, macroalgae dominant	737.54	15.26
High profile shallow reef 1-4 m, macroalgae dominant	453.50	9.38
Low profile reef with sand, seagrass and macroalgae	807.22	16.70
Pavement with sand, high density seagrass	559.69	11.58
Pavement with sand, low density seagrass	175.42	3.63
Pavement with sand, macroalgae	244.55	5.06
Pavement with sand, no epibenthic macrobiota	26.37	0.55
Pavement with shallow sand, seagrass dominant	860.40	17.81
Sloping pavement with sand, low density seagrass and macroalgae	709.80	14.69
Sloping pavement with sand, no epibenthic macrobiota	60.95	1.26
Coral	0.00	0.00
TOTAL	**4,832.52**	**100.00**

2.2.5 Current extent

The current extent of the subtidal BCH types in the LAU, including the per cent loss, is outlined in **Table 2-2**. The current extent was derived from *Benthic Communities and Habitat Cumulative Loss Assessment: MPWA Tourist Jetty* (O2 Marine, 2022a).The current extent of subtidal BCH in the LAU is 4,563.18 ha.

Table 2-2 The estimated current extent of BCH in the LAU and the percentage loss since European settlement (derived from O2 Marine, 2022a)

BCH category	Approximation of current area (ha)	Δ area (±ha)	Δ area (±%)
Deep pavement with sand, macroalgae	48.81	0.00	0.00
Deep sand, no epibenthic macrobiota	37.56	0.00	0.00
Deep water reef slope, macroalgae	107.81	-2.90	-2.62
High profile deep reef 1-4 m, macroalgae dominant	737.54	0.00	0.00
High profile shallow reef 1-4 m, macroalgae dominant	451.45	-2.05	-0.45
Low profile reef with sand, seagrass and macroalgae	806.99	-0.23	-0.03
Pavement with sand, high density seagrass	328.15	-231.54	-41.37
Pavement with sand, low density seagrass	158.62	-16.80	-9.58
Pavement with sand, macroalgae	209.94	-34.61	-14.15
Pavement with sand, no epibenthic macrobiota	74.92	+48.55	+184.11
Pavement with shallow sand, seagrass dominant	830.33	-30.07	-3.49
Sloping pavement with sand, low density seagrass and macroalgae	709.80	0.00	0.00
Sloping pavement with sand, no epibenthic macrobiota	60.95	0.00	0.00
Coral	0.31	+0.31	-
TOTAL	**4,563.18**	**-269.34**	**-**

2.2.6 Assumptions and limitations

The cumulative loss calculated is based on areas identified in the *Benthic Communities and Habitat Assessment: MWPA Tourist Jetty* (O2 Marine, 2022b). The accuracy of the impact area calculations is influenced by the resolution of the BCH interpolation, BCH survey locations and spatial coverage and projection errors inherent in aerial photography.

3.0 Potential impacts

Potential impacts on BCH as a result of the PMaxP are identified in the sections below and are based on the extent of the Proposal Footprint, the combined Zone of High Impact (ZoHI) and the Zone of Moderate Impact (ZoMI) modelled and described in *Dredge Plume Modelling Assessment: Geraldton Port Maximisation Project* (RoyalHaskoningDHV, 2025).

The Proposed Footprint lies within Location 1 and the shipping channel (**Figure 3-1**). The ZoHI and ZoMI for all modelled scenarios have been combined to form a combined ZoHI and ZoMI for the purposes of defining the extent of impacts to BCH. The modelled ZoHI excludes the area inside the Proposed Footprint. The modelled combined ZoHI and ZoMI extends across locations 1 and 3. Some nearshore areas outside of the interpolation locations were also encompassed in the ZoMI and the categorisation of BCH of these areas is discussed in **Section 3.4**.

Shading of BCH under the proposed wharf decks, physical dredging disturbance, elevated suspended solids concentration (SSC) and sedimentation within the ZoHI are assumed to result in the irreversible loss/modification of all BCH except bare soft sediment/pavement with sand, no epibenthic macrobiota. Bare soft sediment in the following areas within the Proposal Footprint is not expected to be irreversibly impacted and will likely recover following construction completion:

- Under the wharf decks[8]
- In dredge footprints
- In areas between dredge footprints and the Tug Harbour seawall[9], and
- The ZoHI.

Bare soft sediment habitats generally lack the habitat complexity and biodiversity compared to other BCH, although infauna occurring in these habitats are closely linked to ecosystem functions by forming basal elements of many food webs (Gadd & Griffiths, 1977; Eyre & Ferguson, 2005; Connell & Gillanders, 2007). Bare soft sediment communities are known to recover from physical disturbances as quickly as 64 days, depending on disturbance intensity and any subsequent sediment granulometry and organic content alterations (Dernie, et al., 2003a; Dernie, et al., 2003b). It is assumed bare soft sediment in the areas above would be recolonised and continue to be available following construction and will be considered in indirect impacts in **Section 3.4**.

