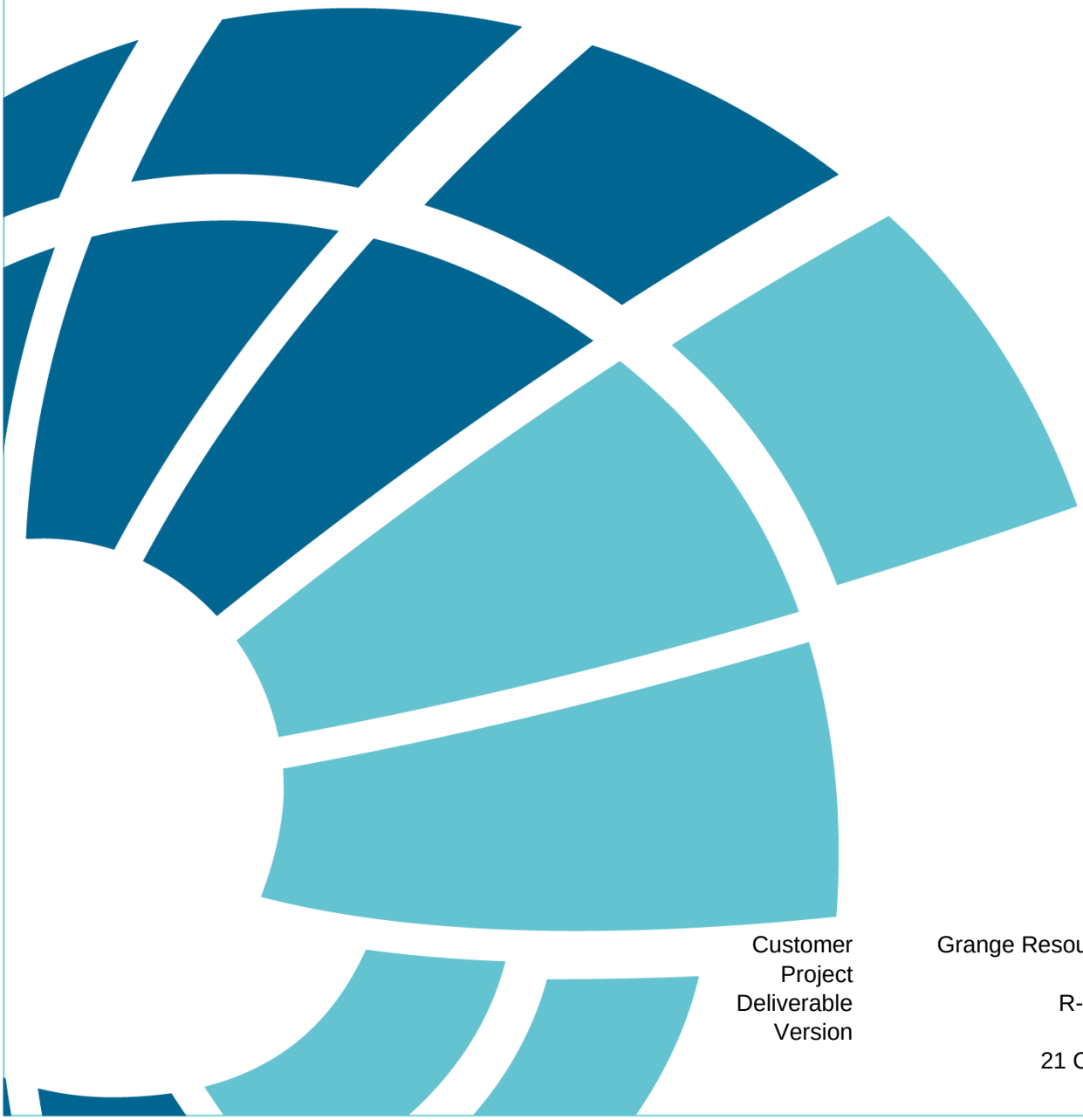
Southdown Joint Venture Magnetite Transhipping Project - Benthic Habitat Mapping

Updating historical benthic habitat mapping in King George Sound



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Contents

Acronyms 4

1 Introduction 5

1.1 Background 5
1.2 Environmental approval pathways 7
1.3 Historical BCH mapping 7
1.4 Purpose of this document 7

2 Methods 8

2.1 Benthic habitat mapping 8
2.1.1 Survey sites and timing 8
2.1.2 Data acquisition 8
2.1.3 Towed video 8
2.1.4 Classification of ground truth data 11
2.1.5 Classification and mapping procedures 12

