Appendix J Benthic Habitat Survey

Little Paradise Wharf Benthic Impact Assessment

Groote Holding Aboriginal Corporation

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EcOz Pty Ltd.
ABN: 81 143 989 039
Level 1, 70 Cavenagh Street
DARWIN NT 0800
GPO Box 381, Darwin NT 0800

Telephone: +61 8 8981 1100
Email: ecoz@ecoz.com.au
Internet: www.ecoz.com.au

RELIANCE, USES and LIMITATIONS

TABLE OF CONTENTS

Tables

Figures

EXECUTIVE SUMMARY

Groote Holdings Aboriginal Corporation (GHAC) is progressing a residential, commercial, logistics and utility development in the Little Paradise peninsula area of Groote Eylandt Projects (the Project). The Project is located on Groote Eylandt in a remote area off the eastern coast of the Northern Territory of Australia, in the Gulf of Carpentaria. The island is approximately 50 kilometres (km) off the eastern coast of Arnhem Land, about 630 km east southeast of Darwin and approximately 1,000 km west of Cairns. Groote Eylandt falls within the Anindilyakwa Land Council (ALC) area.

The Project includes a new wharf at the location of a disused rock wharf on the eastern side of the Little Paradise peninsula. The upgraded wharf will service both commercial and recreational vessels associated with tourism, mining, biosecurity, marine management, aquaculture and fisheries. The existing disused rock wharf at Little Paradise is proposed to be extended approximately 300 m further seaward as part of the Project.

To assess the potential impact of the wharf extension on the benthic community and benthic species, EcOz has utilised a benthic habitat assessment, using underwater video transects, completed on the 29th and 30th of October 2019. A total of eight coral genera and two seagrass species were identified at twelve sites around the proposed wharf extension at Little Paradise, Groote Eylandt. All recorded species are commonly found in intertidal and fringing reefs of Northern Australia and the Western Gulf.

We conclude that the proposed wharf extension will impact a small area of the benthic communities at the proposed site. These communities are common at the surveyed location. Furthermore, the proposed disturbed area supports only a small portion of potential foraging marine habitat. Consequently, the wharf extension will not have a significant impact on the benthic communities or marine biota generally.

1 INTRODUCTION

EcOz has been engaged by CDM Smith Australia Pty Ltd on behalf of Groote Holdings Aboriginal Corporation (GHAC) to report on previous benthic surveys complete off the north of Groote Eylandt and consider the impact of a proposed extension to the existing disused rock wharf at the little Paradise peninsula. The wharf extension is part of a wider community development project, termed the Little Paradise development, being progressed by GHAC. GHAC is an Aboriginal Corporation established to facilitate the economic development in accordance with Local Decision-Making Agreements formalised between the Anindilyakwa Land Council (ALC) and Northern Territory Government in 2018.

The Project includes a new wharf at the location of a disused rock wharf on the eastern side of the Little Paradise peninsula, Groote Eylandt (Figure 1 and Figure 2). The upgraded wharf will service both commercial and recreational vessels associated with tourism, mining, biosecurity, marine management, aquaculture and fisheries. The existing disused rock wharf at Little Paradise is proposed to be extended approximately 300 m further seaward as part of the Project.

The existing landing structure at Little Paradise is proposed to be extended approximately 300 m further seaward. The preliminary layout of the wharf structure is presented in Figure 1.

This report assesses the impact that the wharf extension will have on the benthic biota. To inform this, photographic surveys of the area to be disturbed was undertaken.

