Benthic Communities and Habitat Assessment

MWPA Tourist Jetty

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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 Tourist Jetty is to be used by the commercial vessel fleet running tourism operations around the local area and to the Abrolhos Islands.

As part of this project a benthic habitat investigation was implemented to assess the area around the current proposed Tourist Jetty, specifically the proposed access channel. Data acquired for the investigation was obtained using a combination of side scan sonar to map the habitats and drop camera as a visual verification to ground truth the surveyed area.

Overlapping side scan sonar data was collected over an area of approximately 17.8 Ha and this data was analysed and mapped indicating that there was six (6) categorised benthic communities and habitat classes in the survey area. Mapped classes and their approximate spatial coverage observed within the project area include;

- 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 of seagrass, *Posidonia sinuosa*, 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* spp. was observed in moderate size meadows. This is typical of the winter season, which provides less favourable conditions for growth and support of high-density seagrass, or coloniser seagrass species (i.e. *H. ovalis*) over a greater spatial area. No significant macroalgae assemblages were present. Epibenthos and other fauna species were 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.

The data from this BCH investigation will support the project impact assessment from project activities, such as increased vessel movements, seabed levelling for increased draft and shading from the jetty facility. The BCH mapping will also feed data into cumulative loss assessment calculations to support an application for a vegetation clearing permit due to seagrass loss from proposed seabed levelling activities.

Acronyms, Abbreviations and Definitions

Acronyms & Abbreviations	Definitions
BCH	Benthic Community Habitat
CATAMI	Collaborative and Automated Tools for Analysis of Marine Imagery
EPA	Environmental Protection Authority
GDA	Geographic Datum of Australia
GIS	Geographic Information System
GPS	Global Positioning System
MGD	Map Grid of Australia
MWPA	Midwest Port Authority
ROV	Remote Operated Vehicle
USB	Universal Serial Bus

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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.

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 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. Only one vessel at a time will be able to utilise the facility.

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. Survey Purpose

The purpose of this survey was to identify and map existing Benthic Communities and Habitat (BCH) which occur with the defined study areas to:

- identify key seagrass species and their spatial extent within the defined survey area;
- provide data to facilitate a Cumulative Loss Assessment required to support an application for Native Vegetation Clearing Permit; and
- provide data to facilitate a project environmental impact assessment.

1.3. Survey Scope

This document provides an account of the BCH features occurring within the survey area from a site-specific investigation. This report aims to:

- Document the field activities, methodology and results of the investigation, including a description of BCH identified; and
- Present a validated and representative Geographic Information System (GIS) map layer of distribution and extent of the BCH present.

