TropWATER

Centre for Tropical Water and Aquatic Ecosystem Research

JAMES COOK UNIVERSITY AUSTRALIA

Hay Point Coal Terminal

Marine macrophyte assessment for potential mooring sites – October 2020

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Report No. 21/03

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1. Background & Scope

Hay Point Coal Terminal (HPCT) is assessing proposals for works to install temporary moorings both inside the Half Tide Tug Harbour (HTTH) and in an area directly to the east of the tug harbour for vessel usage during the construction phase of their Shiploader and Berth Replacement (SABR) Project (Figure 1). Additionally, HPCT has also proposed to use an area for cyclone moorings approximately 5-10 km off the coast to the south east of Victor Island that has commonly been used for this purpose in the past (Figure 1).

As part of an information gathering process relevant to both Commonwealth and State (Queensland) approval requirements, Advisian, the lead environmental consultant for the project commissioned the Seagrass Ecology Group at the Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER), James Cook University to conduct marine macrophyte surveys within the area of works for potential moorings. Specifically, TropWATER examined the extent of marine plants (seagrass and macro-algae) growing within the proposed temporary mooring and cyclone mooring boundaries (Figure 1).

Objectives of this scope of works were to:

- Determine the presence, distribution and density of marine macrophytes (seagrass and macro-algae) that may occur within the area of interest;
- Provide a written report and GIS layers of the presence, distribution and density of marine macrophytes within the area of interest.

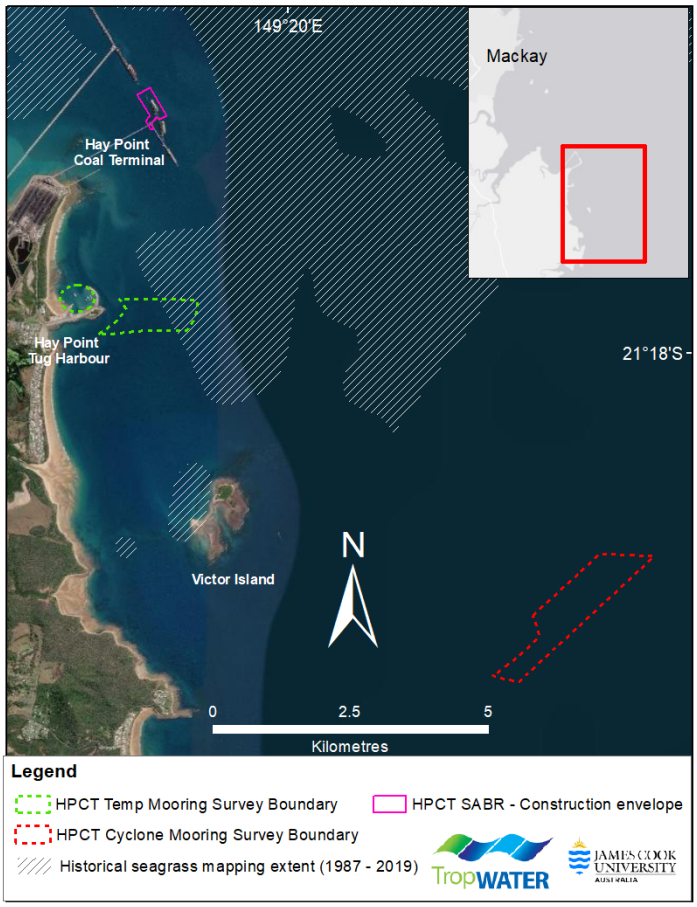

Figure 1. Marine macrophyte survey area showing survey boundaries for proposed temporary mooring and cyclone mooring locations and seagrass distributions from historical mapping from the JCU/NQBP long term seagrass monitoring program.

2. Sampling approach and methods

The sampling methods followed those used in the established annual seagrass monitoring program and previous whole of port surveys in the Mackay/Hay Point/Keswick Island areas (see York and Rasheed 2020 for latest monitoring report). These standard methods are based on the JCU TropWATER seagrass program for baseline assessment and monitoring in the Mackay/Hay Point areas and for other areas of Queensland including the ports of Cairns, Townsville, Weipa, Gladstone, Abbot Point, Karumba and Thursday Island. The survey was conducted in October 2020 when marine plants, such as seagrass are at their peak density and distribution.

