Benthic Communities and Habitat Cumulative Loss Assessment

MWPA Tourist Jetty

CLIENT: Mid West Ports Authority

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Executive Summary

Midwest Port Authority (MWPA) is currently responsible for the development and management of a new Tourist Jetty proposed to be constructed to the East of the current Esplanade (Eastern Breakwater). The proposed jetty is to be used by the commercial vessel fleet running operations around the local area and to the Abrolhos Islands. The new facility will be located within the foreshore tourism precinct providing a purpose built jetty separate from the marine industries housed within the Fishing Boat Harbour.

As part of this project a benthic habitat investigation was implemented to assess the area around the current proposed tourist jetty footprint. A Local Assessment Unit (LAU) was identified between Point Moore to Glenfield Beach representing a spatial area of 4832.21 ha. A total seabed disturbance footprint of 2.39 ha has been identified associated with the planned approach channel and jetty structures which includes a 5 m buffer zone around the disturbance footprint. Data acquired for the investigation includes using a combination of side scan sonar to map the habitats and drop camera / visual verification to ground truth the mapped habitats.

Overlapping side scan sonar data was collected over the broader project area of approximately 17.8 ha and this data was analysed and mapped indicating that there was six categorised benthic community and habitat classes in the surveyed area. Mapped classes and their spatial extent within the surveyed area include;

- Bare Sand (1.77 ha);
- High Density Seagrass (0.30 ha);
- Moderate Density Seagrass (0.24 ha); and
- Low Density Seagrass (0.08 ha).

The dominant macrophytic community comprised the seagrass, *Posidonia australis* and there was a lack of any other significant macroalgae present. Epibenthos and other fauna species was also lacking in the survey area more than likely due to the coarse sediments and strong influence of oceanographic conditions within the area. Bare sediment dominated the substrate which prevents the establishment of attaching sessile organisms. Over the entire LAU seagrasses represent a spatial area of 1,294.14 ha.

This Project will result in Vegetation Clearing of 0.62 ha of seagrasses within a total Clearing Area of 2.39 ha.

This the irreversible loss is classified as follows:

- 0.08 ha of low-density seagrass or 0.002 % of LAU;
- 0.24 ha of medium-density seagrass or 0.005 % of LAU; and
- 0.30 ha of high-density seagrass or 0.006 % of LAU.

No indirect irreversible losses are predicted for the Project due to the methods proposed of bed levelling rather than large scale dredging.

These small areas comprise of *Posidonia australis*. URS (2001) identified no habitats or species that are confined in their distribution within Champion Bay, and O2 Marine (2022) and BMT (2022) have identified widespread distribution of *P. australis* across Champion Bay and along the Mid West region. This species of seagrass is noted to be a slow coloniser however is known to be quite resilient to disturbance (Bennett et al. 2021).

Table E 1 presents a summary of the assessment against the requirements for a Flora Clearing Permit. Based on the assessment and the data presented herein, the proponent considers the principles underpinning assessment of vegetation clearing applications have been met.

Table E 1. Summary of assessment against key Native Vegetation Clearing Principles

Item	Description	Response	Principles Met (Y/N)	Section
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	Based on the findings of this investigation the native vegetation within the project area does not contain a high level of biological diversity. The flora recognised for clearing is well represented within the region, and the Local Assessment Unit (LAU)	Y	1.6 Policy and Guidance 3. Benthic Communities and Habitat Mapping 3.3 Seagrass Condition – Regional 3.5 Seagrass Condition – Project Area
(b)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Based on the findings of this investigation the native vegetation recognised for clearing is well represented within the region, and the LAU, and if cleared will not reduce the ecosystem integrity of the region or LAU or compromise a significant indigenous fauna habitat.	Y	1.5.1 Environmental Assets 3. Benthic Communities and Habitat Mapping 3.1 Broadscale Mapping – Champion Bay 4. Local and Regional Values 4.4 Fauna
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	The flora recognised for clearing is well represented within the region and the LAU. There is no rare flora identified within the proposed clearing area	Y	1.7 Consultation 3. Benthic Communities and Habitat Mapping

Item	Description	Response	Principles Met (Y/N)	Section
(d)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community	The flora and assemblages are not considered a threatened ecological community	Y	3.2 Fine Scale Habitat Mapping 3.4 Known Threats 4.1 Conservation Values 4.2 Regional Significance 4.3 Functional Ecological Values 4.4 Fauna
(e)	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared	The flora and assemblages are not considered to represent a remnant of natural vegetation. The flora recognised for clearing is well represented within the region with approximately 90 to 95% of high-density seagrass communities maintained within the LAU.	Y	3.3 Seagrass Condition – Regional 3.5 Seagrass Condition – Project Area 4.4 Pre-European Extent 6. Cumulative loss
(f)	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland	Not Applicable to this assessment	Y	-
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation	Not Applicable to this assessment	Y	-

Item	Description	Response	Principles Met (Y/N)	Section
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area	Based on the findings of this investigation the native vegetation recognised for clearing is well represented within the region, and the LAU. If the vegetation is cleared there will be no reduction of the ecosystem integrity of the region or LAU. Removal of native vegetation from the proposed area will not reduce the environmental values of any nearby conservation area	Y	2. Local Assessment Unit (LUA) 3. Benthic Communities and Habitat Mapping 4. Local and Regional Values
(i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water	Not Applicable to this assessment	Y	-
(j)	Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding	Not Applicable to this assessment	Y	-

Acronyms, Abbreviations and Definitions

Acronyms & Abbreviations	Definitions
AHIS	Aboriginal Heritage Inquiry System
BCH	Benthic Community Habitat
BCM	Batavia coast Marina
CATAMI	Collaborative and Automated Tools for Analysis of Marine Imagery
CGG	City of Greater Geraldton
DER	Department of Environment and Regulation
DoT	Department of Transport
EBW	Geraldton and Eastern Breakwater
EPA	Environmental Protection Authority
GDA	Geographic Datum of Australia
GPS	Global Positioning System
LAU	Local Assessment Unit
MWDC	Midwest Development Corporation
MWPA	Midwest Port Authority
ROV	Remote Operated Vehicle

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1. Introduction

1.1. Project Background

Geraldton and the Eastern Breakwater (EBW) Project site are located approximately 430 km north of the Western Australian capital city of Perth on the Mid West coastline. Locally the EBW is situated on the eastern side of the Geraldton Port commercial harbour in the southern end of Champion Bay (Figure 1). The Midwest Ports Authority (MWPA) are responsible for the ongoing management and environmental performance of the Port and Port Waters. The Port of Geraldton consists of the area of water, land and seabed depicted within the following documents and publications;

- Port Authorities (Description of Port of Geraldton) Order 2017
- Landgate Deposit Plan – (*https://www.midwestports.com.au/Profiles/midwestports/Assets/ClientData/Documents/General/410027.pdf*)
- Gazette pg. 1169 – *(https://www.legislation.wa.gov.au/legislation/prod/gazettestore.nsf/FileURL/gg2017_034.pdf/$FILE/Gg2017_034.pdf?OpenElement)*.

MWPA have been instructed by the Minister for Transport to design and construct a new maritime facility to facilitate commercial vessels servicing the tourism industry. The tourism jetty will facilitate embarkation and disembarkation of tourists which is currently only possible in the Fishing Boat Harbour via facilities designed to support maritime and fishing industries. The new facility is intended to provide a tourist friendly purpose built jetty.

MWPA, in consultation with the City of Greater Geraldton, Department of Transport, and the Midwest Development Commission were appointed the lead agency, responsible for the final design, construction and ongoing operational management, navigational access requirements and environmental performance of the Tourism Jetty, access channel and surrounding waters

1.2. Key Project Characteristics

The Tourist Jetty will facilitate embarkation and disembarkation of tourists from the EBW via the gangway and jetty infrastructure onto vessels greater than 25 m in length. Vessels up to 2.8 m draft will be able to access the jetty under all tidal conditions, however larger vessels greater than 2.8 m draft will be restricted to specific tidal heights based on the navigational channel depth. Currently, only one vessel at a time will be able to utilise the facility.

Current vessel use of this area is typically small trailer vessels transiting to/from the nearby vessel ramp, recreational water sport vessels accessing the water-ski area and recreational pleasure vessels which utilise the calm embayment to anchor up whilst on a layover and to access supplies form the nearby city centre.

MWPA will be responsible for maintaining navigation, including the access channel, swing basin, vessel speeds, establishing tidal restrictions and maintenance of navigation markers. Vessel operators accessing this facility will be required to always comply with MWPA navigational requirements when accessing the facility.

To facilitate safe navigable waters for access to the Tourist Jetty, seabed levelling within an area of 2.39 ha, associated with the inner channel, will be required to reduce high spots which have been identified through bathymetric survey.

A summary of the Project is provided in Table 1 and presented in Figure 1.