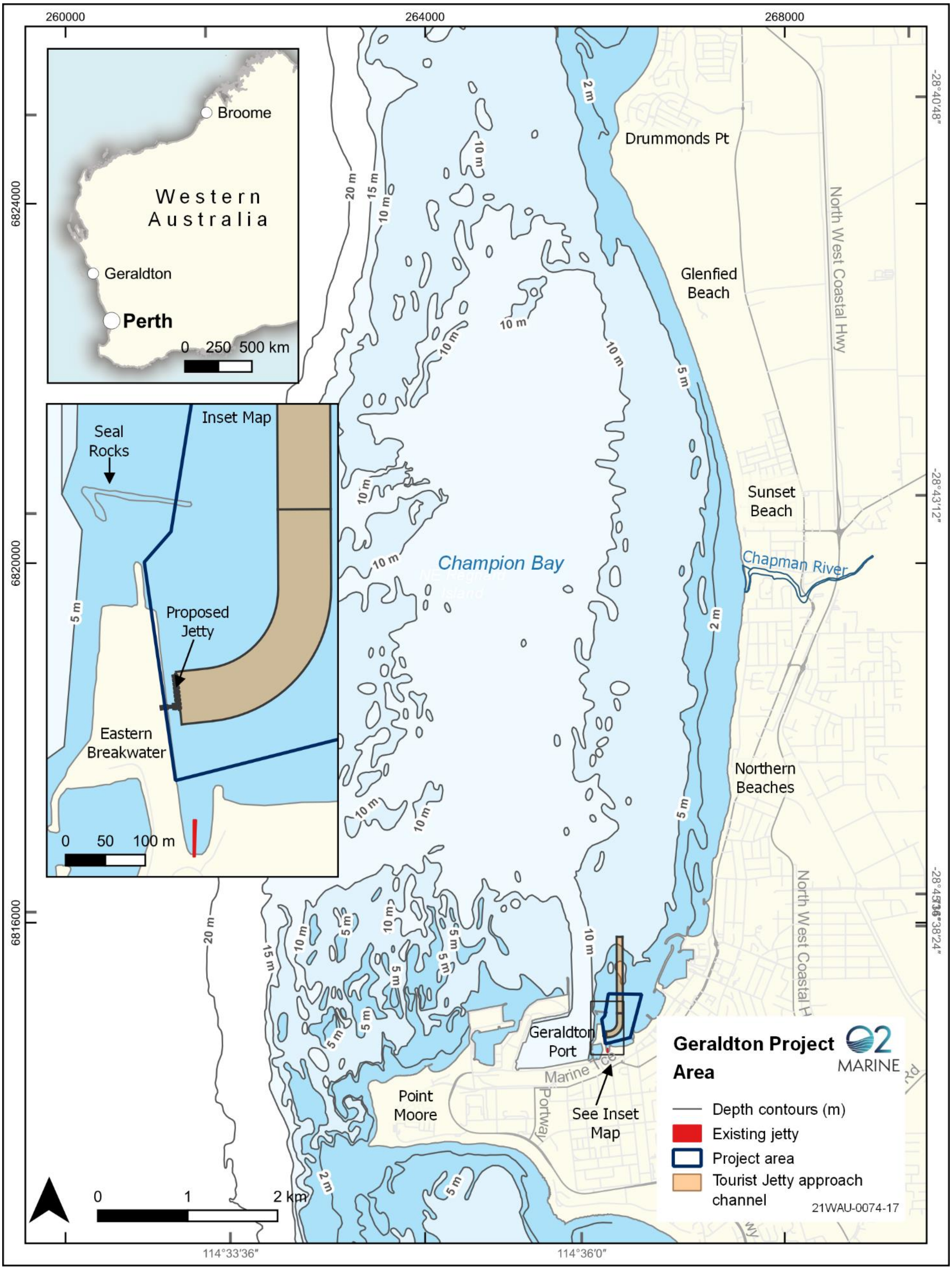


Figure 1: Site location

1.4. Benthic Communities and Habitats

Benthic communities and habitats (BCH) play an extremely important role in the ecosystem by helping to maintain biological diversity within the area (EPA, 2016). The communities provide structurally complex and diverse habitats which offer refuge and protection for various fauna and assist in increasing food supply (EPA, 2016). Within the habitats, the presence of primary producers is particularly important as these communities form the basis for the coastal food webs in Western Australia (EPA, 2016). The lack of significant upwelling along the Western Australian coast further increases the importance of the primary producer communities (EPA, 2016).

Typically, within the Geraldton nearshore area the benthic communities and habitats are dominated by areas of sand, limestone substrate, macroalgae assemblages and seagrass beds (AECOM, 2020).

2. Methodology

2.1. Overview

The Project area was approximately 17.8 Ha in size, with northern extent boundaries approximately 0.5 km from the southern shore (Figure 1). The area is subject to <1.2 m tidal range, which is diurnal in nature, therefore experiencing one high and low tide per day. The site is situated within the small embayment adjacent to the EBW in the Indian Ocean (Figure 2). The project area is bordered on the West by Geraldton Port and Fishing Boat Harbour. The survey methodology was designed to incorporate the recommendations contained within the Technical Guidance – Protection of Benthic Communities and Habitats (EPA, 2016).

Figure 2: Project area location.

2.2. Survey Effort

The BCH project area and habitat survey effort is presented in Figure 3. Field survey activities were completed by qualified and experienced marine scientists using Side Scan Sonar (SSS) to determine the boundaries of seabed features and drop camera deployments using a Remotely Operated Vehicle (ROV) to provide ground truth data. The survey was conducted over two separate field days, to provide time for sonar data processing and selection of targeted drop camera sites. A summary of the survey effort is presented in Table 1.

Table 1: Schedule of survey effort.

Survey area	Survey days	Survey hours	Number of towed sidescan sonar transects	Number of ROV Sites
Proposed Tourist Jetty	18/07/2022	5	11	-
	19/07/2022	3	-	19

Figure 3: Benthic communities and habitat survey effort and project area.

2.3. Survey Equipment

2.3.1. Sidescan Sonar

Sidescan Sonar (SSS) was used to identify consistent habitat features across the project area. Whilst the SSS is immersed in the water column it emits acoustic pulses that are reflected by seabed forms and other objects back to the SSS (i.e. backscatter). The travel times and intensities of the returned pulses (echoes) are recorded and used to generate an image in real-time.

The survey utilised a portable dual channel 450 kHz SSS system (Tritech Starfish 452F, **Figure 4**) that was operated via a topside control unit and proprietary acquisition software Scanline V2.1. Data was recorded as raw data files (.logdoc).

