Hydrobiology

RIDLEY MAGNETITE PROJECT – ATLAS IRON

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BENTHIC COMMUNITIES AND HABITAT SURVEY

P22028

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EXECUTIVE SUMMARY

Hydrobiology completed a survey of the Benthic Communities and Habitats along the proposed desalination pipeline for the Atlas Iron Ridley Magnetite Project in September 2022. The proposed desalination pipeline is planned to be constructed 57 km east of Port Hedland, Western Australia. The desalination plant will provide the necessary freshwater for the magnetite processing. The survey aimed to categorise the Benthic Communities and Habitats surrounding the proposed pipeline to assist in the future planning of the Ridley Magnetite Project. The project involved the collection of benthic habitat images at 62 sites, either by Remote Operated Vehicle (ROV) transects or using a drop camera.

Overall, the area of the proposed pipeline was dominated by sand, macroalgae and sponge. Nearly half of the sites had seagrass cover and eight sites were identified as having coral cover. Two seagrass species were identified (*Halophila decipiens* and *Halophila spinulosa*) and seagrass density was categorised into three levels of cover (light, medium and heavy), with the medium coverage being the most common among the seagrass sites.

Prior to commencing fieldwork, Hydrobiology completed a desktop review of the available regional BCH data to help inform the survey design. The desktop review included bathymetry data collected in July 2022 (MMA Offshore, 2022). Four distinct seabed features were identified by the bathymetry survey, these features were incorporated into the survey design and investigated with ROV transects. Three of the four seabed features were observed to have at least some hard coral cover, however, only feature KP9.490 had a hard coral >50%.

The backscatter data was also used to identify potential substrate transition zones. Three examples of these transition zones were identified prior to the commencement of fieldwork and were included within the BCH survey design. While there was no specific transition pattern identified there is an indication that lower reflectivity values could indicate suitable substrates for benthic primary producers.

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1. INTRODUCTION

1.1 BACKGROUND

Atlas Iron Pty Ltd is proposing a desalination plant with associated offshore pipeline to support the Ridley Magnetite Project. The proposed pipeline is located approximately 57 km east of Port Hedland, Western Australia. As a part of the environmental approvals process Atlas Iron has proposed a suite of studies to inform the environmental impact assessment process.

Surveys of the Benthic Communities and Habitats (BCH) were completed by Hydrobiology between 23rd – 26th September as a part of an environmental baseline survey for the proposed desalination pipeline for the Ridley Magnetite Project. Prior to Hydrobiology's field work, a bathymetry survey was completed in July 2022. This survey identified four potential areas of interest that were investigated along with the planned BCH sites.

1.2 DESKTOP REVIEW

Prior to commencing fieldwork, Hydrobiology completed a desktop review of the available regional BCH, bathymetry, and backscatter data to inform the BCH survey design. The benthic habitat within the vicinity of the proposed pipeline was assessed using the following:

- Ridley Magnetite Bathymetry Survey (MMA Offshore 2022; backscatter data provided to Hydrobiology)
- Port Hedland Spoilbank Marina EPA Proposal– Benthic Communities and Habitat (O2 Marine, 2019)
- Port Hedland Outer Harbour EPA Proposal – Subtidal Marine Benthic Habitat Survey (SKM, 2009)
- Port Hedland Outer Harbour EPA Proposal – Marine Coastal Intertidal Benthic Habitat Impact Assessment (SKM, 2011)
- Asian Renewable Energy Hub EPA Proposal – Benthic Communities and Habitat Survey, Eighty Mile Beach (BMT, 2018)

The seabed level in the Port Hedland region deepens gradually with distance from the coast (between 0.5 to 1 m every km). The study area is located entirely upon the continental shelf with an approximate depth range of 0.4 m to 12.4 m LAT. The subtidal habitats of Port Hedland are characterised by extensive plains of sand, silt, and rubble with low relief limestone ridgelines of hard pavement, including hard corals, macroalgae, sponges and soft corals (O2 Marine, 2019).

There are infrequent occurrences of seagrass in the Port Hedland region. Seagrasses within the region are predominantly ephemeral species such as *Halophila ovalis*. Other species known to occur in the Port Hedland region include *H. decipiens, Thalassia hemprichii* and *Halodule uninervis* (Walker & Prince, 1987). Previous mapping of seagrass within the Port Hedland region found that seagrass cover is sparse to moderate (5 – 50% cover) indicating that seagrass distribution is spatially and temporally dynamic.

The Port Hedland region is considered to have low species richness and abundance of corals. The dominant coral species in the region are Faviidae and Poritidae from the genus *Turbinaria*. *Turbinaria spp.* are considered well adapted to high turbidity and high sedimentation environments which is typical of the subtidal environments in Port Hedland as well as having considerable bleaching resistance (Marshall & Baird, 2000; SKM, 2009; Lafratta et al., 2016).

BCH modelling in the vicinity of the proposed pipeline was completed as a part of the EPA referral for Port Hedland Outer Harbour Development (SKM, 2009), with some areas of this habitat modelling overlapping with the area of the proposed pipeline. Subtidal habitat mapping was developed from LiDAR, field observations and underwater video of marine benthic habitat distribution. Modelling included two substrate types, hard and soft substrate. Identification of hard substrate was used to identify areas that would potentially facilitate the growth of benthic primary producers such as seagrass, coral, sponge or macroalgae. Modelling was produced for the area around Little Turtle Island, in the vicinity of the offshore diffuser site. The habitat modelling and in-field surveys found the substrate in this area was predominantly sand, rubble and rock (90% sediment). Benthic Primary Producers in the area were predominantly macroalgae (0.0-14.7%) and hard corals (8.4-17.8%; encrusting and massive species), with <5% sponges (SKM, 2011).

Backscatter data collected during acoustic seabed surveys is commonly considered a qualitative, high-level indicator of the possible nature of the seafloor, providing information on the hardness of the seafloor. Backscatter intensity values (dB) correspond to the seabed reflectivity, where a lower dB value corresponds to lower seabed reflectivity (MMA Offshore, 2022).

Hydrobiology was provided backscatter data from the July 2022 multibeam bathymetry survey (MMA Offshore, 2022). This survey identified four areas with distinct seabed features to be investigated, these four features were included in the survey design and were investigated using ROV transects (Table 1-1 and Figure 1-1)

The backscatter data was also reviewed to identify any potential transition zones of the substrate along the proposed pipeline. The backscatter intensity values (dB) were colour coded to illustrate the distribution of seabed reflectivity within the study area. Three example transition zones (one inshore and two offshore) were identified by selecting distinct areas of the backscatter (dB) that appeared to have similar seabed reflectivity values (Figure 1-1). Histograms were produced to visualise the distribution of dB values in each transition zone (Appendix A).

The inshore example transition zone contains three of the four isolated seabed features (Table 1-1) identified in the data and has the highest frequency of dB values between -28 – -26 dB. Offshore transition zone 1 has the highest frequency of dB values between -22 - -21 dB. Offshore transition zone 2 had the highest frequency of dB values at -30. The dB values of these three transitional zones illustrate potential differences in the substrate along the proposed pipeline and as such, the BCH survey aimed to include specific sites to investigate these potential transition zones.

Table 1-1 Overview of MMA Seabed features

Target	Northing	Easting	MMA Offshore descriptor
KP9.490	693520	7776348	A change in the seabed type occurs at approximately KP9.490
KP14.100	697824	7774673	Isolated seabed feature observed inshore of the 5m contour.
KP14.410	698117	7774579	Isolated seabed feature observed inshore of the 5m contour.
KP14.915	698588	7774408	Isolated seabed feature observed inshore of the 5m contour.

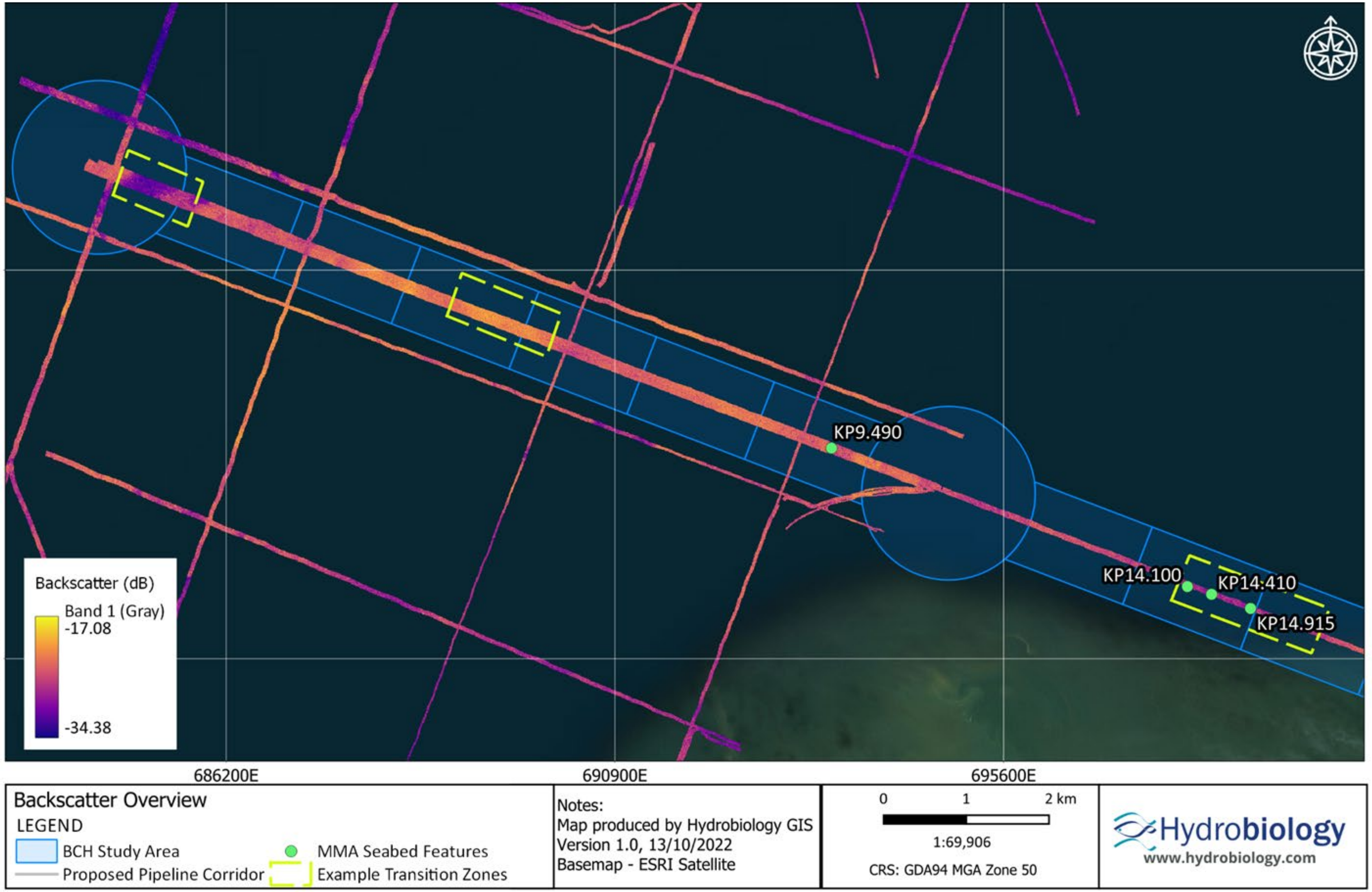


Figure 1-1 Overview of the backscatter intensity (dB) at the proposed desalination pipeline with isolated seabed features and potential transition zones