The following techniques were used to survey marine plants in the survey area:

1. Shallower inshore habitat (1-12 m deep) for the proposed temporary moorings were monitored from a small vessel using a digital camera mounted on a drop frame that provided a live feed to a monitor on the surface. The transmitted image incorporated a 0.25m^2 view of a quadrat on the seafloor from which a researcher could estimate habitat cover, biomass and species or functional groups present (Figure 2a & c). At each site key seagrass, macro-algae and sediment information from three random placements of the quadrat were collected.
2. Deeper offshore habitat (11-14 m deep) including the cyclone mooring area were monitored from a large research vessel using a towed digital camera system mounted on a sled that incorporates a net 600 mm wide and 250 mm deep with a net of 10 mm-mesh (Figure 2b). At each survey site, seagrass and macro-algae will be sampled along a 100 m transect at drift speed and assessed at 10 random video grabs from the digital videotape. Footage was observed on a TV monitor on board the vessel and also recorded. Marine plant samples captured in the net were used to confirm benthic algal and seagrass taxa or functional groups observed on the monitor. Transect footage was used to determine seagrass meadow and macro-algae habitat characteristics including seagrass meadow area, species composition, above-ground biomass, percent algal cover, depth below mean sea level (MSL), sediment type and time and position (Global Positioning System) fixes. (Figure 2c).

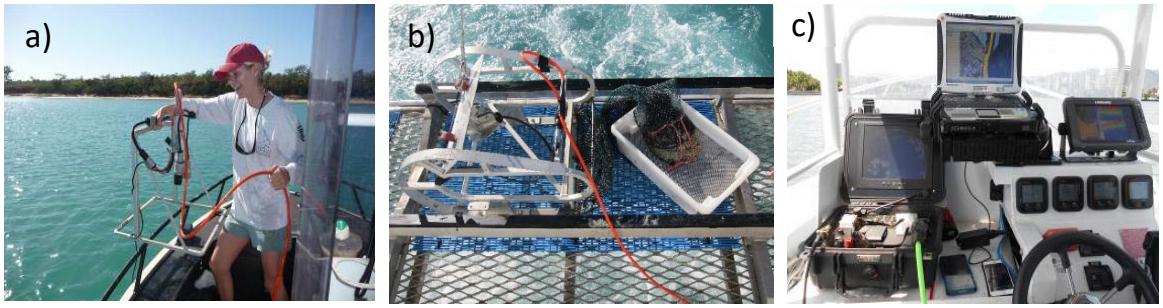

Figure 2. Monitoring set ups for marine macrophyte habitat assessments using live digital cameras (a & b) and on-vessel assessment, spatial referencing and recording of images (c).

Data recorded at each site included:

- **Seagrass species composition -** Seagrass identifications in the field and from video. Species composition was measured from the sled net sample and from the video screen when species are distinct.

- **Seagrass biomass** - Estimates of seagrass biomass from video images and live feed were made using a calibrated visual estimates technique adapted from Mellors (1991). All observers are calibrated to a standard set of video images that have been harvested and measured.

- **Algae** - Presence/absence, algae type and per cent cover. Per cent cover was estimated from the video or live feed on the monitor. For each site an algal community density category were determined. Six community density categories will be used:

Open substrate -	dominant feature was bare substrate;
Very low -	algae covered less than 1% of the substrate;
Low -	algae covered between 1% and 5% of the substrate;
Low/moderate -	algae covered between 5% and 20% of the substrate;
Moderate -	algae covered 20-80% of the substrate;
High -	algae covered more than 80% of the substrate.

Algae collected in the sled net and grab provide a taxa list. Algae were identified into the following five functional groups:

Erect macrophytes -	Macrophytic algae with an erect growth form and high level of cellular differentiation e.g. *Sargassum*, *Caulerpa* and *Galaxaura* species.
Erect calcareous -	Algae with erect growth form and high level of cellular differentiation containing calcified segments e.g. *Halimeda* species.
Filamentous -	Thin thread-like algae with little cellular differentiation.
Encrusting -	Algae growing in sheet like form attached to substrate or benthos e.g. coralline algae.
Turf Mat -	Algae that forms a dense mat or "turf" on the substrate.

3. GIS layers

All survey data were entered into a Geographic Information System (GIS) using ArcGIS 10.7®. GIS layers were created to describe the survey and each of the habitat components (seagrass, macro-algae) within the investigation areas. For each habitat component the following GIS layers was created:

- **Seagrass:**
  - Area data for seagrass meadows and information on community characteristics;
  - Interpolation (raster) layer describing spatial variation in seagrass density using an inverse distance weighted (IDW) interpolation of seagrass site data.

- **Macro-algae:**
  - Area data for algae and information on community characteristics;
  - Interpolation (raster) layer describing spatial variation in algae density using an inverse distance weighted (IDW) interpolation of algae site data.

3. Results & Discussion

Marine macrophyte surveys in the area of interest (Figure 1) were conducted on the 10th October 2020 for inshore areas (temporary moorings) and on the 12th October 2020 for offshore areas (cyclone moorings). Favourable weather and sea state conditions provided excellent water visibility for the assessment of benthic habitats using a live-feed, remote camera. Fifty three (53) sites were assessed during the survey of the proposed temporary mooring grounds with 3 separate camera drops at each site, making a total of one hundred and fifty nine (159) camera drops (Figure 3). More specifically, within the HTTH, twenty (20) sites were assessed for marine macrophyte, and just outside of the HTTH, thirty three (33) sites were assessed. A further twenty two (22) sites were assessed using camera towed video along 100 m transects in the offshore area for the proposed cyclone mooring area (Figure 3).

