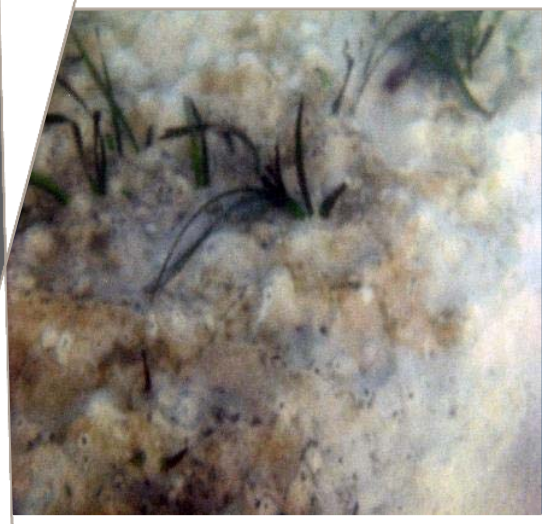
Port Botany Foreshore Beach Groynes

Seagrass Survey During Construction

59916193



Prepared for
Ward Civil

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Cardno
Shaping the Future

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Executive Summary

Ward Civil Pty Ltd (Ward Civil), on behalf of the Port Authority of New South Wales, is in the process of installing three groyne structures along Foreshore Beach to protect against beach erosion. These are low crested, primarily submerged, groynes that will significantly decrease the erosive forces that have been removing sediment from the beach and depositing it to the north and offshore of the beach. The two outside groynes will incorporate and extend seaward from two existing stormwater outlets. The design should provide a hydrological environment that allows recovery of the last remaining beds of seagrass along the northern shoreline of Botany Bay.

Ward Civil have requested that Cardno undertake a seagrass survey during construction at Foreshore Beach to investigate the state of seagrass following severe weather conditions experienced on Friday 23 September, 2016, which included south-west winds of up to 43 km/hr and unexpected wave conditions within the construction area. At that time, the sand bund around the perimeter of the construction area failed and sections of silt curtains, put in place to protect seagrass beds near to the groyne construction areas, were compromised.

Cardno's divers undertook the seagrass survey at Foreshore Beach and surrounds on 26 September 2016. The survey involved comparing the extent, shoot density, leaf length and epiphyte growth on seagrass in September 2016 with data from June 2016. Seagrass was also monitored in Yarra Bay to contextualise any potential changes at Foreshore Beach with broader patterns within Botany Bay.

The results of the survey indicated that the severe weather conditions experienced on Friday 23 September 2016, that caused the sand bund around the perimeter of the construction area and sections of silt curtains to fail, had little, if any, effect on seagrass at Foreshore Beach. In particular, there appeared very little change to the extent or density of patches of the threatened seagrass *Posidonia australis* in September 2016 since the previous (June 2016) survey. Although there was a small change in area of one of the patches (~6.8 m^2) this is more likely to be a consequence of long term deterioration in the condition of the remnant patches of *P. australis* at Foreshore Beach rather than an effect of the recent weather event and failed containment of the bund. The heavy cover of epiphytes in the remnant patches of *P. australis* is a sign of their poor condition. The small patch of *Zostera capricorni* (Patch 5) observed in previous surveys was unable to be located in September 2016. Given the patch was very small (0.6 m^2) with evidence of patch recession and regeneration at Foreshore Beach in recent years, as well as the patch being situated well away from construction of the groynes and the failed bund, its loss is unlikely to have been attributed to construction. The extent of *Halophila* spp. patches appears similar to June 2016 and the density had increased since June 2016. Further, observations of the seabed made by Cardno's divers soon after the severe weather did not note any signs of smothering and there was no evidence of the introduced pest alga *Caulerpa taxifolia* at Foreshore Beach. Notwithstanding these results, the general condition of seagrass at Foreshore Beach appears poor, with more epiphytes on leaves in September 2016 than in June 2016, however this is unlikely to be a consequence of construction for the groynes and rather a consequence of long term pressures to seagrass generally at this location.

