EPBC 2020/8692 Yorkeys Knob Boating Infrastructure Project: Preliminary Documentation Report

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Synopsis: Preliminary documentation for assessment of EPBC 2020/8692: Yorkeys Knob Boating Infrastructure Project

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1 Introduction

The Yorkeys Knob Boating Infrastructure Project (EPBC 2020/8692) was referred under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to the Department of Agriculture, Water and the Environment (DAWE) on 14 July 2020. On 15 September it was identified that the Project is a Controlled Action and would be assessed by Preliminary Documentation.

The Project was determined to be a controlled action due to the potential for significant impacts to the following matters of national environmental significance (MNES) protected under Part 3 of the EPBC Act:

- Listed threatened species and communities (section 18 and section 18A)
  - Ant plant (*Myrmecodia beccarii*) – Vulnerable
- Listed migratory species (section 20 and section 20A)
  - Dugong (*Dugong dugon*) – Migratory
  - Australian humpback dolphin (*Sousa sahulensis*) – Migratory
  - Australian snubfin dolphin (*Orcaella heinsohni*) – Migratory
- World Heritage properties (section 12 and section 15A)
  - Great Barrier Reef World Heritage Property
- National Heritage places (section 15B and section 15C)
  - Great Barrier Reef National Heritage Place.

This report presents the Preliminary Documentation as required by DAWE in a request for information (RFI) dated 29 September 2020. The structure of the RFI has been followed in this report, as follows:

Section 1	Introduction
Section 2	Description of the Action
Section 3	Description of the Environment and MNES
Section 4	Impact Assessment
Section 5	Proposed Avoidance and Mitigation Measures
Section 6	Residual Impacts and Environmental Offsets
Section 7	Environmental Outcomes
Section 8	Ecologically Sustainable Development
Section 9	Economic and Social Matters
Section 10	Environmental Record of the Person Proposing to Take the Action
Section 11	Other Approvals and Conditions
Section 12	Conclusion
Section 13	References
Section 14	Public Submission Response.

2 Description of the Action

2.1 Overview

The Project is made up of a series of different infrastructure elements, as shown in Figure 2-1 and described in Table 2-1. TMR will be the proponent for construction of all works. Once constructed, TMR will own the boat ramp, floating walkways and breakwaters while Cairns Regional Council (Council) will manage the entire facility and own the carpark and land-based facilities. TMR will also undertake maintenance dredging for the basin and access channel as part of Council's broader maintenance dredging program for Half Moon Bay, subject to their environmental approvals. These arrangements are part of a Deed of Agreement between TMR and Council.

The following approvals have already been obtained for the works from the Queensland Government:

- Development Permit (2007-17779 SDA) under the *Planning Act 2016*, covering dredging, tidal works, marine plant disturbance and waterway barrier works
- Environmental Authority (EA0002459) under the *Environmental Protection Act 1994*, covering capital dredging.

The State Marine Parks permit was about to be issued when the EPBC referral decision was made as a controlled action. DES have advised TMR that they will delay issue of the permit until the final EPBC decision is made. State Marine parks were surprised that the Project was called in as a controlled action. The EPBC decision and subsequent correspondence with DAWE has been shared with State Marine Parks on their request.

Plans showing the Project infrastructure are attached in Appendix A.

Table 2-1 Description of Project design elements

Element	Description
Boat ramp	6-lane boat ramp
Floating walkways	3x floating walkways, co-located with boat ramp
Beach	Queuing beach for vessels queuing in peak periods
Breakwater	Two breakwaters: one <250 m long, running south-north to west of boat ramp; second <100 m long running east-west to north of boat ramp HAT + 1.75 M (3.6 mAHD)
Basin	Dredged basin design depth -1.5 m LAT with navigation channel to access main dredged channel Includes both capital and maintenance dredging
Carpark	Carpark with toilet block, constructed on raised land (including reclaimed area) – minimum height HAT+0.5 m (2.357 mAHD)
Access road	Access road from Buckley Street (RL2.2 mAHD) – height to remain as close as possible to existing ground level to avoid impacts to local drainage paths – culverts for waterway crossing to not impact on flows or fish passage
Fence	Strategic sections of high fence are required between the access road/carpark and the 14th hole of Half Moon Bay Golf Course

Aerial image: 19 August 2019 © Nearmap

0.078 ha

0.848 ha

0.001 ha

Half Moon Bay Marina

Buckley Street

Reclamation area for access road and pedestrian paths is 0.145 ha

Half Moon Bay Golf Course

Concept Design

- Toilet block
- Beach
- Breakwaters
- Boat ramp
- Fence footprints
- Rock protection
- Carpark, access road and pedestrian paths
- Carpark and boat ramp line marking, kerbing, pedestrian paths, culvert lines and gradient lines
- Fence lines
- Disabled parking

Data source: Royal Haskoning DHV (30 July 2020)

LEGEND

- Post-development HAT line
- Pre-development HAT line

Total reclamation area is 1.072 ha.

Data source: Royal Haskoning DHV (30 July 2020)

Title:

Yorkeys Knob Boating Infrastructure Project Overview, Including Reclamation Area

Figure: 2-1

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2.2 Construction and Operation

2.2.1 Construction Activities

The Project construction methodology will be finalised by the contractor engaged for the works. Noting this, the following provides an indicative sequencing of construction activities:

(1) Installation of a golf fence and boundary fence to the Golf Course along the road reserve boundary.

(2) Development of a construction access road from Buckley Street. This will include clearing and installation of culverts in the waterway. As the access road and culverts will be upgraded and finalised prior to commissioning for public use, what is originally constructed may differ slightly to the final road but will have the same footprint.

(3) Construction of the breakwaters using rock material imported from a local quarry. This construction would most likely be land based construction. Discussion of breakwater construction options and material management is provided below.

(4) Dredging of the basin and navigation channel and use of the material as fill for reclamation and raising of the carpark is proposed. However, if some geotechnically unsuitable material is identified this material will be disposed of to an approved site. The potential dredging methodologies are discussed below.

(5) Importation and placement of additional fill material from a local quarry. Potential quarry locations and logistics routes are discussed below.

(6) Civil works to construct boat ramp, install floating walkways, install toilet block and finalise carpark and access road.

A total area of 1.072 ha will be reclaimed below HAT, as shown in Figure 2-1. The total marine footprint of project 2.237 ha while the total terrestrial footprint is 1.962 ha.

Additional construction fill material can be sourced from sand quarries in the Cairns region within 20-25 km of the Project site (i.e. Boral's Redlynch quarry). Regardless of which locations are used, the Project will require truck movements across a combination of local and state-controlled roads, leading to Yorkeys Knob Road-Varley Street-Buckley Street. The total number of truck movements will depend on the quantities of material to import and remove.

Note that sediment sampling and geotechnical investigations suggest that all dredged material will be reused as part of the Project, thereby avoiding the need for material being brought off site. However, in the very unlikely event material does need to be removed, it will be taken to a site with relevant approvals to accept the material.

The closest known hard rock quarry to the Project site is at Edmonton, over 30 km to the south. The total volume of rock material required depends on design but is expected to generate a significant amount of traffic if brought directly to the Project site. As an alternative, rock material could be stockpiled at a site at Cairns Port where it is loaded onto a barge and then brought to site. Marine based construction includes significantly higher construction costs so is unlikely given the tight project budget but cannot be excluded until the design and construction methodology is finalised.

Construction of the breakwaters will likely be land-based construction of the north-south breakwater through progressive placement of rock material from trucks; then construction of a temporary causeway to access and build the east west breakwater (This methodology would be required for the east-west breakwater as there is no vehicle access on the existing marina breakwaters.). This methodology would also potentially enable the basin dredge works and reclamation works to occur in an enclosed area hence minimising water quality impacts to the adjacent Marine Park. Causeway material could then be used in the carpark works. The final construction methodology will be determined in consultation with the contractor.

2.2.2 Capital and Maintenance Dredging

The excavation works proposed as part of the project are in two parts. Part 1 is excavation of material that will be required for the construction of the breakwater structures and Part 2 is excavation of the dredge basin. The total volume of material to be excavated in the capital works is approximately 18,000 m3. Maintenance of this basin is estimated to include dredging of 5,000-10,000 m^3 of material every 3-4 years. Plans showing the basin and dredging requirements are provided in Appendix A.

As outlined in the plans the proposed design dredging depth for all capital areas and the navigational basin is -3.15 m AHD (-1.507 m LAT) with a typical over-dredge allowance of 0.3 m creating a maximum depth of -1.807 m LAT.

The capital dredging will most likely be undertaken by cutter suction dredge and pipeline to the reclamation area, with material to be dewatered in temporary bunds before placement as part of the reclamation or removal from site if unsuitable for engineering fill. The small volume of capital dredge material (less than 18,000cu.m) relative to the size of land works area means containment of tailwater can be readily achieved with temporary low and flat earth bunds. Alternatively, a backhoe dredge (BHD) and trucks may be employed for dredging works, either by sealing off the area with breakwaters and then excavation in the dry or works from barges. TMR will work with the contractor to develop the methodology.

Maintenance dredging is planned to be undertaken as part of CRC's existing program of works in the area by a cutter suction dredge and pipeline (under Environmental Authority EPPR00795313). To either an existing approved beach nourishment site or their approved offshore placement site. All dredging works (capital and maintenance) will utilise the existing best practices and accepted monitoring methods and management triggers applied by Cairns Regional Council in their current maintenance program, given the proposed dredging works represent the same environmental risks.

Sediment sampling has been undertaken in accordance with the NAGD (2009) and found to be suitable for all management options including offshore placement and the material was found to be of very low ASS/PASS risk. The results of this are provided in Appendix B.

2.2.2.1 Dredging Options

TMR manages and maintains 10 state boat harbours throughout Queensland, several of which are immediately adjacent to or are in the GBRMP and is well versed in all dredging methods, the risks they pose and best practice methods to mitigate these risks with an associated monitoring, trigger and action framework to ensure the works meet the objectives (of water quality, habitat and marine

fauna protection). These methods will be detailed in the specific project EMP for this project. Queensland has state legislation (*Marine Parks Act 2000* and *Environmental Protection Act 1994*).

There are two possible methods of dredging;

(1) **Cutter suction dredge and pipeline** – A significant amount of maintenance dredging (~60,000 m^3/yr) currently occurs in Half Moon Bay to maintain the Yorkey's Knob Boat Harbour, Bluewater Marina and Canal estate and the access channels to these facilities both of which are immediately adjacent to the proposed facility. This maintenance dredging is undertaken by a cutter suction dredge and pipeline to the approved offshore placement facility. In the event the capital dredging works for the proposed facility was to use a cutter suction dredge and pipeline the impacts from the dredging (itself) would be identical to the existing maintenance dredging undertaken in the surrounding areas given sediment sampling against the NAGD (2009) has shown the material has similar properties and has no contamination that represents a risk to the marine environment. On this basis the primary risk of dredging works are water quality impacts, primarily turbidity. A cutter suction dredge is not self-powered so moves very slowly on spuds so there is no risk of boat strike from the dredge, with the only risk potentially from the associated work boat(but given the very slow speeds in the working area do not represent a significant risk). Similarly cutter suction dredges step forward incrementally on the spuds sweeping the seabed very slowly and for this reason marina fauna (such a turtles) has lots of time to move.(TMR has never experienced any marine fauna impacts from a cutter suction dredge, typically trailer suction hopper dredges are the ones that need turtle-excluded devices given the dredge is a self-powered vessel that can cover larger areas quite quickly when dredging. Regarding dredge material placement, the capital material would be pumped to temporary land-based dewatering ponds and then used in the reclamation project for the carpark. The temporary dewatering ponds would be RPEQ designed to provide suitable settling time to maintain water quality standards at the outlet (which TMR has significant experience with at Port Douglas and Ross River (as two examples of many). Although sediment sampling indicates a very low ASS/PASS risk, TMR will include monitoring of the placement ponds in the EMP to ensure the released tailwater meets all required water quality objectives for protection of adjacent bay and adjacent GBRMP. The EMP will include triggers and actions for treatment to ensure tailwater meets objectives before release.

(2) **Excavator on barge** – An alternative dredging method is via an excavator on a barge that would excavate the material and then transport it manually to the foreshore for placement in the reclamation. This method would generate turbid plumes at the dredge site and foreshore placement area however given the sheltered environment of the dredging location a silt curtain would most likely be effectively implemented to contain any turbidity locally within the dredge and placement area during the works to ensure water quality was maintained outside the works area (i.e. adjacent GBRMP). This method would include similar monitoring and action criteria as above but be amended to suit the handling method. For example pH sediment testing would be undertake of the material at a specific frequency to confirm no ass/pass risk, and if risk identified SPOCAS testing to confirm treatment requirements prior to inclusion in the reclamation. Given this method does not include large amounts of tailwater the land-based side and associated management is much simpler but manual handling of the material is much less efficient.

TMR had considered the potential of enclosing the breakwater area and excavating the basin in the dry, however the logistics of clearing the area of marine life and keeping the basin dry are not considered viable for the relatively small quantity of material to be dredged (17,000m^3), and on this basis this option is no longer being considered.

Note that both options have environmental risk that are equivalent to or less than the existing maintenance dredging that occurs within Half Moon Bay and Half Moon Creek (see Section 2.3.2).

2.2.3 Operational Management

No refuelling or other services will be offered at the boat ramp as these are available at the Half Moon Bay Marina. Therefore, during the operational phase, the main works required will be maintenance of the infrastructure. This includes dredging of the basin and access channel which will be TMR's responsibility. However, these works are planned to be incorporated into the maintenance dredging program undertaken by Cairns Regional Council. All dredged material, therefore, will be placed in the Half Moon Bay offshore dredged material placement or an alternative approved beach nourishment site covered under Cairns Regional Council's existing dredging strategy. Dredging and disposal practices will be subject to the existing management plans and approval conditions for these areas.

2.2.4 Timing

Works are likely to take approximately 12-18 months to complete. Most major works are to occur in the winter months to the greatest extent possible.

The project has been delayed by an unexpected additional EPBC assessment process, which throws into doubt the commencement timing of the project. Tenders were to be released in October 2020 with works to commence after the wet season in March/April 2021 however tenders are now likely in early 2021 (subject to EPBC approval) with likely mid-year commencement.

2.3 Local and Regional Context

2.3.1 Boating Infrastructure Demand

In 2017 TMR conducted a Recreational Boating Facilities Demand Forecasting Study, with a focus on identifying existing and projected demand for boating infrastructure and associated facilities over the next 20 years based on boating registrations, population data and stakeholder consultation (see Section 9.1.1). The study included covered every local government area (LGA) in Queensland, with individual reports prepared per LGA.

The report for the Cairns Region was provided with the original EPBC Act referral and is attached in Appendix E of this report. Key findings from the report were as follows:

- There is a high demand for recreational boating infrastructure in the Cairns Region as a result of tourism.
- There are presently 13 boat ramp facilities with 27 boat ramp lanes in the Cairns Region. However, the lack of parking for car-trailer units (CTUs) and the limited tidal access at some locations limits the effective ramp capacity to 19-20 lanes.

- The shortfall in boat ramp lanes in 2016 was 12.7, expected to increase to 14.7 in 2021, 17.7 in 2026 and 24.7 by 2036 without further works. This shortfall contributes to increased waiting time at ramps and queuing on local roads, as well as informal street parking of CTUs (with associated community disruption).
- Works are required immediately to address existing and projected demand. This includes expansion to several existing facilities (Fearnley Street, Tingira Street, Packers Camp) and the construction of a new or expanded facility.
- This new/expanded facility needed to provide a minimum of four boat ramp lanes and two floating walkways, all-tide open water access in sheltered waters, space for safe navigational operations, a minimum ongoing maintenance dredging liability, space for an appropriate scale carpark to manage expected demand, no significant environmental, flooding or coastal process impacts, no negative impacts to existing infrastructure, and be good value for money taking into consideration state-wide equity.

The demand study identified a new facility at Yorkeys Knob as the most appropriate option for a new facility. This was based on an assessment of several options including the following:

(1) Ellis Beach, new facility

(2) Buchan Point, new facility

(3) Palm Cove, new facility

(4) Taylor Point (Kewarra Beach), new facility

(5) Bluewater boat ramp expansion

(6) Reed Road, Trinity Park, new facility

(7) Wattle Street, Yorkeys Knob, new facility

(8) Yorkeys Knob marina ramp expansion or new facility adjoining marina

(9) Thomatis Creek/Holloways Beach boat ramp expansion

(10) Barron River at Machans Beach or Captain Cook Highway boat ramp expansion

(11) Fearnley Street (Sugar Terminal), Portsmith, boat ramp expansion

(12) Dutton Street, Cairns CBD, new facility

(13) Tingira Street, Portsmith, boat ramp expansion.

Based on the assessment criteria, expansion of the boat ramps at the Half Moon Bay Marina was identified as the least constrained option, followed by the development of a new facility adjoining the marina. However, the Yorkeys Knob Boating Club (YKBC) formally advised TMR that they could not support the boat ramp expansions within the marina, leading to the selection of the current project option.

TMR undertook an additional options assessment process which included the above options and an additional option at Redden Island in the Barron River, which was raised by opposition groups to the Yorkey's Knob site. This additional assessment resulted in the same recommended outcome, with

the Redden island site representing a need for a large scale and ongoing dredging to provide all tide ocean access through the Barron River Delta which presented unacceptable environmental and economic impacts.

2.3.2 Land Use

Figure 2-2 to Figure 2-7 show historical aerial imagery of Yorkeys Knob. Development of the area has occurred since 1974. Originally Half Moon Bay was an undeveloped site, formed between Yorkeys Knob and the headland north of Trinity Park. Similarly, Half Moon Creek was a mostly undeveloped mangrove-lined estuary feeding into the bay. Since 1974 progressive works have been undertaken in the area, including the clearing of wetlands for expansion of the Half Moon Bay golf course by 1990; the development of Bluewater Harbour on Half Moon Creek, commencing in late 1980s and continuing until mid-2000s, and the construction of Half Moon Bay Marina in the mid-1990s. The area is now a mixed density residential township, supporting a large golf-course and marina as well remnant mangrove and melaleuca wetland areas.

As discussed, Council undertake maintenance dredging annually, as shown in Figure 2-8. The existing maintenance dredge volumes, and the predicted capital and maintenance dredge volumes for the Project, are shown in Table 2-2.

Table 2-2 Indicative 5-year maintenance dredging program for Cairns Regional Council at Half Moon Bay (EcoSustainAbility, 2018) compared to capital and maintenance dredging for the Project

Location	Volume dredged ('000 m^3)					
	2019	2020	2021	2022	2023	Cumulative 2019-23
Dredge Area 1: Zone A Half Moon Creek, Bluewater Harbour canals and marina, Riverside Parade Frontages	55.0	30.0	10.0	30.0	25.0	150.0
Dredge Area 2: Zone B Inner Entrance Channel (Half Moon Creek mouth to Half Moon Bay Marina) and Zone C Outer Entrance Channel (Half Moon Bay Marina to Outer Leads)	91.8	91.8	91.8	91.8	91.8	459.0
Dredge Area 2: Zone B Sand (Half Moon Creek Mouth)	20.0	20.0	20.0	20.0	20.0	100.0
Dredge Area 3: Zone D Half Moon Bay, marina entrance, fuel wharf and boat ramp, and Zone E inner Half Moon Bay Marina	16.0	4.0	16.0	4.0	16.0	58.0
Annual volume (placed at dredged material placement site)	167.8	125.8	117.8	135.8	117.8	667.0
Yorkeys Knob boating infrastructure project development and maintenance*	-	-	18.0	-	10.0	28.0

*Capital dredging for the project is assumed to occur in 2021. The first round of maintenance dredging would likely not occur until 2024/25 but is shown for comparative purposes.

Figure 2-2 Yorkeys Knob and Half Moon Bay, 1974 (QImagery)

Figure 2-3 Yorkeys Knob and Half Moon Bay, 1982 (QImagery)

Figure 2-4 Yorkeys Knob and Half Moon Bay, 1990 (QImagery)

Figure 2-5 Yorkeys Knob and Half Moon Bay, mid-1990s (QImagery)

Figure 2-6 Yorkeys Knob and Half Moon Bay, early-2000s (QImagery)

Figure 2-7 Yorkeys Knob and Half Moon Bay, 2004 (QImagery)

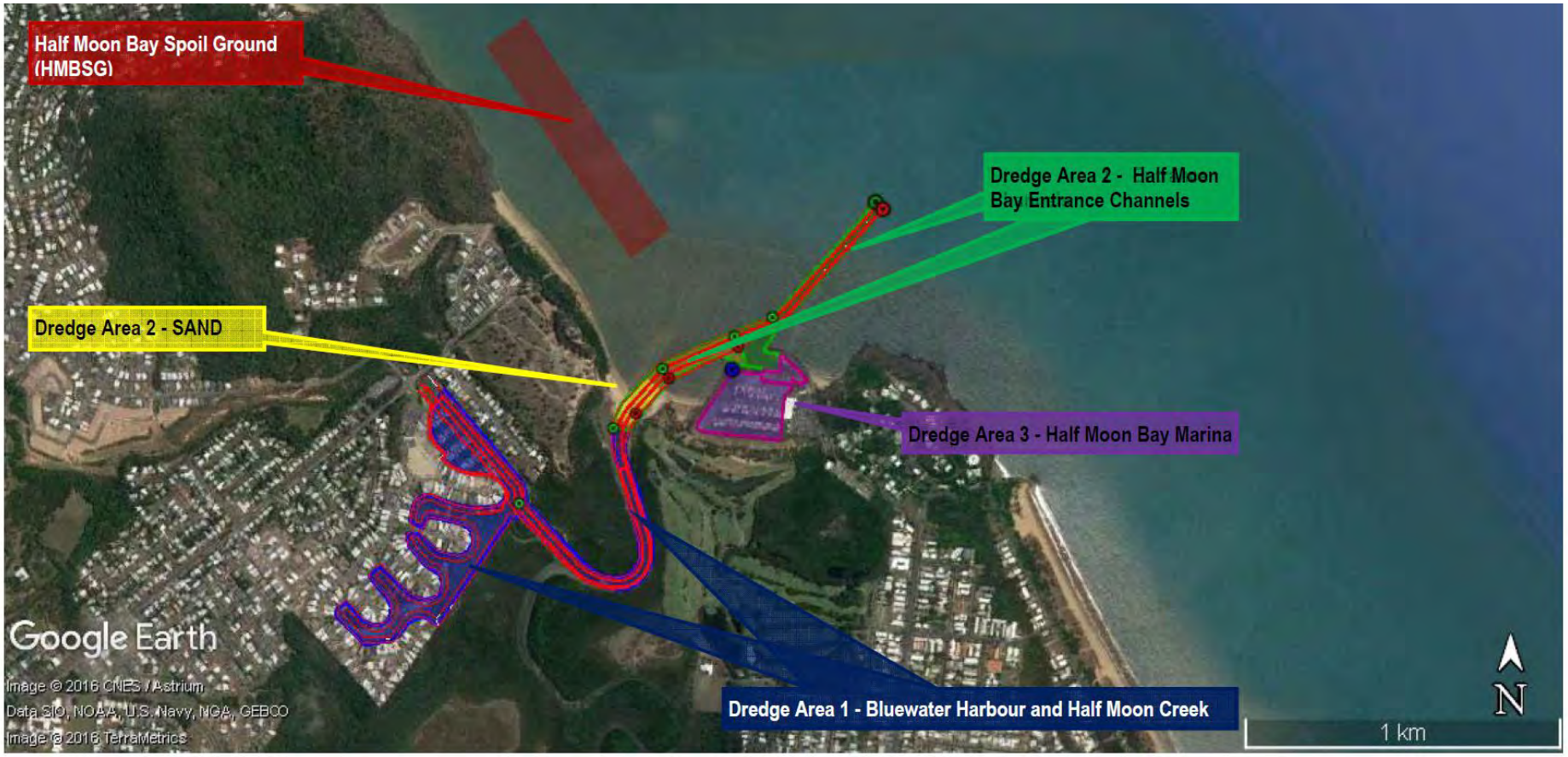

Figure 2-8 Maintenance dredging and disposal activities undertaken by Cairns Regional Council (EcoSustainAbility, 2018)

2.3.3 Vessel and Navigation Management

Navigational aids are provided for the existing access channels to manage access but no additional regulation of boating use occurs in Half Moon Bay access channels. (speed limits etc.).

TMR has no information on the dispersion patterns of vessels leaving the existing facilities however can confirm all facilities primarily accommodate offshore access, with little if any upstream access into Half Moon Creek. The proposed facility is immediately adjacent to the only offshore access channel for all existing marine infrastructure within Half Moon Creek and this primary channel is accessed by the Half Moon Bay Marina entrance channel approximately 150 m north of the proposed facility access point. On this basis the proposal does not represent a change to ocean access paths than currently exist.

2.4 Alternatives Considered

Section 2.3.1 lists the alternative options considered to arrive at the proposed Yorkey's Knob site and configuration as the best alternative. This assessment was considered based on the following criteria.

The proposed boat ramp facility is required to have:

- A minimum of 4 boat ramp lanes with 2 floating walkways
- All-tide open water access in a sheltered waters boat launching facility
- Space for safe navigational operations associated with the facility
- Minimum ongoing maintenance dredging liability
- Space for an appropriate scale carpark to manage expected demand
- Does not have significant environmental, flooding or coastal process impacts – that is, the chosen site is likely to gain legislative approvals
- Does not have the potential to be significantly impacted by flooding or coastal processes
- Does not negatively impact existing infrastructure
- Good value for money (initial capital investment and ongoing maintenance costs) taking into consideration state-wide equity.

TMR has communicated on numerous occasions with community members and stakeholders the reasons the proposed site was chosen over other alternatives and this information was presented as part of State Development applications that have been subsequently granted.

Following this process opposition groups continue to claim that better alternatives exist at the end of Reed Road, Trinity Park and on Redden Island, Machans Beach, with additional claims that the proposed facility at Yorkey's Knob would be more suitably access via a road west of the golf club. For completeness, TMR has included its assessment of these options in the following sections.

2.4.1 Alternative 1 - Redden Island, Machans Beach

Description: The Redden Island (Barron River) option includes a new boat launching facility near the mouth of the Barron River (see Figure 2-9). This site, although undeveloped, looks as though it has been previously cleared/disturbed. Relatively minor foreshore clearing of mangroves would be required for the boat ramp access and carpark facilities. However, as with other Barron River options, the most significant consideration of this option is the required capital and ongoing maintenance dredging of the extensive Barron River entrance delta to gain all-tide ocean access.

Figure 2-9 Alternative 1 – Redden Island

Benefits:

- Significant land area available (subject to purchase) to accommodate required parking
- Likely minor environmental impacts for the boat ramp facilities construction/installation
- Nearby road access from Cinderella Street (requiring upgrade)
- Within river system naturally sheltered from wind and waves.

Constraints:

- The land in question on Redden Island is freehold and would incur a purchase cost (for whole or part) on top of construction costs.

- The need for a large scale initial and continuous maintenance dredging program of the Barron River entrance delta to maintain all-tide access to the facility is a terminal constraint.
- Unacceptable environmental impacts associated with the required large-scale capital and maintenance dredging program to service a recreational boat ramp facility.
- Frequent flooding of the Barron River system makes the site unsuitable for floating walkway infrastructure given the damage and high ongoing maintenance costs associated with flooding debris.
- filling of land to give these facilities a level of flood immunity may be restricted due to impacts on the upstream catchment.

Summary: The Redden Island site presents a large land area for a carpark, but the need for a large scale capital and maintenance dredging program to gain and maintain all tide access is a financial and environmental terminal constraint to this option. In addition flooding impacts make it unacceptable for significant new marine infrastructure, particularly floating walkways. For this reason, Redden Island was not considered further.

2.4.2 Alternative 2 - Reed Road, Trinity Park

Description: The end Reed Road option includes use of a currently vacant large parcel of freehold land at the end of Reed Road to accommodate parking. There are two sub-options considered for this alternative which include different locations where the marine access might occur. Option A would involve the foreshore clearing and construction (dredging) of a basin area in the mouth of Half Moon Creek and subsequent construction of a boat ramp facility with extensive erosion protection works (Figure 2-10). Option B would include construction of a mini harbour on the open coast beach for the boat ramp facility (Figure 2-11).

Figure 2-10 Alternative 2A – Boat ramp facility in mouth of Half Moon Creek

Figure 2-11 Alternative 2B – Boat ramp facility on open coast protected by breakwaters

2.4.2.1 Option A

Benefits:

- Ample parking space would be available for future growth on existing cleared land.
- Cairns Regional Council regularly dredges the entrance area so maintenance costs for the facility is likely to be cost competitive.

Constraints:

- The cost to acquire some (or all) of the vacant land to support the carpark is likely to be cost-prohibitive for this project. When first considered, a Development Approval (DA) existed over the land and in the event a resumption or agreement was made to acquire the land, the value of the land in question and the funds invested in the DA would need to be factored into compensation. TMR is aware that this block was recently (in early 2020) been put on the market for sale with a price range between $30 and $40 million. This confirms TMR's previous assessment that the land purchase itself would exceed TMR's estimate project budget.
- The vacant lot is significantly elevated which presents challenges in construction of a boat ramp and its associated parking.

- The entrance area is spatially constrained with respect to water area for vessel movements, queuing vessels and the need to maintain a navigational channel for vessels from upstream development in Half Moon Creek. These constraints would necessitate the need to dredge a large basin area, which is likely to create a significant maintenance liability.
- Creek and river entrances are highly dynamic, particularly during cyclones and flooding events. Because of this, significant erosion protection works would be required as part of any proposed ramp in this location.
- This entrance area is a declared Fish Habitat Area (FHA) which excludes dredging works. On this basis, dredging a basin and ongoing dredging to maintain the basin would require the FHA to be revoked via legislative process.
- The basin dredging would require a large area of marine plants to be removed, which would present difficulty in gaining approvals when a suitable less impact alternative exists at Yorkey's Knob on an old dredge material disposal site (The proposed option).
- This entrance area is significantly exposed to flooding impacts likely giving rise to high ongoing maintenance costs associated dredging siltation, and potentially frequent damage to floating walkways and other infrastructure. The Half Moon Creek entrance is a critical point of high-volume water conveyance during local flooding. Development in this area has significant potential to negatively impact upstream catchment ecology and flooding.

Summary: The cost of acquiring the freehold land at the end of Reed Road is a significant constraint to this option. However, this option was primarily excluded from further consideration because the dynamic entrance of the narrow Half Moon Creek is significantly exposed to large changes from cyclone and flooding events, which cannot be completely negated. This represents ongoing maintenance issues, particularly associated with damage to floating walkways. In addition, the dredging of a basin in the FHA, which is essential to facilitate this option, is unlikely to be supported by approval agencies where a suitable alternative exists in non-declared FHA areas (the proposed site). Extensive removal of marine plants would likely not be supported by approval agencies where suitable alternate sites exist without this negative environmental impact.

2.4.2.2 *Option B*

Benefits:

- Ample parking space available for future growth on existing cleared land once acquired
- Open coast all-tide access in protected waters
- No flooding impacts.

Constraints:

- The cost to acquire some (or all) of the vacant land to support the carpark is likely to be cost-prohibitive for this project. When first considered, a Development Approval (DA) existed over the land and in the event a resumption or agreement was made to acquire the land, the value of the land in question and the funds invested in the DA would need to be factored into compensation. TMR is aware that this block has recently (in early 2020) been put on the market for sale with a

price range between $30 and $40 million. This confirms TMR's previous assessment that the land purchase itself would exceed TMR's estimate project budget.

- This site is exposed to open coast wind and waves, making the entrance design complex to ensure low wave heights inside a mini-harbour.
- Significant length of breakwaters required on both sides of facility to provide shelter to new facility. Given the northern end of Half Moon Bay is natural beach, construction of a mini-harbour in this area north-west of the Half Moon Creek entrance would significantly change:
  - coastal processes of the north-western beach
  - processes that have developed since Yorkeys Knob Marina was constructed.
- The isolation of a small section of disturbed beach, and the creek entrance lying between two harbour structures, represent fragmentation of the coastal processes. Such fragmentation would likely create more significant impacts than adding a mini-harbour immediately to the west of the existing marina (as proposed).
- Part of this area is a declared Fish Habitat Area (FHA) which excludes dredging works. On this basis dredging a basin and ongoing dredging to maintain the basin would require the FHA to be revoked via legislative process.

Summary: This option shares the same constraint of cost risk associated with acquiring freehold land as the other option at the end of Reed Road. However, this option was primarily excluded from further consideration because of the likely unacceptable impacts on coastal processes and the costs associated with a significant length of breakwater(s) to achieve the required protection and mini-harbour size.

2.4.3 Alternative 3 - Access Route to Proposed Yorkey's Knob Facility – Western Side of Golf Course

TMR considered accessing the proposed facility between Half Moon Bay golf course and Half Moon creek (see Figure 2-12), rather than the chosen access between the Half Moon Bay Golf Course and Yorkey's Knob Boat Club. There was a temporary haul road in this location when the proposed development site was a dredge material disposal area approximately 10-12 years ago and some of the sand was transported by trucks from this site.

Figure 2-12 Alternative access road option

This western alignment would either require large scale mangrove clearing and wetland impacts or resumption of the golf course either of which are not acceptable outcomes for the project, representing significantly greater impacts than the proposed access option. This option would require a greater amount of high fencing than the proposed option to manage the road and golf course conflict. This route would also include a greater amount of road to be constructed, impact on a declared Fish Habitat Area and would join a small local street which would necessitate an upgrade to facilitate traffic when the proposed access joins Buckley street which is already the main access to Yorkey's Knob Boat Club.

On the basis of these constraints this alternative access was not considered further.

3 Description of the Environment and Matters of National Environmental Significance

The results of an updated (1st October 2020) Protected Matters Search Tool (PMST) report are attached in Appendix F. The matters identified in this report consist of species (listed threatened and listed migratory species) and the Great Barrier Reef (GBR) World Heritage Property and National Heritage Place. These groups are considered further below.

The PMST report also identifies the potential occurrence of the Endangered broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Queensland listed threatened ecological community (TEC). However, ground-truthing mapping of the vegetation of the Project area confirms that this species is not present.

3.1 Ecological Context

3.1.1 Habitat Conditions

The Project area is located at the mouth of Half Moon Creek, with most of the proposed infrastructure occurring within an area that was historically used for placement of dredged material from navigation dredging in the creek. This can be identified through historical aerial photography of the area, as shown in Figure 2-7, and is consistent with the findings of sediment sampling undertaken in December 2018 (Appendix B).

Half Moon Creek drains a catchment that includes significant areas of remnant wetland vegetation, together with developments associated with the Trinity Park and Yorkeys Knob townships. The Half Moon Bay Marina has been developed adjacent to Yorkeys Knob, on the eastern side of Half Moon Bay, while Trinity Park Marina is located further upstream on the western side of the creek. To support both marinas and associated boating traffic in Half Moon Creek, regular maintenance dredging is undertaken by Cairns Regional Council. As noted above, some of this material was historically placed at the proposed boating infrastructure site, although all dredged material is now placed at an offshore dredged material placement area, approved under the *Great Barrier Reef Marine Park Act 1975* and *Environment Protection (Sea Dumping) Act 1981*.

Habitat mapping of Half Moon Creek and surrounds indicate that there are no seagrass meadows or rocky reefs in the immediate area or broader surrounds[1]. Existing broad-scale seagrass mapping[2] indicates that the closest seagrass meadow to the Project area is to the south at Ellie Point, on the western side of Trinity Bay, although some historical seagrass is known to have occurred around the mouth of the Barron River (frc environmental, 2013; Reason *et al.* 2020). These sites are more than 10 km from the Project.

Half Moon Bay and surrounding areas supports macroalgae beds, with densities up to 25% cover near the proposed boat ramp site. This consists mostly of the common red algae cf. *Hypnea*. See Figure 3-1.

[1] A single *Halodule pinifolia* leaf was recorded during targeted seagrass surveys on the western side of the bay in December 2018. If meadows exist they are expected to be sparse and small
[2] Aquis Great Barrier Reef Resort environmental impact assessment (EIA) and Long-term monitoring undertaken by James Cook University for the Port of Cairns

Aerial image: 22 June 2020 © Nearmap

Half Moon Bay Marina

Half Moon Creek

Moores Gully

Half Moon Bay Golf Course

LEGEND

- Project footprint [Royal Haskoning DHV (30 July 2020)]
- Ecology survey extent

Macroalgal Cover and Density

- <1%
- 1-5%
- 5-10%
- 10-15%
- 15-20%

Title:

Macroalgae Communities in the Project Area and Surrounds

Figure: 3-1

Rev: A

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A boulder field is located adjacent to the existing navigation channel, outside the footprint of the proposed works. The boulder field does not support high quality hard coral habitat as it is subject to turbid, freshwater runoff from Half Moon Creek and influenced by sediment plumes from existing dredging. The boulders provide potential habitat for filter-feeding species such as bryozoans, sponges, stinging hydroids and soft coral species that are tolerant of episodic pulses of low salinity runoff (e.g. *Echinomuracea* spp.). The closest mapped coral reefs occur at Double Island, over 9 km north of the project area.

As noted in Section 2.3.2, progressive development of the Half Moon Bay Golf Course has caused the loss of much of the wetland and woodland environment adjoining the historical foreshore of Half Moon Bay. Remaining vegetation is sparse and heavily modified, except where adjoining Ray Howarth Park and the Half Moon Creek. The area of former foreshore within Half Moon Bay Marina consists of intertidal flats, which adjoins a narrow band of mangrove forest that transitions to open coastal woodland. Beyond the marina, within the area for the proposed carpark, the environment is mainly coastal grassland and open coastal woodland, adjoining sandy beach habitat. More broadly, good quality mangrove and wetland habitat remains intact along the riparian fringes and upstream parts of Half Moon Creek as well as within Ray Howarth Park.

3.2 Listed Species

Table 3-1 provides an assessment of each of the species from the PMST report based on their likelihood of occurrence in the Project area and surrounds. Likelihood of occurrence ratings are based on criteria set out in the footnote of the table (i.e. habitat preferences, records for the area etc.). The desktop literature review and field surveys (conducted December 2018) on which the assessment is based is provided in Appendix C. Note that, in addition to a terrestrial vegetation survey, the surveys undertaken focused on identifying and characterising habitat suitability for fauna, rather than targeted surveys for fauna and flora species.

In summary:

- **Confirmed** – Saltwater crocodile (*Crocodylus porosus*) and the olive Ridley turtle (*Lepidochelys olivacea*), flatback turtle (*Natator depressus*) and green turtle (*Chelonia mydas*) have been recorded at or directly adjacent to Yorkeys Knob marina based on records in the Atlas of Living Australia.[3]
- **Likely** - The following species are likely to occur in the Project area and surrounds based on their habitat preferences and records from Atlas of Living Australia, StrandNet[4] and/or observations during the December 2018 field surveys (see Appendix C):
    - Common sandpiper (*Actitis hypoleucos*), sharp-tailed sandpiper (*Calidris acuminata*), red knot (*C. canutus*), curlew sandpiper (*C. ferruginea*), pectoral sandpiper (*C. melanotos*), bar-tailed godwit (*Limosa lapponica*), eastern curlew (*Numenius madagascariensis*), Latham's snipe

[3] https://www.ala.org.au/. The Atlas of Living Australia is an open access biodiversity database that includes flora and fauna species records provided by contributors. Each record comes with additional data regarding likely accuracy and should be cross-checked against species habitat requirements.
[4] https://environment.des.qld.gov.au/wildlife/animals/caring-for-wildlife/marine-strandings/data-reports/annual-reports. StrandNet is a Queensland Government database of marine wildlife strandings and deaths and includes coordinates based on different species. While the database is not publicly accessible, the Department of Environment and Science periodically produces summary reports of data for cetaceans, pinnipeds, dugong and marine turtle.

(*Gallinago hardwickii*), common greenshank (*Tringa nebularia*), common noddy (*Anous stolidus*) and little tern (*Sternula albifrons*)

- Dugong (*Dugong dugon*), Australian snubfin dolphin (*Orcaella heinsohni*) and Australian humpback dolphin (*Sousa sahulensis*)
- Loggerhead turtle (*Caretta caretta*) and hawksbill turtle (*Eretmochelys imbricata*)
- Spectacled flying-fox (*Pteropus poliocephalus*).

- **Possible** – Several additional species are considered as having a 'possible' likelihood of occurrence in the Project area. These are typically vagrant species that are rare in the Cairns region and/or are species that may fly over the Project area but typically do not directly utilise nearshore, mainland habitats.

A more detailed discussion on the occurrence of these species is provided below. Note that much of this discussion draws heavily on the relevant species entries of the Species Profile and Threats Database (SPRAT)[5]. References to biologically important areas (BIAs) are based on mapping provided in the National Conservation Values Atlas (NCVA)[6].

[5] https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl
[6] https://www.environment.gov.au/topics/marine/marine-bioregional-plans/conservation-values-atlas

Table 3-1 PMST report of threatened and migratory species, and their likelihood of species occurrence in the Project area

Common name	Scientific name	Listing	Habitat preference	Closest known sighting	Source*	Likelihood of occurrence
Birds						
Common sandpiper	*Actitis hypoleucos*	Migratory	Coastal wetlands, especially around muddy margins or rocky shores and/or in association with mangroves	Yorkeys Community Centre Park/Trinity Park Foreshore (2km)	ALA	Likely
Common noddy	*Anous stolidus*	Migratory	Rocky shores and sand shoals, with nesting in low vegetation or grassy areas. Foraging occurs over pelagic waters (outside of nesting) or in nearshore waters near nesting sites (during nesting)	Best Street Reserve, Yorkeys Knob (2km)	ALA	Possible
Fork-tailed swift	*Apus pacificus*	Migratory	Occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland, saltmarsh, cliffs and beaches. Largely aerial, only occasionally land	Ray Hayworth Park, Yorkeys Knob (1km)	ALA	Possible
Sharp-tailed sandpiper	*Calidris acuminata*	Migratory	Sheltered estuaries and wetlands, especially around intertidal mudflats and muddy margins	Yorkeys Knob Lagoon (1km)	ALA	Likely
Red knot	*Calidris canutus*	Endangered, Migratory	Intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. Occasionally within terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely freshwater swamps	Barron River (Mouth) (9km)	ALA	Likely
Curlew sandpiper	*Calidris ferruginea*	Critically Endangered, Migratory	Intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. Occur in both fresh and brackish waters	Yorkeys Knob Lagoon (1km)	ALA	Likely
Pectoral sandpiper	*Calidris melanotos*	Migratory	Coastal wetlands with open fringing mudflats and low, emergent or fringing vegetation	Yorkeys Knob Road (near Yorkeys Creek) (2km)	ALA	Likely

Common name	Scientific name	Listing	Habitat preference	Closest known sighting	Source*	Likelihood of occurrence
Southern cassowary	*Casuarius casuarius johnsonii*	Endangered	Dense lowland and highland tropical rainforest, closed gallery forest, eucalypt forest with vine forest elements, swamp forest and adjacent melaleuca swamps, littoral scrub, eucalypt woodland and mangroves	Torokina Street Reserve (Trinity Park) (1km)	ALA	Unlikely
Oriental cuckoo	*Cuculus optatus*	Migratory	Species mainly occurs in forests.	Wairambar Rainforest (70km)	ALA	Possible
Red goshawk	*Erythrotriorchis radiatus*	Vulnerable	Coastal and sub-coastal woodlands and forest	Redlynch (near Byron Terrace Park)) (15km)	ALA	Possible
Grey falcon	*Falco hypoleucos*	Vulnerable	Shrubland, grassland and wooded watercourses of arid and semi-arid regions. Occasionally found in open woodlands near the coast	Torokina Street Reserve (Trinity Park) (1km)	ALA	Possible
Lesser frigatebird	*Fregata ariel*	Migratory	Nearshore and offshore waters, with nesting exclusively on offshore islands, typically in breeding colonies (DSEWPaC, 2012a; GBRMPA, 2012b)	Yorkeys Knob Marina (0km)	ALA	Possible
Great frigatebird	*Fregata minor*	Migratory	Nearshore and offshore waters, with nesting exclusively on offshore islands, typically in breeding colonies (DSEWPaC, 2012b; GBRMPA, 2012b)	Yorkeys Knob Marina (0km)	ALA	Possible
White-bellied storm-petrel (Tasman Sea)	*Fregetta grallaria grallaria*	Vulnerable	Nearshore and offshore waters, with nesting exclusively on offshore islands, typically in breeding colonies	Coral Sea (-16.2500, 146.91670)	ALA	Possible
Latham's snipe	*Gallinago hardwickii*	Migratory	Freshwater and brackish wetlands	Ray Hayworth Park, Yorkeys Knob (1km)	ALA	Likely
White-throated needletail	*Hirundapus caudacutus*	Vulnerable, Migratory	Almost exclusively aerial. Seen above wooded areas, including open forest and rainforest.	Ray Hayworth Park, Yorkeys Knob (1km)	ALA	Possible
Barn swallow	*Hirundo rustica*	Migratory	Open country in coastal lowlands, often near water, towns and cities.	Ray Hayworth Park, Yorkeys Knob (1km)	ALA	Possible
Bar-tailed godwit	*Limosa lapponica*	Migratory	Intertidal sandflats, banks, mudflats and estuaries, especially around seagrass and saltmarsh (DoE, 2016a and 2016b)	Ray Hayworth Park, Yorkeys Knob (1km)	ALA	Likely

Common name	Scientific name	Listing	Habitat preference	Closest known sighting	Source*	Likelihood of occurrence
Bar-tailed godwit (baueri)	*Limosa lapponica baueri*	Vulnerable, Migratory	Intertidal sandflats, banks, mudflats and estuaries, especially around seagrass and saltmarsh (DoE, 2016a and 2016b)	Barron River (intersection of Captain Cook Highway) (6km)	ALA	Likely
Northern Siberian bar-tailed godwit	*Limosa lapponica menzbieri*	Critically Endangered, Migratory	Intertidal sandflats, banks, mudflats and estuaries, especially around seagrass and saltmarsh (DoE, 2016a and 2016b)	Kuranda (10km)	ALA	Likely
Black-faced monarch	*Monarcha melanopsis*	Migratory	Species occurs mainly in rainforest, including semi-deciduous vine-thickets. Other habitats include gullies in mountain areas or coastal foothills, softwood scrub dominated by Brigalow, coastal scrub dominated by Coast Banksia and occasionally among mangroves	Torokina Street Reserve (Trinity Park) (1km)	ALA	Possible
Spectacled monarch	*Monarcha trivirgatus*	Migratory	Species occurs in dense rainforests and moist eucalypt forests and sometimes inhabits mangroves and other densely vegetated habitats	Torokina Street Reserve (Trinity Park) (1km)	ALA	Possible
Yellow wagtail	*Motacilla flava*	Migratory	Species occurs in shrublands and grasslands with freshwater and marine wetlands	Kewarra Beach (Trinity Bay) (5km)	ALA	Possible
Satin flycatcher	*Myiagra cyanoleuca*	Migratory	Species occurs in wet forests	Kewarra Beach (Trinity Bay) (5km)	ALA	Possible
Eastern curlew	*Numenius madagascariensis*	Critically Endangered, Migratory	Foraging on soft, intertidal mudflat, with a preference for broad flats, often in sheltered areas near mangroves and estuaries/creeks, also on sandflats and occasionally ocean near water/beaches, rock platforms and coral reefs. Roost on saltflat, saltmarsh, mangroves, reef flat, sandy spits and grassland	Ray Hayworth Park, Yorkeys Knob (1km)	ALA	Likely
Osprey	*Pandion haliaetus*	Migratory	Littoral and coastal habitats, errestrial wetlands and offshore islands	Ray Hayworth Park, Yorkeys Knob (1km)	ALA	Possible
Rufous fantail	*Rhipidura rufifrons*	Migratory	Species occurs in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests	Yorkeys Knob (1km)	ALA	Possible
Australian painted snipe	*Rostratula australis*	Endangered	Shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans	Cattana Wetlands, Smithfield (4km)	ALA	Possible

Common name	Scientific name	Listing	Habitat preference	Closest known sighting	Source*	Likelihood of occurrence
Little tern	*Sternula albifrons*	Migratory	Sheltered coastal environments and estuaries, especially around sandbanks, as well as ocean beaches. Nesting occurs in sandy habitats along the coast and estuaries	Half Moon Bay (1km)	ALA	Likely
Common greenshank	*Tringa nebularia*	Migratory	Sheltered coastal habitats and estuaries, especially with large mudflats, saltmarsh, mangroves and/or seagrass	Ray Hayworth Park, Yorkeys Knob (1km)	ALA	Likely
Masked owl (northern)	*Tyto novaehollandiae kimberli*	Vulnerable	Riparian forest, rainforest, open forest, Melaleuca swamps and the edges of mangroves, as well as along the margins of sugar cane fields	Edmonton, Cairns (25km)	ALA	Possible
Fish						
Opal cling goby	*Stiphodon semoni*	Critically Endangered	Pristine rainforest streams that have significant flow and direct access to marine habitats	Gadgarra National Park (52km)	ALA	Highly unlikely
Frogs						
Australian lace-lid	*Litoria dayi*	Vulnerable	Associated with rainforests and rainforest margins. In montane areas the species prefers fast-flowing rocky streams although they also frequent slower watercourses where ample vegetation exists along the margins	Barron Falls, Smithfield (10km)	ALA	Highly unlikely
Waterfall frog	*Litoria nannotis*	Endangered	Restricted to rocky stream habitats in rainforest or wet sclerophyll forest where there is fast flowing water, waterfalls and cascades	Kuranda Range, Smithfield (10km)	ALA	Highly unlikely
Common mistfrog	*Litoria rheocola*	Endangered	Fast flowing rocky creeks and streams in rainforest as well as wet sclerophyll forest	Saddle Mountain Road, Smithfield Regional Park (5km)	ALA	Highly unlikely
Mammals						
Bryde's whale	*Balaenoptera edeni*	Migratory	Coastal/offshore waters – considered pelagic	Agnes Waters (1,100km)	ALA	Highly unlikely
Blue whale	*Balaenoptera musculus*	Endangered, Migratory	No key habitat on East Coast Australia.	St Lawrence (750km)	ALA	Highly unlikely

Common name	Scientific name	Listing	Habitat preference	Closest known sighting	Source*	Likelihood of occurrence
Northern quoll	*Dasyurus hallucatus*	Endangered	Occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert	Black Mountain Rd, Kuranda (10km)	ALA	Highly unlikely
Spotted-tailed quoll (North Queensland)	*Dasyurus maculatus gracilis*	Endangered	Mostly confined to cool, wet upland closed-forests in the upper catchments of rivers draining east and west of the Eastern Escarpment in the Wet Tropics	Captain Cook Highway, Smithfield (5km)	ALA	Highly unlikely
Dugong	*Dugong dugon*	Migratory	Seagrass meadows	Trinity Beach, Cairns (3km)	ALA StrandNet	Known/likely
Semon's leaf-nosed bat	*Hipposideros semoni*	Vulnerable	Tropical rainforest, monsoon forest, wet sclerophyll forest and open savannah woodland. Daytime roost sites include tree hollows, deserted buildings in rainforest, road culverts and shallow caves amongst granite boulders or in fissures	Cedar Bay National Park, Cooktown (120km)	ALA	Highly unlikely
Ghost bat	*Macroderma gigas*	Vulnerable	Arid habitats, tropical savanna woodlands and rainforests. During the daytime they roost in caves, rock crevices and old mines	Kuranda Rainforest Park (10km)	ALA	Highly unlikely
Humpback whale	*Megaptera novaeangliae*	Vulnerable, Migratory	Coastal/offshore waters.	Southern Ocean (25 km)	ALA	Highly unlikely
Black-footed tree-rat (north Queensland)	*Mesembriomys gouldii rattoides*	Vulnerable	Mostly occurs in eucalypt forests and woodlands, especially where hollows are relatively plentiful	Mareeba (35km)	ALA	Highly unlikely
Australian snubfin dolphin	*Orcaella heinsohni*	Migratory	Coastal and estuarine water – close to river mouths and seagrass meadows	Ellis Beach (10km)	ALA StrandNet	Likely
Killer whale	*Orcinus orca*	Migratory	Oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions.	Hicks Reef (250km)	ALA	Highly unlikely
Koala	*Phascolarctos cinereus*	Vulnerable	Naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by eucalyptus species	Tinarro Dam (45km)	ALA	Highly unlikely
Spectacled flying-fox	*Pteropus conspicillatus*	Endangered	Roosts in the vicinity of rainforest and feeds on rainforest species and eucalyptus spp. in tall open forests adjoining rainforest communities and in tropical woodland and savanna ecosystems	Yorkeys Knob (<5km)	ALA	Likely

Common name	Scientific name	Listing	Habitat preference	Closest known sighting	Source*	Likelihood of occurrence
Large-eared horseshoe bat	*Rhinolophus robertsi*	Vulnerable	Found in lowland rainforest, along gallery forest-lined creeks within open eucalypt forest, Melaleuca forest with rainforest understorey, open savannah woodland and tall riparian woodland of melaleuca, forest red gum (*E. tereticornis*) and Moreton Bay ash (*E. tessellaris*)	Maitland Road, Mount Peter (30km)	ALA	Highly unlikely
Bare-rumped sheath-tailed bat	*Saccolaimus saccolaimus nudicluniatus*	Vulnerable	Occurs mostly in lowland areas, typically in a range of woodland, forest and open environments	Kewarra Beach (10km)	ALA	Highly unlikely
Australian humpback dolphin[7]	*Sousa sahulensis*	Migratory	Inlets, estuaries, major tidal rivers, shallow bays, inshore reefs and coastal archipelagos	Offshore of Yorkeys Knob (14km)	ALA StrandNet	Likely
Water mouse	*Xeromys myoides*	Vulnerable	Mangroves and associated saltmarsh, sedgelands, clay pans, heathlands and freshwater wetlands	Cairns Airport (10km)	ALA	Possible
Plants						
Haines's orange mangrove	*Bruguiera hainesii*	Critically Endangered	Mangrove woodlands	Chinaman Creek (18km)[8]	Cooper *et al.* (2016)	Possible (but not recorded in area in detailed targeted survey)
(a tree)	*Canarium acutifolium*	Vulnerable	Almost confined to creek and riverbanks in lowland rain forest from sea level to 100m	Redlynch (10km)	ALA	Highly unlikely
Ant plant	*Myrmecodia beccarii*	Vulnerable	Epiphytic on trees in coastal woodlands and mangroves	Buckley Street and Half Moon Creek (adjoining site)	ALA	Likely
Lesser swamp-orchid	*Phaius australis*	Endangered	Found in coastal swampy sclerophyll forest dominated by melaleucas +/- rainforest in damp, sandy soils which are not subject to prolonged flooding	Chewko (50km)	ALA	Highly unlikely
(an orchid)	*Phaius pictus*	Vulnerable	Restricted to rainforests from 0‑600 m altitude, and usually occurs in sheltered humid sites close to streams and seepage among forest litter on boulders	Babinda (65km)	ALA	Highly unlikely
Reptiles						

[7] Listed on PMST Report as Indo-Pacific humpback dolphin (*Sousa chinensis*) but recognised on SPRAT as the separate species, Australian humpback dolphin (*S. sahulensis*).
[8] Atlas of Living Australia also records an occurrence within Half Moon Creek. However, not all coordinate tests for this record passed (i.e. the location may be incorrect). As the record existed before targeted studies were undertaken in the area, it is expected that if it was validated, it would have been included in Cooper *et al.* (2016) and the Conservation Listing Advice for the species (see TSSC, 2019).

Common name	Scientific name	Listing	Habitat preference	Closest known sighting	Source*	Likelihood of occurrence
Loggerhead turtle	*Caretta caretta*	Endangered, Migratory	Nest on open, sandy beaches and forage in open waters	North East Herald Island (300km)	ALA	Likely
Green turtle	*Chelonia mydas*	Vulnerable, Migratory	Nest on open, sandy beaches and forage in open waters	Yorkeys Knob Marina (0km)	ALA StrandNet	Confirmed
Salt-water crocodile	*Crocodylus porosus*	Migratory	Species habitat includes open ocean waters, beaches and muddy bays	Yorkeys Knob Marina (0km)	ALA StrandNet	Confirmed
Leatherback turtle	*Dermochelys coriacea*	Endangered, Migratory	Nest on open, sandy beaches and forage in open waters	Green Island (30km)	ALA	Possible
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable, Migratory	Nest on open, sandy beaches and forage in open waters	Yorkeys Knob Lagoon (1km)	ALA StrandNet	Likely
Olive Ridley turtle	*Lepidochelys olivacea*	Endangered, Migratory	Nest on open, sandy beaches and forage in open waters	Yorkeys Knob Marina (0km)	ALA StrandNet	Confirmed
Flatback turtle	*Natator depressus*	Vulnerable, Migratory	Nest on open, sandy beaches and forage in open waters	Yorkeys Knob Marina (0km)	ALA StrandNet	Confirmed
Sharks and Rays						
Narrow sawfish	*Anoxypristis cuspidata*	Migratory	Inshore marine waters, estuaries, river mouths, embankments and along sandy and muddy beaches	Cardwell (150km)	ALA	Possible
White shark	*Carcharodon carcharias*	Vulnerable, Migratory	Close inshore around rocky reefs, surf beaches and shallow coastal bays to outer continental shelf and slope area	Ellis Bay, Innisfail (80km)	ALA	Highly unlikely
Porbeagle	*Lamna nasus*	Migratory	Oceanic waters and areas around the edge of the continental shelf	Coral Sea (150km)	ALA	Highly unlikely
Reef manta ray	*Manta alfredi*	Migratory	Oceanic/Coastal waters	Upolu Reef (30km)	ALA	Highly unlikely
Giant manta ray	*Manta birostris*	Migratory	Oceanic/Coastal waters	Peart Reef, Innisfail (100km)	ALA	Highly unlikely
Freshwater sawfish	*Pristis pristis*	Vulnerable, Migratory	Inshore waters, estuaries, river mouths, embankments and along sandy and muddy beaches	Normanby River, Jack River National Park (260km)	ALA	Possible

Common name	Scientific name	Listing	Habitat preference	Closest known sighting	Source*	Likelihood of occurrence
Green sawfish	*Pristis zijsron*	VU, Mi	Inshore marine waters, estuaries, river mouths, embankments and along sandy and muddy beaches	Four Mile Beach, Port Douglas (50km)	ALA	Possible
Whale shark	*Rhincodon typus*	VU, Mi	Oceanic/coastal waters	Ribbon Reef (250km)	ALA	Highly unlikely

*ALA: Atlas of Living Australia database (https://www.ala.org.au/). StrandNet (annual reports at https://environment.des.qld.gov.au/wildlife/animals/caring-for-wildlife/marine-strandings/data-reports/annual-reports#document_availability and DES Library Catalogue).

Likelihood of Occurrence rating:

- Confirmed - species, population or ecological community was recorded during the field investigations or recent contemporary surveys in the Project area;
- Likely – species, population or ecological community could occur as species known or highly likely to occur in the Cairns region and suitable habitat is present in the Project area;
- Possible – species, population or ecological community that have not been recorded in the broader Cairns region but are known to occur in nearshore environments within 200 km of the Project area, or terrestrial elements that are known from the Cairns region and may occasionally occur in nearshore environments, or species that may fly over the Project area but typically do not directly utilise nearshore, mainland habitats;
- Unlikely – oceanic species that area do not typically occur in nearshore environments, or freshwater or terrestrial species that do not occur in nearshore/coastal habitats potentially affected by the Project.

3.2.1 International Migratory Shorebirds

The curlew sandpiper, sharp-tailed sandpiper, red knot, curlew sandpiper, pectoral sandpiper, bar-tailed godwit (including the *Limosa lapponica baueri* and *menzbieri* subsp.), eastern curlew, Latham's snipe and common greenshank are international migratory shorebirds which overwinter in Australia between November and April (Bamford *et al.* 2008; SPRAT). These species utilise intertidal and supratidal habitat for roosting and foraging purposes, most commonly around estuaries, tidal wetlands and shoals (SPRAT). As international migratory shorebirds, none of these species breed in Australia (Bamford *et al.* 2008).

Targeted shorebird surveys were undertaken in the Project area in December 2018 (the period when migratory shorebirds occur in Australia). No shorebird species were detected, but suitable habitat is present in the Project area. For the purposes of this assessment, the Project area was considered to represent potential habitat for all the above listed shorebird species. Table 3-2 provides further detail on the habitat requirements of these species and habitat conditions in the Project area. Potential shorebird habitat in and adjacent to the Project area is mapped in Figure 3-2.