2. METHODS

2.1 BENTHIC COMMUNITIES AND HABITAT SURVEYS

Benthic Communities and Habitat Surveys were conducted between 23rd – 26th September 2022 at the site of the proposed desalination plant pipeline, approximately 57 km east of Port Hedland. In total, 47 ROV transects, and 15 Drop Camera sites were completed. Two transects were completed at site KP9.490 to provide a comprehensive assessment of the coral habitat (Table 2-1).

2.1.1 REMOTE OPERATED VEHICLE AND DROP CAMERA

Benthic Communities and Habitat (BCH) surveys were performed with a Remote Operated Vehicle (ROV). Hydrobiology used the FiFISH V6 Plus ROV with a GoPro Hero Black 9 mounted to the underside of the unit with the lens faced to the seafloor. The GoPro was set to take one photo every second with a wide-angle field of view (FOV).

After navigating to each BCH site, the ROV was deployed at the surface and then dropped to the seafloor where the depth was recorded. The ROV was then lifted to approximately 30 – 40 cm above the seafloor (depending on the visibility at the site) and fixed at this height using the ROV's altitude locking system. The ROV was driven on a set bearing for five minutes and a consistent speed (approximately 13 m per minute). The average length of each transect was 66 m. Geospatial coordinates were taken at the start and end of each ROV transect using a Gamin eTrex 10. Arrows illustrate the set bearing taken for each ROV transect.

Due to both unfavourable conditions and time constraints, BCH surveys at 15 sites were completed using a drop camera frame (). As with the ROV, the drop camera system comprised of a GoPro Hero 9 set to take one photo every second with a wide angle FOV. The GoPro is mounted to 50cm x 50 cm quadrat frame such that the entirety of the quadrat is within the focal length of the camera underwater. The drop camera frame was left on the bottom for a minimum of 10 seconds per drop. The duration for each drop-camera deployment will be such that at least 10 high quality images are captured for analysis per site. Geospatial coordinates were collected for each drop camera site Table 2-1).

Table 2-1 Coordinates (latitude and longitude, Datum: WGS84), survey method and the approximate depth (m) for each BCH transect)

Site Name	Latitude	Longitude	Study Site	Equipment	Depth (m)
BCH_07	-20.1338	118.9327	BCH Corridor	ROV	1.5
BCH_08	-20.1295	118.9344	BCH Corridor	ROV	1.9
BCH_09	-20.1253	118.936	BCH Corridor	ROV	2
BCH_10	-20.1314	118.9258	BCH Corridor	ROV	2.6
BCH_11	-20.1229	118.9292	BCH Corridor	ROV	3.6
BCH_12	-20.1247	118.9207	BCH Corridor	ROV	3.3
BCH_13	-20.1266	118.9122	BCH Corridor	ROV	3.2
BCH_14	-20.1181	118.9155	BCH Corridor	ROV	3.8
BCH_15	-20.1199	118.907	BCH Corridor	ROV	4.3
BCH_16	-20.1218	118.8985	BCH Corridor	ROV	6.9
BCH_17	-20.1133	118.9018	BCH Corridor	ROV	8.2
BCH_18	-20.1151	118.8933	BCH Corridor	ROV	8.2
BCH_19	-20.117	118.8848	BCH Corridor	ROV	8.3
BCH_20	-20.1085	118.8881	BCH Corridor	ROV	9.2
BCH_21	-20.1103	118.8796	BCH Corridor	ROV	9
BCH_23	-20.1037	118.8745	BCH Corridor	ROV	9
BCH_26	-20.0997	118.8494	BCH Corridor	ROV	7.5
BCH_26a	-20.0997	118.8566	BCH Corridor	ROV	7.5
BCH_26b	-20.0969	118.842	BCH Corridor	Drop Camera	7.5
BCH_29	-20.095	118.8357	BCH Corridor	Drop Camera	5.2
BCH_29a	-20.0915	118.8279	BCH Corridor	Drop Camera	5.2
BCH_32	-20.0902	118.8221	BCH Corridor	Drop Camera	9.2
BCH_32a	-20.0875	118.8147	BCH Corridor	Drop Camera	9.2
BCH_35	-20.0854	118.8084	BCH Corridor	Drop Camera	-
BCH_35a	-20.082	118.7984	BCH Corridor	Drop Camera	-
BCH_38	-20.0806	118.7947	BCH Corridor	Drop Camera	-
BCH_38a	-20.0787	118.7865	BCH Corridor	Drop Camera	-
BCH_41	-20.0758	118.781	BCH Corridor	Drop Camera	-
DIF_Drop_1	-20.1026	118.8694	BCH Diffuser	Drop Camera	7.3
DIF_IN_01	-20.0958	118.8625	BCH Diffuser	ROV	8.5
DIF_IN_01a	-20.1096	118.8774	BCH Diffuser	ROV	8.1
DIF_IN_02	-20.0962	118.8683	BCH Diffuser	ROV	8.1
DIF_IN_02a	-20.1107	118.8815	BCH Diffuser	ROV	8.3

Site Name	Latitude	Longitude	Study Site	Equipment	Depth (m)
DIF_IN_03	-20.0992	118.8724	BCH Diffuser	ROV	8.5
DIF_IN_04	-20.1005	118.8634	BCH Diffuser	ROV	9.3
DIF_IN_05	-20.1023	118.8684	BCH Diffuser	ROV	8.9
DIF_IN_06	-20.1017	118.8551	BCH Diffuser	ROV	8.1
DIF_IN_07	-20.1035	118.86	BCH Diffuser	ROV	8.7
DIF_IN_08	-20.1051	118.8645	BCH Diffuser	ROV	9.4
DIF_IN_09	-20.1067	118.8695	BCH Diffuser	ROV	9.7
DIF_IN_10	-20.1083	118.8739	BCH Diffuser	ROV	8.4
DIF_IN_11	-20.1076	118.8602	BCH Diffuser	ROV	8.2
DIF_IN_12	-20.1096	118.8655	BCH Diffuser	ROV	9
DIF_IN_13	-20.1109	118.8566	BCH Diffuser	ROV	7.2
DIF_IN_14	-20.114	118.8612	BCH Diffuser	ROV	8.8
DIF_OUT_10	-20.0737	118.7754	BCH Diffuser	Drop Camera	13
DIF_OUT_1a	-20.078	118.7665	BCH Diffuser	ROV	12.5
DIF_OUT_2a	-20.0749	118.7663	BCH Diffuser	ROV	13.2
DIF_OUT_3a	-20.0705	118.7659	BCH Diffuser	ROV	13.4
DIF_OUT_4a	-20.0727	118.7724	BCH Diffuser	ROV	13.8
DIF_OUT_5a	-20.0669	118.7741	BCH Diffuser	ROV	14
DIF_OUT_6a	-20.0648	118.7678	BCH Diffuser	ROV	14.8
DIF_OUT_7a	-20.063	118.7625	BCH Diffuser	ROV	15.2
DIF_OUT_8a	-20.0683	118.76	BCH Diffuser	ROV	14.3
KP14.100	-20.115	118.8923	MMA Seabed Features	ROV	6.2
KP14.410	-20.1158	118.8951	MMA Seabed Features	ROV	6.8
KP14.915	-20.1173	118.8996	MMA Seabed Features	ROV	6.5
KP9.490	-20.1003	118.8509	MMA Seabed Features	ROV	8.3
KP9.490 II	-20.1003	118.8509	MMA Seabed Features	ROV	8.8
MEQ_01	-20.1158	118.8663	BCH Corridor	Drop Camera	8
MEQ_03	-20.0976	118.8144	BCH Corridor	Drop Camera	9
MEQ_05	-20.0793	118.7624	BCH Corridor	Drop Camera	8

