Seagrass Distribution

Cook Island Aquatic Reserve

Prepared for: Transport for New South Wales

Prepared by Ecological Service Professionals Pty Ltd

January 2024

Document Control

Report Title: Seagrass Distribution: Cook Island Aquatic Reserve

Project Reference: 2346

Client: Transport for New South Wales

Client Contact: Sarah Dobe

Report Status	Version Number	Date Submitted	Authored By	Reviewed By	Issued By	Comment
Draft	2346.001V1	22/01/2024	S Walker L West	L West	L West	Draft for client review
Final	2346.001V2	21/02/2024	L West	L West	L West	Final Report

Acknowledgement of Country: In the spirit of reconciliation Ecological Service Professionals acknowledges the Kombumerri and Minjungbal peoples, the Traditional Custodians of country where we have worked, and we recognise their connection to land, sea and community. We pay our respect to their Elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples through our scientific work on country.

Table of Contents

List of Figures

List of Tables

Executive Summary

Ecological Service Professionals Pty Ltd (ESP) was commissioned by Transport for New South Wales (NSW) to complete a desktop assessment and field survey to quantify the extent and coverage of seagrass around Cook Island to provide a baseline against which potential changes from Tweed Sand Bypassing (TSB) activity can be measured.

A desktop review of data (including underwater video and images) collected around Cook Island in 2020, 2021, 2022 and 2023 was completed to assess seagrass habitat during these years, including species present and an estimate of the cover. In addition, a benthic survey was completed on 14 November 2023 to map the distribution, coverage and condition of seagrass around Cook Island using remote techniques.

Based on data collected between 2020 and 2023, seagrass on the north-western side of Cook Island was dominated by *Halophia ovalis,* with the extent and coverage varying over time. In July 2020 and May 2021, the seagrass on the north-western side of Cook Island was moderate to dense, covering approximately 30% to 50%. In June 2021 and May 2023, while seagrass was still present in this area, the coverage had declined, covering approximately 10% to <10% of the space where it was present.

In November 2023, seagrass was recorded on the north-western and south-western sides of Cook Island (in approximately 7 to 9 m water depth) and covered a total area of 958 m^2. This is a relatively small area compared with the extent of rocky reef, macroalgae and coral, which are the dominant habitats around Cook Island. The condition of seagrass was generally good, with the patches likely to persist over time despite some changes in the overall area covered.

On the north-western side of Cook Island, seagrass had a discontinuous extent, recorded in patches between macroalgae, rock and rubble on sand habitats. The community was dominated by *H. ovalis*, with coverage of patches ranging between approximately 15% and 50%. On the south-western side of Cook Island, seagrass was more continuous and had a much greater extent. The community was typically dominated by *H. ovalis* often growing amongst various foliose macroalgae, with a patch of mixed seagrass (*H. ovalis* and *Zostera muelleri*) also present. Coverage of seagrass on the south-western side of Cook Island was dense (>60% coverage) on the fringe of the rocky reef and decreased as the patches extended out over bare sand.

Changes in the extent and coverage of seagrass may be due to natural variation (e.g. from catchment runoff and associated changes in water quality). Seagrasses are also sensitive to smothering and burial from sand. The extent and condition of seagrass measured around Cook Island in November 2023 provides comparative data against which future potential impacts of TSB operations can be measured. Given the spatial variability in the extent and cover of seagrass over time and limited suitability of comparative sites (as offshore seagrass in the region is scarce), ongoing annual monitoring (ideally in the month of November) to confirm the extent and coverage of seagrass around Cook Island is recommended.

1 Introduction

1.1 Background

The Tweed Sand Bypassing (TSB) project is a joint initiative of the New South Wales (NSW) and Queensland State Governments, with the objectives to establish and maintain the entrance to the Tweed River, and to restore and maintain coastal sand drift to the Southern Gold Coast beaches. Part of the TSB project is achieved via a fixed sand bypass system that pumps sand from a jetty on the southern side of the Tweed River, under the river through a series of buried pipelines, to four outlets on the northern side of the river. Supplementary dredging to clear the Tweed River entrance is also commissioned by TSB when required.

When dredging occurs, the dredge deposits sand in approved placement areas along the Tweed Coast and Southern Gold Coast (Figure 1.1). In 2019, additional placement areas at Fingal and Dreamtime were approved to provide greater flexibility in TSB operations. These areas are located near the Cook Island Aquatic Reserve, which is managed under the *Marine Estate Management Act 2014* to protect marine biodiversity and to support marine science, recreation and education. Prior to approval of the Dreamtime and Letitia deposition areas, a Review of Environmental Factors (REF) completed in 2019 stated *the habitat in the proposal area and adjacent habitats is a high energy coastal area of open beach that is not suitable for the establishment of seagrass* (APP 2019). However, since the REF, seagrass has been observed on the north-western side of Cook Island by local divers and by Ecological Service Professionals Pty Ltd (ESP) during the TSB Reef Monitoring Program (ESP 2020; ESP 2021; ESP 2022; ESP 2023).

Seagrass are a marine plant protected under the *NSW Fisheries Management Act 1994*. Seagrass have a broadly important ecological function, including (but not limited to) fisheries habitat, nursery habitat, protection from predators, contributing to food webs, controlling sediment runoff and processing nutrients (Nagelkerken et al. 2008; McKenzie et al. 2021). Seagrass habitats have high ecological value, and provide connectivity between inshore and offshore ecosystems, which is vital for the maintenance and regeneration of numerous fish and invertebrate populations (Waycott et al. 2009; Waycott et al. 2011). They provide food and shelter for a diverse range of marine fauna; and support benthic macroinvertebrate communities, which in turn provide a food resource for many larger, commercially important species of crustacean, mollusc and finfish (Coles et al. 1993; Carruthers et al. 2002). Several threatened species, including sea turtles and dugong, also rely on seagrass as a foraging habitat.