Table 1: Summary of the Project

Project Title	Geraldton Eastern Breakwater Tourism Jetty Project
Proponent Name	Midwest Ports Authority
Short Description	Design, construct and maintain a Tourism Jetty and associated navigation requirements located adjacent to the EBW. The Tourism Jetty is proposed to be located on the eastern edge providing pedestrian access to vessels from the existing EBW facility. Design of the jetty will include a north-south aligned jetty situated on pile, with a permanent gangway for access to the vessel. Moring piles will be extended north and south of the hard structure for securely mooring vessels alongside. The access channel and swing basing is typically deep enough, though removal of some high spots and ongoing maintenance via seabed levelling will be required within the inner portion of the channel.

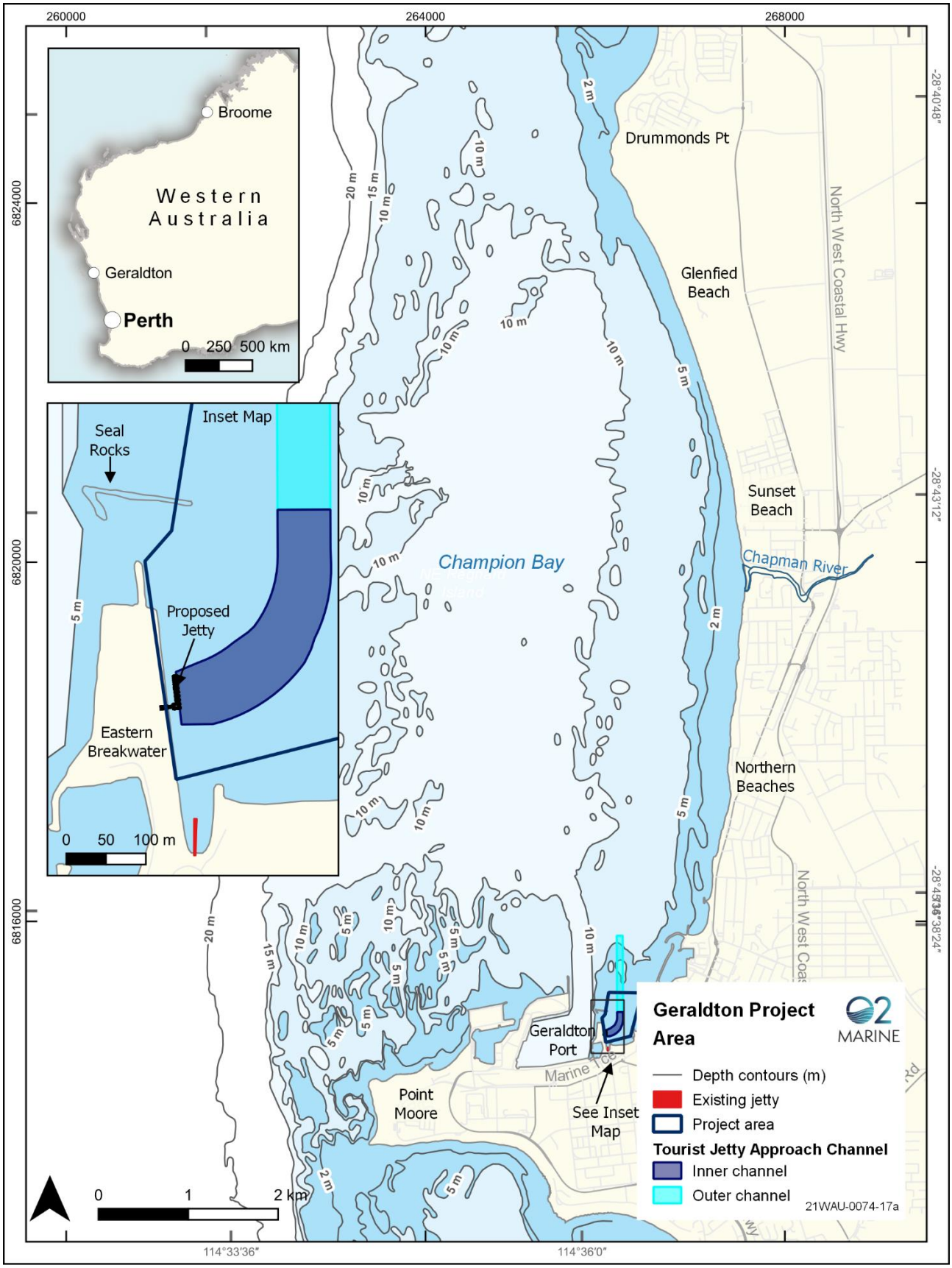


Figure 1: Location of Proposed Tourist Jetty, including infrastructure and approach channel

1.3. Project Justification

The requirement for a Tourism Jetty was first identified in the Mid West Tourism Strategy prepared in July 2014 by the City of Greater Geraldton (CGG) and the Mid-West Development Commission (MWDC) (MWDC 2014). Tourism in the Mid West has been identified as a key opportunity to enable continued sustainable economic growth in the region. The strategy recognised key opportunities for the region with the first being 'The Abrolhos Islands maritime history and nature-based experiences' currently being serviced by charter flights and supported by a limited number of vessels.

Current infrastructure on the Abrolhos islands is minimal and there are no overnight accommodations available. The strategy identified a growing demand for vessel-based tourism departing from Geraldton. The CGG and MWDC recognised an opportunity to construct infrastructure to help stimulate further tourism spend in Geraldton and the region and sought funding to develop a concept design.

In August 2020 the McGowan Government announced funding as part of the Government's $5.5 billion WA COVID Recovery Plan. This investment commitment allowed the project to go into the detail design and construction phase. Funding aims were outlined as follows:

- $3 million allocated towards construction of two new jetties to boost tourism along the Batavia Coast
- A jetty for vessels up to 25 metres will be built at the Batavia Coast Marina and a second, to accommodate larger vessels, will be located at Geraldton Port's eastern breakwater.
- Targeted infrastructure to increase visits to the pristine Houtman Abrolhos Islands
- The new jetties, expected to generate an additional $1.9 million in annual visitor expenditure by 2031, and support other local marine-based tourism opportunities including fishing and diving charters, glass bottom boat tours, whale watching, aquaculture farm and maritime history tours.

The Business Case supporting this funding application stated the delivery and management of the facilities would be undertaken by DoT, MWPA and CGG, as follows:

- DoT would be responsible for delivery of the BCM jetty and other marine components.
- MWPA would be responsible for delivery of the EBW jetty and other marine components.
- CGG will deliver landside components (seating, signage etc) for both the BCM and EBW.

The asset ownership and ongoing maintenance was allocated as follows:

- The BCM jetty will be owned by the DoT with management and maintenance also falling to the Department.
- The EBW jetty will be owned and managed by the MWPA.

CGG will own and maintain the landside associated infrastructure such as toilets, paving, landscaping, signage and seating.

1.4. Channel Optimisation and Maintenance

Seabed levelling is a hydrodynamic dredging technique that mobilises material underwater and then uses the seabed slopes and natural water currents to move the material to another location. It has been used very successfully to level high spots within the Fishing Boat Harbour entrance by relocating accreted deposits into

nearby deeper areas (i.e., approximately 100-200 m to the north-east). A plough or sweep bar is mounted on a large steel A-frame then suspended below a seagoing tug or barge that can raise or lower the plough to the required depth (Figure 2). Ploughing and bed levelling is carried out with a high degree of accuracy using on-board GPS enabled system. The operations are supported by a hydrographic survey vessel to ensure required depths are achieved, new high points are not created and the operations remaining within the designated footprint to minimise environmental impacts.

Once initial seabed levelling has been conducted and high points reduced to safe navigable limits, it is anticipated that ongoing maintenance seabed leveling operations will be required to maintain the swing basin and navigation channel to a minimum depth of 3 m LAT within the inner channel (Figure 1). Channel maintenance will be undertaken using the same method within the original footprint of the channel and swing basin. It is not anticipated that any additional seabed levelling activities would be required (i.e., to further deepen or widen the existing channel).

As there has previously been no dredging or other seabed levelling activities in this area, MWPA are uncertain how regular seabed levelling activities would be, although it is not anticipated to be more frequent than every five years.

Figure 2: Quest Marine during June 2020 FBH works (Photo MWPA).

1.5. Local and Regional Context

The proposed Project footprint is situated near to the town of Geraldton, in Champion Bay between Point Moore in the south and Drummonds Point in the north, in the Mid-West Region of Western Australia (Figure 3). The Project and all activities will occur entirely within the designated Port Waters of Geraldton Port.