3 Results 13

3.1 Anchorage D 13
3.2 Anchorage W 13
3.3 Anchorage Y 13
3.4 Anchorage Z 13

4 Discussion and Conclusions 15

5 References 16

Tables

Table 2.1 Benthic habitat classification categories 11

Figures

Figure 1.1 Port of Albany existing harbour channel and proposed transhipping anchorages (D, W, Y, Z) in King George Sound 6
Figure 2.1 Imagery and location of ground truth survey transects in King George Sound 10
Figure 3.1 Updated benthic habitat map inclusive of towed video survey in the four potential anchorage sites in King George Sound 14

Acronyms

BCH	Benthic communities and habitat
EIA	Environmental impact assessment
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
KGS	King George Sound
km	Kilometre
Mtpa	Million tonnes per annum
n/a	Not applicable
PRH	Princess Royal Harbour
SCADZ	South Coast Aquaculture Development Zone
SDJV	Southdown Joint Venture
SKM	Sinclair Knight Merz Pty Ltd
SLIP	Shard Location Information Platform

1 Introduction

1.1 Background

The Port of Albany (hereafter, 'the Port') is on the southern coast of Western Australia with infrastructure in Princess Royal Harbour (PRH) and King George Sound (KGS; Figure 1.1). The Port is an industrial harbour operated by Southern Port Authority (hereafter, 'the Proponent') under the *Port Authority Act 1999*, exporting bulk products such as grain, woodchips and silica sand, and importing fertiliser, fuel and timber products.

The Port has undergone trade growth in the past decades and to meet the proposed additional shipping needs of the Southdown Magnetite Project run by the Southdown Joint Venture (SDJV; Grange Resources Limited and Sojitz Corporation) additional environmental approvals are required to facilitate this. The SDJV proposes to construct and operate an open pit magnetite mine at the Southdown Magnetite deposit located ~90 km north-east of Albany, Western Australia (hereafter, 'the Proposal'). The Proposal will include pumping magnetite as a slurry via a 104 km-long buried pipeline to newly installed land-based facilities at the Port. The loadout facility will be located on unused land within the Port and will include the construction of a new loading facility at Berth 5, including a filtration plant, a concentrate stockpile, and conveyor system. These new facilities will be constructed and operated by the SDJV. The magnetite concentrate will be loaded onto a transhipment vessel and then barged to larger Cape size vessels (~175 thousand tonnes) located at a proposed anchorage site (D, W, Y and Z) in KGS (Figure 1.1). The magnetite concentrate is intended for export at a target rate of 5 million tonnes per annum (Mtpa) for 30 years. Large vessels regularly transit through the shipping channel and KGS, however, the transhipping operations involved in the Proposal may have potential impacts and risks to benthic communities and habitat (BCH), and it is anticipated that approvals under the following state and federal legislation may be required.