1.2 Scope of Works

ESP was commissioned by Transport for NSW to complete a desktop assessment and field survey to quantify the extent and coverage of seagrass around Cook Island. This information was required to provide a baseline of the extent, cover and condition of seagrass present, against which potential changes from TSB activity can be measured.

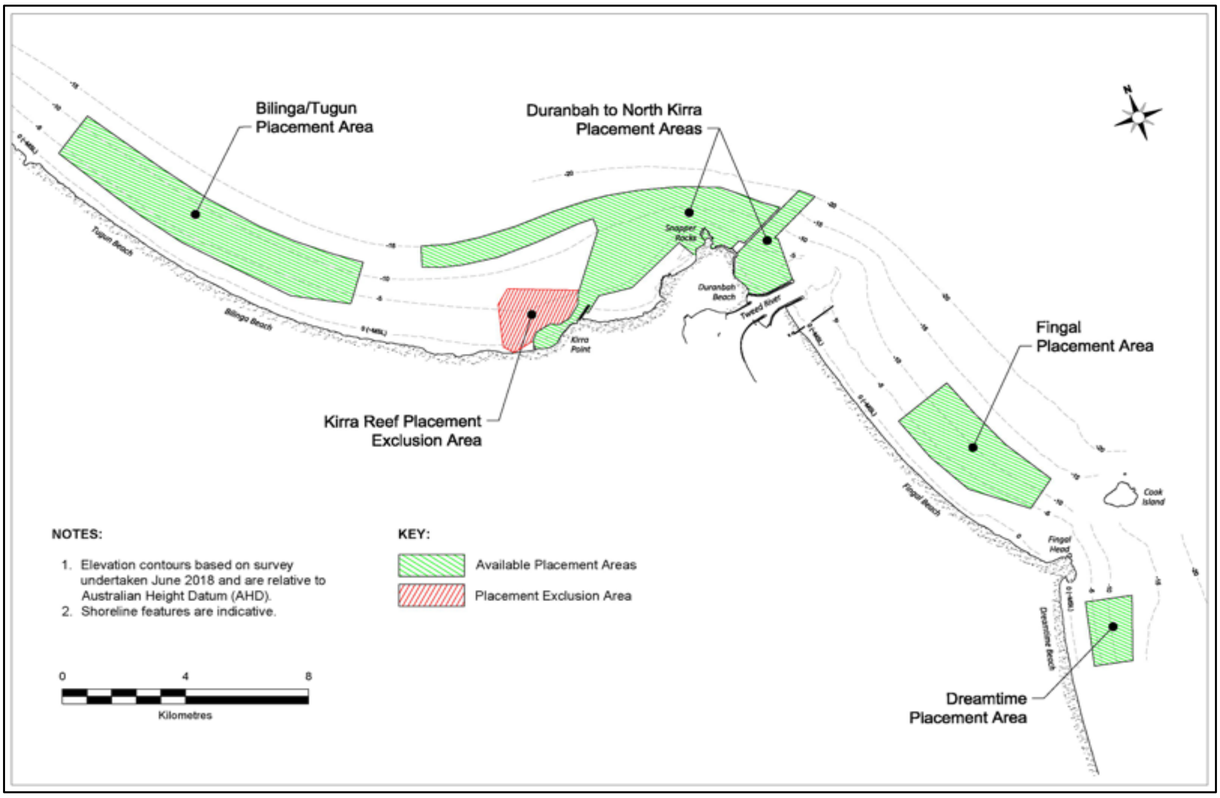

Figure 1.1 Current approved placement areas for disposing dredged sand (TSB 2023)

2 Methods

2.1 Desktop Assessment

While measuring the extent of seagrass was not specifically targeted as part of the TSB Reef Monitoring Program, the presence was confirmed around Cook Island in 2020, 2021, 2022 and 2023 by ESP. Data (including underwater video and images) collected as part of the TSB Reef Monitoring Program were reviewed to assess seagrass habitat during these years. While data were deemed unsuitable to map the extent of seagrass, data were used to provide a general description of seagrass, including species present and a rough estimate of the cover.

2.2 Field Survey

A benthic survey was completed to map the distribution, coverage and condition of seagrass around Cook Island. The survey was completed on 14 November 2023 at a time of year when seagrass is likely to be at the maximum extent (i.e. towards the end of the peak growing season and prior to the wet season, which can result in greater freshwater, turbidity, reducing light penetration for photosynthesis).

The survey was completed using remote techniques from a commercial vessel operated by a suitably qualified skipper (i.e. coxswain or Master 4). The species composition, percent coverage and condition of seagrass was assessed qualitatively, based on expert assessment of georeferenced imagery (video and photos) at more than 1000 points across the surveyed area. Methods were adapted from Roelfsema & Phinn (2009) where a GPS unit is towed along the water surface with the type of substrate recorded using imagery from an underwater remotely operated vehicle (ROV) (Figure 2.1). Broad seagrass coverage categories were either determined directly from imagery or in the laboratory using georeferenced imagery.