The previously recommended mitigation measures, including working zones, no go zones and no anchoring zones for barge operations during construction, should continue to apply for the remainder of construction.

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1 Introduction

1.1 Background

Foreshore Beach, located along the northern shoreline between Sydney Airport and Port Botany, has been reduced significantly in length since its creation as a part of the original construction of Port Botany in the late 1970s. This has followed foreshore developments including the third runway for Kingsford Smith (Sydney) Airport and associated realignment of the Mill Stream, and construction of the parallel airport runway in the early 1990s. A recent expansion of Port Botany and development of a public boat ramp and creation of a flushing channel for the rehabilitated Penrhyn Estuary (The Port Botany Expansion Project, see below) further reduced beach habitat to the southeast of Foreshore Beach. At just over 500 m long, Foreshore Beach is now approximately one third as long as it was in 2007, and approximately one-tenth of its length prior to the development of the airport runways. It represents some of the only beach habitat remaining in the northern shoreline of Botany Bay.

Sydney Ports Corporation (now Port Authority of New South Wales) completed construction of the Port Botany Expansion Project in 2013. This included rehabilitation of the nearby Penrhyn Estuary to enhance the existing intertidal habitat and to expand the estuary as a long-term habitat for migratory shorebirds. Extensive dredging and modifications were required in Penrhyn Estuary and along nearby Foreshore Beach in Botany Bay. Prior to construction, monitoring works carried out in 2008 indicated that approximately 317 sq. m of seagrass (including *Zostera capricorni*, *Halophila* spp. and *Posidonia australis*) would be lost due to land reclamation, boat ramp construction and dredging works associated with the project. Changes in seagrass habitat were monitored during the construction phase and are now being monitored post-construction by Cardno in accordance with the Penrhyn Estuary Habitat Enhancement Plan (PEHEP) (Sydney Ports Corporation 2007). Monitoring records changes in seagrass distribution and condition. Cardno (NSW/ACT) Pty Ltd (Cardno) has completed several seagrass surveys and reports as part of the PEHEP (Cardno 2014, 2015a), identifying several patches of *Z. capricorni*, *Halophila* spp. and *P. australis* present along Foreshore Beach. All seagrass is protected under New South Wales State legislation and, in addition, *P. australis* in six locations within New South Wales (Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie) have been listed as endangered populations under the Threatened Species Schedules of the *Fisheries Management Act 1994* (FM Act). '*Posidonia australis* seagrass meadows of the Manning-Hawkesbury ecoregion', which includes Botany Bay, is also listed as an endangered ecological community under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). However, this listing does not apply to *P. australis* at Foreshore Beach given the consultation guide (DOE 2014). According to the Approved Conservation Advice for the listing (DOE 2014), an ecological community of *P. australis* is defined as a meadow, dominated by *Posidonia,* which is greater than 1 ha in size. The *P. australis* off Foreshore Beach does not meet the key diagnostic characteristics of the Commonwealth listing (Cardno 2014, 2015a).

Ward Civil Pty Ltd (Ward Civil), on behalf of the Port Authority of New South Wales, is in the process of installing three groyne structures along Foreshore Beach to protect against beach erosion. These are low crested, primarily submerged, groynes that will significantly decrease the erosive forces that have been removing sediment from the beach and depositing it to the north and offshore of the beach. The two outside groynes will incorporate and extend seaward from two existing stormwater outlets. The design should provide a hydrological environment that allows recovery of the last remaining beds of seagrass along the northern shoreline of Botany Bay. Previously, Cardno prepared the Marine Assessment Report for the installation of the groynes along Foreshore Beach which included a review of relevant legislation, assessment of impacts and recommended impact mitigation measures (Cardno 2015b). A key component of the assessment was the mapping of seagrass in the vicinity of the proposed groynes prior to construction. Cardno also undertook a pre-construction seagrass survey at Foreshore Beach on behalf of Ward Civil to record the location, extent, condition and type of all seagrass existing on the site in the form of a GIS map. The map was used to recommended 'Barge Working Zones' including no-go zones and no anchoring zones, during construction of the groynes.