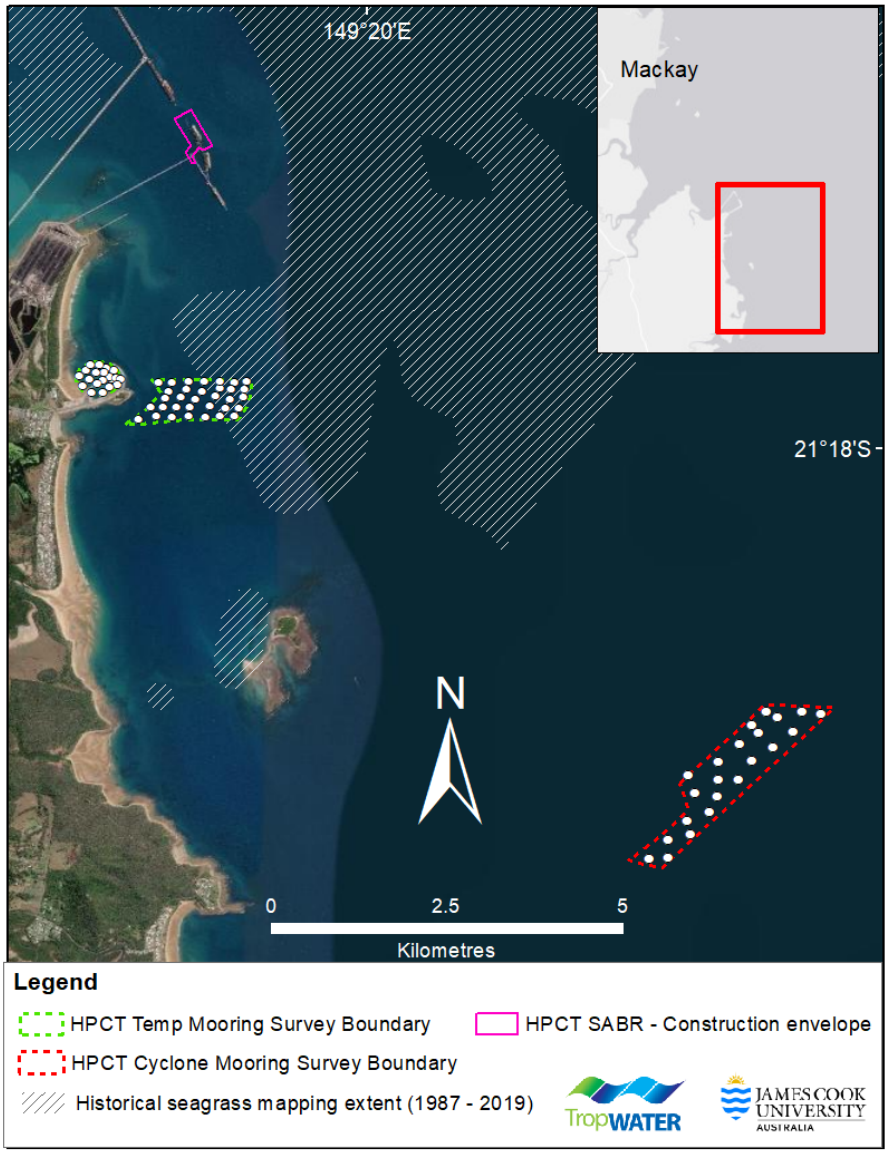

Figure 3. Sampling sites for marine macrophyte assessment at the inshore temporary mooring grounds and the offshore cyclone mooring grounds in October 2020.

Marine Macrophytes in Temporary Mooring Areas

The benthic habitat for the proposed temporary moorings within the HTTH consisted of open substrate of muddy sediments with no marine plants (seagrass or macro-algae) present at any of the assessment sites (Figure 4). The area surveyed for proposed temporary moorings outside of the Tug Harbour also contained predominately open substrate of muddy to sandy sediments and no seagrasses were recorded during the survey. Five of the thirty three sites sampled in this area contained sediment covered in a filamentous algal mat ranging in percent cover from 5 - 40 % (Figure 4). The area covered by the filamentous algal mat (Figure 6a) in the north eastern corner of the survey boundaries was estimated at 8.1 ± 2.6 ha with a low/moderate percent cover of 19.0 ± 5.8 % (Figure 4).