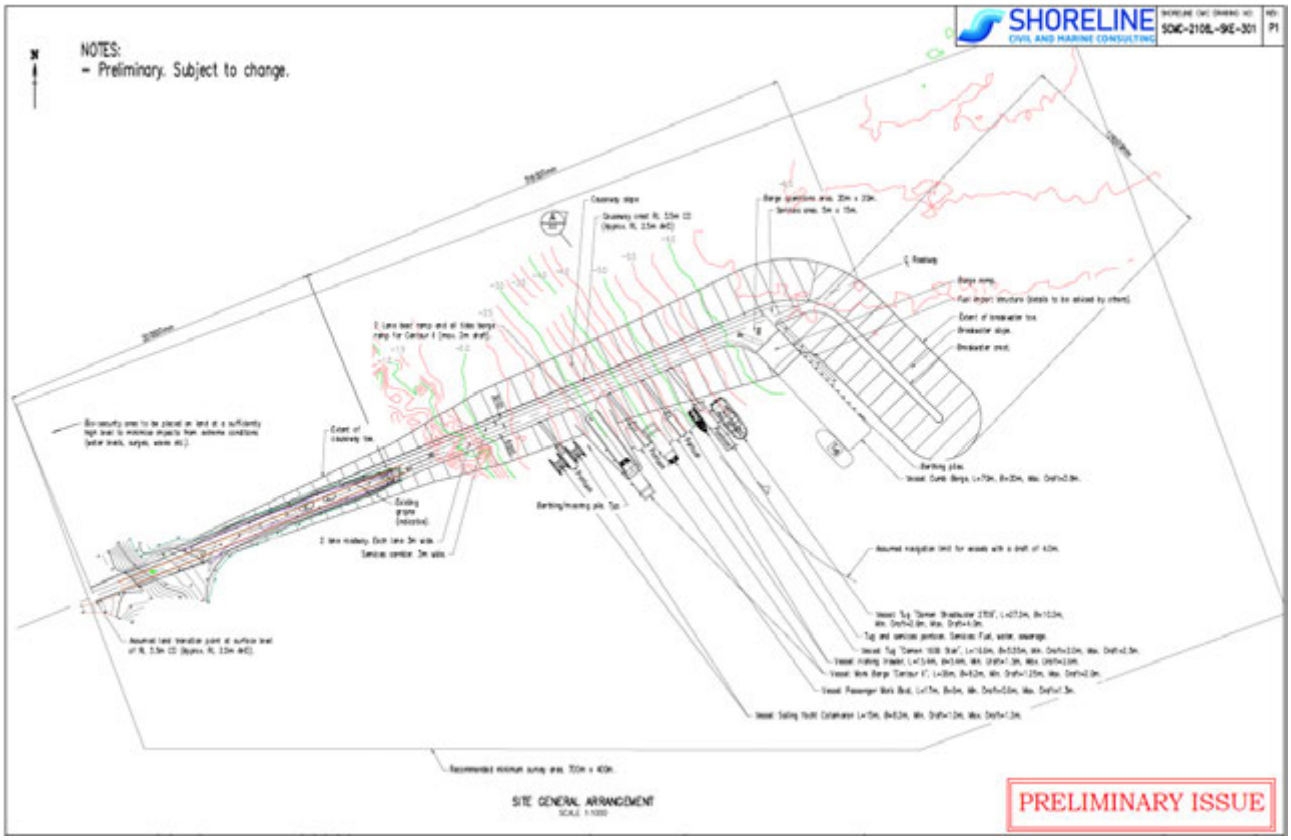
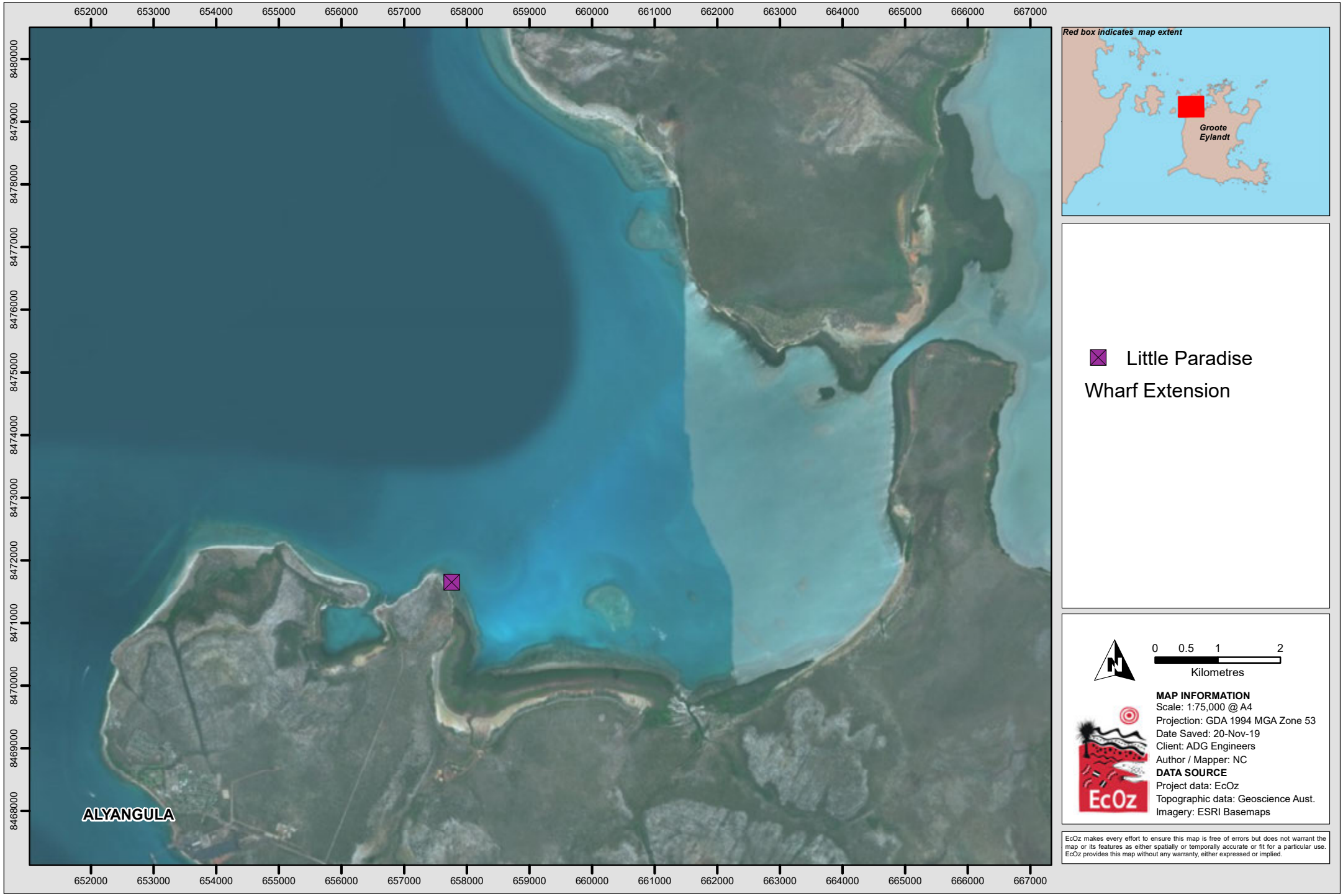


Figure 1. Preliminary Wharf Extension



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ19189 - Ecology assessment of barge landings\01 Project Files\Figure X-X. Map of barge landing locations.mxd

Figure 2. Project location

2 SURVEY METHODS

The survey was undertaken on the 29th and 30th of October 2019. At the proposed Little Paradise wharf extension photographic transects were taken along the proposed extension area and a similar transect was performed parallel (20-50 m away) as a control.

Photos were taken in a camera suspended in a frame giving the photograph 1m by 1m. The camera was weighted by a frame and manually lowered to the sea floor for two minutes to allow for sediment to settle and clear visual to be recorded, these were called sites and their GPS locations were recorded. Site locations were positioned approximately 10-15m apart spatially covering the disturbance footprint and adjacent habitat.