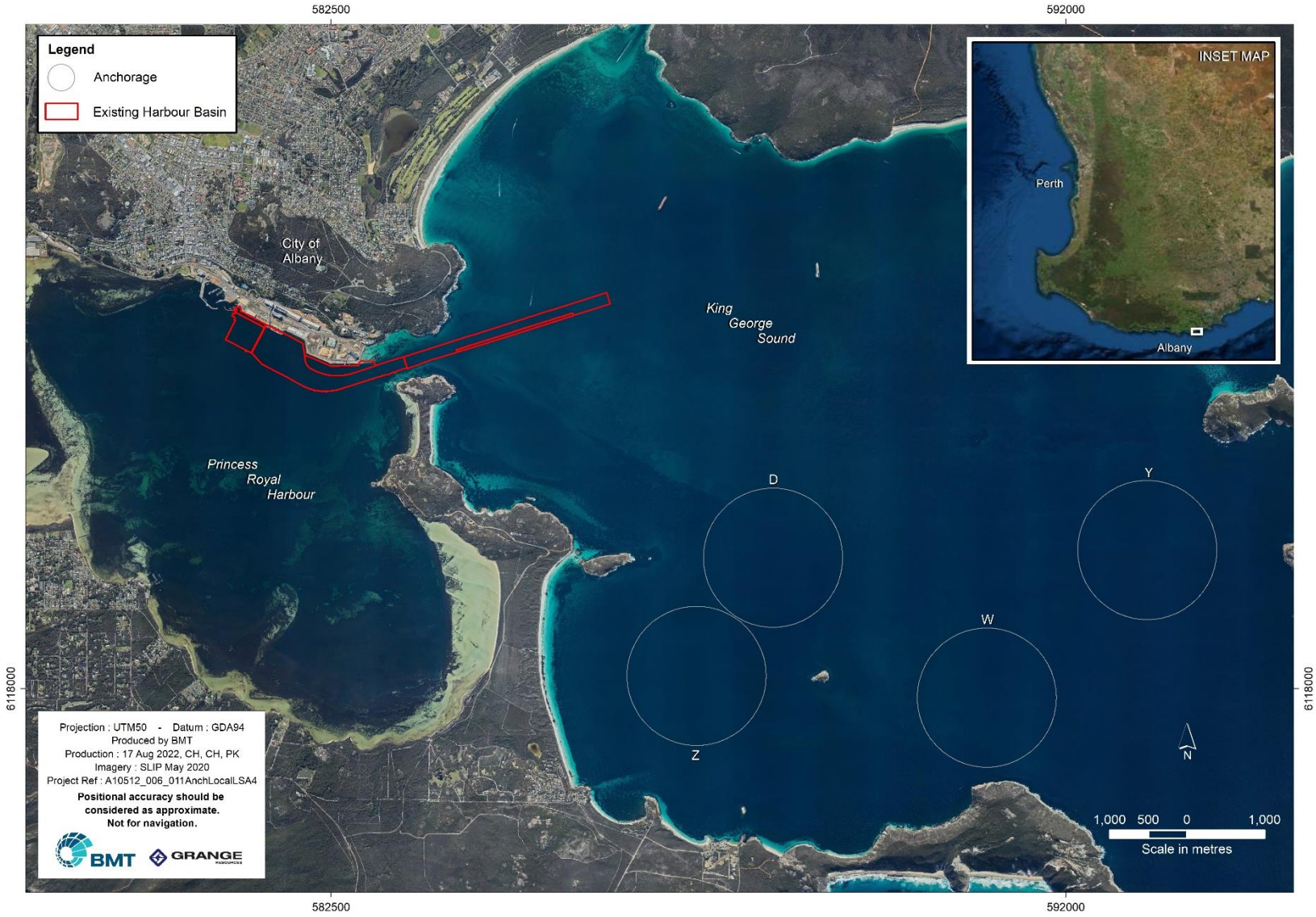

Figure 1.1 Port of Albany existing harbour channel and proposed transhipping anchorages (D, W, Y, Z) in King George Sound

1.2 Environmental approval pathways

The Project proposal will be referred to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act) Part IV to determine the level of assessment. The EPA applies a Significance Framework to make decisions through the environmental impact assessment process, based on the concept of significance established under the EP Act. One of the principles outlined in the EP Act is the conservation of biological diversity and ecological integrity, relevant to BCH.

1.3 Historical BCH mapping

In Albany, the distribution of BCH has been the subject of multiple studies, most of which have been commissioned to support the environmental impact assessment (EIA) processes of various projects (Bastyan 1986, Cambridge et al. 2002, Ecologia 2007, Ecologia 2009).

The BCH for KGS and PRH was previously categorised and georeferenced in 2006 by SKM (Ecologia 2009). The three dominant habitat types included macroalgae, bare sediment (sand/silt) and seagrass. Across both embayments (KGS and PRH), bare sediment was the dominant habitat type. The sediment was characterised as fine sand with little to no sessile benthic flora or fauna (Ecologia 2009). The few invertebrates that were present included echinoderms and sea pens. Other features that were present in the bare sediment included bioturbation, feeding scars, shell debris and plant/detrital matter.

In 2020, maps were produced for an aquaculture EIA using a composite of Sentinel-2 satellite images combined with publicly available and custodian data (DWER 2021, Bastyan 2015, Ecologia 2007, DPaW 2006, Oceanica 2006, Kirkman 1997), which were analysed for a broad range of benthic categories (sparse seagrass, seagrass, bright sand, dark sand and sand where it could not be differentiated). The composite images were ground-truthed using imagery captured in situ.