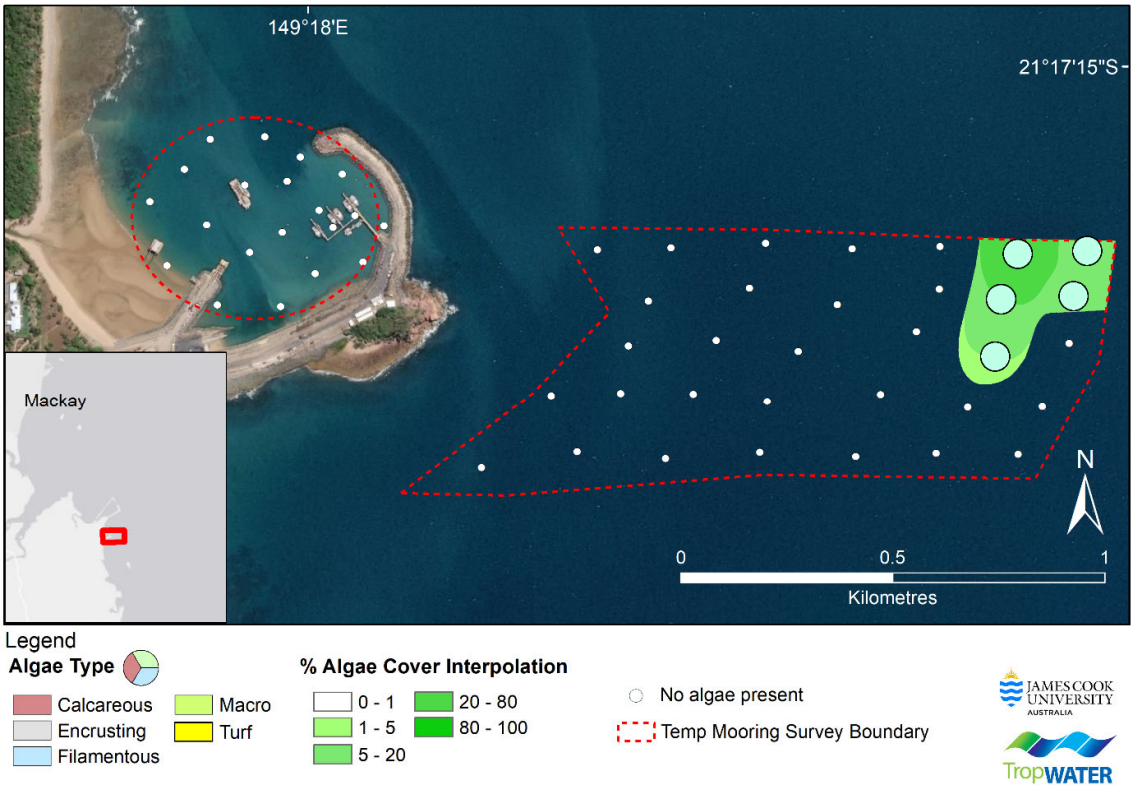

Figure 4: Marine macrophyte distribution among temporary mooring areas inside and outside of the Hay Point Tug Harbour. The area was surveyed on 10th October 2020 and no seagrass was present.

Marine Macrophytes in Cyclone Mooring Areas

The benthic habitat for the proposed cyclone moorings contained a sparse covering of deep-water seagrass at nine of the twenty two sites surveyed, very low (less than 1 % cover) of marine algae at four sites and a combination of sparse seagrass and very low algae at a further four sites (Figure 5 a, b and c). At the thirteen sites where seagrass was present *Halophila decipiens* was the dominant species with one site also containing *Halophila spinulosa* (Figure 6b & c). The area of the seagrass

footprint within the cyclone mooring survey boundary was estimated at 100 ± 16 Ha with a very low mean biomass of 0.008 ± 0.002 gDW/m^2 (Figure 7). At the eight sites where marine algae was present macro-algae were the dominant functional group (Figure 6d & e) with rare occurrences of erect calcareous algae and filamentous algae (Figure 8). The cover of marine algae was very low and ranged between 0.05 and 0.3 % among the sites where it was present consisting of one to several small clumps along the 100 m transects (Figure 6d & e; Figure 8). The area of algal distribution within the proposed cyclone mooring boundary was 53 ± 13 Ha (Figure 8). Despite the large area covered by marine macrophytes in the cyclone mooring survey area (seagrass and algae combined - Figure 9) substantial gaps of open substrate remained where cyclone moorings could be located without damage to marine plants.