A standard Universal Serial Bus (USB) Global Positional System (GPS) antenna (<2 m accuracy) was used to provide geographic positioning of the system in real time. This was mounted on the roof of the survey vessel and offsets to the SSS measured to centimetric accuracy.

Figure 4: Example pole mounted Starfish Sidescan Sonar, Freedom II vessel undertaking survey.

2.3.2. Ground Truthing Video

Targeted ground-truth benthic videos were executed to assess areas of interest based on the combined bathymetric and SSS survey results. The QYSEA FiFish V6 Remotely Operated Video (ROV) (**Figure 5**) was deployed at each site to record high resolution video footage.

Figure 5: QYSEA Fifish HD ROV

2.4. Survey Procedures

2.4.1. Sidescan Sonar

SSS data acquisition was conducted from the survey vessel using transects completed at a speed of approximately 3 knots and maintained at a height of between 1-5 m above the seabed. The SSS depth was varied live based on the data feed displayed on the topside control unit. Survey transects were designed to cover maximum coverage within the survey area to provide greater ability to accurately map the BCH. As excessive vessel movement can introduce noise in the SSS data, local conditions such as strong currents, adverse meteorological conditions and geomorphology were assessed at the beginning of each transect to minimise vessel movement and to collect the best quality data. In addition, local swell surge can generate noise through sediment suspension above the seafloor and through movement of detached wrack, both of which was noticed on SSS transects and visually observed at some locations of ROV video footage across both surveys. SSS recorded data using a swath width of ~ 50 m in shallow waters over an average depth of 9 m. Real-time observations of the side scan sonar were used to identify key seabed features

2.4.2. Ground Truthing Video

At each site, the ROV was positioned laterally (i.e. camera view directly down) approximately 2-3 m from the seafloor and a haphazard transect was recorded based upon the surge vector. Approximately 30-40 seconds of footage was analysed visually in the field via the topside control viewfinder, enabling approximately 20 m of seafloor imagery to be captured per transect

2.5. Data Analysis

2.5.1. Sidescan Sonar

The side scan sonar data was loaded initially into Sonarwiz.7.2 software for the seabed characterisation process. An acoustic image classification algorithm was used to characterise pixels within collected acoustic imagery based on the similarity of their 'texture'. After calculating metrics including standard deviation and entropy, the algorithm interpolated pixels with the same values before assigning each identified class to a colour and representing these on a final acoustic image. Classes were later validated using underwater video of the classified target (Section 2.5.2).

Each Side Scan transect was processed for backscatter image classification and different classes could be discriminated, whereby each class represented a different bottom substrate type. Where automated classification was not successful due to noise in the backscatter signal, classification was undertaken by an operator through manually digitalising the seabed feature identified in the data. To assign a habitat classification to the backscatter data classes, 'acoustic supervised classification' was performed through interpolation of the drop camera footage.

2.5.2. Ground Truthing Video Classification

Footage from underwater video were later visually analysed for benthic community composition and abundance according to the breakdown shown in Table 2. Each target location was plotted and classified using the QGIS software system. Habitat and substrate classification was undertaken in accordance with the Collaborative and Automated Tools for Analysis of Marine Imagery (CATAMI) standard classification scheme for scoring marine biota and physical characteristics from underwater imagery (Althaus et al 2015).

Table 2: Breakdown of classification of ROV footage

Group	Classification	Distinguishing feature
Relief	Flat	N/A
	Low	<1 m
	Moderate	1 – 3 m
	High	>3 m
	Wall	>5 m vertical wall
Substrate type	Consolidated	Boulders
		Rock

Group	Classification	Distinguishing feature
		Cobbles
	Unconsolidated	Pebble / Gravel
		Sand / mud
Bedforms	2D Ripples (2DR)	< 10 cm
	2D Waves (2DW)	> 10 cm
	3D Ripples (3DR)	< 10 cm
	3D Waves (3DW)	> 10 cm
	Bioturbated	N/A
	None	N/A
BCH (%)	Sparse	0 – 10 %
	Low	10 – 50 %
	Medium	50 – 75%
	High	75 – 100 %
Taxa	*Posidonia sinuosa (Po)*	N/A
	Halophila spp. *(Ha)*	N/A

2.6. Benthic Communities and Habitat Mapping

Once back in the O2M office all collected data (i.e. SSS and video) was analysed and compiled in the QGIS (v3.22.7) software. The SSS data was mosaiced and exported at 0.1 m resolution and maps were output in GDA2020 MGA Zone 50. Using the roughness, backscatter information and satellite imagery (Google Earth, 2018), seabed features were visually assessed for any discernible physical geomorphic or other notable benthic features. Assessments were made for potential sediment type, presence of rock or subsurface rock, relief, slope and sedimentary bedforms according to the CATAMI classification scheme (Athaus et al. 2015; Butler et al. 2017). These features were nested within common boundaries to allow GIS polygon attribution. Additionally, a morphological descriptor nested with the CATAMI scheme was also provided.