3.1 Avoid and minimise

The placement of the optimised Tug Harbour footprint avoids areas of high-density seagrass and macroalgae.

The approved proposal MS600 completed a capital dredge campaign utilising a large cutter suction dredge and hopper barge, which resulted in elevated turbidity in the marine environment and could have had resultant impacts on BCH due to the reduced light availability. The detailed dredge review undertaken as part of the development of the PMaxP involved a review of the MS600 dredge campaign and geotechnical data with the objective of adopting a more suitable dredge method to reduce potential impacts to water quality and

[8] Where wharf decks overly the seabed. We note that bare soft sediment/pavement with sand, no epibenthic macrobiota would be lost below the footprint of the piles however, these areas are considered proportionally negligible.

[9] These areas will not be dredged or have infrastructure installed but are included in the calculations conservatively as they are fragmented amongst disturbed areas.

inadvertently marine fauna and benthic communities (RoyalHaskoningDHV, 2023). Based on the findings of the review, the PMaxP capital dredging will be completed by hydro-hammer (rock-breaker) and long arm excavator to minimise the potential for generation of excess suspended sediments and hence reduce potential impacts to BCH beyond the Proposal Footprint.

The PMaxP also involves maintenance dredging adjacent Berth 1 and based on recent success with the Port maintenance dredge campaigns utilising a suction hopper dredge, the same method will be used for the PMaxP maintenance dredge at Berth 1. This dredge method may also be utilised for the capital dredge required in the tug harbour because only the overlying sandy sediments are required to be dredged, not hard rock.

3.2 Benthic communities and habitats equivalence

To determine the cumulative loss of subtidal BCH, the BCH categories mapped in the contemporary SLR (2024) mapping must align with the legacy BCH categories in **sections 2.2.4** and **2.2.5**. This is completed by aligning the habitat and community description from the SLR (2024) survey to the best suited legacy BCH category descriptions in Section 3.1 of the *Benthic Communities and Habitat Cumulative Loss Assessment: MPWA Tourist Jetty* (O2 Marine, 2022a). The equivalence categories are outlined in **Table 3-1**.

Table 3-1 Subtidal BCH equivalence

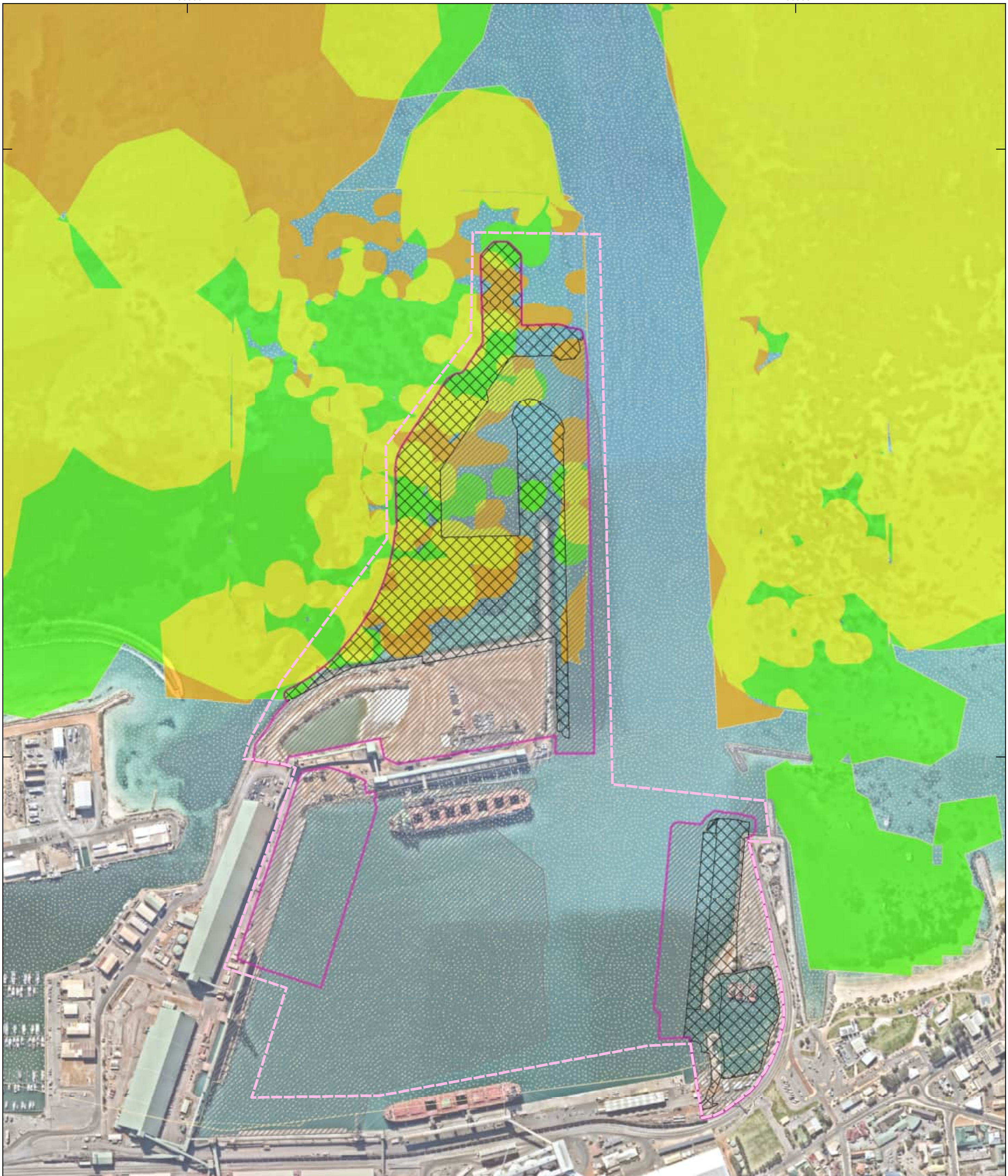
Contemporary BCH category (SLR Consulting Pty Ltd, 2024)	Legacy BCH category equivalence (O2 Marine, 2022a)
Seagrass >1-25%	Pavement with sand, low density seagrass
Seagrass >25-50%	Pavement with sand, high density seagrass
Seagrass >50%	
Macroalgae >1-25%	Pavement with sand, macroalgae
Macroalgae >25-50%	
Macroalgae >50%	
Seagrass >25-50% and Macroalgae >1-25%	Pavement with shallow sand, seagrass dominant
Seagrass >50% and Macroalgae >1-25%	
Seagrass >50% and Macroalgae >25-50%	
Seagrass >1-25% and Macroalgae >1-25%	Low profile reef with sand, seagrass and macroalgae
Seagrass >1-25% and Macroalgae >25-50%	
Seagrass >25-50% and Macroalgae >25-50%	
Seagrass >1-25% and Macroalgae >50%	
Seagrass >25-50% and Macroalgae >50%	
Seagrass >50% and Macroalgae >50%	
Bare soft sediment	Pavement with sand, no epibenthic macrobiota