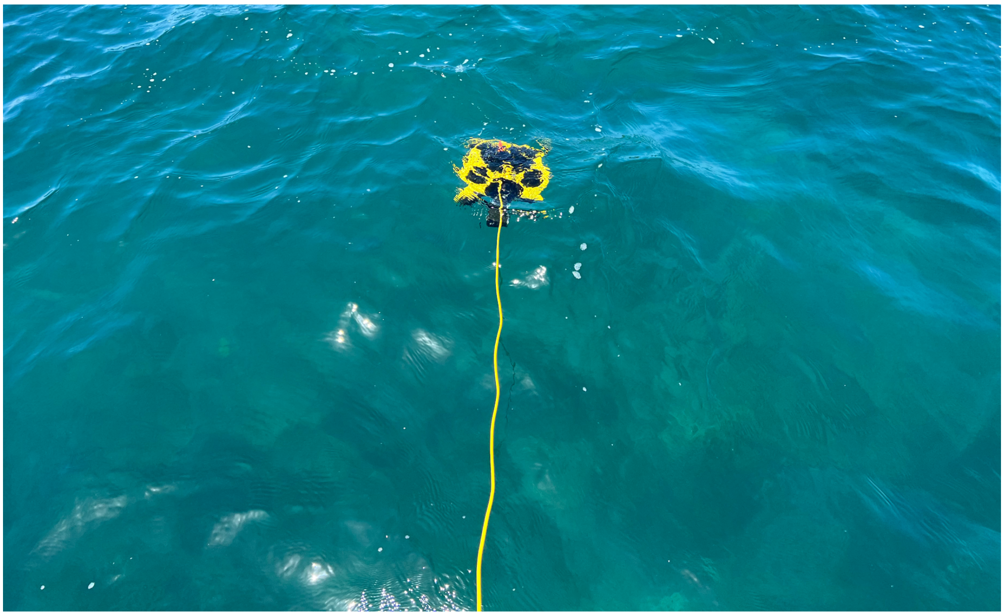

Figure 2.1 ROV used to assess seagrass in November 2023

2.2.1 Seagrass Condition

Based on field survey results, the condition of seagrass was assessed for each patch based on the criteria adapted by ESP from the Wetland Assessment Manual (Price et al. 2007) and a review of the available fisheries literature[1] linking habitat features with fisheries productivity as outlined in Appendix A. Patches of seagrass were scored based on the presence of various criteria and the total was summed across each criteria to determine whether the seagrass habitat was poor, fair, good or very good (Appendix A).

2.3 GIS Mapping

A map based on the field data showing the extent of seagrass habitat present around Cook Island was produced using ESRI ArcGIS Pro. The total area for each patch of seagrass was calculated using ESRI ArcGIS Pro.

[1] Bell & Westoby 1986a, b; Edgar & Robertson 1992; Short & Wyllie-Echeverria 1996; Boström & Bonsdorff 1997; Heck et al. 1995; Webster et al 1998; Skilleter et al. 2005; Vanderklift & Jacoby 2003; Pittman et al. 2004; Boström et al. 2006; Jelbart et al. 2007; Price et al. 2007; Shoji et al. 2007

3 Results

3.1 Desktop Review

Seagrass has historically been recorded on the north-western side of Cook Island since 2020, although the distribution of seagrass has not been previously mapped. The seagrass community on the north-western side of Cook Island has a discontinuous extent, being recorded between macroalgae, rock and rubble on sand habitats. Past surveys indicate the community is dominated by *Halophila ovalis*.

Based on observations from imagery available, the extent and coverage of seagrass patches changes annually (Figure 3.1). In July 2020, the seagrass on the north-western side of Cook Island was moderate to dense, covering approximately 30% to 50% of the space (between macroalgae, rock and rubble on sand) where it was present. This moderate to dense patch of seagrass was also present in May 2021, with the cover consistent with July 2020 (i.e. approximately 30% to 50% of the space where it was present). In June 2021, while seagrass in this area was still present, the coverage had declined, covering approximately 10% of the space where it was present. In May 2023, while still present, the cover again remained low, covering <10% of the space where it was present.

a) b) c) d)