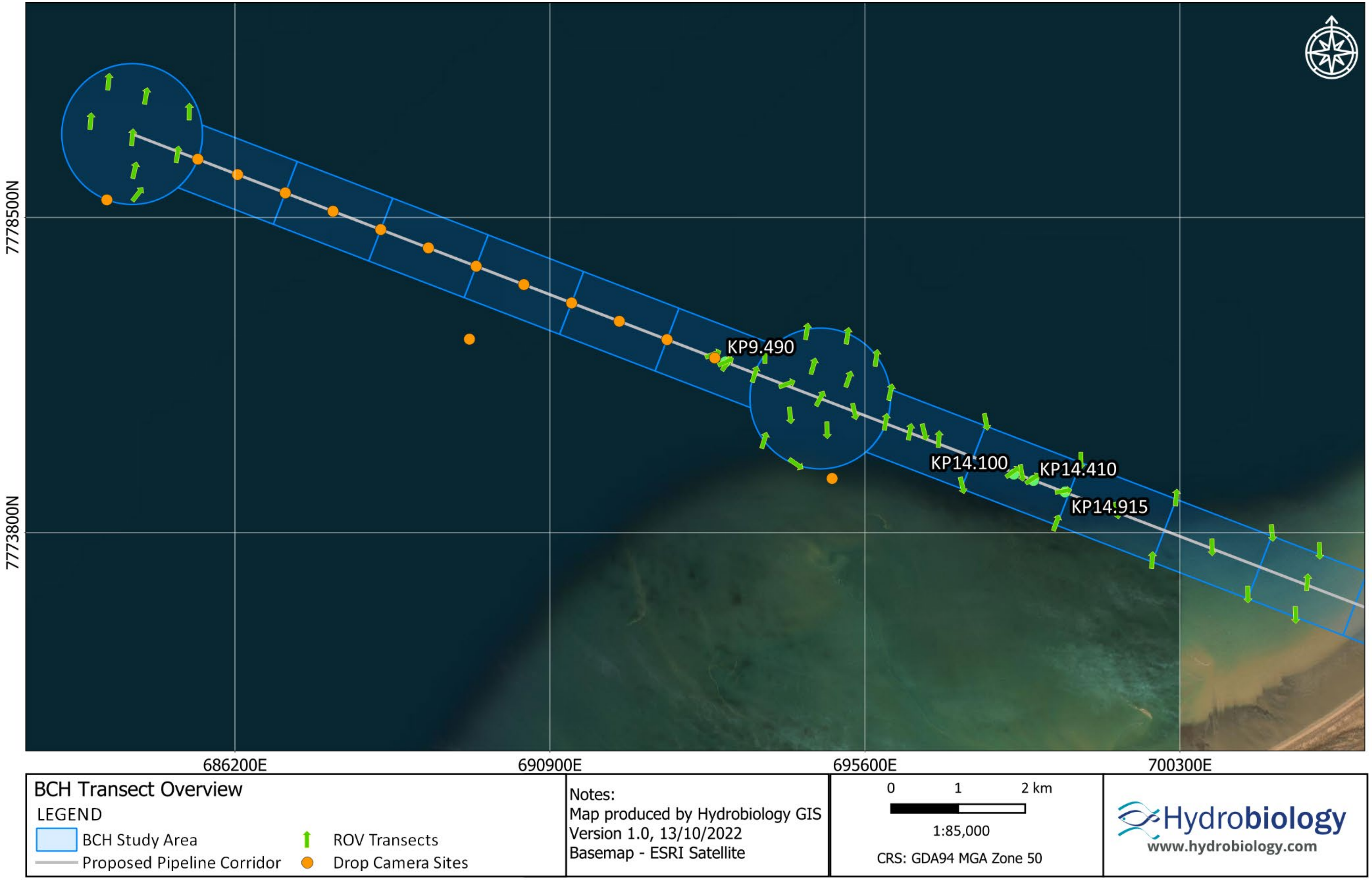


Figure 2-1 Overview of the ROV transects and drop camera sites

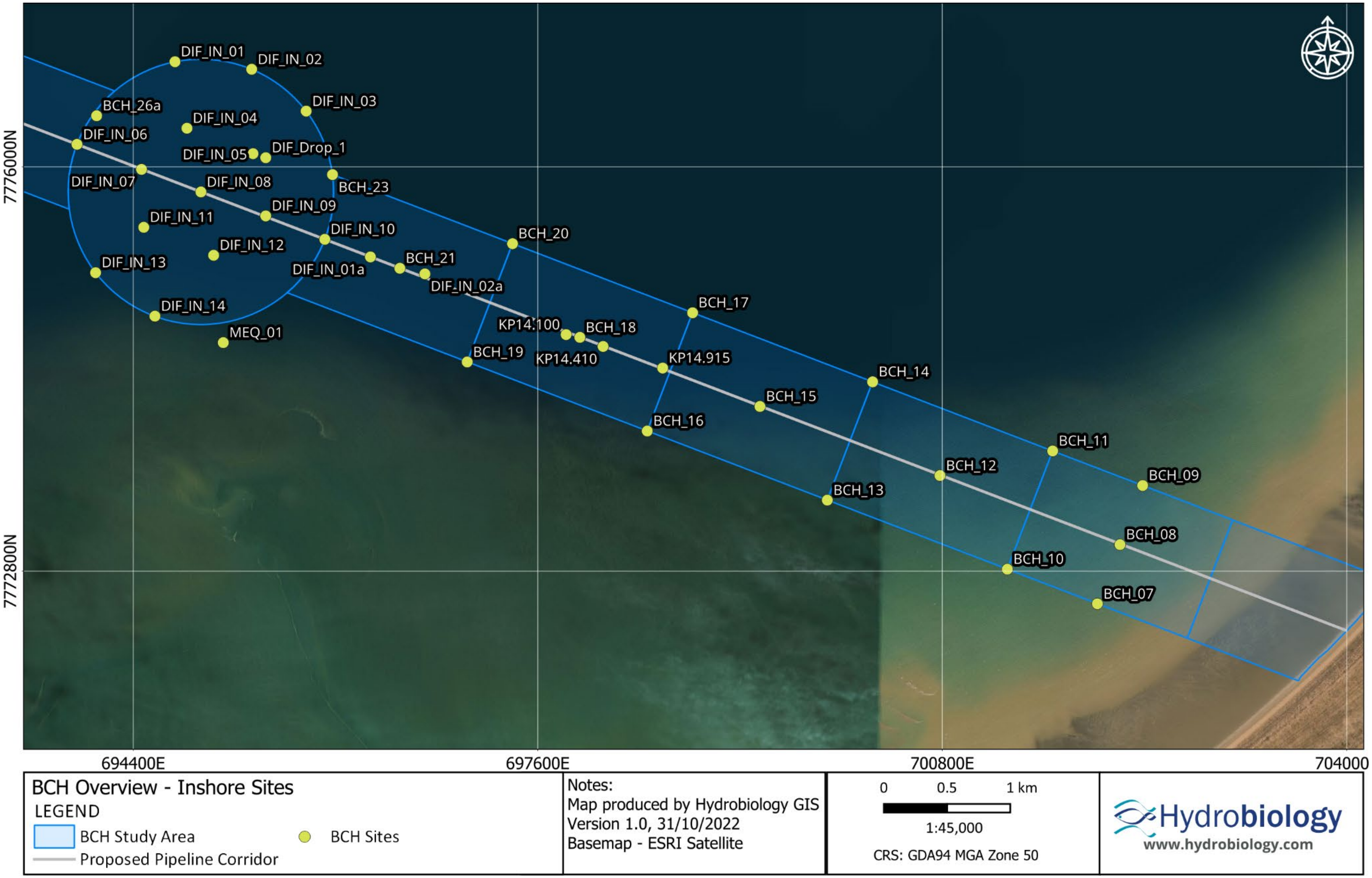


Figure 2-2 Overview of the inshore BCH sites

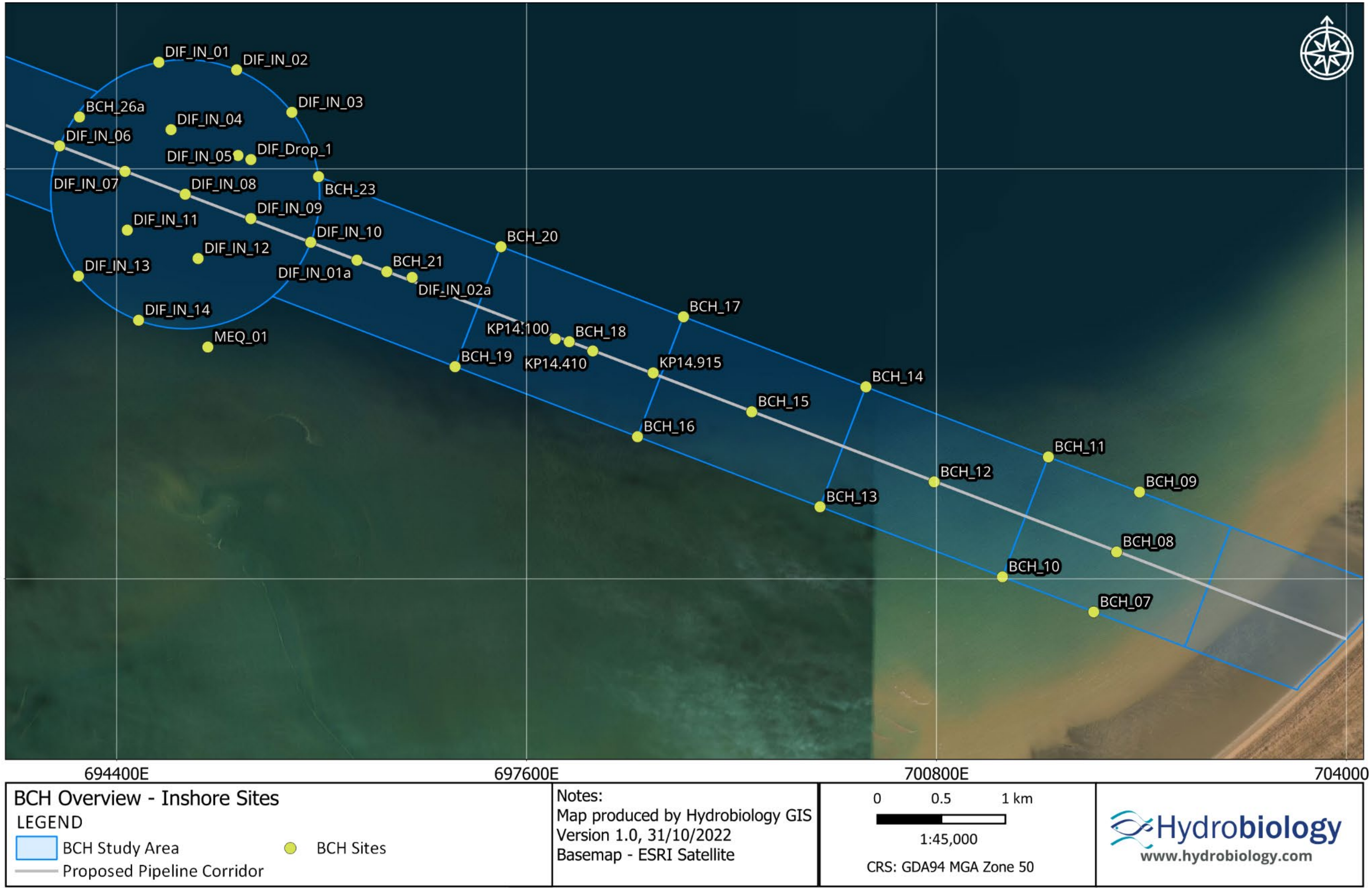


Figure 2-3 Overview of the offshore BCH sites

Plate 2-1 ROV with deck power supply (left) and set up on deck (right)

Plate 2-2 Drop camera frame system with 50 x 50 cm quadrat (left) In water use (right)

3. RESULTS

3.1 BENTHIC HABITAT AND COMMUNITIES CLASSIFICATION

Each BCH site was classified into five broad categories: Hard Coral (hard coral coverage >50%), Seagrass, Bare Sand, Macroalgae/Sponge/Soft coral, and Mixed Assemblage with Hard Coral (hard coral coverage <50%).