3.3 Direct impacts

The area of direct impacts on subtidal BCH has been calculated based on the Proposed Footprint and the ZoHI illustrated in **Figure 3-1**. The PMaxP would result in the irreversible loss/modification of approximately 18.63 ha of BCH (**Table 3-2**). The area of bare soft sediment/pavement with sand, no epibenthic macrobiota that is included in the area of direct impact is the area lost to the construction of the New Tug Harbour seawall and reclamation and material disposal areas. The majority of the ZoHI overlies bare soft sediment with minimal areas of macroalgae/pavement with sand, macroalgae on the western edge of the proposed Berth 8/9 footprint.

Table 3-2 Areas of directly impacted BCH within the Proposed Footprint and ZoHI

<table>
<tr><th>BCH category
(SLR Consulting Pty Ltd, 2024)</th><th>Legacy BCH category
(O2 Marine, 2022b)</th><th>Area of direct impact (ha)</th></tr>
<tr><td>Seagrass >1-25%</td><td>Pavement with sand, low density seagrass</td><td>2.00</td></tr>
<tr><td>Seagrass >25-50%</td><td rowspan="2">Pavement with sand, high density seagrass</td><td rowspan="2">0.54</td></tr>
<tr><td>Seagrass >50%</td></tr>
<tr><td>Macroalgae >1-25%</td><td rowspan="3">Pavement with sand, macroalgae</td><td rowspan="3">3.84</td></tr>
<tr><td>Macroalgae >25-50%</td></tr>
<tr><td>Macroalgae >50%</td></tr>
<tr><td>Seagrass >25-50% and Macroalgae >1-25%</td><td rowspan="3">Pavement with shallow sand, seagrass dominant</td><td rowspan="3">0.65</td></tr>
<tr><td>Seagrass >50% and Macroalgae >1-25%</td></tr>
<tr><td>Seagrass >50% and Macroalgae >25-50%</td></tr>
<tr><td>Seagrass >1-25% and Macroalgae >1-25%</td><td rowspan="6">Low profile reef with sand, seagrass and macroalgae</td><td rowspan="6">4.47</td></tr>
<tr><td>Seagrass >1-25% and Macroalgae >25-50%</td></tr>
<tr><td>Seagrass >25-50% and Macroalgae >25-50%</td></tr>
<tr><td>Seagrass >1-25% and Macroalgae >50%</td></tr>
<tr><td>Seagrass >25-50% and Macroalgae >50%</td></tr>
<tr><td>Seagrass >50% and Macroalgae >50%</td></tr>
<tr><td>Bare soft sediment</td><td>Pavement with sand, no epibenthic macrobiota</td><td>7.13</td></tr>
<tr><td colspan="2">TOTAL</td><td>18.63</td></tr>
</table>