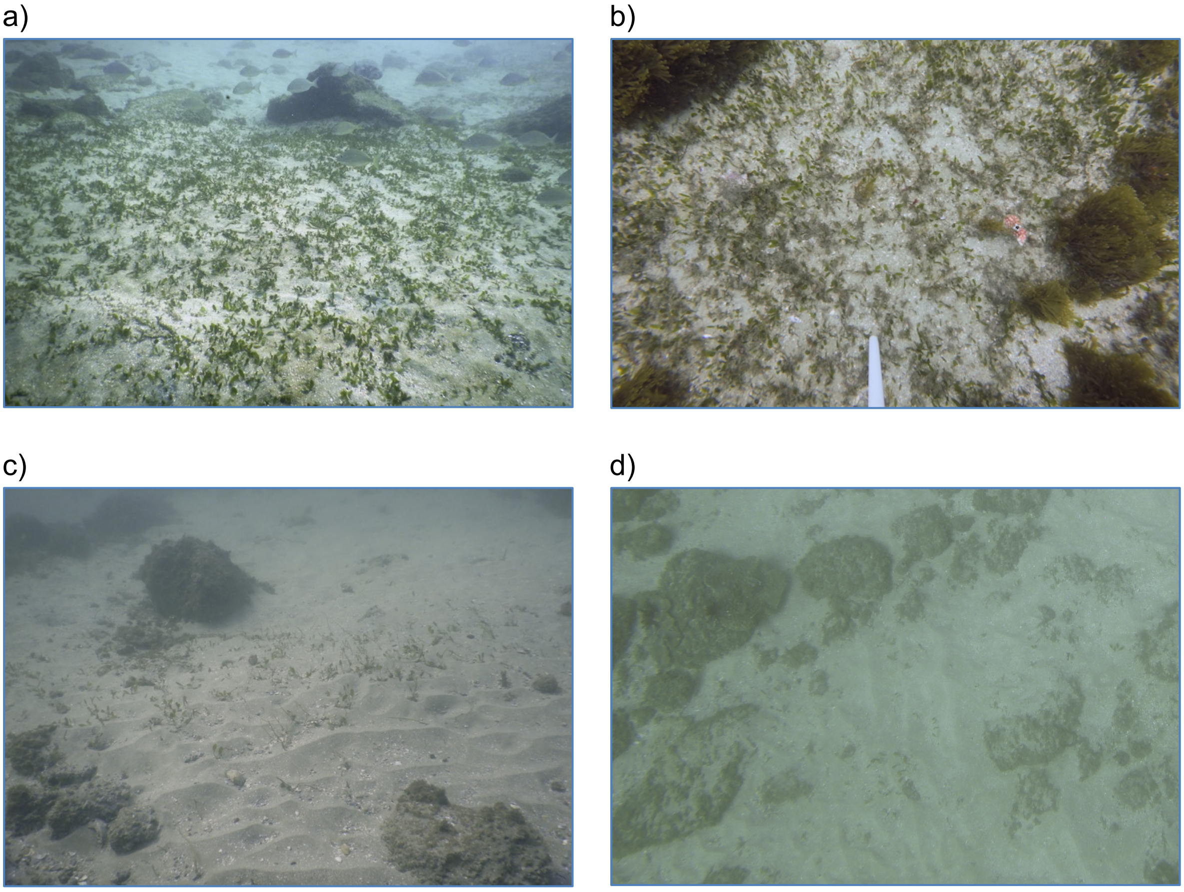

Figure 3.1 Seagrass *Halophila ovalis* at Cook Island in a) July 2020 b) May 2021 c) June 2022 and c) May 2023

3.2 Field Survey

In November 2023, seagrass was recorded on the north-western and south-western sides of Cook Island (Figure 3.2). The seagrass present on the north-western side of the reef was recorded in patches of up to 10 m in diameter, with sparse to dense coverage of *H. ovalis* covering a total area of 111 m^2. The seagrass was growing on sandy patches between rock covered with macroalgae at approximately 7 to 9 m depth (Figure 3.3 & Figure 3.4). The percent coverage of patches ranged from 15 to 50%. Seagrass on the north-western side of Cook Island was in good condition.