3 RESULTS

Twelve sites were photo surveyed in the two transects at the proposed wharf extension area. A total of eight coral genera and two seagrass species were recorded during the survey (Table 1). All recorded species are commonly found in intertidal and fringing reefs of Northern Australia and the Western Gulf (Kenyon et al 1997, Ferns 2016). Broadly, the surveyed area was hard bottom communities dominated by coral. The findings are explained in detail in the following sections.

The survey coincided with poor underwater visibility due to first rain for the season and engine propulsion disturbing sediments within the shallow intertidal environment, however enough visual information was collected to characterise each site.

Table 1. Species recorded during survey

	Little Paradise
Coral genera	*Acropora spp.* *Favia spp.* *Pectinia spp.* *Porites spp.* *Montipora spp* *Platygyra spp.* *Goniopora spp.* *Lobophyllia spp.*
Sea Grass species	*Enhalus acoroides* *Haophila ovalis*

3.1 Little Paradise

It is planned to extend the existing disused Little Paradise wharf to approximately 400 m offshore or, an extension of approximately 300 m. A total of eight sites were photographed at the potential wharf extension disturbance area and another four sites approximately 20 m parallel (Figure 3). Photographic assessment of benthic habitat recorded a total of eight coral genera and two seagrass species *Enhalus acoroides* and *Halophila ovalis* (Table 1).

Benthic substrate of coarse sand and shell grit typical of fringing reefs were recorded throughout the depths and shallows of the benthic survey. Habitat was consistent between the proposed disturbance area and adjacent undisturbed communities, comprised of seagrass, sponge and rocky coral. Habitat transition was evident in both benthic and aerial surveys. Hard bottom rocky coral common to the area was recorded immediately offshore the existing disused wharf. Deeper water habitat was characterised by sandy bottom and sparse seagrass, Halophila ovalis.

While the 2019 survey benthic photo points did not include the full seaward extent of the proposed wharf, survey points P4 through P8 (Figure 3) were considered representative of the generally homogenous benthic environment beyond the fringing rocky reef structure.