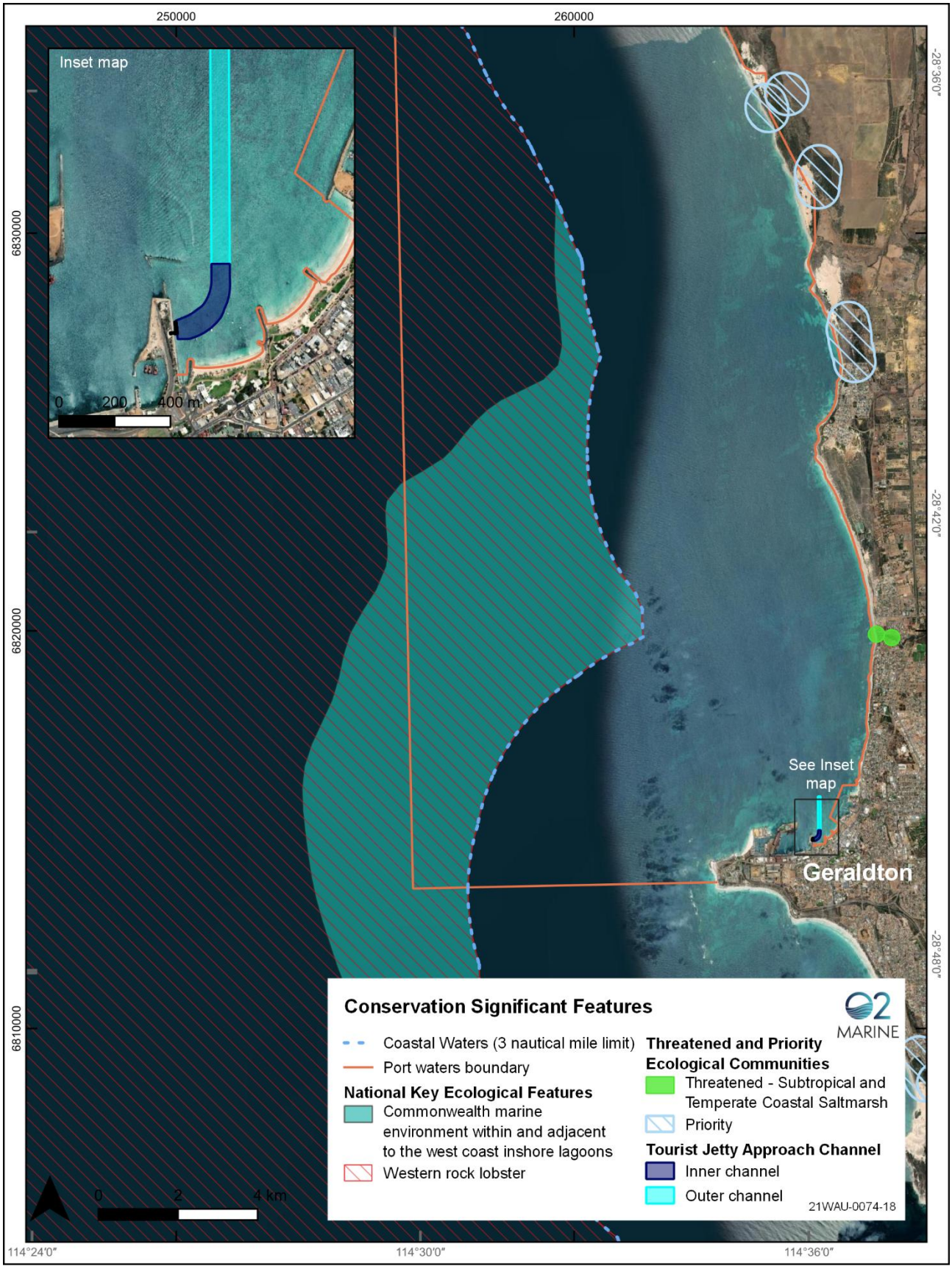


Figure 3: Proposed Tourism Jetty Project – Local and Regional Context

1.5.1. Environmental Assets

Other than protected or conservation significant species which may occur in the Project Area, the following key features of conservation significance have previously been identified within or adjacent to the Project area:

Commonwealth Features of Conservation Significance

- Abrolhos Commonwealth Marine Park (CMP) – Special Use Zone - The nearest CMP to the Project area is the Abrolhos CMR, which is located approximately 27 km south-west of the Project area. Given the distance from the Project area there are no risks to this CMR from the Project; and
- Threatened Ecological Community: Subtropical and Temperate Coastal Saltmarsh – Subtropical and temperate coastal saltmarsh Threatened Ecological Community (TEC) is known to occur adjacent to the Project area with an established community occurring within the Chapman River. The community occurs within the rivermouth area, typically an enclosed river system which intermittently flushes post heavy localised rainfall. There is no risk from this Project on the TEC.

State Features of Conservation Significance

- Abrolhos Islands National Park and Fish Habitat Protection Areas - The seabed levelling area lies entirely within MWPA Port Limits. Around 60km offshore from the Port of Geraldton is the Abrolhos Islands National Park and Fish Habitat Protection Areas, jointly managed between the Departments of Biodiversity, Conservation and Attractions and Primary Industry and Regional Development. There is no risk from this Project on these conservation areas.
- Aboriginal Heritage - Two registered Aboriginal Heritage Sites are recorded in the Aboriginal Heritage Inquiry System (AHIS) as being in the vicinity of the Project area. These include site ID 5561 Chapman River Mouth and 5874 Bluff Point Midden. There is no risk from this Project on Aboriginal Heritage.
- *Posidonia australis* complex seagrass meadows – The Department of Biodiversity, Conservation and Attractions Species and Communities Program listed *Posidonia australis* meadows as possible threatened ecological communities and assigned a Priority 3(i) for further survey, definition, and evaluation. The community consists of the assemblage of plants, animals and micro-organisms associated with seagrass meadows dominated by species from the *Posidonia australis* complex. It occurs as continuous to patchy monospecific and multispecies seagrass meadows dominated by species from the *Posidonia australis* complex - *P. angustifolia, P. australis and P. sinuosa*. The community is distributed in temperate Australian waters between Shark Bay (25°S) on the west coast, across southern Australia to Wallis Lake (32°S) on the east coast, around Bass Strait islands and along the north coast of Tasmania (DCBA, 2022).

1.6. Policy and Guidance

The following policies and guidance have been considered in this assessment:

- DBCA (2022). Priority Ecological Communities for Western Australia Version 33. 1 June 2022
- DER (2014). A guide to the assessment of applicants to clear native vegetation, DER, Western Australia;
- EPA (2016a). Environmental Factor Guideline: Benthic Communities and Habitats, EPA, Western Australia;
- EPA (2016b). Technical Guidance – Protection of Benthic Communities and Habitats, EPA, Western Australia; and

- EPA (2016c). Technical Guidance – Environmental Impact Assessment of Marine Dredging Projects, EPA, Western Australia.
- DEE (2018) Guide – 'Posidonia australis: Seagrass Meadows of Manning-Hawkesbury Ecoregion: A Nationally Significant Community, Commonwealth of Australia 2018'

1.7. Consultation

A summary of stakeholder consultation, including key stakeholders, regarding Project planning and consulting milestones, outcomes and responses is presented in Table 2.

Table 2: Stakeholder Consultation

Stakeholder	Date	Method	Purpose	Outcome	Response
City of Greater Geraldton	02/11/2021	CGG Concept Forum Presentation by MWPA CEO	Inform CGG of: Design concept, Three possible locations along the Esplanade, and Proposed supporting facilities (e.g. toilets)	CGG nominated preferred location (Site 3) CGG questioned the need for additional toilets	Design incorporates CGG preferred location. Proposed new amenities were removed from scope.
Department of Transport	27/05/2022	Concept Forum Presentation to DoT Marine Safety	DoT to confirm acceptance of navigation channel – Safety review and operational overview	Amend / review / consult with stake holders in regards to adjoining land / waterway uses ski area and yacht club restrictions around channel use.	Inform local stakeholder and user groups of amendments impacted by navigation channel to service jetty. Additional public notices and warning signs instigated at DoT controlled boat ramps
Vessel Operators	02/11/2022	Forum, engagement from MWPA Trade Office	Concept layout, operability, functional form, vessel channel depth	Agreement on concept as fit for purpose	Incorporate design requests to the extent possible to provide a multi user commercial facility
Geraldton Yacht Club & Ultimate Water sports	01/08/2022	Emailed letter	Advised of project and advise will keep informed.	Nil.	Ultimate Water sports – positive. GYC – Nil.
Department of Transport	16/08/2022	Emailed letter	Request to Modify Operation of the Existing Town Beach Navigation Area		DoT advised they will review and come back to MWPA.
City of Greater Geraldton	3/10/2022	Briefing Paper	Project update and sharing final design.	CGG queried the need for the	MWPA advised the design incorporated security and

Stakeholder	Date	Method	Purpose	Outcome	Response
		CGG Concept Forum Presentation by MWPA CEO		facility to be secured for private use	safety aspects required for tourism industry.
Department of Transport	3/10/2022	Briefing Paper	Project update. Sharing of final design. Notification of proposed seabed leveling and native vegetation clearing requirements.	DoT advised the designated water ski area boundary would remain the same until the facility was nearing completion	MWPA to provide updates on construction progress.
Department of Biodiversity, Conservation and Attractions	3/10/2022			Nil	
Department of Primary Industries and Resources - Fisheries	3/10/2022			Nil	
Public	Nov 2022	Website and social media	Inform community of current port development projects.	Public access to the Environmental Impact Assessment, and this Cumulative Loss Assessment and Clearing Permit once granted	

2. Local Assessment Unit

Section 4.2 of EPA (2016b) outlines the requirement to clearly define spatially based LAUs within which BCH can be quantified, assessed, and presented. LAUs are required to be location specific, assessed on a case-by-case basis and consider local aspects of bathymetry, substrate type, exposure, currents, biological attributes such as habitat types. EPA (2016b) suggests that LAUs should typically be established in units approximately 5000 ha. Applying this guidance for the Project scale the DoT defined secondary sediment cell for Point Moore to Glenfield (Stul et. al. 2014) is considered to represent a suitable boundary for the LAU related to this Project. Sediment cells define natural units with each cell encompassing adjoining marine and terrestrial environments, thereby providing a base for integrated coastal management in which the component of each cell is considered holistically as an interactive system.