EPBC Act Policy Statement 3.21 *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DoEE, 2017a) sets out criteria for identification of nationally significant shorebird habitat. This guideline identifies nationally important shorebird habitat as wetlands that regularly supports any of the following: 0.1% of the flyway population of a single species of migratory shorebird, 2,000 migratory shorebirds, 15 migratory shorebird species, and/or at least 18 individual Latham's snipes. A fauna habitat assessment in December 2018 did not identify large numbers of shorebirds in the Project area, however quantitative counts were not undertaken. Further surveys would be required to assess whether shorebirds 'regularly' occur in the Project area and to quantify abundance.

Similarly, while the Project area includes suitable shorebird habitat, this is not considered to be habitat critical to the survival of any of the shorebird species. Under the Significant Impact Guidelines 1.1 (DoE, 2013), such habitat consists of areas considered *necessary* for foraging, breeding, roosting or dispersal, the long-term maintenance of a species, the maintenance of genetic diversity of species, and/or the reintroduction of populations or recovery of species. The habitat in the Project area represents a small subset of the available habitat utilised by shorebirds in the Cairns region and is marginal comparative to habitat in the immediate area, such as remnant mangrove forest and shoals of Half Moon Creek and Richters Creek.

Table 3-2 Project area habitat assessment – migratory shorebirds

Species	Flyway population*	Preferred habitat*	Habitat in Project area
Common sandpiper	190,000	Coastal wetlands, especially around muddy margins or rocky shores and/or in association with mangroves.	Project area supports suitable foraging habitat around sand flats, especially areas adjoining remnant woodland habitat. Grassland and foredune habitat may also support roosting activities.
Sharp-tailed sandpiper	85,000	Sheltered estuaries and wetlands, especially around intertidal mudflats and muddy margins.	

Species	Flyway population*	Preferred habitat*	Habitat in Project area
Red knot	110,000	Mudflats, sandflats and sandy beaches on sheltered coasts and in estuaries.	Overall habitat value, however, is low, with higher value habitat available at Trinity Park and amongst wetlands of Half Moon Creek.
Curlew sandpiper	90,000	Mudflats on sheltered coasts and in estuaries.	
Pectoral sandpiper	1,220,000-1,930,000	Coastal wetlands with open fringing mudflats and low, emergent or fringing vegetation.	
Bar-tailed godwit (and subsp.)	325,000	Intertidal sandflats, banks, mudflats and estuaries, especially around seagrass and saltmarsh (DoE, 2016a and 2016b).	
Eastern curlew	35,000	Intertidal mudflats and sandflats of sheltered coasts and estuaries, especially around saltmarsh and mangroves (DoE, 2015a).	
Latham's snipe	30,000	Freshwater and brackish wetlands.	
Common greenshank	110,000	Sheltered coastal habitats and estuaries, especially with large mudflats, saltmarsh, mangroves and/or seagrass.	

*Except where otherwise noted, habitat information is taken from the Species Profile and Threats Database (SPRAT) entries for each species and EPBC Act Policy Statement 3.21. The flyway population is based on estimates provided in Bamford *et al.* (2008), as revised by Hansen *et al.* (2016).

3.2.2 Seabirds

The common noddy, lesser frigatebird, great frigatebird, white-bellied storm-petrel (Tasman Sea) and little tern are nominally considered seabirds. These species are characterised by their preference for foraging over marine waters, typically for long periods at a time, and ability to travel long distances between coastal environments. While most seabird species roost and nest on offshore islands and rocky headlands, the little tern and common noddy are known to utilise sand shoals and sand dunes (GBRMPA, 2012b; SPRAT).

While not identified in the Project area during ecological surveys undertaken in December 2018, it is conservatively assumed that the little tern and common noddy could occur in the area based on habitat suitability. Other species may forage in the marine environment and overfly the site but are not considered to have a high likelihood of occurrence. The lack of observation indicates, however, that the site is unlikely to support significant numbers of individuals of these species.

Further detail on the habitat requirements of these species comparative to that known to occur in the Project area is identified in Table 3-3. Suitable habitat comparative to Project infrastructure is mapped in Figure 3-2.

Note that the Project area and surrounds do not overlap with any BIAs for any seabird species, as mapped on the NCVA. The closest BIA is 100 km seaward in the outer islands of the Coral Sea.

Table 3-3 Project area habitat assessment – seabirds

Species	Preferred habitat*	Habitat in Project area
Common noddy	Rocky shores and sand shoals, with nesting in low vegetation or grassy areas. Foraging occurs over pelagic waters (outside of nesting) or in nearshore waters near nesting sites (during nesting).	Some sand shoals existing in the Project area, although better habitat is available at Trinity Park. No roosting or nesting sites are support in the Project area.
Little tern	Sheltered coastal environments and estuaries, especially around sandbanks, as well as ocean beaches. Nesting occurs in sandy habitats along the coast and estuaries.	

*Except where otherwise noted, habitat information is taken from the SPRAT entries for each species.

Yorkeys Point

Half Moon Bay Marina

Moores Gully

Half Moon Ck

Half Moon Bay Golf Course

Ray Howarth Park

Aerial image: 22 June 2020 © Nearmap

LEGEND

- High value habitat
- Marginal habitat
- Project footprint [Royal Haskoning DHV (30 July 2020)]

Terrestrial Habitats (BMT 2018)

- Coastal melaleuca woodland
- Intertidal flats
- Mangroves

Title:

Project Area Habitat Suitable for Shorebirds and Seabirds

Figure: 3-2

Rev: A

N

0 200 400

Metres

BMT

www.bmt.org

Filepath: I:\B24067_I_GML_Yorkeys Knob Approval\DRG\ECO_015_201008_Habitat Suitability for Migratory Seabirds.WOR

3.2.3 Dugong

Dugongs are present in the Cairns region, most notably in Trinity Inlet (FCG and Ports North, 2017; DEHP, 2016b). This species is typically associated with seagrass meadows, their feeding habitat (FCG and Ports North, 2017; SPRAT). There are no seagrass meadows at Half Moon Bay or surrounds, with the closest known meadows occurring 10 km to the south at the mouth of the Barron River (FCG and Ports North, 2017). The Project area is therefore not considered a high-quality habitat for this species. Dugong may transit through the Project area when moving between seagrass meadows.

Suitable habitat for dugong in the broader region is shown in Figure 3-3. High value habitat has been mapped based on the known and historical occurrence of seagrass meadows, due to the close association of dugong with this habitat.

The project area does not contain dugong protection areas (DPAs) under the *Fisheries Act 1994* nor is it mapped as part of a BIA for dugong on the NCVA.

3.2.4 Nearshore Dolphins

Both the Australian snubfin dolphin and Australian humpback dolphin occur in the Cairns region (Parra 2006; Parra *et al.* 2006; DEHP, 2016a). These species form small metapopulations across the north of Australia, however the size and spatial distribution of any metapopulation in the Cairns region is undefined (Brown *et al.* 2014).

All nearshore waters (<20 m depth) in Queensland north of Gladstone are mapped as BIAs for humpback dolphins. This includes breeding, calving and foraging. No high density foraging habitat is mapped in the Cairns region, with the closest areas being Princess Charlotte Bay and Bathurst Bay (~300 km northwest) and the Capricorn Coast (~150 km southeast). The BIA approximates the known distribution of humpback dolphins (Brooks *et al.* 2014).

Notwithstanding the BIA designation, local habitat conditions determine patterns in the distribution and abundance of both species. Through most of their range, both species are commonly found in nearshore waters, especially around river mouths (SPRAT). However, the GBR Marine Park Authority's Megafauna Expert Group (Brooks *et al.* 2019) found that nearshore environments of the Cairns region do not provide favourable habitat conditions for these species, due to the presence of reefs and sandflats that extend almost continuously from the mainland to the mid-shelf reef. Consequently, both dolphins tend to occur further from the shore in the Cairns region comparative to areas further south (Brooks *et al.* 2019). The humpback dolphin in particular was known to occur on average 6.4 km from shore and 2.4 km from water with a depth of <2 m. Similar patterns have also been noted in other parts of Queensland and the Northern Territory (SPRAT). Snubfin dolphins are also often found near seagrass meadows (SPRAT; Parra, 2006), which are not present in and adjacent to Half Moon Bay and surrounds.

Based on the above, nearshore environments in the Cairns area do not appear represent high quality habitat for these species. The main entrance channel to Half Moon Bay is currently dredged to 2.86 m below LAT and the river is approximately 2.36 m below LAT (EcoSustainAbility, 2018). These deeper areas provide potential habitat for these species. To date however, there are no records of either species in the creek or bay. By comparison, both species are known to occur in waters further

offshore and around seagrass habitat in Trinity Bay. Considering this, the most likely habitat for these species occur outside of the Project area, as shown in Figure 3-3. High value habitat for the snubfin dolphin has been mapped in association with known and historical seagrass meadows as this provides highly productive habitat known to be utilised by this species. For the humpback dolphin, high value habitat corresponds to the BIA between 2.4 and 6.4 km from the shore, reflecting the habitat preferences noted by Brooks *et al.* 2019.

3.2.5 Marine Turtles

All six marine turtle species found in Australian waters are known or possibly occur in the Cairns region (FCG and Ports North, 2017; GBRMPA, 2014a). These species use a variety of habitats as part of their life cycle. In conceptual terms (Musick and Limpus, 1997):

- All species nest on beaches (islands and mainland), with mating typically occurring close to nesting beaches
- Early juvenile nursery habitat is usually pelagic/oceanic, and later juvenile habitat is usually demersal and neritic (shallow waters)
- Adult foraging habitat varies among species and includes both pelagic and demersal habitats.

Table 3-4 describes adult feeding habitat preferences and known nesting sites of sea turtle species known from the Cairns region. Also shown are habitat types found in the Project area.

Table 3-4 Project area habitat assessment – marine turtles

Species	Preferred habitat (foraging)*	Preferred habitat (nesting)*	Habitat in Project area
Loggerhead turtle	Reef habitat and seagrass meadows	Beach and offshore island rookery sites within the southern GBR and Moreton Bay	Green turtle may forage on algae and mangrove fruits, although higher value seagrass foraging habitat is not present. Foraging by other species may also occur, although higher value foraging habitat such as coral reefs is not present. No nesting habitat is available although some isolated nesting could occur at Trinity Park beach.
Green turtle	Seagrass meadows and occasionally macroalgae attached to reefs and hard substrate	Offshore island rookery sites within the northern GBR	
Hawksbill turtle	Reef habitat and seagrass meadows	Offshore island rookery sites and isolated beaches in northern GBR	
Olive Ridley turtle	Soft sediment habitat	Isolated beaches along northwest Cape York Peninsula	
Flatback turtle	Nearshore soft sediment habitat with soft corals, sponges and sea cucumbers	Beach and offshore island rookeries throughout GBR; closest to site are at Cape Cleveland and Cape Bowling Green	

*Except where otherwise noted, habitat information is taken from the SPRAT entries for each species and from the species chapters in *A biological review of Australian marine turtles* (Limpus, 2007, 2008a, 2008b, 2008c, 2009a, 2009b).

Based on these habitat assessments, suitable foraging habitats for older juveniles and adults occurs in the area but high value foraging habitat is not present. The Project area does not support nesting beaches but beaches in the Cairns region are occasionally used for nesting (e.g. by flatback turtles).

The green, olive Ridley and flatback turtles are known to occur in Half Moon Bay based on Atlas of Living Australia records at the marina.

There are no BIAs mapped for any of the marine turtles in the Project area and surrounds. The closest mapped BIA on the NCVA is inter-nesting habitat for the hawksbill turtle near Cooktown, approximately 150 km to the north.

Suitable habitat comparative to Project infrastructure is mapped in Figure 3-3.

Note that the leatherback turtle is primarily a pelagic species, returning to shore only for nesting. As there are no nesting sites for leatherback turtles in the Cairns region, the species is considered unlikely to occur (see Limpus, 2009b).

3.2.6 Saltwater Crocodile

The saltwater crocodile occurs in the Cairns region, commonly sighted in rivers and estuaries in the area (FCG and Ports North, 2017). While not sighted during field surveys in December 2018, there are reports of this species in Half Moon Bay from Atlas of Living Australia and it likely occurs in Half Moon Creek. Nesting is unlikely to occur in the Project area due to lack of suitable habitat but may occur upstream in Half Moon Creek.

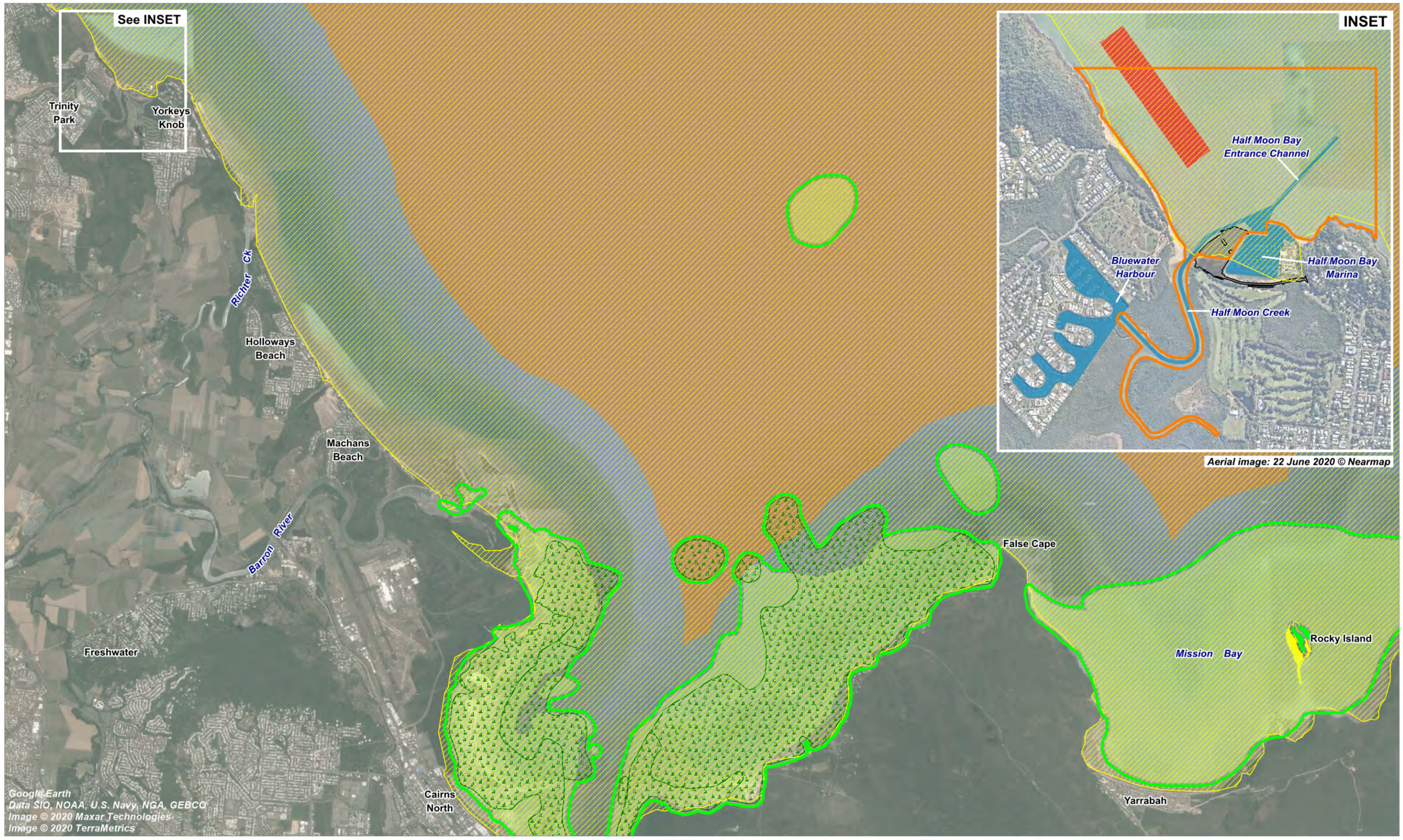
Note that all marine habitat in the project area is considered potentially suitable habitat for the saltwater crocodile.

3.2.7 Spectacled Flying-Fox

While spectacled flying-foxes prefer rainforest communities, a camp is known to occur periodically within Ray Howarth Park (see National Flying-fox Monitoring Viewer)[9]. No studies have been conducted on the flight paths of flying-foxes from Ray Howarth Park or the Yorkeys Knob area. However, it is known that spectacled flying-foxes regularly travel between their roosting area and vegetation communities containing suitable feeding trees, including rainforests, vine forests and tall open forests (Parsons *et al.* 2006; SPRAT)). Parsons *et al.* (2006) identify a typical foraging range for spectacled flying-foxes of 20 km. Applying this radius to Ray Howarth Park, there are extensive areas of vegetation northwest, west, southwest and southeast of the site that would likely provide foraging habitat for this colony. Considering this, Figure 3-4 presents the potential flight paths to and from Ray Howarth Park.

Note that the Project area itself does not provide high value foraging habitat, but it is expected that some foraging occurs within the woodland trees adjoining Half Moon Bay Marina.

[9] http://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf



LEGEND

- Marginal habitat
- Current dredging activities
- Half Moon Bay spoil ground
- Project footprint [Royal Haskoning DHV (30 July 2020)]
- Coral reefs
- High value habitat (*O. heinsohni* and marine turtles)
- 2018 seagrass extent
- 1984 to 2015 historic seagrass extent
- Biologically important area for the Indo-Pacific humpback dolphin
- High value habitat (*S. sahulensis*)

Title:

Project Area Habitat Suitable for Marine Megafauna, Comparative to Broader Region

Figure: 3-3

Rev: B

N

0 1.5 3
Main map - kilometres

0 400 800
Inset - metres

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www.bmt.org

Filepath: I:\B24067_I_GML_Yorkeys Knob Approval\DRG\ECO_016_201009_Habitat Suitability for Marine Species.WOR

Simpson Point
Buchan
Taylor Point
See Inset
Yorkeys Point
Myola
Redlynch
CAIRNS
Yarrabah

Inset

Aerial image: 19 August 2019 © Nearmap

Yorkeys Point
Half Moon Bay Marina
Moores Gully
Half Moon Ck
Ray Howarth Park
Half Moon Bay Golf Course

bing © 2020 Microsoft Corporation Earthstar Geographics SIO

LEGEND

- Known flying-fox camp
- Potential flying-fox feeding habitat
- 25m high boundary fences
- Projected flying-fox flight paths
- 20km feeding range

Data sources:
1. © State of Queensland (Department of Natural Resources, Mines and Energy) 2019
2. © State of Queensland (Department of Environment and Science) 2020
3. Royal Haskoning DHV (30 March 2020)

Title:

Spectacled Flying-fox *(Pteropus conspicillatus)*

Figure: **3-4**

Rev: **A**

N

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Metres - inset

0 5 10
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Filepath: I:\B24067_I_GML_Yorkeys Knob Approval\DRG\ECO_012_200421_Spectacled Flying-fox.WOR

3.2.8 Ant Plant

Ant plants (*Myrmecodia beccarii*) are epiphytes that grow on mangrove and melaleuca species. The species gets its name from the attendant colonies of golden ant (*Iridomyrmex cordatus*) that occur with older ant plants. The ant plants and ants have a mutualistic relationship, with the ant plant providing shelter for ants and the ants provide nutrients for the plant (ANBG & CANBR, 2012; DEWHA, 2008). Ant plants are primarily spread by the mistletoe bird (*Dicaeum hirundinaceum*) which consume the fruit of the plant and excretes the sticky seeds on to other trees (see QTFN; Bush and Boat & Floravilla Icecream, 2016; and Kimble, 2016).

The December 2018 surveys, conducted over a day throughout the Project footprint, detected four ant plant colonies on a large *Melaleuca leucadendra* located on Buckley Street near the entrance to the proposed road access. Additionally, ant plants were identified in two *Rhizophora stylosa* at the mouth of Half Moon Bay, southwest of the proposed carpark. All three sites were shown in the material provided with the project referral and are all outside of the proposed infrastructure footprint. The species is also likely to occur in the remnant mangrove and melaleuca communities of Half Moon Creek and may also occur within Ray Howarth Park.

No other ant plants were identified during the December 2018 surveys. The area within the study area consisted of an area of high value habitat for ant plants together with a fringe along the Half Moon Bay Marina that has lower habitat value. Within the high value habitat area, no ant plants were identified and as such it is considered highly unlikely that ant plants will occur in this area. The area fringing the marina was not able to be fully surveyed due to access constraints but, due to its lower value for ant plants, is considered to have a very low likelihood of any species occurrence.

Consistent with the precautionary approach, TMR will undertake pre-construction surveys to ensure that any change in distribution of ant plants in the study area is captured.

Note that previous estimates of ant plants that could occur were provided with the Project referral material. These estimates are ‘worst case’, on the basis that up to four trees in the fringing area contain ant plants. As noted above, this is considered highly unlikely.

See Figure 3-5 for location of ant plants in the vicinity of the Project area and the habitat in which they can often occur. Note that, even though ant plant was not identified in the high value habitat of the Project footprint, it is understood DAWE conservatively consider this habitat to be theoretical habitat for ant plant due to the close proximity of known records. This is considered further in Section 4.2.7 in the context of ant plant impacts. Despite this, only habitat where ant plant have been recorded are currently mapped as ‘known/likely’ habitat while other habitat has been mapped as ‘unlikely’ either due to confirmed absence during field surveys or due to habitat quality and suitability.

The mangrove and melaleuca habitat within the Project area and immediate surrounds represents approximately 1% of the total equivalent habitat found across the Half Moon Creek catchment, and less than 0.1% of the total equivalent habitat across the Barron River, Richters Creek and Half Moon Creek catchments. Additionally, the habitat of the Project area represents a narrow fringe on the edge of significant historical clearing, with ongoing disturbance from the adjoining golf course and marina. Thus, any habitat of the Project area provides a negligible contribution to the broader distribution of the species in the Cairns region.

Aerial image: 19 August 2019 © Nearmap

Concept Design

- Toilet block
- Beach
- Breakwaters
- Boat ramp
- Fence footprints
- Rock protection
- Carpark, access road and pedestrian paths
- Carpark and boat ramp line marking, kerbing, pedestrian paths, culvert lines and gradient lines
- Fence lines
- Disabled parking

Data source: Royal Haskoning DHV (30 July 2020)

Half Moon Bay Marina

Buckley Street

Half Moon Bay Golf Course

LEGEND

- Ant plant records December 2018
- Known/likely ant plant habitat
- Habitat unlikely to contain ant plant based on survey
- Habitat unlikely to contain ant plant based on quality and condition

Terrestrial Habitats

- Beach
- Coastal grassland
- Coastal melaleuca woodland
- Coastal woodland
- Intertidal flats
- Mangroves

Title:

Known Habitat for Vulnerable Ant Plant *(Myrmecodia beccarii)* Near Project Area

Figure: 3-5

Rev: G

N

0 40 80

Metres

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www.bmt.org

Filepath: I:\B24067_I_GML_Yorkeys Knob Approval\DRG\ECO_007_200408_Known Habitat for Vulnerable Ant Plant Near Updated Project Area.WOR

3.3 GBR Heritage Areas

The *EPBC Act referral guidelines for the Outstanding Universal Value of the Great Barrier Reef World Heritage Area* (DoE, 2014) set out examples of the attributes of the GBR that contribute to its listing under the criteria of the World Heritage Convention. The GBR Marine Park Authority also identified the series of values, attributes and processes of the GBR that contribute to world heritage and national heritage property values as part of the GBR Strategic Assessment (Tables 4.8 and 4.9) (GBRMPA, 2014).

The application of these values, attributes and processes to the environment of the Project area and its surrounds (including Yorkeys Knob, Half Moon Bay, Half Moon Creek and Trinity Park) is presented in Table 3-5. Based on this assessment, the following features of the Project area and surrounds are considered to be important in the context of the GBR World Heritage Area:

Criterion (vii) – 'contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance'

- Remnant vegetation communities along Half Moon Creek, at Yorkeys Knob and north of Trinity Park
- Remnant mangrove forest communities upstream in Half Moon Creek.

Criterion (viii) – 'be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features'

- The landscape mosaic of Half Moon Bay to Yorkeys Knob and the headland north of Trinity Park.

Criterion (ix) – 'be outstanding examples representing significant on-going ecological and biological processes in evolution and development of terrestrial fresh water, coastal and marine ecosystems and communities of plants and animals'

- No applicable attributes.

Criterion (x) – 'contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of science or conservation'

- Habitat values within Half Moon Creek and Half Moon Bay, associated with internationally migratory species
- Species of dugong, inshore dolphin, marine turtles, shorebird and seabird species occurring in the area
- The ant plant as a species on the basis of its nature of being endemic to northern Queensland.

Importantly, none of these attributes are directly linked to the Project footprint, although as discussed above a number of the Criterion (x) species may occur. Rather, the attributes link more closely to the mosaic of remnant habitat in the Project area and surrounds, including within Half Moon Creek, and to the geomorphology associated with the two headlands between which Half Moon Bay has formed. Like most estuarine environments on the GBR coast, the Project area and surrounds provide multiple environmental values that support the OUV of the GBRWHA. These environmental values provided

by the Project area are representative of those occurring in the local area and broader region and have been subject to significant historical disturbance.

Considering Criterion (x) species specifically, Section 3.2.1 to Section 3.2.5 provides details on the values of the Project footprint and surrounds relevant to these species, which can be summarised as follows:

- Shorebirds and seabirds will utilise intertidal and wetland habitats within the Half Moon Creek catchment and Half Moon Bay for roosting and feeding. Importantly, however, the intertidal shoals and mudflats of Half Moon Bay are not extensive, partly due to ongoing maintenance dredging in the area and the historical loss associated with the development of the Half Moon Bay Marina. This limits the importance of the area for foraging purposes, with more suitable habitat represented in other parts of the region, especially Trinity Inlet.
- Dugongs almost exclusively occur in connection to seagrass meadows. As the closest meadows are 10 km south near the mouth of the Barron River, no dugong are expected within Half Moon Bay except for transient individuals that may be travelling between meadows.
- Nearshore dolphin species may occur more regularly in Half Moon Bay than dugongs but likely occur in greater numbers further offshore and/or south in Trinity Inlet. This is due to the preference for the Australian snubfin dolphin to occur around high productivity habitats near river mouths, such as the seagrass meadows at the Barron River mouth, and the preference for the Australian humpback dolphin, in the Cairns region, to occur 2.6 to 6.4 km offshore.
- Marine turtles may also occur within Half Moon Bay but are more likely to occur within Trinity Inlet, around seagrass and coral reef habitat. These species are not known to nest in the local area and suitable habitat has been lost through the historical development of the Half Moon Bay Marina.
- Ant plant is known to occur adjacent to the Project footprint and is expected to occur throughout the Half Moon Creek catchment in remnant mangrove and melaleuca forest. There are no actual ant plant within the Project footprint, however, and any theoretical habitat in this area is of lower value comparative to the large remnant habitat across the catchment as it is a narrow coastal fringe of woodland between a golf course and marina, representing less than 1% of equivalent and better habitat located across the catchment.

The values described above in relation to the GBR World Heritage Area also apply to the GBR National Heritage Property.

Mapping of the Project area comparative to the GBR properties is shown in Figure 3-6.

Table 3-5 Key GBR World Heritage Area attributes and environmental processes in the Project area and surrounds, adapted from GBR Strategic Assessment Tables 4.8 and 4.9 (GBRMPA, 2014b)

Key values, attributes and environmental processes	Criterion viii	Criterion ix	Criterion vii	Criterion x	Integrity	Project area	Surrounding area
Biodiversity – GBR habitats							
Islands		✓	✓	✓	✓		
Beaches and coastlines			✓		✓	✓	✓
Mangrove forests			✓	✓	✓		✓
Seagrass meadows				✓	✓		
Coral reefs (<30m)		✓	✓	✓	✓		
Deeper reefs (>30m)		✓	✓	✓	✓		
Lagoon floor				✓	✓		
Shoals				✓	✓	✓	✓
Halimeda banks		✓			✓		
Continental slope			✓		✓		
Open waters			✓	✓	✓		✓
Biodiversity – terrestrial habitats that support the GBR							
Saltmarshes							
Freshwater wetlands							
Forested floodplains							
Heath and shrublands							
Grass and sedgelands							
Woodlands							
Forests							
Rainforests			✓				
Connecting water bodies				✓	✓		✓
Biodiversity - species							
Mangroves			✓	✓	✓		✓
Seagrasses				✓	✓		
Macroalgae				✓	✓	✓	✓
Benthic macroalgae				✓	✓	✓	✓
Corals			✓	✓	✓		
Other invertebrates		✓		✓	✓	✓	✓
Plankton and microbes				✓	✓	✓	✓
Bony fish		✓	✓	✓	✓	✓	✓

Key values, attributes and environmental processes	Criterion viii	Criterion ix	Criterion vii	Criterion x	Integrity	Project area	Surrounding area
Sharks and rays				✓	✓		✓
Sea snakes				✓	✓	✓	✓
Marine turtles			✓	✓	✓	✓	✓
Estuarine crocodiles				✓	✓	✓	✓
Seabirds			✓	✓	✓	✓	✓
Shorebirds				✓	✓	✓	✓
Whales			✓	✓	✓		
Dolphins				✓	✓	✓	✓
Dugongs				✓	✓	✓	✓
Geomorphological features							
Coral reefs	✓		✓		✓		
Islands and shorelines	✓		✓		✓		✓
Channels and canyons	✓				✓		
River deltas	✓				✓		
Halimeda banks	✓				✓		
Seagrass meadows	✓				✓		
Indigenous heritage							
Cultural practices, observations, customs and lore		✓			✓		
Sacred sites, sites of particular significance, places important for cultural tradition		✓			✓		
Stories, songlines, totems and languages		✓			✓		
Indigenous structures, technology, tools and archaeology		✓			✓		
Historic heritage							
Places of historic significance – historic shipwrecks							
Places of historic significance – World War II features and sites							
Places of historic significance – lightstations							
Places of historic significance – other							
Places of scientific significance (research stations, expedition sites)							
Places of social significance – iconic sites							
Community benefits of the environment							
Income							✓
Employment							✓
Understanding							✓

Key values, attributes and environmental processes	Criterion viii	Criterion ix	Criterion vii	Criterion x	Integrity	Project area	Surrounding area
Appreciation			✓				✓
Enjoyment			✓				✓
Access to reef resources							
Personal connection							✓
Health benefits							
Aesthetics			✓		✓		✓
Environmental processes							
Waves, currents and tides	✓	✓			✓	✓	✓
Cyclones	✓	✓			✓		
Wind	✓	✓			✓		
Sedimentation	✓	✓			✓	✓	✓
Sea level	✓	✓			✓		
Sea temperature		✓			✓		
Light		✓			✓		
Nutrient cycling		✓			✓	✓	✓
Freshwater inflow and salinity		✓			✓		✓
Microbial processes		✓			✓		✓
Particle feeding		✓			✓	✓	✓
Primary production		✓			✓	✓	✓
Herbivory		✓			✓	✓	✓
Predation		✓			✓	✓	✓
Symbiosis		✓			✓		
Competition		✓			✓	✓	✓
Connectivity	✓	✓			✓		✓
Recruitment		✓			✓		✓
Reef building	✓	✓	✓		✓		
Tectonic forces	✓	✓	✓		✓		

0.1701 ha

0.2704 ha

Half Moon Bay
Marina

Buckley Street

0.0454 ha

Half Moon Bay
Golf Course

Aerial image: 19 August 2019 © Nearmap

LEGEND

- Great Barrier Reef World Heritage Area
- Great Barrier Reef National Heritage Place

Data source:
© Commonwealth of Australia
(Department of the Environment and Energy) 2019

Concept Design

- Toilet block
- Beach
- Breakwater
- Boat ramp
- Carpark, access road and pedestrian paths
- Carpark and boat ramp line marking, kerbing and pedestrian paths
- Disabled parking

Data source: Royal Haskoning DHV (30 March 2020)

Title:

Great Barrier Reef World Heritage Area and National Heritage Place

Figure: 3-6

Rev: A

N

0 40 80

Metres

BMT
www.bmt.org

Filepath: I:\B24067_I_GML_Yorkeys Knob Approval\DRG\ECO_010_200420_Great Barrier Reef World Heritage Area and National Heritage Place.WOR

4 Impact Assessment

4.1 Project Impacts

The construction and operation of the Project is described in Section 2.2. Based on this, the impacting processes associated with the Project are listed below and linked to MNES in Table 4-1.

Construction

- Clearing and disturbance of terrestrial habitat within the footprint of the access road and carpark
- Movement of construction vehicles across the site, including importation of construction fill
- Noise generated by construction equipment and activities
- Dust generated by construction vehicle movements and from construction fill and stockpiles
- Capital dredging within the basin, including the onshore placement of this material, and associated generation of turbid plumes
- Disturbance of ASS within the construction footprint, including any ASS within the dredging footprint that is being placed onshore
- Dewatering of dredged material once placed onshore
- In-water construction works, including placement of imported and local fill
- Movement of construction vessels, including dredging vessel and construction barges
- Generation of underwater noise and vibration, especially from in-water works
- Introduction of pests and pathogens through the importation of fill or from construction vehicle and vessel movements.

Operation

- Maintenance dredging, including placement of dredged material offshore, and associated generation of turbid plumes
- Changes in frequency and number of recreational boating movements
- Vehicle movements along access road and changes in frequency of vehicle movements to and from Yorkeys Knob
- Changes in waterway linking marina basin and wetlands at Ray Howarth Park through installation of a culvert for access road crossing
- Erection of golf course fences along access road.

Note that the facility will not include pump-out or refuelling and therefore is not expected to have operational discharges to the environment. Additionally, spills and leaks from vessels and vehicles during construction and operation are not considered as there is not expected to be a material increase in risk of these incidents comparative to the existing risk associated with vessel movements from Half Moon Bay Marina, Bluewater Marina and the maintenance dredging.

Table 4-1 Description of impacting processes associated with the Project construction and operation

Impacting process	Impact description	Applicable MNES							
		Birds	Dugong	Dolphins	Turtles	Crocodile	Flying-fox	Ant plant	GBR
Construction									
Clearing and disturbance of terrestrial habitat	Loss of terrestrial habitat and flora in footprint	✓	N/A	N/A	N/A	N/A	✓	✓	N/A
Construction vehicle movements	Terrestrial fauna strike and visual/noise disturbance	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Construction noise	Disturbance of fauna	✓	N/A	N/A	N/A	N/A	✓	N/A	N/A
Construction dust	Loss of habitat values	✓	N/A	N/A	N/A	N/A	✓	✓	N/A
Capital dredging	Water quality changes Loss of marine habitat	N/A	N/A	✓	✓	N/A	N/A	N/A	✓
Disturbance of ASS	Water quality changes	N/A	N/A	✓	✓	N/A	N/A	N/A	✓
Dewatering of dredged material	Water quality changes	N/A	N/A	✓	✓	N/A	N/A	N/A	✓
In-water construction	Loss of marine habitat Strike of marine fauna	N/A	✓	✓	✓	N/A	N/A	N/A	✓
Construction vessel movements	Strike of marine fauna	N/A	✓	✓	✓	N/A	N/A	N/A	✓
Underwater noise and vibration	Disturbance of fauna	N/A	✓	✓	✓	N/A	N/A	N/A	✓
Introduction of weeds and pathogens	Loss of habitat values Fauna morbidity or mortality	✓	N/A	N/A	N/A	N/A	N/A	✓	N/A
Operation									
Maintenance dredging	Water quality changes	Note 1							
Boating traffic	Strike of marine fauna	N/A	✓	✓	✓	N/A	N/A	N/A	✓
Vehicle movements	Strike of terrestrial fauna	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Waterway changes (culverts)	Water quality changes Fish movement changes	Note 2							
Erection of barriers	Entanglement of fauna	N/A	N/A	N/A	N/A	N/A	✓	N/A	N/A

NOTE:

1. While the Project will introduce additional maintenance dredging requirements, the scale of maintenance dredging is such that there will be no material increase in environmental impacts associated with dredging comparative to the maintenance dredging already undertaken by Cairns Regional Council.
2. The waterway flowing into the Half Moon Bay Marina will be converted to a channel and culverts. These have been designed to avoid material changes in flushing and flooding regimes and to promote fish passage. Therefore, there is no applicable impact from these.

The increase in boating traffic for Half Moon Creek, Half Moon Bay and surrounds has been noted in the Preliminary Documentation request as an area of particular focus for Project-related impacts. The actual increase in boating movements is not possible to be quantified. However, it is important to note that a significant proportion of the boating traffic that will use the new ramp will be traffic that would otherwise use the existing boat ramps at Half Moon Bay Marina and Bluewater Marina. These existing ramps represent the best offshore access for recreational boaters in Northern Cairns, with the primary drawback of these facilities being an inadequate number of access lanes and parking to meet demand. The remainder of additional users would mostly come from Northern Cairns who might currently be happy to drive further to avoid the crowds. As there is already significant boating traffic in the area (as identified in the Demand Forecasting Study and detailed below) the new facility will act to concentrate some of this traffic to Yorkeys Knob rather than to represent a significant increase in total number of boating movements. This could represent an increase in up to 25% at Half Moon Bay. However, once outside the bay, the change in boating numbers therefore becomes negligible comparative to the existing situation as, from here, boats will disperse to the same routes and locations already used by boaters in the region.

In the order of 300 vessels are permanently moored in Half Moon Bay Marina and Bluewater Marina and canal estate, and the existing boat ramp facilities accommodate parking for approximately 80 CTUs. On very favourable weekend boating days satellite images show that more than 50 CTUs are overflow parking in local streets. On the basis of this information the proposed new facility will not represent a significant increase to boating traffic currently utilising the area. It will just facilitate current demand much more effectively by providing sufficient parking and more efficient water access.

With regards changes in hydrodynamic, fluvial and sediment transport conditions, see modelling studies in Appendix G. These all indicate the project does not lead to a significant change in physical coastal and riverine processes.

4.2 Listed Threatened and Migratory Species

4.2.1 Shorebirds and Seabirds

The MNES shorebirds and seabirds noted for the Project area primarily utilise intertidal habitat for foraging, with roosting occurring within the adjoining foredune, grassland and woodland communities. In total, 1.93 ha of habitat has been mapped in the disturbance footprint (Figure 3-2). This habitat loss is considered to be permanent, as remaining habitat in the footprint will be highly modified and subject to ongoing use and disturbance by car trailer units (CTUs) and maintenance dredging. In terms of this habitat loss:

- Available tidal/supratidal habitat:
    - The extent of habitat loss is <10% of the total available habitat in the Half Moon Creek area. Large areas of intact sandy habitat occur on the northern banks of Half Moon Creek and along Half Moon Bay at Trinity Park, habitat that directly adjoins intact vegetation. High quality intact sand shoal habitat occurs to the south at the mouth of Richters Creek and the Barron River.
    - Much of the area of tidal and supratidal habitats in the disturbance footprint are in a modified condition. Sand shoals of Half Moon Bay have been substantially modified by the construction of Half Moon Bay Marina and the ongoing dredging that occurs within the area. The supratidal

environment of the Project area consists of dredged material, historically placed and regularly disturbed as part of maintenance dredging campaigns.

- Wetland and forest habitat:
  - The terrestrial portions of the Project area are comprised of open woodland that represents the remnant foreshore strip left after clearing for the golf course and development of the marina. This vegetated strip is narrow (25-75 m wide) and highly fragmented.
  - the extent of habitat loss is <5% of the total available habitat in the Half Moon Creek area. Higher quality, intact fringing remnant terrestrial and wetland habitat occur on the banks of Half Moon Creek and associated tributaries and within Ray Howarth Park.

Biosecurity management controls will be undertaken as part of construction to manage the risk of weeds, pests and pathogens being introduced and spread during these works. With these controls, the risks are expected to be low.

Where possible, works will be undertaken in winter months which is outside the overwintering season for migratory shorebirds (November to April). This will reduce the risk of direct impact on these species from construction. However, there will be ongoing disturbance after construction associated with boat and CTU movements.

Overall, the significance of impacts to shorebirds and seabirds, as assessed using to the Significant Impact Guidelines 1.1 (DoE, 2013), is presented in Table 4-2 for species that are listed critically endangered and endangered, Table 4-3 for species that are listed vulnerable and Table 4-4 for species that are listed migratory. Note that where species are both listed threatened and migratory, they have only been assessed as listed threatened, consistent with the Significant Impact Guidelines 1.1. As shown tables, no significant impact is expected to any of these species as a result of the Project.

Table 4-2 Significant impact assessment – listed critically endangered and endangered species (shorebirds and seabirds)

Species	Criteria	Response
• Red knot • Curlew sandpiper • Eastern curlew	*Is there a real chance or possibility that the Project will:*	
	Lead to a long-term decrease in the size of a population?	No. The extent of habitat loss represents a small (<10%) proportion of total available similar habitat in the local Half Moon Creek area. Several of the habitat types in the disturbance footprint are in a modified condition and are subject to existing disturbances, including dredging, frequent vessel movements etc. Given the small proportion of habitat affected at even a highly localised scale, it is highly unlikely that direct and indirect disturbance resulting from the Project would impact the population size of these species.
	Reduce the area of occupancy of the species?	No. As noted above, the habitat loss for the Project represents a small (<10%) portion of total available similar habitat in the local area. As suitable habitat will be retained in Half Moon Creek and Half Moon Bay, it is highly unlikely the Project would change the area of occupancy of these species.
	Fragment an existing population into two or more populations?	No. The Project area does not link extant habitat areas so any habitat loss would not cause any fragmentation of populations. Note that each of these species are wide-ranging birds which would be able to overfly the Project area without limitations.
	Adversely affect habitat critical to the survival of a species?	No. The Project area is not considered to support habitat critical to the survival of any of these species. While it does support foraging and roosting activities, these are not at a scale considered significant to any one species. As noted above, any loss of habitat in the Project area is not expected to affect the population holding capacity of the local area.
	Disrupt the breeding cycle of a population?	No. These species breed in Northeast Asia and Siberia (Bamford *et al.* 2008) and travel to Australia for over-wintering. As no impact to population size and occupancy is expected to the overwintering populations (see above) it is highly unlikely the Project would impact breeding cycles.
	Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	No. See discussion above.
	Result in an invasive species that is harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?	No. The construction contractor with implement weed management controls to reduce the risk of weed spread/introductions. The risk of impacts to populations is considered to be very low.
	Introduce disease that may cause the species to decline?	No. See above.
	Interfere with the recovery of the species?	No. As the Project works are not expected to cause any impact to populations or habitat availability for these species, the works are not likely to have any material effect on any species' recovery.

Table 4-3 Significant impact assessment – listed vulnerable species (shorebirds and seabirds)

Applicable species	Criteria	Response
• Bar-tailed godwit (baueri)	*Is there a real chance or possibility that the Project will:*	
	Lead to a long-term decrease in the size of an important population of a species?	No. The extent of habitat loss represents a small (<10%) proportion of total available similar habitat in the local Half Moon Creek area. Several of the habitat types in the disturbance footprint are in a modified condition and are subject to existing disturbances, including dredging, frequent vessel movements etc. Given the small proportion of habitat affected at even a highly localised scale, it is highly unlikely that direct and indirect disturbance resulting from the Project would impact the population size of this species.
	Reduce the area of occupancy of an important population?	No. As noted above, the habitat loss for the Project represents a small (<10%) portion of total available similar habitat in the local area. As suitable habitat will be retained in Half Moon Creek and Half Moon Bay, it is highly unlikely the Project would change the area of occupancy of this species.
	Fragment an existing important population into two or more populations?	No. The Project area does not link extant habitat areas so any habitat loss would not cause any fragmentation of populations. Note that each of these species are wide-ranging birds which would be able to overfly the Project area without limitations.
	Adversely affect habitat critical to the survival of a species?	No. The Project area is not considered to support habitat critical to the survival of any of these species. While it does support foraging and roosting activities, these are not at a scale considered significant to any one species. As noted above, any loss of habitat in the Project area is not expected to affect the population holding capacity of the local area.
	Disrupt the breeding cycle of an important population?	No. This species breeds in Siberia (Bamford *et al.* 2008) and travel to Australia for over-wintering. As no impact to population size and occupancy is expected to the overwintering populations (see above) it is highly unlikely the Project would impact breeding cycles.
	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	No. See discussion above.
	Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	No. The construction contractor with implement weed management controls to reduce the risk of weed spread/introductions. The risk of impacts to populations is considered to be very low.
	Introduce disease that may cause the species to decline?	No. See above.
	Interfere substantially with the recovery of the species?	No. As the Project works are not expected to cause any impact to populations or habitat availability for these species, the works are not likely to have any material effect on any species' recovery.

Table 4-4 Significant impact assessment – listed migratory species (shorebirds and seabirds)

Applicable species	Criteria	Response
• Curlew sandpiper • Common noddy • Sharp-tailed sandpiper • Pectoral sandpiper • Latham's snipe • Bar-tailed godwit • Little tern • Common greenshank	*Is there a real chance or possibility that the Project will:*	
	Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	No. The Project area does not support important habitat for any of the species as it is does not support an ecologically significant proportion of any one species, is not used for breeding, is not critical to feeding and resting activities comparative to broader habitat availability in the region, does not occur at the limit of any species range, and is not an area in which any of these species are declining.
	Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	No. Construction works could lead to the introduction of weed species in the Project area and adjoining habitat. However, it is proposed that strong weed management controls are introduced which will diminish this risk. Even where weeds are inadvertently introduced and causes a loss of habitat broader than the Project area footprint, this impact No.
	Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	No. The Project area does not support an ecologically significant proportion of the population of any one species. This is evident based on the small numbers of shorebirds and seabirds that would likely utilise the area.

4.2.2 Dugong

Seagrass meadows are not present in the Project area, so dugong feeding habitat will not be impacted by the Project.

Vessel Strike

The key Project risks to dugong is related to direct strike, either during construction or through subsequent boating traffic. Dugong are vulnerable to boat strike as they are slow moving, spend a significant amount of time within 1.5 m of the surface, and tend to not evade the approach of fast vessels until an impact is unavoidable (DoEE, 2017b; citing Hodgson, 2004 and Groom *et al.* 2004). In considering the risks associated with vessel strike for dugong, two factors need to be considered, namely the abundance of dugongs in Half Moon Bay and the likely change in strike risk attributable to the Project.

As discussed in Section 3.2.3, dugongs are present in the Cairns region and are most commonly associated with seagrass meadows. Based on the absence of meadows in Half Moon Bay and surrounds, dugongs are not expected to occur in the Project area except potentially when transiting between meadows. due to the lack of foraging sites, dugongs are not known or likely to be abundant in Half Moon Bay.

The Queensland Department of Environment and Science marine stranding database (StrandNet) does not contain any dugong stranding records for the Half Moon Bay area, and consequently there are no records of dugong strandings caused by boat strike for this area. Dugong strandings attributed to boat strike in the Cairns region are mostly located in the vicinity of seagrass meadows, such as the Barron River mouth and Trinity Inlet. At a regional scale, DoEE, (2017b) found that Cairns was a lower risk location for dugong vessel strike, based on the low density of dugongs and registered recreational vessels. While the Project could increase the concentration of boating movements within Half Moon Bay, especially where redirecting boat launching from other ramps in northern Cairns, the low abundance of dugong in the area and the existing low strike risk indicate that a significant change in strike risk is unlikely. Additionally, the Project is located adjacent to two existing marinas and a canal estate which collectively support over 300 permanently moored vessels that regularly use Half Moon Creek. The potential contribution of the Project to the overall strike risk, therefore, is low.

Underwater Noise

Additional to boating traffic, dredging and in-water works will generate underwater noise and vibration which could potentially disturb any dugong occurring in the area. However, due to the low likelihood of occurrence of the species in the area, the risk of impact is considered to be low. Any underwater noise generated from dredging or boat movements would also be negligible comparative to the existing dredging and boating activities occurring within Half Moon Creek.

Dredging and ASS

Dredging works will cause the mobilisation of sediment leading to temporary increase in turbidity and suspended sediment levels within Half Moon Bay. This is not expected to have any effect on dugong, however, due to the low abundance of dugong in the local area and the lack of foraging habitat (e.g. seagrass) that could be impacted by these water quality changes. Note also that the scale of impact from dredging for the project is negligible comparative to that associated with existing maintenance

dredging for the marina and channels, with the total volume associated with the new boat ramp facility representing less than 2% of already scheduled and approved dredging by CRC in the area (see Table 2-2).

The placement of dredged material onshore is not expected to cause any water quality impacts relevant to dugong as the generation of acidic leachate from PASS is highly unlikely due to the low PASS risk of the material (see Appendix B).

The overall change in risk to the dugong is therefore considered to be low. The significance of impacts based on the Significant Impact Guidelines 1.1 is presented in Table 4-5. Based on this assessment, the Project is not expected to have a significant impact on the dugong.

Table 4-5 Significant impact assessment – listed migratory species (dugong)

Criteria	Response
Is there a real chance or possibility that the Project will:	
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	No. The Project area does not support important habitat for dugong.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	No. The Project area does not support important habitat for dugong. Any risk of construction vessels introducing or spreading invasive species would be managed through standard biosecurity controls of the Port of Cairns.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	No. The Project is not expected to lead to any attributable disturbance to dugong lifecycle activities nor does the Project area support and ecologically significant proportion of the species population.

4.2.3 Dolphins

The primary potential impacting processes to the Australian snubfin dolphin and Australian humpback dolphin are vessel strike, direct loss and fragmentation of foraging habitat, and indirect impacts to prey resulting from sediment plumes from dredging.

Habitat Impact

The Project area supports up to 1.5 ha of subtidal area that could be utilised by dolphins for feeding, which represents <5% of the total subtidal habitat across Half Moon Bay. The Project design has been developed to minimise impacts to the movement patterns of mobile marine fauna (e.g. fish, prawns, dolphins etc.). The Project will not create a barrier to the movement patterns of dolphins and other mobile fauna between Half Moon Bay and surrounding areas. Any changes to movement patterns will be highly localised (impacts measured in hundreds of metres of the final structure) and are not expected to result in detectable changes to the habitat values of Half Moon Bay, or populations status of dolphins and other resident marine fauna.

Vessel Strike

The abundance of nearshore dolphins in the Project area is expected to be low, based on the lack of high value habitat and the existing vessel-related disturbance that occurs within this area. As described in Section 3.2.4, dolphins likely occur in the area but in low numbers, with greater concentrations occurring further offshore (Australian humpback dolphin) and in Trinity Inlet (Australian snubfin dolphin).

During the operational phase, there will be increased concentration of boat movements within Half Moon Bay, potentially increasing the risk of vessel strike. Both the Australian snubfin dolphin and Australian humpback dolphin are known to be vulnerable to vessel strike at a population scale due to their smaller numbers (GBRMPA, 2012a; see also Van Waerebeek *et al.* 2006). However, as individual dolphins are highly agile, the likelihood of vessel strike is considered low. Combined with the lack of abundance in the Half Moon Bay area, no significant change in strike risk is anticipated. Additionally, the Project is located adjacent to two existing marinas and a canal estate which collectively support over 300 permanently moored vessels that regularly use Half Moon Creek. The potential contribution of the Project to the overall strike risk, therefore, is low.

Dredging and ASS

Water quality performance criteria for the capital dredging will be aligned to that already achieved by Cairns Regional Council as part of maintenance dredging. In this way, the Project will not introduce impacts significant different to the periodic disturbance already experienced in the area. See further Table 2-2 for a comparison of the dredging effort required for the Project comparative to that associated with the existing maintenance dredging. This indicates the total dredging volume required for the Project is less than 2% of what has already been approved and scheduled long-term for Half Moon Creek and Half Moon Bay.

Increases in turbidity and suspended solids do not poses a significant risk for nearshore dolphins which are accustomed to nearshore environments near river mouths which experience regular sediment plume impacts from natural variability. As there is no sensitive feeding habitat in Half Moon Bay that could be affected by plumes (e.g. seagrass) this would also not cause any indirect habitat impacts.

Similarly, onshore placement of dredged material is not expected to cause any water quality impacts relevant to dolphins as the generation of acidic leachate from PASS is highly unlikely based on sediment testing (see Appendix B).

Underwater Noise

Dolphins are vulnerable to underwater noise and vibration. However, due to the existing disturbance and traffic occurring in the area and the small number of piling activities proposed for the floating walkways (using best practice slow start and noise reduction strategies), no material impacts are expected. Any underwater noise generated from dredging or boat movements would also be negligible comparative to the existing dredging and boating activities occurring within Half Moon Creek.

The significance of impacts based on the Significant Impact Guidelines 1.1 is presented in Table 4-5. Based on this assessment, the Project is not expected to have a significant impact on either dolphin species.

Table 4-6 Significant impact assessment – listed migratory species (nearshore dolphins)

Applicable species	Criteria	Response
Is there a real chance or possibility that the Project will:		
• Australian snubfin dolphin • Australian humpback dolphin	Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	No. Half Moon Bay is not important habitat for either dolphin species as it does not support and ecologically significant proportion of their populations, is not known to provide critical to breeding or feeding habitat, and is not at the limit of either species range.
	Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	No. The Project area does not support important habitat for dolphins. Any risk of construction vessels introducing or spreading invasive species would be managed through standard biosecurity controls of the Port of Cairns.
	Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	No. The Project is not expected to lead to any attributable disturbance to dolphin lifecycle activities nor does the Project area support and ecologically significant proportion of either species population.

4.2.4 Marine Turtles

As with nearshore dolphins, the marine turtles potentially occurring in the Project area are at risk from vessel strike during construction and operation as well as impacts associated with construction noise and water quality disturbance.

Vessel Strike

Marine turtles are considered unlikely to avoid vessels travelling at speeds greater than 4 km/hr (DoEE, 2017b, citing Hazel *et al.* 2007). Additionally, turtles are often difficult to see prior to strike due to their behaviour of remaining below the surface for long periods. Vessel disturbance, including from recreational boat traffic, has been identified as a key threat under the National Recovery Plan for Marine Turtles (DoEE, 2017c). Based on the GBR Marine Park Authority's vulnerability assessment for marine turtles, vessel strike is considered to a moderate risk for all marine turtles collectively, although at a species level it is of low concern for all marine turtle species except the loggerhead turtle (GBRMPA, 2014a). Some incidence of strike could therefore occur for these species. However, as the area is already heavily trafficked, the change is risk is not considered to be significant comparative to an area with low levels of existing boat traffic.

Additionally, the Project is located adjacent to two existing marinas and a canal estate which collectively support over 300 permanently moored vessels that regularly use Half Moon Creek. The potential contribution of the Project to the overall strike risk, therefore, is low.

Underwater Noise

Additional to boating traffic, dredging and in-water works will generate underwater noise and vibration which could potentially disturb any turtles occurring in the area. However, due to the low likelihood of occurrence of turtles in the area, the risk of impact is considered to be low. Any underwater noise generated from dredging or boat movements would also be negligible comparative to the existing dredging and boating activities occurring within Half Moon Creek.

Dredging and ASS

As for the dugong, marine turtles are not expected to be impacted by additional dredging for the Project due to the low abundance of turtles in the area and the lack of foraging habitat (e.g. seagrass) that could be impacted by water quality changes. ASS impacts from onshore placement are also not expected as the generation of acidic leachate from PASS is highly unlikely based on sediment testing (see Appendix B).

The significance of impacts based on the Significant Impact Guidelines 1.1 is presented in Table 4-7 for turtle species that are endangered (loggerhead and olive Ridley turtles) and in Table 4-8 for species that are vulnerable (green, hawksbill and flatback turtles). Note that while all species are also migratory, as per the Significant Impact Guidelines 1.1 only the threatened criteria need be considered. Based on this assessment, the Project is not expected to have a significant impact on any marine turtle species.

Table 4-7 Significant impact assessment – listed critically endangered and endangered species (marine turtles)

Species	Criteria	Response
• Loggerhead turtle • Olive Ridley turtle	*Is there a real chance or possibility that the Project will:*	
	Lead to a long-term decrease in the size of a population?	No. The rate of vessel strike impacts are not expected to materially increase as a result of the Project. Additionally, the Project will not cause loss of key habitat utilised by these species. Without these processes, long-term impacts on species population is not anticipated.
	Reduce the area of occupancy of the species?	No. The Project will not cause change in the area occupied by these species as it does not make any area of existing habitat unsuitable for ongoing use.
	Fragment an existing population into two or more populations?	No. The Project will not cause any physical or behavioural barriers that could fragment population.
	Aversely affect habitat critical to the survival of a species?	No. The Project area is not known to support any habitat critical to the survival of turtle species as it does not contain key nesting or feeding habitat.
	Disrupt the breeding cycle of a population?	No. The Project area is not known to support and breeding or nesting activities for turtles.
	Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	No. See above.
	Result in an invasive species that is harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?	No. Any risk of construction vessels introducing or spreading invasive species would be managed through standard biosecurity controls of the Port of Cairns.
	Introduce disease that may cause the species to decline?	No. See above.
	Interfere with the recovery of the species?	No. The key recovery threat identified in the Recovery Plan of relevance to the Project is vessel strike. As discussed, the change in risk associated with vessel strike is considered to be negligible. Note that the Recovery Plan prioritises management of coastal development activities in BIAs, of which there are none in the Project area.

Table 4-8 Significant impact assessment – listed vulnerable species (marine turtles)

Applicable species	Criteria	Response
• Green turtle • Hawksbill turtle • Flatback turtle	*Is there a real chance or possibility that the Project will:*	
	Lead to a long-term decrease in the size of an important population of a species?	No. The rate of vessel strike impacts are not expected to materially increase as a result of the Project. Additionally, the Project will not cause loss of key habitat utilised by these species. Without these processes, long-term impacts on species population is not anticipated.
	Reduce the area of occupancy of an important population?	No. The Project will not cause change in the area occupied by these species as it does not make any area of existing habitat unsuitable for ongoing use.
	Fragment an existing important population into two or more populations?	No. The Project will not cause any physical or behavioural barriers that could fragment population.
	Adversely affect habitat critical to the survival of a species?	No. The Project area is not known to support any habitat critical to the survival of turtle species as it does not contain key nesting or feeding habitat.
	Disrupt the breeding cycle of an important population?	No. The Project area is not known to support and breeding or nesting activities for turtles.
	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	No. See above.
	Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	No. Any risk of construction vessels introducing or spreading invasive species would be managed through standard biosecurity controls of the Port of Cairns.
	Introduce disease that may cause the species to decline?	No. See above.
	Interfere substantially with the recovery of the species?	No. The key recovery threat identified in the Recovery Plan of relevance to the Project is vessel strike. As discussed, the change in risk associated with vessel strike is considered to be negligible. Note that the Recovery Plan prioritises management of coastal development activities in BIAs, of which there are none in the Project area.

4.2.5 Saltwater Crocodile

Crocodiles are not considered particularly vulnerable to any of the impacting processes associated with the Project. Clearing will not occur in habitat used by the species; the species is not known to be vulnerable to boat strike; and vessel noise is unlikely to cause a material difference to the use of key habitat by crocodile.

The significance of impacts based on the Significant Impact Guidelines 1.1 is presented in Table 4-9. Based on this assessment, the Project is not expected to have a significant impact on the saltwater crocodile.

Table 4-9 Significant impact assessment – listed migratory species (saltwater crocodile)

Criteria	Response
Is there a real chance or possibility that the Project will:	
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	No. Half Moon Bay is not important habitat for the saltwater crocodile as it does not support and ecologically significant proportion of their populations, is not critical to breeding or feeding, and is not at the limit of either species range.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	No. The Project area does not support important habitat for crocodiles. Any risk of construction vessels introducing or spreading invasive species would be managed through standard biosecurity controls of the Port of Cairns.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	No. The Project is not expected to lead to any attributable disturbance to crocodile lifecycle activities nor does the Project area support and ecologically significant proportion of the species population.

4.2.6 Spectacled Flying-Fox

As the flying-fox is primarily nocturnal, there is a risk that daylight construction will generate noise that disturbs flying-foxes while roosting. However, as the primary construction site is at least 500 m from Ray Howarth Park, this risk is considered to be low. Similarly, dust generated from construction is not expected to cause impacts within Ray Howarth Park or on other habitat utilised by flying-foxes.

The vegetation to be cleared represents marginal feeding habitat for flying-foxes, especially considering the abundance of alternative habitat within the immediate region. The loss of this habitat, therefore, is not expected to have any material impact to the species.

As part of construction, three sections of protective screening fence will occur between the golf course and access road. The fences are required to contain golf balls within the course and are therefore substantially higher than fences used for other sporting activities. The netting 'Dyneema' is made of High Molecular Weight Polyethylene (HMPE) which is both light and strong, with low water absorption. The lower section of fence from 0 to 1.8 m will consist of chain wire fence for maintenance and safety purposes. Figure 4-1 shows the sections of the proposed fence layout as described below:

- Section 1 – Southern End: 135 m (L) x 25 m (H)
- Section 2 – Second Shot: 50 m (L) x 20 m (H)

- Section 3 – Green Side: 25 m (L) x 20 m (H).