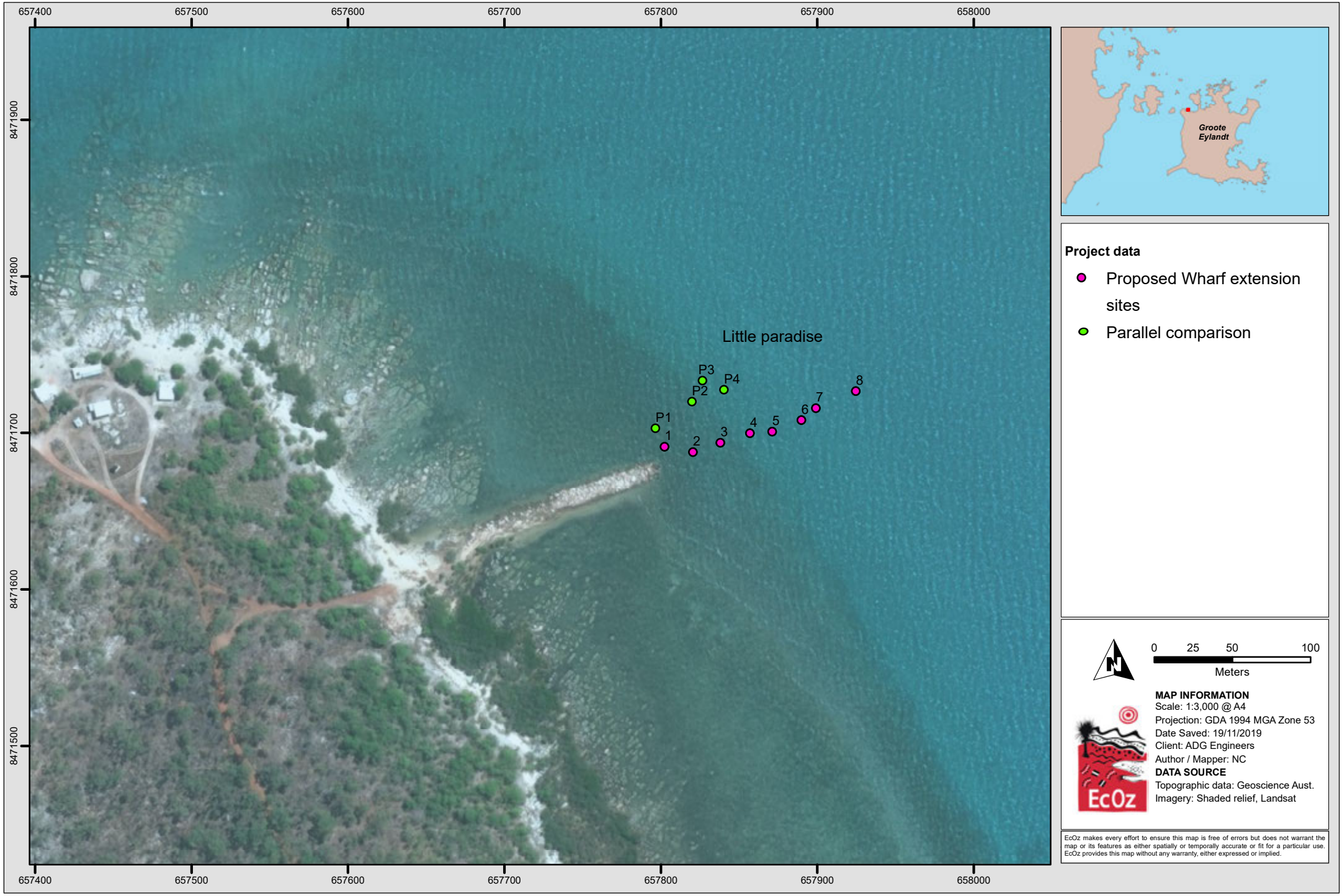


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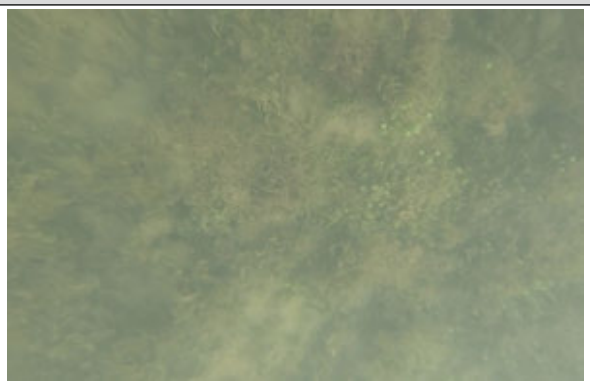
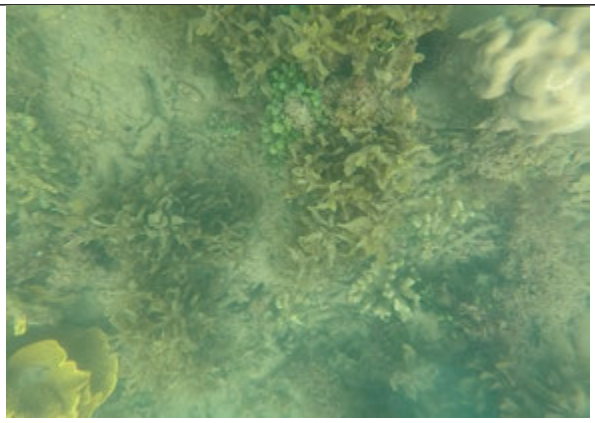
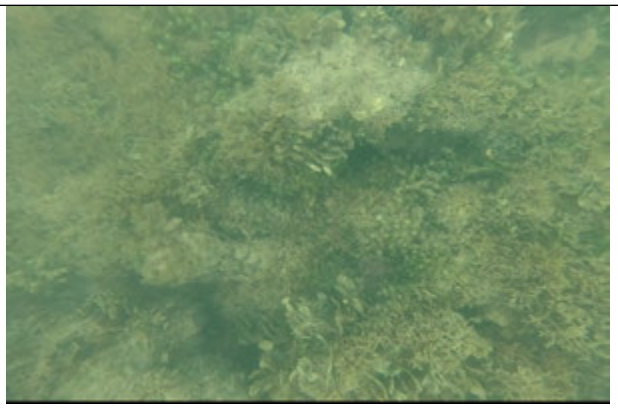
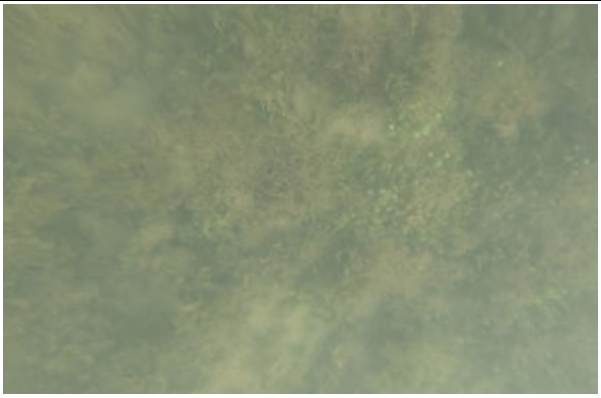
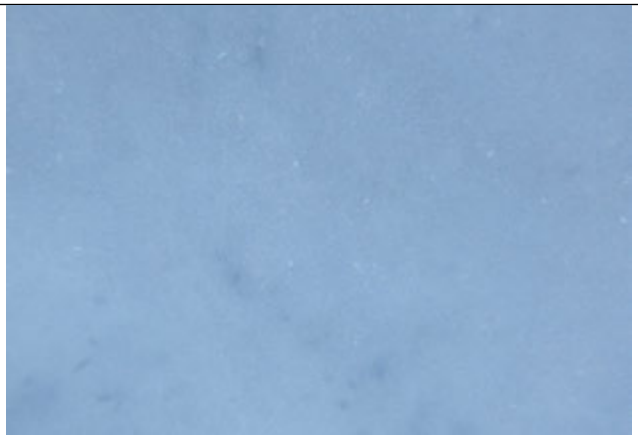
Figure 3. Little Paradise survey sites

The locations of the photographs below are shown in Table 2, with the uppermost photo below the site closest to shore.

Table 2. Benthic survey photograph results

Proposed wharf area	Parallel comparison
	
	
	
	

Proposed barge landing site	Parallel comparison
	N/A
	N/A
	N/A
	N/A

4 CONCLUSION

The wharf extension at Little Paradise will impact a small area of the benthic communities at the proposed extension area. These communities are common at the surveyed location and across the gulf. Furthermore, the proposed disturbed area supports only a small portion of potential foraging marine habitat. Consequently, we conclude that the wharf extension will not have a significant impact on the benthic communities or marine biota generally.