Desktop assessments, combined with the above data found that seagrass habitat was dominated by both perennial and ephemeral species of varying densities, which included *Posidonia sinuosa*, *P. coriacea*, *Amphibolis antarctica* and *Halophila* spp. (Ecologia 2009). Ephemeral species were relatively sparse and were often seen as a mixed assemblage with perennial species.

A small proportion of the benthic habitat identified in KGS comprised of macroalgal species growing over sand, occasional patches of rubble and shell debris, and low relief reef. The macroalgal species included *Ecklonia radiata* and *Sargassum* spp. Macroalgal communities were found at Gio Batta Patch, Michaelmas Reef, and adjacent to large offshore islands (Michaelmas Island and Breaksea Island) (Ecologia 2009).

Considering the potential impacts and risks (i.e. anchor drag) the Proposal may have on the BCH, an updated BCH map of the four anchorage sites (D, W, Y and Z; Figure 1.1) that are proposed to be developed within KGS was developed to inform existing habitats within these areas.

1.4 Purpose of this document

The purpose of this document is to report the sampling methods and results of the ground truthing survey within the anchorage sites and present an updated benthic habitat map. This document forms part of an overarching document that will support the assessment of the Proposal under Section 38 of the EP Act.

2 Methods

2.1 Benthic habitat mapping

2.1.1 Survey sites and timing

To delineate the BCH within and adjacent to the four proposed anchorage sites, ground truthing survey took place 14 and 15 October 2021. The anchorages sites D, W. Y and Z are in the southern half of KGS (Figure 2.1). The below sections summarise BCH based on historical mapping.

Anchorage D
Anchorage D is located on the western side of KGS near the northern access to Goode Beach and adjacent to Mistaken Island Nature Reserve, in water depths between 17–25 m (Figure 2.1). Bare sand is the dominant BCH within the proposed site, with seagrass bordering the site on the west.

Anchorage W
Anchorage W is the most southern proposed site in KGS in shallower waters (15–25 m) and is dominated by bare sediment with seagrass located to the south of the site (Figure 2.1).

Anchorage Y
Anchorage Y is on the eastern side of KGS in deeper waters (25–35 m). It is dominated by bare sediment with sparse patches of macroalgae and filter feeders due to its proximity to Michaelmas Reef and Gio Batta Patch (Figure 2.1) to the north.

Anchorage Z
Anchorage Z is located south of Anchorage D, adjacent to Goode Beach in water depths ranging from 19 to 30 m (Figure 2.1). It is dominated by bare sediment with seagrass bordering the west end of the site.

2.1.2 Data acquisition

Habitat maps for the present-day scenario were created using a combination of publicly available and custodian data together with high resolution aerial/satellite imagery, which provided coverage for the entire area of interest. Custodian data from Middleton Beach was used with permission from the City of Albany.

BMT also collated available current Landgate's Shard Location Information Platform (SLIP) of PRH and KGS (Figure 2.1). The images with the highest quality of defining features (e.g. minimal visible turbidity, sun glint, shading etc.) were selected to produce an interim map of targeted transects.

Previous habitat maps have been compiled to create an updated habitat map for the greater KGS and PRH area. Habitat data used to supplement the updated map was sourced from the PER (Ecologia 2009) and South Coast Aquaculture Development Zone (SCADZ) technical report (BMT 2021). The SCADZ habitat mapping was used as it was the most contemporary benthic habitat map available (Bastyan 2015).

2.1.3 Towed video

Ground truth data were collected using towed video along 17 transects throughout the four proposed anchorage sites (five transects at Anchorage D and four transects at Anchorage sites W, Y, Z; Figure 2.1). Transects lengths varied between 1 km and 1.5 km and resulted in a total of ~22 km of ground truth survey data. Targeted areas for ground truthing were based off historical habitat maps and areas of potential disturbance.

The towed video system was configured with a high-definition video camera mounted in a waterproof housing facing on a 45° angle with a live feed to the survey vessel. The height of the camera above the seafloor was moderated by a field member who could review the footage in real time and adjust the camera as applicable. A GoPro was also attached to the housing as a backup to the digital camera. A track log was collected in real-time using a handheld geographical positioning system and within the QGIS software package. The vessel maintained a tow speed of 1-2 knots.