Given the protective fence sections will be up to 25 m high, this poses a potential barrier to spectacled flying-fox movements. The likely risk is dependent on two factors:

- Likely flight paths for flying-foxes from Ray Howarth Park (the local colony) – see Figure 3-4.
- Likelihood of entanglement with fence.

One of the flight paths identified in Figure 3-4 runs close to the golf course fence. While the path does not run across (perpendicular) to the fence, it is likely that individual flying-foxes will periodically interact with the fence.

Under the National Recovery Plan for the spectacled flying-fox (DERM, 2010) the 'entanglement in netting and on barbed-wire fences' were identified as minor threats to the species. This includes the risk of entanglement in mesh netting that is typically used to keep flying-foxes from feeding on fruit trees (Amesbury, 2007; Booth, 2006; DERM, 2010; Land for Wildlife, Note G4). This mesh netting is similar to that could potentially be used for the golf course. The risk of entanglement is highest where visibility of fences is low (e.g. fine or dark-coloured mesh) and where mesh is not taut (tightly stretched mesh leads to flying-foxes 'bouncing' off rather than becoming entangled) (cf. Land for Wildlife, Note G4). Fences topped with barbed wire increase the risk of injury.

Considering the above, the risk to the Ray Howarth Park colony is expected to be low as:

- The number of flying-foxes interacting with the fence will not be high
- The fence mesh will be taut, thereby decreasing the chance of entanglement
- Fences used for this purpose throughout Australia and the world have been developed and improved in design to reduce and avoid entanglement.

However, it is proposed that initial monitoring be undertaken of flying-fox entanglement in the fence after construction, with a focus on local flowering seasons. Where this monitoring shows an entanglement is occurring in numbers critical to the survival of the colony, additional actions will be taken (e.g. installation of reflective strips on the fence).

The significance of impacts based on the Significant Impact Guidelines 1.1 is presented in Table 4-10. Based on this assessment, the Project is not expected to have a significant impact on the spectacled flying-fox.

Figure 4-1 Proposed fence layout

Table 4-10 Significant impact assessment – listed vulnerable species (spectacled flying-fox)

Criteria	Response
Is there a real chance or possibility that the Project will:	
Lead to a long-term decrease in the size of an important population of a species?	No. Due to the low risk of flying-fox entanglement, there is no key impacting process that could impact on the size of the local population.
Reduce the area of occupancy of an important population?	No. See above.
Fragment an existing important population into two or more populations?	No. See above.
Adversely affect habitat critical to the survival of a species?	No. Ray Howarth Park is likely habitat critical to the survival of the species. The low risk of flying-fox entanglement for individuals dispersing from this camp means that there are no key impacting processes that could impact on this habitat. Construction activities are considered too remote to have material noise and dust impacts.
Disrupt the breeding cycle of an important population?	No. See above.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	No. The habitat cleared for the Project is not important to the sustaining of the local flying-fox population.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	No. Weed and pest control measures will be implemented as part of Project works such that the risk of invasive species being introduced to the Project area and surrounds is low.
Introduce disease that may cause the species to decline?	No. See above.
Interfere substantially with the recovery of the species?	No. Entanglement is considered the key risk to flying-fox recovery in the context of the Project. As noted above, the risk of entanglement is low and thus the Project is not expected to materially affect the recovery of this species and is consistent with actions of the National Recovery Plan.

4.2.7 Ant Plant

No ant plants were identified within the proposed project footprint during the December 2018 surveys and, as discussed previously, the likelihood of occurrence is considered to be low. Any clearing in the footprint will therefore have a very low likelihood of impacting on ant plants. However, see discussion below regarding application of the precautionary approach by TMR.

No indirect impacts from the works to retained ant plant habitat is expected. Weeds are not considered a key threat to ant plant (DEWHA, 2008) as the species is epiphytic. Dust produced during the construction phase is also unlikely to lead to smothering of nearby plants. The clearing will also not impact on dispersal as no long-term impacts to its key vector (mistletoe bird) are expected.

Adopting the precautionary approach, TMR intend to undertake pre-construction surveys to confirm if any ant plants or other listed threatened flora occur in the construction footprint. This will ensure

that any ant plants that may not have been present or identified previously are confirmed. Where possible, any such plants and their host tree would be retained. However, if necessary, translocation works will be undertaken. Translocation of ant plants has successfully occurred in Far North Queensland, and Biotropica (who regularly undertake such translocation works) estimate a success rate of 30-80% (Biotropica, 2017). The rate of success is highest where there is readily available habitat adjoining the impact area, as is the case for the Project.

This approach was considered a significant enough success rate for the Cairns Shipping Development Project that no conditions regarding ant plants were set by (then) Department of the Environment and Energy (see EPBC 2012/6538) and led to the Queensland Coordinator-General to make the following conclusion (OCG, 2018, 94).

> *To mitigate impacts to ant plants and to ensure there is no net loss of the species, the proponent has committed to translocate all directly affected ant plants to suitable nearby habitat before any vegetation is cleared.*
>
> *The pre-clearance survey will inform preparation of the translocation plan that the proponent will submit to DES for approval before construction starts. The plan will include a monitoring program to verify translocation success…*
>
> *I am satisfied that translocation and rehabilitation would ensure that potential impacts to ant plants from constructing the onshore segment of the delivery pipeline are adequately managed and that the project is unlikely to result in a net loss of the species.*

It is important to note this is a worst case scenario only and that there are existing permitting approaches under the Queensland *Nature Conservation Act 1992* to manage specific translocation activities.

Within the Project footprint is 1.8 ha of habitat considered unlikely to support ant plant based on survey but known to represent theoretical habitat. This would be loss through clearing and converted to infrastructure (e.g. road, carpark). This loss represents a loss of area in which ant plant could potentially occur in the future. However, this theoretical loss represents a negligible amount of overall available habitat for the species in the region, as described in Section 3.2.8. The total area of potential habitat in the footprint represents less than 1% of the total available remnant habitat in the Half Moon Creek catchment and less than 0.1% of that in the Half Moon Creek, Richters Creek and Barron River catchments. Additionally, this habitat is of much lower quality than the larger remnant communities in these areas as it represents a small remnant strip less than one hundred metres wide wedged between a golf course and a marina.

The significance of impacts based on the Significant Impact Guidelines 1.1 is presented in Table 4-11. Based on this assessment, the Project is not expected to have a significant impact on the ant plant.

Table 4-11 Significant impact assessment – listed vulnerable species (ant plant)

Criteria	Response
Is there a real chance or possibility that the Project will:	
Lead to a long-term decrease in the size of an important population of a species?	No. It is unlikely that the species occurs within the impact area. Where the species does occur, 20-70% of the population could be lost through unsuccessful translocation but the remainder are expected to be successful and the population would likely recover over time.
Reduce the area of occupancy of an important population?	No. The abundance of habitat immediately adjacent to the Project area means that any loss within the Project area will not represent overall loss from the area.
Fragment an existing important population into two or more populations?	No. Sufficient vegetation will be retained in the area to allow for cross-pollination of species to continue in the local area.
Adversely affect habitat critical to the survival of a species?	No. The Project area does not contain habitat important for the long-term maintenance of the species or its genetic diversity.
Disrupt the breeding cycle of an important population?	No. Any disruption to the species would be limited to individuals occurring within the Project area. No broader disturbance to reproduction of the species will occur.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	No. See above.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	No. Weed and pest control measures will be implemented as part of Project works such that the risk of invasive species being introduced to the Project area and surrounds is low.
Introduce disease that may cause the species to decline?	No. See above.
Interfere substantially with the recovery of the species?	No. It is unlikely that the species occurs within the impact area. Where it does, translocation efforts will reduce the extent of individual loss.

4.3 GBR Heritage Areas

4.3.1 Significant Impact Assessment

Table 4-12 assesses the Project against the significant impact criteria of the Significant Impact Guidelines 1.1 for World Heritage properties and national heritage places. This considers the examples of impacts provided in the guidelines for properties with natural heritage values.

Note that this relates only to impacts to the attributes of the GBR identified in Section 3.3 that are relevant to the Project area. As many of these values relate to particular species groups, cross-reference is made to the assessments made in Section 4.2. However, in summary, the following is noted:

- **Shorebirds and Seabirds** – habitat loss associated within the Project works is minimal comparative to the equivalent habitat available in the local area and will not represent the loss of any habitat that is considered important for shorebirds or seabirds generally nor that is of critical importance to the survival of any shorebird or seabird species. Additionally, direct disturbance

during construction is not expected as works would occur during the winter season when shorebird numbers are limited to resident birds only.

- **Dugong** – as the likelihood of dugong occurring in Half Moon Creek is low, construction works and any changes in boating traffic will not have an impact on the species as there is already a low risk of direct disturbance and vessel strike. Additionally, as there is no seagrass in the Project footprint or surrounds, there would be no loss of high value habitat utilised by this species.
- **Nearshore Dolphins** – while there is the potential for dolphins to occur in Half Moon Bay, the likely local abundance and the potential changes to boating traffic are not sufficient to pose a risk to the local population of these species. Similar to the dugong, there is no high value habitat for these species within the Project footprint or surrounds so construction and dredging works will not have a direct habitat impact for these species. Additionally, dredging works are not anticipated to pose any additional risk through water quality changes and underwater noise as significant dredging already occurs frequently through the area, and no ASS leachate from onshore placement is expected.
- **Marine Turtles** – as for nearshore dolphins, impacts are not anticipated to any marine turtle species due to low local numbers, lack of high value habitat, and lack of significant changes in boating traffic and dredging activities.
- **Ant Plant** – no ant plant occur within the Project footprint, although some individuals theoretically could occur in mangrove and melaleuca habitat. Where ant plants do occur, impacts would be managed through translocation which significantly minimises the risk of any population-level impacts. Overall habitat loss is considered of negligible significance to the species due to the abundance of remnant mangrove and melaleuca habitat throughout the Half Moon Creek catchment and the ability for the species to disperse by birds.

Importantly, the Project is not expected to have a significant impact on the GBR as it does not have a significant impact on constituent species (i.e. shorebirds, seabirds, dolphins, turtles) nor does it have any impacts on the landscape or remnant vegetation communities of the area. The key contributing attributes of Half Moon Bay and the Half Moon Creek catchment, such as the Yorkeys Knob headland and the mangrove forests and wetlands, will be retained and remain unaffected by the Project.

As the National Heritage values of the GBR effectively duplicate the World Heritage values, the findings for the GBR World Heritage Area are considered applicable to the GBR National Heritage Property.

The total volume of dredging associated with the new boat ramp facility will be less than 2% of that already scheduled and approved for maintenance of the Half Moon Creek navigation channel and adjoining marinas (see Table 2-2). Any suspended sediment and water quality impacts attributable to the construction and maintenance of the Project, therefore, would be negligible comparative to the existing disturbance that occurs in the area. The material to be dredged is free of contaminants, in accordance with NAGD testing, indicating that suspended sediments would not cause acute or chronic impacts to the marine environment, either during dredging or disposal. Capital dredging material would be retained onshore and managed to prevent acid leachate (if any) while maintenance material would be placed at the existing and approved at-sea placement site managed by CRC.

Thus, the dredging for the Project is not expected to have a net effect on the GBR when compared to existing long-term maintenance dredging that occurs within the area.

Table 4-12 Significant impact assessment – World Heritage property

Criteria	Response
Is there a real chance or possibility the Project will cause:	
One or more of the World Heritage values to be lost?	No. No geomorphological process will be significantly affected by the Project, including no conversion of existing estuaries or wetlands. The Project is also not expected to substantially increase concentrations of suspended sediments or pollutants through dredging or construction, noting the existing maintenance dredging occurring in Half Moon Bay and Half Moon Creek. As noted in previous sections, no significant impact to important fauna or flora species is expected and the Project will not cause a material loss of available habitat. The Project area is not a 'wilderness' site as it has been subject to substantial disturbance over the past few decades. Notwithstanding this, remnant areas of natural beauty, such as Half Moon Creek, Yorkeys Knob, Ray Howarth Park and the headland north of Trinity Park, will all be retained and remain unaffected by the Project.
One or more of the World Heritage values to be degraded or damaged?	No. As above.
One or more of the World Heritage values to be notably altered, modified, obscured or diminished?	No. As above.

4.3.2 World Heritage and National Heritage Management Principles

Principles for the management of Australia's world heritage and national heritage sites are set out in Schedule 5 and Schedule 5B of the *Environment Protection and Biodiversity Regulations 2000* (EPBC Regulations), respectively. Table 4-13 and Table 4-14 provides an assessment of the Project against these management principles. As can be seen, the EPBC Referral process for the Project is consistent with the management principles for set out under the regulations and, as the Project is not expected to cause a significant impact to the GBR, ongoing approval and management of the Project is consistent with Australia's national and international obligations.

Table 4-13 Assessment of Project against Australian World Heritage management principles (EPBC Regulations Schedule 5)

Management principle	Assessment
1. General principles	
1.01 The primary purpose of management of natural heritage and cultural heritage of a declared World Heritage property must be, in accordance with Australia's obligations under the World Heritage Convention, to identify, protect, conserve, present, transmit to future generations and, if appropriate, rehabilitate the World Heritage values of the property.	As the Project is considered not to pose a risk of a significant impact on the GBR based on the Significant Impact Guidelines, it is considered that any impacts are consistent with Australia's obligations under the World Heritage Convention. The Project does not present a future risk to the GBR that would otherwise impact on the ability of future generations to enjoy the values of the property.

Management principle	Assessment
1.02 The management should provide for public consultation on decisions and actions that may have a significant impact on the property.	The Project is not expected to have a significant impact on the GBR. Nevertheless, stakeholder consultation has been undertaken by TMR as part of the development of the Project (see Section 9.1.1 and Section 9.1.2) and, through this current EPBC Referral process, the Project is available to the public for further comment. This is consistent with the level of public consultation required under the EPBC Act.
1.03 The management should make special provision, if appropriate, for the involvement in managing the property of people who: (a) have a particular interest in the property; and (b) may be affected by the management of the property.	As noted above, TMR have undertaken stakeholder consultation as part of the Project options analysis and design (see Section 9.1.1 and Section 9.1.2). This has included consultation with the YKBC and the Half Moon Bay Golf Club (HMBGC), the two stakeholders directly adjoining the Project site. Additionally, TMR has been in consultation with the Cairns Regional Council (authority for the LGA) and all key State Government agencies as part of approval processes.
1.04 The management should provide for continuing community and technical input in managing the property.	Stakeholder input has been sought as part of the stakeholder consultation and approval processes (see Section 9.1.1 and Section 9.1.2), including technical input from key State Government agencies. TMR have engaged specialist consultants to undertake environmental assessments and design of the Project.
2. Management planning	
2.01 At least 1 management plan should be prepared for each declared World Heritage property.	-
2.02. A management plan for a declared World Heritage property should: (a) state the World Heritage values of the property for which it is prepared; and (b) include adequate processes for public consultation on proposed elements of the plan; and (c) state what must be done to ensure that the World Heritage values of the property are identified, conserved, protected, presented, transmitted to future generations and, if appropriate, rehabilitated; and (d) state mechanisms to deal with the impacts of actions that individually or cumulatively degrade, or threaten to degrade, the World Heritage values of the property; and (e) provide that management actions for values, that are not World Heritage values, are consistent with the management of the World Heritage values of the property; and (f) promote the integration of Commonwealth, State or Territory and local government responsibilities for the property; and	See assessment against Reef 2050 (Section 4.3.3).

Management principle	Assessment
(g) provide for continuing monitoring and reporting on the state of the World Heritage values of the property; and (h) be reviewed at intervals of not more than 7 years.	
3. Environmental impact assessment and approval	
3.01 This principle applies to the assessment of an action that is likely to have a significant impact on the World Heritage values of a property (whether the action is to occur inside the property or not).	-
3.02 Before the action is taken, the likely impact of the action on the World Heritage values of the property should be assessed under a statutory environmental impact assessment and approval process.	The EPBC Referral and this Preliminary Documentation assessment represent an environmental assessment of the Project's impacts on World Heritage values in accordance with the EPBC Act processes.
3.03 The assessment process should: (a) identify the World Heritage values of the property that are likely to be affected by the action; and (b) examine how the World Heritage values of the property might be affected; and (c) provide for adequate opportunity for public consultation.	See Section 3.3 for identification of World Heritage values and Section 4.3.1 for assessment of significance of impact to these values. Opportunity for public comment is provided as part of the EPBC Referral process. Additionally, TMR has also direct engaged with stakeholders as part of Project development.
3.04 An action should not be approved if it would be inconsistent with the protection, conservation, presentation or transmission to future generations of the World Heritage values of the property.	Based on the assessment of impact significance in Section 4.3, the Project is not considered inconsistent with the protection, conservation, presentation or transmission to future generations of World Heritage values as it will not lead to a significant impact.
3.05 Approval of the action should be subject to conditions that are necessary to ensure protection, conservation, presentation or transmission to future generations of the World Heritage values of the property.	To be determined by DAWE. However, see Section 7 regarding identification of proposed Project environmental outcomes.
3.06 The action should be monitored by the authority responsible for giving the approval (or another appropriate authority) and, if necessary, enforcement action should be taken to ensure compliance with the conditions of the approval.	To be determined by DAWE.

Table 4-14 Assessment of Project against National Heritage management principles (EPBC Regulations Schedule 5B)

Management principle	Assessment
1. The objective in managing National Heritage places is to identify, protect, conserve, present and transmit, to all generations, their National Heritage values.	As the Project is considered not to pose a risk of a significant impact on the GBR based on the Significant Impact Guidelines, it is considered that the Project will not cause a significant impact to National Heritage Values. The Project does not present a future risk to the GBR that would otherwise impact on the ability of future generations to enjoy the values of the property.
2. The management of National Heritage places should use the best available knowledge, skills and standards for those places, and include ongoing technical and community input to decisions and actions that may have a significant impact on their National Heritage values.	Stakeholder input has been sought as part of the stakeholder consultation (see Section 9.1.1 and Section 9.1.2) and approval processes, including technical input from key State Government agencies. TMR have engaged specialist consultants to undertake environmental assessments and design of the Project.
3. The management of National Heritage places should respect all heritage values of the place and seek to integrate, where appropriate, any Commonwealth, State, Territory and local government responsibilities for those places.	Regulation of the Project brings in both Queensland Government, including as regulators of the GBR Coast Marine Park, and DAWE.
4. The management of National Heritage places should ensure that their use and presentation is consistent with the conservation of their National Heritage values.	The proposed use of the GBR National Heritage Property involved ongoing use for recreational boating, subject to existing management regimes (e.g. zoning plans). This is consistent with the presentation of and access to the GBR for the community.
5. The management of National Heritage places should make timely and appropriate provision for community involvement, especially by people who: (a) have a particular interest in, or association with, the place; and (b) may be affected by the management of the place.	As noted above, TMR have undertaken stakeholder consultation as part of the Project options analysis and design. This has included consultation with the YKBC and the HMBGC, the two stakeholders directly adjoining the Project site (see Section 9.1.1). Additionally, TMR has been in consultation with the Cairns Regional Council (authority for the LGA) and all key State Government agencies as part of approval processes.
6. Indigenous people are the primary source of information on the value of their heritage and the active participation of indigenous people in identification, assessment and management is integral to the effective protection of indigenous heritage values.	Consultation was undertaken with the Cairns Regional Claim, the local Traditional Owner group for the Project area (see Section 9.1.2).
7. The management of National Heritage places should provide for regular monitoring, review and reporting on the conservation of National Heritage values.	To be determined by DAWE.

4.3.3 Reef 2050

The *Reef 2050 Long-Term Sustainability Plan* (Commonwealth Government and Queensland Government, 2018) sets the policy and management context for the GBR, based on the outcomes of the GBR Strategic Assessment (GBRMPA, 2014b). The plan sets out the policy approach for the GBR and actions associated with addressing key threats and achieving the plan's vision.

While the plan limits port infrastructure and dredging, it does not contemplate a constraint on boating infrastructure associated with recreational boating. Rather, there is emphasis on ensuring appropriate management of recreational and commercial boating activities. Noting this context, the development of a new boating facility to support existing and projected demand is not inconsistent with the plan.

Action WQA20 requires the Queensland Government to require dredging proponents to demonstrate their project is commercially viable prior to commencement. The mechanism for such an assessment is currently through the Queensland environmental and planning approvals system. As discussed in Section 11, the Project has already been approved subject to this system.

5 Proposed Avoidance and Mitigation Measures

Design refinement undertaken by TMR to date is discussed below. Aside from design, the key avoidance and mitigation measures that will be implemented as part of the works consist of the following:

- Implementation of a Construction Environmental Management Plan (CEMP), including Dredge Management Plan
- Pre-construction surveys for ant plant and translocation of any identified individuals.

A copy of a draft CEMP is attached in Appendix D. This document has been prepared to support approval applications and sets out the management requirements that will need to be integrated into a contractors CEMP prior to commencement of the works. Note that this was provided with approval applications made to Queensland Government agencies. Key management actions from the CEMP are identified below.

Details of translocation strategy for ant plant is discussed below.

Further mitigation measures associated with State Government approvals are discussed in Section 11.

5.1 Construction Management Actions

5.1.1 Vegetation Clearing

Management measures related to these impacts are described in Table 5-1. Measures related to the threatened species are described in Section 5.1.2.

Table 5-1 Management measures for vegetation clearing

Management Measures: Vegetation Clearing		
Further Investigations	**Responsibility**	
A Clearing Plan must be prepared, clearly identifying: • Areas of vegetation that will be permanently lost, areas that will be impacted but rehabilitated, and areas that will be retained • Methodology for clearing, including staging and equipment to be used • Measures for retaining topsoil and vegetation material for use in mulching.	*Preparation*: Contractor, using a qualified botanist/arborist	
	Approval: TMR	
A Rehabilitation Plan must be prepared, including long-term rehabilitation objectives, native species intended to be used for rehabilitation.	*Preparation*: Contractor, using a qualified botanist/arborist	
	Approval: TMR	
Preferred Management	**Responsibility**	**Timing**
Clearing must be undertaken in accordance with the approved Clearing Plan.	Contractor Superintendent	At all times
Mangroves will be cut off at ground level leaving roots in situ to prevent disturbance to PASS.	Contractor Superintendent	At all times

Management Measures: Vegetation Clearing		
Ensure that vegetation clearing boundaries are established with appropriate signage at regular intervals and visible and physical markings (high visibility tape, barricade webbing). Ensure that all contractors are aware of these boundaries.	Contractor Superintendent	At all times
All topsoil disturbed during vegetation clearing must be retained in a bunded and covered stockpile on site and used for rehabilitation works.	Contractor Superintendent	Prior to rehabilitation
No vegetation is to be burned as a form of removal or disposal.	Contractor Superintendent	At all times
Weed management will be undertaken during construction to ensure new weeds are not introduced to the area, including: • Mandatory weed wash down for vehicles and plant entering/existing the study area • Limited vehicle and plant movements in known weed infested areas • Any filling in works area to use only clean fill material that is certified as weed free (weed certificates to be retained).	Contractor Superintendent	At all times
Soil stockpiles to be located away from existing vegetation.	Contractor Superintendent	At all times
Upon completion of works, areas for rehabilitation and/or offsetting must be planted in accordance with the Rehabilitation Plan.	Contractor Superintendent	Following completion of works
Drainage from works area following works to be restored as close to pre-works condition as possible. Where not practicable, drainage to be designed to ensure no waterlogging and death of adjoining vegetation.	Contractor Superintendent	During restoration works

5.1.2 Flora and Fauna

Management measures related to terrestrial and marine flora and fauna impacts are described in Table 5-2. Measures related to construction phase traffic (e.g. risks of striking fauna crossing access roads (once built)) will be considered under a traffic management plan outlined Section 5.1.6, while measures related to clearing and weed management are considered in Section 5.1.1. Management actions for noise and light are outlined in Section 5.1.5.

Table 5-2 Management measures for terrestrial flora and fauna

Management Measures: Flora and Fauna		
Further Investigations	**Responsibility**	
A Pre-construction Survey must be undertaken to identify threatened and other important flora and fauna species (or habitat) within the construction area.	Contractor Superintendent, using a qualified ecologist	
If Pre-construction Survey identifies threatened flora species within the construction area, a Translocation Permit must be obtained.	*Preparation*: Contractor Superintendent, using a qualified ecologist	
	Approval: DNRME/DES	
If Pre-construction Survey identifies threatened fauna species or habitat within the construction area, a Species Management Plan must be prepared.	*Preparation*: Contractor Superintendent, using a qualified ecologist	
	Approval: DES	
Management Action	**Responsibility**	**Timing**

Management Measures: Flora and Fauna		
Any threatened flora species within the construction area identified during the Pre-construction Survey must be translocated in accordance with the Translocation Permit by a suitably qualified person.	Contractor Superintendent	Prior to works
Any threatened fauna species or habitat within the construction area identified during the Pre-construction Survey must be translocated in accordance with the Species Management Plan by a suitably qualified person.	Contractor Superintendent	Prior to works
If native fauna enters the work site, construction works must cease. Construction activities will continue once the animals has moved from the work site or caught and relocated by a qualified and licenced spotter/catcher.	Contractor Superintendent	At all times
Domestic animals must be prohibited in the construction area.	Contractor Superintendent	At all times
Artificial light sources must be shielded, redirected away from the foreshore, directional fixtures that pointed down and the lowest wattage possible lighting used to ensure terrestrial fauna behaviour/movement patterns is not disrupted.	Contractor Superintendent	At all times
Low-noise and vibration-emitting equipment must be used during construction activities where possible.	Contractor Superintendent	At all times
Temporary fish passage works are undertaken with Approval conditions.	Contractor Superintendent	At all times
All marine works must be conducted only during daylight hours when there is surface visibility of up to 1 km (360 degrees).	Contractor Superintendent	At all times
Pre-start and ongoing regular visual inspections of the works area must be conducted during rock placement and piling activities. If marine megafauna are sighted within the works area, potentially harmful marine activities must be stopped until animals have moved away from the construction area.	Contractor Superintendent	During rock placement and piling activities
Construction activities will be planned and executed to minimise and avoid interactions between with marine mammals and turtles, including: • Construction vessel operational buffers of 100m from large cetaceans and 50m from dolphins • No-wash speed limits within 100m of whales or 50m from dolphins 'Go-slow' limits for small construction vessels near seagrass and reef areas	Contractor Superintendent	At all times
Water-based noise activities (e.g. rock placement) must be commenced gradually to provide warning to nearby marine megafauna (i.e. soft-start procedure).	Contractor Superintendent	At all times
Where possible artificial light sources will be shielded and redirected away from adjacent beach environments to ensure marine fauna behaviour/movement patterns is not disrupted.	Contractor Superintendent	At all times
Directional fixtures that point down will be used wherever possible.	Contractor Superintendent	At all times
The lowest wattage possible lighting will be used with the source selected to avoid environmental impacts, e.g. low-pressure sodium vapour lighting and 'bug' lights.	Contractor Superintendent	At all times

5.1.3 Water Quality

The management of water quality in relation to earthworks, stockpiling of material, clearing vegetation, marine works and dredging will be governed under this CEMP and following documents:

- Dredge Management Plan (including management of placement either for direct placement onshore, or placement in reclamation cells)
- Erosion and Sediment Control Plan
- Acid Sulfate Soil Management Plan
- Water Quality Monitoring Program.

Table 5-3 Management measures for water quality

Management Measures: Water Quality	
Further Investigations	**Responsibility**
Undertake detailed design of dredging works, including location, volume, depths and profile	Contractor
Develop detailed methodology for dredging and pump-out works, including: • Dredge vessel to be used for works • Other (support) vessels to be used for the works • Type of dredging to be undertaken • Pump-out pipeline alignment • Location of pipeline connections and booster pumps (if any) • Duration of dredging.	Contractor
Develop a Dredge Management Plan based on detailed design and dredge methodology to manage any impacts from dredging.	Contractor
Apply waste hierarchy principles in designing work campaign, including reducing volume of material for dredging to a minimum.	Contractor
If works will cause obstruction to the Half Moon Bay navigation channel, prepare the following documentation in consultation with Regional Harbour Master and Maritime Safety Queensland: Marine Execution Plan Vessel Traffic Management Plan.	Contractor
Prepare a Notice to Mariners in consultation with Regional Harbour Master and Maritime Safety Queensland.	Contractor
Prepare detailed ESC Plan in accordance with: • FNQROC Development Manual • IECA Best Practice Erosion and Sediment Control 2008 • TMR Environmental Management Policies.	*Preparation*: Contractor, using a qualified ESC engineer *Approval*: TMR

Management Measures: Water Quality		
This must include measures to control sediment resuspension associated with excavation in intertidal and subtidal areas.		
Prepare ASS Management Plan (if required) in accordance with: • Queensland Acid Sulfate Soil Technical Manual • Guidelines for sampling and analysis of lowland acid sulfate soils	*Preparation*: Contractor, using a qualified ASS specialist	
	Approval: TMR	
Develop water quality performance criteria based on Cairns Regional Council's existing baseline data for the area	Contractor, using a qualified water quality scientist	
Establish a Water Quality Monitoring Program for the construction phase.	Contractor, using a qualified water quality scientist	
Preferred Management	**Responsibility**	**Timing**
Manage dredging and pump-out activities in accordance with DMP, including management actions specific to dredged sediment, as determined by sediment testing.	Contractor	As required
Ensure cells within the MRA are constructed to promote drainage of tailwater off settled material, towards the southeast weir box.	Contractor	Prior to dredging
Isolate any contaminated material in bunded area for treatment before placement.	Contractor	As required during works
Undertake visual monitoring of dredge plumes throughout dredging	Contractor	Continually during dredging
Where significant (>250 m) dredge plume is formed, modify dredging activities as appropriate, including potential implementation of any of the following: • Dredging only on incoming tide • Dredging without overflow (where relevant) • Use of silt curtains and booms.	Contractor	If significant plume is formed
Dredge only within approved areas and to approved depths.	Contractor	During works
All pump-out and placement activities to be in compliance with relevant approval.	Contractor	During pump-out
Retain a minimum freeboard of 1.0 m between the top of placed material in the MRA and top of the outer bunds of the MRA.	Contractor	During pump-out
Where required, lime dredged material that contains potential ASS in accordance with liming rates.	Contractor	During placement
Undertake monitoring of tailwater discharge points from reclamation cells.	Contractor	During placement
Where exceedances are identified and likely to be attributable to the placement works, undertake actions necessary to prevent further releases of unsuitable material, including: • Change to discharge rates to allow more time for material to settle • Application of flocculants to promote greater settling; • Raising of cell bunds/weir boxes to allow more time for material to settle • Other actions as relevant.	Contractor	During placement
Both on-land and in-water works must be undertaken using equipment that is appropriately sized for the relevant works, and	Contractor Superintendent	At all times

Management Measures: Water Quality		
should be undertaken in a way that minimises the risk of disturbance of soils (including benthic sediment).		
Only clean rock material (that will not cause a turbid plume) can be used for construction of the breakwater OR Measures are designed and installed that will prevent turbid plumes extending to sensitive receptors in the Project area.	Contractor Superintendent	At all times
Prior to commencement of construction activities, ESC installations required for the works under the ESC Plan must be put in place and checked for compliance by the Project Engineer (or delegate).	Contractor Superintendent	Prior to works
ESC installations must be retained in a state that meets the requirements of the ESC Plan at all times during the construction phase	Contractor Superintendent	At all times
Any other measures within the ESC Plan must be implemented as set out in the plan.	As per ESC Plan	As per ESC Plan
Works must be undertaken in accordance with requirements of the ASS Management Plan.	As per ASS Management Plan	As per ASS Management Plan
Any excavation in intertidal and subtidal areas must occur at low tide or an adequate containment solution must be implemented by the contractor.	Contractor Superintendent	At all times
Bunding must be put in place around any stockpiles retained on site except where it is established there is not risk of contaminated or sediment-laden runoff being generated from the stockpile (e.g. clean rock material).	Contractor Superintendent	At all times
No active discharges are to be made to the marine environment as part of construction activities unless treated and designed to meet relevant WQOs.	Contractor Superintendent	At all times
Spill response equipment must be maintained on site at all times and all Contractor Staff are to be trained in the use of spill response equipment and actions to be taken in event of small and large spills.	Contractor Superintendent	At all times

5.1.4 Spills and Waste Management

Management measures to reduce the impacts associated with this litter are described in Table 5-4. Additional measures focused on avoiding stormwater mobilisation of materials into the marine environment are described in Section 5.1.3.

Table 5-4 Management measures for spills and waste management

Management Measures: Spills and Waste Management		
Further Investigations	**Responsibility**	
A Spills Management Plan must be developed to govern potential for and response to spills during construction phase (including from landside and marine activities). The plan must have procedures for treatment of minor and major spills, including thresholds to determine the difference between these.	*Preparation*: Contractor	
	Approval: TMR	
Identify capacity of construction area to stockpile waste and set maximum limits on waste volumes and hold-times for site.	Contractor Superintendent	
Management Action	**Responsibility**	**Timing**

Management Measures: Spills and Waste Management		
Waste segregation and storage must be established on site and designed to avoid loss of waste (e.g. as a result of stormwater, winds).	Contractor Superintendent	Prior to works
Arrangements must be established for the removal and appropriate disposal of waste once waste volumes and hold-times are met.	Contractor Superintendent	Prior to works
All vegetation cleared during works must be mulched and used for rehabilitation and/or disposed as green waste.	Contractor Superintendent	During clearing
Spill kits must be available and all spills treated in accordance with the Spills Management Plan.	Contractor Superintendent	At all times
Any waste discharged into the marine environment must be immediately recovered.	Contractor Superintendent	At all times
At completion of works, all waste and excess construction material must be removed from the site.	Contractor Superintendent	Upon completion

5.1.5 Dust, Noise and Light

In accordance with the EPP (Noise) and EPP (Air) the EVs considered most relevant are health and wellbeing (including in relation to the ability to sleep), community amenity, biodiversity of ecosystems, and the aesthetic environment. Objectives to be achieved at different sensitive receptor locations are set out in the schedules to the EPPs.

Management measures related to these impacts are described in Table 5-5. Artificial lighting impacts are discussed in the context of ecology (which is considered the more sensitive value in relation to impacts).

Table 5-5 Management actions for dust, noise and light

Management Measures: Dust, Noise and Light		
Further Investigations	**Responsibility**	
n/a		
Management Action	**Responsibility**	**Timing**
Service and inspect all plant and equipment regularly to ensure they perform according to specifications and do not produce excessive noise, emissions or light.	Contractor	During works
Undertake dredging and pump-out between 6:00am and 6:00pm.	Contractor	During works
Direct lighting away from residential areas and sensitive environmental receptors.	Contractor	During works
Wherever possible, turn off work-specific lights at night.	Contractor	During works
Investigate any complaints received regarding air, noise, vibration, or lighting to determine if there is an impact to amenity.	Contractor	As required
All stockpiles of soil or other material that may cause mobilisation of dust must be covered and/or sprayed.	Contractor Superintendent	At all times
Significant dust-generating events must not be undertaken during periods of strong easterly winds.	Contractor Superintendent	At all times
If necessary, noise cancelling devices must be installed and/or utilised during construction activities that cause significant noise.	Contractor Superintendent	At all times

Management Measures: Dust, Noise and Light		
All construction equipment must be kept in good working condition and not cause excessive noise or emissions.	Contractor Superintendent	At all times

5.1.6 Traffic

In order to manage these impacts, a separate Traffic Management Plan (or equivalent) will be developed by TMR and/or the construction contractor at a later date. This plan will require updating following commissioning of a preferred Contractor but is expected to include the following elements:

- Management of site compound set up
- Access management for Buckley Street
- Trucking routes between quarry(ies) and construction site
- Management of fauna crossings.

In addition, a Notice to Mariners will be prepared by the Contractor for any works undertaken within the water in order to ensure management of navigational impacts. This will be approved by the Regional Harbour Master.

5.2 Design Refinements

An original concept design was developed by TMR following the Recreational Boating Facilities Demand Forecasting Study that incorporated the infrastructure elements identified as necessary. Subsequent to this, TMR undertook environmental and coastal studies of Yorkeys Knob with the intention of understanding the environmental values and constraints of the site. These studies are referenced in Appendix C. The key constraint identified from the study was the occurrence of ant plant within the potential area for the access road. Reflecting this, TMR ensured that a design was adopted that avoided the need to clear these ant plants. The study also identified the suitability of material in the dredge footprint for onshore placement, either as fill or for disposal at an onshore facility.

The design was then subject to further coastal and fluvial studies, eventually leading to detailed design which formed the basis of approval applications. This included detailed design of the culverts replacing the waterway into Half Moon Bay Marina to ensure appropriate flushing and fish passage. This current design is considered to minimise environmental impacts to the greatest extent possible while still allowing for the development of the facility. Further environmental gains through design refinement are not likely, particularly considering the minimal impact of the current Project footprint.

Note that, as discussed in Section 2.3.1, TMR originally considered a wide range of alternative options before progressing with Yorkeys Knob as the preferred site. This options assessment included consideration of environmental outcomes. As an existing developed site, Yorkeys Knob is preferred over other options to meet the demand in Northern Cairns. Alternatives which occurred at ‘greenfield’ sites and/or required significant vegetation clearing, extensive and ongoing dredging to maintain all tide ocean access and/or significant impacts on coastal processes.

5.3 Ant Plant Translocation

If ant plants are identified in the access road footprint during pre-construction surveys, they will require translocation. Note that the likelihood of ant plants occurring in this area is considered very low based on December 2018 field survey. This means that the chance of translocation being required is considered very low and is considered only from a precautionary approach.

In accordance with EPBC Act Policy Statement: Translocation of Listed Threatened Species (DSEWPaC, 2013), the proposed translocation is being identified as a mitigation option, rather than as the subject of the Project referral or a proposed offset.

Ant plant translocation has occurred several times in North Queensland including, most recently, as part of the Cairns Shipping Development Project. During this project, ant plant translocation was required at two locations: 1) vegetation near the mouth of Richters Creek (3 km southeast of Half Moon Creek) that was in the footprint of the dredged material delivery pipeline, and 2) vegetation at port land at Tingira Street, Portsmith, that was in the footprint of a marine offloading facility. In both instances, translocation was undertaken successfully, subject to a Translocation Permit issued under the Queensland *Nature Conservation Act 1992*.

Unpublished advice from the botanist responsible for these works (and other successful translocations) indicates ant plant translocation is possible where the following methodology is adopted:

- Sawing off of the host branch on which ant plants are attached, rather than physically removing ant plants from the host branch
- Securing the cut branch by natural fibres to a new host as quickly as possible (<20 minutes)
- Smaller ant plants (<50 mm diameter) with minimal root development can be physically removed from the host branch but will need to be resecured to the new host with grafting tape to maintain close contact between plant and host.

This relies on there being suitable receival habitat within the immediate area. Noting that ant plant commonly occur in association with melaleuca and mangrove species, Yorkeys Knob provides a number of readily available candidate sites, including Ray Howarth Park and the riparian vegetation of Half Moon Creek.

Based on this habitat availability and the previous success experienced in the north Queensland, it is considered highly likely that any translocation of ant plants, if necessary, will be successful.

Biotropica (who undertook the works for the Cairns Shipping Development Project) have previously identified a success rate of 30-80%, relating to the number of plants expected to survive translocation (Biotropica, 2017). Additionally, the species is known to be readily propagated according to the Australian National Botanic Gardens (2015) and it is understood that illegal gathering and propagation are a key species risk, indicating the species is readily translocated (DoEE, 2016).

The contents of a translocation plan cannot be determined prior to a preconstruction survey as the exact methodology depends on where ant plants are found and where they will be transferred to. However, it is proposed that translocation would be undertaken subject to the processes under the *Nature Conservation Act 1992* which regulates plant disturbance through Impact Management Plans

(IMPs). Under the Queensland Government *Protected Plants Assessment Guidelines* (2020), an IMP will include the following sections:

- Attempts to avoid and minimise harm
- Nature of impact
- Management of impact (including translocation)
- Justification of impact management
- Survival of the plant in the wild.

This provided with an application for a protected plant permit and cannot proceed until approved by Queensland DES. A translocation plan would also include a monitoring regime, aimed at identifying the success of translocation methods.

6 Residual Impacts and Environmental Offsets

Table 6-1 summarises the residual impacts for every matter triggered for the Project area based on a PMST report. Note that for items previously identified as not likely to occur in the area, it is automatically assumed that there will be no significant impact. For other matters, this assessment is based on the findings of Section 4, modified (if relevant) by the avoidance and mitigation measures noted in Section 5.

As can be seen, the Project is not expected to have a significant impact on any MNES. Therefore, no environmental offsets are required.

Table 6-1 Residual impact assessment for all MNES for Project area

Description	Type	Residual impact finding
Great Barrier Reef	World Heritage Property	**No significant impact** (significance criteria not met)
Great Barrier Reef	National Heritage Property	**No significant impact** (significance criteria not met)
Broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Queensland – Endangered	Listed threatened ecological community	**No significant impact** (not present)
Common sandpiper (*Actitis hypoleucos*)	Listed migratory species	**No significant impact** (significance criteria not met)
Common noddy (*Anous stolidus*)	Listed migratory species	**No significant impact** (significance criteria not met)
Fork-tailed swift (*Apus pacificus*)	Listed migratory species	**No significant impact** (not present)
Sharp-tailed sandpiper (*Calidris acuminata*)	Listed migratory species	**No significant impact** (significance criteria not met)
Red knot (*Calidris canutus*) – Endangered	Listed threatened species	**No significant impact** (significance criteria not met)
	Listed migratory species	
Curlew sandpiper (*Calidris ferruginea*) – Critically Endangered	Listed threatened species	**No significant impact** (significance criteria not met)
	Listed migratory species	
Pectoral sandpiper (*Calidris melanotos*)	Listed migratory species	**No significant impact** (significance criteria not met)
Southern cassowary (*Casuarius casuarius johnsonii*) – Endangered	Listed threatened species	**No significant impact** (not present)
Oriental cuckoo (*Cuculus optatus*)	Listed migratory species	**No significant impact** (not present)
Red goshawk (*Erythrotriorchis radiatus*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Grey falcon (*Falco hypoleucos*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Lesser frigatebird (*Fregata ariel*)	Listed migratory species	**No significant impact** (not present)
Great frigatebird (*Fregata minor*)	Listed migratory species	**No significant impact** (not present)
White-bellied storm-petrel (Tasman Sea) (*Fregetta grallaria grallaria*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Latham's snipe (*Gallinago hardwickii*)	Listed migratory species	**No significant impact** (significance criteria not met)
White-throated needletail (*Hirundapus caudacutus*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
	Listed migratory species	
Barn swallow (*Hirundo rustica*)	Listed migratory species	**No significant impact** (not present)

Description	Type	Residual impact finding
Bar-tailed godwit (*Limosa lapponica*)	Listed migratory species	**No significant impact** (significance criteria not met)
Bar-tailed godwit (baueri) (*Limosa lapponica baueri*) - Vulnerable	Listed threatened species	**No significant impact** (significance criteria not met)
	Listed migratory species	
Northern Siberian bar-tailed godwit (*Limosa lapponica menzbieri*) – Critically Endangered	Listed threatened species	**No significant impact** (significance criteria not met)
	Listed migratory species	
Black-faced monarch (*Monarcha melanopsis*)	Listed migratory species	**No significant impact** (not present)
Spectacled monarch (*Monarcha trivirgatus*)	Listed migratory species	**No significant impact** (not present)
Yellow wagtail (*Motacilla flava*)	Listed migratory species	**No significant impact** (not present)
Satin flycatcher (*Myiagra cyanoleuca*)	Listed migratory species	**No significant impact** (not present)
Eastern curlew (*Numenius madagascariensis*) – Critically Endangered	Listed threatened species	**No significant impact** (significance criteria not met)
	Listed migratory species	
Osprey (*Pandion haliaetus*)	Listed migratory species	**No significant impact** (not present)
Rufous fantail (*Rhipidura rufifrons*)	Listed migratory species	**No significant impact** (not present)
Australian painted snipe (*Rostratula australis*)	Listed threatened species	**No significant impact** (not present)
Little tern (*Sternula albifrons*)	Listed migratory species	**No significant impact** (significance criteria not met)
Common greenshank (*Tringa nebularia*)	Listed migratory species	**No significant impact** (significance criteria not met)
Masked owl (northern) *Tyto novaehollandiae kimberli*)	Listed threatened species	**No significant impact** (not present)
Opal cling goby (*Stiphodon semoni*) – Critically Endangered	Listed threatened species	**No significant impact** (not present)
Australian lace-lid (*Litoria dayi*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Waterfall frog (*Litoria nannotis*) - Endangered	Listed threatened species	**No significant impact** (not present)
Common mistfrog (*Litoria rheocola*) – Endangered	Listed threatened species	**No significant impact** (not present)
Bryde's whale (*Balaenoptera edeni*)	Listed migratory species	**No significant impact** (not present)
Blue whale (*Balaenoptera musculus*) – Endangered	Listed threatened species	**No significant impact** (not present)
	Listed migratory species	
Northern quoll (*Dasyurus hallucatus*) – Endangered	Listed threatened species	**No significant impact** (not present)

Description	Type	Residual impact finding
Spotted-tailed quoll (North Queensland) (*Dasyurus maculatus gracilis*) – Endangered	Listed threatened species	**No significant impact** (not present)
Dugong (*Dugong dugon*) – Migratory	Listed migratory species	**No significant impact** (significance criteria not met)
Semon's leaf-nosed bat (*Hipposideros semoni*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Ghost bat (*Macroderma gigas*) - Vulnerable	Listed threatened species	**No significant impact** (not present)
Humpback whale (*Megaptera novaeangliae*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
	Listed migratory species	
Black-footed tree-rat (north Queensland) (*Mesembriomys gouldii rattoides*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Australian snubfin dolphin (*Orcaella heinsohni*)	Listed migratory species	**No significant impact** (significance criteria not met)
Killer whale (*Orcinus orca*)	Listed migratory species	**No significant impact** (not present)
Koala (*Phascolarctos cinereus*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Spectacled flying-fox (*Pteropus conspicillatus*) – Endangered	Listed threatened species	**No significant impact** (significance criteria not met)
Large-eared horseshoe bat (*Rhinolophus robertsi*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Bare-rumped sheath-tailed bat (*Saccolaimus saccolaimus nudicluniatus*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Australian humpback dolphin (*Sousa sahulensis*)	Listed migratory species	**No significant impact** (significance criteria not met)
Water mouse (*Xeromys myoides*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Haines's orange mangrove (*Bruguiera hainesii*) – Critically Endangered	Listed threatened species	**No significant impact** (not present)
(*Canarium acutifolium*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
Ant plant (*Myrmecodia beccarii*) – Vulnerable	Listed threatened species	**No significant impact** (unlikely to be present and if present translocation will provide sufficient success to ensure species population not impacted over time)
Lesser swamp-orchid (*Phaius australis*) – Endangered	Listed threatened species	**No significant impact** (not present)
Phaius pictus – Vulnerable	Listed threatened species	**No significant impact** (not present)
Loggerhead turtle (*Caretta caretta*) - Endangered	Listed threatened species	**No significant impact** (significance criteria not met)
	Listed migratory species	

Description	Type	Residual impact finding
Green turtle (*Chelonia mydas*) - Vulnerable	Listed threatened species	**No significant impact** (significance criteria not met)
	Listed migratory species	
Salt-water crocodile (*Crocodylus porosus*)	Listed migratory species	**No significant impact** (significance criteria not met)
Leatherback turtle (*Dermochelys coriacea*) – Endangered	Listed threatened species	**No significant impact** (not present)
	Listed migratory species	
Hawksbill turtle (*Eretmochelys imbricata*) – Vulnerable	Listed threatened species	**No significant impact** (significance criteria not met)
	Listed migratory species	
Olive ridley turtle (*Lepidochelys olivacea*) – Endangered	Listed threatened species	**No significant impact** (significance criteria not met)
	Listed migratory species	
Flatback turtle (*Natator depressus*) – Vulnerable	Listed threatened species	**No significant impact** (significance criteria not met)
	Listed migratory species	
Narrow sawfish (*Anoxypristis cuspidata*)	Listed migratory species	**No significant impact** (not present)
White shark (*Carcharodon carcharias*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
	Listed migratory species	
Porbeagle (*Lamna nasus*)	Listed migratory species	**No significant impact** (not present)
Reef manta ray (*Manta alfred*)*i*	Listed migratory species	**No significant impact** (not present)
Giant manta ray (*Manta birostris*)	Listed migratory species	**No significant impact** (not present)
Freshwater sawfish (*Pristis pristis*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
	Listed migratory species	
Green sawfish (*Pristis zijsron*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
	Listed migratory species	
Whale shark (*Rhincodon typus*) – Vulnerable	Listed threatened species	**No significant impact** (not present)
	Listed migratory species	

7 Environmental Outcomes

Suggested environmental outcomes identified for the Project are set out in Table 7-1 below. Note that these reflect the low environmental risk of the Project and are intended to be adapted to specific risks considered relevant to the delivery of the Project. These outcomes and associated information have been identified in accordance with the Outcomes-based Conditions Policy (DoE, 2016c) and associated guidance (DoE, 2016d).

Note that, consistent with Section 4.1, no environmental outcomes related to maintenance dredging are suggested. This is because such works will be managed through the existing approvals regime held by Cairns Regional Council. See further Section 11.

Specific outcomes associated with boat strike are not provided as the Project is considered to have a negligible contribution to this existing risk within Half Moon Bay and Half Moon Creek.

Table 7-1 Suggested Project environmental outcomes

Outcome	Reasoning	Risk and approach
There is no net loss of seagrass and coral habitats outside of the Project footprint	The key values contributing to the GBR and associated megafauna species in the Cairns region is the presence of seagrass and coral reef habitats. While the likelihood of occurrence of these habitats in the Project area is low based on previous survey, it is important to ensure that any potential occurrence of these values is protected. This principally requires management of water quality impacts during dredging and in-water construction (which is discussed below) and managing in-water works to not go beyond the boundaries of what has already been identified.	Ensuring that dredging and construction activities do not extend beyond the footprint of the Project area. This can readily be achieved, based on the standard practices used by construction contractors for similar works.
Water quality is maintained with the range of ambient variability currently experienced	A key potential impact of the Project is the generation of water quality impacts during dredging and in-water works which could impact marine habitats in the area. Ensuring these impacts are within the range of that experienced already in Half Moon Bay will eliminate the risk that the Project is causing acute environmental impacts.	Use of the CEMP and a DMP to set water quality performance criteria and to manage in-water works to meet these criteria. The criteria to be met would be aligned to those set in the approval for maintenance dredging (EPPR00795313). This approach has a high likelihood of success, given the existing experience of dredging in the area.
There is no disturbance of ant plant, except where subject to robust translocation approaches	While the likelihood of ant plant occurring within the construction footprint is low, where the species does occur it will introduce a key environmental risk, requiring translocation. This outcome is intended to drive the need to survey for the occurrence of the plant and then, if identified, to develop a robust translocation and monitoring methodology, in agreement with relevant agencies. Note that it is not intended that the outcome require no net loss after translocation as success cannot be 100% confirmed and may depend on external factors outside TMR's control. The commitment, therefore, is to a robust approach being in place.	Use of pre-construction surveys and development of Translocation and Monitoring Plan as part of state approval applications. If necessary, this plan can also be prepared in conjunction with the Department to ensure alignment with EPBC Act outcomes and to allow for post-translocation monitoring results to be provided.

8 Ecologically Sustainable Development

The principles of ecologically sustainable development (ESD) under s3A of the EPBC Act are:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- The principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
- The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making
- Improved valuation, pricing and incentive mechanisms should be promoted.

The Project involves the development of a new boat ramp facility for northern Cairns to promote access by recreational boaters to the GBR. This primarily focuses on meeting existing and projected boating demand and is co-located within existing boating facilities at Half Moon Bay Marina and Bluewater, rather than developing a green-field site that opens boating traffic to a new area of the marine environment. Thus, while the Project may lead to a net increase over time in the concentration of boating traffic in the area, it is being located within an area in which maritime developing, boating activity and dredging already frequently occur. This is considered preferable to many of the other options considered while still achieving important social and economic outcomes for the area as well as securing opportunities for future generations to access the reef.

Within this context, the Project is not considered to pose a significant present or future risk to the environment, for either present or future generations. It also is not expected to impact on the conservation of biological diversity or ecological integrity of the local area or the broader marine environment of northern Cairns and the GBR.

The risks discussed within this report are well understood. Some uncertainty remains as to the volume of boating traffic that will be introduced and whether ant plant translocation will be required, but this uncertainty does not pose a material risk to the associated MNES matters.

The Project is therefore considered to be compatible with these ESD principles.

9 Economic and Social Matters

9.1 Stakeholder Engagement

9.1.1 Public Consultation

The dot points below summarise the public consultation completed as part of the project:

- For many years, TMR has received requests from Cairns recreational boat users and anglers to improve the capacity of boat launching facilities on Cairns' northern beaches. Feedback from local residents and ramp users is that the existing facilities at Yorkeys Knob and Bluewater are inadequate to cater for current demand and this leads to congestion, parking issues and some antisocial behaviour during peak periods.
- From 8 December 2015 to 30 September 2016, TMR ran a state-wide community consultation via the Queensland Government's 'Get involved' website inviting website feedback and direct email submissions. TMR received a lot of feedback, including comprehensive emailed submissions about the Cairns area.
- The 'Get involved' survey information and emailed submissions were provided to the consultant preparing the *Recreational Boating Facilities Demand Forecasting Study 2016*. The consultant conducted face to face meetings with officers from Cairns Regional Council (CRC) and, prior to publication, gained CRC's 'no objection' to its recommendations for the Cairns area. The study recommended as a Priority 1 (as soon as possible) a new boat launching facility at Yorkeys Knob.
- In mid-2016, in response to concerns raised by local recreational boat users, TMR formed a community reference group made up of representatives from TMR, CRC, elected representatives, CAirns REcreational Fishing Industry Stake Holders (CAREFISH) and local boaties. Over the next few months, the Community Reference Group met regularly and investigated multiple locations between Cairns and Ellis Beach to determine the most appropriate location for a new recreational marine facility. After representatives from Yorkeys Knob Boating Club (YKBC) and Half Moon Bay Golf Club (HMBGC) raised no objections at initial meetings, the reference group unanimously recommended Yorkeys Knob as the most suitable location for the facility.
- During 2017, TMR officers attended a number of meetings with officials and members of YKBC to discuss concept designs for the new facility. TMR listened to feedback from YKBC about its initial proposal and prepared an amended design to present to YKBC. Following further objections from YKBC, TMR abandoned its proposal to construct new boat ramps inside the marina harbour, due to navigational safety concerns.
- In June 2018, TMR officers met with elected officials from HMBGC and YKBC to brief them on the proposed project. Prior to this, a campaign of misinformation about the project had commenced suggesting the project would significantly impact the viability and playability of HMBGC. Based on expert advice from a golf course design consultant, TMR does not consider this to be inaccurate. .
- In July 2018, TMR officers conducted face-to-face public consultation at the Yorkeys Knob shopping centre with display boards and concept plans available for viewing. The shopping centre

display was coordinated in consultation with the Yorkeys Knob Residents Association (YKRA), which agreed that the week-long public display was preferable to a 'town hall' style meeting.

- The sessions were well attended and enabled members of the public to engage directly with technical experts about the project. This consultation proved valuable for those who attended and for project officers, who gained many insights as to project impacts and possible solutions. 155 people attended. 63 per cent of the 71 who completed a feedback form and who expressed a preference were in favour of the project, and 37 per cent were against it.
- Written and verbal feedback received by TMR at the display was generally balanced, with many local residents and business owners expressing strong support for the project. Feedback from the display has been carefully considered by TMR, with the main concerns being in relation to parking availability and environmental impacts. TMR has listened to concerns about parking and has modified the design to provide significantly more parking bays than originally proposed. This will help considerably to reduce the congestion and parking issues currently experienced in Yorkeys Knob on good fishing days, which is one of the main community concerns.
- Opposition to the project has been led by Yorkeys Knob Boat Ramp Action Group (YKBRAG), which is driven largely (but not exclusively) by residents adjacent to the proposed development either within the YKBC marina (liveaboards) or residential properties. TMR has consulted at length with this group, listened to their concerns and refined the project to mitigate these concerns to the greatest extent possible.
- The main concerns raised by YKBRAG are in relation to the adequacy of car parking and environmental impacts.
- YKBRAG is campaigning for the facility to be constructed somewhere else and has suggested two alternative locations. At the request of YKBRAG, TMR has thoroughly investigated these suggested locations and has determined that neither are a viable alternative. TMR has communicated extensively with YKBRAG and provided detailed feedback about its suggested sites, which has been largely disregarded by YKBRAG.
- TMR has engaged with YKRA throughout the project development, providing project updates for community newsletters and responding to queries about project scope and timeframes. Until mid-2019, YKRA remained 'neutral' on the project. At a meeting in mid-2019, YKRA passed a motion for YKRA to formally change its stance on the project from 'neutral' to 'opposed'. At the YKRA Annual General Meeting in October 2019, YKBRAG members were elected onto the YKRA executive.
- Throughout the project, TMR has maintained a dedicated project web page. TMR has updated this page regularly with updated concept designs, technical and environmental investigations, Frequently Asked Questions and project updates. The page has contact details for anyone who requires further information.
- YKBC and HMBGC both formally oppose the project but continue to work positively with TMR to achieve the best outcomes for all parties.
- TMR has engaged with the local boating and fishing community through CAREFISH and administrators of the 'Cairns and FNQ fishing group' on Facebook, which has more than 15,000

members. There is very strong support for the project from the local boating and fishing community.

- Extensive consultation undertaken by TMR indicates that opposition to the project is based primarily on concerns about local amenity and environmental impacts.
- In December 2019, TMR briefed key stakeholders, including CRC, CAREFISH, HMBGC, YKBC, YKRA and Yorkeys Knob Community Progress Association on the newest concept layout. Feedback from these discussions was incorporated into the final project design.
- TMR and CRC continue to liaise and provide updates on the project to the community.

9.1.2 Consultation with Indigenous Stakeholders

Consultation with the Traditional Owners of the Cairns Regional Claim commenced in September 2019, this process has included engagement with respect to geotechnical investigations and monitors to ensure cultural heritage was protected during these investigations and then a native title assessment and formal notification process. The Cairns Regional Claim response from the notification process was that they had concerns with the project and requested that the project should not progress until further information was provided and concerns addressed. TMR provided further information on the project and continues to have ongoing consultation to address any remaining concerns. Both parties are working together in the development of a Cultural Heritage Management Plan for the project.

9.2 Projected Economic costs and Benefits of the Project

The *Recreational Boating Facilities Demand Forecasting Study* (GHD, 2017) clearly justifies the need for a significant increase in all-tide recreational boating access facilities to service northern Cairns. The group of Yorkeys Knob community members that opposes the project being located at Yorkeys Knob, agrees that much improved boating facilities are required in northern Cairns.

The Project capital cost at the detailed design stage is estimated at $17 million. The facility being proposed is in an already highly development area of concentrated marine and terrestrial disturbance and represents the lowest ecological impact of the site options considered, while providing protected all-tide ocean access with minimal maintenance dredging requirements. While the estimated costs are significant, they are less than alternative options and because the choice of such an option presents minimal ongoing maintenance liability, it best achieves the objective of meeting the demand for northern Cairns of all-tide ocean access as detailed in the *Recreational Boating Facilities Demand Forecasting Study* (GHD, 2017). The proposed site is strongly supported by the local and regional boating community, given it is already a boating hub for access to the GBR.

In the context of the economic impacts of COVID-19 on the north Queensland economy, the Queensland economy and the national economy, this Project has been in planning stages for several years, is funded and holds state legislative environmental approvals to proceed to tender and construction. The Project forms a key element of the post-COVID economic recovery for the city of Cairns.

9.3 Project Employment Opportunities Expected to be Generated

40 permanent jobs are anticipated during construction, with likely flow-on benefits to retail businesses at Yorkeys Knob.

10 Environmental Record of Person Proposing to Take the Action

TMR manages over 300 boat ramp facilities and ten boat harbours throughout Queensland and has undertaken numerous construction projects across these facilities without environmental incidents.

TMR has not been and is not subject to any past or present proceedings under Commonwealth or Queensland law for the protection of the environment or the conservation and sustainable use of natural resources.

11 Other Approvals and Conditions

As noted in Section 2.1, TMR currently hold majority of the State approvals required to undertake the proposed works. Key elements of these approvals as they overlap with MNES features include the following:

- Development Permit
  - All ASS disturbed during works must be treated and managed in accordance with the Queensland Acid Sulfate Soil Technical Manual (DSITIA, 2014) and certified by a suitably qualified person
  - Environmental offsets are required for disturbance of marine plants, including macroalgae, and parts of the marine environment mapped as high ecological significance (HES) wetlands and high ecological value (HEV) waters.
- Environmental Authority
  - All material to be placed onshore as part of dredging and construction must be tested and found suitable in accordance with the *National Environment Protection (Assessment of Site Contamination) Measure 1999* and the Queensland Acid Sulfate Soil Technical Manual (DSITIA, 2014)
  - A DMP must be developed, including clear water quality performance criteria and a sediment-plume associated monitoring program.