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EcOz Environmental Consultants

EcOz Pty Ltd.
ABN 81 143 989 039

Level 1, 70 Cavenagh St,
GPO Box 381,
Darwin, NT 0801

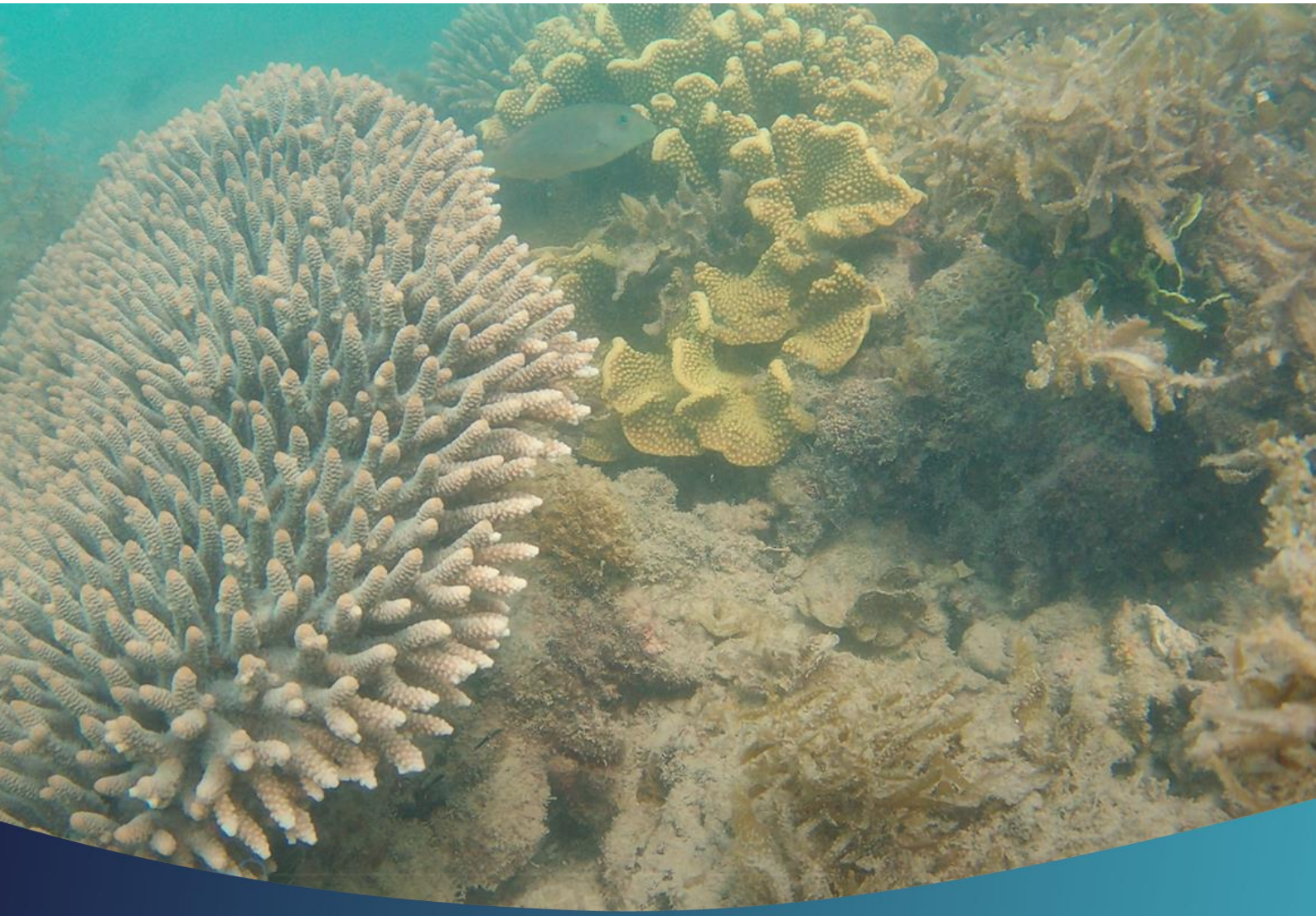
T: +61 8 8981 1100
E: ecoz@ecoz.com.au

www.ecoz.com.au

APPENDIX L-2

Benthic Communities and Habitats of Little Paradise, Groote Eylandt

Technical Memorandum



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ISSUE DATE: 5th October 2022

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Date	05/10/2022	Reference	T220002
To	Tim Kinny	Email	kinnytp@cdmsmith.com
From	Max Wellington	Email	Max.Wellington@o2Marine.com.au
Subject	Technical Memo – Benthic Communities and Habitats of Little Paradise, Groote Eylandt		

Introduction

Groote Holdings Aboriginal Corporation (GHAC), are proposing to construct and operate a marina in a coastal area of Groote Eylandt as part of their Little Paradise Development (LP; Groote Eylandt). Groote Eylandt is situated within the North Marine Region in the Gulf of Carpentaria system and part of the North Central West subsystem (DEWHA, 2007). The North Marine Region is characterised as shallow, with most depths being less than 200 metres, and maximum depths within the Gulf of Carpentaria reaching only 70 metres (DEWHA, 2007).

The geomorphology of the Gulf is dominated by a low-gradient, depositional basin that formed over the broad, seaward sloping shelf during sea level low stands (DEWHA, 2007). There are smaller areas in the north, east and west where carbonate banks have formed in situ under relatively recent marine conditions (DEWHA, 2007). Submerged reefs, many of which support living corals, are also an important feature of the North Marine Region but have only recently been investigated. There have been few studies on the benthic habitat close to marine elements of the Project and in the North Central West subsystem of the Gulf of Carpentaria, however the microtidal range allows for the development of more abundant and diverse invertebrate and macroalgal assemblages on the rocky intertidal and shallow subtidal areas (DEWHA, 2007).

Corals and Corallimorpharians are present in the area as are submerged rocky reefs (DEWHA, 2007). Previous studies have identified benthic habitats close to the Little Paradise Marina location and noted the presence of seagrass, coral, patch reefs, rock platforms, coarse sand, and shell grit (Davies et al., 2020; EcoOz, 2019). EcoOz (2019) have identified several coral species, belonging to 5 families (Lobophylliidae, Poritidae, Merulinidae, Acroporidae, and Faviidae), and 2 seagrass species, *Enhalus acoroides* and *Halophila ovalis*, in the waters off Little Paradise. However, no studies have mapped the benthos in this area in a comprehensive manner using scanning technology.