3. Results

3.1. Sidescan Sonar Mosaic

Overlapping, 100% coverage SSS data was collected over an area of approximately 17.8 Ha (Figure 3). Data could not be acquired in water less than approximately 0.5 m deep, resulting in minor survey gaps and some spatial distortion along the shoreline and along the beach to the south of the survey area. Overall, the data quality was excellent due to the relatively calm inshore conditions. Positional errors in the SSS mosaic are observed with a combined positional error of approximately +/- 5 m. Some interference in the SSS data was noticed possibly due to nearby vessels working sonar systems in the area.

Various seabed features are visible in the sonar dataset, including sediment ripples, areas of low acoustic reflectivity (soft sediments), areas associated with seagrass banks, and human infrastructure such as rock walls and navigation markers.

3.2. Ground Truthing Video Visual Assessment

Nineteen underwater video drops were completed in total at each location presented in Figure 3. As conditions were relatively good, adequate seabed imagery was obtained for each location surveyed. A summary of the BCH observed at each location is presented in Table 3 and photo stills and a description presenting an example of each BCH type identified within the survey area in Table 4.

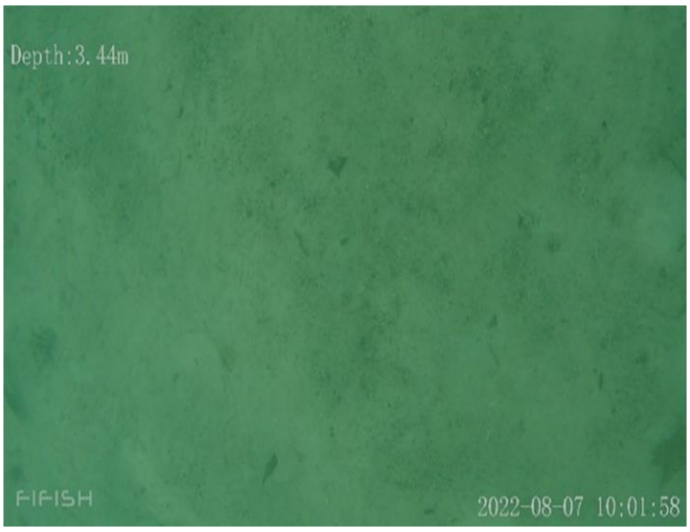
A total of five benthic community classes were identified from the video analysis. Only two seagrass species were identified including *Posidonia sinuosa* and *Halophila* spp. Seagrass were observed in densities ranging from sparse to high, with *P. sinuosa* the only species observed occurring as high density, occurring at four survey locations. From the video footage *P. sinuosa* was observed to have a moderate level of epiphytic growth along with quite a high level of sedimentation occurring over the leaves at most locations. Bare sand, or unvegetated sediments was the dominant BCH type occurring at 10 of the survey locations, whilst sandy substrates were observed at all 19 survey locations.