Most transects comprised of multiple categories, however, to highlight potentially sensitive environments the Hard Coral and Seagrass categories were given priority. Table 3-1 provides examples of each broad habitat type, with some examples of the sub-categories that were found within that habitat type. Figure 3-1 provides an overview of broad habitat classification for each BCH site. The sites closest to shore were predominantly sand with sparse macroalgae growth. Further offshore, sites with Seagrass or Macroalgae/Sponge/Soft coral were more common.

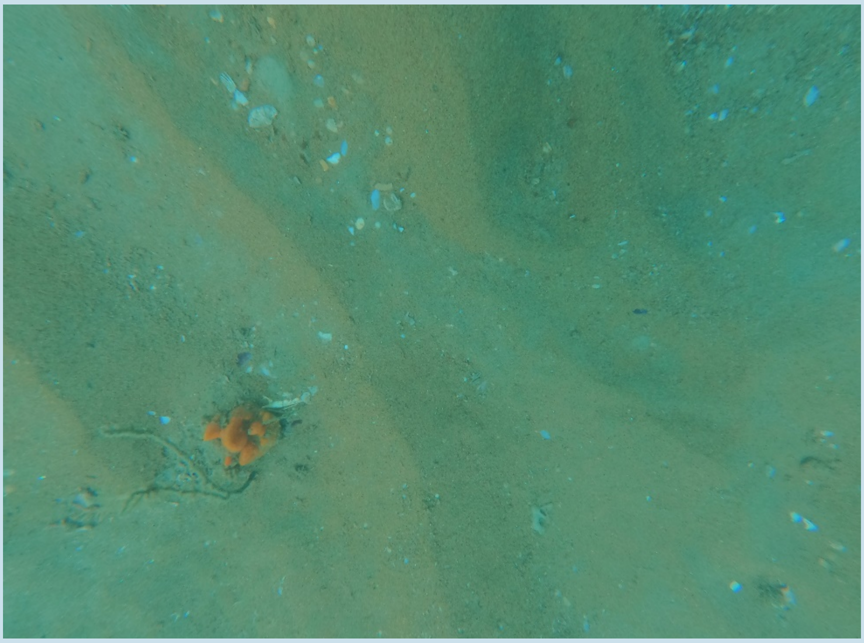
Hard Coral was identified at eight sites, including two sites that also had seagrass present (BCH-14 and BCH-16). Sites with coral were mostly condensed to near the proposed inshore diffuser site with some infrequent occurrences within the proposed offshore diffuser site. Coral sites had light to moderate coral coverage (predominantly <30%), with the site of the seabed feature KP9.490 having the highest coral coverage (75% coral coverage; Table 3-2).

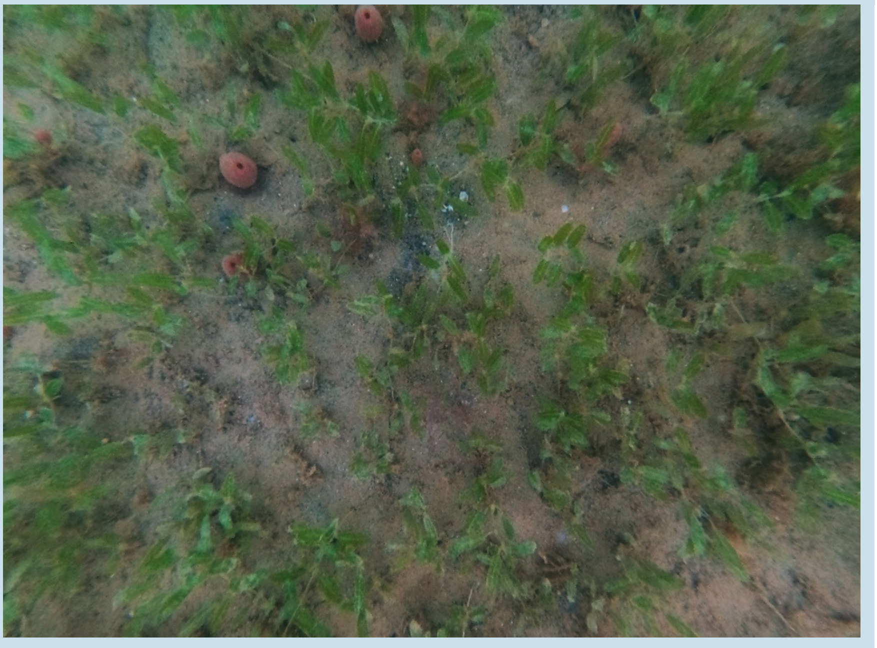
The isolated seabed features identified by the backscatter intensity data was found to show incidence of corals, soft corals, macroalgae and sponges. Three of the four seabed features identified through the July 2022 bathymetry survey were found to have at least some coral cover (KP14.100, KP14.915 and KP9.490). While the other isolated seabed feature (KP14.410) did not have coral present, both sites were dominated by macroalgae and sponges, which likely indicates these communities have established on hard substrate suitable for benthic primary producer growth.

Assessments of the potential transition zones did not identify any specific patterns, however there is some indication of lower dB values indicating dense benthic primary producer coverage. Sites BCH-32a and BCH-35 were located within offshore transition zone 1 which recorded the highest frequency of dB between -22 and -21 dB and was dominated by bare sand substrate with sparse macroalgae growth. In contrast, the inshore transition zone which contained three of the seabed features had the highest frequency of dB values range between -28 and -26 dB, these three sites were predominantly corals, macroalgae and sponges.

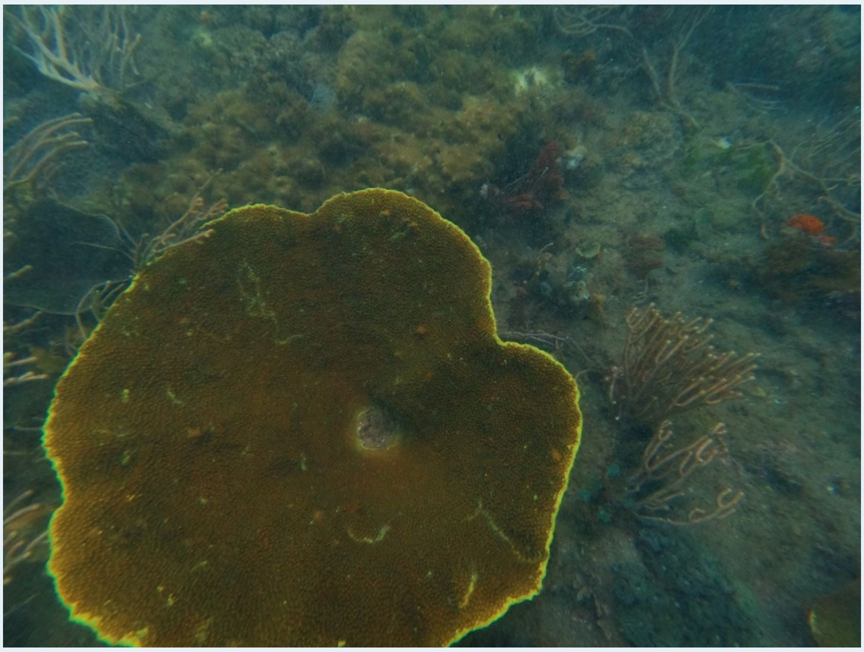
A habitat map was created from the major BCH categories to present the distribution of each classification within the area of the proposed pipeline (Figure 3-2). Cover of each BCH category was estimated with coral and seagrass given priority over macroalgae and bare sand in areas of overlap. Habitat distribution along the offshore corridor is largely generalised as most surveys here were completed with drop camera transects.