Objectives

The objective of this technical memorandum is to characterise and map the benthic communities and habitat (BCH) within the marine environment which may be impacted by further development of the Little Paradise marina. O2 Marine (O2M) have been engaged by CDM Smith Australia Pty Ltd (CDM Smith) to undertake the survey to identify benthic communities and habitats.

The scope of this technical memorandum includes:

- Summary of the existing environment within the survey area and any existing benthic habitat mapping;
- A description of the field survey and analysis methodology;
- Mapping of survey effort and presentation of interpolated habitat maps;
- Description of key habitats identified in the BCH maps and a breakdown of each category; and
- Discussion and interpretation of BCH distribution types within the survey area.

Survey Methods

The field survey was conducted over 3 days (27/05/22, 01/06/22, and 02/06/22) by two qualified and experienced marine scientists from O2M. The BCH mapping fieldwork involved two primary survey techniques:

- Side scan sonar (SSS) to capture textural information over a series of broad swaths through the study area; and
- Drop camera/ROV to determine the type of benthic communities present and 'ground truth' the SSS data.

In total, eight (8) SSS transects, covering a length of 10.5 km, and fifty-two (52) drop camera videos were completed.

The SSS system used in this survey was a portable dual channel 450 kHz towed system (Tritech Starfish 452F) that was operated through a topside control unit, using the acquisition software Scanline V2.1. While immersed in the water column, the SSS emits and records acoustic waves that are reflected by the seabed. High accuracy (<1 m) geographic positioning of the SSS data was acquired using a non-differential GPS system (Hemisphere R120 integrated with OmniSTAR A20 receiver antenna). Real-time observations of the sonar imagery were used to identify different BCH types. Coordinates of targeted features were marked using a handheld Garmin GPS to be assessed as part the subsequent habitat validation via ROV survey. A FiFish V6 ROV was used to record high-definition video footage. The ROV was deployed at each target location and operated by a scientist using the top-side controls. The ROV was 'dropped' to the seabed, with the operator recording a minimum of 60 seconds of benthic video footage at each site. Vessel drift was controlled by the skipper to maintain position and allow the recording of good quality footage. Date/time, GPS coordinates, depth (m), dominant BCH, and general comments, were recorded during field survey to aid in post-processing analysis.

The SSS data files were uploaded into Sonarwiz version 7.2 for post-survey processing. The processed side-scan mosaic of all transects were exported for analysis by a GIS specialist. The mosaic was classified based on the backscatter signature, with similar areas grouped and delineated from adjacent different areas. Towed benthic video target locations and their subsequent classification were overlaid onto the grouped side-scan data. To assign a habitat classification to backscatter classes, 'acoustic supervised classification' was performed using the drop camera footage collected.

Video footage from each target video assessment location was visually analysed and classified by a qualified marine scientist. The identified BCH was split into habitat classes based on substrate type, dominant biological community, species distribution and density. BCH descriptors were completed in accordance with the Collaborative and Automated Tools for Analysis of Marine Imagery (CATAMI) standard classification scheme (Althaus et al., 2015) for scoring marine biota and physical characteristics from underwater imagery, which includes:

- Relief;
- Substrate;
- Bedforms;
- Visual estimate of percent cover of benthic flora and fauna; and
- Dominant and sub-dominant taxa.

Survey Results

The Little Paradise survey area covered 88.3 hectares (ha) and was located on the northern coast of Groote Eylandt, ~0.6 kilometres wide and ~1.6 kilometres long. The survey area is aligned parallel to the shoreline and incorporates the outer edge of a shallow reef platform that fringes this part of the island (Figure 1). Water depths ranged from 1 – 9 metres within the areas surveyed, with the shallowest sites inshore adjacent to the reef and deepest sites offshore. A description of the identified BCH categories, as well as example images, are presented in Appendix A, Table 2. Table 1 (below) presents the relative cover (m^2, km^2, ha) of each BCH category. The fringing reef had a mixed assemblage dominated by hard corals and macroalgae (High cover coral/macroalgal reef) which covered an area of 2.1 ha (2.37%). Together, hard coral dominated communities (moderate cover coral field, high cover coral/macroalgal reef, high cover coral reef) occupied 8 ha within the area surveyed. The reef edge formed the outer edge of a wide and shallow reef platform which was not surveyed due to the limited access by vessel and equipment. However, visual observations made from the vessel reported that hard corals were the dominant benthic biota, followed by macroalgae. Inshore of the reef platform, extensive stands of mangroves were observed in the intertidal zone, particularly to the south-west of the survey area. Moderate cover coral field was reported predominantly in the north-west of the survey area, where the fringing reef edge became less pronounced. Rather than an abrupt change in BCH communities (i.e., steep reef edge to flat sand) a gradual transition was seen from higher cover coral inshore, to moderate cover coral field away from the shore. Inshore sites adjacent to the reef in the south of Little Paradise survey area were reported to have low and high cover seagrass communities, with the highest cover in the south. Sparse seagrass and Sparse filter feeders occupied 10.8 % and 18.47 % of the survey area, respectively. Sites over 300 metres offshore of the fringing reef were dominated by bioturbated sand/silt which was the most reported BCH category at LP, occupying 53.82 % of the survey area (47.5 ha).

Table 1 Each identified BCH category presented in area (m^2, km^2, and ha), and relative cover (%).