Additionally, as already noted, maintenance dredging will be undertaken by Cairns Regional Council. This will likely occur under their existing Environmental Authority EPPR00795313 (subject to an amendment). Water quality performance criteria have been set under this approval for Half Moon Bay. Note that Council also undertake offshore disposal of dredged material under a Sea Dumping Permit (SD2018/3842) which requires dumping to be undertaken subject to a management and monitoring plan. A long-term management and monitoring plan (EcoSustainAbility, 2018) has been developed by Council to meet the Sea Dumping Permit and Environmental Authority requirements and includes commitment to the required water quality performance criteria.

12 Conclusion

The Yorkeys Knob Boating Infrastructure Project will involve the conversion of marine habitat and coastal vegetation into a new boat ramp facility to meet existing and forecast recreational demand for the Cairns region. These works are located within Half Moon Bay, adjacent to the mouth of Half Moon Creek, an area that has been substantially modified in the past by development of the Half Moon Golf Course, Bluewater Harbour and Marina and the Half Moon Bay Marina, as well as annual maintenance dredging activities.

While the Project will cause the loss of some marine and woodland habitat, the loss is in areas of marginal value, especially compared to the higher quality habitat available within Half Moon Creek, Ray Howarth Park, Trinity Park and associated beaches, and the broader north Cairns Region. Additionally, while the Project will introduce new dredging requirements and recreational boating movements, these will not be materially different to the existing activities already occurring in the area as a result of Bluewater Harbour and Marina and Half Moon Bay Marina.

Within this context, the Project is not anticipated to have a significant impact on any MNES feature, including listed threatened and migratory species (e.g. shorebirds, seabirds, megafauna, flying-foxes, ant plant) or on the World Heritage and National Heritage features of the GBR. These matters are recognised by TMR as important values for the area and will be managed through CEMP and DMP for the works in accordance with State and Federal approval requirements. The Project is consistent with the principles of ESD and the broader objects and requirements of the EPBC Act, especially as it does not involve significant environmental risk, uncertainty or intergenerational equity concerns.

Considering this, the Project is considered to not be a controlled action in accordance with the EPBC Act.

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13.2 Databases and Interactive Mapping

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Commonwealth Department of Agriculture, Water and the Environment Species Profile and Threats Database: https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Commonwealth Department of Agriculture, Water and the Environment Protected Matters Search Tool: https://www.environment.gov.au/epbc/protected-matters-search-tool

Commonwealth Department of Agriculture, Water and the Environment National Conservation Values Atlas: https://www.environment.gov.au/topics/marine/marine-bioregional-plans/conservation-values-atlas

Commonwealth Department of Agriculture, Water and the Environment National Flying-Fox Monitoring Viewer: http://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf

Queensland Department of Environment and Science StrandNet: https://environment.des.qld.gov.au/wildlife/animals/caring-for-wildlife/marine-strandings/data-reports/annual-reports

14 Public Submission Response

In compliance with the process under the EPBC Act, Version 7 of this Preliminary Documentation report was published by TMR for public comment from Monday 8 March to Wednesday 7 April 2021.

Within this period, TMR received a total of 39 submissions. Of these submissions, 29 were in favour of the project, nine were in opposition, and one did not express a direct opinion. Table 14-1 below presents a summary of these submissions together with responses to substantive issues. Where relevant, cross-reference has been made to other parts of this report where further information has already been provided. No changes have been made within the body of this report or relevant appendices with the exception of the addition of Appendix G, which provides additional information on the numerical modelling undertaken.

Note that only issues related to the scope of this Preliminary Documentation assessment have been discussed. No details of submitters have been included.

Table 14-1 Response to submissions received on Preliminary Documentation report

No.	Comment	Response	Cross-section
1	General opposition to project but no specific submission against elements on the Preliminary Documentation report	Opposition recorded but no specific response required	N/A
2	Support for project, highlighting safety risks of existing facility	Support recorded but no specific response required	N/A
3	Support for project	Support recorded but no specific response required	N/A
4	Support for project	Support recorded but no specific response required	N/A
5	Support for project, highlighting need of region for additional facilities	Support recorded but no specific response required	N/A
6	Support for project, highlighting increased safety and useability compared to existing facility	Support recorded but no specific response required	N/A
7	Asked for clarification as to whether a toilet block is included in the design.	Confirmed that the design does include a toilet block.	Table 2-1
8	Support for project	Support recorded but no specific response required	N/A
9	Support for project	Support recorded but no specific response required	N/A
10	Support for project, highlighting safety risks of existing facility	Support recorded but no specific response required	N/A
11	Support for project, highlighting lack of capacity of existing ramp	Support recorded but no specific response required	N/A
12	Support for project, highlighting congestion and lack of capacity associated with existing ramp and lack of feasible alternative site in north Cairns	Support recorded but no specific response required	N/A
13	Support for project, highlighting lack of capacity of existing ramp	Support recorded but no specific response required	N/A
14	Support for project	Support recorded but no specific response required	N/A
15	Support for project, highlighting congestion associated with existing ramp	Support recorded but no specific response required	N/A
16	Support for project	Support recorded but no specific response required	N/A
17	Support for project	Support recorded but no specific response required	N/A

No.	Comment	Response	Cross-section
18	Support for project	Support recorded but no specific response required	N/A
19	Support for project	Support recorded but no specific response required	N/A
20	Support for project	Support recorded but no specific response required	N/A
21	Support for project	Support recorded but no specific response required	N/A
22	Support for project	Support recorded but no specific response required	N/A
23	Support for project	Support recorded but no specific response required	N/A
24	Opposition for project location on the basis of frequency of dredging required to maintain the boat ramp and the difficulty of undertaking this dredging based on size of the boat ramp and breakwater area. Proposes boat ramp construction on the northern side of Half Moon Creek, accessible for Reed Road, which is argued to be safer and easier to access and maintain.	Frequent maintenance dredging will be required as part of the works because of high siltation rates within Half Moon Creek. However, as the creek, bay and associated marinas are regularly subject to maintenance dredging, the boat ramp only represents a small increase in total dredging requirements. Difficulty of dredging is inherent in the sizing of the boat ramp project but is not considered significantly different from dredging undertaken at equivalent facilities elsewhere. The Reed Road site was considered as part of an options analysis and discounted on the basis of significant constraints. A comparison of difference in access and maintenance does not indicate the Reed Road site would be significantly safer or easier to access or maintain.	Section 2.2.2 Section 2.4.2
25	Support for project, highlighting congestion associated with existing ramp	Support recorded but no specific response required	N/A
26	Support for project	Support recorded but no specific response required	N/A
27	Support for project	Support recorded but no specific response required	N/A
28	Support for project	Support recorded but no specific response required	N/A
29	Support for project	Support recorded but no specific response required	N/A
30	Opposition for project on the basis of traffic congestion, loss of coastal vegetation, impacts to sand transport, and impacts to local fauna and flora.	Existing data indicates that there is significant congestion regularly occurring in Yorkeys Knob due to the lack of capacity and parking associated with the existing boat ramp. A key outcome of the new ramp is to reduce this congestion.	Section 9.1 (congestion) 4.2 and 4.3 (clearing and

No.	Comment	Response	Cross-section
		Localised habitat and vegetation impacts are an inevitable impact of the project but have been assessed as not causing a significant impact. It is important to note that the areas being impacted represents a narrow fringe of vegetation remaining between the golf course and marina. Wherever possible, vegetation in this area will be retained. No impacts are occurring to broader coastal vegetation and ecosystems in the immediate area and catchment. Siltation assessments conducted as part of project feasibility indicate the development of the facility will have a net reduction in deposition rates within Half Moon Bay, leading to improved navigational outcomes. No broader changes in sediment movement is anticipated, noting that Half Moon Bay and Half Moon Creek are continually modified through ongoing maintenance dredging that shifts sand from the coastal environment to an offshore placement site.	flora and fauna values)
	Objection to the process of community consultation undertaken for the project.	Community consultation completed is factually recorded in this Preliminary Documentation report. With respect to the petition mentioned in the response, the primary opposition group to this project presented a petition to Queensland Parliament in September 2019 with 1837 signatures requesting that this project at Yorkeys Knob be stopped. This petition was considered and a decision was made to proceed with the project.	Section 9.1
31	Support for project	Support recorded but no specific response required	N/A
32	Support for project	Support recorded but no specific response required	N/A
33	Support for project, highlighting congestion and lack of capacity associated with existing	Support recorded but no specific response required	N/A
34	Challenge of descriptions in Preliminary Documentation report of the project area as being disturbed and having marginal habitat value, highlighting the known presence of crocodile, beach stone-curlew and other shorebirds, and the dynamic nature of coastal environments.	References to the project area as disturbed reflect the historical disturbance that has occurred throughout Half Moon Bay and Half Moon Creek, including the progressive clearing of parts of the lower catchment for the Half Moon Golf Couse, the partial enclosure of the bay for the Half Moon Bay Marina, and the ongoing maintenance dredging that occurs. Much of the site for the carpark and boat ramp works is located within an area formerly used for placement of dredged material. The presence of crocodile and shorebirds and waders has been acknowledged within the Preliminary Description and included in the	Sections 2.3.2 and 2.2.2 (historical and ongoing disturbance) Section 3.2 and Appendix C (ecological

No.	Comment	Response	Cross-section
		significant impact assessments undertaken. Note that the beach stone-curlew is not a MNES-listed matter. All ecological surveys undertaken as part of the project assessments have been in accordance with prevailing State and Federal guidelines.	context and surveys)
	Opposition to project on basis of traffic and congestion impacts onshore, detrimental impacts to business, security and amenity of Yorkeys Knob Boat Club, and risk of boating collisions in marine environment.	As noted above, the project is designed in part to address *existing* congestion and traffic impacts associated with the lack of capacity at the existing boat ramp. By providing greater launching and parking capacity, there will be improved outcomes for local congestion and business at the boat club. The facility does not pose a direct risk of increase of boating accidents as it is intended to address existing capacity concerns. Providing an additional ramp to spread boat launching out, including separating some launching activities from the marina, is likely to reduce the risk of collisions.	Section 9.1
	Opposition to the process undertaken to consider alternatives, citing need for independent review.	Alternative options investigations have been provided to regulating authorities as part of State and Federal approval processes.	Section 2.4
	Objection to the process of community consultation undertaken for the project.	Community consultation completed is factually recorded in this Preliminary Documentation report. With respect to the petition mentioned in the response, the primary opposition group to this project presented a petition to Queensland Parliament in September 2019 with 1837 signatures requesting that this project at Yorkeys Knob be stopped. This petition was considered and a decision was made to proceed with the project.	Section 9.1
35	Opposition to project on basis of impacts to GBR and availability of Redden Island as an alternative site.	The Redden Island site would require development of a new facility within the GBRWHA and would introduce significant new capital and maintenance dredging activities for the Barron River (which are currently not undertaken). Development at this site would therefore not avoid impacts to the GBR and may actually represent a greater impact due to the dredging requirements.	Section 2.4.1
	Opposition to clearing and habitat disturbance due to impacts on beach stone-curlew, squirrel glider and mangroves.	None of the species noted in the submission are MNES-listed and therefore were not considered within the scope of the Preliminary Documentation. However, these matters were considered in equivalent State approval applications and management will be subject to relevant State approvals.	Section 11

No.	Comment	Response	Cross-section
	Opposition to protective fence along access road due to visual impacts, impacts to birds and flying-foxes and displacement during cyclonic conditions.	Protective fence is necessary to minimise injury associated with the development of the 14th hole at the Half Moon Bay Golf Course. Note that the fencing is not continuous and will occur only in three selected areas. The design of the fence has intentionally integrated the existing treescape where possible to reduce any visual amenity impacts. Additionally, the material chosen for the fence is designed for strong wind environments. Impacts of flying-fox entrainment have been assessed in the context of the spectacled flying-fox. This includes reference to the national recovery plan for the species which identifies entanglement in mesh nets as a minor risk to the species. While equivalent assessment material is not available on various bird species, the same principles applicable to flying-foxes are expected to apply.	Section 3.2.7
	Challenge to characterisation of waterway between Ray Howarth Park and Half Moon Bay Marina as 'small waterway' due to its significance as a tidal connection.	The significance of this waterway was identified early in the design of the project and has been considered in numerical modelling undertaken to understand fluvial and coastal impacts. The crossing of this waterway has been subject to detailed assessments as per requirements of the State regarding waterway barrier works. The culvert that will be installed is designed to allow ongoing tidal connectivity and fish passage and to mitigate the risk of flooding impacts.	N/A
	Challenge to exclusion of proposed training wall at Trinity Park from the assessment undertaken for the project, i.e. it is argued this training wall forms part of the Yorkeys Knob Boating Infrastructure Project and therefore should have been assessed as part of the Preliminary Documentation.	TMR are providing funding assistance to CRC to develop a training wall at Trinity Park at the mouth of Half Moon Creek. However, there is a long history of works associated with the identification of the need for a training wall on the northern side of the creek that precedes the Yorkeys Knob Boating Infrastructure Project. This wall (proposed on the northern side of the creek) is required to address erosion in this area caused by the maintenance dredging that occurs within Half Moon Creek to provide an access channel to the Bluewater Marina and Canal estate. It is not necessitated by the current project and any overlap in timing of works is opportunistic only. The projects are therefore not linked or part of a broader development strategy for Half Moon Creek and Half Moon Bay.	N/A
36	Opposition to project due to concerns with flooding impacts, significant impacts to fish and bird breeding, loss of habitat for the beach stone-curlew, and congestion.	As part of detailed design and State approval applications, the boat ramp facility and access road have been subject to detailed numerical	Section 4.2 (ecological impacts)

No.	Comment	Response	Cross-section
		modelling of flood and tidal impacts. The design has been refined based on these assessments to such impacts will not occur. Tidal connectivity between Half Moon Bay and Ray Howarth Park will be maintained through culverts under the access road, design to provide fish passage and tidal connectivity. Some habitat for birds will be lost along the access road area but is considered negligible comparative to the broader habitat available in the immediate area and the catchment more generally. As noted previously, the beach stone-curlew is not a MNES-listed species but has been considered as part of State approval applications. Existing data indicates that there is significant congestion regularly occurring in Yorkeys Knob due to the lack of capacity and parking associated with the existing boat ramp. A key outcome of the new ramp is to reduce this congestion.	Section 9.1 (congestion)
37	Opposition to project due to coastal impacts, availability of alternative sites at Redden Island and Trinity Park, impacts to the Half Moon Bay Golf Course and impacts from the proposed protective nets.	Numerical modelling of the works, as part of feasibility studies and detailed design, indicate a net decrease in deposition within Half Moon Bay, creating a reduction in navigational dredging needs. This will not cause any increase in erosion elsewhere, however. See above regarding discussion of impacts to local habitat and fish passage. See above regarding Redden Island and Trinity Park options. There are anticipated to be some lighting and amenity impacts for the 14th hole at the Half Moon Bay Golf Course. However, works have been designed to mitigate this, including through the incorporation of a treescape between the fairway and access road. These same measures will also reduce the amenity impacts of the net to other users of the area (e.g. as viewed from the marina). See above regarding impacts of the net on flying-foxes and birds. The assessment of impacts was undertaken in accordance with State and Federal guidelines and aligns with the national recovery plan for flying-foxes.	Section 3.2.7 (flying-foxes)
	Confusion regarding whether project is occurring within the GBRMP.	Most of Cairns and Trinity Inlet are located within an exclusion area of the Commonwealth GBRMP and therefore the project footprint is not within the GBRMP. However, this exclusion does not apply to the State	Section 11 (State-level approvals)

No.	Comment	Response	Cross-section
		GBR Coast Marine Park. Impacts to this marine park are assessed through State approval application processes and are not relevant to the Preliminary Documentation which addresses only Commonwealth matters. The exclusion does not apply to the GBRWHA or GBR National Heritage Property. These areas have been considered in the impact assessment within the Preliminary Documentation.	Section 4.3 (Commonwealth GBR assessments)
	Challenge to statements of ant plant transplantation success	Most monitoring studies are confidential or anecdotal and therefore are not publicly available but have been summarised within the report. Translocation activities are managed under State approvals under the *Nature Conservation Act 1992*. Note that translocation is an accepted mitigation measure for works involving clearing of ant plant habitat. It is recommended as a management action if ant plants are encountered but is not being used as a justification for the development to progress.	Sections 4.2.7 and 5.3
	Clarification required regarding monitoring of protective fence along access road	The golf protective fence will be one of the first elements of the project to be delivered to effectively separate the golf course from the construction site. For this reason the impact of the fence will form part of monitoring works under the project construction environmental management plan which will occur for the 12 to 18 month construction period. At the conclusion of the project Cairns Regional Council (CRC) will take over management responsibilities for the facility which includes the protective fence. Long term management and maintenance requirements for the fence will be better understood following the construction monitoring period and implemented long term in consultation with CRC.	N/A
38	Opposition to project due to impacts to GBRWHA.	A significant impact assessment of likely impacts to the GBRWHA has been conducted for the project and concludes no significant impact.	Sections 4.3 and 6
	Opposition to project due to risks from cyclones.	Numerical modelling has been used to design the facility to resist both cyclonic and non-cyclonic conditions in accordance with relevant standards, including climate change impacts. Note that the facility is not intended to provide a safe harbour from cyclones as it is for the launching and retrieval of vessels.	N/A

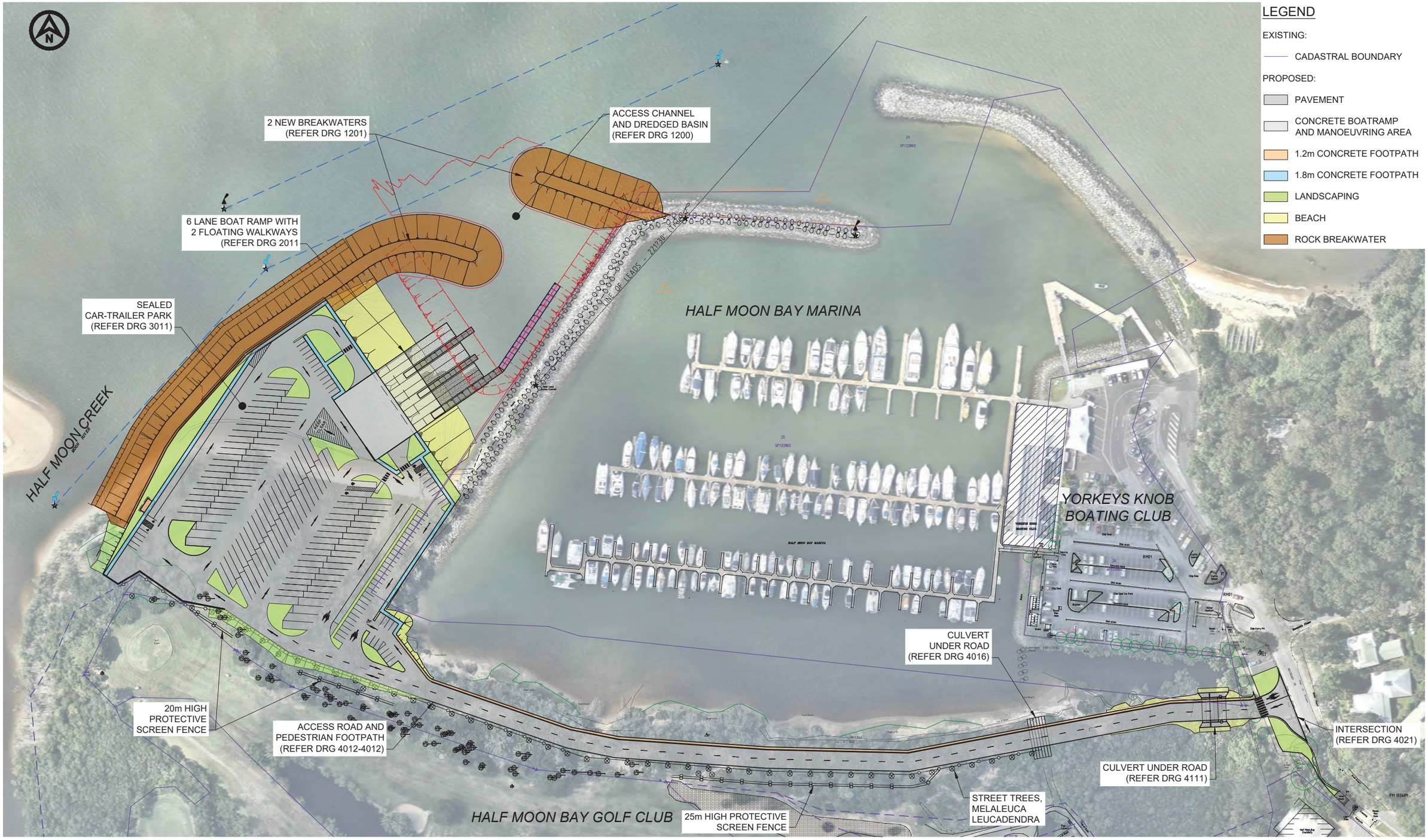
No.	Comment	Response	Cross-section
39	Challenge to comprehensiveness of sediment sampling undertaken for the works.	Sediment sampling was undertaken in compliance with NAGD, subject to a sediment sampling and analysis plan endorsed by DES. This was to inform the characterisation of material and was considered adequate to understand dredging and placement risks. Other coring activities were undertaken as part of a broader geotechnical investigation to finalise detailed design works and do not have any implications for the finding of the Preliminary Documentation assessment.	Appendix B
	Challenge to numerical modelling and project design as not appropriately considering cyclonic and rain event effects or siltation.	Calibrated numeric models have been used to design this facility to resist both cyclonic and non-cyclonic conditions in accordance with relevant standards including climate change impacts. TMR has modelled changes to local siltation and wave trends associated with the development using statistically representative wave conditions showing no significant impacts, this result was expected given the existing marina has already significantly changed coastal processes and the proposed development does not significantly influence this change. TMR agrees that gradual siltation associated with prevailing conditions and episodic siltation associated with extreme events will continue and need to be managed. The siltation modelling determined that the proposed facility would not cause an undesirable impact to siltation or increase the frequency of maintenance dredging. Impacts to local catchment and regional Barron River flooding were also assessed using numerical models. This led to several design iterations to ensure the facility would not cause an impact to flooding. Entrance scour associated with flood flows in the creek was also assessed to ensure the foundation of the proposed breakwaters would remain stable during extreme flow events. A reference to these studies have been included in Section 4 of this Preliminary Documentation report and the studies themselves have been included as Appendix G for reference.	Section 4.1 and Appendix G
	Challenge to assessment regarding dredging, with particular focus on the need to bund the construction area to avoid siltation impacts.	Dredging works are not anticipated to exceed the impacts associated with ongoing maintenance dredging in Half Moon Bay and Half Moon Creek as the dredging methodology and material are similar and the volumes are significantly less than what is currently being undertaken. TMR have committed to achieving the same water quality outcomes as	Sections 2.2.2, 4.1 and 5.1.3 and Appendix D

No.	Comment	Response	Cross-section
		approved for the maintenance dredging and it is expected that this can be achieved without the need to bund the construction area. The exact construction and dredging methodology to be adopted will be decided by the contractor for the works but will be subject to the management controls and performance outcomes of State and Federal approvals, including those listed within the CEMP for the works.	
	Opposition to project due to large maintenance dredging volumes, highlighting that these indicate the site is not suitable	The frequent maintenance dredging required for the project is acknowledged but as this will form a small part of a much larger maintenance dredging program that is ongoing for Half Moon Creek and Half Moon Bay, this is considered acceptable by TMR. Any material dredged and placed is material already within the coastal system; it is not new material being added by the project. Note that majority of the material subject to maintenance dredging will be sandy material.	Section 2.2.2
	Challenge to finding that boating traffic will not cause a significant impact, including perceived conflict between this finding and the demand study.	The projections within the demand study indicate the *demand* for boat ramps at present and into the future. The finding of the study for northern Cairns indicated significant shortfall at present between demand and availability of ramps and associated infrastructure. This is backed up by the high levels of congestion currently experienced at the existing boat ramp. Adding the new boat ramp lanes is intended to meet the existing and projected demand which will in turn decrease the congestion associated with existing ramp. Majority of the users of the new infrastructure will be those that currently use the existing ramp, spreading the use across both facilities. Additional boat-owners from north Cairns may also use the facility in preference to other facilities in the area but the effect of any of this additional use is not expected to be significant. It is important to note that the new facility is not intended to *create* demand; it only services existing and projected demand. In this way it is not the main driver of any change in boating traffic. For clarification, statement sin the Preliminary Documentation regarding boating use of the area relate to the broader boating activities within Half Moon Creek and Half Moon Bay rather than the project footprint.	Section 4.2 (regarding assessment of vessel strike) and Appendix E

No.	Comment	Response	Cross-section
	Challenge to statements regarding translocation success for ant plants, citing studies by James Cook University.	It is uncertain which studies are being referred to so a comparison of statements cannot be made. As noted within the Preliminary Documentation, success rates referred to are based on unpublished and anecdotal studies conducted as part of translocation projects in north Queensland. Note that translocation is an accepted mitigation measure for works involving clearing of ant plant habitat. It is recommended as a management action if ant plants are encountered but is not being used as a justification for the development to progress. Ant plant are considered unlikely to occur in the project footprint and have only been assessed within the Preliminary Documentation as part of a precautionary approach to ensure appropriate management is in place.	Sections 4.2.7 and 5.3
	Challenge to assessment findings regarding megafauna and shorebird impacts, including characterisation of the area as not supporting high value habitat and as historically disturbed.	See comments above regarding characterisation of site as modified and disturbed.	Section 4.2

Appendix A Infrastructure and Dredging Plans

YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
SITE OVERVIEW PLAN
DRG 0010



LEGEND

EXISTING:

- CADASTRAL BOUNDARY

PROPOSED:

- PAVEMENT
- CONCRETE BOATRAMP AND MANOEUVRING AREA
- 1.2m CONCRETE FOOTPATH
- 1.8m CONCRETE FOOTPATH
- LANDSCAPING
- BEACH
- ROCK BREAKWATER

YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
BOATING FACILITY - GENERAL ARRANGEMENT
DRG 0101

TOILET BLOCK

TIMBER VIEWING PLATFORM WITH ACCESS RAMP

WESTERN BREAKWATER (REFER DRG 1201)

ACCESS CHANNEL AND DREDGED BASIN

EXISTING CHANNEL

KEEP CLEAR

6 LANE BOAT RAMP WITH 2 FLOATING WALKWAYS

BEACH

EXISTING BREAKWATER

NORTHERN BREAKWATER (REFER DRG 1201)

BP 0.00

PI 1128.41

PI 246.17

CP 306.78

LINE OF LEADS 221°30' (True)

Rock Breakwall

Rocks

Sand Beach

Grass

Seaward Vessel in Vicinity

Royal Yacht Club Access Channel

Front Land Access Channel

NOTES

1. HYDROGRAPHIC AND LAND DETAIL SURVEY UNDERTAKEN BY QLD GOV. HYDROGRAPHIC SERVICES, DATED 14/09/2016 AND 21/07/2017.
2. HAT = 1.86m
   MHWS = 0.98m
   AHD = 0.00m
   MLWS = -0.86m
   LAT = -1.64m

LEGEND

EXISTING:

- CADASTRAL BOUNDARY

PROPOSED:

- PAVEMENT
- CONCRETE BOATRAMP AND MANOEUVRING AREA
- 1.2m CONCRETE FOOTPATH
- 1.8m CONCRETE FOOTPATH
- LANDSCAPING
- BEACH
- ROCK BREAKWATER
- DREDGED BASIN
- PRE-DEVELOPED HAT CONTOUR
- POST-DEVELOPED HAT CONTOUR

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S0 WORK IN PROGRESS**

8 0 8 16 24 32 40m

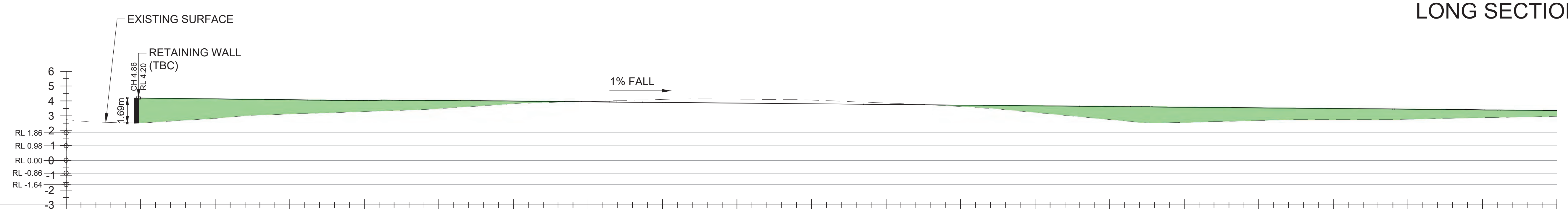
1:800 (A3) 1:400 (A1)

C:\Users\220025\Box\PA2158 Yorkeys Knob\PA2158 Yorkeys Knob Team\PA2158 Technical Data\E11 Working Drawings\PA2158-RHD-LA-M3-MA-3000-Civil Model-Land.dwg

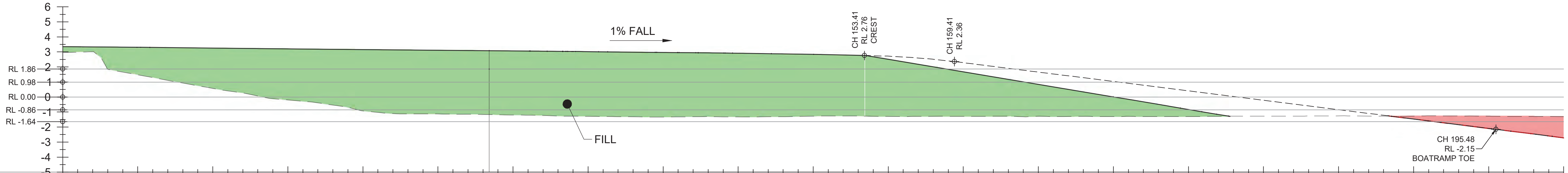
SAVED: 2-Jul-20

Royal HaskoningDHV
Enhancing Society Together

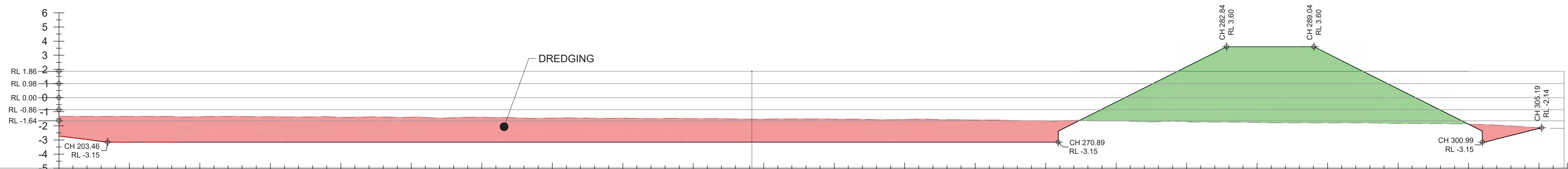
YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
BOATING FACILITY
LONG SECTIONS - SHEET 1
DRG 0111



CHAINAGE	DESIGN LEVELS	EXISTING LEVELS
0.000		2.749
5.000	4.195	2.518
10.000	4.136	2.830
15.000	4.078	3.119
20.000	4.029	3.283
25.000	4.029	3.476
30.000	3.992	3.808
35.000	3.948	3.970
40.000	3.902	4.103
45.000	3.857	4.124
50.000	3.811	4.061
55.000	3.765	3.865
60.000	3.720	3.617
65.000	3.674	3.220
70.000	3.628	2.754
75.000	3.583	2.561
80.000	3.537	2.685
85.000	3.491	2.745
90.000	3.446	2.767
95.000	3.400	2.877
100.000	3.353	2.961



CHAINAGE	DESIGN LEVELS	EXISTING LEVELS
105.000	3.306	1.473
110.000	3.258	0.570
115.000	3.211	-0.199
120.000	3.163	-0.921
125.000	3.116	-1.129
130.000	3.067	-1.197
135.000	3.017	-1.287
140.000	2.967	-1.335
145.000	2.915	-1.324
150.000	2.835	-1.273
155.000	2.504	-1.293
160.000	1.671	-1.283
165.000	0.837	-1.283
170.000	0.004	-1.302
175.000	-0.829	-1.300
180.000		-1.273
185.000		-1.255
190.000	-1.467	-1.272
195.000	-2.092	-1.278
200.000	-2.717	-1.309



CHAINAGE	DESIGN LEVELS	EXISTING LEVELS
205.000	-3.150	-1.329
210.000	-3.150	-1.358
215.000	-3.150	-1.364
220.000	-3.150	-1.402
225.000	-3.150	-1.398
230.000	-3.150	-1.403
235.000	-3.150	-1.454
240.000	-3.150	-1.466
245.000	-3.150	-1.490
250.000	-3.150	-1.525
255.000	-3.150	-1.526
260.000	-3.150	-1.548
265.000	-3.150	-1.588
270.000	-3.150	-1.655
275.000	-0.319	-1.644
280.000	2.181	-1.704
285.000	3.600	-1.762
290.000	3.119	-1.793
295.000	0.619	-1.830
300.000	-1.881	-1.888
300.978	-2.370	-1.912
305.000	-2.183	-2.127
307.000		

SECTION (A / 0101) 1:150 (A1)

LONG SECTION
BOATING FACILITY

AUSTRALIAN HEIGHT DATUM

NOT FOR CONSTRUCTION

S0 WORK IN PROGRESS

3 0 3 6 9 12 15m
1:300 (A3) 1:150 (A1)

C:\Users\220025\Box\PA2158 Yorkeys Knob\PA2158 Yorkeys Knob Team\PA2158 Technical Data\E11
Working Drawings\PA2158-RHD-LA-M3-MA-3000-Civil Model-Land.dwg

SAVED: 2-Jul-20

Royal HaskoningDHV
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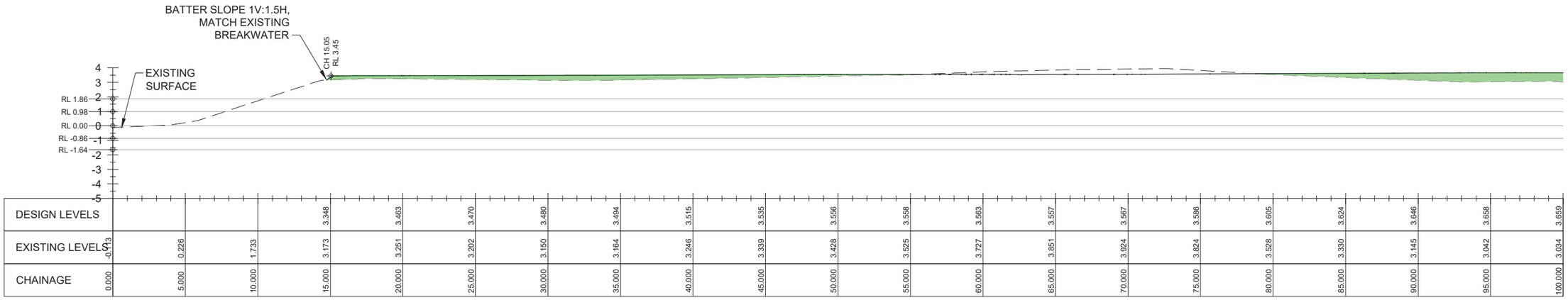
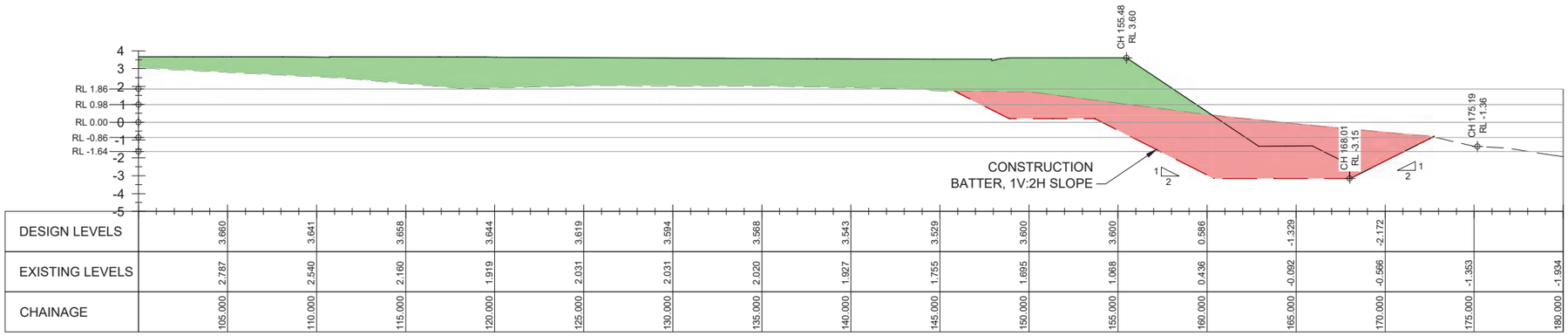
YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
BOATING FACILITY
LONG SECTIONS - SHEET 2
DRG 0112

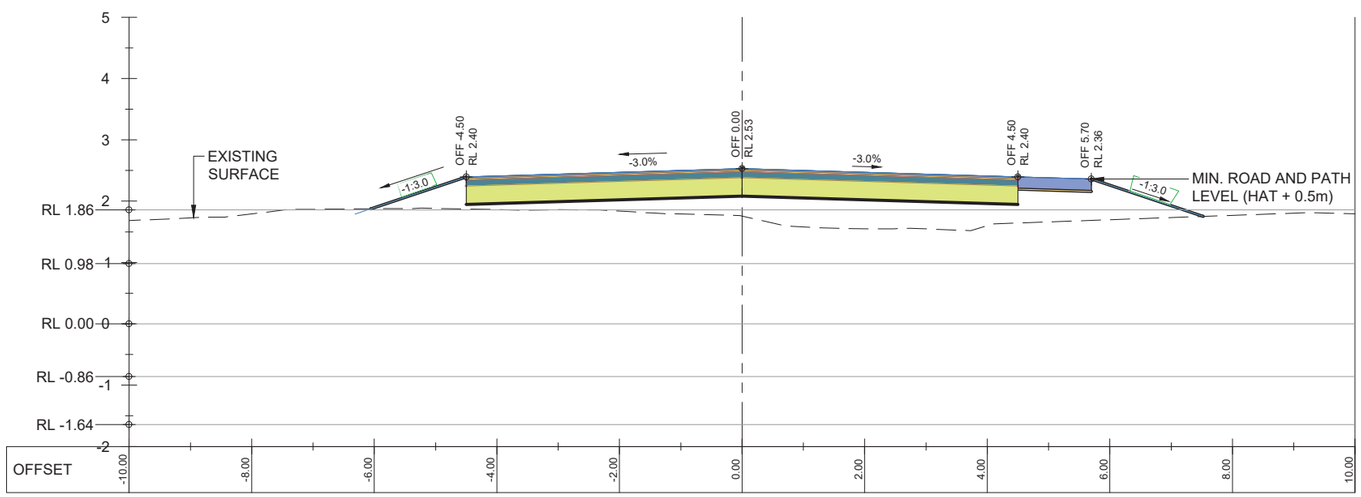


DESIGN LEVELS			3.348	3.463	3.470	3.480	3.494	3.515	3.535	3.556	3.558	3.563	3.557	3.567	3.586	3.605	3.624	3.646	3.658	3.659	
EXISTING LEVELS	-0.113	0.226	1.733	3.173	3.251	3.202	3.150	3.164	3.246	3.339	3.428	3.525	3.727	3.851	3.924	3.824	3.528	3.330	3.145	3.042	3.034
CHAINAGE	0.000	5.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000	55.000	60.000	65.000	70.000	75.000	80.000	85.000	90.000	95.000	100.000



DESIGN LEVELS	3.660	3.641	3.658	3.644	3.619	3.594	3.568	3.543	3.529	3.600	3.600	0.586	-1.329	-2.172		
EXISTING LEVELS	2.787	2.540	2.160	1.919	2.031	2.031	2.020	1.927	1.755	1.695	1.068	0.436	-0.092	-0.566	-1.353	-1.934
CHAINAGE	105.000	110.000	115.000	120.000	125.000	130.000	135.000	140.000	145.000	150.000	155.000	160.000	165.000	170.000	175.000	180.000

SECTION 1:150 (A1) B 0101 LONG SECTION
BOATING FACILITY



OFFSET	-10.00	-8.00	-6.00	-4.00	-2.00	0.00	2.00	4.00	6.00	8.00	10.00

SECTION 1:50 (A1) C 0101 TYPICAL ACCESS ROAD

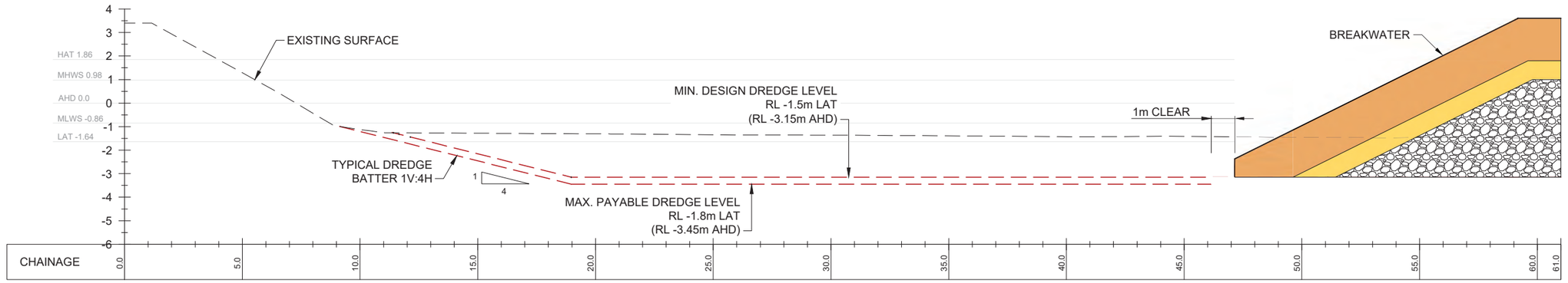
AUSTRALIAN HEIGHT DATUM

NOT FOR CONSTRUCTION

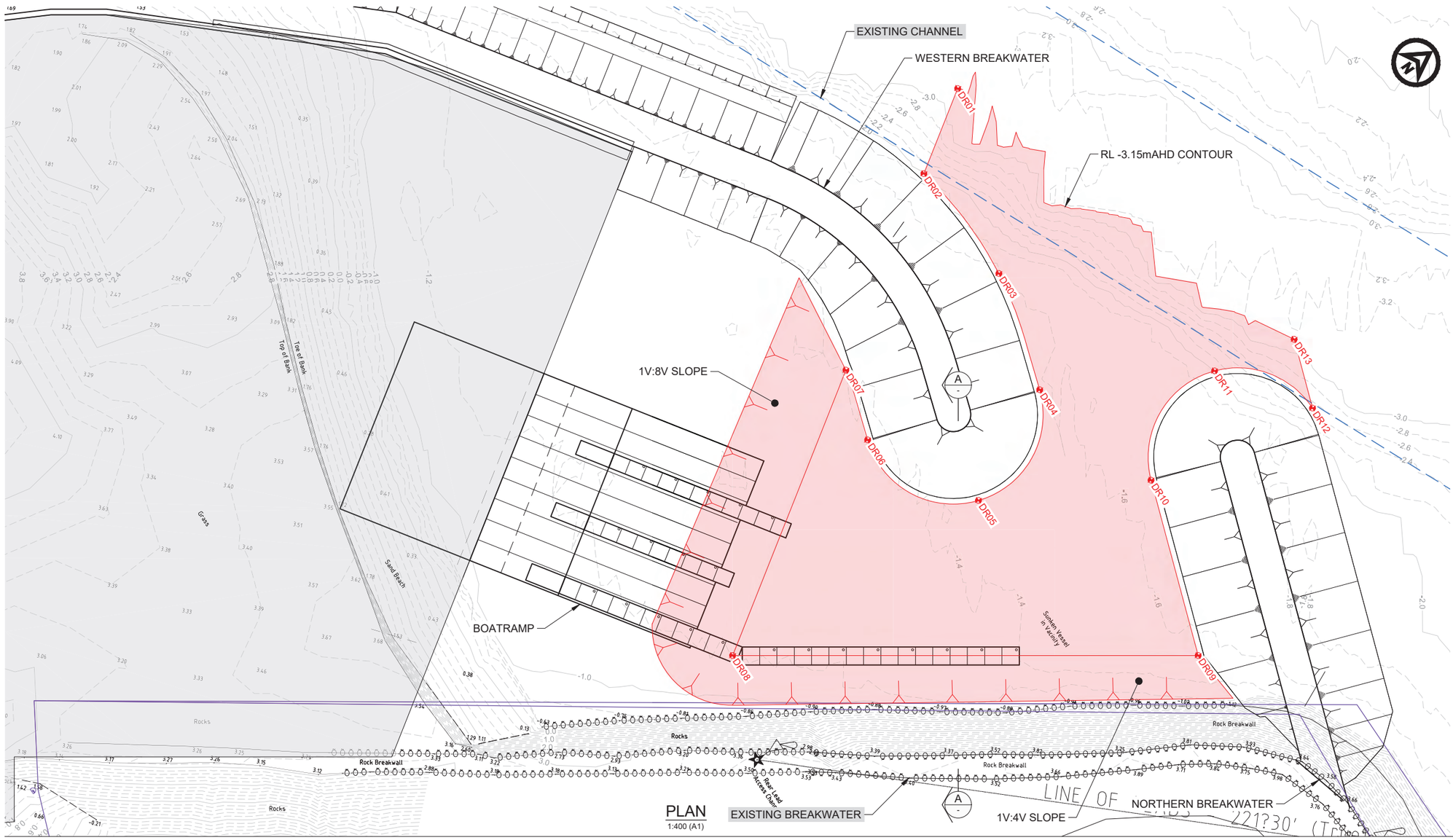
S0 WORK IN PROGRESS

1000 0 1000 2000 3000 4000 5000mm
1:100 (A3) 1:50 (A1)

YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
NAVIGATIONAL DREDGE PLAN
FIGURE 4



SECTION A 1:100 (A1) — TYPICAL DREDGE SECTION 1:100 (A1)



PLAN 1:400 (A1)

NOTES

1. HYDROGRAPHIC AND LAND DETAIL SURVEY UNDERTAKEN BY QLD GOV. HYDROGRAPHIC SERVICES, DATED 14/09/2016 AND 21/07/2017.
2. HAT = 1.86m
   MHWS = 0.98m
   AHD = 0.00m
   MLWS = -0.86m
   LAT = -1.64m

LEGEND

- DREDGE FOOTPRINT
- DR* DREDGE TOE SETOUT COORDINATES

DREDGE COORDINATES		
ID	EASTING	NORTHING
DR01	363035.34	8142058.59
DR02	363044.64	8142045.06
DR03	363066.97	8142046.26
DR04	363088.34	8142040.74
DR05	363098.68	8142020.62
DR06	363078.63	8142010.15
DR07	363066.10	8142013.87
DR08	363097.25	8141968.57
DR09	363143.66	8142037.85
DR10	363112.87	8142048.32
DR11	363102.95	8142068.65
DR12	363118.25	8142079.52
DR13	363106.20	8142083.65

NOT FOR CONSTRUCTION

AUSTRALIAN HEIGHT DATUM

2 0 2 4 6 8 10m
1:200 (A3) 1:100 (A1)

8 0 8 16 24 32 40m
1:800 (A3) 1:400 (A1)

SAVED: 2-Jul-20

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YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
MARINE CIVIL - DREDGE PLAN
DRG 1200

LEGEND

DREDGE / CUT

NOTES

1. HYDROGRAPHIC AND LAND DETAIL SURVEY UNDERTAKEN BY QLD GOV. HYDROGRAPHIC SERVICES, DATED 14/09/2016 AND 21/07/2017.
2. HAT = 1.86m
   MHWS = 0.98m
   AHD = 0.00m
   MLWS = -0.86m
   LAT = -1.64m

MOON RIVER

EXCAVATE TO RL -3.15mAHD

CONSTRUCTION BATTER, 1V:2V SLOPE

CH 20.00
CH 40.00
CH 60.00
CH 80.00
CH 100.00
CH 120.00
CH 140.00
CH 160.00
CH 180.00
CH 200.00
CH 220.00
CH 249.45
CH 60.00
CH 45.00
CH 30.00

RL -3.15mAHD CONTOUR

EXISTING CHANNEL

1V:8V SLOPE

DREDGE TO RL -3.15mAHD

EXISTING BREAKWATER

1V:4V SLOPE

CONSTRUCTION BATTER, 1V:2V SLOPE

LINE OF LEADS 221?30' (True)

Rock Breakwall

Rocks

Sand Beach

Grass

Top of Bank

Toe of Bank

Rear Land Access Chainage

Front Land Access Chainage

Spoil Ground

Survey Vessel in Vicinity

A
B
C

DREDGE QUANTITIES

No.	MIN. (m)	MAX. (m)	AREA (m2)	VOL (m3)	COLOUR
1	-3.56	-3.00	337	73	
2	-3.00	-2.00	609	665	
3	-2.00	-1.00	8,866	5,842	
4	-1.00	0.00	2,767	11,194	
		TOTAL	12,579	17,774	

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S0 WORK IN PROGRESS**

8 0 8 16 24 32 40m

1:800 (A3) 1:400 (A1)

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SAVED: 8-Jul-20

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YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
BREAKWATER PLAN
DRG 1201

NOTES

1. HYDROGRAPHIC AND LAND DETAIL SURVEY UNDERTAKEN BY QLD GOV. YDROGRAPHIC SERVICES, DATED 14/09/2016 AND 21/07/2017.
2. HAT = 1.86mAHD.
   LAT = -1.643mAHD.
3. BREAKWATER DESIGN:
   RL 3.6mAHD
   TOE -3.15mAHD

LEGEND

- DREDGE / CUT
- BREAKWATER
- BH1 BOREHOLE
- CPT1 CONE PENETRATION TEST
- TP1 TEST PIT

MOON RIVER

WESTERN BREAKWATER - TYPE 1
1V:1.5H SLOPE, CREST 6.6m WIDE
(REFER NOTE 3)

3m TOE BERM (KEEP CLEAR OF EXISTING CHANNEL

CH 20.00 CH 40.00 CH 60.00 CH 80.00 CH 100.00 CH 120.00 CH 140.00 CH 160.00 CH 180.00 CH 200.00 CH 220.00

3m 6.6m

CORE ROCK TO BATTER DOWN TO EXISTING SURFACE WHERE REQUIRED

WESTERN BREAKWATER - TYPE 2
1V:2H SLOPE, CREST 6.2m WIDE
(REFER NOTE 3)

RL -3.15mAHD CONTOR

EXISTING CHANNEL

KEEP CLEAR OF EXISTING CHANNEL

20m MIN. CLEAR

6.2m

CH 249.45

CH 60.00

CH 45.00

CH 30.00

Sunken Vessel in vicinity

Rock Breakwall

Rocks

Rear Lead Access Channel

Front Lead Access Channel

LINE OF LEADS 221?30' (TRUE)

EXISTING BREAKWATER

NORTHERN BREAKWATER
1V:2H SLOPE
CREST 6.6m WIDE
(REFER NOTE 3)

Sand Beach

Grass

Top of Bank

Toe of Bank

BH1 BH2 BH4 CPT15 TP6 TP7 TP8 TP9 TP10

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S0 WORK IN PROGRESS**

8 0 8 16 24 32 40m
1:800 (A3) 1:400 (A1)

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SAVED: 8-Jul-20

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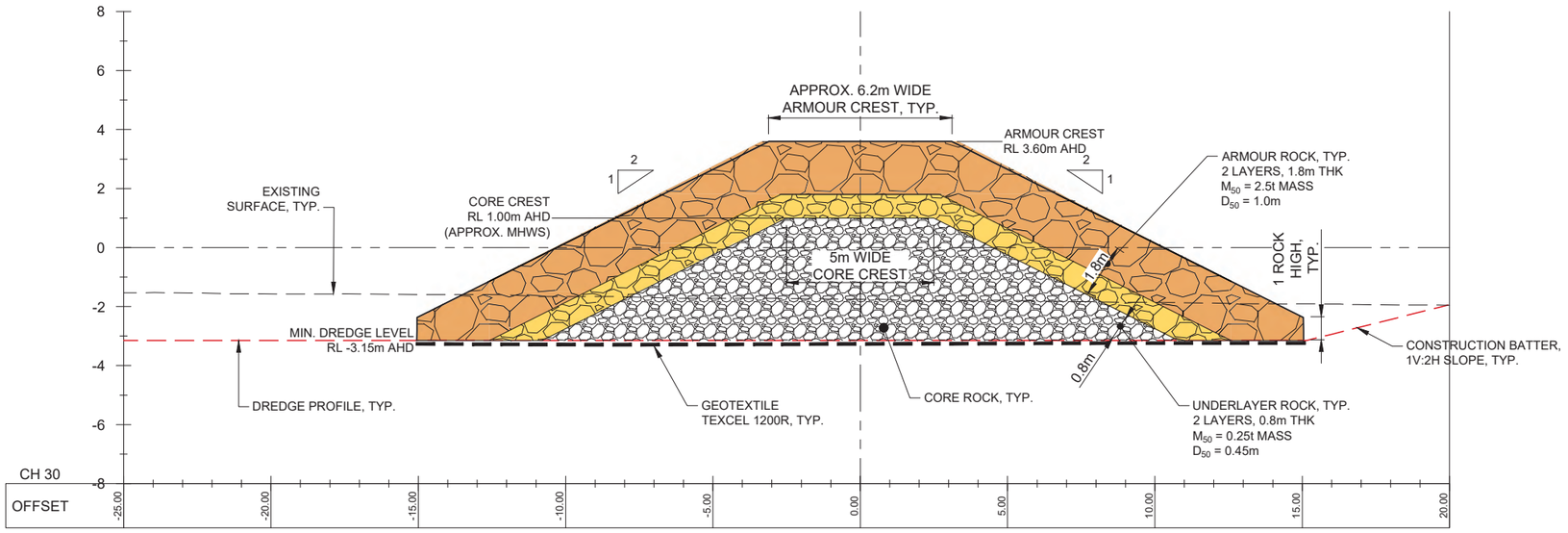
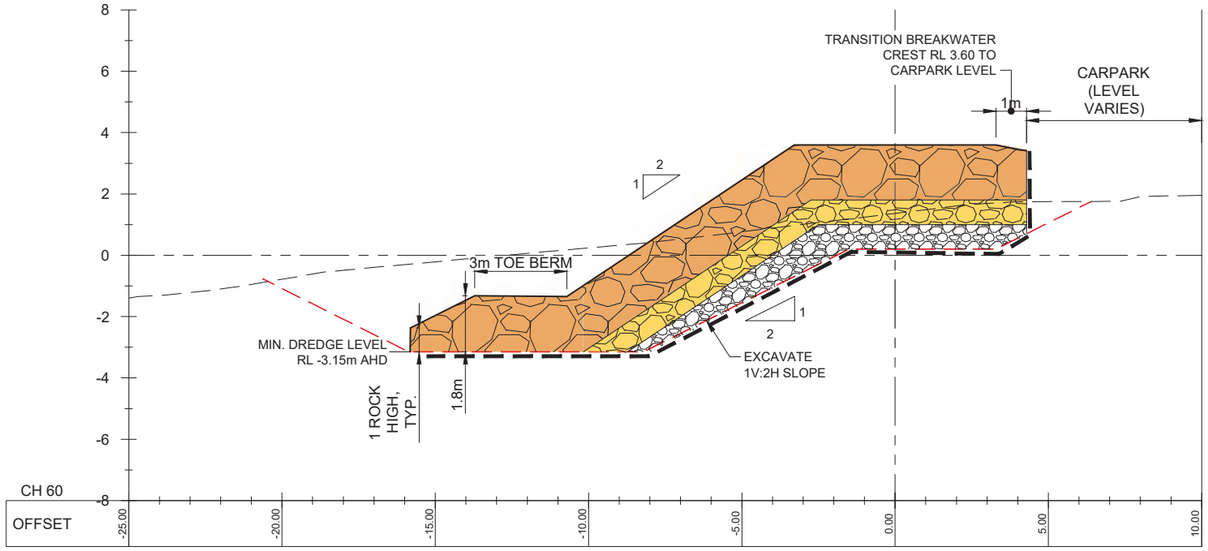
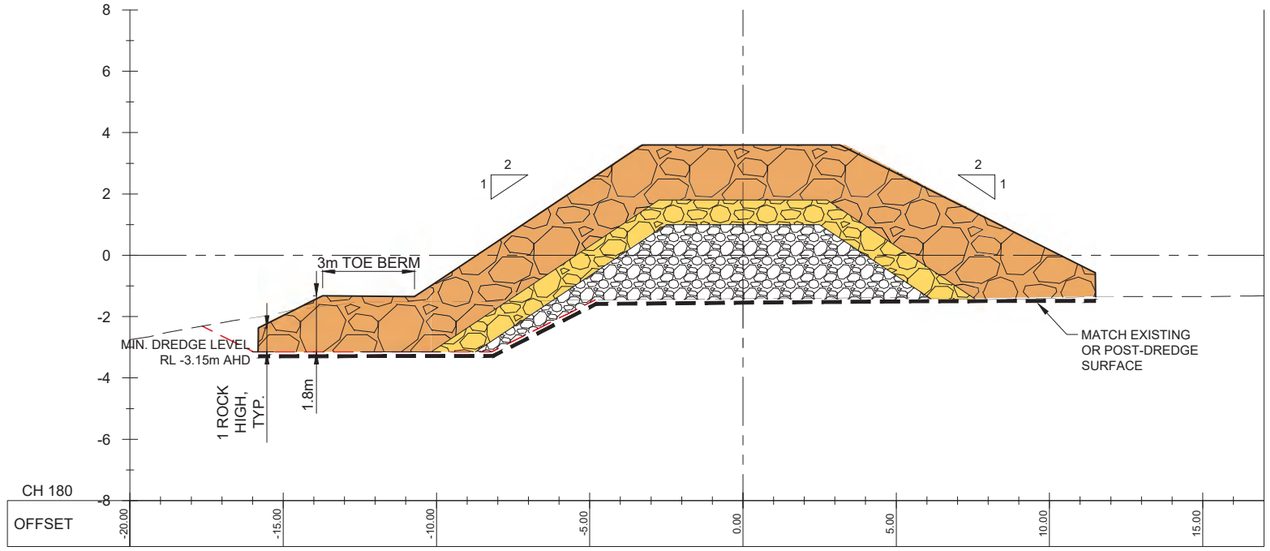
YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
MARINE CIVIL - BREAKWATER TYPICAL SECTIONS
DRG 1211



SECTION C (1:100 (A1)) — TYPICAL SECTION (DOUBLE SIDED)



SECTION A (1:100 (A1)) — TYPICAL SECTION (ADJACENT CARPARK WITH BERM)



SECTION B (1:100 (A1)) — TYPICAL SECTION (DOUBLE SIDED WITH BERM)

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S0 WORK IN PROGRESS**

2 0 2 4 6 8 10m
1:200 (A3) 1:100 (A1)

SAVED: 8-Jul-20

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YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
CARPARK - GENERAL ARRANGEMENT
DRG 3011

NOTES

1. HYDROGRAPHIC AND LAND DETAIL SURVEY UNDERTAKEN BY QLD GOV. HYDROGRAPHIC SERVICES, DATED 14/09/2016 AND 21/07/2017.
2. HAT = 1.86m
   MHWS = 0.98m
   AHD = 0.00m
   MLWS = -0.86m
   LAT = -1.64m
3. TOTAL 60° CAR TRAILER UNITS (CTU) = 135.
4. TOTAL CAR ONLY SPACES = 63.
5. 8m AISLE WIDTH ADJACENT CTU.