LEGEND

- Proposal Footprint
- Development Envelope
- Irreversible impacts to all BCH
- Irreversible impacts (seagrass and macroalgae only)
- Bare soft sediment
- Macroalgae
- Seagrass
- Seagrass and macroalgae

0 50 100 200 m

Scale: 1:8,500 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 15/04/2025
Project Number: 675.072500

Data Source:
Nearmap, 2 May 2023

SLR

BCH DIRECTLY IMPACTED BY THE PMAXP

FIGURE 3-1

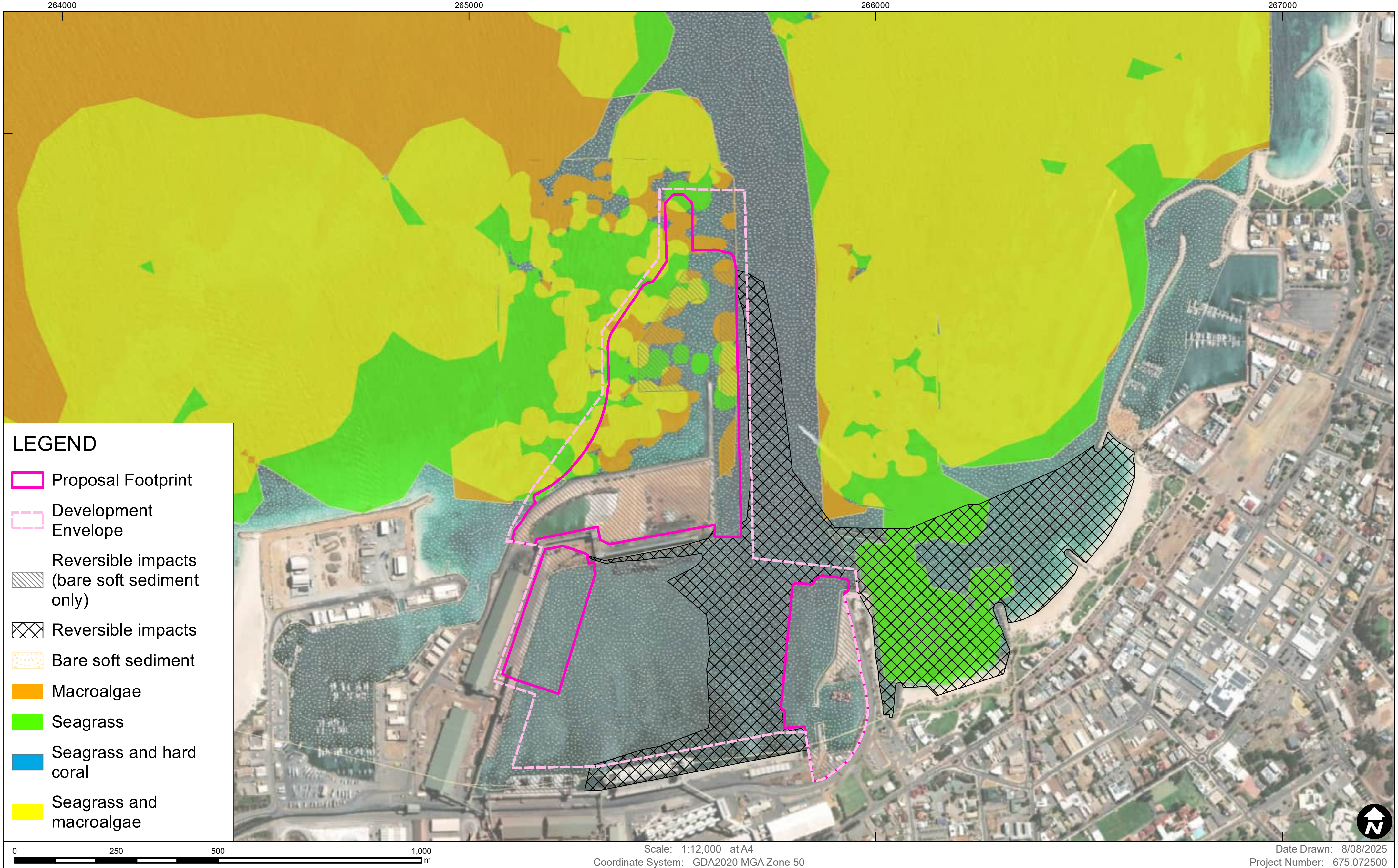
\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F044_DirectImpacts.mxd