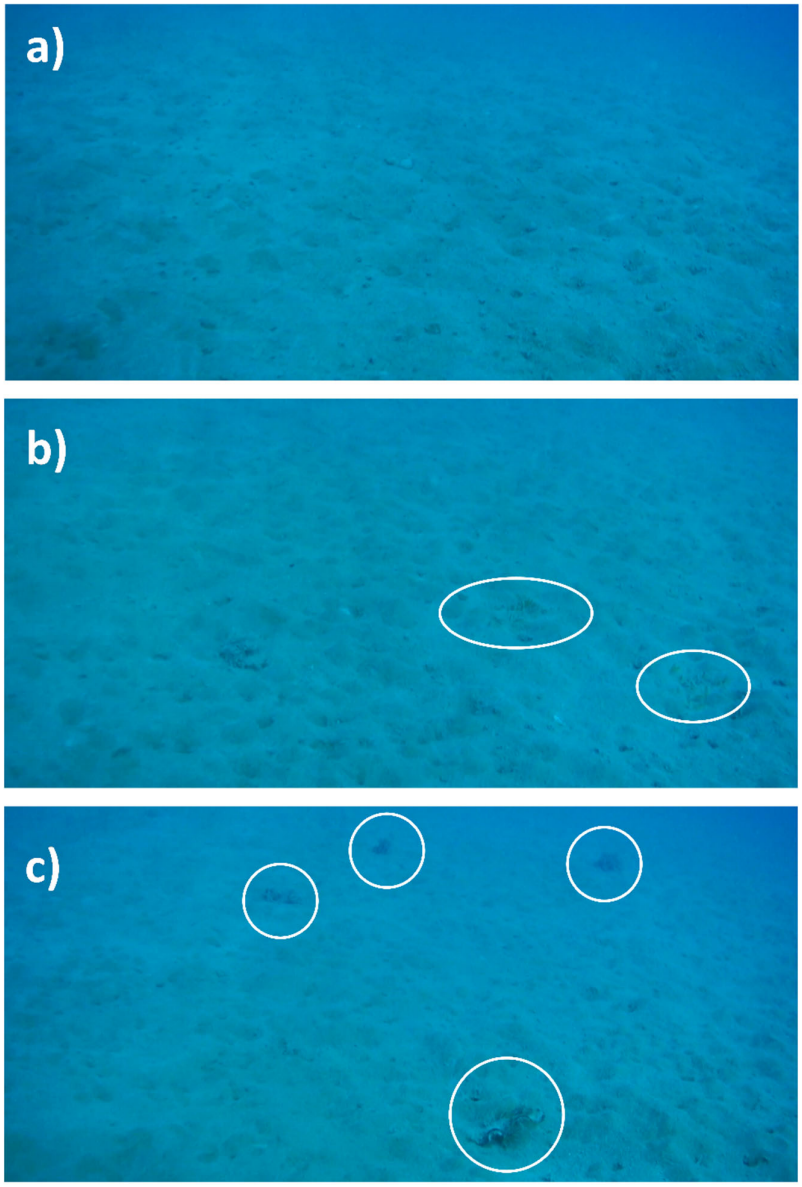

Figure 5: Landscape views of the offshore cyclone mooring area showing benthic habitat seen during the survey including a) open sandy substrate b) open substrate with patches of seagrass and c) open substrate with isolated macroalgae

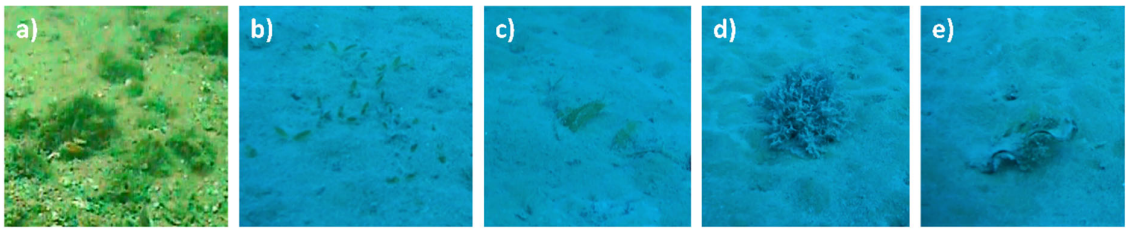

Figure 6: Major marine macrophyte groups observed during the study including a) filamentous algae, seagrass b) *Halophila decipiens* and c) *Halophila spinulosa* and macro-algae d) and e). The image of the filamentous algae is from a previous survey.

Spatial and temporal distribution of marine macrophytes within the Hay Point Region

Seagrass habitat in the Hay Point and Mackay region has been monitored regularly since 2004 as part of a series of annual and broad-scale monitoring programs undertaken by TropWATER's Seagrass Ecology Group at James Cook University on behalf of North Queensland Bulk Ports (York and Rasheed 2020). The annual monitoring survey boundaries of these programs include a large part of the area for proposed temporary moorings outside of the HTTH but not the areas within the HTTH or the offshore cyclone mooring areas. Seagrass (*Halophila* species) was present at the eastern end of this temporary survey area outside of the HTTH in 2004 (see historical mapping extent of seagrass in Figure 3) but has not been observed in this area in the nine monitoring events since then.

The monitoring programs have been valuable in providing baseline information on seagrass communities in the region. These can be characterised as predominately offshore deep-water meadows consisting of *Halophila* species which are highly variable in their spatial and temporal distribution (York and Rasheed 2020). A long-term (8-year) analysis of the presence of offshore seagrass at Hay Point has found a regular annual occurrence of the colonising species *Halophila decipiens* between July and December and the occasional occurrence of *Halophila spinulosa* (York et al. 2015). For the remainder of the year these populations remain dormant in the form of a seed bank (York et al. 2015, Chartrand et al. 2018). The region also contains smaller meadows on intertidal and shallow-subtidal mud and sand flats consisting of species larger in morphology than deep-water species (e.g. *Halodule uninervis* and *Zostera muelleri*) such as those found at Dudgeon Point (York et al. 2020).