LEGEND

EXISTING:
- CADASTRAL BOUNDARY

PROPOSED:
- PAVEMENT
- CONCRETE BOATRAMP AND MANOEUVRING AREA
- 1.2m CONCRETE FOOTPATH
- 1.8m CONCRETE FOOTPATH
- LANDSCAPING
- BEACH
- PRE-DEVELOPED HAT CONTOUR
- POST-DEVELOPED HAT CONTOUR
- DREDGED BASIN

TOILET BLOCK
RIGGING BAYS
TOPSOIL BATTER 1V:3H
PAVED AREA FOR FUTURE USE
EP 180.00
95.89m
3.5m
8m
23.15m
R10m
48
PI 128.41
13
3m
12.5m
60°
KEEP CLEAR
46
RETAINING WALL, APPROX. 1.5m HIGH
CONCRETE MANOEUVRING AREA
VERTICAL CURVE
25m
6m
36.05m
9.06m
2.7m
EXISTING CHANNEL
PI 240.17
2 x DISABLED CAR TRAILER UNITS WITH SHARED AREA
1.8m
47
4m
69.44m
9
30
11
3.05m
DERIGGING BAYS
WIDEN SPACE BY 550mm
BP 0.00
ROCK PROTECTION, 1V:1.5H SLOPE
BOAT RAMP
6 LANES & 3 x ON-RAMP PONTOONS
CREST RL 2.76mAHD, TOE RL -2.15mAHD
1V:8H SLOPE
49.6m BERTHING PONTOON (FUTURE)
BEACH
1V:6H SLOPE
EXISTING BREAKWATER
Rock Breakwall
Rocks
Road Level Access Channel
Front Level Access Channel
LINE OF LEADS 221?30' (True)
TOPSOIL BATTER 1V:3H
9m

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S0 WORK IN PROGRESS**

8 0 8 16 24 32 40m
1:800 (A3) 1:400 (A1)

SAVED: 8-Jul-20

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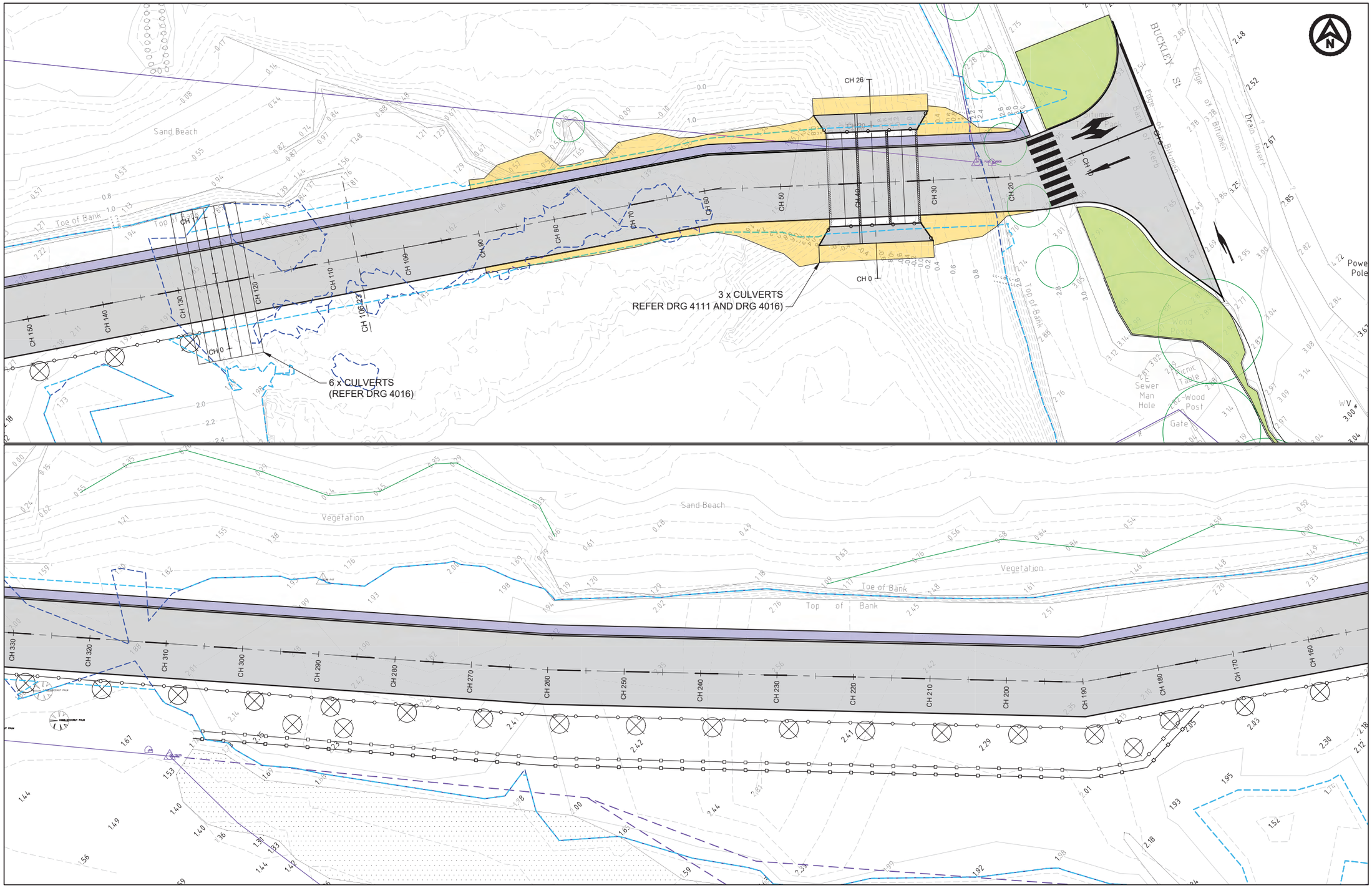
YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
ACCESS ROAD - GENERAL ARRANGEMENT PLANS - SHEET 1
DRG 4011



NOTES

1. HYDROGRAPHIC AND LAND DETAIL SURVEY UNDERTAKEN BY QLD GOV. HYDROGRAPHIC SERVICES, DATED 14/09/2016 AND 21/07/2017.
2. HAT = 1.86m
   MHWS = 0.98m
   AHD = 0.00m
   MLWS = -0.86m
   LAT = -1.64m

LEGEND

EXISTING:

- CADASTRAL BOUNDARY

PROPOSED:

- PAVEMENT
- CONCRETE BOATRAMP AND MANOEUVRING AREA
- 1.2m CONCRETE FOOTPATH
- 1.8m CONCRETE FOOTPATH
- LANDSCAPING
- BEACH
- ROCK BREAKWATER
- PRE-DEVELOPED HAT CONTOUR
- POST-DEVELOPED HAT CONTOUR

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S0 WORK IN PROGRESS**

5 0 5 10 15 20 25m
1:500 (A3) 1:250 (A1)

C:\Users\220025\Box\PA2158 Yorkeys Knob\PA2158 Yorkeys Knob Team\PA2158 Technical Data\E11 Working Drawings\PA2158-RHD-LA-M3-MA-3000-Civil Model-Land.dwg

SAVED: 2-Jul-20

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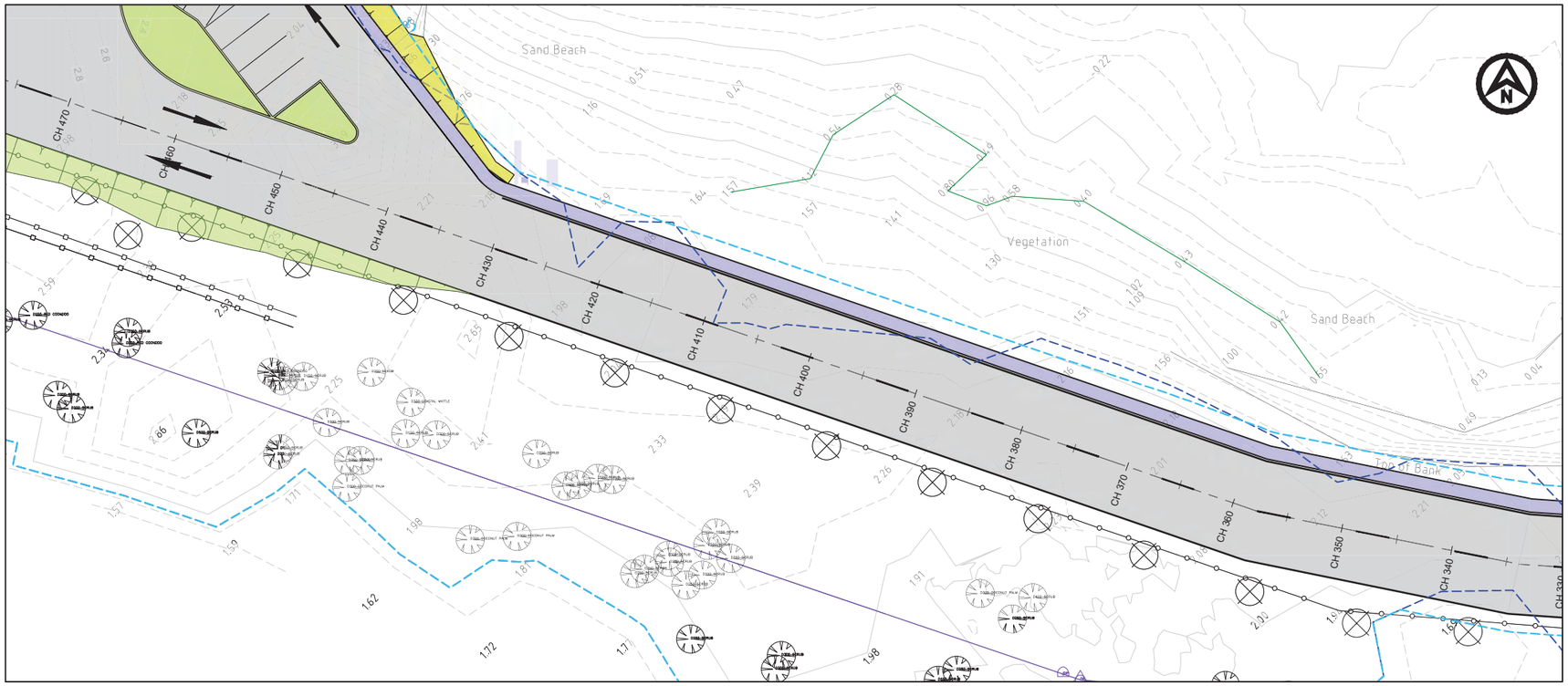
YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
ACCESS ROAD - GENERAL ARRANGEMENT PLANS - SHEET 2
DRG 4012



NOTES

1. HYDROGRAPHIC AND LAND DETAIL SURVEY UNDERTAKEN BY QLD GOV. HYDROGRAPHIC SERVICES, DATED 14/09/2016 AND 21/07/2017.

2. HAT = 1.86m
   MHWS = 0.98m
   AHD = 0.00m
   MLWS = -0.86m
   LAT = -1.64m

LEGEND

EXISTING:

- CADASTRAL BOUNDARY

PROPOSED:

- PAVEMENT
- CONCRETE BOATRAMP AND MANOEUVRING AREA
- 1.2m CONCRETE FOOTPATH
- 1.8m CONCRETE FOOTPATH
- LANDSCAPING
- BEACH
- ROCK BREAKWATER
- PRE-DEVELOPED HAT CONTOUR
- POST-DEVELOPED HAT CONTOUR

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S0 WORK IN PROGRESS**

5 0 5 10 15 20 25m
1:500 (A3) 1:250 (A1)

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SAVED: 2-Jul-20

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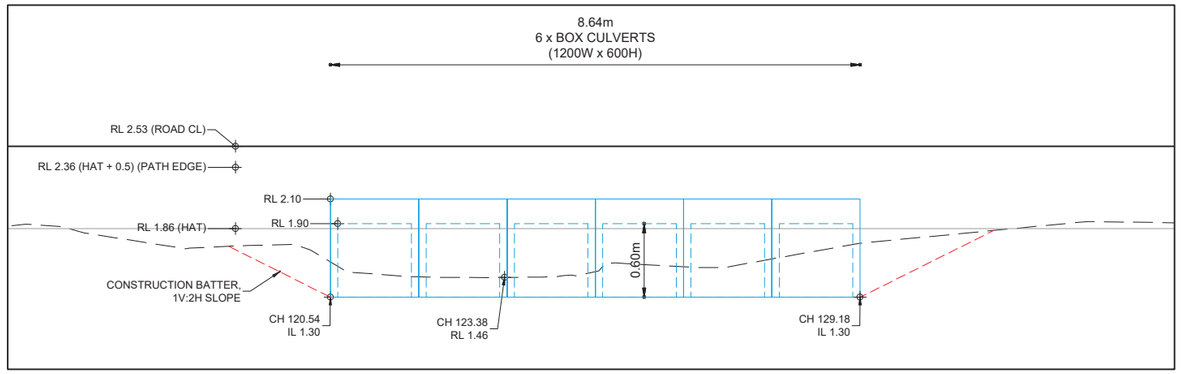
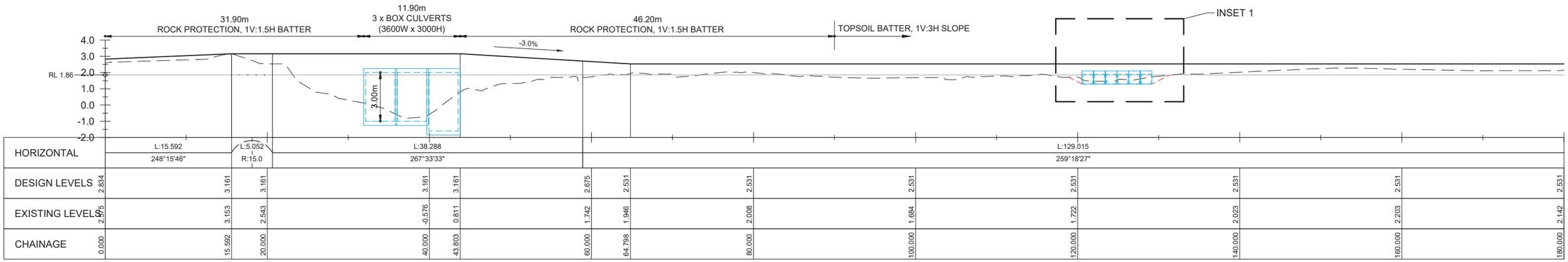
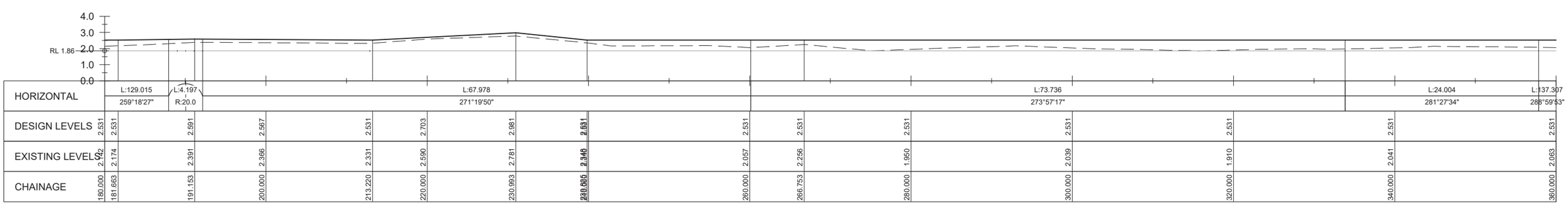
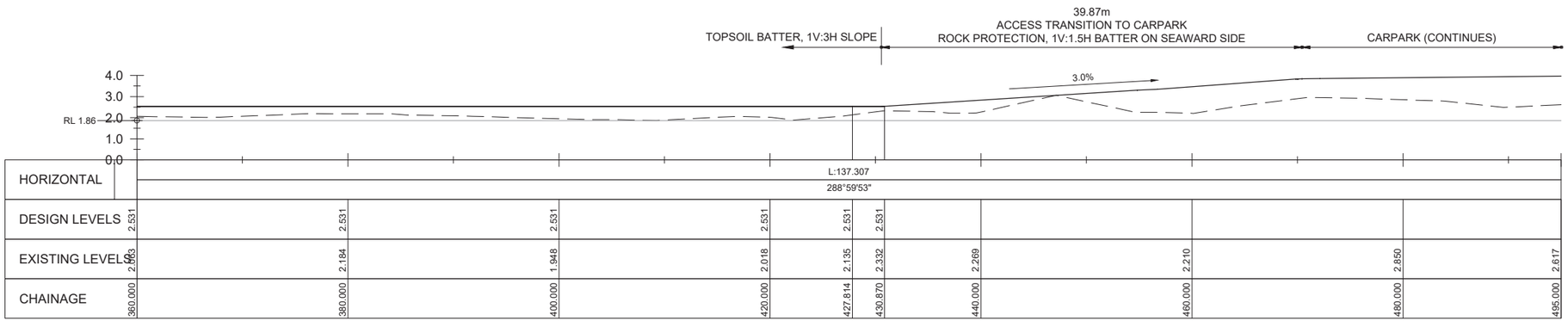
YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
ACCESS ROAD LONG SECTION
DRG 4016



INSET 1 - CULVERT
1:25V, 1:50H (A1)







LONG-SECTION - ACCESS ROAD CL
1:125V, 1:250H (A1)

NOTES

1. VERTOCAL SCALE EXAGGERATED 2x
2. HAT = 1.86mAHD
3. ACCESS ROAD MIN. LEVEL:
   HAT + 0.5m = 2.36mAHD

AUSTRALIAN HEIGHT DATUM

NOT FOR CONSTRUCTION

S0 WORK IN PROGRESS

2.5 0 2.5 5 7.5 10 12.5m
1:250 (A3) 1:125 (A1)

5 0 5 10 15 20 25m
1:500 (A3) 1:250 (A1)

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SAVED: 2-Jul-20

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YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
INTERSECTION PLAN
DRG 4021

JOIN TO EXISTING FOOTPATH

KEEP CLEAR OF EXISTING TREE

BUCKLEY St

NOTES

1. HYDROGRAPHIC AND LAND DETAIL SURVEY UNDERTAKEN BY QLD GOV. HYDROGRAPHIC SERVICES, DATED 14/09/2016 AND 21/07/2017.
2. HAT = 1.86m
   MHWS = 0.98m
   AHD = 0.00m
   MLWS = -0.86m
   LAT = -1.64m

LEGEND

EXISTING:

- CADASTRAL BOUNDARY

PROPOSED:

- PAVEMENT
- CONCRETE BOATRAMP AND MANOEUVRING AREA
- 1.2m CONCRETE FOOTPATH
- 1.8m CONCRETE FOOTPATH
- LANDSCAPING

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S0 WORK IN PROGRESS**

3 0 3 6 9 12 15m

1:300 (A3) 1:150 (A1)

C:\Users\220025\Box\PA2158 Yorkeys Knob\PA2158 Yorkeys Knob Team\PA2158 Technical Data\E11 Working Drawings\PA2158-RHD-LA-M3-MA-3000-Civil Model-Land.dwg

SAVED: 2-Jul-20

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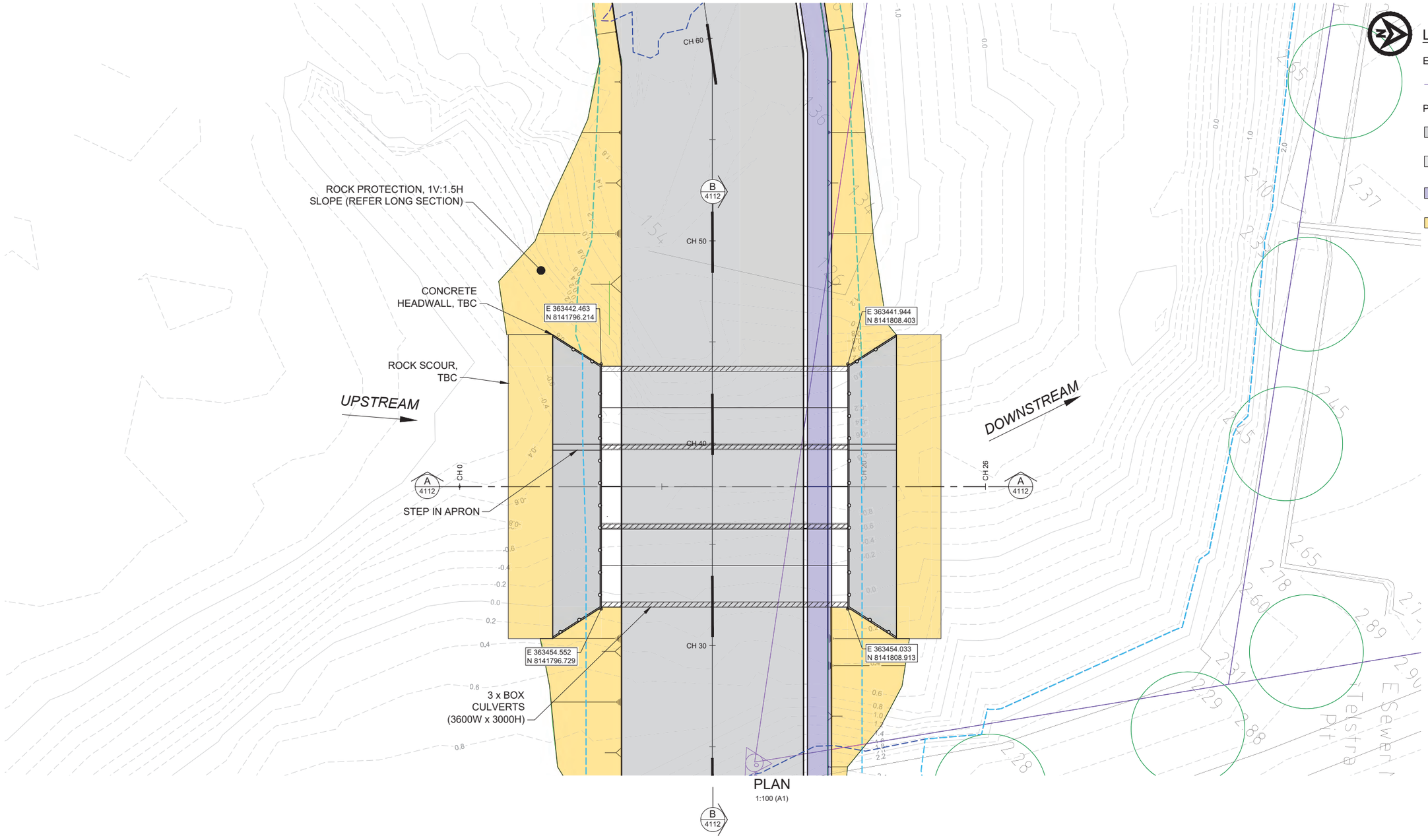
YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
CULVERT PLAN
DRG 4111



PLAN
1:100 (A1)

LEGEND

EXISTING:

- CADASTRAL BOUNDARY

PROPOSED:

- PAVEMENT
- CONCRETE BOATRAMP AND MANOEUVRING AREA
- 1.2m CONCRETE FOOTPATH
- ROCK PROTECTION

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S0 WORK IN PROGRESS**

2 0 2 4 6 8 10m
1:200 (A3) 1:100 (A1)

SAVED: 2-Jul-20

C:\Users\220025\Box\PA2158 Yorkeys Knob\PA2158 Yorkeys Knob Team\PA2158 Technical Data\E11 Working Drawings\PA2158-RHD-LA-M3-MA-3000-Civil Model-Land.dwg

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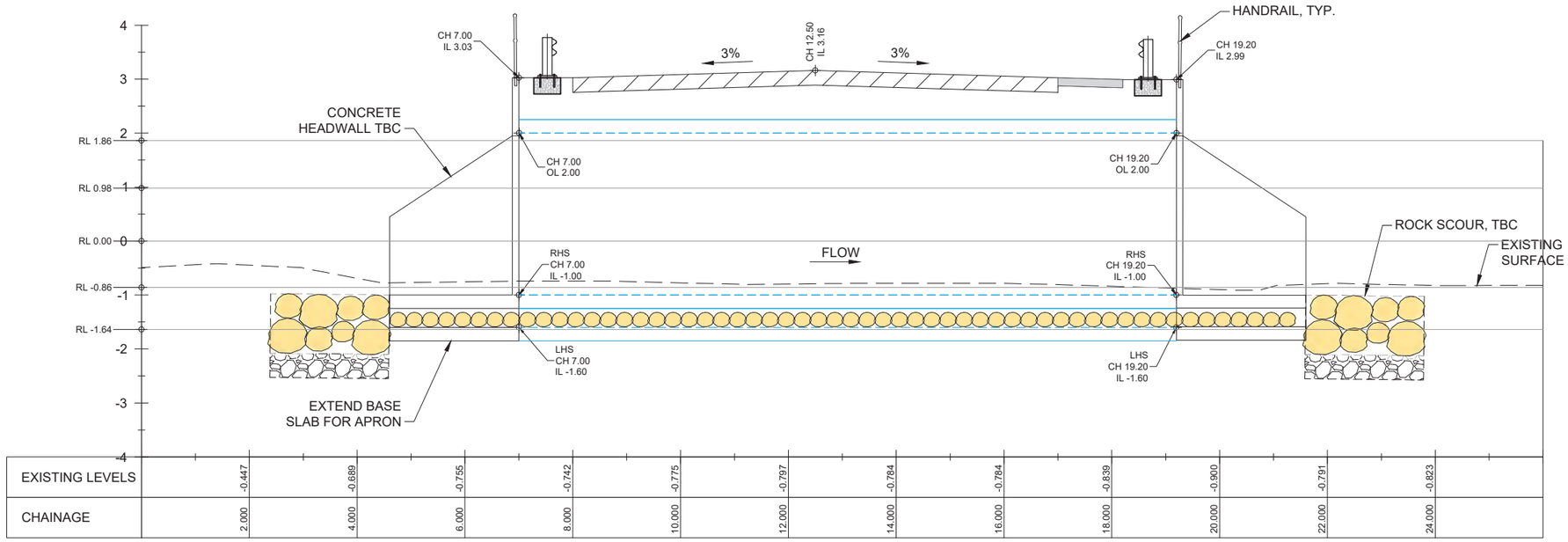
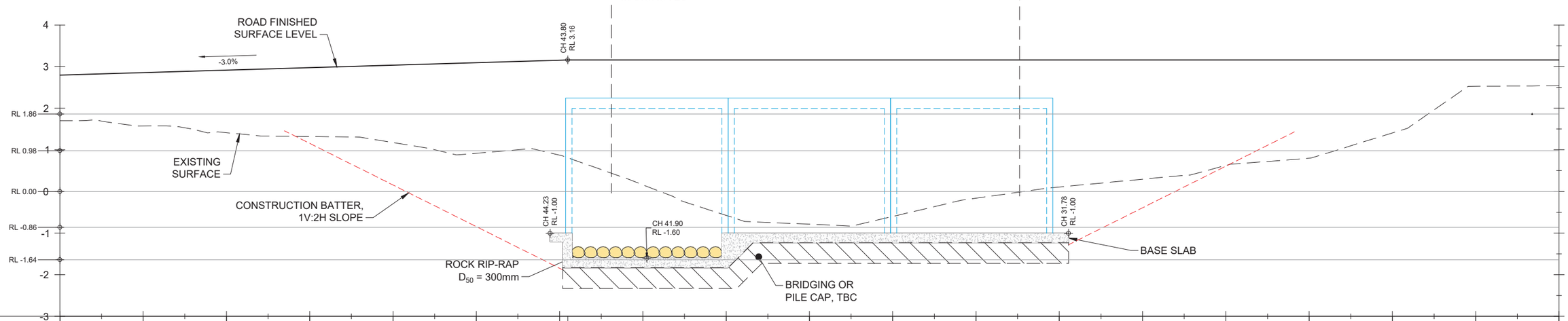
YORKEY'S KNOB BOATING INFRASTRUCTURE PROJECT
CULVERT SECTIONS
DRG 4112



CHAINAGE	2.000	4.000	6.000	8.000	10.000	12.000	14.000	16.000	18.000	20.000	22.000	24.000
EXISTING LEVELS	-0.447	-0.689	-0.755	-0.742	-0.775	-0.797	-0.784	-0.784	-0.839	-0.900	-0.791	-0.823

SECTION A
1:50 (A1) 4111



CHAINAGE	56.000	54.000	52.000	50.000	48.000	46.000	44.000	43.803	42.000	40.000	38.000	36.000	34.000	32.000	30.000	28.000	26.000	24.000	22.000	20.000
EXISTING LEVELS	1.500	1.574	1.413	1.320	1.177	0.917	0.874	0.811	0.161	-0.576	-0.786	-0.600	-0.161	0.108	0.296	0.625	0.797	1.407	2.528	2.543
DESIGN LEVELS	2.795	2.855	2.915	2.975	3.035	3.095	3.155	3.161	3.161	3.161	3.161	3.161	3.161	3.161	3.161	3.161	3.161	3.161	3.161	3.161

SECTION B
1:50 (A1) 4111

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S0 WORK IN PROGRESS**

1000 0 1000 2000 3000 4000 5000mm
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Appendix B Sediment Sampling and Analysis Results

B.1 Methodology

B.1.1 Sampling Overview

A sampling and analysis plan (SAP) for the project was prepared by BMT on behalf of TMR and executed on the 9th and 11th December 2018.

Contaminant List

Contaminants lists have been developed based on existing recent data for the study area (EcoSustainAbility 2018). Nutrient and acid sulfate soil testing have not been undertaken pervious and have been included in the present survey. The contaminant to analysed are presented in tables below.

Table B-1 Laboratory testing – upper horizons <1.5m

Parameter	Target PQL	NEPM [1] (mg/kg) Screening Level	NAGD or other Screening Level	Level of Investigation
Basic Characteristics				
Particle Size Distribution (sieve and hydrometer)	1%	-	-	All samples
Moisture Content (%)	0.1	-	-	All samples
Total Organic Carbon (%)	0.1	-	-	All samples
Metals and metalloids (mg/kg)				
Aluminium	200	-	12,918 [6]	All samples
Antimony	0.5	-	2 [2]	All samples
Arsenic	1	3000	20 [2]	All samples
Beryllium	1	500		All samples
Boron	50	300000		All samples
Cadmium	0.1	900	1.5 [2]	All samples
Chromium	1	3600	80 [2]	All samples
Copper	1	240000	65 [2]	All samples
Iron	100	-	33,870 [6]	All samples
Lead	1	1500	5 [2]	All samples
Mercury	0.01	730	0.15 [2]	All samples
Manganese	10	60000	-	All samples
Nickel	1	6000	21 [2]	All samples
Selenium	5	10000		All samples
Silver	0.1	-	1 [2]	All samples
Zinc	1	400000	200 [2]	All samples
Nutrients				
Total Nitrogen as N	20	-	-	All samples
Total Kjeldahl Nitrogen as N	20	-	-	All samples
Total Phosphorus as P	1	-	-	All samples
Nitrate and Nitrite as N	0.1	-	-	All samples
Ammonia as N	0.2	-	4 [3]	All samples

Parameter	Target PQL	NEPM [1] (mg/kg) Screening Level	NAGD or other Screening Level	Level of Investigation
Organotins				
MBT, DBT, TBT	0.5 µg Sn/kg	-	9 µg Sn/kg	surface horizons (to 0.5 m) at two sites only

Table B-2 Laboratory testing – lower horizons >1.5m

Parameter	Target PQL	NEPM[1] Screening level	NAGD or other Screening Level	Level of Investigation
Basic Characteristics				
Particle Size Distribution (sieve and hydrometer)	1%	-	-	All samples
Total Organic Carbon (%)	0.1	-	-	All samples

Table B-3 ASS testing

Parameter	Target PQL	NEPM[1] Screening level	NAGD or other Screening Level	Level of Investigation
Acid Sulfate Potential				
Chromium Suite	2 mole H^+/tonne	-	Liming rate based on Table 4.2 (Dear *et al.*, 2014)	0.5 m intervals for entire core length
Field test (pH_F and pH_{FOX})	0.1 pH unit	-	-	0.5 m intervals for entire core length

Sampling Locations

The number of sampling locations was based on the guidance provided in Appendix D of NAGD (Commonwealth of Australia 2009). A total of six locations were sampled within the footprint and the sampling location were chosen at random with the dredge footprint as shown in Figure B-1. Table B-4 provides a list of the GPS coordinates of the sampling locations.

Table B-4 Sampling sites

Location	Easting	Northing
1	363083.63	8141976.05
2	363110.60	8141991.94
3	363087.18	8142004.73
4	363029.48	8142027.49
5	363129.28	8142021.16
6	363112.83	8142026.81

LEGEND

- Core Locations
- Ecology Survey Extent
- Indicative Boat Ramp Footprint

Title:

SAP Sampling Locations

Figure: **B-1**

Rev: **A**

N

0 100 200m

Approx. Scale

BMT

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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\DRG\ECO_012_190114_Yorkey_A3_SAP_Locations.WOR

B.1.2 Sampling Collection

Sampling Procedure

Sediment samples were collected using aluminium 75mm diameter (72mm ID) core tubes driven into the sediment using a vibro-corer. Cores were collected to sufficient depth or until refusal was met. Sampling was conducted from BMT's commercially registered and surveyed research vessel "Resolution II" with the sampling led by a suitably qualified scientist with experience in the application of the NAGD and sediment quality assessments. The vessel was anchored at each sampling location prior to samples and the located was recorded on a handheld GPS.

Any potential contaminants (e.g. lead diving weights, antifoulant, fuel/oils and sunscreen) were removed from the sampling area prior to mobilisation to minimise the potential for cross contamination of samples. The sampling processing area and sampling apparatus (e.g. core tubes, sampling trays and utensils) were thoroughly cleaned with De-con 90 solution prior to use, and were cleaned and rinsed with sea-water to prevent cross contamination between samples. The respective sub-sample horizons of each core from each location were carefully homogenized in a clean container prior to the filling of analytical laboratory-supplied clean sampling jars.

Nitrile gloves were worn by all field personnel handling the sediment, and gloves were disposed of after processing of each sample.

Sample bottles were labelled with a waterproof marker pen on the bottle label and lid. All storage containers were chilled on ice immediately following sample collection. Samples were then delivered to the analytical laboratories within holding times. All samples were submitted to the laboratories with Chain of Custody documentation.

Core Details

Sediment samples were logged and processed onboard the sampling vessel. At each sample location a standardised pro-forma was completed to document sample collected and sediment description. The following information was collected.

Photographs of each core were taken. For each sample, the following details were recorded on a standardised pro-forma:

- Project name and number;
- Date and time of sampling;
- Field sample number;
- Northing and Easting of sample location;
- Type of sampler used (aluminium, PVC, stainless steel, etc);
- Weather conditions and sea state at the time of sampling;
- Tidal Stage and water depth at sample location (derived from onboard depth sounder);
- Depth of core penetration/length of core; and
- Photographs of each sediment sample.

In addition, a sediment log of each sore was recorded, providing a description of the composition of each sample which included the following information:

- Sediment colour;
- Odour;
- Field texture;
- Observed particle size (fine, fine silt, clay, sand, clayey sand, solid clay, loamy clay);
- Plasticity;
- Estimated % stones; and
- Presence of shell/shell grit.

Quality Assurance and Quality Control

Quality Control during sampling was ensured by:

- Using suitably qualified staff experienced in sediment sampling, field supervision and sediment logging;
- Using a survey vessel that is thoroughly inspected and washed down, prior to the beginning of works each day;
- Following specific sampling procedures, including the provision of field trip blanks, field replicates and field duplicates;
- Ensuring staff wear nitrile gloves while processing samples with gloves changed between samples to avoid cross-contamination;
- Storing samples in appropriately cleaned, pre-treated and labelled sample containers;
- Chilling samples (4°C, -20°C for sPOCAS samples) after sampling and during transport, storing in eskies with pre-frozen ice bricks and ice; and
- Maintaining an accurate chain of custody form for sediment samples collected from the study area. The form identified all sample numbers and the respective analysis and practical quantitation limits required for analysis.

Quality assurance samples (field triplicates and split samples) was collected and analysed as outlined in NAGD (2009), and as specified in the SAP. The primary and secondary laboratories followed laboratory QC procedures in accordance with requirements outlined in Appendix F of NAGD. This includes analysis of laboratory blanks, duplicates, certified surrogate materials and spiked samples, as described below.

Laboratory Analysis

Analytical tests

All analytical testing was conducted by NATA accredited laboratory facilities.

Primary analysis of sediment samples was conducted by ALS Brisbane and ALS Sydney was used as the secondary (reference) laboratory for inter-laboratory quality testing for all sediment core samples.

Laboratory Quality Control

Laboratories followed laboratory QC procedures in accordance with requirements outlined in Appendix F of NAGD. This includes analysis of laboratory blanks, duplicates, certified surrogate materials and spiked samples, as described below.

Laboratory Blanks

The purpose of this assessment is to monitor for potential laboratory contamination of samples due to cross-contamination during laboratory preparation, extraction or analysis. Blank sample concentrations should be at or near the detection limit of the method used.

Laboratory Duplicates

This assessment refers to a randomly selected intra-laboratory split sample, which provides information regarding the method precision and sample heterogeneity. Results are presented as Relative Percent Difference (RPD) values of two sample concentrations for a specific contaminant.

NAGD recommends that duplicates should agree within a typical RPD of the method of ±35 %. This recommended RPD is typically not adopted by analytical laboratories as it does not account for the greater uncertainty for contaminant concentrations close to the method's detection limit. For the primary laboratory ALS the permitted ranges for the Relative Percent Deviation (RPD) of laboratory duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting:

- Result < 10 times LOR: No Limit;
- Result between 10 and 20 times LOR: 0% - 50%; and
- Result > 20 times LOR: 0% - 20%.

Surrogate and Matrix Spikes

Surrogate spikes or Laboratory Control Samples (LCS) are certified reference materials similar in composition to the target analyte but not likely to be present in the environment. The purpose of this measurement is to monitor method precision and accuracy.

Matrix spikes refer to an intra-laboratory split sample spiked with a representative set of target analytes of known concentration. Matrix spikes are assessed to monitor potential sample matrix effects on analyte recoveries.

For both surrogate and matrix spikes, a calculation of the percent recovery of the spiked amount against the returned concentration is performed indicating analytical performance.

NAGD states that recovery limits of 75% - 125% are generally acceptable. Analytical laboratories typically adopt specific surrogate and matrix spike recovery limits for the various contaminant compound groups. It is also noted that ideal recovery ranges may be waived in the event of sample matrix interference.

Date Analysis

Concentrations of contaminants measured in sediment samples will be compared to screening levels as described in (reference) and (reference). Those being Table 1A(1) and Table 1B(6) of the NEPM Volume 2 Schedule B1 in the first instance to determine whether the material is acceptable for placement on land, and

subsequently, Table 2 of NAGD if required to determine potential impact of dredge plumes and suitability for placement at sea (if required).

Mean concentrations of chemical parameters at the upper 95% confidence level (95% UCL) will be compared against screening levels described in (reference) and (reference). An assessment of the material's suitability for land-based re-use will follow the statistical analysis and the data evaluation procedures in Section 3.4, Volume 5 Schedule B4 of the NEPM. In the event that 95th percentile upper confidence limits for particular contaminants are exceeded, the next steps would be to follow the decision tree in Volume 1, Schedule A of the NEPM to determine a site remediation plan or collect further data describing the nature of contamination.

The statistical analysis will follow the approach given in Appendix A of NAGD if necessary to inform whether the material is appropriate for placement at sea.

B.2 Results

All laboratory results QAQC reports, photographs and sediment quality logs are attached to the end of this Appendix.

B.2.1 Retained Core Sample Depths

Summary of the tarted and retained core lengths are provided in Table B-5. All samples met refusal at each site and multiple cores were undertaken at each sampling site to ensure sufficient material was retained for laboratory analysis.

Table B-5 Targeted and retained core lengths

Location	Targeted core length (m)	Retained core length (m)
1	2.6	0.8
2	2.6	1.0
3	2.6	1.73
4	2.6	1.1
5	2.6	1.9
6	2.6	1.5

B.2.2 Particle Size Distribution and Settling Rate

Figure B-2 illustrates the percentage of sediment size classes in each sub-sample. All samples were dominated by gravel and sand size fractions typically representing from 3-51% and 42-60% of the sample weight, respectively. The exception to this was the lower horizon at sites 3, 5 and 6 which had relatively high proportion of silts and clays compared to other sub-samples. It should be noted that these sub-samples were taken from below the maximum dredge depth.

Settling velocity for 50% and 90% of particles ranged between 30.6 to 57.6 mm/min and 1.8 to 57.6 mm/min respectively. Apart from 3-A, 4-A, 4-B and 5-A, the other sites recorded 50% settling velocity ate was equal to the 90% settling velocity rate, which is a reflection the particle size.

Figure B-2 Particle Size Distribution

B.2.3 Trace Metals and Metalloids

Table B-6 presents summary statistics for metals and metalloids. Concentration of all metals and metalloids were below the NAGD screening levels and NEPM investigation levels at all sampling locations. The 95% UCL for all metals and metalloids were also below NAGD screening levels.

Silver, mercury, antimony, and cadmium were not detected in any samples. Selenium was only detected in one sub-sample at levels slightly greater than the laboratory detection limit. There is no NAGD screen level for selenium, but the concentration was below the NEPM investigation levels.

Concentrations of metal and metalloid were typically higher at sites 4, 5 and 6 while levels for similar between the upper horizon (e.g. <0.5m) and lower horizon (e.g. 0.5-1.5m).

B.2.4 Organic Compounds

Concentrations of organotins compounds (e.g. monobutyltin, dibutyltin and tributyltin) were below the LOR for all sub-samples.

Table B-6 Concentration of metals and metalloids (mg/kg) results and 95th precent UCLs

Location	Al	Fe	Sb	As	Cd	Cr	Cu	Pb	Mn	Ni	Se	Ag	Zn	Hg
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR	50	50	0.50	1.00	0.1	1.0	1.0	1.0	10	1.0	0.1	0.1	1.0	0.01
NAGD	-	-	2	20	1.5	80	65	50	-	21	-	1	200	0.15
NEPM	-	-	-	3000	900	3600	240000	1500	60000	6000	10000	-	400000	730
1-A	1310	2120	<0.50	2.25	<0.1	2.5	<1.0	1.2	53	1	<0.1	<0.1	3.2	<0.01
1-B	860	1460	<0.50	1.56	<0.1	1.7	<1.0	<1.0	23	<1.0	<0.1	<0.1	2.4	<0.01
2-A	1350	2210	<0.50	2.18	<0.1	2.2	<1.0	1.3	29	1.1	<0.1	<0.1	3.4	<0.01
2-B	1500	2100	<0.50	1.97	<0.1	2.6	<1.0	1.5	20	1.2	<0.1	<0.1	3.7	<0.01
9-A	1430	2080	<0.50	2.3	<0.1	2.7	<1.0	1.2	24	1.1	<0.1	<0.1	3.5	<0.01
3-A	2070	2960	<0.50	2.5	<0.1	3.5	1.5	1.9	60	1.7	<0.1	<0.1	6	<0.01
3-B	1850	2680	<0.50	2.69	<0.1	3.4	1.1	1.8	51	1.6	<0.1	<0.1	4.6	<0.01
7-A	1470	2300	<0.50	2.24	<0.1	2.6	1	1.4	35	1.2	<0.1	<0.1	6.8	<0.01
7-B	4780	7440	<0.50	7.55	<0.1	8.5	2.9	4.2	114	3.9	0.1	<0.1	11	<0.01
8-A	1760	4910	<0.50	6.3	<0.1	3.2	1.7	2.7	56	1.7	<0.1	<0.1	4.5	<0.01
8-B	1920	3040	<0.50	2.78	<0.1	3.6	1.4	2	48	1.7	<0.1	<0.1	5.2	<0.01
4-A	2710	4110	<0.50	3.15	<0.1	5	2.1	2.5	48	2.3	<0.1	<0.1	7.6	<0.01
4-B	2100	3080	<0.50	2.8	<0.1	3.9	1.6	2	52	1.7	<0.1	<0.1	5.5	<0.01
5-A	2300	2940	<0.50	2.08	<0.1	3.8	1.7	2.1	42	1.8	<0.1	<0.1	6.2	<0.01
5-B	2390	3170	<0.50	2.65	<0.1	4	1.6	2	46	1.9	<0.1	<0.1	5.7	<0.01
6-A	3210	4620	<0.50	3.8	<0.1	5.7	2	2.8	89	2.8	<0.1	<0.1	7.6	<0.01
6-B	2520	6200	<0.50	5.47	<0.1	6.6	1.7	3	72	2.1	<0.1	<0.1	5.9	<0.01
Mean	2090	3377.6	-	3.2	-	3.9	1.7	2.1	50.7	1.8	0.1	-	5.5	2090
Standard deviation	909.2	1602.6	-	1.7	-	1.7	0.5	0.8	24.1	0.7	-	-	2.1	909.2
95% UCL	2475	4190	-	3.899	-	4.73	1.948	2.449	60.92	2.124	-	-	6.345	-

B.2.5 Nutrients and Organic Carbon

Nutrients and total organic and inorganic carbon analysis results are shown in Table B-7. The concentrations of total organic carbon in sediment sub-samples within the proposed dredge footprint ranged from 0.05% (sample 3-A) and 2.82 (sample 3-C), with an overall average of 0.31%, reflecting the sandy nature of sediments. Total inorganic carbon (TIC) concentration were similar to TOC and ranged from 0.08% to 0.83% with an overall average of 0.25%.

Total nitrogen (TN) and total phosphorus (TP) concentrations across the proposed dredge area ranged between 40 to 230 mg/kg, and 24 to 80 mg/kg, respectively. Nutrient concentrations were highest at locations 4, 5 and 6. Nitrate and nitrite concentrations were below the LORs in all samples from the dredge area. NAGD (2009) guidelines do not provide screening levels for nutrients or TOC in bulk sediments, but typical of sandy estuarine sediments. There are no NEPM investigation levels for nutrients or TOC.

Table B-7 Concentrations of nutrients (mg/kg) and total organic carbon (%) in each sub-sample

Location	Ammonia	Nitrite	Nitrate	NOx	TKN	TN	TP	TOC	TC	TIC
LOR	0.2	0.1	0.1	0.1	20	20	2	0.02	0.02	0.02
NAGD	-	-	-	-	-	-	-	-	-	-
NEPM	-	-	-	-	-	-	-	-	-	-
1-A	0.2	<0.1	<0.1	<0.1	50	50	29	0.06	0.15	0.09
1-B	<0.2	<0.1	<0.1	<0.1	40	40	24	0.06	0.18	0.12
2-A	<0.2	<0.1	<0.1	<0.1	50	50	30	0.08	0.16	0.08
2-B	<0.2	<0.1	<0.1	<0.1	50	50	28	0.09	0.3	0.21
9-A	0.2	<0.1	<0.1	<0.1	60	60	28	0.07	0.16	0.09
3-A	<0.2	<0.1	<0.1	<0.1	40	40	35	0.05	0.13	0.08
3-B	0.3	<0.1	<0.1	<0.1	40	40	29	0.06	0.47	0.41
3-C	----	----	----	----	----	----	----	2.82	3.64	0.82
7-A	0.3	<0.1	<0.1	<0.1	80	80	38	0.08	0.18	0.1
7-B	0.4	<0.1	<0.1	<0.1	120	120	58	0.41	0.61	0.2
8-A	0.3	<0.1	<0.1	<0.1	60	60	40	0.08	0.2	0.12
8-B	0.5	<0.1	<0.1	<0.1	140	140	42	0.36	0.68	0.32
4-A	0.2	<0.1	<0.1	<0.1	190	190	69	0.14	0.4	0.26
4-B	0.2	<0.1	<0.1	<0.1	60	60	32	0.29	0.6	0.31
5-A	0.4	<0.1	<0.1	<0.1	70	70	42	0.07	0.28	0.21
5-B	0.4	<0.1	<0.1	<0.1	90	90	44	0.07	0.17	0.1
5-C	----	----	----	----	----	----	----	0.55	0.86	0.31
6-A	0.3	<0.1	<0.1	<0.1	100	100	48	0.09	0.33	0.24
6-B	0.3	<0.1	<0.1	<0.1	230	230	80	0.09	0.28	0.19
6-C	----	----	----	----	----	----	----	0.61	1.44	0.83

B.2.6 Acid Sulfate Soils

Acid sulfate soil test results are shown in Table B-8. All samples reported pH_f greater than 5 with an average value of 7.93 which indicates that actual ASS is not present. Likewise, pH_{FOX} for all samples were greater than 5, indicating the presence of potential ASS is unlikely. The change in pH_F and pH_{FOX} varied between 1.12 and 2.34 with average value of 1.65. This indicates that minimal potential for PASS, with the change at 3-B, 4-A and 5-A generally indicating a stronger indication of PASS.

Samples returned pH_{KCl} values ranging from 8.8 and 9.5, which indicates actual acidity in the samples is unlikely. These results are supported by titratable Actual acidity (TAA and sTAA) which were noted as less than the LOR at all locations and does not indicate the presence of ASS.

Chromium Reducible Sulfur (S_{cr}) values were above the LOR for all samples, ranging from 0.13 to 0.815 %S and therefore including low amounts of sulfur were present in the samples. Results from acid neutralising capacity (ANC) tests indicate that sediments have sufficient capacity to self-neutralise if exposed to oxygen (values ranging between 0.89 and 6.47 $\%CaCO_3$), and liming would not be required to treat soils if placed on land (Table B-8).

Table B-8 Acid Sulfate Soil (Chromium suite and SPOCAS)

Analyte grouping/Analyte	Units	PQL	1-A	1-B	2-A	2-B	3-A	3-B	4-A	4-B	5-A	5-B	6-A	6-B	6-C
pH field and FOX															
pH_F	pH Unit	-	7.86	7.86	7.93	7.77	7.93	7.98	8.10	8.03	8.24	7.96	7.92	7.80	7.74
pH_{FOX}	pH Unit	-	6.74	6.37	6.46	6.58	5.98	5.64	6.08	6.77	6.09	6.08	6.34	6.17	6.31
ΔpH	pH Unit	-	1.12	1.49	1.47	1.19	1.95	2.34	2.02	1.26	2.15	1.88	1.58	1.63	1.43
Actual Acidity															
pH KCl	pH Unit	0.1	9.5	9.5	9.5	9.5	9.5	9.6	9.3	9.0	9.4	9.5	9.5	9.4	8.8
Titratable Actual Acidity	mole H+ / t	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity	% pyrite S	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Potential Acidity															
Chromium Reducible Sulfur	% S	0.005	0.016	0.013	0.013	0.015	0.021	0.014	0.064	0.296	0.054	0.021	0.025	0.062	0.815
acidity - Chromium Reducible Sulfur	mole H+ / t	10	<10	<10	<10	<10	13	<10	40	185	34	13	16	39	508
Acid Neutralising Capacity and Acid Base Accounting															
Acid Neutralising Capacity	% CaCO3	0.01	0.97	0.89	1.03	1.24	0.89	3.49	1.23	1.46	1.48	1.03	2.04	1.19	6.47
acidity - Acid Neutralising Capacity	mole H+ / t	10	194	177	206	249	177	698	246	292	296	206	409	237	1290
sulfidic - Acid Neutralising Capacity	% pyrite S	0.01	0.31	0.28	0.33	0.40	0.28	1.12	0.39	0.47	0.47	0.33	0.66	0.38	2.07
ANC Fineness Factor		0.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	% S	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	mole H+ / t	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Liming Rate	kg CaCO3/t	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	% S	0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	0.06	0.30	0.05	0.02	0.02	0.06	0.82
Net Acidity excluding ANC (acidity units)	mole H+ / t	10	<10	<10	<10	<10	13	<10	40	185	34	13	16	39	508
Liming Rate excluding ANC	kg CaCO3/t	1	<1	<1	<1	<1	<1	<1	3	14	2	<1	1	3	38

B.3 Quality Assurance and Quality Control

B.3.1 Laboratory QA/QC

Limits of Reporting

LORs used by the primary laboratory (ALS) were below relevant PQLs for most parameters (as per NAGD).

Sampling Holding Times

All samples were received by the laboratories in appropriately pre-treated and preserved containers. Samples were chilled with ice whilst in the field and during delivery. All analyses were undertaken by the laboratories within recommended holding times.

Laboratory Blanks

Results indicated that the laboratory blank assessment was within the acceptable criteria.

Laboratory Duplicates

Results indicated that laboratory duplicates were within the permitted ranges for the Relative Percent Deviation (RPD).

Surrogate and Matrix Spikes

The assessment of surrogate and matrix spike recoveries was satisfactory for all sub-samples.

B.3.2 Field QA/QC

Field Triplicate

Analyses of field triplicate samples were within the ±50 % NAGD criterion for RSDs for most parameters samples in the upper horizon (e.g. <0.5m). The exception was arsenic, with the variability occurring between one of the triplicate samples and the primary sample. The RSD for most metals and nutrients in the lower horizon (e.g. 0.5-1.5m) did not met the 50% NADG criteria. This included aluminium. Iron, arsenic, chromium, copper, manganese, nickel, zinc, TKN, TN and TOC.

Triplicate Laboratory Split

The NAGD states that the RPD for split triplicate samples should be within ±35 %. The inter-laboratory RPDS exceeded the criteria guideline level for moisture content, ammonia, total carbon and total inorganic carbon.

Appendix C Ecological Surveys Undertaken

The following environmental investigations have been undertaken for the project to date:

- Collection of metocean data from a series of tide, wave, pressure and current instruments deployed between November and December 2018.
- Transecting of Half Moon Bay in December 2018 to collect current, tide and bathymetric data.
- Collection and analysis of marine sediment in December 2018 in accordance with a sampling and analysis plan (SAP) approved by the Queensland Department of Environment and Science. The SAP was prepared in accordance with the National Assessment Guidelines for Dredging 2009[10] and *National Environment Protection (Assessment of Site Contamination) Measure 1999*. However, due to the availability of other sediment sampling data from other parts of Half Moon Bay which indicated material was mostly free from contaminants, a reduced set of sampling sites was used. The sampling was based on six cores, undertaken until refusal.
- Collection of side-scan sonar in December 2018, with processing and interpolation to produce benthic sediment classes and characterisation of benthic habitat.
- Seagrass surveys (raking) in December 2018 to collect marine plants and estimate density of seagrass cover and interpolation to determine likely distribution of seagrass.
- Vegetation assessments in December 2018 to ground-truth maps developed based on desktop review. The assessments were undertaken in accordance with the Methodology for Survey and Mapping of Regional Ecosystems[11] and included identification of any prohibited or restricted invasive matters under the *Biosecurity Act 2014* (Qld) or locally significant pest species.
- Terrestrial fauna habitat assessment in December 2018 (concurrent with vegetation assessment) focused on identifying and describing the fauna habitat features of the area and potential occurrence of various fauna species. Important habitat features and indicators in the area were identified and described.

These environmental data collection exercises supplemented already published literature and data for the Project area.

The results of the December 2018 terrestrial ecology survey are attached overleaf.

[10] Department of the Environment, Water, Heritage and the Arts (2009), *National Assessment Guidelines for Dredging*, Commonwealth of Australia, Canberra.
[11] Neldner, VJ, Wilson, BA, Dillewaard, HA, Ryan, TS, Butler, DW, McDonald, WJF, Addicott, EP and Appelman, CN (2017), *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland*, Version 4.0, Queensland Herbarium and Queensland Department of Science, Information Technology and Innovation, Brisbane.

C.1 Introduction

This Ecological Assessment Report was prepared to identify terrestrial ecological management considerations for the proposed Yorkey's Knob boating facility. The proposed facility will consist of a single 6-lane boat ramp and associated road infrastructure (refer Figure 2-1).

The objectives of this report include the following:

- Review state and federal ecological values documented for the site and surrounds;
- Assess and describe current flora and fauna habitat composition and condition across the site based on survey;
- Confirm the known/potential occurrence of matters of state and national environmental significance (MSES/MNES) such as threatened communities and potential habitat for threatened taxa;
- Describe potential impacts of the proposal on site ecological values; and
- Provide recommendations for site ecological management including potential approval requirements.

C.2 Methodology

C.2.1 Desktop Review

The following data was reviewed to map and describe documented ecological values of the study site to be validated in the ensuing field survey:

- Current and historical aerial imagery;
- Data for State biodiversity interests, including:
  - Vegetation and Essential Habitat regulated under the *Vegetation Management Act 1999* (VM Act);
  - 2015 Preclear and Remnant Regional Ecosystem (RE) Mapping (V10.1);
  - High risk areas mapped under the Protected Plants Flora Survey Trigger Map regulated under the *Nature Conservation Act 1992* (NC Act);
  - Wetland Protection Areas;
  - Nature Refuges/offsets and other biodiversity covenants;
  - Queensland Wildnet Online Data Search;
- Data for Federal biodiversity interests: EPBC Act Protected Matters Search Tool (PMST) to identify MNES supported with relevant Department of the Environment and Energy (DoEE) Species Profiles and Threats Database (SPRAT);
- Other data resources:
  - Atlas of Living Australia; and
  - DES threatened species modelling.

C.2.2 Field Survey

A field survey was undertaken to verify the results of the desktop review and to describe the nature, extent, condition and suitability of site habitats and their capacity to support terrestrial and wetland MNES/ MSES.

C.2.2.1 Vegetation Assessment

To ground truth the desktop assessment, surveys were undertaken within representative sites for each vegetation community accessible on foot to record landscape features, vegetation composition, structure and condition. The flora survey methodology was consistent with the Methodology for Survey and Mapping of Regional Ecosystems (Neldner *et al.* 2017). Data collected included: site location, environmental and overall structural information (height and cover of each layer), and a list of dominant species within each layer. Informal notes and photographs of site condition were recorded throughout the survey.

A targeted search was undertaken across the various vegetation communities to determine habitat suitability, likely/known presence and location of significant flora species. The study site has not been mapped as High-risk under the Protected Plants Flora Survey Trigger Map, therefore the flora survey did not need to conform with the Flora Survey Guidelines – Protected Plants.

Any prohibited or restricted invasive matters listed under the *Biosecurity Act 2014* or locally significant pest species were recorded.

C.2.2.2 Terrestrial Fauna Habitat Assessment

A terrestrial fauna habitat survey was undertaken concurrently with the vegetation assessment. The fauna habitat survey was undertaken to:

- Describe fauna habitat features of the study site;
- Identify known and potential terrestrial fauna species within the study site;
- Identify the known or potential presence of significant terrestrial fauna species and their preferred habitat; and
- Confirm presence of essential habitat features of the study site for targeted fauna species.

The following fauna habitat features/indicators were recorded within representative habitat types, including:

- Presence or proximity to freshwater and estuarine wetlands;
- Presence or proximity to intertidal mudflats/sandflats/reef/rock platforms;
- Presence of large hollow-bearing trees (Note: a detailed tree survey to record all hollow-bearing trees across the study site was beyond the scope of this assessment);
- General assessment of ground cover attributes for shelter and foraging resources;
- Presence of woody debris / leaf litter / rock crevices; and
- Types and level of habitat disturbances.

Whilst no targeted fauna survey techniques such as trapping, fishing, spotlighting, call playback etc. were undertaken, the desktop assessment and habitat survey were completed to a level of detail sufficient to describe the overall environmental values and potential impacts of the proposed development. If the habitat

survey indicated future targeted fauna survey work is warranted, recommendations for further work have been detailed in the following sections.

C.2.2.3 Assumptions and Limitations

The apparent absence of some species during field surveys does not unequivocally determine that the species does not occur or utilise the site. It is not possible to identify all species present on a site during one-off surveys due to seasonal patterns in activity or the cryptic nature of some species. For this reason, the precautionary principle has been adopted to ascertain the likelihood of a species occurring on the site given the preferences of that species, the available habitat on site and historic records for the species.

C.3 Results

C.3.1 Desktop Review

Based on the site Vegetation Management Report prepared by the Department of Natural Resources, Mines and Energy (2018) (refer C.4):

- The regulated vegetation management map shows Category B (remnant vegetation) on site comprising REs 7.1.1 and 7.2.7 (refer Table C-1 for RE descriptions);
- No vegetation management wetlands have been mapped on the site;
- RE7.2.7 on site has been mapped as Essential Habitat for Southern Cassowary (*Casuarius casuarius johnsonii* (southern population));
- RE7.1.1 on and adjacent to the site has been mapped as Essential Habitat for Estuarine Crocodile (*Crocodylus porosus*); and
- The site has not been captured by the flora survey trigger map regulated under the *NC Act.*

Database records and habitat modelling for the region identified several conservation-significant species listed under the NC Act and/or EPBC Act as known, or potentially occurring, in the site vicinity (refer Table C-2 and Table C-3). The following section describes their potential for occurring on the site based on the results of the field survey.

The PMST results also indicate the study site has the potential to support Broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Queensland which are listed as Endangered communities under the EPBC Act.