1.2 Aims

Ward Civil have requested that Cardno undertake a follow-up seagrass survey (during construction) at Foreshore Beach to investigate the state of seagrass in relation to severe weather conditions experienced on Friday 23 September 2016, which included south-west winds of up to 43 km/hr and unexpected wave conditions within the construction area. At that time, the sand bund around the perimeter of the construction area failed and sections of silt curtains, put in place to protect seagrass beds near to the groyne construction areas were compromised.

The aim of the seagrass survey was to assess whether the damage to the sand bund and silt curtains (and potential mobilisation of sediments) resulted in any detectable or significant damage to seagrass beds at Foreshore Beach.

This document provides the results of the seagrass survey and how this has been used to address the aim given above.

2 Methodology

2.1 Field Survey of Seagrass

Cardno's divers investigated seagrass at Foreshore Beach and surrounds on 26 September 2016 from a 5 m boat. There were light winds and no cloud cover in the morning and strong onshore south-west winds in the afternoon. The underwater visibility was between 1-2 m. This was not unusual for Foreshore Beach and was adequate for divers to undertake investigations of seagrass beds.

Maps created from the pre-construction (June 2016) seagrass survey of Foreshore Beach (Cardno 2016) were used to plan the September 2016 survey, which included:

1. Visiting five previously identified small patches of *P. australis* and *Z. capricorni* (**Figure 2-1**) to determine their presence and, if present, to measure their extent and percentage cover. Divers were directed to these locations using a hand-held GPS. Once located, previous coordinates of these small patches were confirmed, the area of each patch was measured using a tape measure and the percentage cover and evidence of sedimentation was estimated visually.
2. Measuring the condition of the large area of *Halophila* spp. at Foreshore Beach in five 0.25 sq. m quadrats at four locations monitored previously as part of the PEHEP (P1A, P2A, P1B and P2B) (**Figure 2-1**) using the following indicators within each quadrat:

   > Shoot Density - The total number of shoots within each of the five quadrats was recorded to provide a measure of seagrass density.

   > Leaf Length - The length of 10 randomly selected leaves within each of the five quadrats was recorded to provide an indicator of growth which can vary widely depending on the habitat in which seagrass grows.

   > Epiphyte Load - Epiphyte load was recorded by divers on 10 randomly selected leaves within each of the five quadrats using a four-point classification scale: L=Low; M=Medium; H=High; N=None.