3.4 Indirect impacts

The area of indirect impacts on subtidal BCH has been calculated based on the Proposed Footprint, ZoHI and ZoMI illustrated in **Figure 3-2** and **Figure 3-3**. The PMaxP would result in the reversible impact of approximately 74.42 ha of BCH (**Table 3-3**) where recovery to a condition similar to existing conditions is expected within five years. This includes the areas of bare soft sediment/pavement with sand, no epibenthic macrobiota under the wharf decks (where it would still overlie subtidal areas), in the dredge footprints and the ZoHI (**Figure** 3-1). The ZoMI mostly overlies bare soft sediment except for the area east of the Eastern Breakwater where seagrass is mapped (**Figure 3-2**) and the corner of a patch of macroalgae north of Seal Rocks. Narrow slivers of bare soft sediment/pavement with sand, no epibenthic macrobiota occurs outside the interpolation areas (**Figure 3-3**). The BCH categorisation of this area was determined based on adjoining, interpolated habitats and is illustrated in **Figure 3-3**.

Table 3-3 Areas of reversible impact to BCH

BCH category (SLR Consulting Pty Ltd, 2024)	Legacy BCH category (O2 Marine, 2022b)	Area of indirect impact (ha)
Seagrass >1-25%	Pavement with sand, low density seagrass	5.51
Seagrass >25-50%	Pavement with sand, high density seagrass	4.70
Seagrass >50%		
Macroalgae >1-25%	Pavement with sand, macroalgae	0.20
Macroalgae >25-50%		
Macroalgae >50%		
Seagrass >25-50% and Macroalgae >1-25%	Pavement with shallow sand, seagrass dominant	0.00
Seagrass >50% and Macroalgae >1-25%		
Seagrass >50% and Macroalgae >25-50%		
Seagrass >1-25% and Macroalgae >1-25%	Low profile reef with sand, seagrass and macroalgae	0.00
Seagrass >1-25% and Macroalgae >25-50%		
Seagrass >25-50% and Macroalgae >25-50%		
Seagrass >1-25% and Macroalgae >50%		
Seagrass >25-50% and Macroalgae >50%		
Seagrass >50% and Macroalgae >50%		
Bare soft sediment	Pavement with sand, no epibenthic macrobiota	64.01
TOTAL		**74.42**



Scale: 1:12,000 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 8/08/2025
Project Number: 675.072500

Data Source:
Esri, Maxar, Earthstar Geographics, and the GIS User Community

SLR

BCH INDIRECTLY IMPACTED BY THE PMAXP

FIGURE 3-2

\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F045_IndirectImpacts.mxd

0 250 500 1,000 m

Scale: 1:12,000 at A4
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 8/08/2025
Project Number: 675.072500

Data Source:
Esri, Maxar, Earthstar Geographics, and the GIS User Community

SLR

ASSUMED BCH IN THE ZOHI AND ZOMI

FIGURE 3-3

\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CADGIS\GIS\640_30470_F046_AssumedBCHinZones.mxd

3.5 Cumulative loss assessment

The cumulative loss assessment details the irreversible (direct impacts identified in **Section 3.3**) and reversible impacts (indirect impacts identified in **Section 3.4**), is expressed in hectares and includes the following:

1. Estimated pre-European areas of each BCH category
2. Estimated current extent of each BCH category as a proportion of the pre-European conditions outlined in (1)
3. Estimated approved historical BCH losses (and gains) since European settlement
4. Proposed losses of each BCH category as a result of the PMaxP
5. Proportion of the proposed losses of each BCH category as a result of the PMaxP compared to pre-European conditions outlined in (1), and
6. Proportion of the cumulative (approved historical and proposed irreversible losses as a result of the PMaxP) of each BCH category compared to pre-European conditions outlined in (1).

Table 3-4 presents the cumulative impacts of the PMaxP on BCH in the LAU. The proportion of BCH loss due to direct (irreversible) impacts from the PEP (70.00 ha) and PMaxP (18.63 ha) is 1.83% of the total pre-European extent of BCH within the LAU (4,832.52 ha).

As the PMaxP is a significant amendment to the PEP, the combined cumulative impact to BCH using a historical ‘geomorphological structure based approach’ (URS 2001) as assessed in the Public Environmental Review (PER) for the PEP is provided in **Table 3-5.**

Following the historical methodology used in the PEP demonstrates that the PMaxP constitutes an increased impact of <0.1% of the original area of habitat in Champion Bay-Port Grey and Geelvink Channel which was assessed in the PEP PER. This provides further context on the cumulative impacts from the perspective of a significant amendment to a historical approved proposal, noting that the original PEP PER did not adopt the equivalent LAU boundary and is therefore not directly comparable to **Table 3-4**.