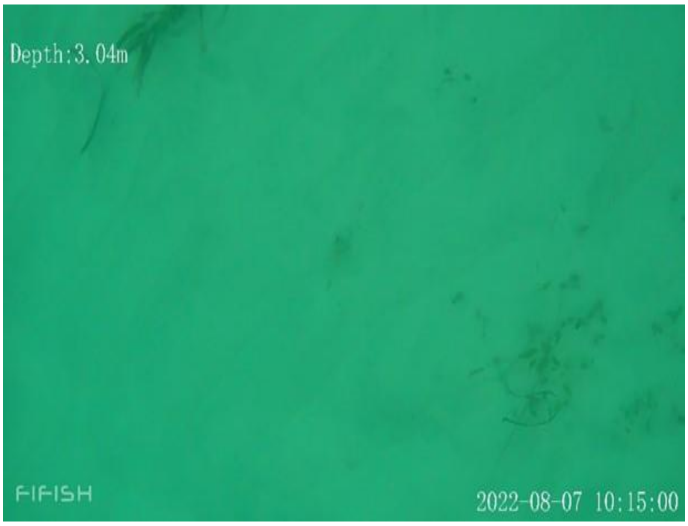
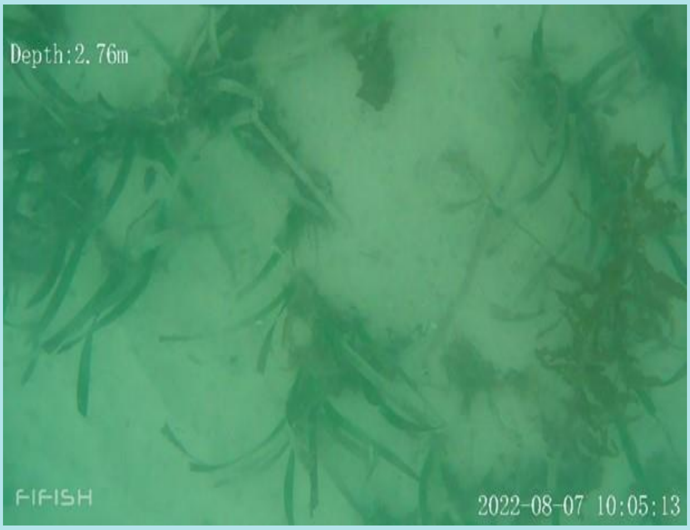
Table 3. Outcomes of CATAMI classification of ROV videos (GDA2020, MGA50).

Site ID	Easting	Northing	Relief	Substrate Type	Bedforms	Dominant BCH (%)	Subdominant BCH (%)	Dominant Taxa	Subdominant Taxa	Comments
DC1	266030	6814780	F	S	N	-	-	-	-	Bare sand
DC2	266072	6814801	F	S	3DR	S (L)	-	*Po*	-	-
DC3	266163	6814758	F	S	3DR	S (H)	-	*Po*	-	-
DC4	266267	6814783	F	S	3DR	S (H)	-	*Po*	-	-
DC5	266234	6814828	F	S	3DR	-	-	-	-	Bare sand
DC6	266285	6814874	F	S	3DR	S (S)	-	*Ha; Po*	-	-
DC7	266282	6814949	F	S	3DR	-	-	-	-	Bare sand
DC8	266288	6815087	F	S	3DR	-	-	-	-	Bare sand
DC9	266316	6815166	F	S	3DR	-	-	-	-	Bare sand
DC10	266209	6815135	F	S	3DR	-	-	-	-	Bare sand; Highly turbulent with suspended sediment above substrate
DC11	266155	6815167	F	S	3DR	-	-	-	-	Bare sand
DC12	266085	6815171	F	S	3DR	S (M)	-	*Ha*	-	-
DC13	266152	6815001	F	S	3DR	-	-	-	-	Bare sand; seawrack
DC14	266092	6814951	F	S	3DR	-	-	-	-	Bare sand; seawrack
DC15	266018	6814957	L	S	3DR	S (H)	-	*Po*	-	Patchy high density seagrass and bare sand

Site ID	Easting	Northing	Relief	Substrate Type	Bedforms	Dominant BCH (%)	Subdominant BCH (%)	Dominant Taxa	Subdominant Taxa	Comments
DC16	266064	6814867	F	S	2DR	S (M)	-	*Po*	-	Patchy moderate density seagrass and bare sand
DC17	266047	6814797	F	S	2DR	S (M)	-	*Po*	-	Patchy moderate density seagrass and bare sand
DC18	266115	6814757	F	S	3DR	S (H)	-	*Po*	-	
DC19	266137	6814880	F	S	3DR	-	-	-	-	Bare sand; seawrack

Table 4: 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* spp. and *Posidonia sinuosa*	
Flat sand with low seagrass (Site DC6)	Relatively well compacted sediments comprising fine sands with ripples present. Presence of *Posidonia sinuosa*	
Flat sand with moderate seagrass (Site DC12)	Relatively well compacted sediments comprising fine sands with ripples present. Presence of *Halophila* spp.	

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 sinuosa*	

3.3. Benthic Communities and Habitat Mapping

The spatial areas represented by each BCH type is presented in Table 5 and the BCH GIS map is displayed in Figure 6.

Bare sand, or unvegetated sediments, was the dominant BCH type by spatial area representing over 79% of the project area. This is followed by high density seagrass which represented over 12% of the project area. High density seagrass, and most of the moderate density seagrass occurred as a meadow in the south of the project area, with a small pocket of high-density seagrass occurring in the central west, adjacent to Seal Rocks. Other seagrass meadows were small, with unvegetated sediments represented across the remainder of the project area.

Table 5: Characteristics and spatial area of mapped benthic communities and habitats.