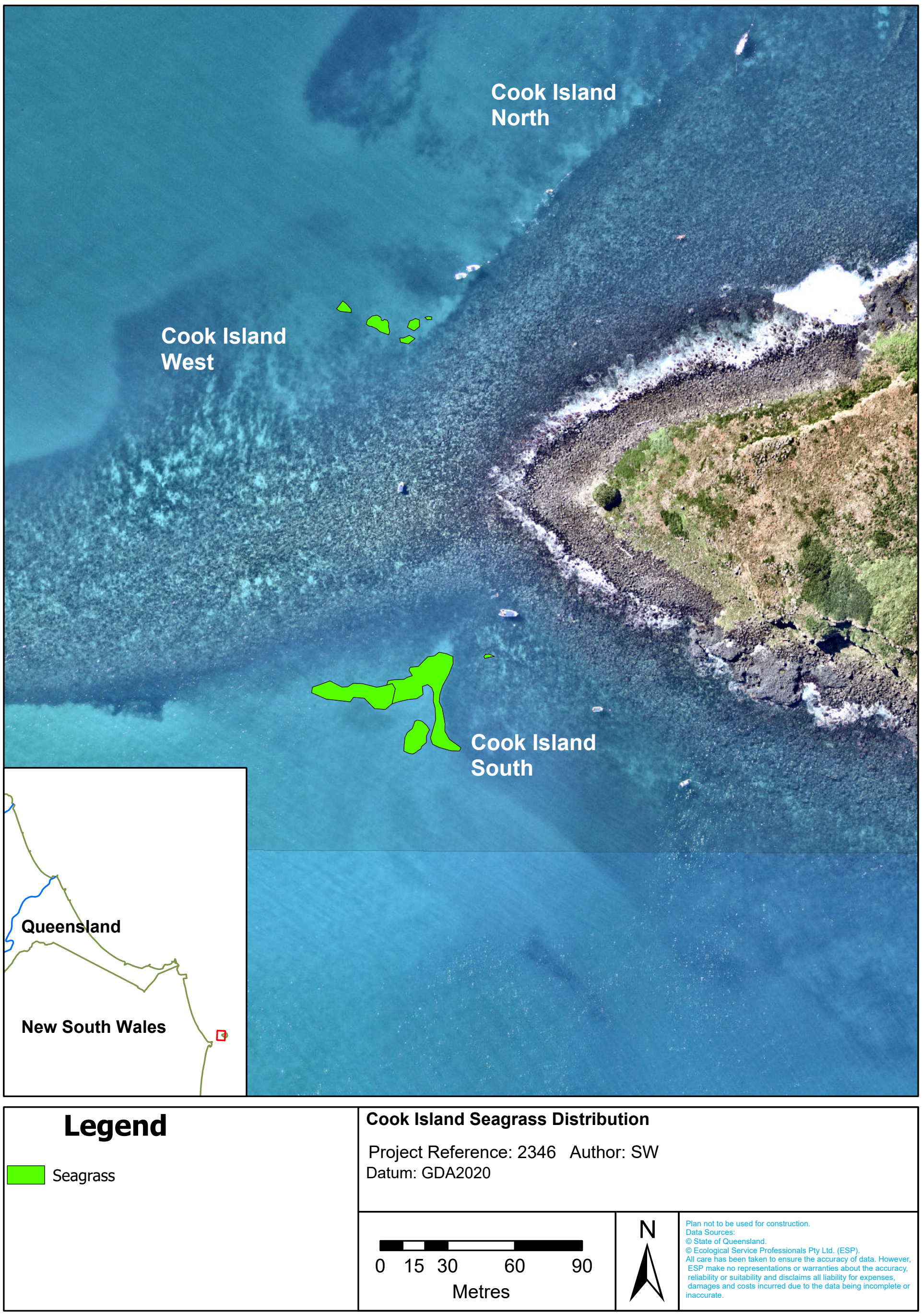

Figure 3.2 Seagrass distribution at Cook Island in November 2023

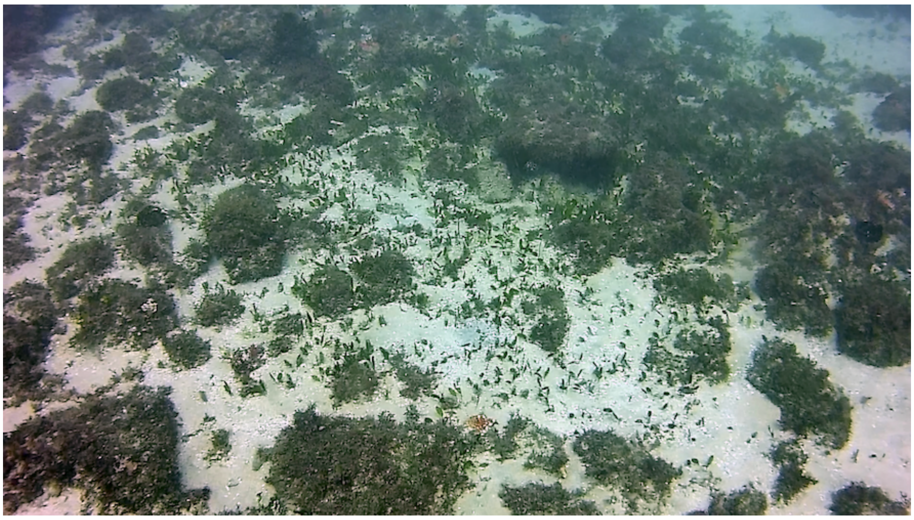

Figure 3.3 Small patch of sparse seagrass (*H. ovalis*) on the north-western side of Cook Island

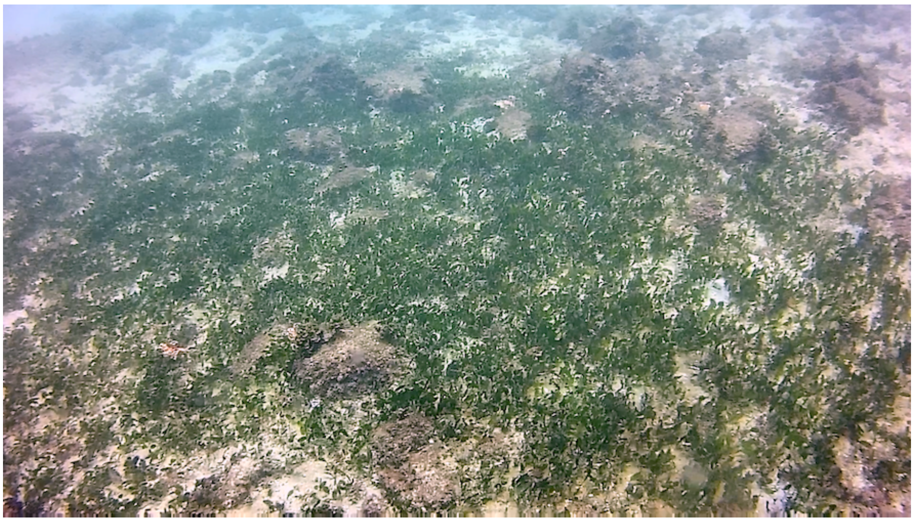

Figure 3.4 Patch of dense seagrass (*H. ovalis*) on the north-western side of Cook Island

Seagrass grew at a similar depth on the south-western side of the island, although typically had a higher coverage (>60%) and much greater extent (a total of 847 m^2) than on the north-western side (111 m^2) (Figure 3.2). The seagrass was most dense on the fringe of the rocky reef (Figure 3.5) and decreased in coverage as the patches extended out over bare sand, with a distinct edge between the seagrass and bare sand (Figure 3.6). On the southern side of the reef, the community composition was typically dominated by healthy *H. ovalis* often growing with various foliose macroalgae (*Dictyota* sp.) on rubble (Figure 3.5). There was a patch of mixed seagrass (*H. ovalis* and *Zostera muelleri*) at the western extent covering 268 m^2 (Figure 3.7). The seagrass transitioned to sparse macroalgae and rocky rubble habitat further west. Seagrass on the south-western side of Cook Island was in good to very good condition.