BCH category	Area (m2)	Area (km2)	Area (ha)	Relative Cover (%)
Bioturbated sand/silt	475195	0.4752	47.5	53.82
Sparse filter feeder	163117	0.1631	16.3	18.47
Sparse seagrass	95393	0.0954	9.5	10.80
Moderate cover coral field	54779	0.0548	5.5	6.20
Low cover seagrass/macroalgae	32190	0.0322	3.2	3.65
Sand/shell hash	24660	0.0247	2.5	2.79
High cover coral/macroalgal reef	20961	0.0210	2.1	2.37
High cover seagrass	11569	0.0116	1.2	1.31
High cover coral reef	4011	0.0040	0.4	0.45
Low cover macroalgae/sponge	1105	0.0011	0.1	0.13
Total	**882981**	**0.8830**	**88.3**	**100**

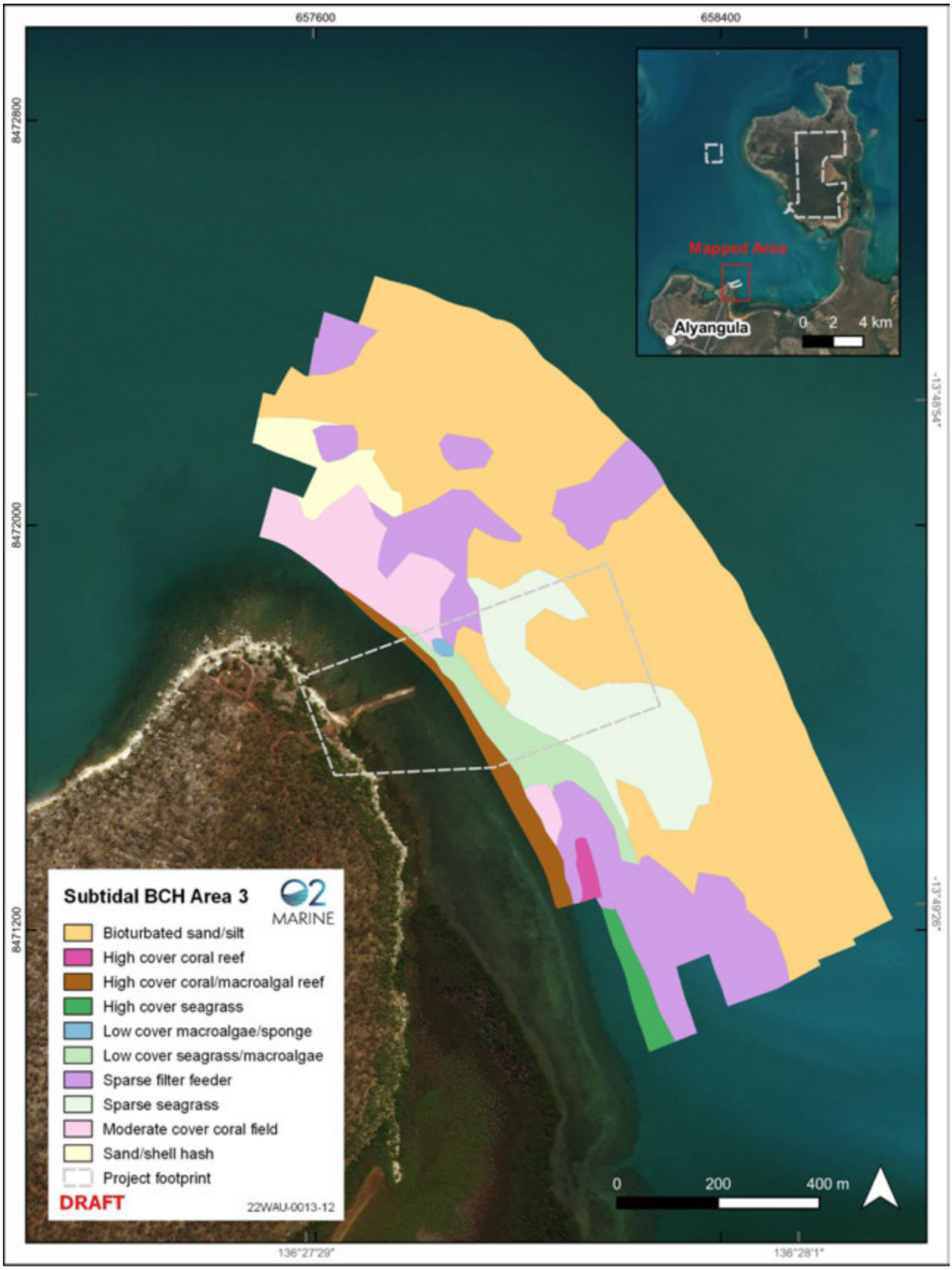

Figure 1 Little Paradise Marina BCH map presenting the relatively cover of 10 BCH categories and proposed project footprint.

Discussion

Little Paradise survey area showed similar physical and biotic distribution patterns to the Barge Loading Facility (BLF) (see O2 Marine, 2022), with several minor differences. Both survey areas were adjacent to shorelines from which a shallow reef platform extends. An interesting difference was the communities on the reef edge and reef platform, with mixed macroalgae/coral reef communities at Little Paradise, while in the BLF, equivalent communities were almost exclusively coral, with a much lower proportion of macroalgae. This illustrates that while environmental and physical conditions at each survey area appear very similar, equivalent biological communities are not necessarily the same. The drivers of these differences are not immediately clear, although differences in nutrient and dissolved carbon levels in water may be a factor, as indicated by the extensive areas of mangrove adjacent to Little Paradise. Other potential environmental drivers for differences in reef communities are the exposure to prevailing wind and wave patterns, which is affected by shoreline aspect. Little Paradise is an east facing shoreline and is exposed to prevailing easterly winds in the region (Hansen Bailey, 2015), while the BLF has a west facing shoreline, and has a lower exposure to wave action.

Inshore of the reef platform edge was inaccessible due to water depth, however observations from the vessel by field scientists indicated that a similar community extended to the shore. As this was not mapped using survey methodology, the coral/macroalgal communities inshore of the reef edge were not included in calculation and the actual cover of this BCH category is higher than reported (2.37 ha). This is particularly relevant for estimating cumulative loss of BCH in later project stages. Traditional Ecological Knowledge (TEK) mapping reports the presence of the coral reef (Yerrimilya) platform at Little Paradise, which is valued by Traditional Owners and a food source i.e., fish and clams (Davies et al. 2020). A range of tropical reef-associated fish were observed on video transects along the reef edge and over the moderate cover coral field.