Drone imagery that captured an area of approximately 12.8 km^2 encompassing part of Anchorage W and Z was used to supplement ground truth data in southern KGS near Goode Beach and Frenchman's Bay.

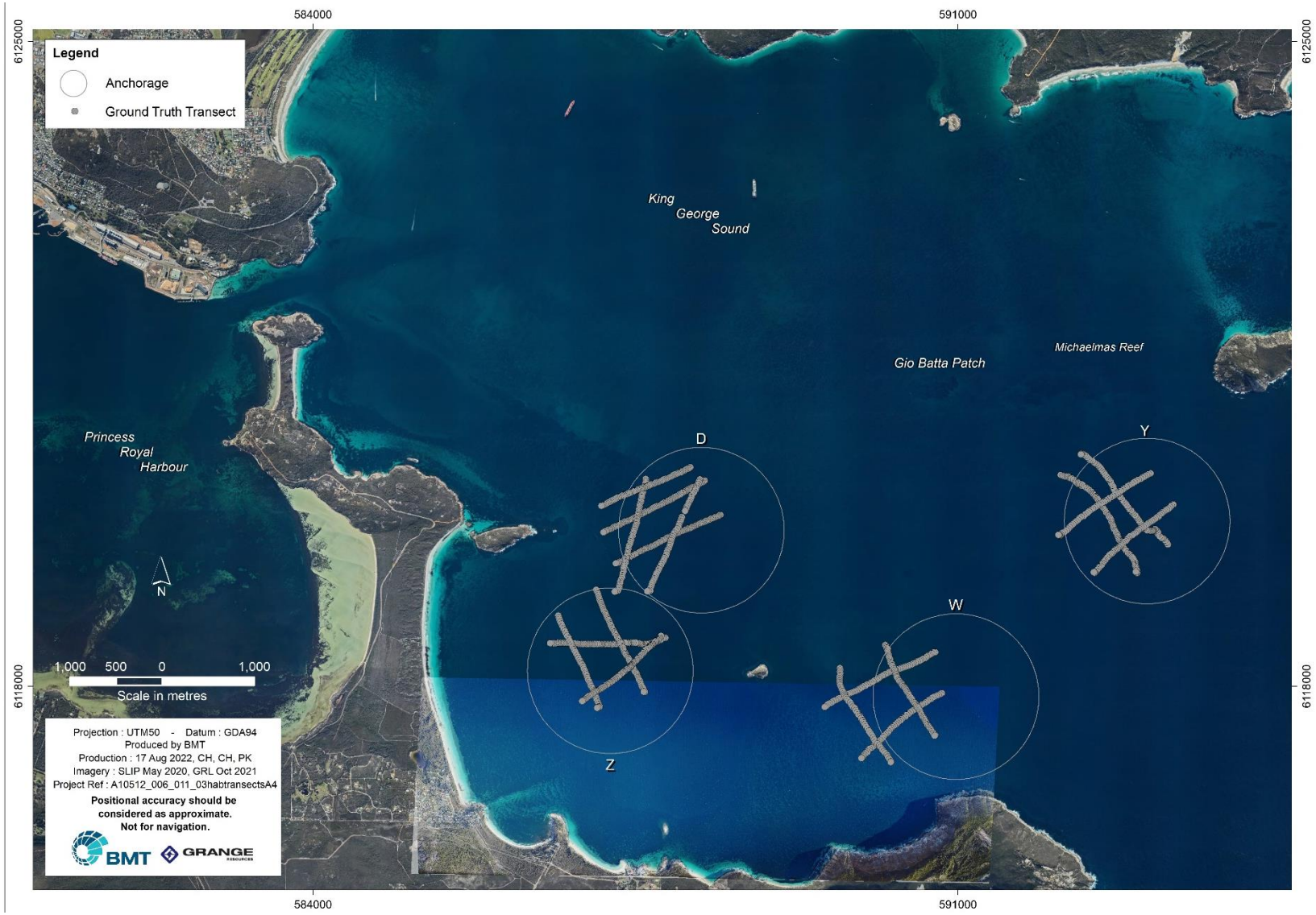

Figure 2.1 Imagery and location of ground truth survey transects in King George Sound

2.1.4 Classification of ground truth data

Ground truthing video footage was analysed in the office using TransectMeasure (SeaGIS 2021) and classified by an experienced marine scientific analyst using the BCH categories listed in Table 2.1. Along each transect, a single benthic habitat type was assigned to each frame of video footage. Benthic habitat was classified by identifying the substrate and habitat type, and presence or absence of fauna and/or flora (sub-category) in each frame of the video. A density (e.g., percent cover) category was also applied to each frame of the video during classification of habitat, ranging from sparse (<20%) to dense (>50%; Table 2.1).