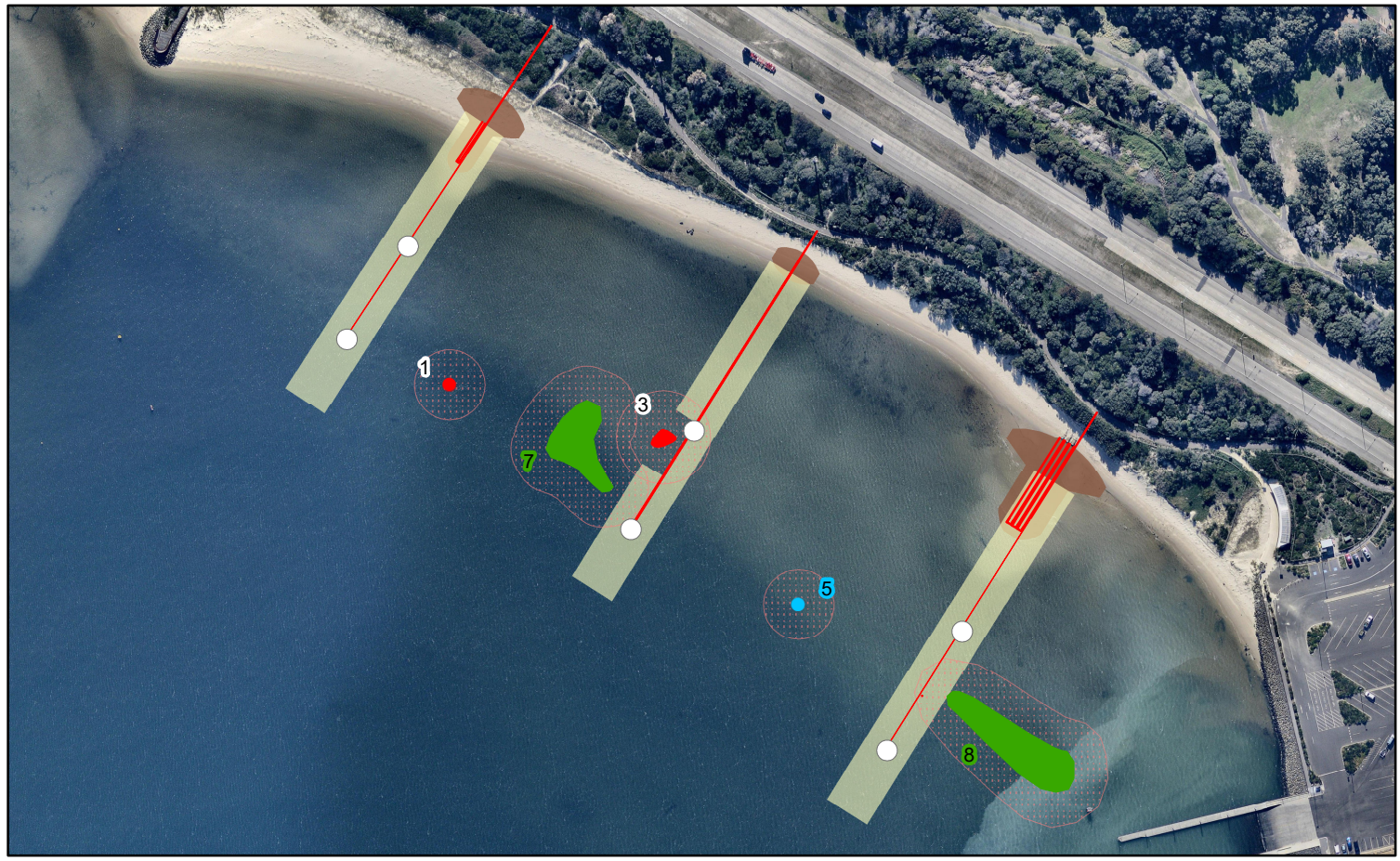
   NB: No seagrass was found at sites P1A and P1B.