The survey was conducted in October 2020 during the peak growing season for seagrass in the region. The absence of inshore seagrass within the temporary mooring is consistent with findings over the last fifteen years of seagrass monitoring in the area (York and Rasheed 2020). The deep-water seagrass communities and their sparse distribution and low biomass within the offshore cyclone mooring boundaries are also typical for the region. The two species found in the area are common deep-water species adapted for low light environments (Chartrand et al 2018). The high variability of these deep-water seagrass assemblages means their distribution is likely to change over coming seasons and years. Areas where seagrass was present would likely become bare during the low light environment of the wet season. Also, areas where no seagrass was present during the survey may contain seagrass in the future if seedbanks in the sediment germinate during favourable growing conditions (York et al. 2015). Inter-annual variability is also primarily driven by the availability of benthic light and the distribution can be adversely influenced by disturbances such as cyclones, flooding or significant and prolonged anthropogenic disturbances (York et al. 2015, Chartrand et al. 2018). There is also an ecological window from January to the end of May each year when the majority of seagrasses in the area are likely to be in their dormant state as a seed bank (York et al. 2015, Wu et al. 2017, Wu et al. 2018).

Macro-algae has also been monitored by the TropWATER Seagrass Ecology Group in Hay Point region in 2004, 2010, 2014 and 2016. These surveys have shown that algal distributions are also highly variable in presence and distribution throughout the region. The temporary mooring area outside of the HTTH had an area of filamentous algae in the north-eastern corner during the survey. This same area had both macro-algae and filamentous algae present during the 2004 and 2016 monitoring surveys (Rasheed et al. 2004, McKenna and Rasheed 2017), but the same area consisted of bare, open substrate during surveys in 2010 and 2014 (Thomas and Rasheed 2011; McKenna and Rasheed 2015). Filamentous algae are able to quickly colonise disturbed habitats and nutrient blooms but their persitence and habitat value is poor realtive to larger habitat forming macro-aglae (Wernberg and Connell 2008). It is therefore likely that the area of filamentous algae within this area would be highly variable in presence and distribution and likely to change over time depending on the growing conditions.

The macro-algae present in the offshore cyclone mooring survey area was very low in density (less than 1 % cover) with only one to several small clumps present (see figures 5 and 6) along each 100 m transect. At this level of cover the probability of disturbing any large quantities of macro-algae when installing mooring sites would be negligible.