Table C-1 Remnant REs mapped at Yorkeys Knob

RE	VMA Class	Biodiversity status	EPBC TEC	Description	Comments
7.1.1	Least concern	No concern at present	N/A	Mangrove closed scrub to open forest. Sheltered coastlines, estuaries, and deep swales between dunes, on fine anaerobic silts, inundated with saline water at high tide.	Structure and composition varies greatly, depending upon distance from the sea and differential freshwater influence. Important fish nursery areas. Threatened species include: *Myrmecodia beccarii* (ant plant) and *Hypochrysops apollo apollo* (apollo jewel butterfly).
7.2.7	Of concern	Endangered	N/A	Casuarina equisetifolia (coast sheoak) +/- Corymbia tessellaris (Moreton Bay ash) open forest +/- groved vine forest shrublands. Beach strand and foredune. 7.2.7a: Complex of open shrubland to closed shrubland, grassland, low woodland and open forest. Includes pure stands of Casuarina equisetifolia, and Acacia crassicarpa, Syzygium forte subsp. forte, Calophyllum inophyllum and Pandanus spp. woodland to open forest. Beach strand and foredune.	Occurs on the majority of foredunes in the Wet Tropics.

Table C-2 Potential threatened flora of the Yorkeys Knob study area

Species	Common Name	NC Act	EPBC Act	Habitat
Acriopsis emarginata	Pale chandelier orchid	V	V	Grows on trees in lowland rainforests and swamps. Frequently found on the upper tree trunks and branches of lower canopy of paperbarks, palms and pandanus.
Cajanus mareebensis		LC	E	Occurs in grassy woodlands of Melaleuca-Acacia, Eucalyptus-Callitris and Eucalyptus-Corymbia woodlands on sandy soils derived from granite with a lower horizon of impeded drainage.
Canarium acutifolium		V	V	Almost confined to creek and river banks in lowland rain forest from sea level to 100m.
Cyclophyllum costatum		V	V	Grows in rainforest and complex notophyll vineforest along creeks and rivers from near sea level to altitudes above 1000 m.

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Species	Common Name	NC Act	EPBC Act	Habitat
Dendrobium johannis	Chocolate tea tree orchid	V	V	Open humid habitats, on slopes in open woodland, close to swamps and in pockets of monsoon forests. Has been recorded growing on Melaleuca and in semi-evergreen vine thicket.
Dendrobium nindii	Blue antler orchid	E	E	Grows on mangroves and palms in near-coastal swamps, coastal rainforest, mangroves, and low altitude gorges and streams.
Dendrobium mirbelianum	Dark-stemmed antler orchid	E	E	Grows mainly on trees in mangroves and coastal swamps in humid locations.
Myrmecodia beccarii	Ant plant	V	V	Epiphytic on trees in coastal woodlands and mangroves.
Phaius australis	Lesser Swamp-orchid	E	E	Found in coastal swampy sclerophyll forest dominated by melaleucas +/- rainforest in damp, sandy soils which are not subject to prolonged flooding.
Phaius pictus		V	V	Restricted to rainforests from 0–600 m altitude, and usually occurs in sheltered humid sites close to streams and seepage among forest litter on boulders.
Phalaenopsis amabilis subsp. Rosenstromii	Native moth orchid	E	E	Found at altitudes from 200–500 m above sea level in humid rainforest close to waterfalls or streams, in deep gorges, sheltered slopes or gullies in notophyll vine thickets, deciduous vine thickets and in open forest.
Polyscias bellendenkerensis		V	V	Recorded at altitudes of 1100 to 1600m in microphyll vine/fern thickets, notophyll vine forest and stunted shrublands on granite substrates.
Toechima pterocarpum		E	E	Recorded in lowland tropical rainforest, often along watercourses, from sea level to 450 m.
Tropilis (Dendrobium) callitrophilum	Thin feather orchid	V	V	Grows at altitudes of 760–1500 m above sea level, in or close to rainforest. It favours Stringybark Cypress Pine but also grows on various shrubby myrtles.

Table C-3 Potential threatened fauna of the Yorkeys Knob study area

Group	Species	Common Name	NC Act	EPBC Act	Habitat
Amphibians	*Litoria dayi*	Australian lace-lid	E	E	Associated with rainforests and rainforest margins. In montane areas the species prefers fast-flowing rocky streams although they also frequent slower watercourses where ample vegetation exists along the margins
Amphibians	*Litoria nannotis*	Waterfall frog	E	E	Restricted to rocky stream habitats in rainforest or wet sclerophyll forest where there is fast flowing water, waterfalls and cascades
Birds	*Calidris canutus*	Red knot	E	E, marine, migratory	Intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. Occasionally within terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely freshwater swamps.
Birds	*Calidris ferruginea*	Curlew sandpiper	E	CE, marine, migratory	Intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. Occur in both fresh and brackish waters.
Birds	*Calidris tenuirostris*	Great knot	E	CE	Foraging on intertidal mudflat/sandflat in sheltered coastal areas, exposed reef, rock platform, mangrove, near coastal swamp/lagoon and salt lakes. Roost on sandy beach, mudflat and coastal claypan.
Birds	*Casuarius casuarius johnsonii (southern population)*	Cassowary	E	E	Dense lowland and highland tropical rainforest, closed gallery forest, eucalypt forest with vine forest elements, swamp forest and adjacent melaleuca swamps, littoral scrub, eucalypt woodland and mangroves.
Birds	*Charadrius leschenaultii*	Greater sand plover	V	V	Forage on intertidal mudflats, sandbank, sandy/shelly/muddy beaches, rock platforms, coral reefs and tidal lagoons. Roost on sandspit, beach, lagoons edge, rocky points, coastal saltmarsh and claypan.
Birds	*Charadrius mongolus*	Lesser sand plover	E	E	Forage on sandy beach, intertidal mudflat/sandflat and mangrove mudflat of coastal bays and estuaries. Also inland at lakes and soaks. Roost on beach, banks, sand/shell spits, rocky spits and exposed reef.
Birds	*Cyclopsitta diophthalma macleayana*	Macleay's fig-parrot	V		Rainforest, gallery forest and adjacent open forest up to 700m.
Birds	*Erythrotriorchis radiatus*	Red goshawk	E	V	Coastal and sub-coastal woodlands and forest.
Birds	*Esacus magnirostris*	Beach stone curlew	V	na	Beaches, islands, reefs, estuaries and edges of mangroves. Forage in the intertidal zone and breed at the backs of beaches, or on sandbanks and

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Group	Species	Common Name	NC Act	EPBC Act	Habitat
					islands, among low vegetation of grass, scattered shrubs or low trees and open mangroves.
Birds	*Grantiella picta*	Painted honeyeater	V	V	Eucalypt forest and woodland, Melaleuca / Casuarina/Acacia woodland; uses mature trees with flowering and/or fruiting mistletoe. Nest in eucalypt and mistletoe.
Birds	*Limosa lapponica*	Bar-tailed godwit	V	V	Forage on large intertidal mudflat/sandflat, banks in estuaries, inlets, bays and coastal lagoons; also saline wetlands, saltmarsh, sandy beach, rock platform and coral reef-flat. Roost on sandy beach/spit and near saltmarsh.
Birds	*Numenius madagascariensis*	Eastern curlew	C	CE	Foraging on soft, intertidal mudflat, with a preference for broad flats, often in sheltered areas near mangroves and estuaries/creeks, also on sandflats and occasionally ocean near water.beaches, rock platforms and coral reefs. Roost on saltflat, saltmarsh, mangroves, reef flat, sandy spits and grassland
Birds	*Rostratula australis*	Australian painted-snipe	V	E	Shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans.
Birds	*Tyto novaehollandiae kimberli*	Masked owl (northern)	V	V	Riparian forest, rainforest, open forest, Melaleuca swamps and the edges of mangroves, as well as along the margins of sugar cane fields
Mammals	*Dasyurus hallucatus*	Northern quoll	na	E	Occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert.
Mammals	*Dasyurus maculatus gracilis*	Spotted-tailed quoll	E	E	Mostly confined to cool, wet upland closed-forests in the upper catchments of rivers draining east and west of the Eastern Escarpment in the Wet Tropics
Mammals	*Hipposideros semoni*	Semon's leaf-nosed bat	E	V	Tropical rainforest, monsoon forest, wet sclerophyll forest and open savannah woodland. Daytime roost sites include tree hollows, deserted buildings in rainforest, road culverts and shallow caves amongst granite boulders or in fissures.
Mammals	*Macroderma gigas*	Ghost bat	E	V	Arid habitats, tropical savanna woodlands and rainforests. During the daytime they roost in caves, rock crevices and old mines.
Mammals	*Mesembriomys gouldii rattoides*	Black-footed tree-rat (north Queensland)	na	V	Mostly occurs in eucalypt forests and woodlands, especially where hollows are relatively plentiful.
Mammals	*Petauroides volans*	Greater glider	V	V	Arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands.
Mammals	*Phascolarctos cinereus*	Koala	V	V	Naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by Eucalyptus species.

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Group	Species	Common Name	NC Act	EPBC Act	Habitat
Mammals	*Pteropus conspicillatus*	Spectacled flying-fox	V	V	Roosts in the vicinity of rainforest and feeds on rainforest species and Eucalyptus spp. in tall open forests adjoining rainforest communities and in tropical woodland and savanna ecosystems.
Mammals	*Rhinolophus robertsi*	Large-eared horseshoe bat	E	V	Found in lowland rainforest, along gallery forest-lined creeks within open eucalypt forest, Melaleuca forest with rainforest understorey, open savannah woodland and tall riparian woodland of Melaleuca, Forest Red Gum (E. tereticornis) and Moreton Bay Ash (E. tesselaris)
Mammals	*Saccolaimus saccolaimus nudicluniatus*	Bare-rumped sheath-tailed bat	E	V	Occurs mostly in lowland areas, typically in a range of woodland, forest and open environments.
Mammals	*Xeromys myoides*	Water mouse	V	V	Mangroves and associated saltmarsh, sedgelands, clay pans, heathlands and freshwater wetlands.
Reptiles	*Crocodylus porosus*	Saltwater crocodile	V	Marine, migratory	Estuaries and major rivers, billabongs and swamps in dry season; freshwater swamps in wet season; dune swale swamps and dams. Nest sites: vegetated areas (preference for Melaleuca swamp forest) near permanent freshwater; will also use marginal sites (grassy areas near forest edge, mangrove fringe).
Reptiles	*Caretta caretta*	Loggerhead turtle	E	E, marine, migratory	Nest on open, sandy beaches and forage in open waters
Reptiles	*Chelonia mydas*	Green turtle	V	V, marine, migratory	Nest on open, sandy beaches and forage in open waters
Reptiles	*Dermochelys coriacea*	Leatherback turtle	E	E, marine, migratory	Nest on open, sandy beaches and forage in open waters
Reptiles	*Eretmochelys imbricata*	Hawksbill turtle	V	V, marine, migratory	Nest on open, sandy beaches and forage in open waters
Reptiles	*Lepidochelys olivacea*	Olive ridley turtle	E	E, marine, migratory	Nest on open, sandy beaches and forage in open waters
Reptiles	*Natator depressus*	Flatback turtle	V	V, marine, migratory	Nest on open, sandy beaches and forage in open waters

C.3.2 Survey Results

C.3.2.1 Vegetation

The study site comprises a range of habitat types including: estuarine wetlands associated with intertidal reaches; foredune communities on coastal sands; and unvegetated beaches. The site is bounded to the west by Half Moon Bay Creek, to the south by previously cleared lands associated with the Half Moon Bay Golf Club, to the north by marine waters associated with Yorkey's Knob Boating Club, and residential development to the east.

Half Moon Bay Creek and the low-lying intertidal reaches of Ray Howarth Park in the east of the study site support mangrove open forest (RE7.1.1) dominated by *Rhizophora stylosa* with patches of *Avicennia marina, Bruguiera gymnorhiza, Lumnitzera racemosa, Excoecaria agallocha* and *Acrostichum speciosum*. The mangroves are bounded on the landward side by sparse fringing *Melaleuca leucadendra*. The intertidal reaches of the marina support a discontinuous fringe of mangroves dominated by *Lumnitzera racemosa* which are bounded on the landward side by patches of saltmarsh dominated by *Sporobolus virginicus*. Threatened epiphytic ant plants (*Myrmecodia beccarii*) were recorded in two *Rhizophora stylosa* at the mouth of Half Moon Bay to the south-west of the proposed car park. Four ant plant colonies were also recorded on a large *Melaleuca leucadendra* on Buckley Street in the vicinity of the proposed road access.

The sand dune in the north of the study site landward of the intertidal zone supports a foredune complex of RE7.2.7a comprising grassland, shrubland, low woodland and open forest of varying structure and condition. The foreshore and headland (proposed carpark) is dominated by *Casuarina equisetifolia* averaging 10-12m in height and 60% cover over a sparse lower canopy of *Hibiscus tiliaceus, Terminalia muelleri, Terminalia arenicola* and *Acacia* spp. averaging 4-6m in height. The headland is fronted by beach strand vegetation comprising a sparse groundcover of *Ipomoea pes-caprae* and *Cyperus pedunculatus* with the weeds *Stylosanthes scabra, Cenchrus echinatus, Melinis repens* and *Ageratum houstonianum.*

The landward zone of the foredune complex is dominated by a mixed canopy ranging from 6-10m in height and 10-50% cover. A variable sub-canopy ranging from 2-4m in height and 5-20% and sparse emergents 12-15m in height also occur at some sites. Dominant trees include *Terminalia* spp., *Planchonia careya, Melaleuca leucadendra, Chionanthus ramiflora, Cocos nucifera* cv. *domesticated, Hibiscus tiliaceus, Macaranga tanarius, Acacia oraria, Acacia spp., Ficus spp., Alphitonia excelsa, Drypetes deplanchei, Sterculia quadrifida, Canarium australianum, Exocarpos latifolius, Schefflera actinophylla, Calophyllum inophyllum* and *Brachychiton acerifolius*. Dominant shrubs include *Tabernaemontana pandacaqui, Alyxia spicata, Caesalpinia bonduc, Dodonaea viscosa, Jasminum simplicifolium* var. *australiense, Capparis* sp. and *Lithomyrtus obtusa*. The vine *Cynanchum viminale* is common and the very sparse ground layer is dominated by *Imperata cylindrica, Ipomoea pes-caprae* and *Megathyrsus maximus.* The epiphytic fern *Pyrrosia longifolia* is common and two unidentified epiphytic orchids were recorded adjacent to the mangroves in the east of the dune complex.

Weeds were widespread throughout the foredune complex. Dominant species included: *Cocos nucifera cv. domesticated*, *Catharanthus roseus*, *Lantana camara*, *Passiflora* spp., *Megathyrsus maximus*, *Mesosphaerum suaveolens*, *Stachytarpheta* spp., *Melinis repens*, *Cenchrus echinatus*, *Ageratum houstonianum* and *Leucaena leucocephala*.

The PMST results indicate the study site has the potential to support Broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Queensland which are listed as Endangered communities under the *EPBC Act*. No vegetation communities conforming to this type were recorded in the study site.

Ant Plants

Epiphytic Orchids

Estuarine Wetlands

Figure C-1 Yorkeys Knob study area vegetation

Foredune Complex

Figure C-2 Yorkeys Knob study area habitat

C.3.2.2 Fauna Habitat

The fauna values and potential habitat features of the study site are summarised in Table C-4 and Table C-5. Some of the more significant fauna habitat observations include:

- Terrestrial habitats in order of dominance include: estuarine wetlands; foredune complex and beach.
- There was high habitat complexity across the study site i.e. prevalence of logs, leaf litter, dense vegetation, marine waters.
- Birds are expected to be the dominant vertebrate group present whilst the number of mammals is expected to be low. Reptile numbers and diversity are also expected to be low due to the poor habitat quality for this fauna group. Common frog species tolerant of disturbed conditions may occur but estuarine wetlands provide poor habitat for this group.
- Estuarine wetlands provided potential habitat for Crocodile.
- The foredune complex provides potential habitat for arboreal mammals and birds.
- Beach habitat provides potential habitat for migratory waders and marine turtles.

Table C-4 Potential threatened fauna of the Yorkeys Knob study area

Group	Species	NC Act	EPBC Act	Habitat	Potential to occur in study are
Amphibians	*Litoria dayi*	E	E	Associated with rainforests and rainforest margins. In montane areas the species prefers fast-flowing rocky streams although they also frequent slower watercourses where ample vegetation exists along the margins	Very low due to lack of habitat
Amphibians	*Litoria nannotis*	E	E	Restricted to rocky stream habitats in rainforest or wet sclerophyll forest where there is fast flowing water, waterfalls and cascades	Very low due to lack of habitat
Birds	*Calidris canutus*	E	E, marine, migratory	Intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. Occasionally within terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely freshwater swamps.	High potential to occur in estuarine wetlands and beach
Birds	*Calidris ferruginea*	E	CE, marine, migratory	Intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. Occur in both fresh and brackish waters.	High potential to occur in estuarine wetlands and beach
Birds	*Calidris tenuirostris*	E	CE	Foraging on intertidal mudflat/sandflat in sheltered coastal areas, exposed reef, rock platform, mangrove, near coastal swamp/lagoon and salt lakes. Roost on sandy beach, mudflat and coastal claypan.	High potential to occur in estuarine wetlands and beach
Birds	*Casuarius casuarius johnsonii (southern population)*	E	E	Dense lowland and highland tropical rainforest, closed gallery forest, eucalypt forest with vine forest elements, swamp forest and adjacent melaleuca swamps, littoral scrub, eucalypt woodland and mangroves.	Very low due to lack of high quality habitat
Birds	*Charadrius leschenaultii*	V	V	Forage on intertidal mudflats, sandbank, sandy/shelly/muddy beaches, rock platforms, coral reefs and tidal lagoons. Roost on sandspit, beach,	High potential to occur in estuarine wetlands and beach

Group	Species	NC Act	EPBC Act	Habitat	Potential to occur in study are
				lagoons edge, rocky points, coastal saltmarsh and claypan.	
Birds	*Charadrius mongolus*	E	E	Forage on sandy beach, intertidal mudflat/sandflat and mangrove mudflat of coastal bays and estuaries. Also inland at lakes and soaks. Roost on beach, banks, sand/shell spits, rocky spits and exposed reef.	High potential to occur in estuarine wetlands and beach
Birds	*Cyclopsitta diophthalma macleayana*	V		Rainforest, gallery forest and adjacent open forest up to 700m.	Low due to lack of high quality habitat
Birds	*Erythrotriorchis radiatus*	E	V	Coastal and sub-coastal woodlands and forest.	May occasionally use the site but does not provide high quality habitat for the species
Birds	*Esacus magnirostris*	V	N/A	Beaches, islands, reefs, estuaries and edges of mangroves. Forage in the intertidal zone and breed at the backs of beaches, or on sandbanks and islands, among low vegetation of grass, scattered shrubs or low trees and open mangroves.	High potential to occur in estuarine wetlands, foredune complex and beach
Birds	*Grantiella picta*	V	V	Eucalypt forest and woodland, Melaleuca / Casuarina/Acacia woodland; uses mature trees with flowering and/or fruiting mistletoe. Nest in eucalypt and mistletoe.	May occasionally use the site but does not provide high quality habitat for the species
Birds	*Limosa lapponica*	V	V	Forage on large intertidal mudflat/sandflat, banks in estuaries, inlets, bays and coastal lagoons; also saline wetlands, saltmarsh, sandy beach, rock platform and coral reef-flat. Roost on sandy beach/spit and near saltmarsh.	High potential to occur in estuarine wetlands and beach
Birds	*Numenius madagascariensis*	C	CE	Foraging on soft, intertidal mudflat, with a preference for broad flats, often in sheltered areas near mangroves and estuaries/creeks, also on sandflats and occasionally ocean near water.beaches, rock platforms and coral reefs. Roost on saltflat, saltmarsh, mangroves, reef flat, sandy spits and grassland	High potential to occur in estuarine wetlands and beach

Ecological Surveys Undertaken

Group	Species	NC Act	EPBC Act	Habitat	Potential to occur in study are
Birds	*Rostratula australis*	V	E	Shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans.	Low due to lack of high quality habitat
Birds	*Tyto novaehollandiae kimberli*	V	V	Riparian forest, rainforest, open forest, Melaleuca swamps and the edges of mangroves, as well as along the margins of sugar cane fields	May occasionally use the site but does not provide high quality habitat for the species
Mammals	*Dasyurus hallucatus*	LC	E	Occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert.	May occasionally use the site but does not provide high quality habitat for the species
Mammals	*Dasyurus maculatus gracilis*	E	E	Mostly confined to cool, wet upland closed-forests in the upper catchments of rivers draining east and west of the Eastern Escarpment in the Wet Tropics	Very low due to lack of habitat
Mammals	*Hipposideros semoni*	E	V	Tropical rainforest, monsoon forest, wet sclerophyll forest and open savannah woodland. Daytime roost sites include tree hollows, deserted buildings in rainforest, road culverts and shallow caves amongst granite boulders or in fissures.	May occasionally use the site but does not provide high quality habitat for the species
Mammals	*Macroderma gigas*	E	V	Arid habitats, tropical savanna woodlands and rainforests. During the daytime they roost in caves, rock crevices and old mines.	May occasionally use the site but does not provide high quality habitat for the species
Mammals	*Mesembriomys gouldii rattoides*	LC	V	Mostly occurs in eucalypt forests and woodlands, especially where hollows are relatively plentiful.	May occasionally use the site but does not provide high quality habitat for the species
Mammals	*Petauroides volans*	V	V	Arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands.	Very low due to lack of high quality habitat
Mammals	*Phascolarctos cinereus*	V	V	Naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by Eucalyptus species.	Very low due to lack of high quality habitat
Mammals	*Pteropus conspicillatus*	V	V	Roosts in the vicinity of rainforest and feeds on rainforest species and Eucalyptus spp. in tall open forests adjoining rainforest communities and in tropical woodland and savanna ecosystems.	May occasionally use the site but does not provide high quality habitat for the species

Group	Species	NC Act	EPBC Act	Habitat	Potential to occur in study are
					Known to occur to southwest in Ray Howarth Park
Mammals	*Rhinolophus robertsi*	E	V	Found in lowland rainforest, along gallery forest-lined creeks within open eucalypt forest, Melaleuca forest with rainforest understorey, open savannah woodland and tall riparian woodland of Melaleuca, Forest Red Gum (E. tereticornis) and Moreton Bay Ash (E. tessellaris)	May occasionally use the site but does not provide high quality habitat for the species
Mammals	*Saccolaimus saccolaimus nudicluniatus*	E	V	Occurs mostly in lowland areas, typically in a range of woodland, forest and open environments.	May occasionally use the site but does not provide high quality habitat for the species
Mammals	*Xeromys myoides*	V	V	Mangroves and associated saltmarsh, sedgelands, clay pans, heathlands and freshwater wetlands.	Some potential to occur in estuarine wetlands and beach
Reptiles	*Crocodylus porosus*	V	Marine, migratory	Estuaries and major rivers, billabongs and swamps in dry season; freshwater swamps in wet season; dune swale swamps and dams. Nest sites: vegetated areas (preference for Melaleuca swamp forest) near permanent freshwater; will also use marginal sites (grassy areas near forest edge, mangrove fringe).	High potential to occur in estuarine wetlands and beach
Reptiles	*Caretta caretta*	E	E, marine, migratory	Nest on open, sandy beaches and forage in open waters	High potential to occur in estuarine wetlands and beach
Reptiles	*Chelonia mydas*	V	V, marine, migratory	Nest on open, sandy beaches and forage in open waters	High potential to occur in estuarine wetlands and beach
Reptiles	*Dermochelys coriacea*	E	E, marine, migratory	Nest on open, sandy beaches and forage in open waters	High potential to occur in estuarine wetlands and beach
Reptiles	*Egernia rugosa*	V	V	Open dry sclerophyll forest, woodland and scrub	Very low due to lack of high quality habitat
Reptiles	*Eretmochelys imbricata*	V	V, marine, migratory	Nest on open, sandy beaches and forage in open waters	High potential to occur in estuarine wetlands and beach
Reptiles	*Lepidochelys olivacea*	E	E, marine, migratory	Nest on open, sandy beaches and forage in open waters	High potential to occur in estuarine wetlands and beach

Group	Species	NC Act	EPBC Act	Habitat	Potential to occur in study are
Reptiles	*Natator depressus*	V	V, marine, migratory	Nest on open, sandy beaches and forage in open waters	High potential to occur in estuarine wetlands and beach

Table C-5 Summary fauna habitat features and values

Habitat	Broad description	Fauna habitat features	Potential fauna values
Estuarine wetlands	Dense and extensive mangrove systems to sparse littoral fringe bounded by saltmarsh patches on the landward side and intertidal flats on the marine side.	• Intertidal flats • Small hollows • Small to large logs • Fleshy fruiting plants • Nectar / pollen	Provides potential feeding and roosting habitat for a wide variety of migratory and woodland dependant birds and arboreal mammals. Probable habitat for estuarine crocodile. Possible habitat for water mouse.
Foredune complex	Grassland, shrubland, low woodland and open forest of varying condition.	• Dense tree/shrub/grass cover • Fleshy fruiting plants • Sparse small hollows • Sparse logs	Provides potential habitat for arboreal mammals and a wide variety of woodland dependant bird species. Possible habitat for beach stone curlew.
Beach	Open beach at mouth of Half Moon Bay Creek	• Dense grass cover • Sparse fleshy fruiting plants	Possible habitat for range of migratory waders, beach stone curlew, water mouse and marine turtles.

C.4 Potential Impacts and Management Recommendations

The following section describes potential impacts on terrestrial ecology MNES and MSES associated with the proposal. Recommendations have been made to manage potential construction impacts associated with clearing and longer-term operation impacts associated with noise, lighting, water quality, pests and fauna movement.

C.4.1 Matters of National Environmental Significance

Based on the results of the desktop review and habitat survey, the following conservation-significant species protected under the EPBC Act are known, or considered to have the potential, to occur:

- The ant plant (*Myrmecodia beccarii*), listed as Vulnerable under the EPBC Act, has been recorded at two locations within the study site.
- A threatened orchid may occur on site and requires further work to confirm species.
- Estuarine wetlands and beaches are likely to provide nesting, roosting and foraging resources for bird species listed as migratory and/or marine.
- Estuarine wetlands and beaches are highly likely to provide habitat for the saltwater crocodile (*Crocodylus porosus*) (listed as marine/migratory).
- Estuarine wetlands and beaches may provide habitat for the water mouse (*Xeromys myoides*) (listed as Vulnerable).

Given the limited extent of habitat disturbance required for the proposal in the context of the wider region, *significant* impacts to MNES are considered unlikely. However, further work may be required to quantify the occurrence of MNES within the footprint and to assess operation impacts on disturbance-sensitive fauna, particularly migratory waders.

C.4.2 Matters of State Environmental Significance

MSES relevant to the study site include the following:

- The study site supports Category B Regulated Vegetation (Remnant) and Category R Regulated Vegetation (Reef Regrowth Watercourse). Design and construction activities should aim to reduce any impacts on regulated vegetation;
- The study site supports marine plants protected under the *Fisheries Act 1994*. Design and construction activities should aim to reduce any impacts on marine plants;
- The following threatened species protected under the *Nature Conservation Act 1992* are known, or considered to have high potential, to occur within the study site:
    - The ant plant (*Myrmecodia beccarii*), listed as Vulnerable under the NC Act, has been recorded at two locations within the study site;
    - A threatened orchid may occur on site and requires further work to confirm species;
    - The estuarine habitats and beaches may provide nesting, roosting and foraging resources for threatened wader species and the beach stone curlew;

- Estuarine wetlands and beaches are highly likely to provide habitat for the saltwater crocodile (*Crocodylus porosus*) (listed as Vulnerable); and
- Estuarine wetlands and beaches may provide habitat for the water mouse (*Xeromys myoides*) (listed as Vulnerable).

Given the limited extent of habitat disturbance required for the proposal in the context of the wider region, significant impacts to MSES are considered unlikely. However, further work may be required to quantify the occurrence of MSES within the footprint to address necessary approvals, permits and offsets under the NC Act and to assess operation impacts on disturbance-sensitive fauna, particularly migratory waders and beach-stone curlew.

C.4.3 Construction Impacts

Indirect effects of construction include impacts to water quality (contaminated spills, acid sulphate soils (ASS) and increased sedimentation), introduction of weeds and pests, increased levels of noise exposure to wildlife and vehicle strike.

Construction activities may have indirect impacts on the aquatic ecology of the site and downstream waterways as a result of vegetation clearance, earthworks, exposure of acid sulphate soils, contaminated runoff and increased stormwater runoff. Construction runoff could impact on downstream aquatic habitats, increase nutrient and contaminant loading and alter the composition of aquatic communities. Given the proximity of the GBR, water quality management measures will need to be carefully detailed under a site-specific Construction Environmental Management Plan (EMP).

Construction activities also have the potential to introduce and spread weeds as a result of ground disturbance and introduction from construction vehicles and materials. *Annona glabra* (pond apple), a restricted invasive plant under the *Biosecurity Act 2014* and a Weed of National Significance, has the potential to spread across estuarine habitats of the study site and will be a high priority for biosecurity management during construction.

Construction plant and vehicle movements would temporarily increase noise and air pollution in the footprint and surrounds. Appropriate management of biodiversity values and fauna handling guidelines will need to be detailed in a Flora and Fauna Management Plan as part of the Construction EMP. Biosecurity management should be detailed in a Pest Management Plan.

In summary, the following management measures may need to be implemented to ensure that potential construction impacts on biodiversity values of the footprint and surrounds are temporary, minimised and contained to the immediate area of works:

- Pre-clearance targeted threatened species surveys;
- Baseline water quality and terrestrial and aquatic habitat condition assessments for monitoring purposes;
- Preparation of Species Management Program\s, if required, if impacts on breeding places of EVNT will occur;
- Offset planning in accordance with the offset frameworks of the EPBC Act and *Environmental Offsets Act 2014*, and associated policies, in the event a significant impact on an environmental matter will occur;
- Preparation of a site-specific Construction EMP providing the following:

- Details of pre-construction and post-construction monitoring program addressing water quality, acid sulphate soils, soils and erosion, weeds and pests, habitat condition;
- Water Quality Management Plan addressing stormwater quality, ASS, management of fuel, chemicals and wastewater, emergency response to environmental incidents and water quality monitoring;
- Flora and Fauna Management Plan addressing vegetation and fauna habitat exclusion zones, clearance approvals, induction program, fauna handling guidelines;
- Pest Management Plan addressing priority biosecurity matters; and
- Habitat Rehabilitation Plan providing details of vegetation and habitat restoration consistent with pre-disturbance conditions.

C.4.4 Operation Impacts

Potential operation impacts on fauna associated with noise, lighting and fauna movement will need to be considered during detailed design of the facility. Sensitive taxa may include breeding crocodiles and roosting and foraging birds. Pest management targeting high priority biosecurity issues, such as pond apple, will also be an ongoing management issue.

The following management measures may need to be implemented to ensure that potential operation impacts on biodiversity values can be minimised and contained to the immediate footprint:

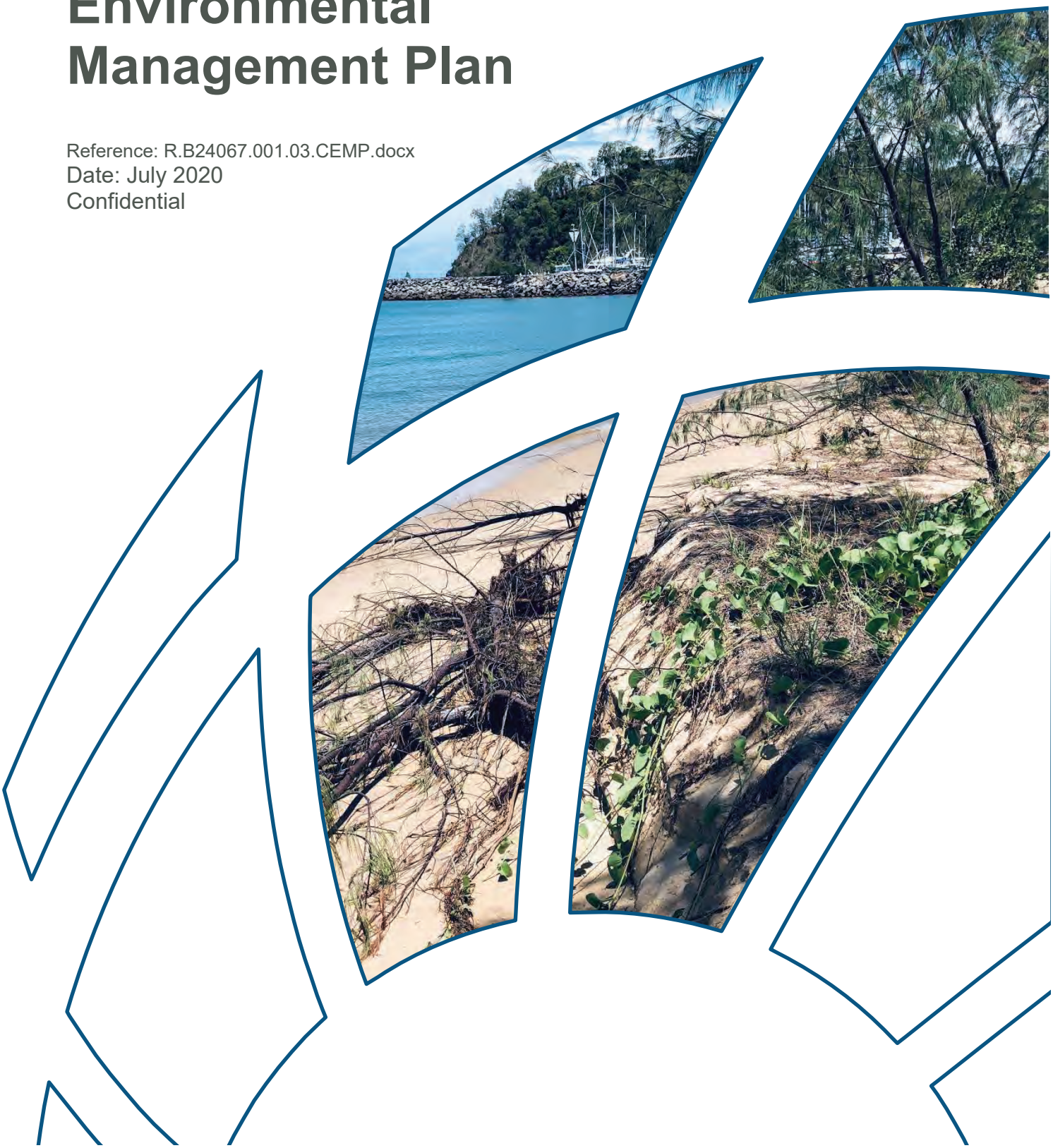
Preparation of a site-specific Operations EMP to address the following:

- Post-construction monitoring program for water quality, acid sulphate soils, habitat condition, sensitive taxa, weeds and pests;
- Water Quality Management Plan addressing stormwater quality, management of fuel, chemicals and wastewater, emergency response to environmental incidents and water quality monitoring;
- Flora and Fauna Management Plan addressing vegetation and fauna habitat protection zones and fauna handling guidelines;
- Species Management Program\s, if required, for fauna sensitive to operation activities such as noise and light impacts; and
- Pest Management Plan addressing high priority biosecurity risks such as pond apple.

Appendix D Draft Construction Environmental Management Plan

Yorkeys Knob Boating Infrastructure Project: Construction Environmental Management Plan

Reference: R.B24067.001.03.CEMP.docx
Date: July 2020
Confidential



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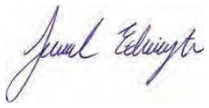
Client:	Department of Transport and Main Roads
Client Contact:	Chris Voisey
Client Reference:	

Synopsis: **Plan to manage construction-phase activities for the Yorkeys Knob Boat Ramp Facility in order to avoid and mitigation environmental impacts**

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
0	18th October 2019	JDV		JME	
1	11th November 2019				
2	25th February 2020				
3	6th July 2020				

DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
TMR	PDF	PDF	PDF	PDF							
BMT File	PDF	PDF	PDF	PDF							
BMT Library	PDF	PDF	PDF	PDF							

Note on Use

October 2019, Version 0

This Version of the Construction Environmental Management Plan (CEMP) has been prepared to support a Development Lease Agreement application with the Department of Natural Resources, Mines and Energy. At the time of preparation, only concept design of the Project elements was available. Further detailed design work is ongoing. Once this is available and after the Development Lease Agreement has been granted, this CEMP will be updated.

February 2020, Version 2

This Version of the CEMP has been updated to support an application for a Development Permit, Environmental Authority, Allocation of Quarry Material and Marine Park Permit. It contains the updated design of all Project elements.

July 2020, Version 3

This Version of the CEMP was updated to reflect minor changes in design.

Contents

List of Figures

List of Tables

1 Introduction

1.1 Purpose

This construction environmental management plan (CEMP) has been prepared in order to manage the environmental impacts associated with the construction phase of the Yorkeys Knob Boating Infrastructure Project. These works involve both landside and water-based activities at Half Moon Bay, Yorkeys Knob.

The CEMP documents the environmental outcomes intended to be achieved during the construction phase, including recommended actions to achieve these outcomes and monitor performance. The CEMP also identifies further management documentation and investigations required prior to commencement of construction works. This has been developed to reflect both the existing environment of the Project area as well as the statutory context for the Project.

The CEMP has been prepared prior to detailed design, the receipt of all statutory approvals for the Project, and adoption of a finalised construction methodology based on construction tendering and funding arrangements. For these reasons, the CEMP is intended to be updated prior to commencement of construction works but, in its current form, sets out the expected obligations and commitments for construction environmental management, and will be included within a future construction tender package.

1.2 Background and Context

TMR completed a demand forecasting study in 2017 which identified a significant shortage of recreational boat launching facilities in the North Cairns Region in terms of current and future demand (GHD, 2017). Based on this study, TMR have been investigating possible sites for a new boating facility. One of the options identified and proposed for further design and refinement is construction of a new boat ramp facility at Half Moon Bay, Yorkeys Knob. The location of the proposed facility (Figure 1-1) is on an area of unallocated state land adjacent to the Yorkeys Knob Marina and Half Moon Bay Golf Course, accessible through an undeveloped road reserve.

Aerial image: 19 August 2019 © Nearmap

0.078 ha

0.848 ha

0.014 ha

Half Moon Bay Marina

Buckley Street

Reclamation area for access road and pedestrian paths is 0.145 ha

Half Moon Bay Golf Course

Concept Design

- Toilet block
- Beach
- Breakwater
- Boat ramp
- Fence footprint
- Fence lines
- Carpark, access road and pedestrian paths
- Carpark and boat ramp line marking, kerbing and pedestrian paths
- Disabled parking

Data source:
Royal Haskoning DHV (30 March 2020)

LEGEND

- Post-development HAT line
- Pre-development HAT line

Total reclamation area is 1.085 ha.

Data source: Royal Haskoning DHV (3 July 2020)

Title:

Yorkeys Knob Boating Infrastructure Project Overview, Including Reclamation Area

Figure: 1-1

Rev: D

N

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Metres

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Filepath: I:\B24067_I_GML_Yorkeys Knob Approval\DRG\ECO_002_200403_Updated Concept Plan with BMT Mapped HAT Boundary.WOR

1.3 Locality Description

The location of the proposed facility is on an area of unallocated state land adjacent to the Yorkeys Knob Marina and Half Moon Bay Golf Course, accessible through an undeveloped road reserve.

The proposed facility is adjacent to the Half Moon Bay Marina and a public accessible boat ramp on State land. The carpark for the marina resides on freehold land held by Far North Queensland Ports Corporation.

The existing infrastructure and facilities at Yorkeys Knob consist of the following:

- 197-berth marina
- Clubhouse and amenities block
- Fuelling wharf and dry storage area
- Two-lane boat ramp
- Rock breakwaters
- Floating walkway
- Car and boat trailer parking facilities.

1.4 Approvals

The Project will be developed under a Development Permit for Operational Works, an Environmental Authority and Allocation of Quarry Material (for dredging and placement), and a Marine Parks Permit for works in the General Use Zone of the Great Barrier Reef (GBR) Coast Marine Park. For works below the highest astronomical tide (HAT), tenure will be provided by a Development Lease Agreement.

2 CEMP Overview

2.1 CEMP Components

The CEMP includes the following components:

- Roles and responsibilities regarding environmental management activities
- Project design and proposed construction methodology
- Environmental and statutory context, including likely construction phase environmental impacts
- Environmental management elements for key environmental values, i.e. water quality and soils, terrestrial ecology, marine ecology, traffic, and air, noise and lighting, as well as for management of waste and hazardous substances
- Actions to take in the event of emergency/contingencies.

Where construction activities include routine and non-routine activities not covered by the CEMP, it is the responsibility of the Contractor to identify the environmental impacts associated with these activities and develop appropriate environmental management measures to discharge their statutory and contractual obligations.

2.2 Roles and Responsibilities

The following persons have roles and responsibilities as part of this CEMP:

- Contractor (for construction phase), including:
  - Contractor Superintendent – manager of the construction works; responsible for on-ground implementation of the CEMP and compliance with all statutory/approval obligations, including regular reporting to TMR.
  - Contractor Staff – personnel involved in actual construction works; responsible for implementation of aspects of the CEMP and compliance with environmental duty of care.
- TMR, as represented by the following:
  - Principal – management of Project, responsible for ensuring works comply with statutory/approval obligations, auditing of the works site, and will report to approving agencies and other relevant bodies (e.g. nominated stakeholders).
  - Project Engineer – overseer of engineering and technical-based work for Project construction; responsible for ongoing review of works against engineering requirements and technical specifications.
- Assessing Agencies, consisting of Department of Natural Resources, Mines and Energy (DNRME), Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP), Department of Environment and Science (DES) and Department of Agriculture and Fisheries (DAF) – agencies responsible for issuing approvals and conditions for the Project; responsible for management of approvals, compliance assessment (where relevant), receipt of reports and notifications, and auditing (where necessary).

2.3 Links to Other Management Instruments

In addition to the CEMP, the following policies, management plans and other instruments will be relevant to environmental management during the construction phase:

- TMR's Environmental Policy
- TMR's environmental management technical publications
- Contractor's Environmental Policy and environmental management system (if applicable)
- Agency operational/environmental policies relevant to the Project
- Project contract package for the Contractor.

3 Project Description and Construction Methodology

3.1 Project Description

The proposed facility is intended to consist of the following features at a minimum:

- Six-lane boat ramp
- Two floating walkways
- Queuing beach (for vessel queuing in peak periods)
- Breakwaters to provide calm waters as per AS3962:2001 *Guidelines for design of marinas*
- Dredged basin (depth of -1.5 m LAT) for navigational access
- Carpark
- Access road from Buckley Street, with culverts over an existing waterway
- High fencing to manage interaction between Half Moon Golf Course and new carpark and access road.

The facility will provide access for launching boats into the existing channel dredged by Cairns Regional Council (CRC) in Half Moon Bay.

These works are shown in Figure 1-1.

As part of construction, it will be necessary to reclaim some land below mean high water springs (MHWS), clear vegetation in proposed terrestrial infrastructure footprints, and remove/cover benthic habitat areas within the proposed marine infrastructure footprints. Impacts associated with these activities are described in Section 5.

TMR will be the proponent for construction of all works. Once constructed, TMR will own the boat ramp, floating walkways and breakwaters while Cairns Regional Council will manage the entire facility and own the carpark, land-based facilities and access road. TMR will also undertake maintenance dredging for the basin and access channel but as part of the broader maintenance dredging program for Half Moon Bay undertaken by Council. These arrangements will be finalised as part of a Deed of Agreement between TMR and Council.

3.2 Construction Methodology and Scheduling

The Project construction methodology will be determined by the contractor engaged for the works, subject to the requirements of detailed design, approvals and this CEMP. Regardless of this, the methodology is expected to consist of the following activities:

(1) Development of a construction access road from Buckley Street. This will include clearing and installation of culverts in the waterway. As the access road and culverts will likely be upgraded and finalised prior to commissioning for public use, what is originally constructed may differ slightly to the final road but will have the same footprint.

(2) Construction of the breakwaters using rock material imported from a local quarry. This construction would most likely be land based construction. Discussion of breakwater construction options and material management is provided below.

(3) Dredging of the basin and navigation channel and use of the material as fill for reclamation and raising of the carpark. This applies only to geotechnically suitable material. If an alternative management strategy is required for this material this would be decided based on the material properties. Given only approximately 10,000 m^3 requires dredging this could be managed either on land or placed at the offshore Half Moon Bay dredged material placement area maintained by Council. The potential dredging methodologies are discussed below.

(4) Importation and placement of additional fill material from a local quarry. Potential quarry locations and logistics routes are discussed below.

(5) Civil works to construct boat ramp, install floating pontoon, install fence, and finalise carpark and access road.

Additional construction fill material can be sourced from sand quarries in the Cairns region within 20-25 km of the Project site (i.e. Boral's Redlynch quarry). Unsuitable dredged material can also be placed onshore at a facility within this distance (e.g. Northern Sands on Captain Cook Highway). Regardless of which locations are used, the Project will require truck movements across a combination of local and state-controlled roads, leading to Yorkeys Knob Road-Varley Street-Buckley Street. The total number of truck movements will depend on the quantities of material to import and remove.

Where material has unsuitable engineering properties if it can be placed in the marine environment, it will reduce the total number of truck movements.

The closest known hard rock quarry to the Project site is at Edmonton, over 30 km to the south. The total volume of rock material required depends on design but is expected to generate a significant amount of traffic if brought directly to the Project site. As an alternative, rock material could be stockpiled at a site at the Cairns Port where it is loaded onto a barge and then brought to site. Marine based construction includes significantly higher construction costs so is unlikely given the very tight project budget but cannot be excluded until the design and construction methodology is finalised.

Construction of the breakwater(s) will likely be land-based construction of the north-south breakwater through progressive placement of rock material from trucks; then construction of a temporary causeway to access and build the east west breakwater (This methodology would be required for the east-west breakwater as there is no vehicle access on the existing marina breakwaters.). This methodology would also enable the basin dredge works and reclamation works to occur in an enclosed area hence minimising water quality impacts to the adjacent Marine Park. Causeway material could then be used in the carpark works.

Two main dredging methodologies are likely for the works: (1) mechanical dredging and placement, e.g. by a backhoe dredge (BHD) directly placing material onshore; and (2) hydraulic dredging and placement, e.g. by a cutter suction dredge (CSD) pumping material to reclamation cells. Where the latter methodology is used, cells will need to be constructed before commencement to allow for capture and dewatering of the material once placed. A preferred methodology has not yet been identified. Note that future maintenance dredging will make use of an approved offshore placement

area; therefore, the construction phase will not include the development of a long-term onshore placement site.

3.3 Future Design

Prior to commencement of works, it will be necessary to undertake detailed design and to engage a contractor based on a detailed construction methodology. As part of these future stages, the following matters will be confirmed:

- Terrestrial and marine infrastructure footprints, including extent of habitat for clearing/direct disturbance
- Footprint for construction activities (e.g. laydown areas, access tracks)
- Construction approach, including equipment to be used (e.g. land-based vs. barge-based equipment)
- Reclamation methodology (excavation v pipeline placement)
- Location and design of erosion and sediment control (ESC) structures
- Final landscaping and drainage arrangements
- Material to be used for construction purposes, including transport corridors and likely truck movements.

Detailed design of the development will be undertaken in accordance with the design standards included in Table 3-1.

Table 3-1 Design standards for Project works

Designation	Title	Application
AS 1170 (Parts 0 to 4)	Minimum design loads on structures	General loadings including wind load and earthquake loads Load combinations
AS 2758.6	Guidelines for the specification of armourstones	Armourstone durability
AS 3962	Guidelines for the design of marinas	Navigation and design for small craft facilities
AS 4997	Guidelines for the design of maritime structures	General design requirements Extreme still water level for deck level determination and extreme wave loads for structural design Design loads Load combinations
BS 6349 (Parts 1 and 7)	British Standard code of practice for maritime structures	Design wave loadings Design of revetment

Designation	Title	Application
n/a	TMR Manual: Design criteria for boat ramps	Design of public boat ramps in Queensland
EM2093	DES Operational Policy: Building and engineering standards for tidal works	Minimum design criteria for tidal works under planning legislation
n/a	Far North Queensland Region Organisation of Councils (FNQROC) Development Manual – Issue 6 (2014)	Design of earthworks and associated structures
AS 4282-1997	Control of the obtrusive effects of outdoor lighting	Design of lighting on structures

4 Environmental and Statutory Context

4.1 Existing Environment

4.1.1 Coastal Processes and Sediment

The coastline of Half Moon Bay is bounded by Yorkeys Point headland to the southeast and Earl Hill to the northwest with Half Moon Creek discharging into the central section of the bay. Prior to 1990 the foreshore of Half Moon Bay was essentially undeveloped; however, since then two significant developments have been constructed, with impacting processes described below:

- Half Moon Bay Marina: dredging within marina and outer entrance channel, material placement to the west and north of the breakwater walls, construction of marina and breakwaters.
- Bluewater Harbour: Construction of channels, marina and canals, cutter suction dredging of Half Moon Creek, material placement at the Half Moon Bay Spoil Ground.

Since construction of the above developments, ongoing maintenance dredging has been required to maintain navigable access. The dredge areas are shown in Figure 4-1. EcoSustainAbility (2018) provides an overview of dredging activities as summarised below.

Dredge Area 1

Dredge Area 1 covers Half Moon Creek upstream of the entrance and the Bluewater Harbour development comprising the marina and canals. The area has had one major maintenance dredging program in 2012 and it is anticipated that dredging will be required every 5-10 years.

Dredge Area 2

Dredge Area 2 includes the active entrance area of Half Moon Creek, the link channel to the Half Moon Bay Marina and its entrance and the outer channel to offshore. The sand bar at the Half Moon Creek mouth has been dredged twice annually in most years since construction.

The link channel area to the entrance to the Half Moon Bay Marina is very active and subject to littoral drift and typically dredged 2-3 times per year. The area just inside the entrance to the Half Moon Bay Marina accumulates fine silt and is dredged at least once per year.

The outer channel area accumulates mostly silts and is dredged 1-2 times per year.

Dredge Area 3

The main basin area of the Half Moon Bay Marina is dredged as sediment accumulates. The Half Moon Bay Marina basin has had irregular dredging of select areas and an overall dredging program in 2008 which removed 40,000 m^3.

Annual Average Inner Channel Siltation

The estimated range of annual average siltation based on the hydrographic survey analysis was 2,700 to 24,000 m^3/year.

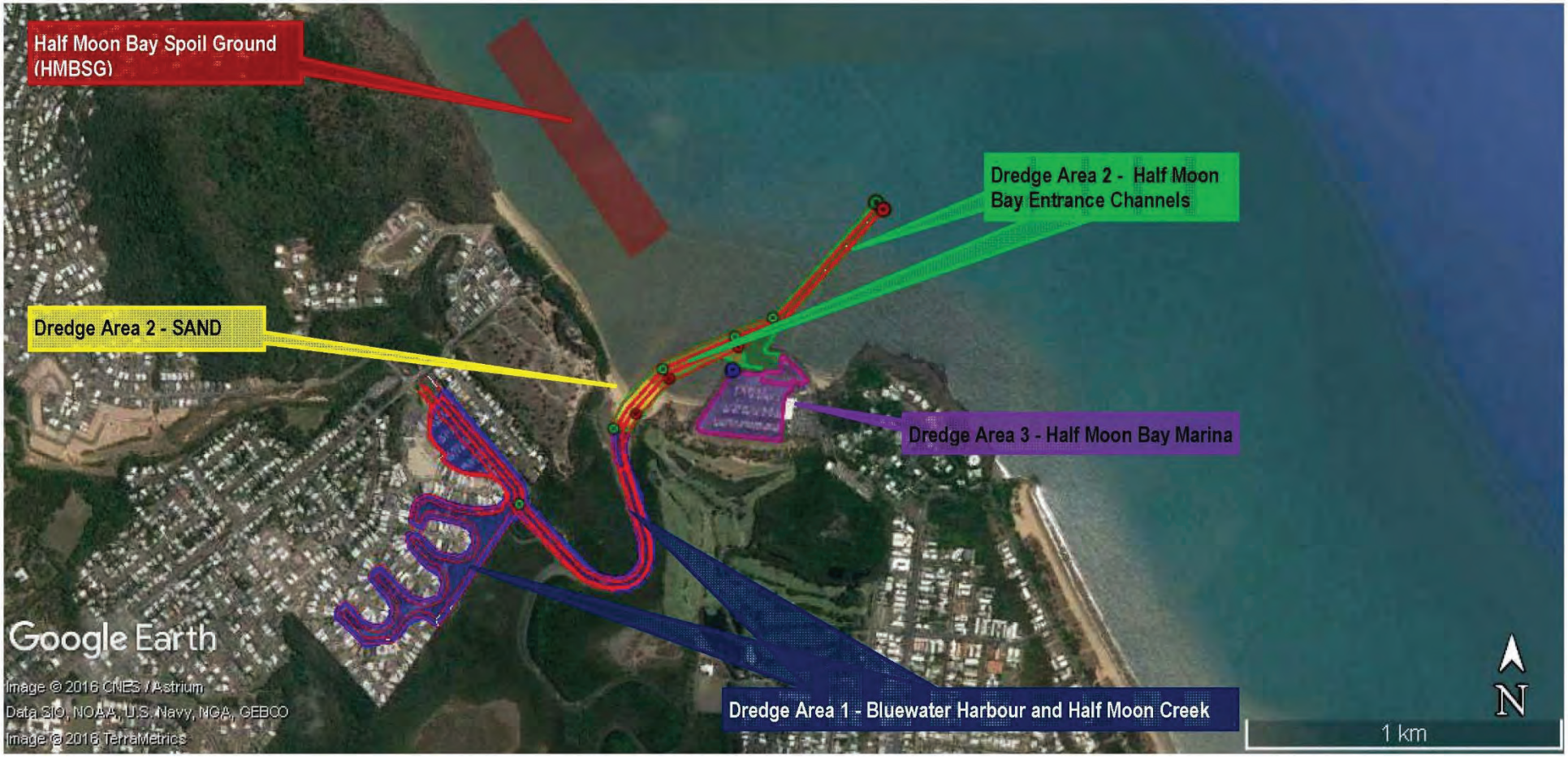

Figure 4-1 Half Moon Bay dredge areas and spoil ground (from EcoSustainAbility, 2018 Figure 3)

The tidal planes for the area are shown in Table 4-1, based on the 2019 semidiurnal tidal planes published by Maritime Safety Queensland (MSQ) for the Cairns standard port (in Trinity Inlet).

Table 4-1 2019 semidiurnal tidal planes for Cairns (MSQ, 2019) – levels are metres above LAT

LAT	MLWS	MLWN	AHD	MSL	MHWN	MHWS	HAT
0.00	0.78	1.46	1.643	1.70	1.94	2.62	3.50

The blended tide plus surge levels for Tropical Cyclone (TC) and Non TC events plus surge at Half Moon Bay are summarised in Table 4-2 based on average recurrence interval (ARI). The blended tide plus surge AEP curve based on these statics for Yorkeys Knob (yellow) is shown in Figure 4-2, together with the non-TC (blue) and TC (red) components. These statistics show that the likelihood of surge events above HAT occur at the 2-year ARI, with TC and non-TC events curves coinciding at the 200 year ARI. Prior to this point, Non-TC events have a higher water level (mAHD) than TC events. These statistics do not include wave influence and, are based on analysis of the current climate that does not include future climate assumptions, such as a projected increase to mean sea level.

Based on these statistics, up to the 200-yr ARI event the Project infrastructure will not be inundated. At the 500-yr ARI the access road may be inundated, while the breakwater and carpark will remain above the surge level.

Table 4-2 Present climate extreme water level statistics in Half Moon Bay (BMT, 2019)

ARI (years)	Tide plus surge (mAHD)
1	1.50
20	1.93
50	1.99
100	2.04
200	2.10
500	2.27

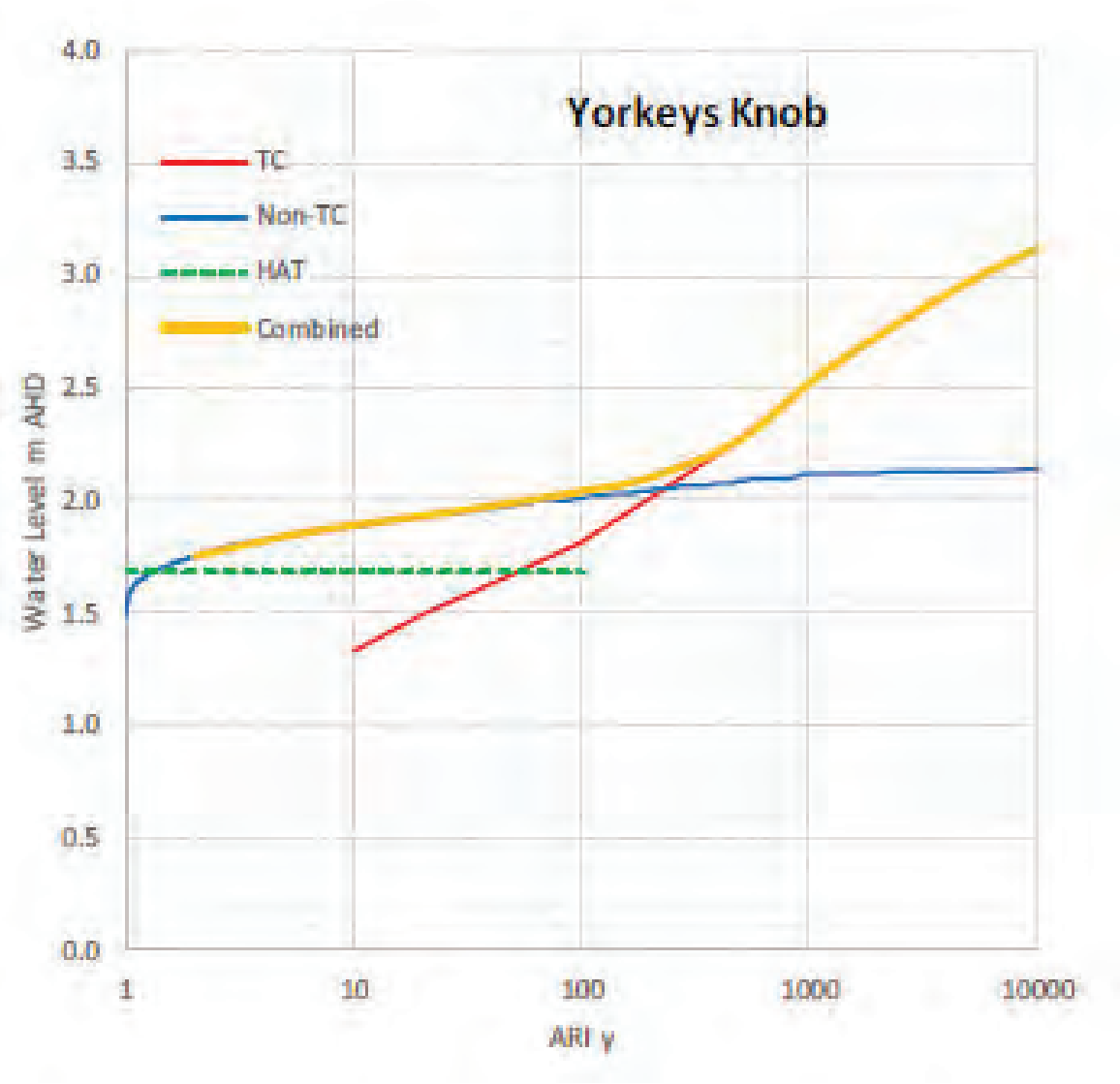

Figure 4-2 Blended TC and Non-TC tide plus surge extreme water levels for Yorkeys Knob

In relation to fluvial flood mechanisms, the dominant source of flooding for the proposed site is from regional flooding associated with the Barron River. Flood impact at the site can vary depending on tide/surge levels within Half Moon Bay. The proposed site (access road and carpark) is generally flood free for all regional flood events up to and including the 50-yr ARI design flood event. Flooding at the site is a result of flow through the creek (proposed car park area) and via breakout through the upstream golf course in the case of the access road. Golf course breakout occurs though existing drainage paths within the golf course to discharge via the existing drainage path in to the downstream marina. For larger flood events (100-yr ARI and greater) flow inundates the majority of the upstream golf course and inundates the length of the proposed access road to discharge across the length of the southern boundary of the marina.

The natural bed surface in this area is gravels and muds which have become overlain with sand displaced by the channel dredging. This material is all uncontaminated due to the absence of

significant upstream contamination sources (e.g. industry, farming) and the dynamic nature of Half Moon Bay. The presence of actual acid sulfate soils (ASS) in the sediment is unlikely and has minimal potential for potential ASS (BMT, 2019).

4.2 Environmental Values

The project site comprises a range of habitat types including estuarine wetlands associated with intertidal reaches, foredune communities on coastal sands, and unvegetated beaches. The site is bounded to the west by Half Moon Creek, to the south by previously cleared lands associated with the Half Moon Bay Golf Club, to the north by marine waters associated with the marina, and residential development to the east.