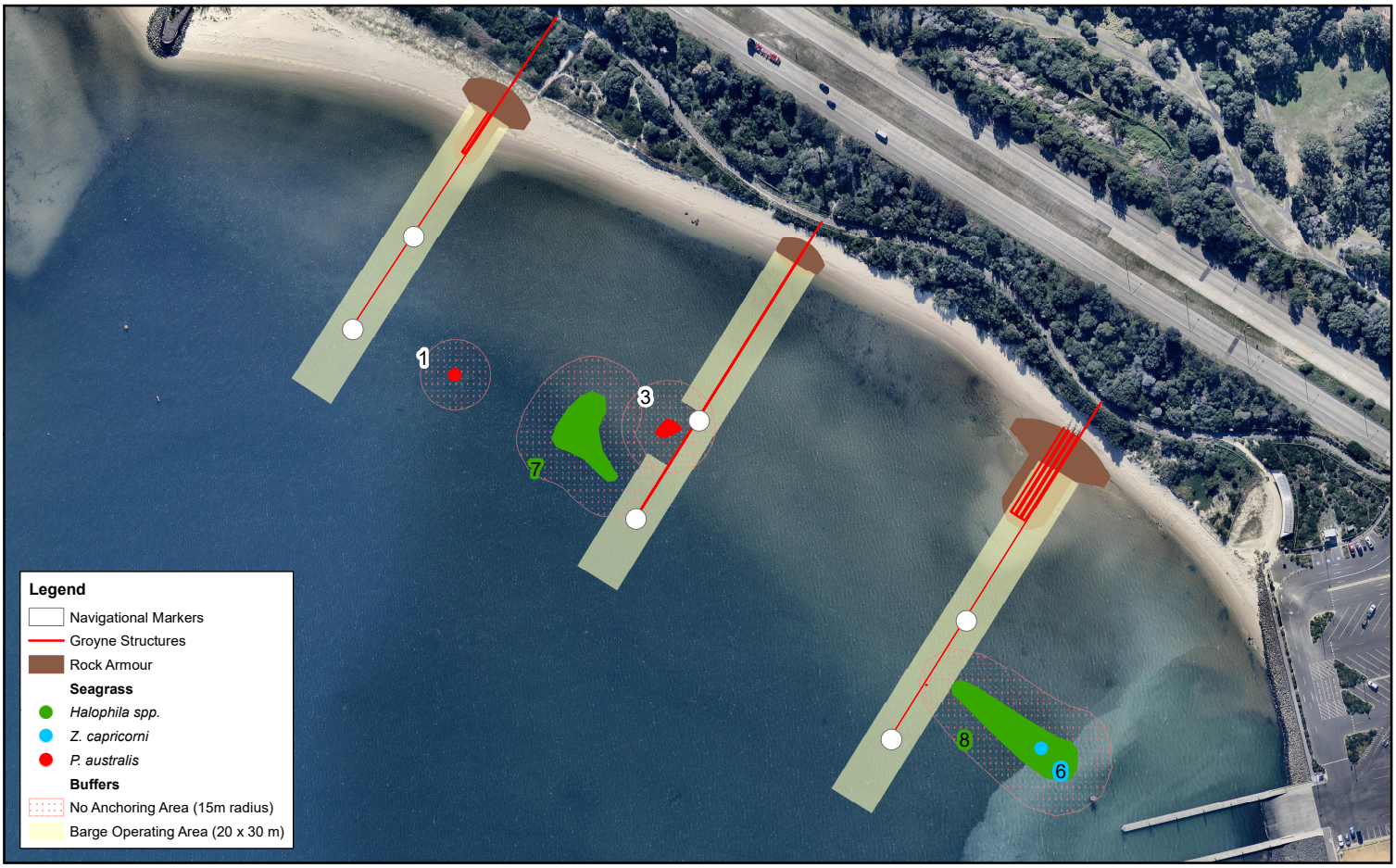
   The amount of epiphytic growth on the leaves is considered an indicator of seagrass health. Excessive epiphytic growth can reduce the amount of light available for and high epiphytic load may be indicative of high nutrient levels within the water column.
3. Measuring the condition of the large area of *Halophila* spp. in Yarra Bay in five 0.25 sq. m quadrats at two locations (to compare with seagrass at Foreshore Beach) (**Figure 2-1**) using the same methods as (2) above.

2.2 Mapping

Cardno used GIS software (MapInfo Pro 15.2) to map the seagrass beds at Foreshore Beach using aerial imagery and the GPS coordinates of seagrass patches recorded by divers during the field survey. The footprint of the groyne structures (supplied by Ward Civil) was overlaid on this map to identify any areas of seagrass, particularly *P. australis*, which was within 5 to 10 m of the proposed groynes.

The map of seagrass and locations for groynes was used to determine whether areas of seagrass had changed between June and September 2016.