Following classification, the time and classification log was merged with the time and position log to provide a single file with a classification for every position where valid video footage was obtained. The classified habitat point data were then observed in a geographical information system by an experienced remote sensing analyst and marine scientist to verify the classification against the satellite image prior to commencement of remote data classification.

Table 2.1 Benthic habitat classification categories

Substrate	Habitat	Sub-category	Density
Unconsolidated sediment	Bare sand		n/a
	Bioturbated sand		
	Bare silt		
	Bioturbated silt		
	Seagrass	Posidonia sp. Amphibolis sp. Halophila sp. Mixed seagrasses	Sparse <20% Medium 20–50% Dense >50%
Rubble	Bare rubble		n/a
	Macroalgae	Brown macroalgae Green macroalgae Red macroalgae Other macroalgae	Sparse <20% Medium 20–50% Dense >50%
	Filter feeders	Filter feeders (sponges, sea whips)	Sparse <20% Medium 20–50% Dense >50%
	Corals	Hard corals Soft corals	Sparse <20% Medium 20–50% Dense >50%
	Mixed assemblage	Macroalgae & filter feeders Macroalgae & seagrasses Macroalgae & corals Seagrass & filter feeders Filter feeders & corals	Sparse <20% Medium 20–50% Dense >50%
Rocky reef	Bare reef		n/a

Substrate	Habitat	Sub-category	Density
	Macroalgae	Brown macroalgae Green macroalgae Red macroalgae Other macroalgae	Sparse <20% Medium 20–50% Dense >50%
	Filter feeders	Filter feeders (sponges, sea whips)	Sparse <20% Medium 20–50% Dense >50%
	Corals	Hard corals Soft corals	Sparse <20% Medium 20–50% Dense >50%
	Mixed assemblage	Macroalgae & filter feeders Macroalgae & seagrasses Macroalgae & corals Seagrass & filter feeders Filter feeders & corals	Sparse <20% Medium 20–50% Dense >50%
Wrack			n/a
Gravel/cobbles			n/a
Bare pavement			n/a

2.1.5 Classification and mapping procedures

Benthic habitats in shallow water (and where visual penetration of the water column was possible) were mapped using an unsupervised classification approach in ERDAS Imagine 2021. The approach involved creating clusters of similar pixels based on the spectral information of the image. The K-means unsupervised classifier was selected, meaning pixels were iteratively classified into a predetermined number of output clusters to determine the habitat signature.

Ground truth classification data were compiled with previous mapping outputs created from previous habitat surveys and satellite imagery, as described in Section 2.2.

3 Results

3.1 Anchorage D

The benthic habitat in Anchorage D comprised solely of unconsolidated bare sand and sparse seagrass habitat, closely resembling the historical BCH map (Figure 3.1). The seagrass habitat found on the western side of anchorage site comprised of sparse *P. sinuosa*, and *Halophila* sp., whereas seagrass found on north-eastern side of the anchorage site consisted of very sparse patches of perennial *P. coriacea*, *P. sinuosa* and *A. antarctica*. No dense or continuous meadows were observed, except on the north-eastern edge of the anchorage area (Figure 3.1).

3.2 Anchorage W

Based on the historical BCH map, the benthic habitat in Anchorage W was dominated by bare sand and seagrass. The ground truth video transects confirmed the presence of unconsolidated bare sand and seagrass as the dominate habitats, although mixed assemblage communities were also observed. The mixed assemblages were noted as sparse and patchy in occurrence and only in the south and western edges of the transects (Figure 3.1). They were also observed outside of the proposed anchorage area (Figure 3.1). The mixed assemblages comprised of brown macroalgae (*Sargassum* spp.), sparse (<20%) patches of seagrass (*P. coriacea*, *P. sinuosa*, *A. antarctica*, *Halophila* sp.) and sparse (<20%) filter feeders. Dense seagrass meadows to the south of Anchorage W were present in the transects and aerial imagery of Frenchman's Bay (Figure 2.1, Figure 3.1). Very sparse seagrass patches of *P. coriacea* were observed on the northern edge of the site just outside of the proposed anchorage area. No continuous seagrass meadows were observed within Anchorage W.