Relevant aspects for application of the Point Moore to Glenfield Beach secondary sediment cell as an LAU considered are as follows:

- The spatial are of the LAU is 4832.21 ha;
- The spatial boundary extends for a similar distribution as the modelling domain and the habitat assessment work completed for this Project;
- The sediment cell is defined by the offshore 15 m bathymetric depth which incorporates the high relief reef system extending north to south between Point Moore and Drummonds Point marking the western extent of Champion Bay;
- The sediment cell classification considered reef systems, substrate types, water circulation, wave exposure and currents occurring when defining the boundary;
- The boundary extends from Point Moore in the south to Drummonds Point in the north, defined at the western extent by the 15 m bathymetric contour and incorporates all the shoreline, including Chapman Rivermouth.

The LAU is presented in Figure 4.

Figure 4: Spatial Local Assessment Unit boundary for the Tourist Jetty project

3. Benthic Communities and Habitat Mapping

Champion Bay and the project area have been extensively mapped over the years as required for impact assessment and environmental surveillance monitoring for Port expansion projects. Of particular relevance to this report are:

- AECOM (2020) - Benthic Habitat Mapping Report – Champion Bay and Surrounds.
- BMT (2021) - Seagrass Communities in Champion Bay and Surroundings.
- BMT (2022) - Long term resilience of seagrass communities in Champion Bay; Post Dredge Seagrass Health Assessment Survey 2022.
- O2 Marine (2022) – Benthic Communities and Habitat Assessment; MWPA Tourist Jetty Project.

3.1. Broad Scale Mapping – Champion Bay

Habitat mapping undertaken by AECOM (2020) identified that the benthic habitats of Champion Bay and the surrounding area can be broken down into a range of habitats, with the key feature of the Bay comprising limestone substrate which underlies most of the bay and surrounds. Limestone reef presence, relief or reef profile, and the depth of sand overlaying reef, are key factors which influence the epibenthic communities in the bay and surrounding areas. Exposure from prevailing south westerly swell and seas is also a key factor as they play a pivotal role in the movement and dispersal of sand within the bay. Deposition, erosion or frequent resuspension of sand due to wave and tidal water movement greatly influences what type of epibenthic communities area able to colonise certain areas in the bay. Key distinctions can be seen in habitats with similar depths, topography, and substrate slope but with varying levels of protection from swell and waves. AECOM (2020) described the following natural habitat types, and associated communities:

1. Deep water sand, No epibenthic macrobiota;
2. Deep water pavement with sand, Macroalgae dominant;
3. Deep water reef slope, Macroalgae;
4. High profile deep reef 1-4 m, Macroalgae dominant;
5. Sloping pavement with sand, Low density macroalgae and seagrass;
6. Pavement with sand, No macrobiota;
7. Pavement with sand, Low density seagrass;
8. Pavement with sand, High density seagrass;
9. Pavement with shallow sand, Seagrass dominant;
10. Pavement with sand, Macroalgae
11. Low profile reef with sand, Macroalgae and seagrass codominant;
12. Low profile reef with deep sand, Low density seagrass and macroalgae;
13. Low profile reef with sand, seagrass and macroalgae; and
14. High profile shallow reef 1-4 m, Macroalgae dominant.

A summary of the habitat mapping is described below. Please refer to AECOM (2020) for further details.

3.1.1. Deep Water Communities and Habitat (1-4)

The deep-water habitats typically occur west of a series of north south orientated limestone reef systems which run from Point Moore to the north of Champion Bay and continue on past Drummonds Point. These habitats occur where the low-profile reef with sand become the high-profile reef line which forms the western edge of Champion Bay and the deep-water offshore habitats of Geelvink Channel. The habitat is highly variable as it transitions from high profile macroalgae dominated reef in relatively shallow waters (8–12 m) to the deeper (>20 m) sand and sand covered pavement offshore habitats. The area is characterised by very high profile (> 4 m) reef walls and overhangs which give way to sloping pavement into deeper water. Epibenthic biota were also highly variable.

Benthic communities associated with low and high relief reef are macroalgal with common species such as red and brown algae (*Sargassum* and *Ecklonia*) with a conspicuous understory of *Amphibolis* and *Thalassodendron* seagrass. Interspersed amongst these floral assemblages are substantial patches of completely bare, heavily rippled deep sand. The deep-water reef slope benthic communities are highly variable with small red and brown algae, brown lobed algae, crustose coralline algae, and sporadic sponges and solitary hard corals including *Turbinaria*, *Faviids* and small *Acropora* species. Deep water pavement and sand habitats typically comprised no benthic communities or were dominated by *Sargassum* and *Ecklonia* some patches of low cover *Amphibolis* and *Thalassodendron*.

3.1.2. Limestone Pavement and Sand Communities and Habitats (5-10)

Limestone pavement, with overlying sand of varying depth which receives regular resuspension from swell waves and currents, comprise most of the habitat type in the eastern side of Champion Bay. It's characterised by gradually sloping sand veneered pavement and supports a mosaic of mixed assemblages of macroalgae and seagrass interspersed with equal areas of bare sand. The south-eastern corner of Champion Bay and directly north of the fishing boat harbour entrance is characterised by areas of stable sand generally overlaying pavement. The area receives some protection from swell waves and consequently supports large high-density seagrass meadows, typically dominated by *Halophila, Syringodium* and *Posidonia* with up to 90% coverage mapped.

The seabed in the central part of Champion Bay is the deepest continuous area in the bay forming a natural basin between the eastern nearshore area and the high-profile western reefs. The topography is relatively flat with no sloping in either direction. The area is predominantly sand covered substrate with seagrass meadows of mostly moderate to dense (up to 70% cover) *Amphibolis* with *Halophila* and *Syringodium*. Low densities of small red and brown algae, *Ecklonia* and *Sargassum* also occur.

Several areas in shallow water fringing the fishing boat harbour, and north of the Northern Reclamation DMPA, consisted of deeper sand on pavement which supported little to no benthic communities. The area is often characterised by loose seagrass and macroalgal wrack. Two areas further seaward also featured sand across large areas with very little benthic communities.

Low density seagrass meadows on sand veneered pavement account for a large area directly north of the fishing boat harbour up to the start of the entrance channel. The 10 m isobath appeared to be the depth limit for seagrass dominance in this habitat. West of the fishing boat harbour a band of low-density meadows

stretching from the 4 m isobath seaward to the start of the low-profile reef areas gradually curving south towards Point Moore. Substrate in the area was characterised by moderately deeper sand veneers on pavement with seagrass density ranging from 5% to 50% and dominated by *Halophila*. Smaller patches of low cover *Posidonia* and *Syringodium* were also observed.

3.1.3. Shallow Reef Communities and Habitats

Running along the south-eastern shoreline of the Bay from Sunset Beach southwards to just north of the marina, and extending out ~400 m from shore, is an area of dissected limestone shoreline platform with high relief at the offshore end. The habitat contains numerous holes and depressions and supports predominantly large *Ecklonia* and *Sargassum*, with occasional patches of high density *Amphibolis* and *Thalassodendron* seagrass.

North of the entrance channel, low profile reef with sand encompasses the transition between the central basin and the high-profile western reefs. Topographically, the area is predominantly moderate profile (0-1 m) with a gradual rise of approximately 2-4 m from the border of the central basin to the base of the high-profile western reefs. Macroalgae dominate the higher relief areas, while seagrass dominate the lower relief areas which also feature sand. Both biota groups were recorded at up to 50% cover with *Amphibolis* dominating the seagrass taxa and *Sargassum* with *Ecklonia* dominating the macroalgae.