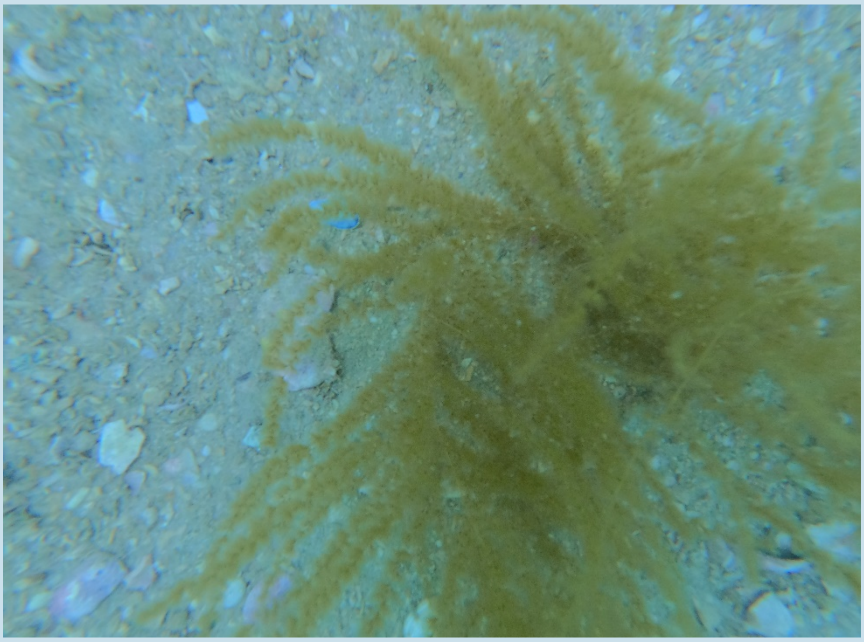
Table 3-1 Example image of each habitat type

Benthic Community Habitat Type	Example Image
Bare Sand	
Bare Sand	
Bare Sand (with infrequent macroalgae or sponge)	

Benthic Community Habitat Type	Example Image
Seagrass	
Halophila decipiens	
Halophila spinulosa	

Benthic Community Habitat Type	Example Image
Hard Coral	
Submassive Coral	
Encrusting Coral	

Benthic Community Habitat Type	Example Image
Plate/Foliose Coral (*Turbinaria spp.*)	
Macroalgae, Sponges and Soft Coral	
Macroalgae and Sponge	

Benthic Community Habitat Type	Example Image
Macroalgae	

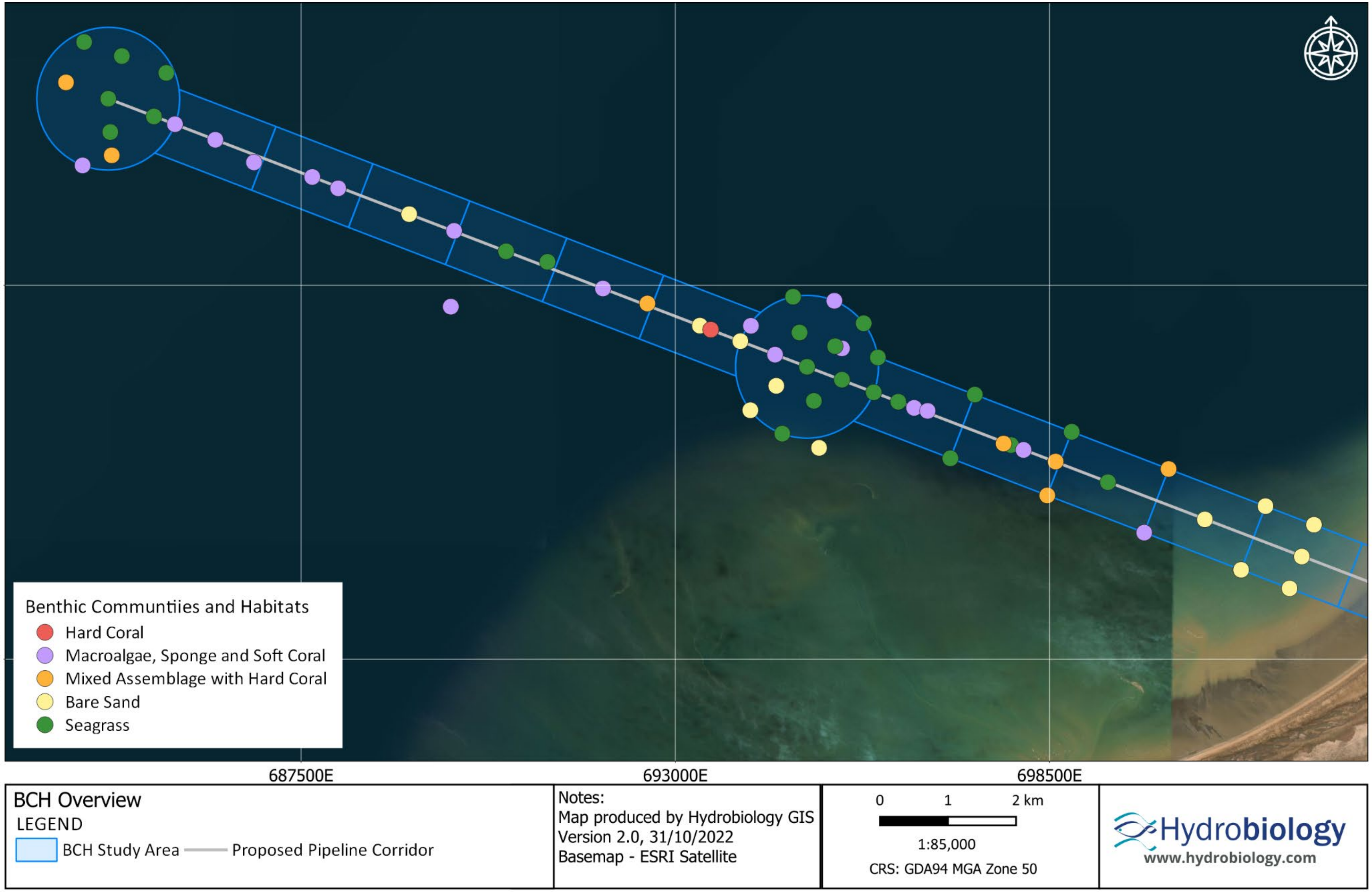


Figure 3-1 Broad Benthic Communities and Habitat (BCH) categories

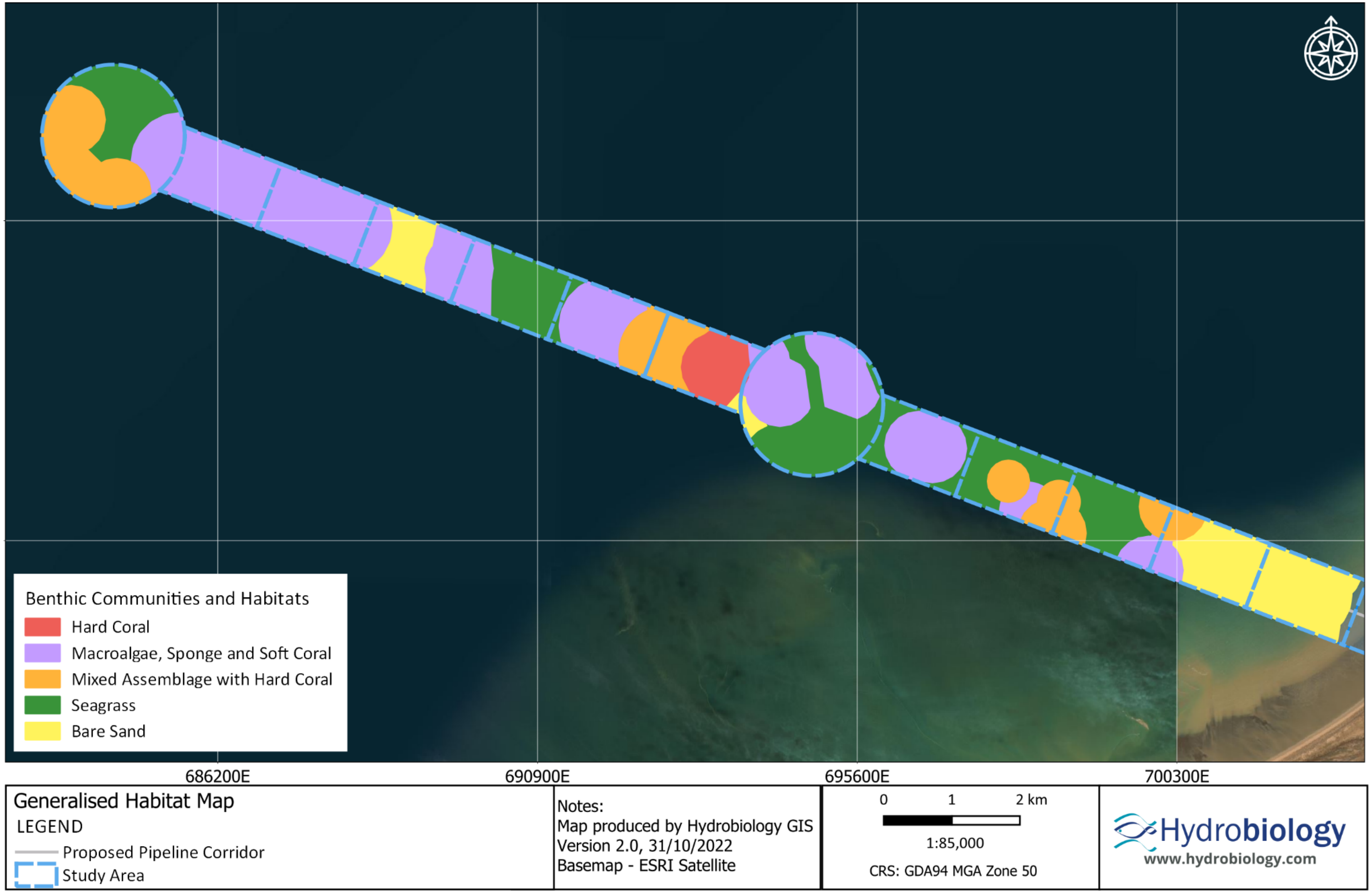


Figure 3-2 Generalised BCH map for the proposed pipeline. Hard Coral (>50% coral coverage), Mixed Assemblage with Hard Coral (<50% coral coverage

3.2 HARD CORAL

Hard coral was observed at eight sites including three of the four isolated seabed features identified through the multibeam backscatter survey (MMA Offshore, 2022). Table 3-2 provides a description of the coral cover and morphological diversity for each site. Hard coral distribution was predominantly patchy except for KP9.490 which recorded relatively high levels of hard coral coverage. Most hard corals observed at the BCH sites were from the *Turbinaria* genus (family: Dentrophyllidae) which has previously been recorded as a dominant coral community in the Port Hedland region, particularly within the vicinity of Little Turtle Island (approximately 6 km north of the proposed pipeline; SKM, 2009). Figure 3-3 provides an example of coral cover at selected BCH sites.