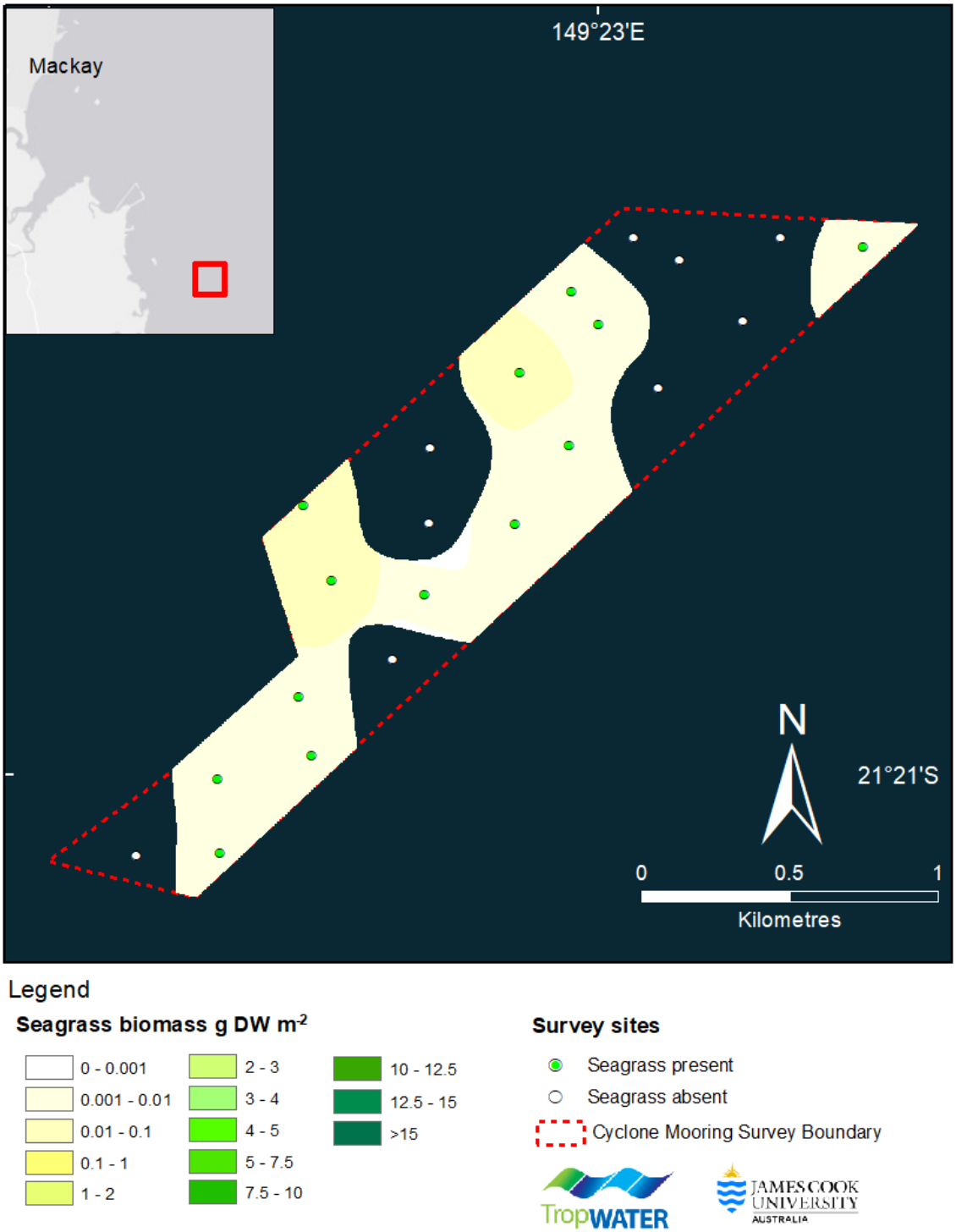

Figure 7: Seagrass distribution and density within the cyclone mooring areas offshore from Hay Point. The area was surveyed on 12th October 2020.