There is no information available on the BCH categories within the direct impact footprint of the PEP between 2001 and 2003. Only a total irreversible BCH loss area related to the Port and Town Beach (36.5 ha) and shipping channel (33.5 ha) was recorded. A subsequent review of the PEP impacts revealed that BCH had demonstrably recovered in reversibly impacted areas by the end of the 2006 summer (LeProvost, et al., 2007) . A study in 2021 highlights that seagrass in Champion Bay and the wider region remains in good condition and has recovered since PEP (BMT, 2021). Surveys in 2021 and 2022, following maintenance dredging of the Port in 2021, indicate that the environmental protection outcomes for BCH had been achieved (BMT, 2021; BMT, 2022). Thus, it is reasonable to infer that the ecosystem function of BCH in Champion Bay and the wider region has not been compromised by the PEP.

Table 3-4 Cumulative loss assessment of BCH as a result of PMaxP

BCH category (SLR Consulting Pty Ltd, 2024)	Legacy BCH category (O2 Marine, 2022b)	(1) Pre-European extent (ha)	(2) Current extent (ha) [% pre-European extent]	(3) Historical loss/gain (ha)[10]	(4) (5) Irreversible loss/modification from PMaxP (ha) [% pre-European extent]	(6) Cumulative loss (ha) [% of pre-European extent][10]	(4) (5) Reversible impacts from PMaxP (ha) [% pre-European extent]
Seagrass >1-25%	Pavement with sand, low density seagrass	175.42	158.62 [90.42]	-16.80	**2.00 [1.14]**	**-18.80 [10.72]**	**5.51 [3.14]**
Seagrass >25-50%	Pavement with sand, high density seagrass	559.69	328.15 [58.63]	-231.54	**0.54 [0.10]**	**-232.08 [41.46]**	**4.70 [0.78]**
Seagrass >50%							
Macroalgae >1-25%	Pavement with sand, macroalgae	244.55	209.94 [85.85]	-34.61	**3.84 [1.57]**	**-38.45 [15.72]**	**0.20 [0.01]**
Macroalgae >25-50%							
Macroalgae >50%							
Seagrass >25-50% and Macroalgae >1-25%	Pavement with shallow sand, seagrass dominant	860.40	830.33 [96.51]	-30.07	**0.65 [0.76]**	**-30.72 [3.57]**	**0.00 [0.00]**
Seagrass >50% and Macroalgae >1-25%							
Seagrass >50% and Macroalgae >25-50%							
Seagrass >1-25% and Macroalgae >1-25%	Low profile reef with sand, seagrass and macroalgae	807.22	806.99 [99.97]	-0.23	**4.47 [0.55]**	**-4.70 [0.58]**	**0.00 [0.00]**
Seagrass >1-25% and Macroalgae >25-50%							
Seagrass >25-50% and Macroalgae >25-50%							
Seagrass >1-25% and Macroalgae >50%							
Seagrass >25-50% and Macroalgae >50%							
Seagrass >50% and Macroalgae >50%							
Bare soft sediment	Pavement with sand, no epibenthic macrobiota	26.37	74.92 [284.11]	+48.55	**7.13 [27.03]**	**+41.42 [157.07][11]**	**64.01 [242.74][11]**
				TOTALS	**18.63 ha**	**-283.33 ha**	**74.42 ha**

[10] Losses are expressed as negative areas while gains are expressed as positive areas.

[11] Approved historical disturbances on bare soft sediment/pavement with sand, no epibenthic macrobiota has resulted in an increase in area in the LAU compared to pre-European estimates.

Table 3-5 Cumulative loss assessment of BCH as a result of PEP and PMaxP[12]

Activity	Habitat(s) impacted	Existing (pre-PEP) impacts	PEP impacts	PMaxP impacts	Cumulative area of impacts (pre-existing, PEP and PMaxP)	Original area of habitat in Champion Bay-Port Grey/ Geelvink Channel	Cumulative proportion of habitat impacted
Reclamation (Port area)	Shallow reef, sand and seagrass meadow	38 ha (includes the Port and Fishing Boat Harbour, recreational boat harbour and Batavia Coast Marina and the area of shoreline progradation that has occurred at Pages Beach)	21.5 ha (15.5 ha including area of the existing Port recreational boat harbour, plus 6 ha of peripheral impact)	17 ha (inclusive of new tug harbour and breakwater; the additional 1.63 ha is within the existing disturbance footprint and hence not included in this calculation)	**76.5 ha**	2,026 ha	**3.78%**
Reclamation (Town Beach)	Subtidal sand and seagrass meadow	Unknown	15 ha	0 ha	**15 ha**	762 ha	**2.0%**
Channel dredging	Limestone reef/ bay pavement, sand and seagrass meadow	80 ha	33.5 ha	0 ha	**113.5 ha**	5,879 ha	**1.9%**
Harbour dredging	Silty sand	37 ha	0 ha	0 ha	**37 ha**	762 ha	**4.9%**
Dredge spoil disposal	Deep water, limestone pavement and sand veneered limestone pavement	100 ha	180 ha	0 ha	**280 ha**	12,240 ha	**2.3%**
				TOTALS	**522 ha**	**21,669 ha**	**2.41%[13]**

[12] Table details adapted from Table 6.2b of the PER related to the PEP (URS 2001)

[13] Compared to 2.33% of total habitat as assessed in the PEP. 17 ha of additional impact attributable to PMaxP is ~0.08% of the total habitat assessed during the PEP.