Table 3-2 Summary of coral coverage and diversity (KP9.490 has two transects completed at site)

Site	BCH Category	Approximate percentage cover	Coral types	Notes
BCH-014	Mixed Assemblage with Hard Coral	<5%	Plate/foliose corals	Very patchy coral distribution amongst some sponges and other soft corals. Also, seagrass present at the start of the transect
BCH-016	Mixed Assemblage with Hard Coral	<5%	Plate/foliose corals, zoanthids	Some coral distributed amongst sponges and red macroalgae. Large areas of sand and some very patchy seagrass
BCH-026B	Mixed Assemblage with Hard Coral	10%	Plate/foliose corals	Patchy coral distribution with large areas of bare sand, some brown macroalgae also present.
DIFF-OUT-1A	Mixed Assemblage with Hard Coral	20%	Plate/foliose corals, massive/ sub massive corals	Large areas of bare sand. Patchy coral distribution with brown and red macroalgae. Some sponges and lace corals
DIFF-OUT-8A	Mixed Assemblage with Hard Coral	15%	Massive/sub massive corals, zoanthids, plate/foliose	Very patchy coral distribution. Large areas of bare sand, some macroalgae (red, green, and brown), some sponges
KP14.100	Mixed Assemblage with Hard Coral	20%	Massive/sub massive, plate/ foliose coral, zoanthids	Patchy distribution mixed with large abundance of sponges
KP14.915	Mixed Assemblage with Hard Coral	25%	Predominantly foliose/plate corals with some zoanthids	Patchy coral distribution with large abundance of sponges and red macroalgae

Site	BCH Category	Approximate percentage cover	Coral types	Notes
KP9.490	Hard Coral	75%	Foliose/plate corals, encrusting corals, massive/sub massive corals	Dense coral cover with some sponges. Also, dense red macroalgae dispersed between corals
KP9.490 II	Hard Coral	75%	Foliose/plate corals, encrusting corals, massive/sub massive corals	Dense coral cover with some sponges. Also, dense red macroalgae dispersed between corals

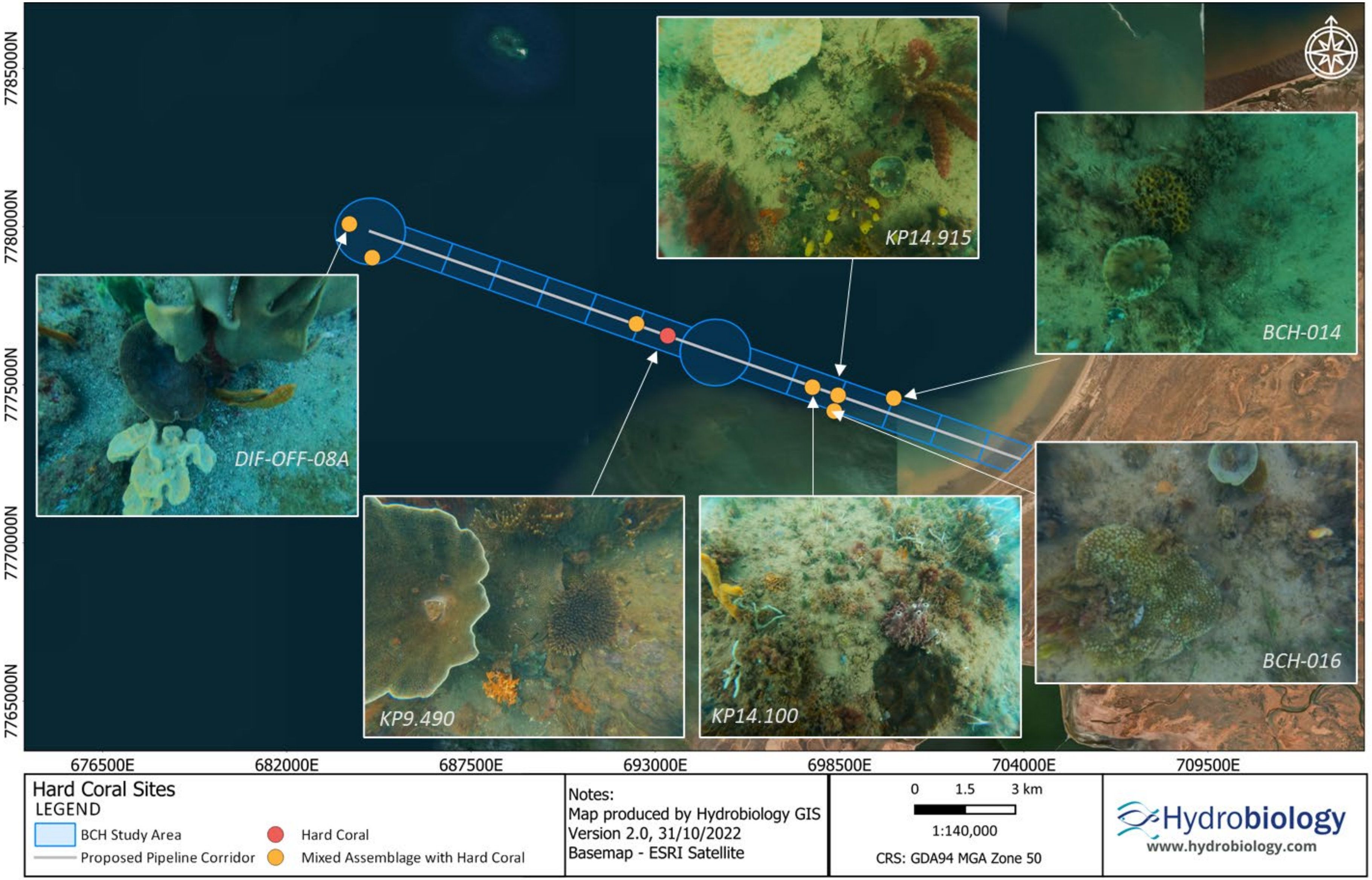


Figure 3-3 Overview of the hard coral sites

3.3 SEAGRASS

Seagrass was identified at approximately 42% of the BCH sites (26 of 62), predominantly around the inshore and offshore diffuser sites. Two seagrass species were identified, *Halophila spinulosa* and *Halophila decipiens.*

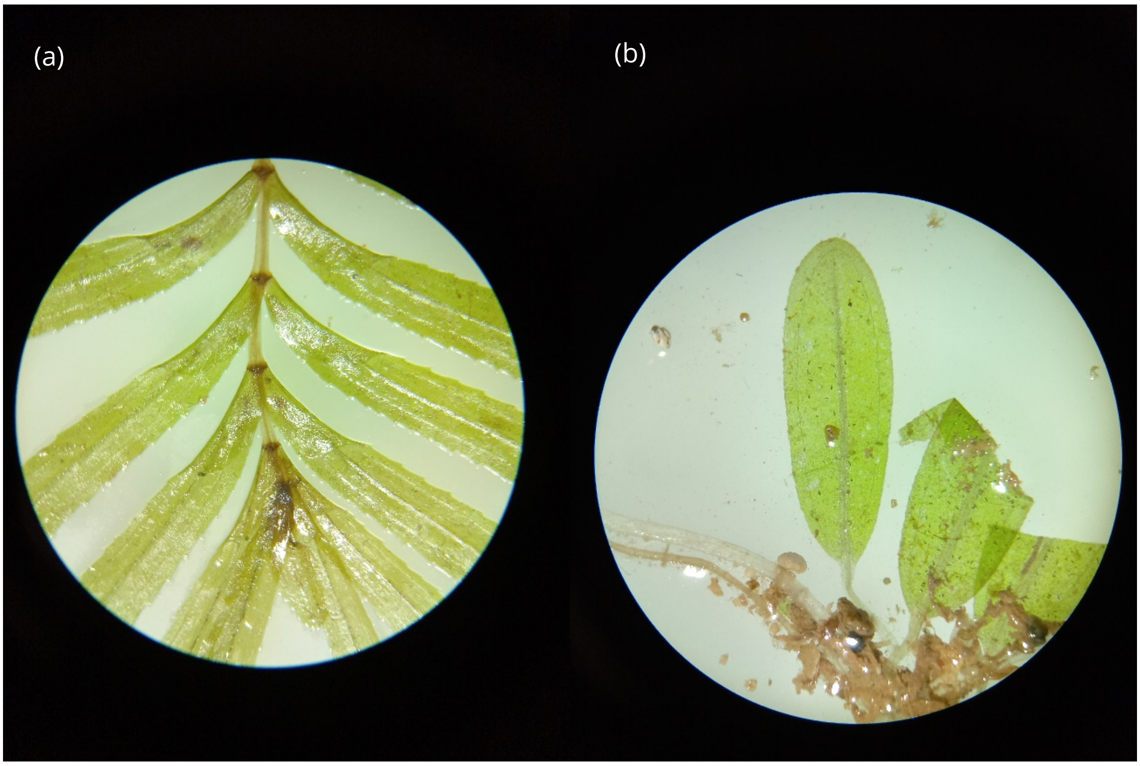


Plate 3-1 Examples of *Halophila spinulosa* (a) and *Halophila decipiens* (b) taken under a microscope

Table 3-3 describes the three seagrass coverage categories. Seagrass coverage was estimated by both the proportion of photos along the transect with seagrass present and by the density of seagrass within each photo. Figure 3-4 provides an overview of the seagrass density at each site. Highest seagrass cover occurred around the inshore outfall site where water depth averaged 8.5 m. Macroalgae and sponge was also present at many of the seagrass sites, predominantly those with a lighter seagrass cover.

Overall, *H. decipiens* was the dominant species however sites BCH 29a, BCH 32 and DIFF-IN-04 only had *H. spinulosa* present. These are drop camera sites however and therefore there is limited capacity to estimate the range of *H. spinulosa* at these sites (Figure 3-5 and Figure 3-6)

Table 3-3 Seagrass cover categories with percentage cover range

Category	Percentage Cover Range (%)	Physical Description
Light	< 30%	Very light cover, seagrass is not consistent throughout the transect

Category	Percentage Cover Range (%)	Physical Description
Medium	30 – 70%	Light to moderate coverage, seagrass is mostly consistent throughout the transect and is usually dominant throughout
Heavy	>70%	Moderate to dense coverage, seagrass is present throughout the entirety of the transect.