Comparison of Foreshore Beach Seagrass:
Top: June 2016
Bottom: September 2016

N

1:3,000 Scale at A4

Seagrass Survey - Comaparison

PORT BOTANY FORESHORE BEACH
FIGURE 2-1

Cardno

Map Produced by Cardno (NSW/ACT) (2304)
Date: 2016-12-23
Coordinate System: GDA 1994 MGA Zone 56
Project: 59916193
Map: 59916193-GS-001-SiteLocation.mxd 02
Aerial Imagery supplied by Nearmap (July 2016)

3 Results

3.1 Distribution and Cover of Seagrass in September 2016

3.1.1 Posidonia australis

P. australis was observed at the two sites where it had been previously mapped in June 2016 (Patches 1 and 3) (**Figure 2-1).**

The two patches identified at Foreshore Beach in the current survey were confirmed to be further than 10 m of the proposed groyne structures (**Figure 2-1**). The western most of the three groynes is the closest (approximately 50 m) proposed structure to *P. australis* Patch 1. The middle groyne is closest (approximately 5 m) to *P. australis* Patch 3. The areas and cover of seagrass within both patches have changed very little since June 2016, although it is noted that the area of Patch 3 had declined by 6.8 m^2 since June 2016 (**Table 3-1**). The condition of *P. australis* was similar (i.e. poor) in June and September 2016 with a thick cover of epiphytes (**Plate 1**).

Table 3-1 Areas and percent cover of patches of *P. australis* at Foreshore Beach

	June 2016		September 2016	
Patch no.	Area (m^2)	Percent Cover (%)	Area (m^2)	Percent Cover (%)
1	0.5	10	0.7	10
3	31.3	15-20	24.5	10-20

Plate 1: *P. australis* at Patch 3 in September 2016 showing a thick cover of epiphytes

3.1.2 Zostera capricorni

The patch of *Z. capricorni* (Patch 5) observed in previous surveys was unable to be located in September 2016. However, a new patch (Patch 6) was found in September 2016 close to the ramp, and away from the area of construction (**Figure 2-1**).

3.1.3 Halophila spp.

A check in the field of the locations of the edges of Patches 7 and 8 of *Halophila* spp. at Foreshore Beach indicated the extent of *Halophila* spp. (which co-existed with some *Z. capricorni)* at Foreshore Beach in September 2016 appears to be unchanged from June 2016 (**Figure 2-1**).

The mean density of *Halophila* spp. at Foreshore Beach in September 2016 was up to five times greater than what had been observed in June 2016 and compared to density of *Halophila* spp. in patches at Yarra Bay. (**Table 3-2**). Leaf length at all sites was similar but the cover of epiphytes on *Halophila* spp. in September 2016 (**Plate 2**) appeared to be higher than in June 2016 and compared to Yarra Bay.

As for previous surveys, there was no evidence of the introduced pest alga *Caulerpa taxifolia* at Foreshore Beach.

Table 3-2 Mean shoot density (shoots per 0.25 sq. m quadrat, n=5) of seagrass in morphology monitoring sites at Foreshore Beach in 2015 and 2016 surveys

Shoot Density (per 0.25 m^2)	Jun-16			Sep-16		
P2A (Foreshore Beach)	2.2			10		
P2B (Foreshore Beach)	2.7			14.8		
YB1 (Yarra Bay)	ND			2.8		
YB2 (Yarra Bay)	ND			2.7		
Leaf Length (mm)						
P2A (Foreshore Beach)	2.2			2.5		
P2B (Foreshore Beach)	2.7			2.7		
YB1 (Yarra Bay)	ND			2.8		
YB2 (Yarra Bay)	ND			2.7		
Epiphyte Load (%)	**Low**	**Med**	**High**	**Low**	**Med**	**High**
P2A (Foreshore Beach)	22%	78%	0%	36%	2%	61%
P2B (Foreshore Beach)	21%	44%	35%	35%	8%	56%
YB1 (Yarra Bay)	ND	ND	ND	72%	18%	10%
YB2 (Yarra Bay)	ND	ND	ND	66%	24%	10%