3.6 Mitigation

A *Dredging Environmental Monitoring and Management Plan* (DEMMP) (SLR Consulting Pty Ltd, 2025b) has been developed to define controls to manage and minimise impacts on BCH and include a monitoring program to determine if the environmental outcomes are met. The DEMMP also details the demarcation of vessel transit areas to preserve BCH in areas outside of the approved disturbance areas, restrictions on seabed disturbing activities during inclement weather and sea conditions, dredge scheduling to allow plume dispersion, restrictions on vessel anchoring and speeds, marine pest control measures and other adaptive management to mitigate any further potential impacts to BCH.

The *Port of Geraldton Coastal Processes Management Plan* (CPMP) (MWPA, 2024) developed as part of this proposal, also includes a BCH management target of “no loss of BCH attributable to Port induced changes in sediment transport”. Incorporating this BCH management target in the CPMP aims to ensure that there are negligible resultant impacts from alterations in longshore sediment movement due to PMaxP infrastructure.

It is expected, based on the outcomes of the modelling, that the indirect impacts that extend beyond the proposal footprint will be temporary and impacts to BCH would be recoverable within a five-year period with no residual impacts to BCH outside the defined footprint.

4.0 Conclusions

The PMaxP would result in the irreversible loss/modification of approximately 18.63 ha of BCH of the following categories, as compared to the pre-European extent:

- 2.00 ha of pavement with sand, low density seagrass, constituting 1.14% of this BCH category in the LAU
- 0.54 ha of pavement with sand, high density seagrass, constituting 0.10% of this BCH category in the LAU
- 3.84 ha of pavement with sand, macroalgae, constituting 1.57% of this BCH category in the LAU
- 0.65 ha of pavement with shallow sand, seagrass dominant, constituting 0.76% of this BCH category in the LAU
- 4.47 ha of low-profile reef with sand, seagrass and macroalgae, constituting 0.55% of this BCH category in the LAU, and
- 7.13 ha of pavement with sand, no epibenthic macrobiota, constituting 27.03% of this BCH category in the LAU.

The proportion of BCH loss due to direct (irreversible) impacts from the PEP (70.00 ha) and PMaxP (18.63 ha) is 1.83% of the total pre-European extent of BCH within the LAU.

The PMaxP would also result in the reversible (recoverable) impact of approximately 74.42 ha of BCH of the following categories, as compared to the pre-European extent:

- 5.51 ha of pavement with sand, low density seagrass, constituting 3.14% of this BCH category in the LAU
- 4.70 ha of pavement with sand, high density seagrass, constituting 0.78% of this BCH category in the LAU
- 0.20 ha of pavement with sand, macroalgae, constituting 0.01% of this BCH category in the LAU, and
- 64.01 ha of pavement with sand, no epibenthic macrobiota, constituting 242.72% of this BCH category in the LAU.

The proportions of BCH expected to be irreversibly lost as a result of PMaxP are small and do not exceed 2% for any BCH category, except for pavement with sand, no epibenthic macrobiota (bare soft sediment). There has been close to 300% increase in bare soft sediment since European settlement, before PMaxP impacts are applied. Loss of this habitat as a result of the PMaxP is partly attributed to the construction of the Tug Harbour seawall. However, placing rock armour (or any marine infrastructure) below the high-water mark provides opportunities for habitat-forming species to colonise and subsequent habitat for mobile marine fauna (e.g., fish and mobile invertebrates). This newly introduced habitat complexity is likely to improve bare soft sediment habitats. The irreversible loss of macroalgae and seagrass habitats in the dredge footprints would result in the conversion of these areas to bare soft sediment. Although these gains are not calculated as part of this report, it should be acknowledged that the remaining bare soft sediment would still contribute to ecosystem function.

The PMaxP has demonstrated the application of the avoid, minimise and mitigate hierarchy in addressing impacts to BCH by avoiding areas of high-quality BCH, selecting a less-impacting dredge method and the development of the DEMMP. This would restrict irreversible impacts to the predicted areas and promote the recovery of reversibly impacted BCH. The BCH categories that were impacted under the PEP and are expected to be irreversibly lost/modified due to PMaxP are widely distributed in the LAU, with likely higher condition areas outside the predicted impact areas. Thus, the combined impacts of the PEP and PMaxP are not expected to impact BCH such that the ecosystem function, integrity and biodiversity will not be impaired.