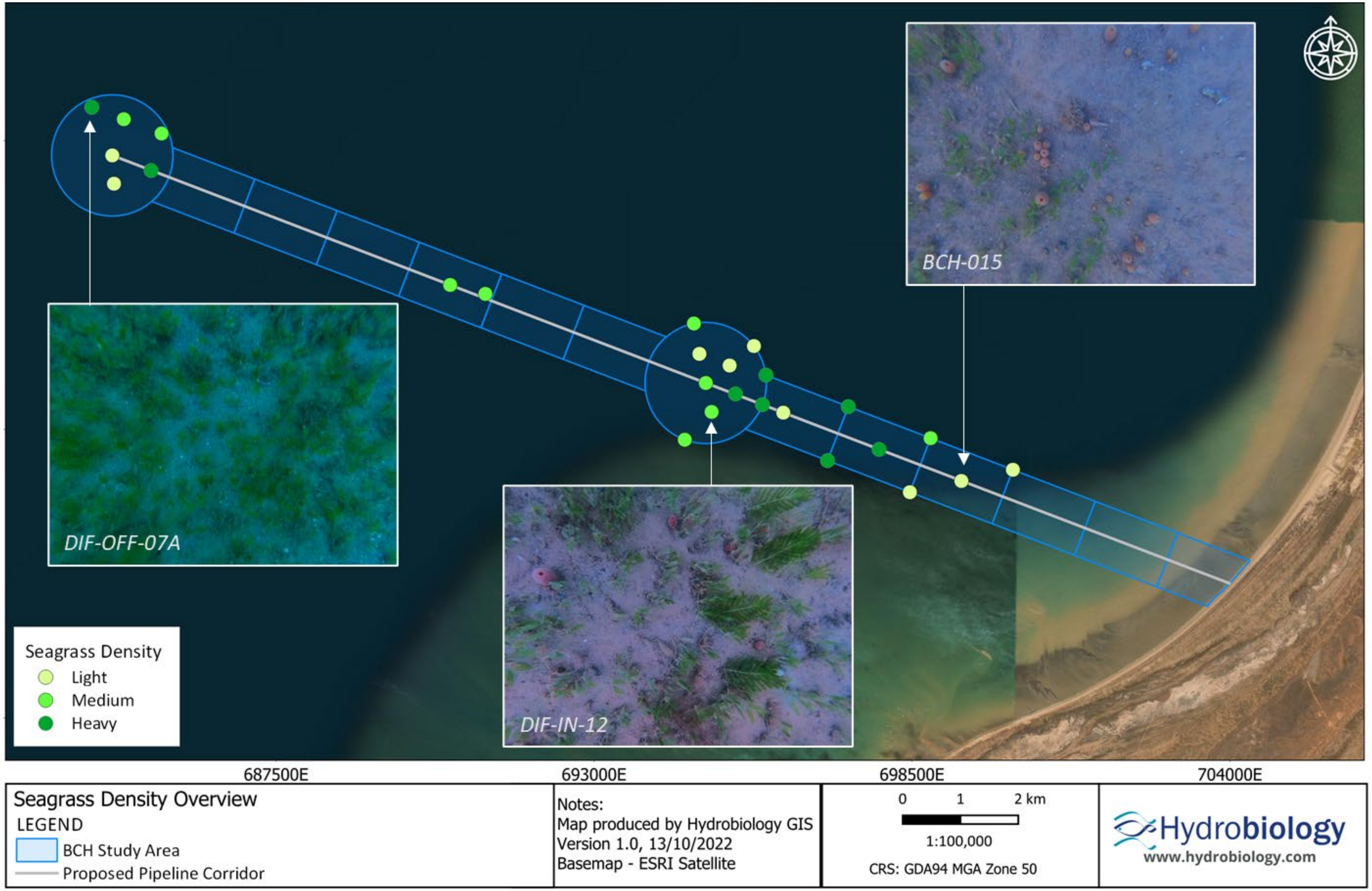


Figure 3-4 Overview of the seagrass density at the BCH sites with example photos

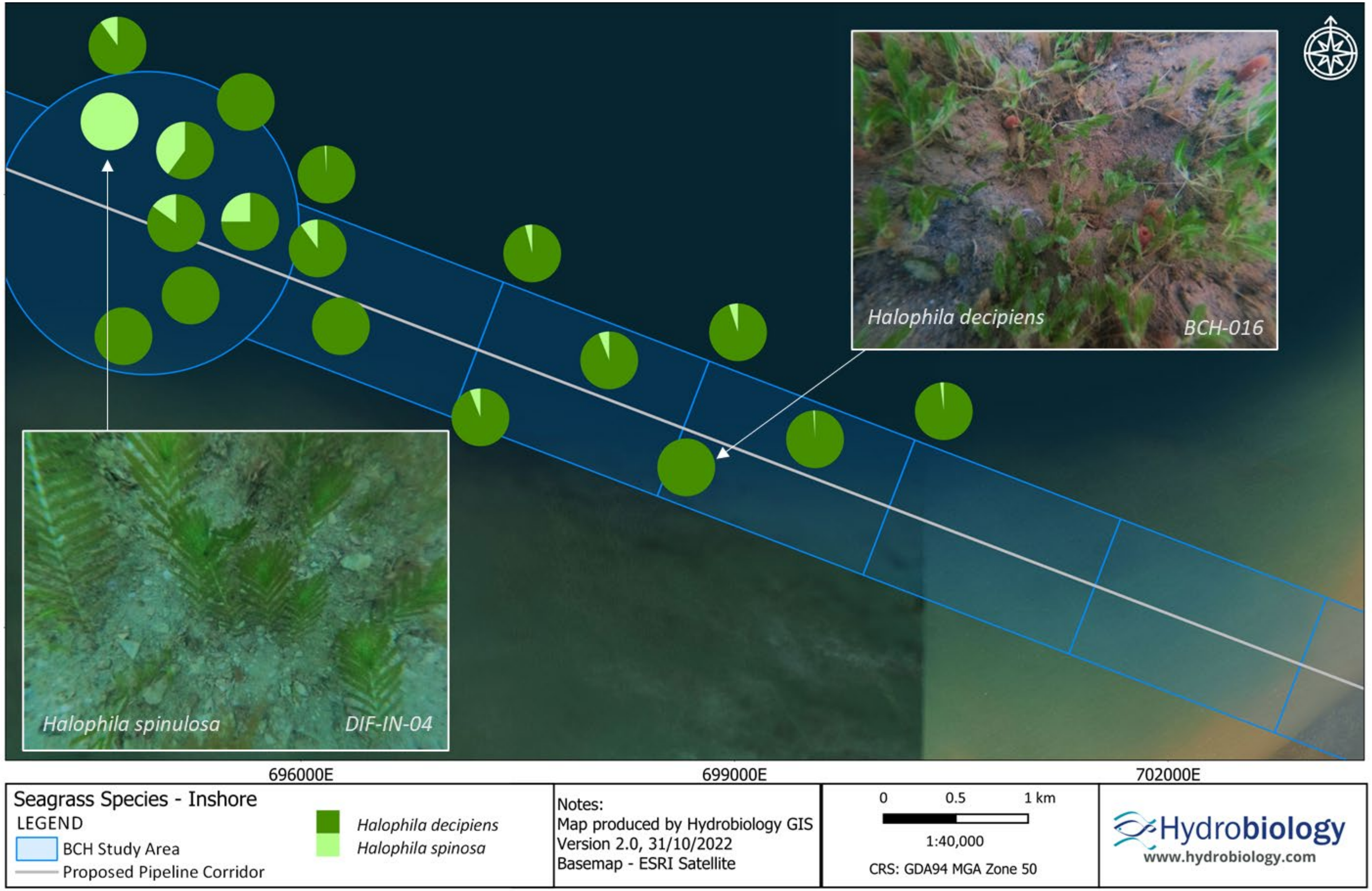


Figure 3-5 Proportion of seagrass species at the inshore BCH sites with example photos of both species

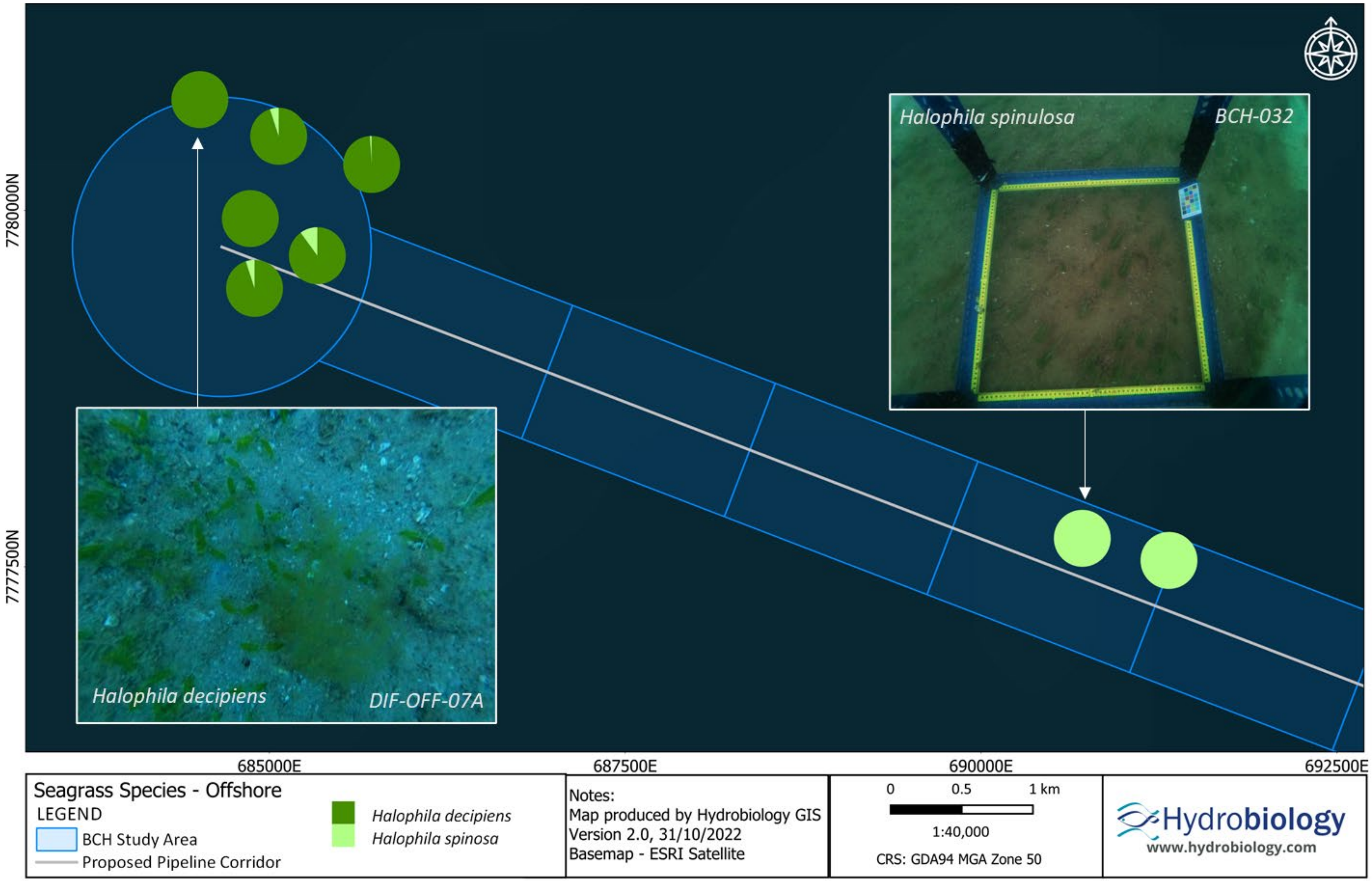


Figure 3-6 Proportion of seagrass species at the offshore BCH sites with example photos of both species