4.2.1 Terrestrial Ecology (including Mangroves)

The project site comprises a range of habitat types including estuarine wetlands associated with intertidal reaches, foredune communities on coastal sands, and unvegetated beaches. The site is bounded to the west by Half Moon Creek, to the south by previously cleared lands associated with the Half Moon Bay Golf Club, to the north by marine waters associated with the marina, and residential development to the east. Key aspects of the habitat values are summarised below:

- Half Moon Creek and the low-lying intertidal reaches of Ray Howarth Park in the east of the project area support mangrove open forest, dominated by *Rhizophora stylosa* mapped as Regional Ecosystem (RE) 7.1.1.
- Intertidal reaches of the marina support a discontinuous fringe of mangroves dominated by *L. racemosa* which are bounded on the landward side by patches of saltmarsh dominated by *Sporobolus virginicus*.
- Threatened epiphytic ant plants (*Myrmecodia beccarii*) have been recorded in two *R. stylosa* at the mouth of Half Moon Bay to the southwest of the proposed carpark. Four ant plant colonies have also recorded on a large *Melaleuca leucadendra* on Buckley Street in the vicinity of the proposed road access.
- The sand dune in the north of the project area landward of the intertidal zone supports a foredune complex of RE 7.2.7a, comprising grassland, shrubland, low woodland and open forest of varying structure and condition. The foreshore and headland (proposed carpark) are dominated by *Casuarina equisetifolia* averaging 10-12 m in height and 60% cover over a sparse lower canopy.
- The headland is fronted by beach strand vegetation comprising a sparse groundcover of Ipomoea pes-caprae and *Cyperus pedunculatus* with the weeds *Stylosanthes scabra, Cenchrus echinatus, Melinis repens* and *Ageratum houstonianum*.
- The landward zone of the foredune complex is dominated by a mixed canopy ranging from 6-10 m in height and 10-50% cover. A variable sub-canopy ranging from 2-4 M in height and 5-20% cover and sparse emergents 12-15 m in height also occur at some sites.
- The epiphytic fern *Pyrrosia longifolia* is common and two unidentified epiphytic orchids have been recorded adjacent to the mangroves in the east of the dune complex.

- Results from a protected matters search indicated the project site could support the Broad-leaf Tea-tree (Melaleuca viridiflora) Woodlands in High Rainfall Coastal North Queensland Endangered threatened ecological community (TEC) under the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act). However, no vegetation communities conforming to this type have been recorded in project site area. Figure 4-4shows the distribution of vegetation types. Figure 4-5 shows the habitat mapping including relevant regional ecosystems (REs) for the area.
- No studies have been conducted on the flight paths of flying-foxes from Ray Howarth Park or the Yorkeys Knob area. However, there are extensive areas of vegetation northwest, west, southwest and southeast of the site that would likely provide foraging habitat for this colony. it is known that spectacled flying-foxes regularly travel between their roosting area and vegetation communities containing suitable feeding trees, including rainforests, vine forests and tall open forests (DoEE, 2019). It is therefore likely that their flight paths occur to and from Ray Howarth Park.

The ant plant (*Myrmecodia beccarii*) is the only threatened species confirmed for the project area during field surveys. However, a camp for spectacled flying fox (*Pteropus conspicillatus*) is also known in the mangrove forest of Ray Howarth Park to the southwest of the study area (DoEE, 2019). Individuals from this camp are likely to regularly overfly the project area.

The remnant vegetation of the project area likely provide habitat for a variety of fauna and flora species. The terrestrial aspects of the project area have high habitat complexity, ranging from dense vegetation to logs and leaf litter through to the intertidal waters. Despite this, habitat availability for mammals and reptiles is still considered to be low, with birds expected to be the dominant vertebrate group present.

4.2.2 Marine Ecology

The majority of the marine environment within the project area is soft sediment. The only reef or rocky area observed is a boulder field located in the existing dredged navigation channel, just north of the proposed boat ramp. It is unlikely that these boulders support hard corals due to their proximity to the creek, the depth of the habitat and the persistent dredging occurring in the area. However, it is possible that these substrates support other sessile species such as bryozoans, sponges, stinging hydroids and very hardy soft corals that can tolerate brief periods of freshwater (e.g. *Echinomuracea* spp.). Some bryozoans, sponges and sea urchins do exist within the project area. The soft sediment communities are considered to have low densities of visible macroinvertebrates. Seagrass studies within the Half Moon Bay (BMT 2019; BMT 2019a) broader project site conclude that no seagrass is present.

Marine macroalgae occurs throughout the project area, with highest densities near the proposed boat ramp and breakwaters (see Figure 4-6). This cover is composed entirely of species resembling the red algae *Hypnea,* a common macroalgae likely to be utilising nutrient runoff from Half Moon Creek.

The listed threatened or migratory species potentially supported include a range of migratory shorebirds together with seabirds, turtles, inshore dolphins and dugong with the intertidal, wetland and beach habitats of the project area. Estuarine wetlands may support saltwater crocodiles.

4.2.3 Water Quality

Water quality monitoring in Half Moon Bay has been undertaken by EcoSustainAbility as part of Council's long-term maintenance dredging in the area. This monitoring has occurred across seven sites (Figure 4-3) between 2007 and 2018. While data is not available for the boat ramp area, a summary of this monitoring in the Half Moon Bay Spoil Ground Monitoring and Management Plan (HMBM&MP; EcoSustainAbility, 2018) indicate the following:

- There is a strong correlation between turbidity and wind/wave climate. Wind has been a greater driver of turbidity in the bay than disturbance associated with dredging.
- Turbidity is naturally high, with turbidity frequently exceeding 20 NTU.

High turbidity levels are expected to also be generated during flood events which typically occur through the wet season each year.

The bay does not support seagrass communities, despite meadows occurring in the local region. This may also indicate naturally high turbidity levels year-round.

The waters of Half Moon Bay are HEV waters under the scheduled plan for the area (Barron River Basin, Basin No. 110 and adjacent coastal waters). Table 4-3 lists the water quality objectives for this area. These represent the values to be achieved to maintain or enhance the water quality of the area. However, these should be considered in light of the monitoring noted above which suggests waters have much higher turbidity (and suspended solid) concentrations.

Figure 4-3 Water quality (WQ) and benthic habitat (BSG) monitoring sites from HMBM&MP (EcoSustainAbility, 2018)

Table 4-3 Water quality objectives for Half Moon Bay (maintain or enhance aquatic ecosystems)

Parameter	Objective
Dissolved oxygen	85-105% saturation
pH	7.5-8.4
Ammonia N	15 µg/L
Oxidised N	10 µg/L
Organic N	135 µg/L
Total N	160 µg/L
Filterable reactive phosphorus	5 µg/L
Total P	20 µg/L
Chlorophyll-a	2.0 µg/L
Turbidity	10 NTU
Secchi depth	1 m

Aerial image: 19 August 2019 © Nearmap

Concept Design

- Toilet block
- Beach
- Breakwater
- Boat ramp
- Carpark, access road and pedestrian paths
- Carpark and boat ramp line marking, kerbing and pedestrian paths
- Disabled parking

Data source:
Royal Haskoning DHV (15 January 2020)

Half Moon Bay Marina

Buckley Street

Half Moon Bay Golf Course

LEGEND

- Ant plant records December 2018

Terrestrial Habitats

- Beach
- Coastal grassland
- Coastal melaleuca woodland
- Coastal woodland
- Intertidal flats
- Mangroves

Title:

Terrestrial Habitats in Works Footprint Including Known Habitat for Vulnerable Ant Plant *(Myrmecodia beccarii)*

Figure: 4-4

Rev: B

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LEGEND

- Indicative Boat Ramp Footprint
- Indicative Dredging Footprint
- Ecology Survey Extent
- Remnant Regional Ecosystem (labelled with ID)

Aerial image 13 February 2019 © Nearmap

Title:

Mapped Habitats (Terrestrial) Within the Works Footprint

Figure: 4-5

Rev: B

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

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Aerial image: 19 August 2019 © Nearmap

Concept Design

- Toilet block
- Beach
- Breakwater
- Boat ramp
- Carpark, access road and pedestrian paths
- Carpark and boat ramp line marking, kerbing and pedestrian paths
- Disabled parking

Data source:
Royal Haskoning DHV (15 January 2020)

Half Moon Bay Marina

Buckley Street

Half Moon Bay Golf Course

LEGEND

Terrestrial Habitats

- Coastal melaleuca woodland
- Intertidal flats
- Mangroves

Macroalgal Cover and Density

- <1%
- 1-5%
- 5-10%
- 10-15%
- 15-20%

Title:

Marine Plants (Casuarina, Mangroves, Saltmarsh, Macroalgae) Within and Adjoining Project Area

Figure: 4-6

Rev: B

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Filepath: I:\B24067_I_GML_Yorkeys Knob Approval\DRG\EMP\ECO_009_200225_Marine Plants Within and Adjoining New Project Area.WOR

4.2.4 Amenity

Half Moon Bay and the surrounding area has existing development, including the marina and golf course on the southeast side of the creek, and Trinity Park on the northwest side (adjoining Bluewater Harbour and canal estate). This development has altered the immediate area from a natural state. The Bluewater canal estate and marina have necessitated a frequent and ongoing maintenance dredging campaign to maintain navigation in Half Moon Creek. Riparian areas of Half Moon Creek and the foreshore of Trinity Park both remain in a mostly natural condition. Riparian areas of Half Moon Creek and the foreshore of Trinity Park both remain in a mostly natural condition.

The current sources of emissions at the project area consist of marina activities, traffic on Buckley Street and overflying planes (the area is in the 20 to 25 aircraft noise exposure forecast contour). These emissions have a minor impact on the amenity of the area.

4.3 Traffic, Transport and Navigation

The project area is access from Buckley Street which comes off Varley Street. Varley Street is the only access road in and out of the Yorkeys Knob area and is the main thoroughfare of the Yorkeys Knob residential area. Varley Street connects to the Captain Cook Highway either via Yorkeys Knob Road, which runs through cane lane, or Dunne Road-McGregor Road, which run through emerging community and residential areas.

The entire road connection from Captain Cook Highway to Yorkeys Knob is single carriage, two-way road utilised solely by light vehicles. This includes vehicles towing boat trailers that utilise the Half Moon Bay marina boat ramp for vessel launching.

Vessel traffic in the area comes from three main sources: vessels launched at the boat ramp, vessels from the marina, and vessels from Bluewater Harbour. Some small vessels are likely to travel up Half Moon Creek while all larger vessels will move towards offshore waters. These larger, ocean-going vessels are expected to make up the bulk of vessel movements for the area. Therefore, the vessel traffic transiting through/past the project site would consist of a small number of vessels heading upstream after launching at the boat ramp and a larger number heading downstream from Bluewater Harbour.

A channel is maintained from Bluewater Harbour through to the Half Moon Bay entrance. This is shown in plans from the HMBM&MP (HMBLTMMP; EcoSustainAbility, 2018). The inner and outer entrance channels have a design depth of -4.5 m AHD, which is approximately -2.9 m LAT. Within the marina and harbour, this decreases to -4.5 m AHD/-2.4 m LAT.

5 Project Impacts

The following Section describes the environmental impacts associated with the proposed development option. The intention of this assessment is to provide an indication of the scale of environmental impact likely to result from construction and operation of the project infrastructure.

5.1 Construction Phase Impacts

5.1.1 Direct Habitat Loss

Expansion of the road and reclamation / construction of the carpark will require clearing of areas of vegetation. Table 5-1 describes the areas of terrestrial and marine habitat overlapped by Project structures. Areas adjoining infrastructure footprints may also require some clearing as part of construction activities but would be subject to rehabilitation at the end of the construction phase. In addition to clearing impacts, works can cause the introduction of invasive species into vegetation communities. These can be introduced through imported rock/soil material and on construction equipment. Clearing also causes a change in light regimes for adjoining areas.

No threatened species are expected to occur within the infrastructure footprint. However, there is the potential for ant plant (*Myrmecodia beccarii*) in the mangroves within the access road footprint. This would need to be confirmed prior to commencement of works. Given the limited extent of habitat disturbance required for the works in the context of the wider region, significant impacts to MNES and MSES are considered unlikely.

In addition, construction activities can have impacts to threatened fauna species in relation to introduction of construction noise and artificial lighting.

Table 5-1 Terrestrial and marine habitat impacted within Project infrastructure footprint

Project element	Habitat lost		MSES impacted (ha)				
	Description	Area (ha)	Marine plants	HES wetlands	HEV waters	Category B vegetation	Essential habitat
Boat ramp (incl. floating walkways)	Macroalgae and benthic substrate Beach	0.264	0.256	0.254	0.174	-	-
Breakwater(s)	Macroalgae and benthic substrate Beach (western breakwater) Coastal woodland (western breakwater) Mangroves (western breakwater)	0.721	0.431	0.651	0.711	-	-
Basin	Macroalgae and benthic substrate	0.559	0.440	0.469	0.497	-	-
Reclamation Area	Macroalgae and benthic substrate	0.432	0.357	0.597	0.531	0.009	0.009

Project element	Habitat lost		MSES impacted (ha)				
	Description	Area (ha)	Marine plants	HES wetlands	HEV waters	Category B vegetation	Essential habitat
	Beach	0.277	-	-	-	-	-
	Coastal grassland, coastal woodland, coastal melaleuca woodland and mangroves	1.210	-	-	-	-	-
Access road and path	Coastal woodland and mangroves	0.418	-	-	-	0.297	0.326
Fence	Coastal grassland, coastal woodland and coastal melaleuca woodland	0.125	-	-	-	0.113	0.113
	Total	**3.881**	**4.006**	**1.484**	**1.971**	**1.913**	**0.419**

5.1.2 Fish Passage

The access road crosses a waterway draining from the golf course into Half Moon Bay Marina. The construction of the road crossing will incur a temporary blockage to the waterway however it is not likely to cause significant impact due to the small construction timeframe associated with this element.

5.1.3 Water Quality

Dredging and placement activities have the potential to cause the following environmental impacts:

- Mobilisation of bed sediment and generation of turbidity during dredging, leading to non-compliance with turbidity, suspended sediments, dissolved oxygen and/or nutrient water quality guidelines.
- Generation of turbid plume at outlet from reclamation cells.
- Overtopping of the reclamation cells.
- Mobilisation of ASS, leading to acidic runoff and non-compliance with dissolved metal and pH water quality guidelines and/or impacts to aquatic life ecosystems.
- Contamination of land and groundwater with saline and/or acidic material.
- Scour of coastal environment near the dredging area.

Construction works activities may cause the following water quality impacts:

- Stormwater runoff from construction areas by sheet flow into the marine environment. Activities at risk of introducing contaminants to the marine environment include earthworks, stockpiling of material, and clearing vegetation, as well as the risk of spills associated with construction equipment and vehicles.

- Turbidity generated by placement of rock for breakwater, including material disturbed from the bed and generated from the rock material directly (if rock material is dirty), as well as any sediment disturbance that may be associated with vessel movements.
- Acid and heavy metal runoff from ASS disturbed during construction. Where excavation is undertaken in intertidal or subtidal waters, sediment, including ASS and/or contaminated material, could resuspend into marine waters. Any material stockpiled from this excavation can also cause turbidity impacts associated with the discharge of tailwater settling from the stockpile.
- Spills and inappropriate discharge of waste into the marine environment.
- The discharge of other contaminants, including hydrocarbons, and the exposure of soils, potentially leading to erosion, runoff and sediment loading, may also occur if appropriate controls are not in place.

5.1.4 Marine Megafauna

The placement of rock material for breakwater construction and piling activities, as well as any vessel traffic associated with water-based works, pose risks to marine megafauna (i.e. cetaceans, dugong, sharks, marine turtles). These relate to the risk of direct strike and vibration. As many marine megafauna species are threatened, management of these potential risks is considered of high importance.

Artificial lighting during the construction phase is not considered a key risk to turtles risk to turtle nesting or hatching. While works should occur outside of turtle nesting season measures will be implemented as a precaution.

5.1.5 Spills and Waste

Construction activities have the potential to release hydrocarbons and other contaminants to the environment as a result of spills from equipment and vehicles, and to generate waste. The potential contaminants/waste products that could be generated during the construction phase includes the following:

- Fuels and oils (from equipment and vehicles)
- Vegetation litter
- Excess rock, soil and/or other construction materials
- Dredge pipeline (if required)
- General litter.

5.1.6 Dust, Noise and Light

Construction phase activities have the potential to generate dust, particular in relation to transport of quarry material to site (if dirty), and from clearing and excavation. In addition, construction works will cause noise. These impacts have the potential to cause impacts to local amenity, including to users/owners of the Half Moon Bay Marina, local residents of Buckley Street and Dowsett Close and to recreational users of Yorkeys Knob.

5.1.7 Traffic

Quarry material for use in construction works is intended to be brought to the site by trucks. Construction equipment will also transit to the site via existing roads. As a result, the construction phase will cause an increase in traffic along Buckley Street as well as connecting road networks. Increase in traffic poses risks to pedestrians, other vehicles and fauna that may be crossing the road.

The impact to traffic can be broken into four categories:

- Within project area – no impact
- Buckley Street-Varley street – some truck movement interacting with residential areas
- Varley Street-Yorkeys Knob – truck movements interacting with light traffic
- Captain Cook Highway (and beyond) – no material change to existing vehicle movements.

As an alternative to truck transport, rock material may be stockpiled at a site at the Cairns Port where it is loaded onto a barge and then brought to site. These marine works would be managed through a Notice to Mariners and Marine Execution Plan/Vessel Traffic Management Plan. The inclusion of marine based construction will be defined once design and construction methodology is finalised.

6 Environmental Management Elements

This Section provides a description of the environmental management actions that will be undertaken during construction phase to avoid and mitigate potential environmental impacts. It includes Project-wide considerations (i.e. those related to design, methodology, timing etc.) and individual management elements focusing on specific environmental values.

For each individual management element, the following have been defined:

Objective	The overall outcome intended to be achieved for that element; typically linked to achieving compliance with statutory/approval requirements
Performance Criteria	Nominated criteria that, if met, indicate the Objective of the element has been achieved
Further Investigations	Further studies to be undertaken by and management plans to be developed by the Contractor (or other party) prior to commencement of construction but subsequent to issue of Project approvals and development of detailed design.
Preferred Management	Nominated management actions that represent the preferred way in which Performance Criteria and Objectives for the element can be met.
Monitoring	Actions to measure whether or not Performance Criteria have been achieved
Reporting and Auditing	Requirements to continually review management actions, check compliance with statutory/approval requirements
Corrective Action	Actions to be taken if monitoring indicates that Performance Criteria are not being met

The Objective for each element is required to be achieved by the Contractor for the works, although this may or may not include the Preferred Management actions. The Contractor is also responsible for ensuring further studies have been undertaken and management plans developed prior to construction commencing.

The individual management elements for the CEMP consist of the following:

- Vegetation clearing
- Flora and fauna
- Water quality (including turbidity and ASS)
- Spills and waste management
- Dust, noise and light
- Traffic.

6.1 Project-wide

In order to mitigate impacts from the construction phase of the Project, the following principles will govern construction activities:

- Prior to the commencement of works, an updated CEMP will be prepared for approval by TMR, based on requirements of approvals and relevant parts of detailed design and construction methodology. This CEMP must meet the objectives of the management elements set out below and also include emergency response/contingency plans.

- Selection of preferred dredging and construction methodology, including location of material to be imported and disposed.
- Works will be primarily undertaken during winter months to avoid the risks associated with summer storms and tropical cyclones.
- Prior to commencement of construction, the footprint of works will be refined to ensure that high value habitat features (i.e. mangroves and other vegetation) are avoided to the greatest extent practicable.
- Final detailed design will be provided to all relevant agencies for sign off (respective to their jurisdiction) prior to commencement of construction.
- All construction stockpiles and laydown areas will be established on already disturbed areas outside of the tidal influences (e.g. existing car park).
- Design of culvert for fish passage.

A monthly Environmental Performance Report (EPR) is required to be prepared by the Contractor Superintendent and provided to the TMR Principal for review. The information required for the EPR is set out in the management elements below but should include details of any works, management actions and monitoring undertaken, and environmental incidents occurring, with the reporting period.

The Principal and/or delegate, and the TMR Project Engineer will conduct at least one audit of the site during the construction phase to ensure compliance with the CEMP and Project approvals.

6.2 Vegetation Clearing

Management measures related to these impacts are described in Table 6-1. Measures related to the threatened species are described in Section 6.3.

The management objective for the mangroves and open/closed shrubland element is:

> ***Vegetation communities, outside of Project footprint, are retained in a natural condition practicable and do not suffer community collapse.***

This management objective is governed by the Fisheries Act and reflects requirements of the NC Act.

Table 6-1 Management measures for vegetation clearing

Objective	Vegetation communities, outside of Project footprint, are retained in a natural condition practicable and do not suffer community collapse
Performance Criteria	• No net loss of vegetation outside of Project footprint • No occurrence of new weeds or disease in adjoining vegetation.

Further Investigations	**Responsibility**
A Clearing Plan must be prepared, clearly identifying: • Areas of vegetation that will be permanently lost, areas that will be impacted but rehabilitated, and areas that will be retained • Methodology for clearing, including staging and equipment to be used • Measures for retaining topsoil and vegetation material for use in mulching.	*Preparation*: Contractor, using a qualified botanist/arborist *Approval*: TMR
A Rehabilitation Plan must be prepared, including long-term rehabilitation objectives, native species intended to be used for rehabilitation.	*Preparation*: Contractor, using a qualified botanist/arborist *Approval*: TMR

Preferred Management	**Responsibility**	**Timing**
Clearing must be undertaken in accordance with the approved Clearing Plan.	Contractor Superintendent	At all times
Mangroves will be cut off at ground level leaving roots in situ to prevent disturbance to PASS.	Contractor Superintendent	At all times
Ensure that vegetation clearing boundaries are established with appropriate signage at regular intervals and visible and physical markings (high visibility tape, barricade webbing). Ensure that all contractors are aware of these boundaries.	Contractor Superintendent	At all times
All topsoil disturbed during vegetation clearing must be retained in a bunded and covered stockpile on site and used for rehabilitation works.	Contractor Superintendent	Prior to rehabilitation
No vegetation is to be burned as a form of removal or disposal.	Contractor Superintendent	At all times
Weed management will be undertaken during construction to ensure new weeds are not introduced to the area, including: • Mandatory weed wash down for vehicles and plant entering/existing the study area • Limited vehicle and plant movements in known weed infested areas • Any filling in works area to use only clean fill material that is certified as weed free (weed certificates to be retained).	Contractor Superintendent	At all times
Soil stockpiles to be located away from existing vegetation.	Contractor Superintendent	At all times
Upon completion of works, areas for rehabilitation and/or offsetting must be planted in accordance with the Rehabilitation Plan.	Contractor Superintendent	Following completion of works
Drainage from works area following works to be restored as close to pre-works condition as possible. Where not practicable, drainage to be designed to ensure no waterlogging and death of adjoining vegetation.	Contractor Superintendent	During restoration works

Monitoring	• Weekly inspections of adjoining vegetation during and up to 3-month post-works in order to identify evidence of weeds, disease and/or native vegetation mortality and feral animals on site. • Contractor Superintendent to undertake monitoring of rehabilitation sites as per the Rehabilitation Plan
Auditing and Reporting	• EPR to be prepared by Contractor Superintendent at end of every fortnight, including details on a) clearing activities, b) rehabilitation activities, including success of plantings, and c) sightings of weeds, disease and/or unapproved vegetation mortality, within the reporting period. • Principal and/or Project Engineer (or delegates) to conduct at least one audit of the Project area during the construction phase to test compliance with the CEMP. • Post-works reporting to be conducted by Construction Superintendent in regards to viability of planted areas, in accordance with Rehabilitation Plan.

Corrective Action	Responsibility	Timing
• Identify source of weeds, disease and/or mortality. • Take actions as necessary to remove weeds, disease and/or mortality, including as advised by State Government agencies. • Report any unapproved clearing to Principal	Contractor Superintendent	Immediately after impact is identified
• Notify DES and DAF of any unapproved clearing. • Review and approve any amendment to the Rehabilitation Plan. • Conduct audit of the Project area to ensure compliance with new plans/management.	Principal	Immediately after impact is identified

6.3 Flora and Fauna

Management measures related to terrestrial and marine flora and fauna impacts are described in Table 6-2. Measures related to construction phase traffic (e.g. risks of striking fauna crossing access roads (once built)) will be considered under a traffic management plan outlined Section 6.7, while measures related to clearing and weed management are considered in Section 6.3. Management actions for noise and light are outlined in Section 6.6.

The management objective for the terrestrial threatened species element is:

No impacts to threatened flora or to fauna as a result of construction activities.

This management objective is governed by the NC Act, and reflects requirements of the EPBC Act.

Table 6-2 Management measures for terrestrial flora and fauna

Objective	No impacts to terrestrial and marine flora or to fauna as a result of construction activities
Performance Criteria	• No incidence of threatened flora clearing or loss as a result of construction • No injury/mortality of fauna during construction

Further Investigations	**Responsibility**
A Pre-construction Survey must be undertaken to identify threatened and other important flora and fauna species (or habitat) within the construction area.	Contractor Superintendent, using a qualified ecologist
If Pre-construction Survey identifies threatened flora species within the construction area, a Translocation Permit must be obtained.	*Preparation*: Contractor Superintendent, using a qualified ecologist
	Approval: DNRME/DES
If Pre-construction Survey identifies threatened fauna species or habitat within the construction area, a Species Management Plan must be prepared.	*Preparation*: Contractor Superintendent, using a qualified ecologist
	Approval: DES

Management Action	**Responsibility**	**Timing**
Any threatened flora species within the construction area identified during the Pre-construction Survey must be translocated in accordance with the Translocation Permit by a suitably qualified person.	Contractor Superintendent	Prior to works
Any threatened fauna species or habitat within the construction area identified during the Pre-construction Survey must be translocated in accordance with the Species Management Plan by a suitably qualified person.	Contractor Superintendent	Prior to works
If native fauna enters the work site, construction works must cease. Construction activities will continue once the animals has moved from the work site or caught and relocated by a qualified and licenced spotter/catcher.	Contractor Superintendent	At all times
Domestic animals must be prohibited in the construction area.	Contractor Superintendent	At all times
Artificial light sources must be shielded, redirected away from the foreshore, directional fixtures that pointed down and the lowest wattage possible lighting used to ensure terrestrial fauna behaviour/movement patterns is not disrupted.	Contractor Superintendent	At all times
Low-noise and vibration-emitting equipment must be used during construction activities where possible.	Contractor Superintendent	At all times
Temporary fish passage works are undertaken with Approval conditions.	Contractor Superintendent	At all times
All marine works must be conducted only during daylight hours when there is surface visibility of up to 1 km (360 degrees).	Contractor Superintendent	At all times
Pre-start and ongoing regular visual inspections of the works area must be conducted during rock placement and piling activities. If marine megafauna are sighted within the works area, potentially harmful marine activities must be stopped until animals have moved away from the construction area.	Contractor Superintendent	During rock placement and piling activities
Construction activities will be planned and executed to minimise and avoid interactions between with marine mammals and turtles, including:	Contractor Superintendent	At all times

• Construction vessel operational buffers of 100m from large cetaceans and 50m from dolphins • No-wash speed limits within 100m of whales or 50m from dolphins 'Go-slow' limits for small construction vessels near seagrass and reef areas		
Water-based noise activities (e.g. rock placement) must be commenced gradually to provide warning to nearby marine megafauna (i.e. soft-start procedure).	Contractor Superintendent	At all times
Where possible artificial light sources will be shielded and redirected away from adjacent beach environments to ensure marine fauna behaviour/movement patterns is not disrupted.	Contractor Superintendent	At all times
Directional fixtures that point down will be used wherever possible.	Contractor Superintendent	At all times
The lowest wattage possible lighting will be used with the source selected to avoid environmental impacts, e.g. low-pressure sodium vapour lighting and 'bug' lights.	Contractor Superintendent	At all times

Monitoring	• Daily inspections of works areas to identify any mortality of fauna or threatened flora. • Contractor Superintendent to undertake monitoring in accordance with Translocation Permit and/or Species Management Plan.
Auditing and Reporting	• Any sightings of threatened flora or fauna in the works area or adjacent environments during construction must be reported. Reports will be stored in a central database developed and maintained by the contractor, and any incident of harm reported to the DES Hotline (1300 130 372). • EPR to be prepared by Contractor Superintendent at end of every fortnight, including details on a) sightings of threatened fauna, including description of behaviour, and b) identification of threatened flora or fauna habitat within works area, and actions taken (e.g. stop works), within the reporting period. • Principal and/or Project Engineer (or delegates) to conduct at least one audit of the Project area during the construction phase to test compliance with the CEMP.

Corrective Action	Responsibility	Timing
• Notify Principal • Bring any injured animal to local vet • Identify cause of the mortality/clearing and updated relevant management plans	Contractor Superintendent	Immediately after impact is identified
• Notify DES and/or GBRMPA • Review and approve any amended management plan element • Conduct audit of the Project area to ensure compliance with new plans/management actions	Principal (or delegate)	Immediately upon notification

6.4 Water Quality

The management of water quality in relation to earthworks, stockpiling of material, clearing vegetation, marine works and dredging will be governed under this CEMP and following documents:

- Dredge Management Plan (including management of placement either for direct placement onshore, or placement in reclamation cells)
- Erosion and Sediment Control Plan
- Acid Sulfate Soil Management Plan
- Water Quality Monitoring Program.

Based on these risks, the WQOs from Section 4.2.3 (necessary for supporting aquatic ecosystems) that could be affected by construction activities (where unmitigated) are:

- pH (related to ASS)
- Turbidity
- Secchi depth
- TSS.

As an alternative to the WQOs set under the EPP (Water), WQOs may be set for the site based on any available baseline monitoring data for Yorkeys Knob.

Management measures for these impacts are set out in Table 6-3 below. Measures related to the control of spills, waste and hazardous materials are discussed in Section 6.5.

The management objective for the water quality element is:

No impact to aquatic ecology EVs in Half Moon Bay and nearby open coastal waters.

This management objective is governed by the EPP (Water) and reflects requirements of the EP Act and Marine Parks Act.

Table 6-3 Management measures for water quality (turbidity and ASS)

Objective	No impact to aquatic ecology EVs in Half Moon Bay and nearby open coastal waters
Performance Criteria	• WQOs for Half Moon Bay and open coastal waters are met throughout the construction phase • WQOs for tailwater discharge are met throughout and after material placement in reclamation cells • No leaks from pump-out pipeline • No visible erosion or scour of river banks near approaches and berth pockets • No contamination of land • 1.0 m freeboard retained at all times between top of reclamation cell outer bund and placed material. • ESC installations remain fit-for-purpose throughout the construction phase • No collapse or evidence of significant erosion from stockpiles • No generation of visual turbid plumes greater than >10 m from works areas

Further Investigations	**Responsibility**
Undertake detailed design of dredging works, including location, volume, depths and profile	Contractor
Develop detailed methodology for dredging and pump-out works, including: • Dredge vessel to be used for works • Other (support) vessels to be used for the works • Type of dredging to be undertaken • Pump-out pipeline alignment • Location of pipeline connections and booster pumps (if any) • Duration of dredging.	Contractor
Develop a Dredge Management Plan based on detailed design and dredge methodology to manage any impacts from dredging.	Contractor
Apply waste hierarchy principles in designing work campaign, including reducing volume of material for dredging to a minimum.	Contractor
If works will cause obstruction to the Half Moon Bay navigation channel, prepare the following documentation in consultation with Regional Harbour Master and Maritime Safety Queensland: Marine Execution Plan Vessel Traffic Management Plan.	Contractor
Prepare a Notice to Mariners in consultation with Regional Harbour Master and Maritime Safety Queensland.	Contractor
Prepare detailed ESC Plan in accordance with: • FNQROC Development Manual • IECA Best Practice Erosion and Sediment Control 2008 • TMR Environmental Management Policies.	*Preparation*: Contractor, using a qualified ESC engineer *Approval*: TMR

This must include measures to control sediment resuspension associated with excavation in intertidal and subtidal areas.		
Prepare detailed ASS Management Plan in accordance with: • Queensland Acid Sulfate Soil Technical Manual • Guidelines for sampling and analysis of lowland acid sulfate soils	*Preparation*: Contractor, using a qualified ASS specialist	
	Approval: TMR	
Establish a pre-construction water quality baseline (e.g. by water quality monitoring and/or use of existing data from regional water quality monitoring programs) and update performance criteria based on this baseline	Contractor, using a qualified water quality scientist	
Establish a Water Quality Monitoring Program for the construction phase.	Contractor, using a qualified water quality scientist	
Preferred Management	**Responsibility**	**Timing**
Manage dredging and pump-out activities in accordance with DMP, including management actions specific to dredged sediment, as determined by sediment testing.	Contractor	As required
Ensure cells within the MRA are constructed to promote drainage of tailwater off settled material, towards the southeast weir box.	Contractor	Prior to dredging
Isolate any contaminated material in bunded area for treatment before placement.	Contractor	As required during works
Undertake visual monitoring of dredge plumes throughout dredging	Contractor	Continually during dredging
Where significant (>50 m) dredge plume is formed, modify dredging activities as appropriate, including potential implementation of any of the following: • Dredging only on incoming tide • Dredging without overflow (where relevant) • Use of silt curtains and booms.	Contractor	If significant plume is formed
Dredge only within approved areas and to approved depths.	Contractor	During works
All pump-out and placement activities to be in compliance with relevant approval.	Contractor	During pump-out
Retain a minimum freeboard of 1.0 m between the top of placed material in the MRA and top of the outer bunds of the MRA.	Contractor	During pump-out
Where required, lime dredged material that contains potential ASS in accordance with liming rates.	Contractor	During placement
Undertake monitoring of tailwater discharge points from reclamation cells.	Contractor	During placement
Where exceedances are identified and likely to be attributable to the placement works, undertake actions necessary to prevent further releases of unsuitable material, including: • Change to discharge rates to allow more time for material to settle • Application of flocculants to promote greater settling; • Raising of cell bunds/weir boxes to allow more time for material to settle • Other actions as relevant.	Contractor	During placement
Both on-land and in-water works must be undertaken using equipment that is appropriately sized for the relevant works, and	Contractor Superintendent	At all times

should be undertaken in a way that minimises the risk of disturbance of soils (including benthic sediment).		
Only clean rock material (that will not cause a turbid plume) can be used for construction of the breakwater OR Measures are designed and installed that will prevent turbid plumes extending to sensitive receptors in the Project area.	Contractor Superintendent	At all times
Prior to commencement of construction activities, ESC installations required for the works under the ESC Plan must be put in place and checked for compliance by the Project Engineer (or delegate).	Contractor Superintendent	Prior to works
ESC installations must be retained in a state that meets the requirements of the ESC Plan at all times during the construction phase	Contractor Superintendent	At all times
Any other measures within the ESC Plan must be implemented as set out in the plan.	As per ESC Plan	As per ESC Plan
Works must be undertaken in accordance with requirements of the ASS Management Plan.	As per ASS Management Plan	As per ASS Management Plan
Any excavation in intertidal and subtidal areas must occur at low tide or an adequate containment solution must be implemented by the contractor.	Contractor Superintendent	At all times
Any material removed from intertidal and subtidal areas must be treated in accordance with the ASS Management Plan and mixed immediately with clean dry material to create a composite suitable for disposal at a licenced facility. Alternatively, adopt a methodology that achieves the performance criteria and objective.	Contractor Superintendent	Immediately upon removal
Bunding must be put in place around any stockpiles retained on site except where it is established there is not risk of contaminated or sediment-laden runoff being generated from the stockpile (e.g. clean rock material).	Contractor Superintendent	At all times
Material removed from the intertidal or subtidal environment must be disposed of at a licenced land-based disposal facility.	Contractor Superintendent	As soon as practicable after achieving suitable composite
No active discharges are to be made to the marine environment as part of construction activities unless treated and designed to meet relevant WQOs.	Contractor Superintendent	At all times
Spill response equipment must be maintained on site at all times and all Contractor Staff are to be trained in the use of spill response equipment and actions to be taken in event of small and large spills.	Contractor Superintendent	At all times
Monitoring	• Monitoring to be undertaken by Contractor Superintendent in accordance with the DMP, ESC Plan, ASS Management Plan and Water Quality Monitoring Program. • Daily inspections of ESC installations by Contractor Superintendent to ensure structures meet ESC Plan requirements, with additional inspections immediately before and after significant rainfall events. • Daily inspection of stockpiles by Contractor Superintendent to identify evidence of collapse or erosion, with additional inspections immediately before and after significant rainfall events. • Visual monitoring of marine water quality by Contractor Staff during in-water works and works in the intertidal area to identify and track turbid plumes.	

	• Inspections of reclamation cells
Auditing and Reporting	• Auditing and reporting to be undertaken by Contractor Superintendent in accordance with the DMP, ESC Plan and ASS Management Plan • EPR to be prepared by Contractor Superintendent at end of every fortnight, including details on a) performance of ESC installations, b) compliance with ESC Plan, c) compliance with ASS Management Plan, d) results of monitoring, including water quality monitoring, e) any environmental incidents, including spills, and management actions taken, and f) any significant rainfall and/or runoff events during the reporting period. • Principal and/or Project Engineer (or delegates) to conduct at least one audit of the Project area during the construction phase to test compliance with the CEMP. • Develop and retain the following documents: – Compliance check against all approval requirements and conditions – Contractual specifications for works. • Inspection of dredging and pump-out area to test compliance with conditions. • Audit of placement activities

Corrective Action	Responsibility	Timing
• Notify Principal • Treat impacts from failed installations and/or collapsed stockpiles. • Identify cause of impact and upgrade or modify management actions, including those in the ESC Plan and/or ASS Management Plan as required. • Regrade or relocate stockpiles as required. • If water quality conditions are breached, stop work, investigate cause, and identify alternative dredging methodology to avoid impacts • If impacts cannot be avoided, negotiate new performance criteria Department of Environment and Science. • If non-compliance occurs at reclamation cells, undertake corrective action.	Contractor Superintendent	Immediately after impact is identified
• Notify relevant assessment agencies • Review and approve any amended ESC Plan and/or ASS Management Plan for the Project Area • Conduct audit of the Project area to ensure compliance with new plans/management actions	Principal (or delegate)	Immediately upon notification

6.5 Spills and Waste Management

Management measures to reduce the impacts associated with this litter are described in Table 6-4. Additional measures focused on avoiding stormwater mobilisation of materials into the marine environment are described in Section 6.4.

The management objective for the spill and waste management element is:

> ***No net contribution of waste or contaminants to the environment within the Project Area as a result of construction works.***

This management objective is governed by the EP Act, and is in accordance with the Marine Parks Act and GBRMP Act.

Table 6-4 Management measures for spills and waste management

Objective	No net contribution of waste or contaminants to the environment within the Project Area as a result of construction works	
Performance Criteria	• No waste is left at the construction site after works • No waste or spills are discharged into the marine environment • No spills made on land are left untreated	
Further Investigations		**Responsibility**
A Spills Management Plan must be developed to govern potential for and response to spills during construction phase (including from landside and marine activities). The plan must have procedures for treatment of minor and major spills, including thresholds to determine the difference between these.		*Preparation*: Contractor *Approval*: TMR
Identify capacity of construction area to stockpile waste and set maximum limits on waste volumes and hold-times for site.		Contractor Superintendent
Management Action	**Responsibility**	**Timing**
Waste segregation and storage must be established on site and designed to avoid loss of waste (e.g. as a result of stormwater, winds).	Contractor Superintendent	Prior to works
Arrangements must be established for the removal and appropriate disposal of waste once waste volumes and hold-times are met.	Contractor Superintendent	Prior to works
All vegetation cleared during works must be mulched and used for rehabilitation and/or disposed as green waste.	Contractor Superintendent	During clearing
Spill kits must be available and all spills treated in accordance with the Spills Management Plan.	Contractor Superintendent	At all times
Any waste discharged into the marine environment must be immediately recovered.	Contractor Superintendent	At all times
At completion of works, all waste and excess construction material must be removed from the site.	Contractor Superintendent	Upon completion
Monitoring	• Contractor Superintendent will undertake monitoring as per the Spills Management Plan • Daily monitoring of the site and stockpiles • Inspections of the site following completion of construction works	
Auditing and Reporting	• EPR to be prepared by Contractor Superintendent at end of every fortnight, including details on a) waste volumes generated, b) any waste movements (i.e. collection of waste) and c) any spills and actions undertaken, within the reporting period. • Principal and/or Project Engineer (or delegates) to conduct at least one audit of the Project area during the construction phase to test compliance with the CEMP.	
Corrective Action	**Responsibility**	**Timing**
• Immediately clean up the waste and/or spill • Identify cause of the waste loss/spill and update procedures as necessary	Contractor Superintendent	Immediately after impact is identified

6.6 Dust, Noise and Light

In accordance with the EPP (Noise) and EPP (Air) the EVs considered most relevant are health and wellbeing (including in relation to the ability to sleep), community amenity, biodiversity of ecosystems, and the aesthetic environment. Objectives to be achieved at different sensitive receptor locations are set out in the schedules to the EPPs.

Management measures related to these impacts are described in Table 6-5. Artificial lighting impacts are discussed in the context of ecology (which is considered the more sensitive value in relation to impacts).

The management objective for the dust, noise and light element is:

No impact to EVs for air, noise and light within the Project Area and surrounds.

This management objective is governed by the EP Act.

Table 6-5 Management measures for dust, noise and light

Objective	No impact to EVs for air, noise and light within the Project Area and surrounds		
Performance Criteria	• Quality objectives for air, noise and light at sensitive receptor sites are met throughout the construction phase • No dust is released beyond the boundaries of the works area		
Further Investigations		**Responsibility**	
n/a			
Management Action		**Responsibility**	**Timing**
Service and inspect all plant and equipment regularly to ensure they perform according to specifications and do not produce excessive noise, emissions or light.		Contractor	During works
Undertake dredging and pump-out between 6:00am and 6:00pm.		Contractor	During works
Direct lighting away from residential areas and sensitive environmental receptors.		Contractor	During works
Wherever possible, turn off work-specific lights at night.		Contractor	During works
Investigate any complaints received regarding air, noise, vibration, or lighting to determine if there is an impact to amenity.		Contractor	As required
All stockpiles of soil or other material that may cause mobilisation of dust must be covered and/or sprayed.		Contractor Superintendent	At all times
Significant dust-generating events must not be undertaken during periods of strong easterly winds.		Contractor Superintendent	At all times
If necessary, noise cancelling devices must be installed and/or utilised during construction activities that cause significant noise.		Contractor Superintendent	At all times
All construction equipment must be kept in good working condition and not cause excessive noise or emissions.		Contractor Superintendent	At all times
Monitoring	• Ongoing monitoring during construction works to ensure no excessive noise and/or dust is being generated • If a complaint is received and if deemed necessary by the Principal, undertake instrument-based monitoring as per a Noise & Dust Monitoring Program designed in accordance with DES guidelines • Check of equipment and plant functionality against specifications. • Inspection of lighting installed for the works.		
Auditing and Reporting	• EPR to be prepared by Contractor Superintendent at end of every fortnight, including details on a) any air and noise complaints received, and b) investigations and/or monitoring undertaken, within the reporting period. • Principal and/or Project Engineer (or delegates) to conduct at least one audit of the Project area during the construction phase to test compliance with the CEMP.		
Corrective Action		**Responsibility**	**Timing**
• Identify cause of the excessive noise and/or dust emissions and modify practices as necessary		Contractor Superintendent	Immediately after impact is identified
• Provide additional/renewed training to Contractor staff regarding environmental management responsibilities.		Contractor	As required

6.7 Traffic

In order to manage these impacts, a separate Traffic Management Plan (or equivalent) will be developed by TMR and/or the construction contractor at a later date. This plan will require updating following commissioning of a preferred Contractor but is expected to include the following elements:

- Management of site compound set up
- Access management for Buckley Street
- Trucking routes between quarry(ies) and construction site
- Management of fauna crossings.

In addition, a Notice to Mariners will be prepared by the Contractor for any works undertaken within the water in order to ensure management of navigational impacts. This will be approved by the Regional Harbour Master.

7 References

BMT (2019), *Yorkeys Knob Boat Ramp Facility – Investigation Report*, prepared for Department of Transport and Main Roads, Brisbane, ref. R.B23406.002.03.Yorkeys.

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Department of Environment and Heritage Protection (Qld) (DEHP) (2014), *Barron River Basin Environmental Values and Water Quality Objectives: Basin No. 110 and adjacent coastal waters*, scheduled to *Environmental Protection (Water) Policy 2009*, Queensland Government, Brisbane.

Department of the Environment and Energy (2019), *Pteropus conspicillatus – Spectacled Flying-fox*, Species Profile and Threats Database, Commonwealth Government, available: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=185 [accessed 17 October 2019].

EcoSustainAbility (2018b), *Dredging to Half Moon Bay Spoil Ground: Monitoring and Management Plan*, prepared for Cairns Regional Council, Cairns, version 2.1.

GHD (2017), *Queensland Recreational Boating Facilities Demand Forecasting Study 2017: Cairns Regional Council Assessment*, prepared for Department of Transport and Main Roads, Brisbane, ref. 41/300098, available online: https://www.publications.qld.gov.au/dataset/recreational-boating-facilities-demand-forecasting-study-2017/resource/ac8e9d7c-061d-4d1c-a99a-9c03333e4942 [accessed 8 October 2019].

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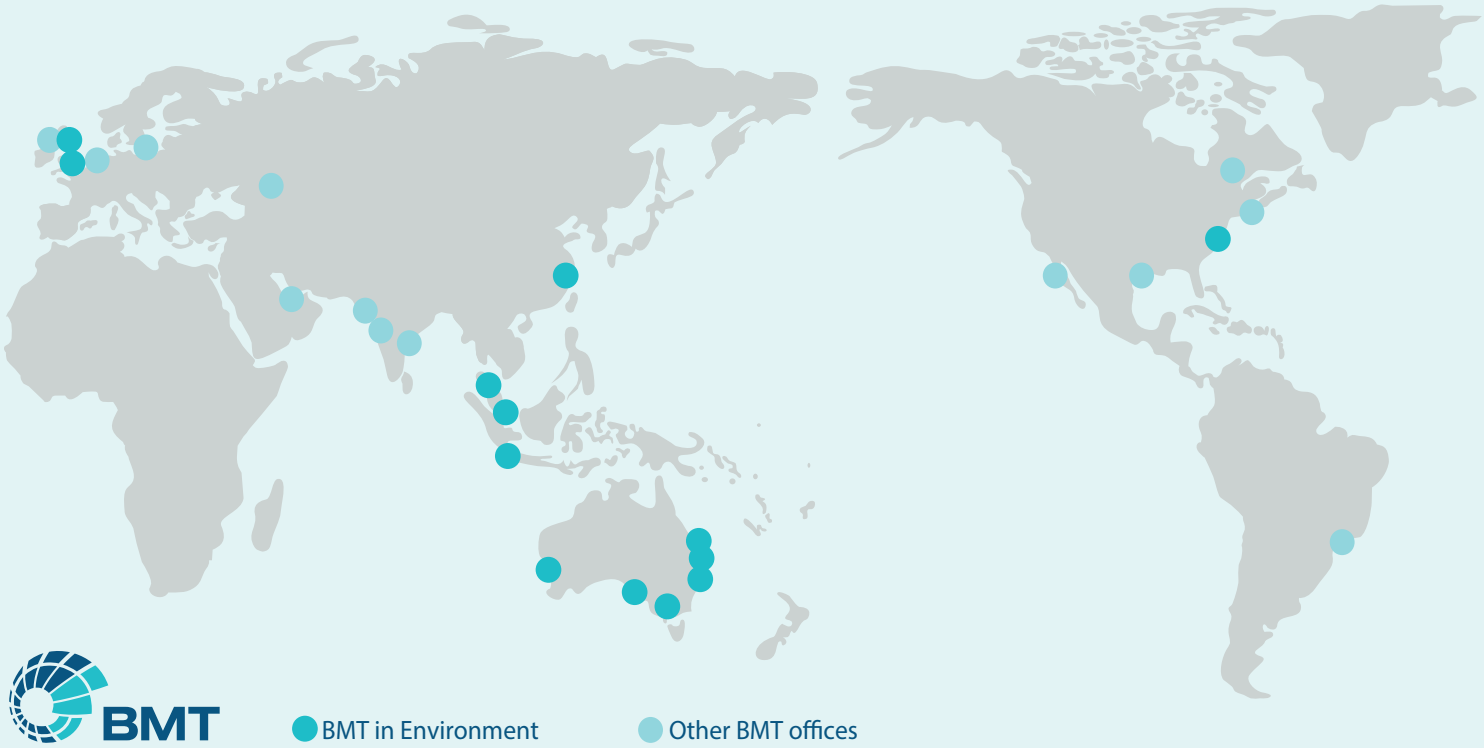

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Appendix E Recreational Boating Facilities Demand Forecasting Study 2017 – Cairns LGA

Queensland Recreational Boating Facilities Demand Forecasting Study 2017

Cairns Regional Council Assessment

GHD

ECONOMIC ASSOCIATES

December 2017

This Report was commissioned by Transport and Main Roads (TMR) for the purposes agreed between GHD and TMR as set out in section 1 of this Report. GHD otherwise disclaims responsibility to any person other than TMR arising in connection with this Report.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in the Report and are subject to the scope limitations set out in the Report.

Our client TMR has advised that this Report may be used by delivering agencies (councils, facility owners and managers, port authorities and Transport and Main Roads) as one tool in a broader assessment process to choose and prioritise sites for development. The views expressed in this Report are not endorsed by Government or Cabinet policy positions. This Report should be used by the delivering agencies on an information only basis.

The opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the date of preparation of the Report. GHD has no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was prepared.

The opinions, conclusions and any recommendations in this Report are based on limitations and assumptions made by GHD described in this Report. GHD disclaims liability arising from any of the assumptions being incorrect

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Appendices

Definitions

'all-tide' means that a vessel can be realistically launched into or retrieved from the waterway at the site for 100% of the tidal range

'ARI' means average recurrence interval, and refers to the average or expected time period between two occurrences of weather exceeding a certain magnitude

'capacity' means the ability to handle throughput for boat ramps, or the ability to handle multiple vessels at pontoons and floating walkways

'CHMP' means Cultural Heritage Management Plan

'CPM Reg' means the *Coastal Protection and Management Regulation 2003*

'CTU' means 'car-trailer unit', and applies to parking bays suitable for use by a tow vehicle with attached boat trailer

'DEE' means the Department of the Environment and Energy (Commonwealth)

'DEHP' means the Department of Environment and Heritage Protection

'demand' means the current or projected requirement at a given year to service the needs of the recreational boating community – assuming full effectiveness of existing facilities and based on current numbers of registered recreational boats only. Excludes non-registered vessels such as canoes, kayaks, sail-boards, row boats, powered vessels not requiring registration, etc.

'effective capacity' for a boat ramp means the number of lanes for boat ramps after adjusting for usage constraints such as the lack of adequate parking or tidal accessibility, or improvements to efficiency such as floating walkways or pontoons, see section 4.1.1 for additional detail

'effective capacity' for a landing means the number of landings after adjusting for usage constraints caused by tidal and depth restrictions, see section 4.2.1 for additional detail

'EPBC Act' means the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)

'FHA' means Fish Habitat Area

'GBR' means Great Barrier Reef

'IDAS' means Integrated Development Assessment System

'landings' means jetty and pontoon structures that facilitate direct berthing of non-trailable vessels (keel boats and >8.0m powerboats), transient vessels and/or tenders from larger vessels (where effective anchoring or mooring is available nearby)

'land-side' refers to infrastructure constructed above high water mark

'LGA' means local government area

'MCU' means a material change of use under the planning scheme

'MIIP' means the TMR works program known as the Marine Infrastructure Investment Program, with the government's Marine Infrastructure Fund forming its capital component

'MNES' means matter of national environmental significance under the EPBC Act

'NC Act' means the *Nature Conservation Act 1992*

'near all-tide' means that a vessel can be realistically launched into or retrieved from the waterway at the site for at least 80% of the tidal range

'NNTT" means National Native Title Tribunal

'P Act' means the *Planning Act 2016*

'P Reg' means the *Planning Regulation 2017*

'part-tide' means that a vessel can be realistically launched into or retrieved from the waterway at the site for at least 50% of the tidal range

'registration activation rate' means the percentage of registered vessels liable to be in use on any given good weather weekend day

'shd' means schedule

'shortfall' means the outstanding number of boat ramp lanes or landings as appropriate (assuming announced TMR projects/upgrades at December 2016 have been built) required to satisfy demand at a particular year, after adjustment for actual number and effective capacity considerations. A negative number for shortfall in a table signifies an oversupply

'SPL' means strategic port land

'Study' means this document including appendices and the state-wide summary

'TMR' means the Department of Transport and Main Roads

'water-side' refers to infrastructure constructed below high water mark

'WHA' means World Heritage Area

means 'number' when used in tables

Executive summary

This study sets out the current and future demand for publicly accessible recreational boating facilities within the Cairns Regional Council area over the next 20 years. The assessment considers facilities for vessels, such as boat ramps and floating walkways, as well as landings for deep-draught vessels. It is intended to be used to inform funding priorities from 2018-19 onwards.

Key issues for Cairns Regional Council

The primary issues raised by stakeholders around access to recreational boating facilities in the Cairns Regional Council area centred on:

- crocodile attack safety
- security of vehicles and vessels
- lack of sheltered facilities for all-tide, all-weather access
- overcrowding.

Demand assessment

The demand assessment is based on boat registrations from within the local government area (LGA) of Cairns and surrounding LGAs. The demand assessment is analysed against existing capacity to produce an outstanding shortfall projection. Key aspects influencing demand considered in the assessment include:

- The population of Cairns Regional Council is projected to increase from 162,451 persons in 2016 to 226,125 persons in 2036, or by 1.7% per annum, above the state-wide five year forecast average of 1.6% (Appendix C).
- Boat registrations are highest for boats up to 4.5 metres in length.
- Trailable and non-trailable vessel registrations within the Cairns LGA are mostly used on the water within the LGA, with some leakage/export in usage from the LGA to Douglas Shire Council and Cassowary Coast Regional Council areas.
- Vessel inflows from outside the LGA are likely from Mareeba Shire Council, Tablelands Regional Council, Etheridge Shire Council, Douglas Shire Council and Cassowary Coast Regional Council.
- There is significant demand for recreational boating infrastructure in Cairns Regional Council as a result of tourism.
- The registration activation rate from residents of the LGA is anticipated to be average (10%) as a result of a relatively low incidence of blue collar workers and lower average age than the Queensland state average.

Boat ramps

At present there are 13 boat ramp facilities in the LGA, containing 27 boat ramp lanes, however the lack of parking for car-trailer units (CTU) or limited tidal access at some locations means that the effective capacity of these ramps is 19 lanes. Once infrastructure planned for implementation by 2017-18 is in place (referred to as Marine Infrastructure Investment Program (MIIP) upgrades), this effective capacity increases only marginally to 20.3 lanes, largely because it is not accompanied by additional CTU parking.

To address any shortfall between demand and current capacity, existing facilities were further assessed to identify what type of access the facility provides to the two main destinations, being either open-water or non-open-water. This then allows identification of the type of additional facilities needed to address demand.

The projected boat ramp lane shortfall for Cairns is shown in Table 1.

Table 1 – Projected boat ramp lane shortfall, Cairns Regional Council

Evaluation category	Existing effective capacity*	2016		2021		2026		2036	
		Demand	Shortfall	Demand	Shortfall	Demand	Shortfall	Demand	Shortfall
Open-water access	9.8	19.3	9.5	20.6	10.8	22.4	12.6	26.8	17.0
Non-open-water access	10.5	13.8	3.3	14.4	3.9	15.7	5.2	18.2	7.7
Total	**20.3**	**33**	**12.7**	**35**	**14.7**	**38**	**17.7**	**45**	**24.7**

**Refer section 4.1.2 and* Table 6 *for detailed evaluation categories*

**Existing effective capacity includes MIIP announced projects/upgrades as at December 2016*

**See Appendix B and* Table 6 *for capacity assessment*

Landings

The assessment of capacity and shortfall in landings is shown in Table 2 and Table 3.

Table 2 – Existing landing capacity, Cairns Regional Council

Evaluation category	Existing effective capacity
# of public sheltered mainland landings*	1
# of public island landings – supplies available	0
# major private landings*	5
Total	**6**
Facilities not contributing to recreational capacity:	
# of public unsheltered mainland landings*	1
# of public island landings – no supplies available*	2

**public sheltered mainland landings include Tingira Street pontoon*

**private landings include marinas and clubs, accessible by fee for deep-draught vessels, and by arrangement, limited access for tender dinghies (varies with private entity, some free)*

**public unsheltered mainland landings include Palm Cove jetty (not in use by recreational or commercial boats, used mainly as a fishing platform)*

**public island landings – no supplies available include Green and Fitzroy Islands*

Table 3 – Projected landing shortfall, Cairns Regional Council

Evaluation category	Existing effective capacity	2016		2021		2026		2036	
		Demand	Shortfall	Demand	Shortfall	Demand	Shortfall	Demand	Shortfall
# of landings*	6	6	0	7	1	7	1	8	2

**# of landings consists of public sheltered mainland landings, public island landings – supplies available and major private landings*

This assessment indicates that at present the public landings network in conjunction with the supplementary capacity provided by commercial or club landings is adequate to cater for existing demand, however an additional landing will be required within the next five years, and a second landing in 10 to 20 years.

Recommended priorities

Refer to Table 4 for the Cairns Regional Council area recommended priorities.

Recommended priorities to increase capacity and meet demand have been defined over the following time scales:

Priority 1 (P1) These sites are needed to meet existing demand.

Priority 2 (P2) Assuming that the priority 1 sites are implemented, these sites are expected to be needed to meet additional demand over the five years ending 2021.

Priority 3 (P3) Assuming that the priority 1 and 2 sites are implemented, these sites are expected to be needed to meet additional demand over the subsequent five years, that is 2021 to 2026.

Priority 4 (P4) These sites are those that will meet future demand, but are not expected to be required before 2026 in demand terms but may be brought forward for construction for other reasons.

Table 4 – Recommended priorities to increase capacity, Cairns Regional Council area

Priority	Sites
Priority 1 (as soon as possible)	Fearnley St – expand parking to maximum extent possible (approx. 20 CTU). New facility at Yorkeys Knob – 4-lane boat ramp plus floating walkway and 90 CTU, plus parking to support new 4-lane boat ramp in 2016-17 to 2017-18 MIIP (90 CTU) – 180 CTU total. Tingira St (Stage 1) – expand parking by 25 CTU at existing facility. Packers Camp – formalisation and expansion of parking to achieve 90 CTU.
Priority 2 (over the next five years)	Deeral – add an additional lane plus a floating walkway; expand parking to achieve 90 CTU. Cairns CBD – install a deep-draught accessible public pontoon. Tingira St (Stage 2) – expand existing facility to incorporate a new 4-lane boat ramp plus floating walkway; parking for new facility (90 CTU); possible reclamation of mangroves to south as the site or to offset addition to existing site.
Priority 3 (over the next five to ten years)	Nil

Priority	Sites
Priority 4 (other)	New facility at Pine Creek Rd, East Trinity – new 4-lane boat ramp plus floating walkway; parking for new facility (90 CTU); reclamation required. Russell River Rd, Bellenden Ker – formalisation and expansion of parking to achieve 45 CTU. The Esplanade, Machans Beach – new pontoon or floating walkway; formalisation of 15 CTU. Acacia St, Holloways Beach – new pontoon or floating walkway.

1. Introduction

1.1 Background

GHD was commissioned by the Department of Transport and Main Roads (TMR) to establish the current and future demand for recreational boating facilities throughout Queensland. This resulting study is the *Recreational Boating Facilities Demand Forecasting Study 2016* (Study) and supersedes the 2011 study of similar name. The study replaces the *Recreational Boating Facilities Demand Forecasting Study 2016* by incorporating the results of the 2016 census.

The Study will be used to inform planning for the development of existing and new recreational boating facilities by a variety of agencies, including TMR, the Gold Coast Waterways Authority, local government, and port and water authorities. The Study is one tool in a broader assessment process to select and prioritise sites for development. Specifically, the Study is not binding in any way on the agencies it is designed to assist. The Study establishes demand and makes informed suggestions as to how the established demand might be addressed. The 2011 study, at December 2016, has had 66% of its recommendations adopted to a greater or lesser extent. A similar recommendation take-up rate may be expected from this Study.