5.0 References

AECOM, 2020. *Benthic Habitat Mapping – Champion Bay and Surrounds,* s.l.: Mid West Ports Authority.

BMT, 2021. *Seagrass Health Survey Report - Seagrass Communities in Champion Bay and Surroundings,* s.l.: Mid West Ports Authority.

BMT, 2022. *Long Term Resilience of Seagrass Communities in Champion Bay,* s.l.: Mid West Ports Authority.

Connell, S. & Gillanders, B., 2007. *Marine Ecology.* Melbourne, Victoria: Oxford University Press.

Department of Biodiversity, Conservation and Attractions, 2023. *Priority Ecological Communities for Western Australia Version 35,* s.l.: s.n.

Department of Climate Change, Energy, the Environment and Water, 2013. *Poidonia australis Complex Seagrass Meadows Draft Description,* s.l.: s.n.

Department of Environment Regulation, 2014. *A Guide to the Assessment of Applications to Clear Native Vegetation,* s.l.: s.n.

Dernie, K. M., Kaiser, M. J., Richardson, E. A. & Warwick, R. M., 2003a. Recovery of soft sediment communities and habitats following physical disturbance. *Journal of Experimental Marine Biology and Ecology,* Volume 285-286, pp. 415-434.

Dernie, K. M., Kaiser, M. J. & Warwick, R. M., 2003b. Recovery rates of benthic communities following physical disturbance. *Journal of Animal Ecology,* Volume 72, pp. 1043-1056.

Diaz-Pulido, G., 2008. Macroalgae. In: P. Hutchings, M. Kingsford & O. Hoegh-Guldberg, eds. *The Great Barrier Reef: Biology, Environment and Management.* s.l.:s.n., pp. 145-154.

Duarte, C. M. et al., 2010. Seagrass community metabolism: Assessing the carbon sink capacity of seagrass meadows. *Global Biogeochemical Cycles,* Volume 24.

EPA, 2016a. *Environmental Factor Guideline: Benthic Communities and Habitats,* s.l.: s.n.

EPA, 2016b. *Technical Guidance: Protection of Benthic Communities and Habitats,* s.l.: s.n.

EPA, 2021. *Technical Guidance: Environmental Impact Assessment of Marine Dredging Proposals,* s.l.: s.n.

Eyre, B. & Ferguson, A., 2005. Benthic metabolism and nitrogen cycling in a subtropical east Australian estuary (Brunwick): temporal variability and controlling factors. *Limnology and Oceanography,* Volume 50, pp. 81-96.

Gadd, G. & Griffiths, A., 1977. Microorganisms and heavy metal toxicity. *Microbial Ecology,* Volume 4, pp. 303-317.

Government of Western Australia, 2023. *Seagrasses in Western Australia.* [Online]
Available at: https://www.wa.gov.au/service/natural-resources/water-resources/seagrasses-western-australia
[Accessed July 2024].

LeProvost, I., Collins, P., Mulligan, M. & Hubbert, G., 2007. *Geraldton Port Dredging Project 2002-3: The Issues, the Events and the Final Outcome,* s.l.: s.n.

MWPA, 2024. *Port of Geraldton Coastal Processes Management Plan,* s.l.: s.n.

O2 Marine, 2022a. *Benthic Communities and Habitat Cumulative Loss Assessment: MPWA Tourist Jetty,* s.l.: Mid West Ports Authority.

O2 Marine, 2022b. *Benthic Communities and Habitat Assessment: MWPA Tourist Jetty,* s.l.: Mid West Ports Authority.

RoyalHaskoningDHV, 2023. *PMaxP capital dredge methodology review, internal memo,* s.l.: Mid West Ports Authority.

RoyalHaskoningDHV, 2025. *Dredge Plume Modelling Assessment: Geraldton Port Maximisation Project,* s.l.: s.n.

SLR Consulting Australia Pty Ltd, 2025a. *Environmental Impact Assessment: Geraldton Port Maximisation Project,* s.l.: Mid West Ports Authority.

SLR Consulting Pty Ltd, 2024. *Port Maximisation Project (PMaxP): Benthic Habitat Report,* s.l.: Mid West Ports Authority.

SLR Consulting Pty Ltd, 2025b. *Benthic Communities and Habitats Monitoring and Management Plan: Geraldton Port Maximisation Project,* s.l.: s.n.

Stul, T., Gozzard, B., Eliot, I. & Eliot, M., 2014. *Coastal Sediment Cells for the Mid-West Region between the Moore River and Glenfield Beach, Western Australia,* s.l.: WA Department of Transport.

URS, 2001. *Marine Habitats of Champion Bay, Port Grey and Geelvink Channel,* s.l.: Geraldton Port Authority.

Making Sustainability Happen