4. CONCLUSIONS

This report summarises the results of the Benthic Communities and Habitat surveys carried out by Hydrobiology in waters 57 km east of Port Hedland, at a location proposed for the desalination plant pipeline for the Ridley Magnetite Project.

A total of 62 sites (47 ROV and 15 drop camera transects) were completed between 23rd – 26th September 2022. Five broad BCH classifications were identified:

- Hard Coral (>50% Hard Coral cover)
- Seagrass
- Mixed Assemblage with Hard Coral (<50% Hard Coral coverage)
- Macroalgae, Sponge and Soft Coral, and
- Bare Sand

Inshore BCH sites were dominated by bare substrate with only infrequent occurrences of macroalgae and sponges.

Two seagrass species were identified –*Halophila decipiens* and *Halophila spinulosa* with *H. decipiens* being considerably more abundant across all seagrass sites. Seagrass was the most common BCH category with varied density across the study area.

Three of the four isolated seabed features identified from the multibeam backscatter data were found to have at least some hard coral present as well as diverse sponge and macroalgae communities. KP14.410 was the only isolated seabed feature to not record any hard coral coverage, however this transect was dominated by large sponges and macroalgae communities. Hard coral was observed at eight sites along the proposed pipeline with predominantly patchy distribution. KP9.490 had the highest coral coverage. Most hard corals observed were from the genus *Turbinaria* which is known to be dominant subtidal waters around Port Hedland (Kirkendale et al., 2016; Lafratta et al., 2016).

5. REFERENCES

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APPENDIX A. HISTOGRAMS

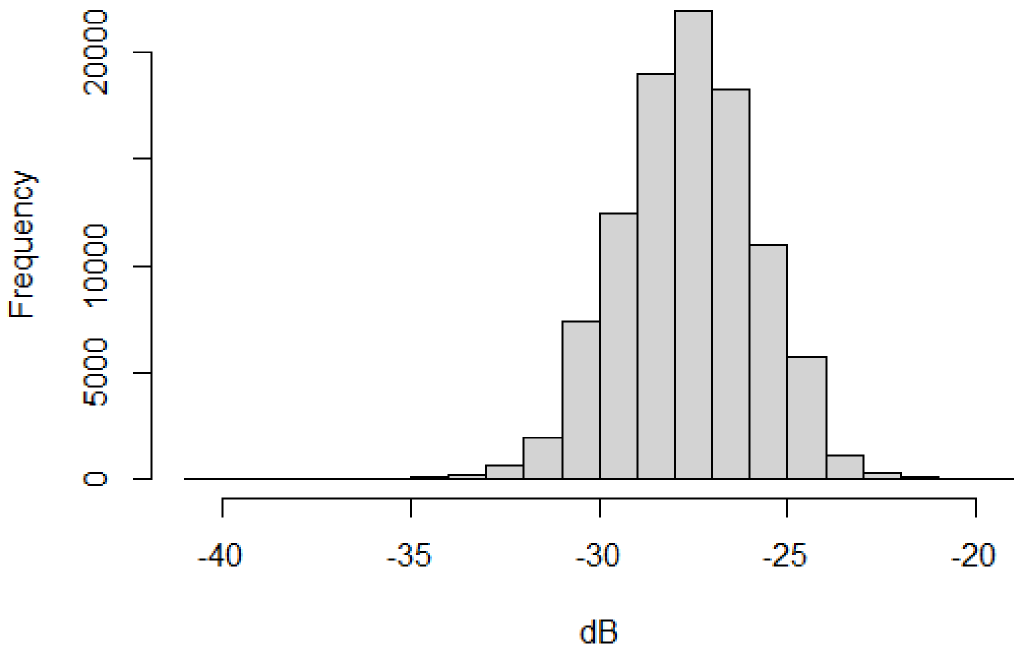

Figure A.1 – Frequency of occurrence of the backscatter (dB) values for the inshore transition zone

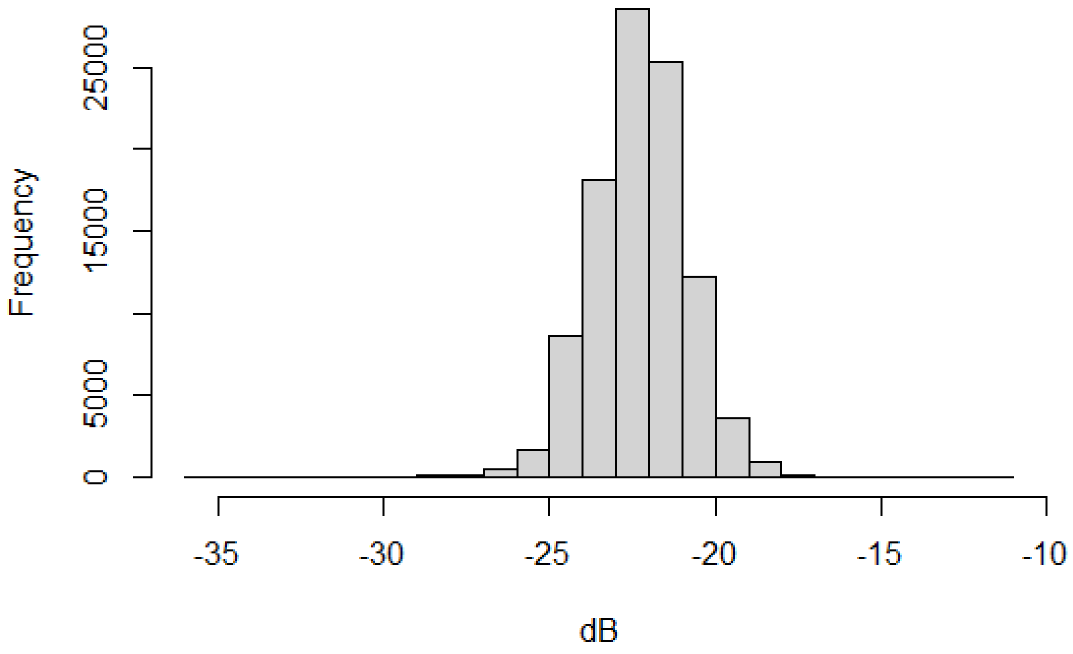

Figure A.2 – Frequency of occurrence of the backscatter (dB) values for offshore transition zone 1

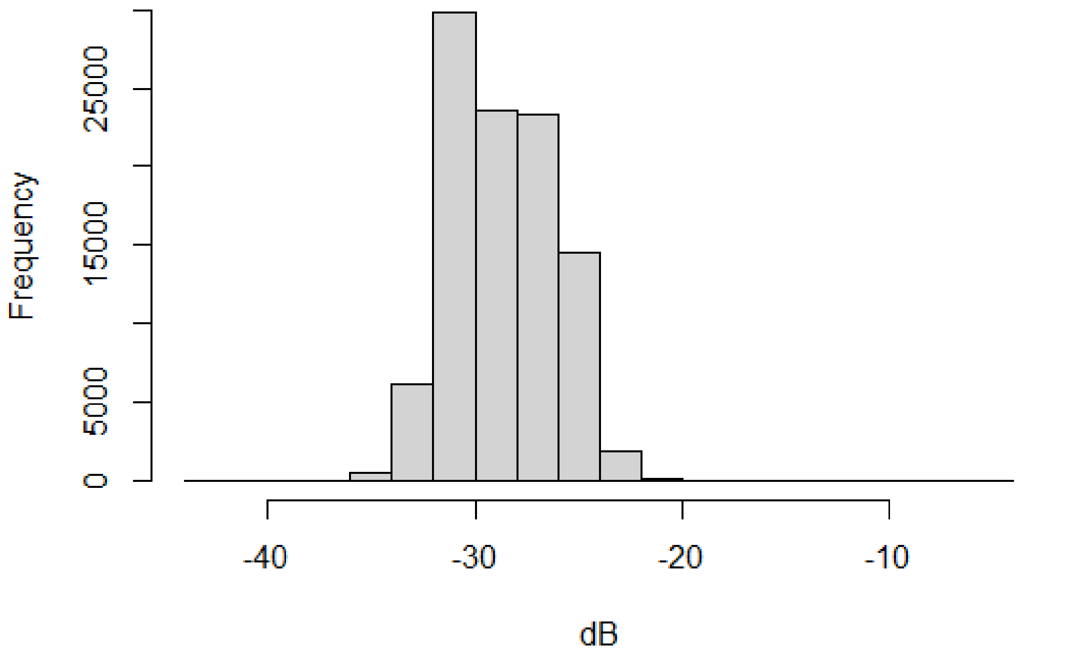

Figure A.3 – Frequency of occurrence of the backscatter (dB) values for offshore transition zone 2

Hydrobiology