Light availability was observed as a major driver of benthic primary producers (corals, seagrass, macroalgae), with these taxa appearing to be restricted to depths less than 7 metres. As depth increased, total cover of photosynthetic taxa reduced, with high cover coral/macroalgae in shallow areas and sparse seagrass found further offshore. In depths greater than ~7 m, sparse filter feeders over soft substrate and bare areas of bioturbated sand were dominant. Extent and size of burrows in bioturbated areas were presumably a result of blue swimmer crabs (*Portunus pelagicus* and *P. armatus*) and mud crabs (*Scylla serrata*).

Filter feeders reported offshore were predominantly one species of Octocorallia (Orders: Alcyonacea, Helioporacea, and Pennatulacea). Octocorals are colonial organisms and are found worldwide, from polar seas to the equatorial tropics and from intertidal flats to over 6100 m in depth (Williams, 2011). These octocorals attach to soft substrates and acquire nutrients from passing particles and plankton. While the dominant species of sea pen was not identified further than Order level, it was prevalent in areas mapped as sparse filter feeders throughout Bartalumba Bay.

Conclusion

The existing BCH in the Little Paradise area is typical of other areas surveyed in tropical, turbid waters, with high variability, cover, and productivity prevalent in shallow waters (<7 m), but quickly becomes far less productive and with sparse biota below these depths. It must be noted that majority of the project footprint

tends to be dominated by the less productive BCH, however, highly productive, and significant BCH are in the vicinity of the project footprint.

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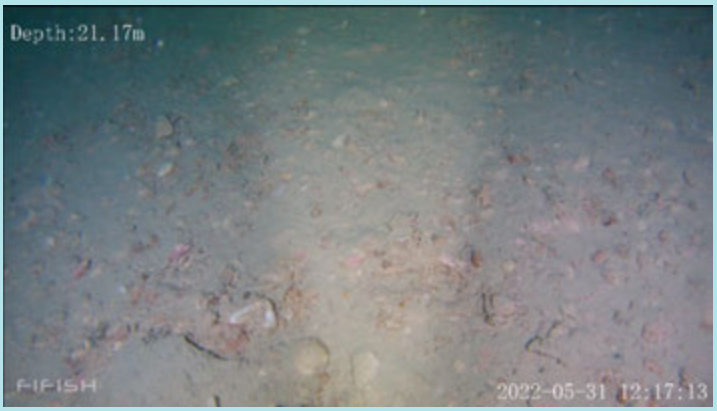
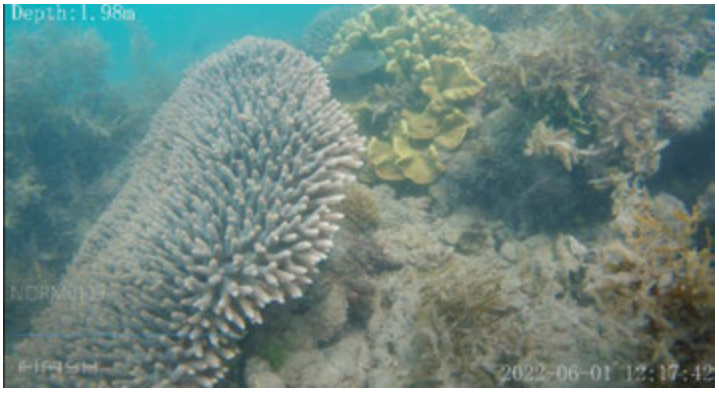
Appendices

Appendix A. BCH table

Table 2 Description and example image of all 10 BCH categories identified within LP survey area.

BCH Category	Description	Example Image
Bioturbated sand/silt	Classified based on the lack of attached sessile biota (<2% cover) and presence of bioturbation. Sediment appears to be fine sand and silt. Level of bioturbation varied, with a variety of small and large burrows.	
Sparse filter feeder	For this report, filter feeders are a broad group of invertebrates including sponges, soft corals and ascidians. The substrate was generally bioturbated sand/silt, however were grouped as sparse filter feeders if benthic cover was between 2 -5%.	
Sparse seagrass	Sparse seagrass <5% found on sand dominated bioturbated substrate. Limited visibility reduced the ability to identify the seagrass taxonomic groups.	

Moderate cover coral field	Predominantly found at the seaward edge of high cover coral reef in a transitional zone where sandy habitats and coral habitats were mixed. Relief generally less than 1 m. Total benthic cover ranged from 5 – 50%.	
Low cover seagrass/macroalgae	Characterised by a low cover of seagrass or macroalgae, or a mixture of both. Total benthic coverage was 5 – 20%. Seagrass taxa in this BCH category were predominantly species of *Halophila*.	
Sand/shell hash	Based on the presence of broken and whole pieces of calcium carbonate shell material as well as sand.	
High cover coral/macroalgal reef	Lower hard coral cover than 'High cover coral reef' and has high macroalgal cover mixed amongst coral colonies. Formed a steep or vertical reef structure on seaward edge of a larger reef platform.	

High cover seagrass	High cover of seagrass without the presence of high densities of macroalgae. Seagrass meadow densities ranged from 20 – 25%. Generally reported in shallow sandy areas.	
High cover coral reef	Structurally complex, moderate relief and dominated by a high cover (40 – 80%) of scleratinian (hard) corals. Typically found in shallow waters (<4 m) and represented the seaward edge of coral reef systems which fringe the coastline.	
Low cover macroalgae/sponge	Macroalgal dominated habitats interspersed with occasional sessile sponge.