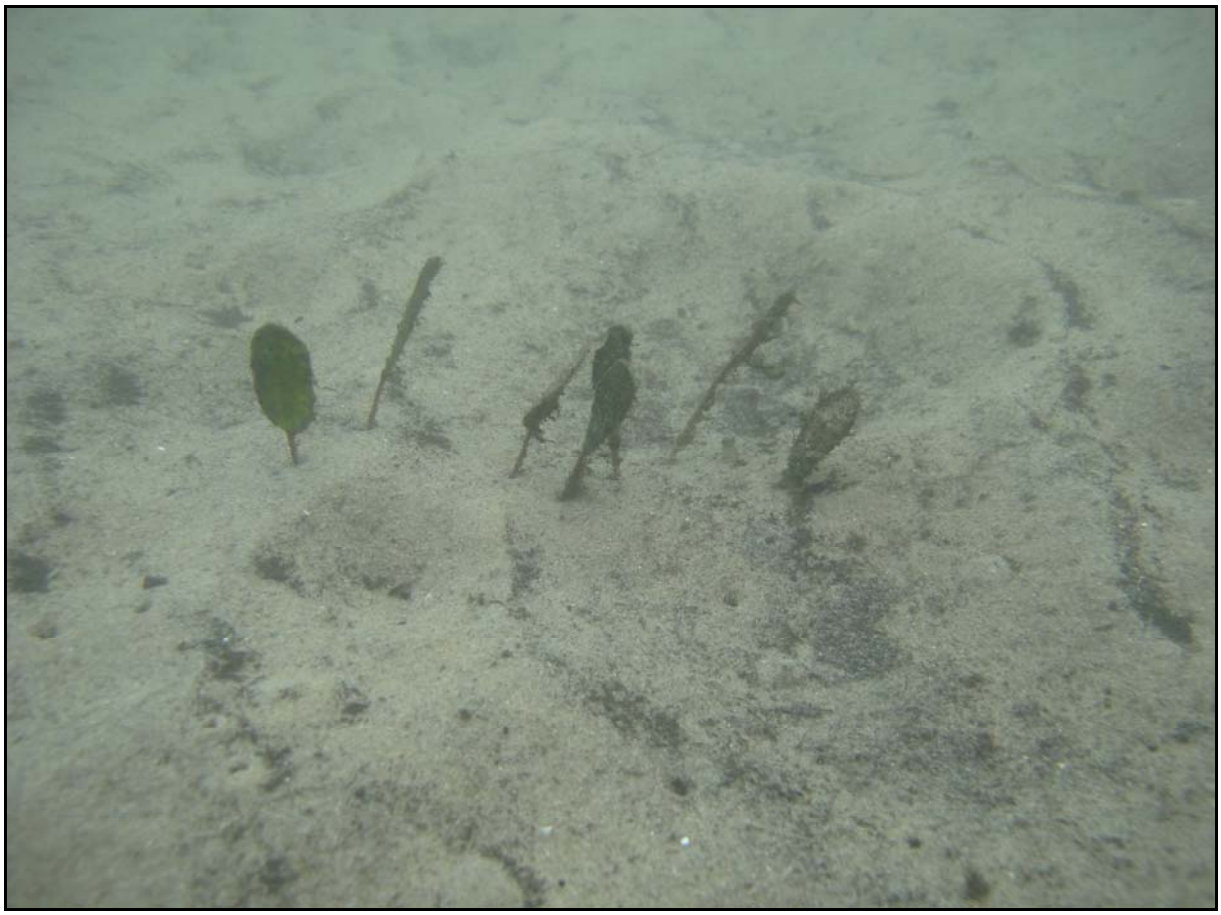


Plate 2: Epiphytes on *Halophila* sp. at Foreshore Beach in September 2016

4 Conclusions and Recommendations

The results of the survey indicated that the severe weather conditions experienced on Friday 23 September 2016, that caused the sand bund around the perimeter of the construction area and sections of silt curtains to fail, had little, if any, effect on seagrass at Foreshore Beach. In particular, there appeared very little change to the extent or density of patches of the threatened seagrass *P. australis* in September 2016 since the previous (June 2016) survey. Although there was a small change in area of one of the patches (Patch 3) (~6.8 m^2) this is more likely to be a consequence of long term deterioration in the condition of the remnant patches of *P. australis* at Foreshore Beach rather than an effect of the recent weather event and failed containment of the bund. The heavy cover of epiphytes in the remnant patches of *P. australis* is a sign of their poor condition. The small patch of *Z. capricorni* (Patch 5) observed in previous surveys was unable to be located in September 2016. Given the patch was very small (0.6 m^2) with evidence of recession and regeneration of *Z. capricorni* patches at Foreshore Beach in recent years, as well as the patch being situated well away from construction of the groynes and the failed bund, its loss is unlikely to have been attributed to construction. The extent of *Halophila* spp. patches appears similar to June 2016 and the density had increased since June 2016. Further, observations of the seabed made by Cardno's divers soon after the severe weather did not note any signs of smothering and there was no evidence of the introduced pest alga *Caulerpa taxifolia* at Foreshore Beach. Notwithstanding these results, the general condition of seagrass at Foreshore Beach appears poor, with more epiphytes on leaves in September 2016 than in June 2016, however this is unlikely to be a consequence of construction for the groynes and rather a consequence of long term pressures to seagrass generally at this location.

4.1 Recommended Marine Working Zones

The previously recommended working zones, no go zones and no anchoring zones for barge operations during construction should continue to apply for the remainder of construction. There would be a small change to the no anchoring zones given the loss of a small patch of *Z. capricorni* between the eastern and middle groynes and the observation of a 'new' patch near the boat ramp. These are described in the sections below.