BCH Type	Associated Video Habitat	Distribution	Defining Characteristics	Spatial Area Occupied (Ha, %)
Bare Sand	Fine sand with presence of ripples in some areas.	Down southwest side and to the northeast and middle of survey area.	SSS variable and low brightness.	14.07 Ha; 79.2%
High Density Seagrass	Fine Sand with some ripples. Presence of *Posidonia sinuosa*	Southeast of the survey area in between the two (2) groynes. Small patch to the northeast of the end of the western groyne.	Highly variable roughness. SSS mostly bright and mottled appearance.	2.21 Ha; 12.4%
Low Density Seagrass	Fine Sand with some ripples. Presence of *Posidonia sinuosa*	Small patch to the east of the western groyne surrounded by high and moderate density seagrass	Smooth, few discernible features in any geophysical data.	0.09 Ha; 0.5%
Moderate Density Seagrass	Fine Sand with some ripples. Presence of *Halophila* spp.	Patch to the east of the sand close to the western groyne. Small parches to the northwest of the survey area.	SSS shows some mottled appearance, low brightness.	0.81 Ha; 4.6%
Sparse Density Seagrass	Fine Sand with some ripples. Presence of *Posidonia sinuosa* *And Halophila* spp.	Two (2) small patches to the north and the northwest of the eastern groyne.	Smooth, few discernible features in any geophysical data. SSS dull.	0.18 Ha; 1.0%
Rockwall	Rock Rubble on Sand.	To the west of the survey area and a small area to the southeast in close to shore	High and varied roughness, SSS bright.	0.41; 2.3%