The south-eastern corner of the Bay is characterised by a shallow nearshore area of low-profile reef consisting of rocks, cobbles and low-profile limestone outcrops, surrounded by areas of mostly bare sand. As the seabed becomes shallower towards the shoreline, progressively less limestone is exposed, and deep sand becomes more prominent. Reef areas support low density small algae, with areas of sand supporting low density *Posidonia* and *Halophila* seagrasses. The area also comprised areas of dense seagrass wrack on bare sand.

South of the entrance channel areas of undulating substrate comprising a mix of low-profile limestone rises interpreted with sandy patches and higher relief reef occur. Low-profile limestone predominantly comprises macroalgae, whilst sand inundated pockets support seagrass such as *Halophila* and *Posidonia*. Sections of higher relief support dense communities of small red and brown algae, *Ecklonia* and *Sargassum.* Notably, *Posidonia* is distinct to the southern areas as the northern low profile reef areas are dominated by *Amphibolis*.

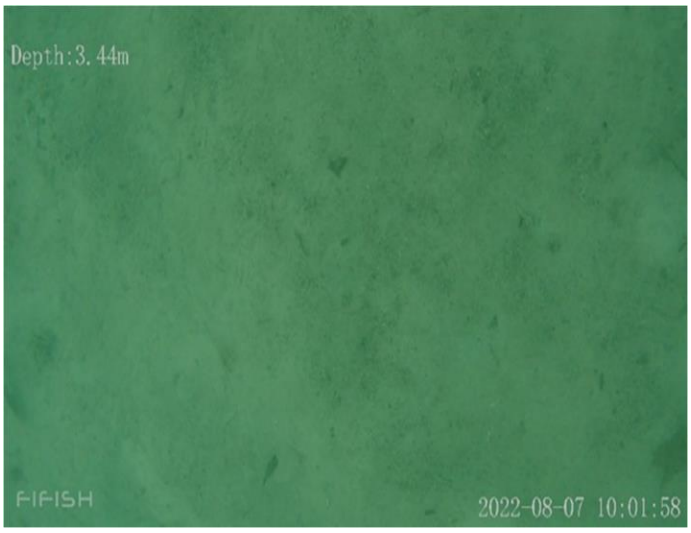
3.2. Fine Scale Habitat Mapping – Project Area

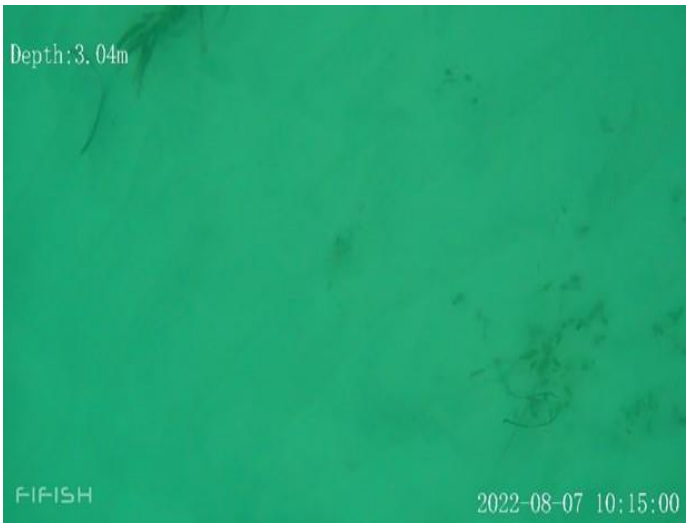
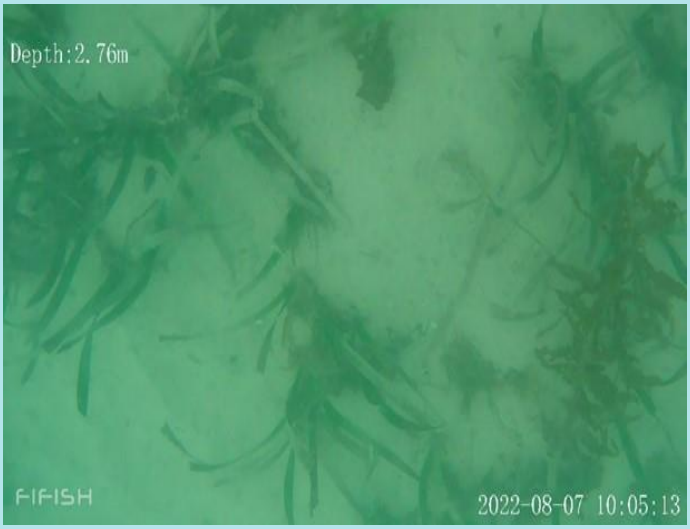
Detailed mapping was conducted within the project area to identify key BCH types and spatial area within the proposed channel access footprint (O2 Marine 2022). A description of each BCH type and example image is presented in Table 3 and the BCH map displayed in Figure 5. The Project area is approximately 17.8 ha and comprises the following BCH types:

- Bare Sand (14.07 ha)
- High Density Seagrass (2.21 ha)
- Moderate Density Seagrass (0.81 ha)
- Low Density Seagrass (0.09 ha)
- Sparse Density Seagrass (0.18 ha)
- Rockwall (0.41 ha)

The dominant macrophytic community comprised the seagrass, *Posidonia australis*, which was present in moderate to high density meadows, generally in the south and adjacent to Seal Rocks in the central west of the project area. *Halophila ovalis* was observed in small moderate density meadows. No significant macroalgae assemblages were present. Epibenthos and other fauna species was also lacking in the project area more than likely due to the coarse sediments and strong influence of oceanographic conditions within the area. Bare sediment dominated the substrate which prevents the establishment of attaching sessile organisms (O2M, 2022).

Table 3: Benthic communities identified using underwater imagery, including example images

Benthic Community	Description	Example Image
Flat bare sand (Site DC1)	Compacted sediment comprising fine sands. No shell debris or algae/seagrass wrack present.	
Bare sand with ripples (Site DC9)	Relatively well compacted sediments comprising fine sands. No shell fragments. Sand ripples present.	

Benthic Community	Description	Example Image
Flat sand with sparse seagrass (Site DC6)	Relatively well compacted sediments comprising fine sands with ripples present. Presence of *Halophila ovalis* and *Posidonia australis*	
Flat sand with low seagrass (Site DC6)	Relatively well compacted sediments comprising fine sands with ripples present. Presence of *Posidonia australis*	
Flat sand with moderate seagrass (Site DC12)	Relatively well compacted sediments comprising fine sands with ripples present. Presence of *Halophila ovalis.*	

Benthic Community	Description	Example Image
Flat sand with high seagrass (Site DC3)	Relatively well compacted sediments comprising fine sands with ripples present. Presence of *Posidonia australis*	