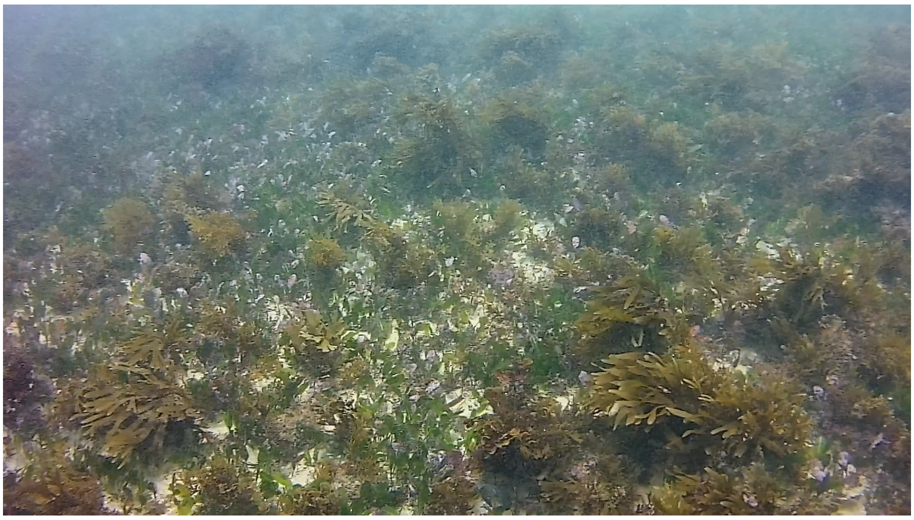

Figure 3.5 Dense seagrass and macroalgae on the southern side of Cook Island

Figure 3.6 Edge of seagrass and bare sand on the southern side of Cook Island

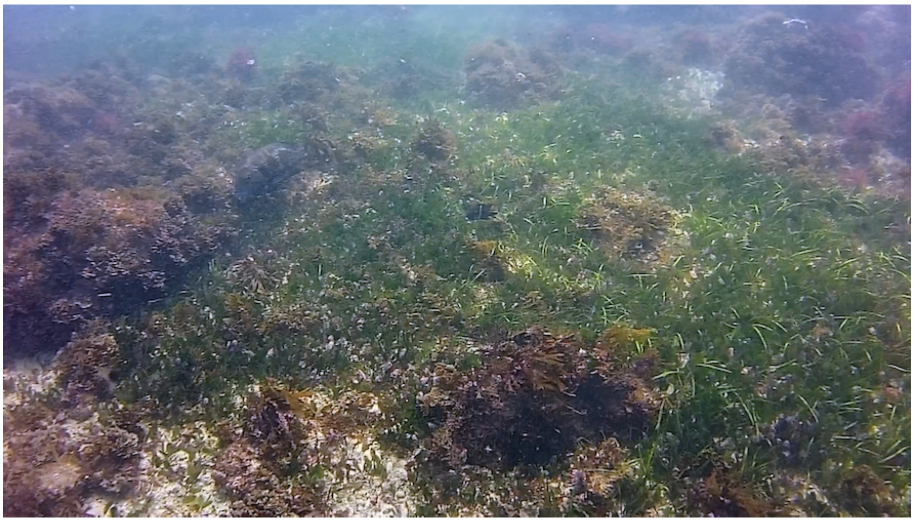

Figure 3.7 Mixed seagrass community (*Halophila ovalis* & *Zostera muelleri*) on the southern western side of Cook Island

4 Discussion & Recommendations

Seagrass is an important marine habitat that is in decline globally due to a range of human pressures (Waycott et al. 2009; Kendrick et al. 2019). Seagrass has been recorded historically on the north-western side of Cook Island, although to our knowledge, no previous surveys mapping the distribution of seagrass around Cook Island or observations of seagrass on the south-western side of Cook Island have been completed.

In November 2023, seagrass was recorded on the north-western and south-western sides of Cook Island (in approximately 7 to 9 m water depth) and covered a total area of 958 m^2. This is a relatively small area compared with the extent of rocky reef, macroalgae and coral, which is the dominant habitat around Cook Island. The condition of seagrass was generally good in November 2023, with the patches likely to persist over time despite some changes in the overall area covered.

On the north-western side of Cook Island, seagrass had a discontinuous extent, recorded in patches between macroalgae, rock and rubble on sand habitats. The community was dominated by *H. ovalis* in good condition, with coverage of patches ranging between 15% and 50%. On the south-western side of Cook Island, seagrass was more continuous and had a much greater extent (total area of 847 m^2) than on the north-western side (total area of 111 m^2). The community was typically dominated by *H. ovalis* often growing amongst various foliose macroalgae, with a patch of mixed seagrass (*H. ovalis* and *Z. muelleri*) also present. Coverage of seagrass on the south-western side of Cook Island was dense (>60% coverage) on the fringe of the rocky reef and decreased in coverage as the patches extended out over bare sand, with a distinct edge between the seagrass and bare sand.

Based on qualitative data, the extent and coverage of seagrass around Cook Island has changed over time. In July 2020 and May 2021, the seagrass on the north-western side of Cook Island was moderate to dense, covering approximately 30% to 50% of the space where it was present. In June 2021 and May 2023, while seagrass was still present in this area, the coverage had declined, covering approximately 10% to <10% of the space where it was present.

Seagrasses are sensitive to changes in environmental conditions, including changes in water quality (Short & Wyllie-Echeverria 1996; Heck et al. 2008). Seagrass (particularly opportunistic species such as *Halophia)* are highly dynamic, and large interannual changes in the extent of seagrass habitats and community structure resulting from natural disturbances (e.g. flood events, changes in rainfall) have been documented (Lyons et al. 2015; Preen et al. 1995; Campbell & McKenzie 2004). Whilst the seagrass meadows around Cook Island are approximate 3.5 km from the Tweed River mouth, changes in extent may be due to changes in water quality from catchment runoff. For example, prior to the July 2020 survey, south-east Queensland experienced dry climatic conditions, including the driest year on record in 2019, whereas during 2022 and 2023, there was typically more rainfall in the region prior to the surveys (BOM 2024). As such, changes in the spatial distribution of seagrass between 2020 and 2023 may be a result of natural disturbances (e.g. rainfall and catchment runoff influencing water quality). Seagrasses are also sensitive to smothering and burial from sand.