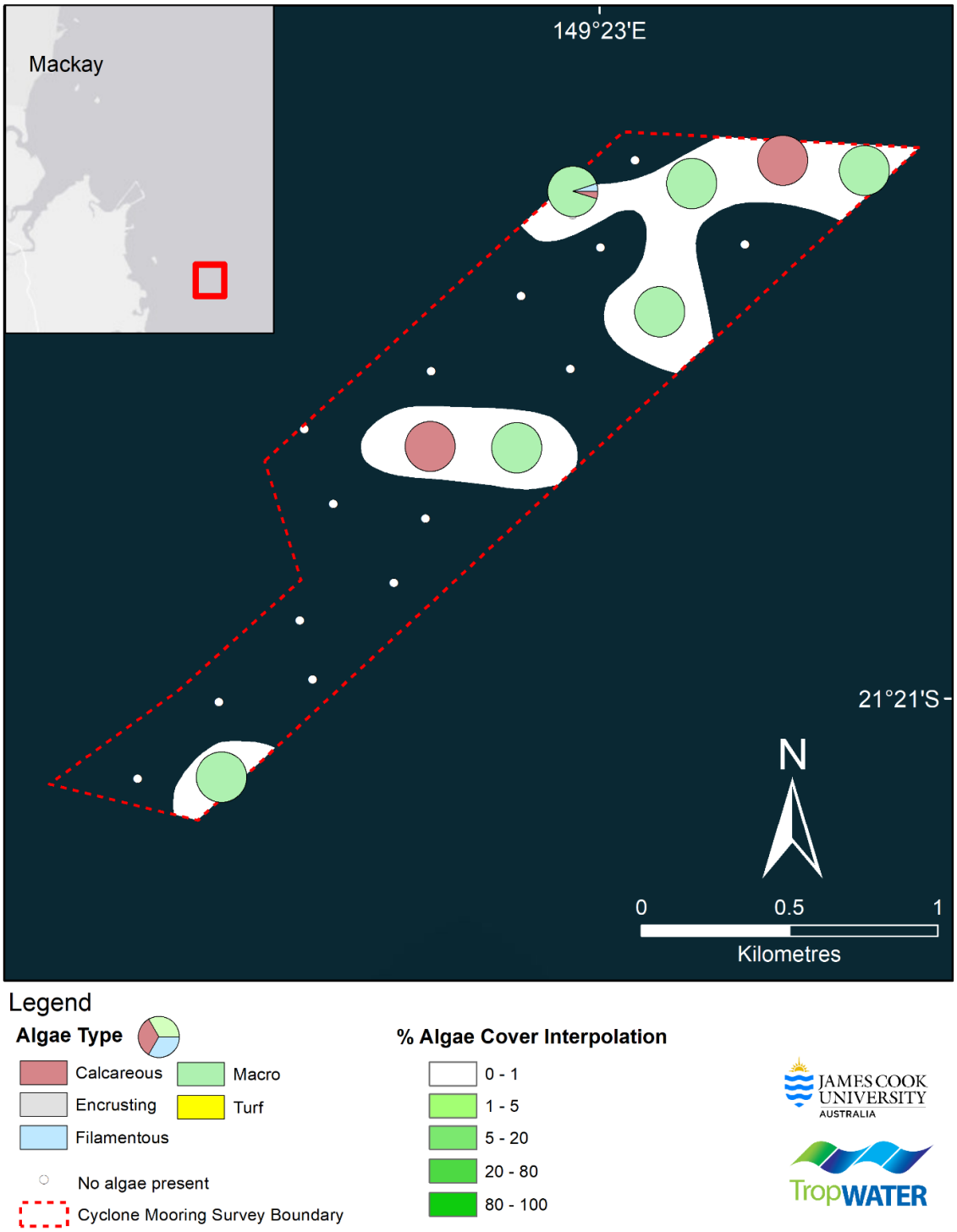

Figure 8: Marine algal distribution and cover within the cyclone mooring areas offshore from Hay Point. The area was surveyed on 12th October 2020.

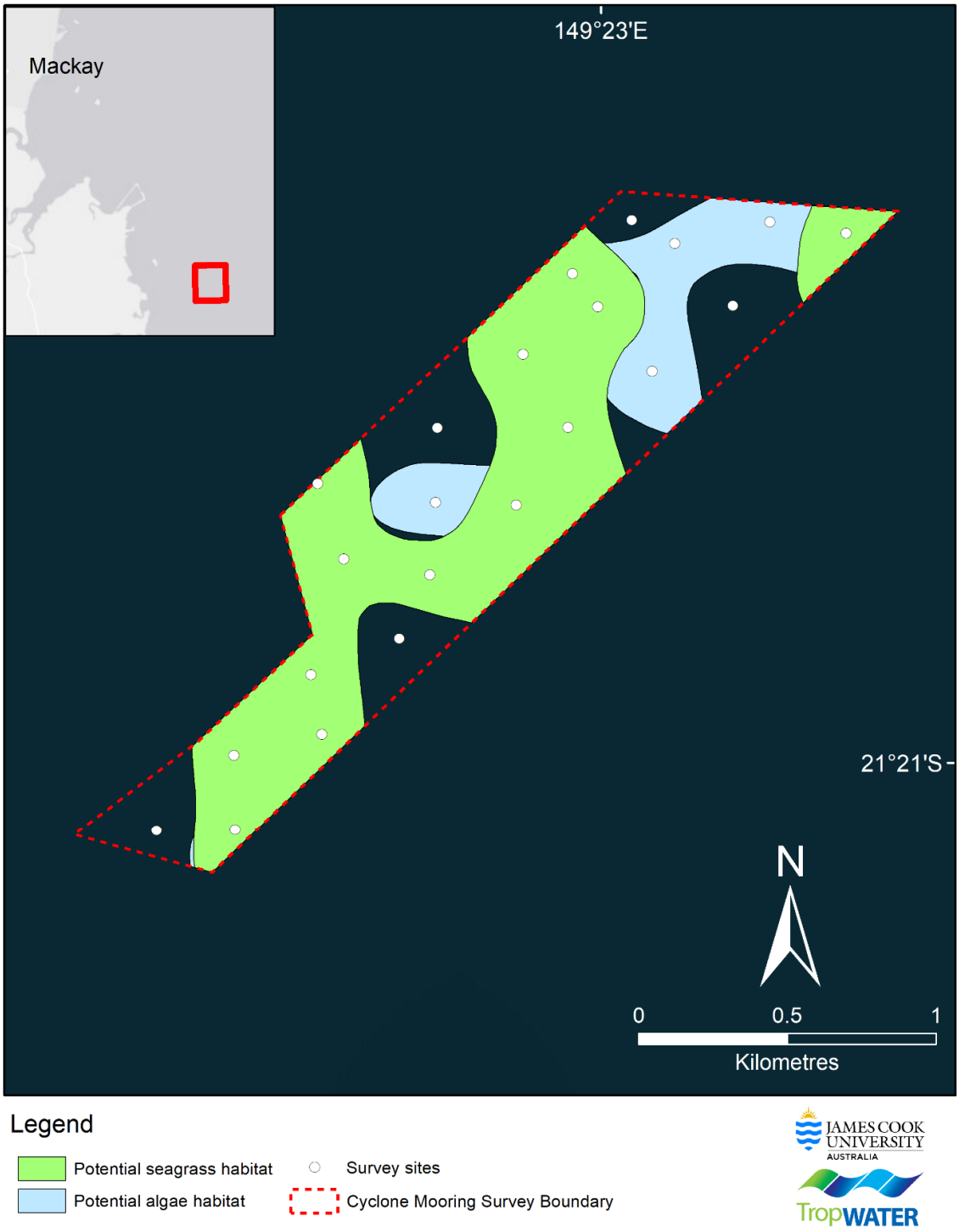

Figure 9: The combined footprint of potential seagrass and algal habitat within the proposed cyclone mooring survey area.

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