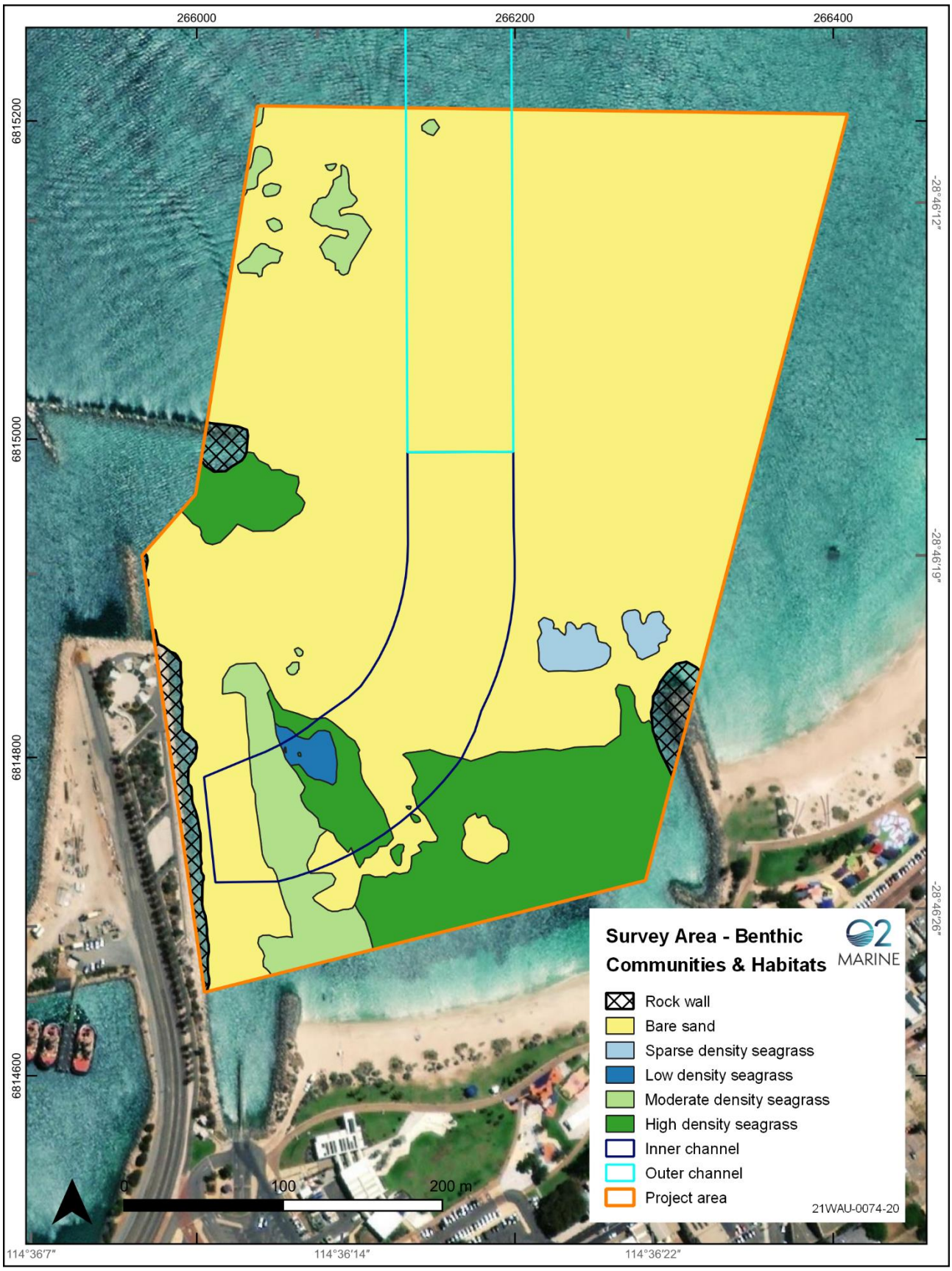


Figure 5: Mapped benthic communities and habitat within the Project area (O2M 2022).

3.3. Seagrass Condition - Regional

To determine seagrass health and condition, BMT (2021) and BMT (2022) conducted health investigations at key locations previously incorporated into Geraldton Port dredging programs (2002/2003 and 2012). BMT (2021 and 2022) collected data on six key seagrass health indicators across 14 sites within Champion Bay, along with sites at Greenough, Dongara and Jurien Bay to provide regional context. As many of these sites have historical data a comparison with previous data to provide statistical assessment on the current health was conducted.

BMT (2021) observed seagrass indicators, such as shoot density, shoot height, leaves per shoot/cluster and aboveground biomass measured at *A. antarctica* and *P. sinuosa* sites showed a relative increase compared to the historical dataset. BMT (2022) observed the reverse with most sites exhibiting a decrease in shoot density and shoot height when compared with 2021. There was no strong evidence to suggest a decline in productivity at any sites, measured as reduced shoot length or canopy heights.

Both BMT surveys identified fluctuations within assemblage composition and health over the years. BMT (2021 and 2022) surmised that the dynamic nature of Champion Bay (strong waves and currents) is continuously responsible for redistributing sand within the Bay, which is responsible for both creating new, and destroying old BCH communities. It is also possible that global water temperature rise, with three marine heatwaves observed since 2007 may have been responsible for community shifts observed during both surveys. It is therefore reasonable to assume that a high level of natural variability occurs within Champion Bay BCH habitats, particularly for seagrasses.

O2 Marine (2022) identified the condition of *P. australis,* within Champion Bay, as somewhat impacted due to the presence of epiphytic algal growth and sedimentation of the foliage observed, however this is most likely explained by the timing of the survey. During winter, cooler water temperatures, more aggressive swell driven currents and increased turbidity reduce the ability for BCH growth whilst during the summer months, warmer waters, less aggressive currents, and lower turbidity provide more suitable conditions for BCH to thrive. This results in higher BCH densities, as well as the ability for seasonal coloniser species (e.g., *H. ovalis*) to establish.

Using the vegetation scale provided in DER (2014) the condition of *P. australis* is considered 'Good to Very Good' while the vegetation structure has obvious signs of disturbance, the vegetation retains its basic structure and is able to support ecological processes and functions. The population continues to retain its ability to regenerate and retains its environmental and social values.

3.4. Seagrass Condition – Project Footprint

Fine scale habitat mapping within the Project Area shows the seagrass communities to be more fragmented and patchier when compared to the broader populations within Champion Bay. The vegetation condition can be classified as being 'Degraded to Good'. Within the Tourism Jetty approach channel there are obvious signs of disturbance from multiple sources including boat moorings, the development of the Esplanade rock wall and use of the recreational boat ramp. Immediately adjacent to the disturbance footprint within the southeast corner of the project area the seagrass meadows are less impacted maintaining a dense and productive seagrass meadow.

3.5. Known Threats

The Department of Biodiversity, Conservation and Attractions (DBCA) recognise *Posidonia australis* complex seagrass meadows as being possible threatened ecological communities due to the limited survey and long-term evaluation of these communities' condition and distribution. The threats that may disrupt the integrity of seagrass meadows include (DBCA 2022, DEE 2018):

- Coastal Development including physical infrastructure construction, boat moorings, increased runoff, sedimentation, and pollution that decreases water and sediment quality; and changes to coastal processes (waves and currents) leading to erosion or burial of seagrasses.
- Boat Moorings scouring seabed and removing rhizomes.
- Catchment Disturbance and pollution runoff from industrial and agricultural lands increasing and introducing nutrients, hydrocarbons, metals, and turbidity into Champion Bay.
- Fishing both recreational and commercial fishers can cause damage to seagrass meadows from boat propellers, dragging fishing gear and or wading through meadows.
- Dredging including seabed leveling can directly and indirectly impact seagrasses via removal, smothering or altering water quality.
- Climate Change resulting in sea level rise, increased frequency and severity of storms and associated turbidity and changes to sea temperatures.

MWPA have engaged CSIRO and BMT to undertake seagrass surveys to determine the current health and resilience of seagrasses within Champion Bay. These studies have shown that seagrasses within Champion Bay have evolved to tolerate periods of high turbidity and smothering showing the dense seagrass meadows within Champion Bay have persisted and remained productive even after extended periods of disturbance (e.g., 4 months of shading from turbidity and sedimentation).

3.6. Benthic Communities and Habitat Mapping – Local Assessment Unit

Based on data from AECOM (2020) and O2 Marine (2022), a consolidated BCH map was created for the current LAU. The consolidated habitat map is presented in Figure 6.

For the purposes of the conducting a cumulative loss assessment (CLA), the BCH descriptions as defined by AECOM (2020) have been assigned to CLA categories in accordance with Table 4. The spatial areas of BCH which occur within the LAU are described in Table 5.

Table 4: Assessment categories as mapped as they relate to mapped BCH descriptors from AECOM (2020)

O2 Marine (2022) BCH Description	Density	AECOM (2020) BCH Description
Bare Sand	NA	Deep water sand, No epibenthic macrobiota.
		Pavement with sand, No macrobiota.
Macroalgae	NA	Deep water pavement with sand, Macroalgae dominant.
		Deep water reef slope, Macroalgae.
		High profile deep reef 1-4 m, Macroalgae dominant.
		Pavement with sand, Macroalgae.
		High profile shallow reef 1-4 m, Macroalgae dominant.
Seagrass	High	Pavement with sand, High density seagrass.
	Medium	Pavement with shallow sand, Seagrass dominant.
	Low	Pavement with sand, Low density seagrass.
Mixed Assemblage – Seagrass and Macroalgae	NA	Sloping pavement with sand, Low density macroalgae and seagrass;
		Low profile reef with sand, Macroalgae and seagrass codominant
		Low profile reef with deep sand, Low density seagrass and macroalgae.
		Low profile reef with sand, seagrass and macroalgae.
Coral	NA	Seal Rocks Breakwater, Coral Habitat

Table 5: Spatial area of BCH within the LAU

CLA Category	Area (Ha)	Area (% LAU)
Deep Pavement with Sand, Macroalgae	48.81	1.01
Deep Sand, No Epibenthic Macrobiota	37.56	0.78
Deep Water Reef Slope, Macroalgae	107.81	2.23
High Profile Deep Reef 1-4 m, Macroalgae Dominant	737.54	15.26
High Profile Shallow Reef 1-4 m, Macroalgae Dominant	451.45	9.34
Low Profile Reef with Sand, Seagrass and Macroalgae	806.99	16.70
Pavement with Sand, High Density Seagrass	328.45	6.80
Pavement with Sand, Low Density Seagrass	158.7	3.28
Pavement with Sand, Macroalgae	209.94	4.35
Pavement with Sand, No Epibenthic Macrobiota	76.69	1.59
Pavement with Shallow Sand, Seagrass Dominant	830.57	17.18
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	0.31	0.000
Non-BCH (infrastructure, beach, groynes etc.)	266.95	5.52