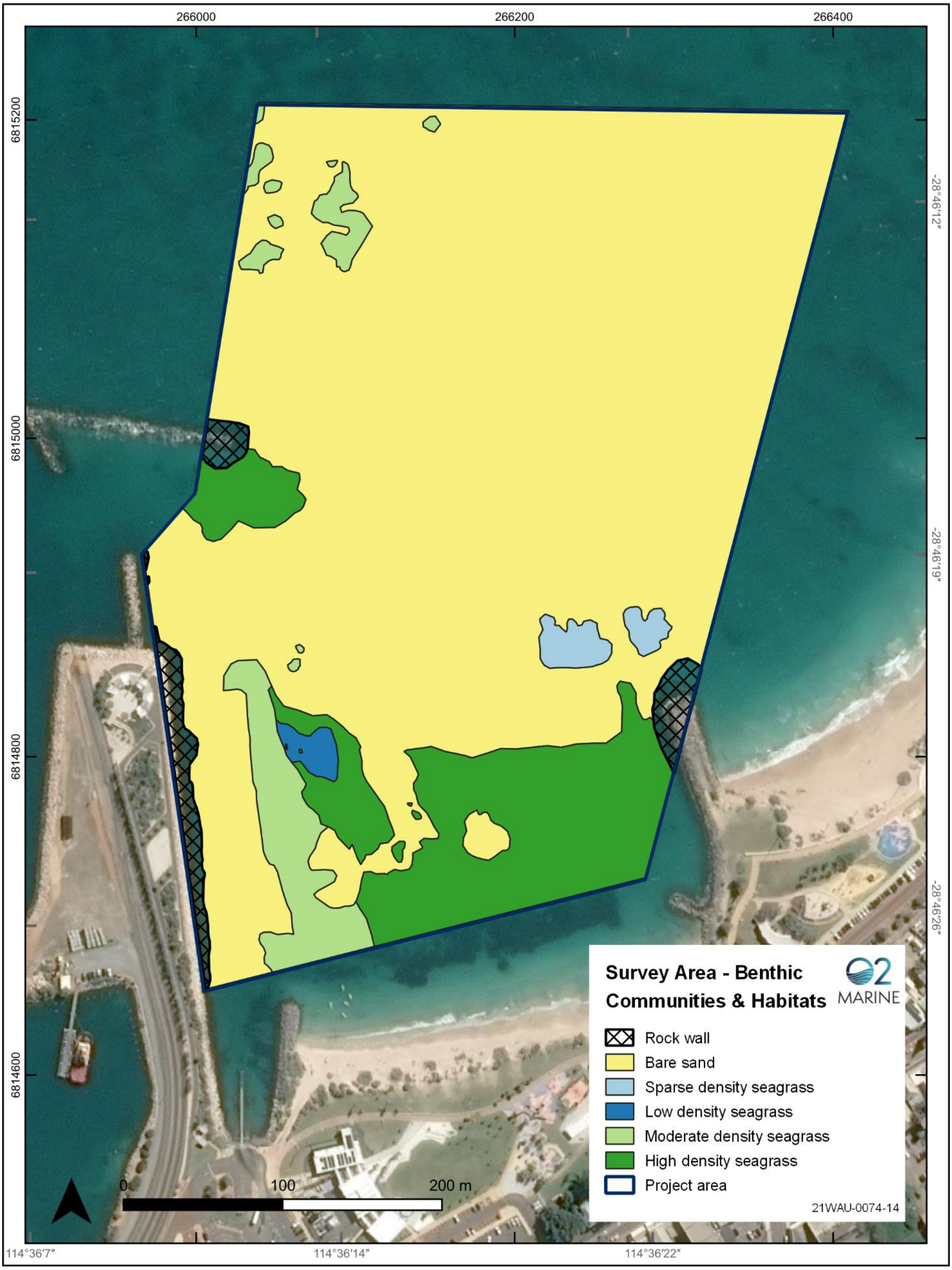


Figure 6: Mapped benthic communities and habitat.

4. Discussion and Conclusions

The benthic community and habitat within the proposed tourist jetty project area were successfully mapped at high resolution using a combination of SSS and ROV (Figure 6). Highest map reliability was achieved where overlapping datasets were available. The sidescan sonar survey correlated well with the ground truth ROV video. The image showed up different reflectivity levels and appearances which when visited with the ROV showed differing benthic habitat communities.

Of the total 17.8 Ha mapped, close to 80% comprised of bare substrate with no visible macrophytes, benthic communities or faunal species. These dynamic sediment environments play an important role in providing habitat for numerous benthic organisms. These organisms contained within the sediments help to regulate carbon, nitrogen and sulfur cycling, water column processes and the transport and redistribution of sediments (Snelgrove et al.).

The dominant visible macrophytic community comprised of dense stands of *Posidonia sinuosa* dominated seagrass meadows, comprising 12.4% of habitat area. The seagrass beds are associated with seagrass epiphytes, macroalgae and other organisms such as sponges and ascidians. It should also be noted that this species of seagrass is typically a slow coloniser (Bennett et al. 2021). The seagrass species plays an important role in the ecological functioning of the area helping to stabilise the soft sediments, providing food and habitat for fauna and helping to maintain water quality of the nearshore area. The condition of *P. sinuosa* was not observed to be of great health with epiphytic 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 restrict the ability for BCH growth (Masini & Manning 1997, Lavery *et al* 2009). During the summer months, warmer waters, less aggressive currents and lower turbidity provide more suitable conditions for BCH to thrive, thus resulting in higher densities, as well as the ability for seasonal coloniser species (e.g., *H. ovalis*) to establish, a species that was observed, however only over a small spatial area.

Other larger benthic communities are rare. No large areas of macroalgae were observed. Dead and decaying algal and seagrass wrack accumulations were observed, mainly confined to the middle of the survey area. These may have been transported some distance by oceanographic conditions and will contribute to the eutrophic nutrient budget of the area (AECOM 2020; Bennett et al. 2021).

Attaching or sessile benthic organisms such as sponges and ascidians are also rare in the mapped area, due to the lack of suitable hard substrate for them to attach to (Schoenberg 2016). In this environment, the dominant hard substrate is debris, rock walls and other features (such as some moorings and navigation markers) which are all anthropogenic. AECOM (2020) note the presence of some coral species along rock walls (i.e., Sea Rocks), however the communities are small and not considered ecologically significant.

Finer sediments which were relatively compact were commonly located throughout the survey area. Very little bioturbation was evident within the sediments however there is a high likelihood that there is quite a presence of buried fauna species in these areas.

The data from this BCH investigation will support the project impact assessment from project activities, such as increased vessel movements, seabed levelling for increased draft and shading from the jetty facility. The

BCH mapping will also feed data into cumulative loss assessment calculations to support an application for a vegetation clearing permit due to seagrass loss from proposed seabed levelling activities.