3.3 Anchorage Y

The ground truth video transects and historical mapping at Anchorage Y revealed that the site predominantly comprised of unconsolidated bare sand, with very sparse patches of *Halophila* sp. on the north and eastern sides. Low relief reef with sparse patches of macroalgae (mostly *Sargassum* spp.) and filter feeders were observed on the north-western edge of Anchorage Y, closest to Michaelmas Reef. Historical mapping shows macroalgal patches in proximity to those observed on the northern edge of the anchorage area (Figure 3.1). No dense or continuous of seagrass meadows were present in Anchorage Y.

3.4 Anchorage Z

Ground truth transects and historical BCH mapping classified Anchorage Z as consisting mainly of bare sand with seagrass on the north-western end of the site. The ground truth video transects also showed patches of macroalgae and very occasional individual sponges (Figure 3.1), throughout the site, although these were very sparse and non-continuous. Moderate (20–50%) to dense (>50%) patches of *P. sinuosa* were observed on the western edge of the anchorage area, consistent with historical mapping.

Overall, there is a strong resemblance between the historical BCH maps and the ground truth video transect data, except for the limited macroalgal and mixed assemblages observed in Anchorage Z. In general, seagrass habitat extent is similar, and the anchorage areas are dominated by unconsolidated sand.

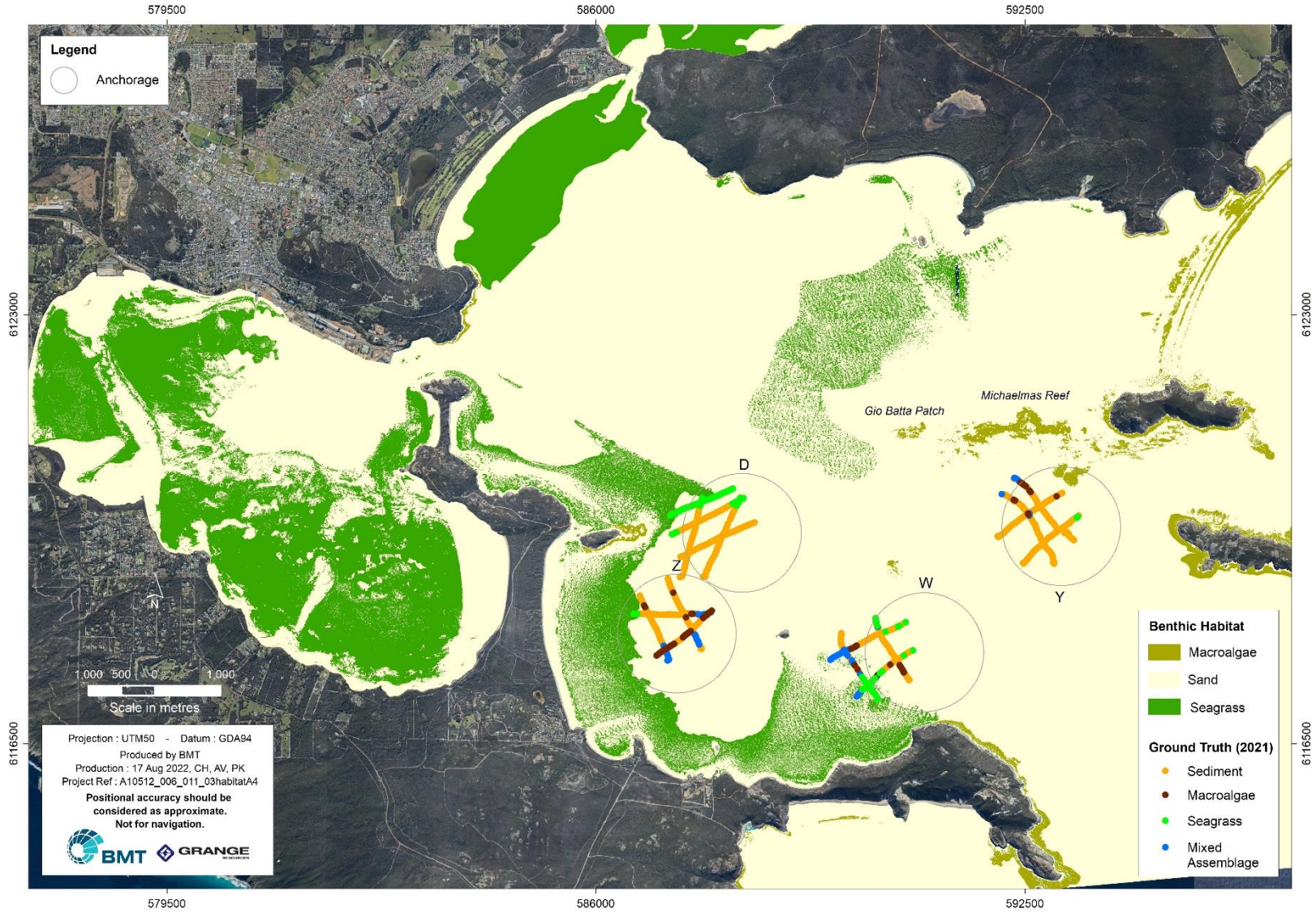

Figure 3.1 Updated benthic habitat map inclusive of towed video survey in the four potential anchorage sites in King George Sound

4 Discussion and Conclusions

The existing BCH maps produced by SKM in 2006 (Ecologia 2009) and BMT for the SCADZ technical report (BMT 2021) were successfully compared and updated to include ground truthing data collected in October 2021. Ground truth transects identified the spatial extent, distribution and characteristics of key BCH within the four proposed anchorage sites (D, W, Y and Z) and support previous mapping that has been done in the area.