The Cook Island Aquatic Reserve is an exclusion zone for placement activities and as such direct disposal of dredge material over the seagrass beds mapped in November 2023 does not occur. Sand from TSB activities (including disposal) has the potential to smother or burry seagrass where it is placed near seagrass and is transported (e.g. by natural drift) to ajacent seagrass beds. Since they were approved in 2019, a total of 94,545 m^3 and 19,061 m^3 of sand has been deposited at the Fingal and Dreamtime placement areas, respectively (Table 4.1; TSB 2023). Sand placed in these areas is predicted to move predominantly in a northerly direction. Any sand placed at Dreamtime (up to 20,000 m^3) is likely to move with the natural transport pathway around Fingal Head to the west of Cook Island in water depths less than 4 m (Jacobs 2017). The movement of sand around the headland is expected to occur during suitable conditions in episodic 'slugs' or sand waves of relatively large quantities of sand over a short period of time (Jacobs 2017).

Table 4.1 Volumes of sand (m^3) desposited at the Fingal and Dreamtime placement areas between 2019 and 2023 (TSB 2023)

Date	Fingal	Dreamtime
August 2019	31,366	–
August 2020	24,750	–
September 2021	7,345	–
August 2022	–	8,626
June 2023	31,084	
September / Octover 2023	–	10,975
Total	**94,545**	**19,601**

The extent and condition of seagrass measured around Cook Island in November 2023 provides comparative data against which (any) future potential impacts of TSB operations can be measured. Given the spatial variability in the extent and cover of seagrass over time and limited suitability of comparative sites (as offshore seagrass in the region is scarce), ongoing annual monitoring (ideally in the month of November) to confirm the extent and coverage of seagrass around Cook Island is recommended to provide good baseline data on the extent and condition of seagrass over time.

5 References

APP 2019. Tweed Sand Bypassing – Back-passing by Dredge: Review of Environmental Factors. Report prepared by Ardill Payne & Partners on behalf of the Department of Industry – Crown Lands.

Bell JD. & Westoby M. 1986a. Abundance of macrofauna in dense seagrass is due to habitat preference, not predation. *Oecologia, 68:* 205-209.

Bell JD. & Westoby M. 1986b. Variation in seagrass height and density over a wide spatial scale: effects on common fish and decapods. *Journal of Experimental Marine Biology and Ecology 104:* 275-295.

BOM 2024. Climate Data Online. Available at: http://www.bom.gov.au/climate/history/rainfall/, accessed January 2024

Boström C. & Bonsdorff E. 1997. Community structure and spatial variation of benthic invertebrates associated with *Zostera marina* (L.) beds in the northern Baltic Sea. *Journal of Sea Research*, *37:* 153-166.

Boström C, Jackson EL. & Simenstad CA. 2006. Seagrass landscapes and their effects on associated fauna: a review. *Estuarine, Coastal and shelf science*, *68*(3-4), 383-403.

Campbell SJ. & McKenzie LJ. 2004. Flood related loss and recovery of intertidal seagrass meadows in southern Queensland, Australia. *Estuarine, Coastal and Shelf Science* 60: 477-490.

Carruthers TJB, Dennison WC, Longstaff BJ, Waycott M, Abal EG, McKenzie LJ. & Lee Long WJ. 2002. Seagrass habitats of north east Australia: models of key processes and controls. *Bulletin of Marine Science,* 71(3):1153-1169.

Coles RG, Lee Long WJ, Watson RA. & Derbyshire KJ. 1993. Distribution of seagrasses, and their fish and penaeid prawn communities, in Cairns Harbour, a tropical estuary, northern Queensland, Australia. *Australian Journal of Marine and Freshwater Research,* 44:193-210.

Edgar GJ. & Robertson AI. 1992. The influence of seagrass structure on the distribution and abundance of mobile epifauna: Pattern and process in a Western Australian *Amphibolis* bed, *Journal of Experimental Marine Biology and Ecology,* 160:13-31

ESP 2020. Tweed Sand Bypassing Project. Reef Biota Monitoring 2020, report prepared for Queensland Department of Environment and Science and Transport for NSW.

ESP 2021. Tweed Sand Bypassing Project. Reef Biota Monitoring 2021, report prepared for Queensland Department of Environment and Science and Transport for NSW.

ESP 2022. Tweed Sand Bypassing Project. Reef Biota Monitoring 2022, report prepared for Queensland Department of Environment and Science and Transport for NSW.

ESP 2023. Tweed Sand Bypassing Project. Reef Biota Monitoring 2023, report prepared for Queensland Department of Environment and Science and Transport for NSW.

Heck KL, Able KW, Roman CT. & Fahay MP. 1995. Composition, abundance, biomass, and production of macrofauna in a New England Estuary: Comparisons among eelgrass meadows and other nursery habitats, *Estuaries,* 18:379-389.

Heck KLJ, Carruthers TJB, Duarte CM, Hughes AR, Kendrick G, Orth RJ. & Williams WS. 2008. Trophic transfers from seagrass meadows subsidize diverse marine and terrestrial consumers, *Ecosystems,* 11(7):1198-1210.

Jacobs 2017. Tweed Quantified Conceptual Sediment Transport Model. Report prepared for Tweed Sand Bypassing. December 2017.

Jelbart JE, Ross PM. & Connolly RM. 2007. Patterns of small fish distributions in seagrass beds in a temperate Australian estuary. *Journal of the Marine Biological Association of the United Kingdom,* 87:1297-1307.

Kendrick GA, Nowicki RJ, Olsen YS, Strydom S, Fraser MW, Sinclair EA, Statton J, Hovey RK, Thomson JA, Burkholder DA, McMahon KM, Kilminster K, Hetsel Y, Fourqurean JW, Heithaus MR. & Orth RJ. 2019. A systematic review of how multiple stressors from an extreme event drove ecosystem-wide loss of resilience in an iconic seagrass community. *Frontiers in Marine Science*, *6*: 455.