4.1.1 Barge Working Zones

It is understood that construction vessels require a 10 m wide work zone on both sides of the footprints of the proposed groynes as well as a 20 m wide x 30 m long work zone seaward from the ends of each groyne.

The 'Working Zones' of construction vessels are indicated in yellow in **Figure 2-1**. The Working Zone for the middle groyne has been modified so that it does not encompass *P. australis* Patch 3. Barges would be required to work only on the eastern side of the groyne during construction activities in the vicinity of *P. australis* Patch 3.

A very small area of *Halophila* spp. would overlap with the Working Zone for the eastern groyne (**Section 3.1.3**). However, given this, the ephemeral nature of *Halophila* spp., its relatively rapid colonisation and growth rate (compared with *Z. capricorni*, and particularly *P. australis*) and its abundance locally and regionally, specific controls, such as modification of the location of the Working Zone, are not considered necessary.

4.1.2 No Go Zones

Two 'No Go Zones' have been identified to minimise the potential for damage to remnant patches (Patches 1 and 3) of the seagrass *P. australis*, which form part of a threatened population in Botany Bay (**Section 1**). These areas, indicated in solid red in **Figure 2-1**, are between the western and middle groynes. The construction Working Zone for the middle groyne has been modified specifically to avoid one of these two patches of seagrass which is located ~ 5 m from the groyne (see **Section 3.2.1**).

It is recommended that silt curtains are placed at 2-3 m from the edges of these two patches to protect them from smothering and sedimentation arising from construction activities and from light attenuation due to elevated turbidity. It is also recommended that surface maker floats be deployed throughout construction to provide a visual aid and help vessel operators avoid these locations.

4.1.3 No Anchoring Zones

'No Anchoring Zones' have been marked in shaded pink in **Figure 2-1**. These provide an approximate 15 m buffer area around all seagrass patches at Foreshore Beach and are recommended as a measure to avoid anchor damage, including anchor chain scour and anchor-drag. These zones also apply to the positioning of jackup barge legs.

4.1.4 Navigational Markers

The proposed cardinal and special markers locations in the middle and seaward end points of the groynes are suitable and not located on seagrass (**Figure 2-1**).

5 References

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