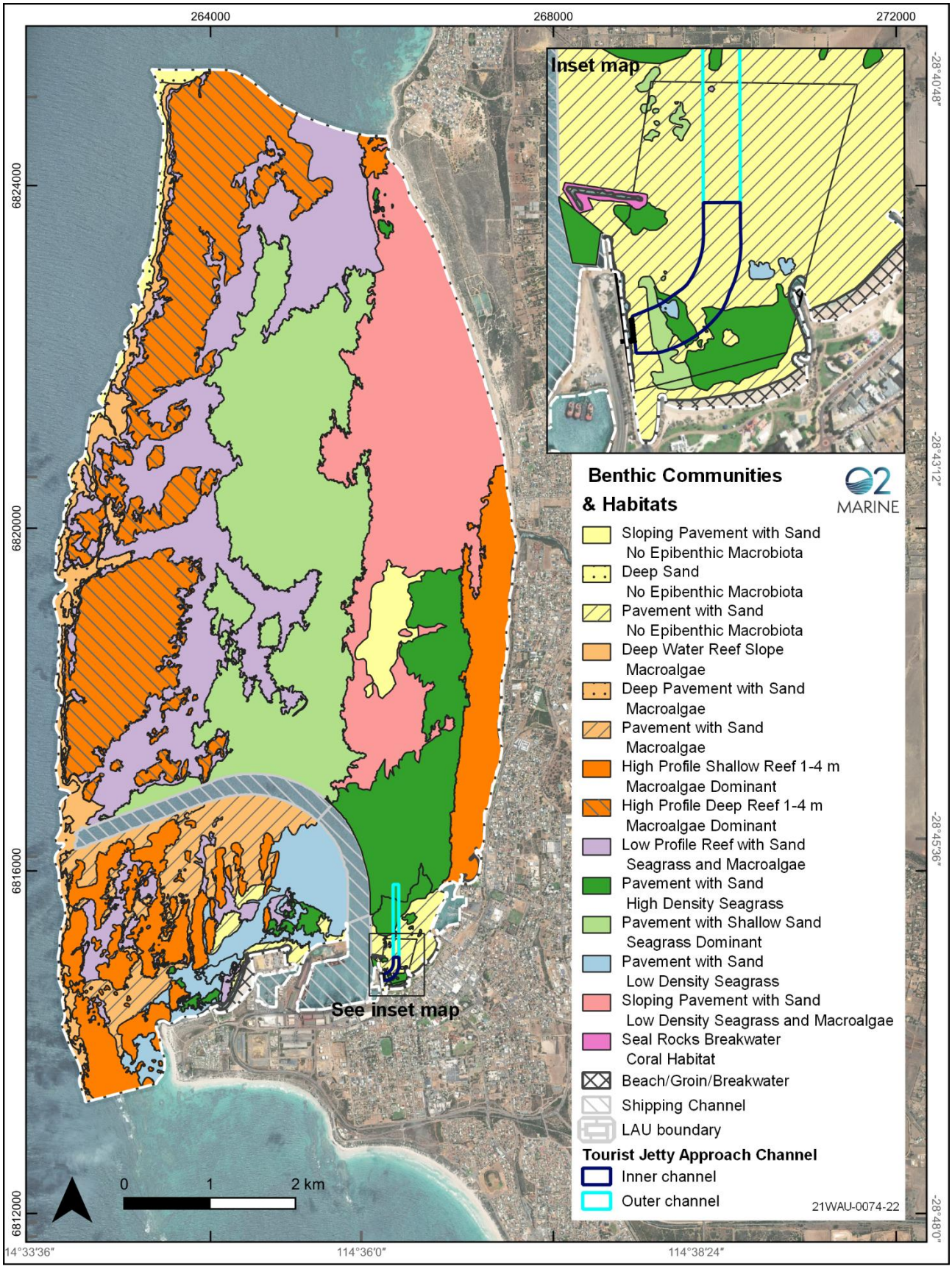


Figure 6: LAU with updated BCH coverage around Tourist Jetty as mapped in O2 Marine 2022

4. Local and Regional Values

4.1. Conservation Values

In WA the conservation of ecologically significant marine, estuarine or terrestrial ecosystems may be managed through reserves established under the CALM Act. The subtidal habitats within the Project area have not been identified as containing significant ecological communities warranting protection through the introduction of marine reserves.

There are no implications from any of the proposed Commonwealth Marine Reserves for the Project due to the coastal location being contained completely within State Waters.

4.2. Regional Significance

The marine habitats mapped by AECOM (2020) and O2 Marine (2022) are largely comparable to previous BCH mapping undertaken during technical studies during 2001 in preparation for the capital dredging project referred to the EPA. URS (2001) identified no habitats or species that are confined in their distribution within Champion Bay, rather identifying their distributions occurring widely throughout the Central West Coast Region.

4.3. Functional Ecological Values

Posidonia australis is the climax community of a successional process that occurs over decades to centuries. It is a slower growing but long lived, meadow forming species, with persistent rhizomes. Spatial structure of meadows can be highly variable. The wide, strap-like leaves of *Posidonia australis* provide a surface for the establishment of a diverse collection of other aquatic plants contributing to the overall primary production of the ecological community (DEE 2018).

Whilst the BCH within Champion Bay has not been identified to warrant a particular conservation status or represent an area of regional significant importance, seagrasses, and to a lower extent macroalgae, are still widely considered as important habitats as they provide a variety of ecological functions. Lavery *et. al.* (2019) and DEE (2018) identifies seagrasses as offering the following ecological services:

- Contribute to the base of the marine food web;
- Provide habitats important for shelter and food and are nursery areas for a variety of species;
- Protect water quality by filtering water and recycling nutrients;
- Play an important role as a blue carbon store and sequestration of carbon;
- Protect the coastline form erosion by stabilising sediment on the seabed; and
- Provide habitat for a variety of sand forming organisms, contributing vast amounts of sediments into the natural system.

Posidonia australis is considered to have structural complexity and play a vital role in ecosystem processes. DEE (2018). Therefore, seagrasses warrant special protection during marine activities which may impact their ability to deliver these functions or maintain their values.

4.4. Fauna

Seagrass meadows can provide habitat, shelter and food resources for a diverse number of fauna. A desktop marine fauna study was undertaken to support the 2021 Maintenance Dredge program (O2 Marine 2021). A key finding of this desktop study was that the Project area does not support restricted populations or habitats of conservation significant or commercially important fish species.

Commonly marine megafauna are known to associate with dense seagrass meadows, however as the Project area is within a high traffic area and is dominated by bare sand with very little (< 10 %) dense seagrass beds it is assumed that these meadows would be of very low ecological value for marine megafauna. It is also recognised that the seagrass meadows within Champion Bay provide foraging and shelter for a variety of species, including western rock lobster and Australian sea lions. However, there is no indication that any species' populations would be significantly impacted by the removal of seagrasses within the project's disturbance footprint, typically due to the location and small spatial area.

4.5. 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 disturbance area, unlikely to represent any social impacts by the Project.

4.6. Pre-European Extent

The Pre-European extent of the subtidal BCH types are presented in Table 6. The Pre-European extent was estimated using historical photographs and interpretation of current BCH assemblages occurring adjacent to existing disturbed areas (i.e., Port infrastructure, breakwaters, shipping channel etc.). The Pre-European LAU area was estimated at 4832.21 ha. Prior to European settlement it has been estimated that seagrass dominant habitats represented ~64.4% of the LAU. As discussed above, the dynamic nature of BCH existing within Champion Bay is recognised as highly variable year upon year, therefore 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 as such.

Table 6: BCH pre-European spatial extent

CLA Category	Approximation of area prior to European settlement (ha)	Area of BCH prior to European settlement (% 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	16.71
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

4.7. Current Extent

In summary, Table 7 shows the current extent of estimated BCH lost through historical anthropogenic activities and existing infrastructure (e.g., marinas, tugpens, rock groynes etc) and shipping channel when compared to the Pre-European LAU extent. There has been an estimated total loss of possible habitat of approximately 266.64 ha, including 5.76% of seagrass dominant habitats, due to European settlement. In contrast, pavement with sand and no epibenthic macrobiota and coral have increased in size since European settlement.