Lyons M, Roelfsema C, Kovacs E, Samper-Villarreal J, Saunders M, Maxwell P. & Phinn S. 2015. Rapid monitoring of seagrass biomass using a simple linear modelling approach, in the field and from space. *Marine Ecology Progress Series*, 530: 1-14.

McKenzie L, Smith N, Johns L, Yoshida R. & Coles R. 2014. *Development of Wet Tropics WQIP elements – seagrass monitoring,* A report to Terrain NRM, Innisfail, Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER) report 14/37, James Cook University, Cairns.

McKenzie LJ, Yoshida RL, Aini JW, Andréfouet S, Colin PL, Cullen-Unsworth LC, Hughes AT, Payri CE, Rota M, Shaw C, Tsuda RT, Vuki VC. & Unsworth RK. 2021. Seagrass ecosystem contributions to people's quality of life in the Pacific Island Countries and Territories. *Marine Pollution Bulletin*, *167*:112307.

Nagelkerken I, Blaber SJM, Bouillon S, Green P, Haywood M, Kirton LG, Meynecke JO, Pawlik J, Penrose HM, Sasekumar A. & Somerfield PJ. 2008. The habitat function of mangroves for terrestrial and marine fauna: A review, *Aquatic Botany,* 89: 155-185.

Pittman SJ, McAlpine CA. & Pittman KM. 2004. Linking fish and prawns to their environment: a hierarchical landscape approach. *Marine Ecology Progress Series,* 283: 233-254.

Price C, Gosling A, Golus C. & Weslake M. 2007. *Wetland Assessment Techniques Manual for Australian Wetlands,* WetlandCare Australia, Ballina.

Preen AR, Long WL. & Coles RG. 1995. Flood and cyclone related loss, and partial recovery, of more than 1000 km2 of seagrass in Hervey Bay, Queensland, Australia. *Aquatic Botany*, *52*(1-2): 3-17.

Roelfsema CM. & Phinn SR. 2009. *A manual for conducting georeferenced photo transect surveys to assess the benthos of coral reef and seagrass habitats version 3.0,* Centre for Remote Sensing and Spatial Information Science, The University of Queensland, Brisbane.

Shoji J, Sakiyama K, Hori M, Yoshida G. & Hamaguchi M. 2007. Seagrass habitat reduces vulnerability of red sea bream Pagrus major juveniles to piscivorous fish predator. *Fisheries Science*, *73*(6):1281-1285.

Short FT. & Wyllie-Echeverria S. 1996. Natural and human-induced disturbance of seagrasses. *Environmental conservation*, *23*(1): 17-27.

Skilleter GA, Olds A, Loneragan NR. & Zharikov Y. 2005. The value of patches of intertidal seagrass to prawns depends on their proximity to mangroves. *Marine Biology*, *147*(2): 353-365.

TSB 2023. Tweed Sand Bypassing. Available at: https://www.tweedsandbypass.nsw.gov.au/operations/sand-delivery, accessed December 2023.

Vanderklift MA. & Jacoby CA. 2003. Patterns in fish assemblages 25 years after major seagrass loss. *Marine Ecology Progress Series*, *247*: 225-235.

Waycott M, Duarte CM, Carruthers TJ, Orth RJ, Dennison WC, Olyarnik S, Calladine A, Fourqurean JW, Heck Jr KL, Hughes AR, Kendrick GA, Kenworthy WJ , Short FT. & Williams SL. 2009. Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the national academy of sciences*, *106*(30): 12377-12381.

Waycott M, McKenzie LJ, Mellors JE, Ellison JC, Sheaves MT, Collier C, Schwartz A–M, Webb A, Johnson J. & Payri CE. 2011. *Vulnerability of mangroves, seagrasses and intertidal flats in the tropical Pacific to climate change* in: Bell, J. D., Johnson, J. E. and Hobday, A. J. (eds.), *Vulnerability of fisheries and aquaculture in the Pacific to climate change,* Secretariat of the Pacific Community, Noumea.

Webster PJ, Rowden AA. & Attrill MJ. 1998. Effect of Shoot Density on the infaunal macro-invertebrate community within a *Zostera marina* seagrass bed. *Estuarine, Coastal and Shelf Science*, *47*(3): 351-357.

Appendix A Seagrass Condition Criteria

Table A1 Seagrass condition index criteria

Seagrass Condition Index	**Criteria Score**			
Score	1	2	3	4
Structural Complexity	Low structural complexity (i.e. max length of seagrass blades <10cm, depending on dominant species present)	Moderate structural complexity (i.e. max length of seagrass blades 10 to 20 cm; depending on dominant species present)	High structural complexity (i.e. max length of seagrass blades 20 to 30 cm depending on dominant species present)	High structural complexity (i.e. max length of seagrass blades >40cm depending on dominant species present)
Coverage of epiphytic algae	Low or very high cover of epiphytic algae (<20% or >80%)	High cover of epiphytic algae >60% of seagrass blades OR low cover of epiphytic (<20%)	Moderate cover of epiphytic algae (20-30%)	Moderate cover of epiphytic algae (30-40%)
Presence of cyanobacterial mats	Presence of dense cyanobacterial mats (Lyngbya).	Sparse coverage of cyanobacterial mats (Lyngbya).	Cyanobacterial mats such as Lyngbya absent	
Coverage of seagrass	Sparse coverage of seagrass (<10%)	Sparse coverage of seagrass (10 to 30%)	Moderately dense coverage of seagrass (30-60%)	Dense coverage of seagrass (>60%)
Seagrass Condition Index (as defined by the metrics below)	**Poor**	**Fair**	**Good**	**Very Good**
Total Condition Index Score	**<4**	**5 to 8**	**9 to 13**	**14 to 16**