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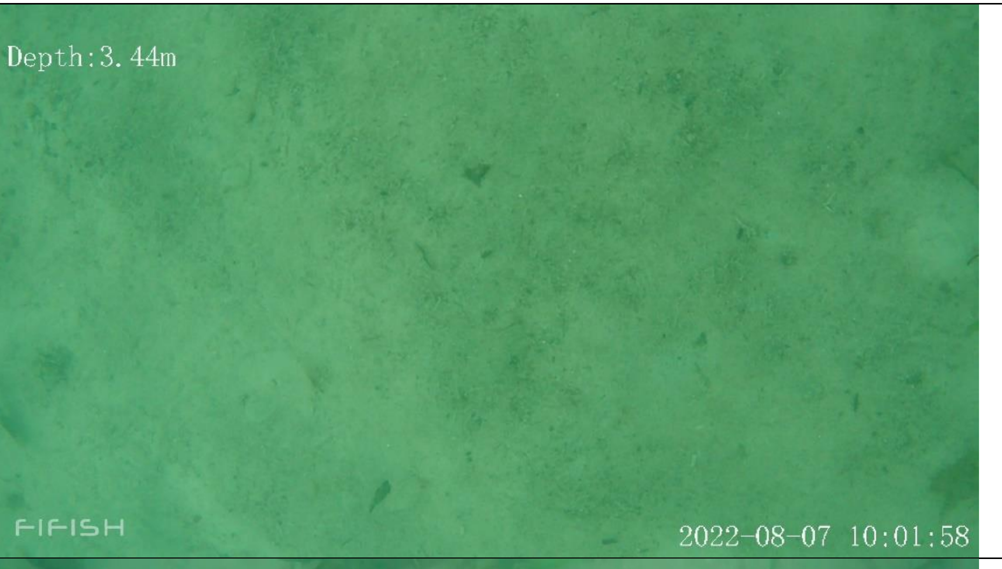
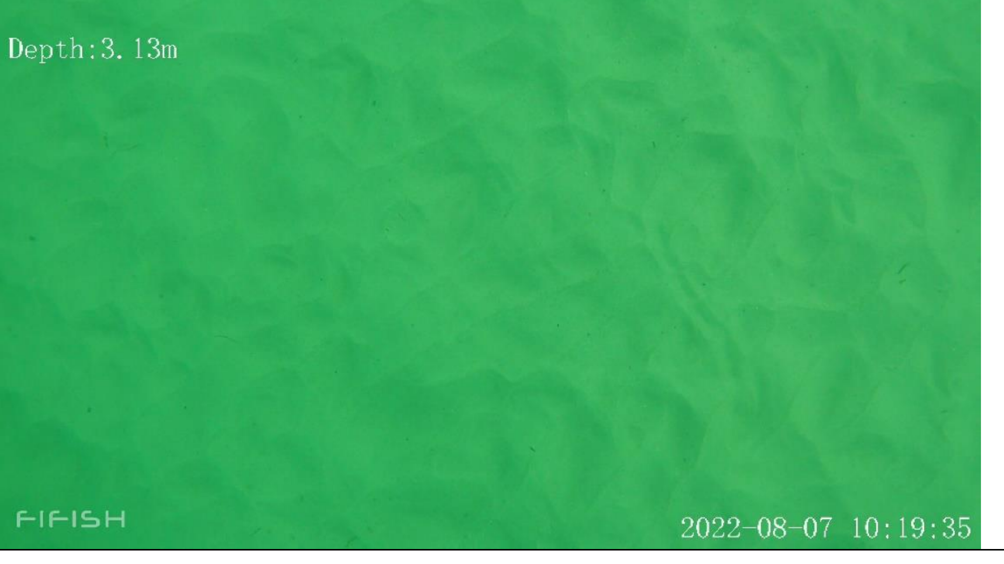
Appendix A – ROV Ground truth video

Tourist Jetty Survey Area	
DC1	
DC2	

DC3		Depth:2.55m FIFISH 2022-08-07 10:07:42	
DC4		Depth:2.11m FIFISH 2022-08-07 10:10:05	

DC5		Depth:3.14m FIFISH 2022-08-07 10:12:19	
DC6		Depth:3.04m FIFISH 2022-08-07 10:15:00	

DC7		Depth:3.33m FIFISH 2022-08-07 10:17:05
DC8		Depth:3.13m FIFISH 2022-08-07 10:19:35

DC9		Depth:4.28m
FIFISH
2022-08-07 10:21:51	
DC10		Depth:4.09m
FIFISH
2022-08-07 10:24:35	

DC11		Depth:4.29m FIFISH 2022-08-07 10:26:35	
DC12		Depth:4.11m FIFISH 2022-08-07 10:28:29	

DC13		Depth:3.27m FIFISH 2022-08-07 10:31:44	
DC14		Depth:2.45m FIFISH 2022-08-07 10:33:53	

DC15		Depth:2.31m FIFISH 2022-08-07 10:36:24	
DC16		Depth:2.01m FIFISH 2022-08-07 10:38:34	

DC17		Depth:2.01m FIFISH 2022-08-07 10:38:33
DC18		Depth:1.51m FIFISH 2022-08-07 10:42:44

DC19		

O2 MARINE

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