Based on the historical BCH maps, the proposed anchorage areas comprised primarily of bare sediment with known seagrass located on the periphery of Anchorages D, W and Z. Ground truthing in 2021 agreed with historical BCH maps with only small variations in the extent of the habitats. The only exception was that ground truth video transects showed limited macroalgal and mixed assemblages observed in Anchorage Z that had not previously been identified. Patches of macroalgae and mixed assemblages were noted as very sparse and there were no continuous macroalgal or filter feeder habitat observed in or around the anchorage area. Natural variations in benthic habitat cover and depths greater than 20 m within anchorage Z (resulting in poor penetration of aerial imagery) would have led to the sparse macroalgal communities not being identified as significant within the historical mapping. Although the current data does not suggest these limited assemblages as significant or dominant habitat types in Anchorage Z, it is noted as relevant benthic habitat in KGS and for the purpose of EIA.

Significant macroalgal communities do occur at Gio Batta Patch, Michaelmas Reef, and adjacent to the large offshore islands (Ecologia 2007), while the rest of KGS is dominated by unconsolidated sand and seagrass meadows (generally limited to areas shallower than 16 m) (Figure 3.1).

The impact on ecological function of BCH in KGS will be assessed based on the updated habitat mapping results described above and shown in Figure 3.1. Updated BCH results generally support the historical BCH knowledge, considering the small variations in extent identified. The proposed anchorage areas are comprised of primarily continuous bare sediment with dense seagrass meadows observed outside of the anchorage areas with the exception of the western edge of Anchorage Z.

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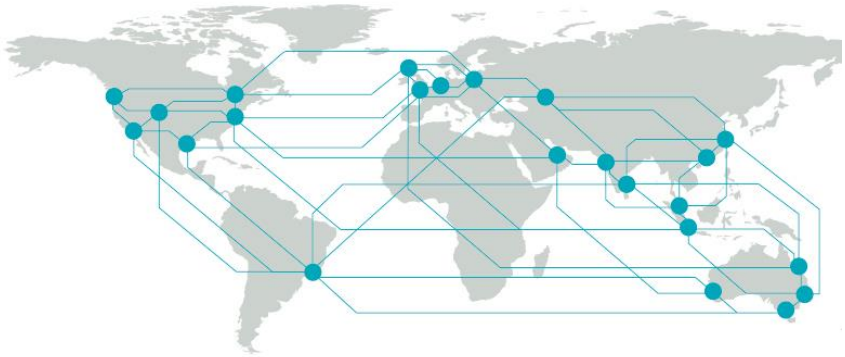

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