Table 7: BCH spatial areas and percentage loss since European settlement

CLA Category	Approximation of area post to European settlement (ha)	Area of BCH loss since European settlement (% LAU)
Deep Pavement with Sand, Macroalgae	48.81	0.00
Deep Sand, No Epibenthic Macrobiota	37.56	0.00
Deep Water Reef Slope, Macroalgae	107.81	-0.06
High Profile Deep Reef 1-4 m, Macroalgae Dominant	737.54	0.00
High Profile Shallow Reef 1-4 m, Macroalgae Dominant	451.45	-0.04
Low Profile Reef with Sand, Seagrass and Macroalgae	806.99	0.00
Pavement with Sand, High Density Seagrass	328.45	-4.79
Pavement with Sand, Low Density Seagrass	158.70	-0.35
Pavement with Sand, Macroalgae	209.94	-0.72
Pavement with Sand, No Epibenthic Macrobiota	76.69	+1.04
Pavement with Shallow Sand, Seagrass Dominant	830.57	-0.62
Sloping Pavement with Sand, Low Density Seagrass and Macroalgae	709.80	0.00
Sloping Pavement with Sand, No Epibenthic Macrobiota	60.95	0.00
Coral	0.31	+0.01

5. Potential Impacts

5.1. Mitigation

5.1.1. Access Channel Optimisation

To reduce impacts to seagrass through implementation of the Project, the proponent has considered and conducted the following before proposing the final access channel footprint:

- Conduct bathymetric surveys to identify potential channels to avoid and minimise any seabed disturbance requirements which would result in seagrass loss.
- Minimise the width of the access channel based on the minimum vessel requirements for safe navigation to and from the Tourist Jetty.
- Undertake a BCH mapping investigation (O2 Marine 2022) to identify where seagrasses occur in order to avoid and minimise impacts to known areas.
- Employing seabed levelling techniques, rather than dredging as this minimises indirect impacts adjacent BCH.
- BCH mapping to identify key BCH types.
- Consultation with stakeholders to identify possible impacts to social surroundings and public safety.

5.1.2. Seabed Levelling Environmental Management Plan

A project specific environmental management plan will be developed by the selected contractor who will implement seabed levelling activities. To ensure no impacts occur outside of those predicted within this report the environmental management plan will ensure:

- Seabed levelling and placement occurs within the defined marine project footprint as presented in Figure 5.
- Bathymetric survey will be conducted with seabed levelling to ensure no impacts occur outside of the defined marine project footprint.
- Standard maritime activity environmental management as required by existing Port Policy and Procedure for any activity will be required such as (but not limited to) pollution, waste and vessel environmental management activities are adequately identified and addressed.

Prior to any seabed levelling activities taking place the contractor's environmental management plan will be required to be endorsed by MWPA as the overseeing Authority.

5.2. Direct Impacts

MWPA intends to apply for a native vegetation clearing permit under Part V, Division 2 of the Environmental Protection Act 1986. The total area of clearing required (Clearing Footprint) has been calculated based on the boundary of the inner channel with a nominal buffer of 5 m to account for any incidental disturbances during seabed levelling (Figure 1). The total area for vegetation clearing is based on the spatial area of seagrass communities occurring within the Clearing Footprint (Table 8). This includes:

- Clearing Footprint = 2.39 ha; and

- Vegetation Clearing = 0.62 ha or 0.013% of the LAU.

Seabed levelling within the inner channel (including a 5 m 'buffer zone') will result in the direct irreversible loss of 0.62 ha of seagrasses (Table 8), comprising:

- 0.08 ha (0.001 % of LAU) of low to sparse seagrass habitat;
- 0.24 ha (0.005 % of LAU) of medium-density seagrass habitat; and
- 0.30 ha (0.005 % of LAU) of high-density seagrass habitat.

A further 1.77 ha (0.037 % of LAU) of Bare 'unvegetated' substrate will also be directly impacted as a result of seabed levelling (Table 8). However, this area will continue to be classified as bare substrate after the completion of dredging and so has not been considered further in the cumulative loss assessment

Table 8: Direct BCH impacts predicted from Seabed levelling activities (inclusive of 2 m buffer zone)

CLA Category	Area (ha)	Area loss (% LAU)
Pavement with Sand, High Density Seagrass	0.30	0.006
Pavement with Sand, Low Density Seagrass	0.08	0.002
Pavement with Sand, No Epibenthic Macrobiota	1.77	0.037
Pavement with Shallow Sand, Seagrass Dominant	0.24	0.005
Total Clearing Footprint	**2.39 Ha**	**NA**

5.3. Indirect Impacts

There are not predicted to be any indirect impacts associated with seabed leveling which will result in irreversible loss of seagrass within the defined marine development footprint.

Indirect impacts which may reduce the quality of adjacent BCH, however not considered irreversible loss are assessed within the Project Environmental Impact Assessment and managed through ongoing Port environmental management and monitoring programs. These comprise programs such as ongoing seagrass and marine environmental quality monitoring.

No further consideration of indirect impacts are considered herein.

6. Cumulative Loss Assessment

The current spatial extent of each BCH type within the LAU is presented in Table 7. The current spatial extent is presented in hectares and is expressed as a percentage of approximated pre-existing conditions. The area of BCH type in the LAU impacted after the proposed project has been completed has been applied has been calculated and is expressed within Table 9 as irreversible losses, reversible impacts, and expressed as percentages of pre-existing conditions estimated since Pre-European settlement.

All *calculated cumulative losses* of BCH are likely to be within the range of error inherent in mapping BCH.

Table 9: Benthic Communities and Habitat Cumulative Loss Assessment (Area expressed hectares & (%) of LAU).

Loss Assessment	Deep Pavement with Sand, Macroalgae	Deep Sand, No Epibenthic Macrobiota	Deep Water Reef Slope, Macroalgae	High Profile Deep Reef 1-4 m, Macroalgae Dominant	High Profile Shallow Reef 1-4 m, Macroalgae Dominant	Low Profile Reef with Sand, Seagrass and Macroalgae	Pavement with Sand, High Density Seagrass	Pavement with Sand, Low Density Seagrass	Pavement with Sand, Macroalgae	Pavement with Sand, No Epibenthic Macrobiota	Pavement with Shallow Sand, Seagrass Dominant	Sloping Pavement with Sand, Low Density Seagrass and Macroalgae	Sloping Pavement with Sand, No Epibenthic Macrobiota	Coral
Pre-European Extent	48.81 (1.010)	37.56 (0.780)	110.71 (2.290)	737.54 (15.260)	453.50 (9.380)	807.22 (16.710)	559.69 (11.580)	175.42 (3.630)	244.55 (5.060)	26.37 (0.550)	860.40 (17.810)	709.80 (14.690)	60.95 (1.260)	0.00 (0.000)
Current Extent	48.81 (1.010)	37.56 (0.780)	107.81 (2.231)	737.54 (15.260)	451.45 (9.343)	806.99 (16.700)	328.45 (6.797)	158.7 (3.284)	209.94 (4.345)	76.69 (1.587)	830.57 (17.188)	709.800 (14.689)	60.950 (1.261)	0.031 (0.006)
Irreversible Loss from Project	**0.00 (0.000)**	**0.00 (0.000)**	**0.00 (0.000)**	**0.00 (0.000)**	**0.00 (0.000)**	**0.00 (0.000)**	**0.30 (0.006)**	**0.08 (0.002)**	**0.00 (0.000)**	**1.77 (0.037)**	**0.24 (0.005)**	**0.00 (0.000)**	**0.00 (0.000)**	**0.00 (0.000)**
Recoverable Impact	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)
Cumulative Loss (%)	*0.00 (0.000)*	*0.00 (0.000)*	*-2.90 (0.060)*	*0.00 (0.000)*	*-2.05 (0.042)*	*-0.23 (0.005)*	*-230.94 (4.780)*	*-16.64 (0.344)*	*-34.62 (0.716)*	*+52.09 (1.078)*	*-29.59 (0.612)*	*0.00 (0.000)*	*0.00 (0.000)*	*+0.03 (0.006)*

7. Conclusion

The Project will result in vegetation clearing of 0.62 ha of seagrasses within a total Clearing Area of 2.39 ha. This includes the irreversible loss of the following seagrass over the entire Project LAU:

- 0.08 ha (0.002 %) of low-density seagrass;
- 0.24 ha (0.005 %) medium-density seagrass
- 0.30 ha (0.006 %) of high-density seagrass

No indirect irreversible loss are predicted for the Project due to the methods proposed of bed levelling rather than large scale dredging.

The BCH mapped within the project footprint were found to be commonly distributed throughout the wider Mid-West region. All of the species identified during the assessment are also typically found within a broader geographical distribution. The mapped *P. australis* communities within the project area were assessed as being in a degraded to good condition. The presence of epiphytic algal growth and sedimentation of the foliage indicate there are multiple sources of disturbance influencing the condition of these ecological communities. The degraded health of the communities might indicate that the meadows are highly variable in both density and size overtime within the project area, and they might not be present year-round.

The pre-feasibility studies and environmental investigations have directed appropriate mitigation through the proposed engineering and development phases of the project. This will ensure that the BCH communities present, which are required for ongoing support and maintenance of the biodiversity and ecological integrity and functionality within the study area, will not incur any significant cumulative losses. Where cumulative losses have been calculated, the impact upon biodiversity and ecological integrity is predicted to be negligible. The direct losses of BCH will be of types that are both well represented elsewhere in the respective LAUs and the wider region and therefore the contribution of these BCH types to ecosystem functions, integrity and biodiversity will not be impaired.

Based on the assessment and the data presented herein, the proponent considers the principles underpinning assessment of vegetation clearing applications have been met.

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