This LGA report is one of a series of reports for the Study comprising LGA and state-wide components. The state-wide report details the Study background and provides an overview of demand for recreational boating facilities over the next 20 years throughout the state. The state-wide report complements individual reports for each local government area (LGA). Each LGA report identifies existing capacity, current and future demand, and potential opportunities for boating infrastructure within the LGA – with appropriate adjustment for interaction with adjacent LGAs.

1.2 Context

This LGA report has been prepared with a focus on in-water recreational facilities and infrastructure comprising boat ramps, floating walkways and landings within each LGA, which are publicly accessible by registered vessels. As car parking can significantly constrain the efficient use of a facility, it has been considered in the assessment. However, facilities used more than 50% of the time for commercial or public passenger transport (e.g. ferry terminals), private facilities (such as yacht clubs and marinas), and general recreational facilities such as canoe ramps and fishing platforms are not included as part of this study.

The types of infrastructure considered in the assessment of capacity are:

- boat ramps used for the launching and retrieval of vessels
- supporting infrastructure for the boat ramp:
  - queuing facilities (floating walkways, pontoons, queuing beaches)
  - parking for car-trailer units (CTUs)
- short-term landings accessible by deep-draught or non-trailable vessels on the outer face, or their tenders (for longer term tying up) on the inner/landward face or ends.

There may be instances where a public pontoon serves multiple purposes – as a short-term landing, as a tender tying up facility, and as a queuing facility for a boat ramp.

2. Local government area overview

The key characteristics and influences on recreational boating within the Cairns Regional Council area are that:

- The area is dominated by key industries of tourism and agriculture.
- The population of Cairns Regional Council is projected to increase from 162,451 persons in 2016 to 226,125 persons in 2036, or by 1.7% per annum, above the state-wide five year forecast average of 1.6% (Appendix C).
- Population growth will be dominated by development in the Mount Peter (Edmonton to Gordonvale) area.
- Windy weather significantly reduces the annual number of days that are suitable for offshore boating.
- There is an accepted/known shortfall in all-tide boat launching facilities.
- The LGA is considered to be a regional centre under the remoteness measures used by the Australian Bureau of Statistics.

3. Existing facilities

3.1 Overview of existing facilities

Within the Cairns Regional Council area, existing recreational boating facilities are owned and managed by several organisations, shown in Table 5.

Table 5 – Recreational boating facilities within Cairns Regional Council area

Infrastructure owner	Boat ramps		Landings	
	Facilities	Lanes	Pontoons	Jetties
TMR mainland	12	24	1	0
TMR island	0	0	0	2
Cairns Regional Council	0	0	0	0
Ports North	1	3	0	0
Private landings (marinas/clubs)	N/A	N/A	5	0
Total	**13**	**27**	**6**	**2**

A map indicating the location of existing facilities is included as Appendix A.

Appendix B contains a summary capacity assessment of these existing facilities.

Important or popular public boat ramp facilities are located at:

- Tingira St, Portsmith, Cairns (Smiths Creek)
- Fearnley St, Portsmith, Cairns (Trinity Inlet)
- Yorkeys Knob boat harbour
- Bluewater canal estate, Trinity Park (Half Moon Creek))
- Ross Rd, Deeral (Mulgrave River)
- Packers Camp (Redbank Rd, Mackey Creek)

Existing ramp facilities (including minor ones not mentioned above):

- service the main population centre close to central Cairns, growth areas of Edmonton and Gordonvale to the south of Cairns, and the Cairns northern beaches area
- provide open-water access, or access to estuarine reaches of the numerous river and creek systems – some facilities providing access to both, such as Fearnley St and Packers Camp.

Research referenced in the previous demand assessment study (GHD, 2011).[1] indicated that boat owners were prepared to travel up to approximately one hour to reach major or preferred marine infrastructure. In many locations, this infrastructure is represented by facilities that provide all-tide, or near all-tide, open-water access.

Between the NSW border and Port Douglas, TMR has therefore adopted a long term strategy to seek to provide access to an all-tide, sheltered facility, within a one-hour drive time where practical. Exceptions to the strategy include where all-tide, sheltered access is not feasible. In these instances, sites that provide near all-tide sheltered access are sought instead.

All-tide, open-water access is provided at the facilities at Fearnley St, Tingira St and Yorkeys Knob, at least one of which is within approximately a one-hour drive of main population areas.

The public deep-draught vessel landings within the LGA comprise:

- a pontoon at the Tingira St boat ramp, which also services the adjacent anchorage, and was originally installed as a boat ramp queuing facility, with that demand now met by the 2016 installation of a floating walkway
- jetties on Green and Fitzroy Islands, destination facilities which access island areas of National/Marine Park, but are primarily used by commercial vessels, with little to nil contribution to meeting recreational vessel demand
- Palm Cove jetty, which has little to nil usage by recreational or commercial vessels and is in use as a popular fishing platform and promenading deck.

3.2 Key issues and hotspots

The primary issues raised by stakeholders around access to recreational boating facilities in the Cairns Regional Council area are centred on safety and security, accessibility (from land and from the sea), and capacity.

3.2.1 Safety and security

Security was identified as a major issue at several of the popular ramps. The main concerns related to a lack of lighting and surveillance of car parking areas, with vehicles broken into or vandalised while the owners are out on their vessels.

Concerns were raised regarding vessel security at the Bluewater boat ramp. There is currently no queuing facility at the boat ramp (other than the ramp itself), and the car-trailer park is located 300m away. There is no direct line of sight between the car-trailer park and the boat ramp. Ramp users are concerned that their vessels may be stolen while they are parking/retrieving their vehicles.

[1] GHD (2011) Recreational Boating Facilities Demand Forecasting Study. Report prepared for TMR, September.

At estuarine ramps, crocodile attack is of concern during launching and retrieval, especially where users may need to enter the water to get their vessel off or onto the trailer. Many ramps display signage alerting users to crocodile dangers and recent sightings. Floating walkways are popularly requested to partially manage this risk.

3.2.2 Accessibility

A key issue raised by stakeholders is the lack of sheltered launching/retrieval facilities that allow all-weather, all-tide access for all trailable boat sizes. This is especially critical for facilities that provide offshore access. On "flat water days" (that is, when the weather conditions are fine, with light winds and low wave action), demand for launching/retrieval facilities is very high, as these days are not frequent. Estuarine areas are generally sheltered and attract greater use on windy days.

The lack of all-tide access at some facilities severely constrains patronage. At locations with part-tide boat ramps, if the tides do not align with preferred usage times, ramp users will travel to other facilities where they can be guaranteed all-tide access. This then puts pressure on the all-tide facilities.

3.2.3 Facilities capacity

Overcrowding at certain facilities was raised by many stakeholders. Most of the overcrowding centred on facilities providing all-tide open-water access, with Tingira St, Fearnley St and Yorkeys Knob being the sites of main concern. Importantly, stakeholders identified that some of these facilities were not currently used to their full potential due to insufficient parking for CTUs.

Crowding at Packers Camp and Deeral was identified as being of concern, with these facilities increasing in popularity due to the Mount Peter growth area and overcrowding of central Cairns all-tide facilities.

4. Capacity assessment

4.1 Boat ramp capacity

The function of a boat ramp is to provide access for launching and retrieval of trailable vessels into a waterway. Alternative launching facilities such as boat stackers are outside scope for this Study.

4.1.1 Boat ramp capacity evaluation

For the purposes of this Study, boat ramp capacity is measured as "effective" boat ramp lanes. An effective boat ramp is quantitatively characterised as being:

- capable of accommodating 40 launch / retrievals per lane per day (in accordance with Australian Standard AS 3962[2] and Economic Associates (2011)[3])
- supported by landside infrastructure such as queuing and manoeuvring areas
- supported by an appropriate number of CTU parking spaces.

The number of launch / retrievals per lane per day has been selected based on the relevant Australian Standard and Economic Associates (2011)[3]. This latter report summarised research

[2] AS 3962-2001 Guidelines for the design of marinas
[3] Economic Associates (2011) Recreational Boating Facilities Demand Forecasting Study: Demand Analysis

undertaken by SKM (1988)[4] and Rose et. al (2009)[5], and stated that a rate of 30 boats per lane per day is considered to provide unhampered overall amenity, whereas a rate of 50 boats per lane per day represents congested operations; thus a midpoint of 40 launches / retrieves per day was selected to represent a balanced scenario.

TMR (2016)[6] provides guidance on its standard/reference number of CTU spaces to match boat ramp lanes:

- 90 CTUs for four-lane ramps
- 70 CTUs for three-lane ramps
- 45 CTUs for two-lane ramps
- 15 CTUs for one-lane ramps with sealed road access
- 10 CTUs for one-lane ramps with all-weather, unsealed road access.

The above figures indicate an average relationship of 22.5 CTU spaces per "effective" lane. The TMR reference standards differ from the number of CTU spaces recommended for public boat launching ramps by AS 3962. That standard requires between 20 and 60 CTU spaces per ramp lane, depending on whether the ramp is in an urban or rural area, whether it has a queuing structure, and whether it has separate rigging and de-rigging areas. For local reasons, TMR may vary from these reference figures in particular cases.

The actual capacity, or "effectiveness" of a boat ramp is unique for each ramp, and is affected by:

- a reduction in the amount of time a ramp is available for use due to tidal variability, the seaward extent of ramp infrastructure, and navigable depths – at each ramp being measured as the % availability of the tidal range that a vessel can be realistically launched or retrieved – with ramps classified as all-tide (100%), near all-tide (>80%), and part-tide (50%) for access – and the reduction in availability occurring either:
  - at the ramp itself, and/or
  - in access channels connecting the ramp to the sea/open water (such as at a river mouth or other channel depth constraint)
- the exposure of the ramp to regular, and sometimes major, wave action – these facilities tending to be beach ramps that are generally only suitable for short excursions in small boats in good weather and with suitable tides – accordingly these ramps are considered to be available only 50% of the time
- factors impacting efficient vessel launching and retrieval cycles, which include:
  - provision of queuing facilities such as pontoons, floating walkways or beaches – with such queuing facilities increasing the capacity of a boat ramp by providing a place for a vessel to be secured during vehicle parking or retrieval without blocking a ramp lane, leading to greater throughput
  - constrained or difficult manoeuvring of vehicles and trailers onto the ramp
  - long distances between the boat ramp and CTU parking spaces
- the physical extent of infrastructure provided, such as:
  - the width and number of ramp lanes

[4] SKM (1988) Public Boat Ramps Central Queensland Strategic Plan, Volume One, demand forecasting – Noosa to Yeppoon
[5] Rose, T., Powell R., & Yu J. (2009) Identification of the Present and Future Recreational Boating Infrastructure in Redland City – A 10 year Infrastructure Plan, Griffith University
[6] TMR (2016) Marine Facilities and Infrastructure Plan

- the number of CTU parking spaces within the facility
- provision for overflow parking during busy periods.

To calculate effective lanes at a boat ramp, the following adjustments have been applied to water-side infrastructure:

- all-tide – no change (that is, multiplication factor of 1.0)
- near all-tide – available 80% of the time (that is, multiplication factor of 0.8)
- part-tide – available 50% of the time (that is, multiplication factor of 0.5)
- beach ramp – available 50% of the time (that is, multiplication factor of 0.5)
- access to a queuing facility in the form of a floating walkway – increase efficiency by 50% (that is, multiplication factor of 1.5)
- access to a queuing facility such as a gangway-access pontoon – increase efficiency by 20% (that is, multiplication factor of 1.2).

Access to a beach, while convenient, is not suitable for all vessel sizes or preferred by some vessel owners, and therefore has not been considered to improve the capacity of a boat ramp.

As an example, the water-side effective lanes for a near all-tide, two-lane boat ramp with a floating walkway will be calculated as:

2	x	0.8	x	1.5	=	2.4
lanes		tidal availability		queuing structure		effective lanes

To calculate the land-side constraint on effective lanes, the following CTU groupings have been applied:

- 1 to 9 CTU – 0.5 effective lanes
- 10 to 20 CTU – 1 effective lane
- 21 to 29 CTU – 1.5 effective lanes
- 30 to 39 CTU – 1.8 effective lanes
- 40 to 54 CTU – 2 effective lanes
- 55 to 64 CTU – 2.5 effective lanes
- 65 to 75 CTU – 3 effective lanes
- 76 to 83 CTU – 3.5 effective lanes
- 84 to 97 CTU – 4 effective lanes
- 98 to 105 CTU – 4.5 effective lanes
- 106 to 117 CTU – 5 effective lanes
- 118 to 127 CTU – 5.5 effective lanes
- 128 to 140 CTU – 6 effective lanes
- 141 to 149 CTU – 6.5 effective lanes
- 150 to 157 CTU – 7 effective lanes.

Unmarked or unformed parking areas are denoted accordingly. The number of CTU parking bays may also be the limiting factor on effective capacity, owing to the number of bays provided being less than the TMR reference standard.

The calculation is illustrated further in Appendix B, which details the actual and effective lanes for each facility.

The effective capacity of a facility is therefore limited by the constraining or "bottlenecking" element, and to realise full capacity a facility must balance the land-side and water-side capacities. The capacity assessment in Appendix B also identifies the limiting capacity constraint for each facility.

4.1.2 Boat ramp classification

As previously discussed, each boat ramp is subject to a unique set of constraints and opportunities, particularly in relation to tidal accessibility. To understand how well existing boat ramp facilities meet current demand, consideration has also been given to the recreational destination(s) accessed by each facility. Where available, this has been informed by local knowledge on actual usage.

Regardless of the tidal range available at the ramp itself, boat ramps typically seek to cater to one or more of the following destinations:

- access to the sea for fishing, diving, islands, jet skiing, and general recreation
- access to creeks and estuaries for fishing, crabbing, skiing and general recreation
- access to fresh water for fishing, skiing, jet skiing, and general recreation.

However, there are some practical limitations on the usage of a ramp for these purposes. These include:

- vessel size, as:
  - Small vessels are unsuitable for use in open and exposed waters under most conditions, although they may be taken into nearshore waters in calm conditions or for short journeys. These vessels are most suited to use in protected waterways such as creeks and estuaries.
  - Large vessels suited to offshore use may be physically constrained in very narrow or shallow waterways, such as the upstream reaches of creeks or estuaries.
- travel time to destination, as:
  - Although navigable access from a boat ramp to open water may be possible, it may not be practical due to the distance travelled by water and/or any speed restrictions that may be in place for the waterway. Most people will seek to launch at the facility that takes the least time to reach their destination. This is particularly the case for offshore destinations where larger volumes of fuel must be paid for and carried to allow for the journey.

Discussions with local government stakeholders throughout the state indicated that vessels longer than 4.5m were generally used to access offshore areas, with smaller vessels tending to be used for creek and estuary access. There will be circumstances where smaller vessels will be used to travel offshore and larger vessels will stay in protected waters.

At facilities where open-water access becomes difficult, the Study assumes that the facility will be more frequently used for accessing local creeks, estuaries, and freshwater areas. Facilities have therefore been classified into one of the following categories to reflect the primary level of accessibility between the ramp and open water:

- open-water access – all-tide access
- depth-limited – access to open-water possible but navigation limited at certain stages of the tide by water depth, for example, crossing a tidal bar, or sand shoals in an estuary

- distance-limited – access to open-water possible but limited by longer travel times between the ramp and open-water, for example due to long distances, or speed restrictions in the waterway – with, in some instances, depth also being a limitation but distance being considered as the main constraint
- infrastructure-limited – access limited by configuration or size or nature of the infrastructure, for example, a low bridge preventing navigation
- beach ramps
- no open-water access – access to open-water is not possible or practical, for example, a facility in a dam, or on the upstream side of a weir, barrage, or waterfall.

4.1.3 Existing capacity

The existing boat ramp facilities have been assessed individually to quantify their "effective" lane capacity. This assessment is presented in Appendix B and summarised in Table 6.

TMR's Marine Infrastructure Investment Program (MIIP) – at December 2016 – sets out the infrastructure planned and funded for implementation until the end of the 2017-18 financial year, and includes the government's Marine Infrastructure Fund capital projects. Specific projects scheduled for implementation in the Cairns Regional Council area under the MIIP that seek to increase the capacity of marine infrastructure comprise:

- reconstruction and widening of the Packers Camp (Redbank Rd, Mackey Creek) ramp to four lanes plus a floating walkway
- reconstruction of the Bellenden Ker ramp
- upgrade and add a floating walkway to the Fearnley St ramp
- add a floating walkway to the Bluewater (Trinity Park) ramp
- add a floating walkway to the Edmonton boat ramp
- new all-tide four-lane boat ramp plus a floating walkway at a location to be confirmed, possibly duplicated to two 4-lane ramps, each with floating walkways, if the site allows.

The implementation of these upgrades informs the "effective" capacity in Appendix B. The summary in Table 6 shows (in brackets) the modified capacity following implementation of these projects.

Key observations drawn from this analysis include:

- There is a reasonable balance in the Cairns LGA between facilities that provide access to open-water and those that provide access into estuaries or river/creek systems.
- There are no freshwater facilities.
- Capacity at most facilities is constrained by the availability of sufficient CTU parking to fully support the water-side infrastructure already at the site.
- There are 27 actual lanes but only 19 effective lanes at present, reflecting limitations imposed by tidal restrictions and the lack of adequate parking. This is most evident for facilities that provide depth-limited open-water access, where there are currently 11 actual lanes but only 7.3 effective lanes.
- The MIIP (at December 2016) provides comparatively little additional capacity in terms of effective lanes due to the lack of accompanying committed CTU parking by Cairns Regional Council and Ports North. Once the parking capacity is addressed, these works will make a notable contribution to improvements in effective capacity.

Table 6 – Summary of existing/planned* boat ramp effective capacity by access type, Cairns Regional Council

Facility accessibility and tidal availability at the ramp	# of facilities	# facilities limited by		Actual # of lanes	Effective lanes
		Water-side infrastructure	Land-side infrastructure		
Open-water access					
All-tide	3 (4)	0	3 (4)	10 (14)	7.8
Near all-tide	1	1 (0)	0 (1)	2	1.6 (2)
Part-tide	0	0	0	0	0
Subtotal	**4 (5)**	**1 (0)**	**3 (5)**	**12 (16)**	**9.4 (9.8)**
Depth-limited open-water access					
All-tide	0 (1)	0	0 (1)	0 (4)	0 (1)
Near all-tide	6	3 (2)	3 (4)	10	6.8 (7.2)
Part-tide	1 (0)	1 (0)	0	1 (0)	0.5 (0)
Subtotal	**7**	**4 (2)**	**3 (5)**	**11 (14)**	**7.3 (8.2)**
Distance-limited open-water access					
All-tide	0	0	0	0	0
Near all-tide	0	0	0	0	0
Part-tide	0	0	0	0	0
Subtotal	**0**	**0**	**0**	**0**	**0**
Infrastructure-limited open-water access	**1**	**0**	**1**	**3**	**1.8**
Beach ramps	**1**	**1**	**0**	**1**	**0.5**
No open-water access	**0**	**0**	**0**		**0**
Total	**13 (14)**	**6 (3)**	**7 (11)**	**27 (34)**	**19 (20.3)**

**Numbers in brackets include MIIP announced projects/upgrades as at December 2016*

4.2 Landing capacity for deep-draught vessels

The function of most landings is to provide short-term shore access for deep-draught vessels to facilitate the transfer of passengers, provisions, or to make short excursions to the shore via tender dinghy. Landings may be located on the coast or in navigable river systems within the LGA, but are of little use unless sheltered from on-shore winds and wave action.

For this Study, landings include jetty and pontoon structures that facilitate direct berthing of non-trailable vessels (keel boats and >8.0m powerboats), transient vessels, and/or tenders from larger vessels (where effective anchoring, berthing, or mooring is available nearby).

4.2.1 Capacity evaluation

The measurement of the recreational capacity of a landing is complex, as it is affected by:

- exposure of the landing to wind and wave conditions
- size and condition of the landing
- tidal availability
- the length of stay permitted
- enforcement practices

- competition from non-recreational boating users (such as authorised commercial users).

To accommodate these factors, landing capacity has been considered in the context of each landing's:

- contribution to a network of public landings within the LGA, and within a day's sail of a landing outside the LGA
- proximity to existing private/commercial recreational boat landings that accommodate visitors (such as those provided by yacht clubs)
- ability to service key destinations, such as access to basic provisions, key population areas or recreational destinations
- proximity to existing anchorage or mooring areas
- anecdotal usage.

4.2.2 Existing capacity – deep-draught vessel landings

Within the Cairns Regional Council area, there are four public landings that can be accessed by larger and deeper draught vessels for short-term stays (a couple of hours or less), as detailed in section 3.1.

Key observations indicate:

- The existing landing facilities on Green and Fitzroy Islands mainly provide commercial vessel access to National Park areas and accommodation. Their contribution to recreational capacity is therefore considered to be negligible.
- Palm Cove Jetty is exposed to wave and wind action, and is mainly used for fishing and promenading rather than as a landing for vessels. Anecdotal and observational evidence indicates that it is not used by either recreational or commercial vessels. Its contribution to capacity is therefore considered to be zero.
- The Tingira St (Smiths Creek) pontoon is accessible to deep-draught vessels. Although it is located nearly 2.5nm upstream from the mouth of Trinity Inlet, Smiths Creek is a popular designated anchorage area. The Tingira St pontoon provides access to the light industrial area of Portsmith. Basic food provisions are available in neighbouring suburbs, and would be a long walk for pedestrians. The pontoon was historically used as a queuing facility for the adjacent boat ramp and still assists to a limited degree in that capacity following the installation of a floating walkway on the boat ramp. It is popular amongst recreational anglers. This pontoon is presently the most consistently weather-available public landing on the mainland within the LGA.

Although outside the scope of this study, key privately owned modern facilities within the LGA that also actively contribute to landing capacity include:

- Cairns Marlin Marina, including Cairns Yacht Club (at the mouth of Trinity Inlet, and adjoining the Cairns central business district for pedestrian access), servicing the marina and vessels on moorings or anchored in Trinity Inlet.
- Cairns Cruising Yacht Squadron (in Smiths Creek, but with several kilometres to the nearest shops).
- Half Moon Bay Marina, including Yorkeys Knob Boating Club (immediately adjacent to the Yorkeys Knob boat ramp – midway along Cairns' northern beaches, but with several kilometres to the nearest shops).

- Bluewater Marina (immediately adjacent to the Bluewater, Trinity Park boat ramp – midway along Cairns' northern beaches, but with several kilometres to the nearest shops).

The effective capacity of landings servicing the Cairns LGA is summarised in Table 7.

Table 7 – Existing landing capacity, Cairns Regional Council

Evaluation category	Existing effective capacity
# of public sheltered mainland landings	1
# of public island landings – supplies available	0
# major private landings	5
Total	**6**
Facilities not contributing to recreational capacity:	
# of public unsheltered mainland landings	1
# of public island landings – no supplies available	2

5. Demand assessment

The assessment of demand for recreational boating has been evaluated in terms of facilities for launching and retrieval of vessels (that is, boat ramps), and landings for short-term stays (generally less than a couple of hours). The demand for:

- boat ramps is driven by trailable vessels that can access the ramp
- landing facilities is focussed on providing a network of short term landings that service key land-side destinations (such as shops) of relevance or attraction to the boating community, with a particular focus on larger (non-trailable) vessels

5.1 Boat ramp demand

The demand for boat ramps has been quantitatively evaluated using vessel registrations as the key indicator. The vessel registrations have been converted to an effective lane demand based on a typical boat ramp lane being able to accommodate 40 launch/retrieval manoeuvres per day.

The following section details the assessment of vessel registrations taking into consideration where vessels are likely to be used relative to where they are registered, and the demographics of the local area.

5.1.1 Registration distribution

People using the boat ramp facilities at a particular location are attracted to that facility by several factors, including:

- proximity to home
- road access (quality and distance)
- proximity to vessel destination (reef, open water, islands, creeks, estuary, fishing grounds, skiing areas, and so on)
- quality of the experience and ease of use (launching/retrieval, parking, security, complementary facilities, and so on).

This means that at many locations and at various times, ramp users will travel out of the LGA in which their vessel is registered to use boat ramp facilities in a different LGA. In some locations, demand is driven by ramp users from outside of the LGA, particularly if the ramp is in reasonable proximity to desirable boating destinations such as fishing grounds or popular islands.

Additional detail on the determination of the registration distribution is provided in Appendix C. Note that vessel registrations are less in inland LGAs compared to adjacent coastal LGAs.

A summary of the relative geographic contribution of demand to boat ramp facilities located in the Cairns Regional Council area is shown in Table 8 below for 2016 registration data.

5.1.2 Registration activation

TMR's approach to the provision of infrastructure for recreational boating is to aim to satisfy average demand rather than peak demand (TMR, 2016).[7].

TMR recognises three levels of demand:

- off-peak demand – to be met in almost all circumstances
- average demand – taken to be demand for a facility on weekends (and for certain regional locations other busy periods)
- peak demand – being demand for a facility at peak holiday periods and for special events such as major fishing competitions.

The qualifier on certain regions and circumstances for average demand recognises that in some areas high numbers of shift workers tend to distribute the demand more evenly across each week.

Provision is not made by TMR for peak boating periods such as Christmas, Easter, school holidays, and long weekends. For facilities provided by them, councils and port/water authority managers may choose to cater for higher than average demand.

Research referenced in the previous demand assessment study (GHD, 2011)[8] indicated that average to high demand was represented by 8% to 14% of registered vessels seeking to use a boat ramp on a typical weekend. This percentage has been termed as "registration activation" for the purposes of this Study.

To better represent the demand within each local government area, refinement of the registration activation percentage considered the following factors as influencing boating popularity over other recreational opportunities:

- incidence of blue collar employment (based on Census data)
- average age of residents (based on Census data)
- remoteness classification by local government area
- whether the LGA is coastal.

Detail on the process for local refinement of registration activation is provided in Appendix C. The adopted parameters for this assessment are summarised in Table 8.

Key observations relevant to the registration activation include a high incidence of older and blue collar workers compared to the state average outside the Cairns LGA.

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[7] TMR (2016) Marine Facilities and Infrastructure Plan

[8] GHD (2011) Recreational Boating Facilities Demand Forecasting Study. Report prepared for TMR, September.

Key observations regarding boat ramp demand relevant to the contributions from the various sources are that:

- Population areas within the Cairns LGA are largely constrained to the coast by the Great Dividing Range. Most (94%) Cairns residents are considered to use facilities within the LGA. The remaining 6% are considered to use facilities in Douglas or Cassowary Coast LGAs.
- Demand for tidal facilities from the inland population centre of Mareeba is largely funnelled into Cairns by virtue of the road network (Kennedy Highway).
- Demand for tidal facilities from Tablelands Regional Council is shared with Cassowary Coast due to the road network.
- No boat ramp facilities are close to the boundaries of Cairns LGA with Douglas Shire and Cassowary Coast Regional Councils. Sharing of demand between Cairns and these adjoining LGAs is expected to be relatively low.

Table 8 – Contribution to demand for boat ramp facilities, Cairns Regional Council

Contributing LGA	% of contributing LGA using Cairns facilities*	# of registered vessels from contributing LGA using Cairns facilities	% registration activation	Contribution comment
Cairns	94%	9,619	10%	Resident population Regional centre
Tablelands	25%	600	12%	Hinterland catchment Older, blue collar, remote, non-coastal
Mareeba	40%	477	12%	Hinterland catchment Older, blue collar, remote, non-coastal
Etheridge	20%	10	12%	Western catchment Older, blue collar, very remote, non-coastal
Douglas	5%	79	12%	Visitation from adjacent coastal LGA Older, blue collar, regional centre
Cassowary Coast	4%	172	14%	Visitation from adjacent coastal LGA Older, blue collar, remote

**See Economic Associates Appendix C for percentage estimates*

In addition to usage of the Cairns facilities by residents from Cairns and adjacent LGAs, the Cairns area is considered to record a significant uplift in boating infrastructure demand as a result of tourism activity. While much increased boating tourism will be commercial, a substantial increase will be incurred by residents taking visiting friends and relatives out on their boats.

Economic Associates (Appendix C) assumed that Cairns would experience a 20% uplift in boat ramp lane demand as a result of tourism activity throughout the year.

5.1.3 Demand classifications

The demand by registered vessels has been sub-classified to better align with differing types of destinations:

- Smaller vessels (less than 4.5m in length) are considered to be generally used to access protected waters such as creeks and estuaries, and to venture into nearshore waters during good weather conditions.
- Larger vessels (between 4.5 and 8m in length) are considered to be generally used to access offshore waters, but seek protected waters during poor weather conditions. Depending on the location, some larger vessels are unable to use more tidally restricted facilities in creeks and estuaries.

5.1.4 Boat ramp lane demand

Applying the registration distribution and activation factors to vessel registration data results in an effective quantitative demand for boat ramp lanes within the catchment. This is summarised in Table 9, and shown in terms of small and large vessel demand. Assumptions used in the projections for future growth in demand are provided in Appendix C (Economic Associates report).

Table 9 – Boat ramp lane demand projections, Cairns Regional Council

Vessel length	Boat ramp lanes				
	2016	2021	2026	2031	2036
0 to 4.5m	22	23	25	26	29
4.5 to 8m	11	12	13	14	16
Total	**33**	**35**	**38**	**40**	**45**

Key observations relevant to the catchment demand include:

- The majority of demand on facilities originates from Cairns Regional Council residents.
- Demand from small boats is approximately twice that of larger boats.
- Growth is forecast to be relatively consistent over the next 20 years.

5.2 Deep-draught vessel landing demand

5.2.1 Local usage and network

Along with private marina facilities, the Tingira St pontoon forms part of a network of mainland landings accessible by deep-draught vessels cruising the Queensland coast. Approaching from the south, it is approximately 54 nautical miles from the public landings in Innisfail to Cairns, and another 34 nautical miles from Cairns to Port Douglas. Depending on the weather conditions and seasonal trade winds, both Innisfail and Port Douglas are within a day's sail of Cairns. Note that while there are several jetties in the Mourilyan/Innisfail area, there are no public deep-draught vessel pontoons in that area and the next one southward is in the Enterprise Channel at Dungeness, some 109 nautical miles south of Cairns.

Given Cairns' status as a tourist destination in its own right and as the last major port for vessels en route to the Northern Territory or Papua New Guinea, visiting vessels tend to stay for more than one night, and therefore will need to seek an overnight protected berth or mooring. Commercial marina facilities cater to this demand, providing landing facilities for their members and for casual visitors. Moorings or berths are generally available at one of the private facilities in Trinity Inlet/Smiths Creek or Yorkeys Knob.

Community stakeholders have indicated a desire for a short term public landing closer to the Cairns central business district, that is, in the vicinity of Marlin Marina. It is understood that vessels accessing the fuelling facility in Marlin Marina can remain berthed for up to 3 hours at no charge and the marina has an arrangement for dinghy tenders from vessels moored or anchor outside the marina.

The Tingira St pontoon is used occasionally by deep-draught vessels but more frequently by tenders associated with vessels moored or anchored in Smiths Creek. The tenders tend to tie up to the landward side of the pontoon for several hours, leaving the front face of the pontoon available for other vessels. Recreational anglers also use the pontoon, however most give way to vessels during berthing manoeuvres. Stakeholders have not indicated that this pontoon is overloaded in demand terms.

Demand for a publicly accessible landing servicing the Cairns northern beaches area appears low. The private facilities in Half Moon Creek (Bluewater Marina) and Yorkeys Knob Boating Club currently cater for pontoon access for their members and casual visitors. There are no berthing facilities for deep-draught vessels in this northern beaches area other than these private facilities.

The Green Island jetty is used more for day use commercial access rather than forming part of the travelling recreational network. Fitzroy Island jetty services commercial vessels and an anchorage protected from south-easterly winds. Neither of these facilities is considered to be overloaded by stakeholders.

5.2.2 Landing demand

The projected demand for deep-draught vessel landings within the Cairns Regional Council area was assessed by Economic Associates as being driven by the size of the non-trailable fleet. A key difficulty with this assessment is understanding how long visits lasts. It was assumed that demand comprises 5% of the active non-trailable fleet seeking to access a landing. The assessment is shown in Table 10.

Table 10 – Landing demand projections, Cairns Regional Council

Evaluation category	Landings				
	2016	2021	2026	2031	2036
# of landings	6	7	7	8	8

6. Development needs and opportunities

The need for additional recreational boating infrastructure within the Cairns Regional Council area has been identified by comparing the existing capacity within the area with the expected demand.

6.1 Evaluation of needs

6.1.1 Development priorities

The priorities for development are linked to need and funding cycles, as follows:

Priority 1 (P1) These sites are identified to meet existing demand.

Priority 2 (P2) Assuming that the priority 1 sites are implemented, these sites are identified to meet additional demand over the next 5 years.

Priority 3 (P3) Assuming that the priority 1 and 2 sites are implemented, these sites are identified to meet additional demand over the subsequent 5 years, i.e. 2021 to 2026.

Priority 4 (P4) These sites are those that will meet future demand, but are not expected to be required before 2026 in demand terms but may be brought forward for construction for other reasons.

6.1.2 Quantification of shortfall – boat ramp lanes

The overall demand for boat ramp lanes compared to the effective capacity provided by existing facilities is summarised in Table 11.

Table 11 – Projected boat ramp lane shortfall, Cairns Regional Council

Evaluation category	Existing effective capacity*	2016		2021		2026		2036	
		Demand	Shortfall	Demand	Shortfall	Demand	Shortfall	Demand	Shortfall
All vessels, all facilities	20.3	33	12.7	35	14.7	38	17.7	45	24.7

**Existing effective capacity includes MIIP announced projects/upgrades as at December 2016*

However, the provision of additional boat ramp lanes needs to cater to the type of demand to appropriately address that demand. This realistically translates to:

- large (that is 4.5 to 8m) vessels seeking access to open-water
- small (that is <4.5m) vessels not seeking access to open-water.

As there will be some small vessels seeking access to open-water, and some larger vessels not seeking access to open-water, an envelope of projected need has been developed. The best estimate represents the average need within the envelope.

This analysis is shown in Table 12 for facilities classified as providing unhindered open-water access from all-tide or near all-tide facilities, with the envelope of projected need in the Cairns LGA based on the following:

upper bound = 100% larger vessels + 50% smaller vessels

lower bound = 90% larger vessels + 30% smaller vessels

Table 12 – Projected boat ramp lane shortfall, open-water access facilities, Cairns Regional Council

Evaluation category	Existing effective capacity *	2016		2021		2026		2036	
		Demand	Shortfall	Demand	Shortfall	Demand	Shortfall	Demand	Shortfall
Best estimate	**9.8**	**19.3**	**9.5**	**20.6**	**10.8**	**22.4**	**12.6**	**26.8**	**17.0**
Upper bound	9.8	22.0	12.2	23.5	13.7	25.5	15.7	30.5	20.7
Lower bound	9.8	16.5	6.7	17.7	7.9	19.2	9.4	23.1	13.3

**Existing effective capacity includes MIIP announced projects/upgrades as at December 2016*

**Example of demand calculation: Upper bound 2016 – 100% of larger vessels (Table 9) + 50% of smaller vessels (Table 9) = 11 + 11 = 22*

The analysis was also conducted for facilities classified as not providing open-water access, or where water depth or the on-water travel time meant that the facility could not reliably or realistically provide access to open-water (see Table 13). In this analysis, the envelope of projected need in the Cairns LGA was based on the following:

upper bound = 70% smaller vessels + 10% larger vessels

lower bound = 50% smaller vessels + 0% larger vessels

Table 13 – Projected boat ramp lane shortfall, non-open-water access facilities, Cairns Regional Council

Evaluation category	Existing effective capacity*	2016		2021		2026		2036	
		Demand	Shortfall	Demand	Shortfall	Demand	Shortfall	Demand	Shortfall
Best estimate	**10.5**	**13.8**	**3.3**	**14.4**	**3.9**	**15.7**	**5.2**	**18.2**	**7.7**
Upper bound	10.5	16.5	6.0	17.3	6.8	18.8	8.3	21.9	11.4
Lower bound	10.5	11.0	0.5	11.5	1.0	12.5	2.0	14.5	4.0

**Existing effective capacity includes MIIP announced projects/upgrades as at December 2016*

There will be some facilities that have been calculated as a "non-open-water access" facility that can, under some circumstances, provide open-water access. However, for the majority of users, access into the local waterway is the primary destination. This also applies to "open-water access" facilities in waterways, where some users will travel upstream into the waterway rather than going offshore.

Given that the majority of demand is driven by Cairns Regional Council residents, the location of additional or upgraded facilities should be targeted to service the main population centres of:

- central Cairns

- Cairns northern beaches
- Edmonton/Gordonvale.

Regional areas and smaller communities to the south of Cairns are currently adequately serviced by several existing facilities on the Russell and Mulgrave River systems and the upper tributaries of Trinity Inlet.

6.1.3 Quantification of shortfall – deep-draught vessel landings

The assessment of shortfall in landings is shown in Table 14. This assessment indicates that at present the public network in conjunction with the supplementary capacity provided by commercial or club landings is adequate to cater for existing and projected demand, but that additional landings will be required in the future.

Table 14 – Projected landing shortfall, Cairns Regional Council

Evaluation category	Existing effective capacity*	2016		2021		2026		2036	
		Demand	Shortfall	Demand	Shortfall	Demand	Shortfall	Demand	Shortfall
# of mainland landings*	6	6	0	7	1	7	1	8	2

**Existing effective capacity includes MIIP announced projects/upgrades as at December 2016*

**# of landings consists of public sheltered mainland landings, public island landings – supplies available and major private landings*

6.2 Identified stakeholder opportunities

Table 15 summarises the key facilities and sites identified by stakeholders during consultation activities as requiring consideration.

Table 15 – Stakeholder identified opportunities to increase capacity, Cairns Regional Council

Facility	Stakeholder comments	Study comments
Fearnley St	Excellent open water access. Limited parking. Floating walkway desirable.	Parking expansion recommended. Floating walkway and ramp upgrade to 4 x 4m wide lanes planned in December 2016 MIIP.
Tingira St	Good open water access. Services southern growth area. Limited parking.	Parking expansion recommended.
Deeral	Mainly estuarine access. Popular ramp. Floating walkway desirable.	Additional lane, floating walkway and parking expansion recommended.
Packers Camp (Redbank Rd, Mackey Creek)	Mainly estuarine access. Services southern growth area. Additional lanes desirable. Floating walkway desirable.	Additional lanes and floating walkway planned in December 2016 MIIP. Parking expansion recommended.

Facility	Stakeholder comments	Study comments
Greenbank Rd (Barron River)	Poor open water access. Room for expansion of lanes and parking.	Navigable access to open water is tidally constrained at the Barron River mouth and by the WW Mason Bridges. Further expansion not recommended.
Bluewater canal estate (Trinity Park)	Good open water access. Parking too far from ramp (security an issue). Floating walkway desirable.	Facility constructed by private developer with parking later provided by Council. Availability of land for parking very constrained and no opportunity for closer location or further expansion. Floating walkway planned in December 2016 MIIP.
Yorkeys Knob	Excellent open water access. Additional lanes desirable. Limited parking.	Parking and lane expansion at existing ramp constrained by geography and existing development. Further expansion of outer existing ramp not currently recommended. Site immediately south of marina recommended as a potential major new facility.
Palm Cove	Beach ramp. Rebuild as an all-weather facility desirable. Floating walkway desirable.	Existing ramp demolished. Coastal exposure of site would necessitate safe harbour scale development to provide suitable protection from wave action. Facility re-establishment not currently recommended. As parking in the area is already constrained, a major harbour would need to incorporate reclamation for CTU parking.
Second Beach, Yarrabah Road	Beach ramp. Rebuild as an all-weather facility desirable. Floating walkway desirable.	Coastal exposure of site would necessitate safe harbour scale development to provide suitable protection from wave action. Remoteness of facility from major population centres would be unlikely to attract demand to justify against cost. Upgrade of facility not currently recommended.

7. Development priorities

7.1 Methodology for selecting priorities

7.1.1 Boat ramp facilities

The selection of recommended works and their priority level has been considered on several levels. The first level of consideration for increasing boat ramp capacity is founded on two main criteria:

- type of access required – open-water or non-open-water
- preference for expansion of existing facilities if suitably located.

Expansion of existing facilities is preferred over the establishment of new facilities in locations where travel times for most users to the existing facilities are not onerous, as road infrastructure for access is already in place and the foreshore is currently allocated to the purpose.

TMR's Marine Facilities and Infrastructure Plan (2016)[9] also guides the prioritisation of boating facilities. This plan states that:

> *"The department favours proposals for boat launching and landing facilities that give access to the open sea at all tides.*
>
> *Priority will be given to the provision of sheltered all-tide or near all-tide launching facilities giving access to the open sea on an all-tide or near all-tide basis.*
>
> *Part-tide facilities (for launching or access) may be provided where there is demand, and dredged access is not feasible. For instance, beach access or open beach ramps may be provided where there is sufficient demand and no suitable nearby sheltered waterway." (Section 3.1.1 – Coastal locations – guideline).*
>
> *"Access channels are not normally provided to open beach boat ramps. Beach access and open beach boat ramps are regarded as part-tide facilities." (Section 6.8 – Dredging of access channels to beach ramps – guideline).*

The process used within each LGA identified opportunities to meet the need for ramp lanes for each type of access (open-water/non-open-water) at each of the priority time steps (2016, 2021, 2026 and 2036), is set out in the flowchart in Figure 1. Once the forecast shortfall for ramp lanes for a priority level has been met, further consideration of facilities falls to the next priority level until all forecast shortfall is met.

7.1.2 Deep-draught vessel landings

The criteria for recommended works and priorities for landings comprises:

- the geographical spread of existing facilities
- unserviced destinations and popular anchorages
- access to water of sufficient depth
- access to landside services (shops or transportation) for mainland locations.

In some instances, deep water is not available and so provision for access by tenders or at higher tides is made.

In most instances where demand for additional landings is identified, there are very few locations that satisfy all needs. The prioritisation for these facilities is based on stakeholder

[9] TMR (2016) Marine Facilities and Infrastructure Plan

perceptions of urgency. From a stakeholder perspective, the demand for landings is all current (that is, now). However, the recommendations have matched the timing of new landings to the demand forecast.

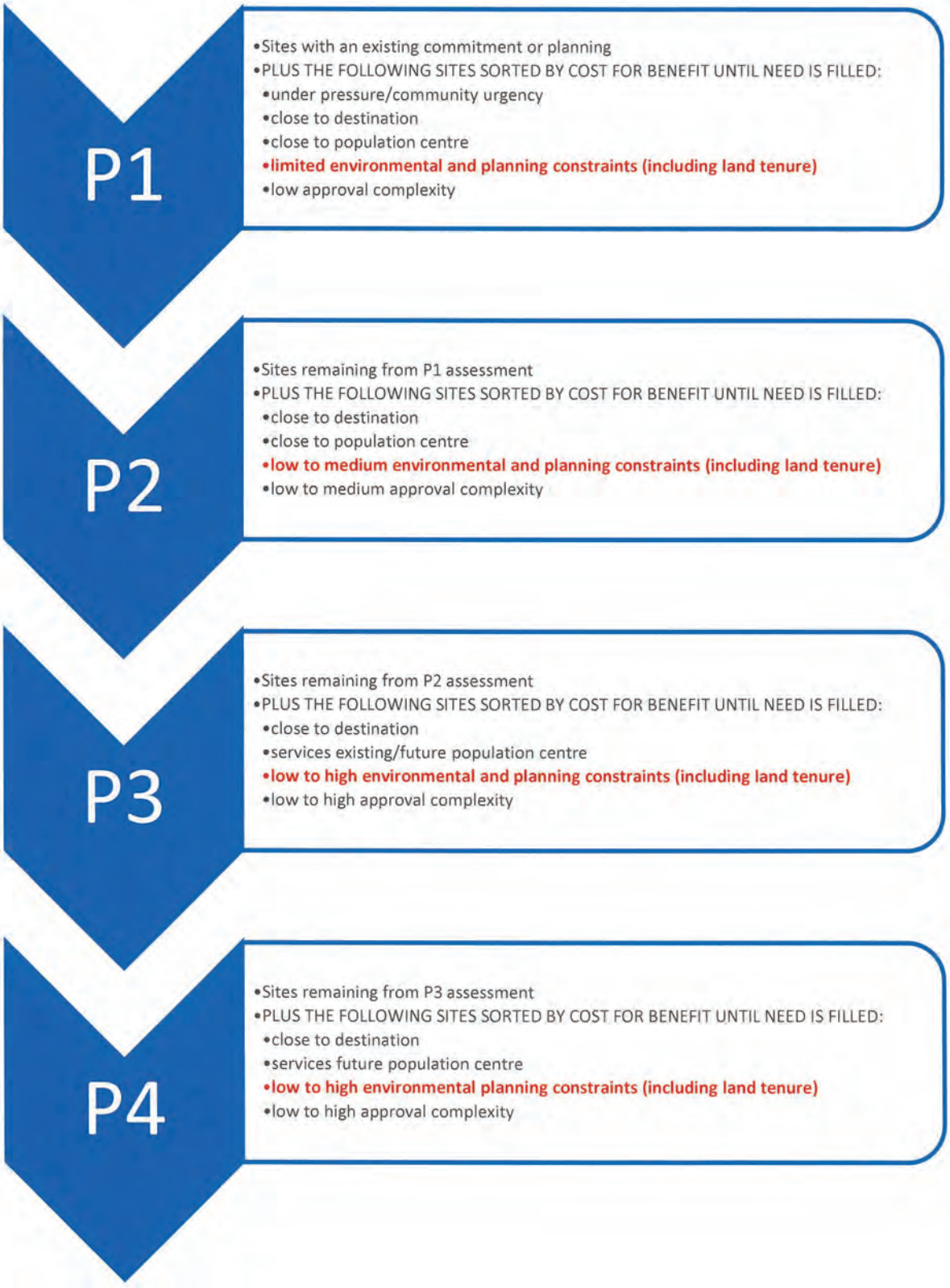

Figure 1 – Priority selection methodology

7.2 Recommended priorities

Table 16 – Recommended priorities to increase capacity, Cairns Regional Council area

Priority	Sites
Priority 1 (as soon as possible)	Fearnley St – expand parking to maximum extent possible (approx. 20 CTU).
	New facility at Yorkeys Knob – 4-lane boat ramp plus floating walkway and 90 CTU, plus parking to support new 4-lane boat ramp in 2016-17 to 2017-18 MIIP (90 CTU) – 180 CTU total.
	Tingira St (Stage 1) – expand parking by 25 CTU at existing facility.
	Packers Camp – formalisation and expansion of parking to achieve 90 CTU.
Priority 2 (over the next five years)	Deeral – add an additional lane plus a floating walkway; expand parking to achieve 90 CTU.
	Cairns CBD – install a deep-draught accessible public pontoon.
	Tingira St (Stage 2) – expand existing facility to incorporate a new 4-lane boat ramp plus floating walkway; parking for new facility (90 CTU); possible reclamation of mangroves to south as the site or to offset addition to existing site.
Priority 3 (over the next five to ten years)	Nil
Priority 4 (other)	New facility at Pine Creek Rd, East Trinity – new 4-lane boat ramp plus floating walkway; parking for new facility (90 CTU); reclamation required.
	Russell River Rd, Bellenden Ker – formalisation and expansion of parking to achieve 45 CTU.
	The Esplanade, Machans Beach – new pontoon or floating walkway; formalisation of 15 CTU.
	Acacia St, Holloways Beach – new pontoon or floating walkway.

A proposed expansion of the Marlin Marina is anticipated to provide additional landings at some point in the future. The increase in capacity provided by this commercial development is considered to satisfy demand for an additional landing by 2036.

7.3 Capacity evaluation incorporating development priorities

The effective lane capacity has been reassessed to incorporate the delivery of the recommended development priorities as shown in Table 17, and described in detail in the following sections. The increase in effective lanes gained by each recommendation is shown in the relevant table for that recommendation.

Table 17 – Effective lane and landing capacity after delivery of recommended priorities, Cairns Regional Council

Evaluation category	Existing effective capacity*	2016		2021		2026		2036	
		Demand	Post-delivery effective capacity *	Demand	Post-delivery effective capacity	Demand	Post-delivery effective capacity	Demand	Post-delivery effective capacity
Open-water access	10	19.5	20	20.5	24	22.5	24	27	28
Non-open-water access	10.5	13.5	13.5	14.5	15.5	15.5	15.5	18	17
All vessels, all facilities	20.5	33	33.5	35	39.5	38	39.5	45	45
# of landings*	6	6	6	7	7	7	7	8	8

**Existing effective capacity includes MIIP announced projects/upgrades as at December 2016*

**Example of post-delivery effective capacity calculation, open-water access, 2016: Existing effective capacity (9.8 – rounded to 10) + Fearnley St parking expansion (1) + new Yorkeys Knob (8) + Tingira St Stage 1 (1) = 19.8 – rounded to 20*

**# of landings consists of public sheltered mainland landings, public island landings – supplies available and major private landings*

7.4 Priority 1 sites

Table 18 – Priority 1 – Fearnley St, Portsmith

Site name	Fearnley St, Portsmith, Cairns	
Existing formal facility?	Yes	
Location	Smiths Creek, Portsmith, Cairns	
Current tidal status	All-tide, open-water access	
Site characteristics	The site is located in close proximity to Trinity Inlet and provides the closest boat ramp access from land to open water south of the Barron River. This facility contains 4 narrow ramp lanes served by 43 CTU spaces. No boat queuing structures are currently in place, although a floating walkway and rebuild of the ramp to standard lane widths is planned as part of the 2016-17 to 2017-18 MIIP.	
Proposed works	Widening of Fearnley St road reserve to accommodate an additional 20 CTU parking spaces along the eastern frontage. Acquisition of a small part of Lot 463 on SP207571 would be required to achieve this.	
Increase in effective lanes provided by works	1 effective lane	
Rationale	Fearnley St is centrally located, very popular and frequently overcrowded. The existing CTU parking is inadequate to fulfil the potential capacity of the existing marine infrastructure. Expansion of parking will increase the efficient usage of the existing infrastructure and contribute to accommodate demand for open-water access.	
Environmental and planning constraints	A registered native title claim is over the site under Cairns Regional Council #2. NNTT ref QN2014/008. TMR to undertake negotiations with registered traditional owners of the land to prepare and execute a CHMP for the works. World Heritage and National Heritage property on boundary of GBR. Works involve the extension of a car park in a previously disturbed area. Impacts on the WHA is likely to be minimal and can be managed. However, if the works are likely to impact on MNES, a referral under the EPBC Act must be made to DEE. Within a nationally important wetland - Port of Cairns and Trinity Inlet. If the works are likely to impact on MNES, a referral under the EPBC Act must be made to DEE. Works are located on land that is Strategic Port Land at the Port of Cairns. The works are therefore exempt from assessment against the Cairns Plan 2016. Assessment will fall under the Cairns Port Authority Land Use Plan (Seaport Local Area Plan). An MCU is required to be lodged under the SP Act if the works are inconsistent with the land use plan. Lands lease tenure.	
Consultation feedback	None received	
Indicative cost (excl. GST) (to ±50%)	Water-based infrastructure	$ -
	Land-based infrastructure (excludes land acquisition costs)	$260,000

Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Populated Places
- Carpark
- State controlled road
- Cadastre

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number	41-30098
Revision	A
Date	15 Dec 2016

Boating facility
Fearnley Street, Portsmith

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Data source: GHD: Layout/2016; DNRM: Roads/2015, Populated Places, Local Government Area/2016, Cadastre/2016, Cadastre/2016, Cadastre/2016, Cadastre/2016, TMR: Facilities/2016, Imagery (2013-2016). Created by: AJIMS

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Table 19 – Priority 1 –Yorkeys Knob South, Yorkeys Knob

Site name	Yorkeys Knob South, Yorkeys Knob
Existing formal facility?	No
Location	Half Moon Creek, off of Buckley St between Half Moon Bay Golf Club and Half Moon Creek
Current tidal status	Near all-tide, open-water access
Site characteristics	Site is located between the southern boundary of the Yorkeys Knob Boating Club lease area and the northern boundary of the Half Moon Bay Golf Club. The land also directly adjoins Half Moon Creek. The site is currently Unallocated State Land, and consists of shallow tidal areas on the edge of Half Moon Bay Marina and a vegetated low coastal sand dune abutting the golf course. The dune no longer functions as a coastal oceanic barrier since it was isolated by the construction of the Half Moon Bay Marina and an extension of the golf course. A local drainage line that services the golf course runs through the site.
Proposed works	Navigable access is intended to be provided via the existing Half Moon Bay Marina. Minor dredging to achieve all tide navigable depths at the ramp approaches will be required. The planned works in the 2016-17 to 2017-18 MIIP are proposed to be augmented by an additional 4 boat ramp lanes (to achieve an 8 lane, 2 floating walkway facility). Construction of 180 CTU to support all ramp lanes.
Increase in effective lanes provided by works	12 waterside effective lanes, but limited to 8 by CTU
Rationale	The ramp lanes and CTU parking at the existing Yorkeys Knob boat ramp cannot be expanded. This site provides an opportunity for sheltered, all weather, all tide access to be provided to the open ocean without affecting residential amenity. It will service the growing demand from Cairns and the northern beaches area. Maintenance of tidal access can leverage off existing dredging works undertaken at the Half Moon Bay Marina.
Environmental and planning constraints	Commonwealth NT Act - A registered native title claim is over the site – for Yirrganydji (Irukandji) People #2. NNTT ref # QC2015/004. TMR to undertake negotiations with registered traditional owners of the land to prepare and execute a CHMP for the works. World Heritage and National Heritage property – GBR. As the works are likely to impact on MNES, a referral under the EPBC Act must be made to DEE. Marine Park Permits may be required for any works that occur within the GBR Marine Park. Low disturbance area – potential for impact to threatened flora and fauna species. If the works are likely to impact on MNES, a referral under the EPBC Act must be made to DEE. Of concern remnant vegetation of regional ecosystem 7.2.7a (category B) mapped over site. Site is also mapped as containing essential habitat. Exemptions apply for clearing native vegetation on land generally that is clearing for the construction or maintenance of community infrastructure mentioned in Shd 21, Part 1, Section 14 (b) of P Reg that is government supported transport infrastructure. Operational Works for tidal works or works within a coastal management district is triggered under P Act for the works in the tidal area. Works are considered accepted development under the P Reg Shd 7 Part 3, Item 10 (b) for tidal works that

Site name	Yorkeys Knob South, Yorkeys Knob	
	is undertaken by TMR. Accepted development works are to comply with the requirements for the work prescribed under the Coastal Act, Section 167(5)(b). Marine plants are established along the waterway and this area is mapped accordingly under the local planning scheme as an area of high ecological significance. Removal of marine plants will require an Operational Works permit for the removal, destruction or damage of marine plants under P Act (Shd 10 Part 17 Item 28 of P Reg). May be accepted development if works can comply with the requirements under Shd 7 Item 8 of the P Reg. Environmental Relevant Activity 16 extracting and screening activities for dredging more than 1000 tonnes of material in a year may be triggered depending on works (P Reg Shd 10, Part 5, Div 2, Item 1). FHA management area B is located in the site area. Operational work completely or partly in a declared fish habitat area is assessable development, unless the work is accepted development under shd 7, part 3, section 7 of the P Reg. Under the local planning scheme: • The works for the boat ramp lanes and dredging are located within the SPL. The works are therefore exempt from assessment against the Cairns Plan 2016. Assessment for MCU and operational works will fall under the Cairns Port Authority Land Use Plan. An MCU is required to be lodged under the SP Act if the works are inconsistent with the land use plan. • The works for the car park are located in Sport and Sport and Recreation Zoning of the Cairns Plan 2016 (some aspects may protrude into SPL). A material change of use application will be required for the car park expansion works to be assessed under the Cairns Plan 2016. • The operational works are exempt from assessment against the local planning scheme as the works would be undertaken by or on behalf of a public sector entity (TMR) (Shd 6 Part 3, Section 8 of P Reg). Therefore, the works for the car park will not trigger operational works under the Cairns Plan 2016. Unallocated state land tenure.	
Consultation feedback	None received	
Indicative cost (excl. GST) (to ±50%)	Water-based infrastructure	$7,270,000
	Land-based infrastructure	$6,760,000

Paper Size A3

0 12.5 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Populated Places
- State controlled road
- Cadastre
- Breakwater
- Carpark
- Floating Walkway
- Boat Ramp

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number	41-30098
Revision	A
Date	15 Dec 2016

Boating facility
Yorkeys Knob South, Yorkeys Knob

C:\Users\hamiltonl\Desktop\GIS\30098\MXD\ROADS\41_30098_019_MG91_MG92_MG94_RevA.mxd

Data source: GHD: Layout/2016; DNRM: Roads/2015, Populated Places, Local Government Area/2016, Cadastre/2016; TMR: Facilities/2016; Imagery (2013-2016). Created by: AJMB

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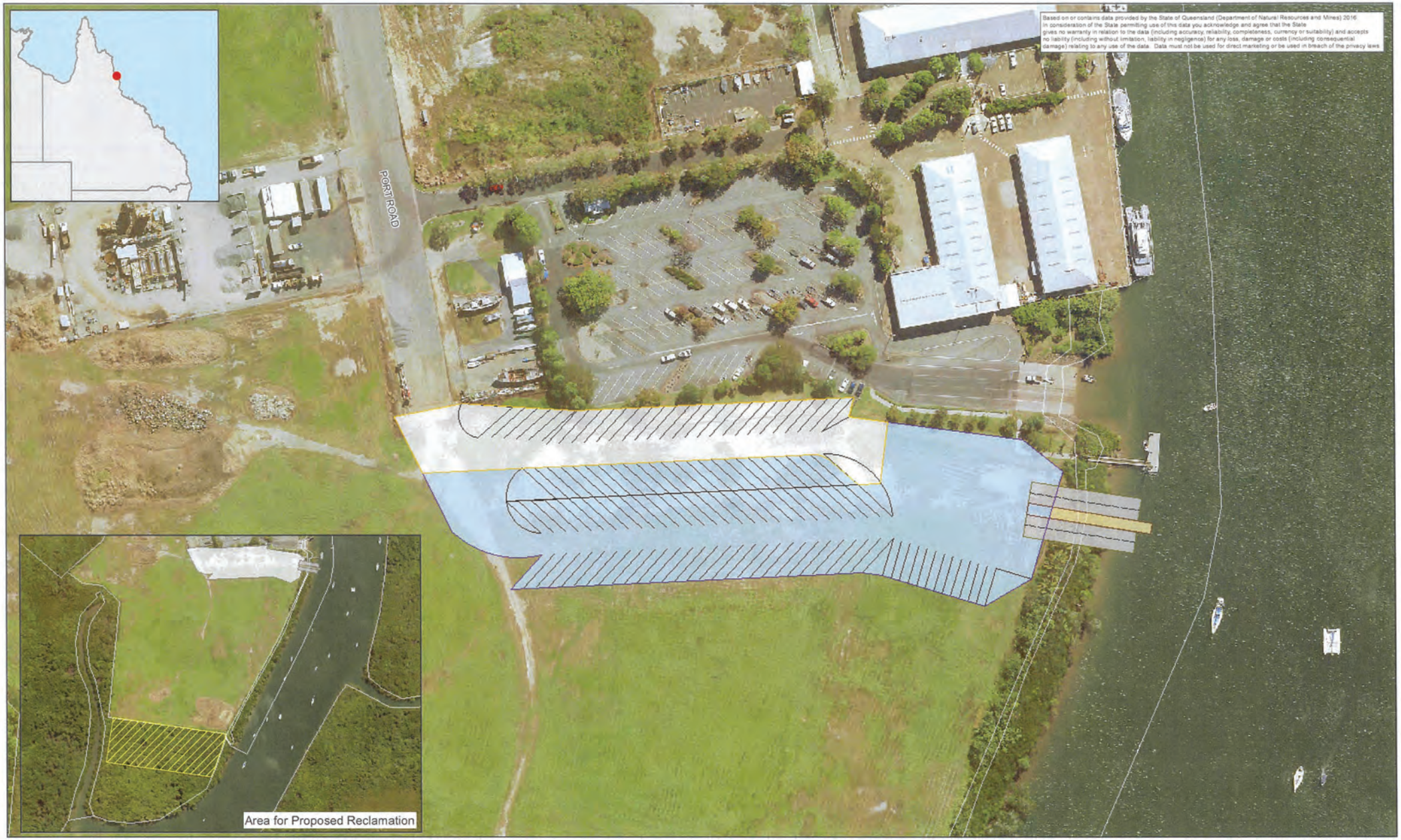
Table 20 – Priority 1 – Tingira St, Portsmith

Site name	Tingira St, Smiths Creek, Portsmith, Cairns
Existing formal facility?	Yes
Location	Southern end of Tingira St, Smiths Creek, Portsmith, Cairns
Current tidal status	All-tide, open-water access
Site characteristics	The site is located approximately 1.2 km (0.65 nautical miles) upstream of the Fearnley St boat ramp. This facility contains 5 narrow ramp lanes served by 84 CTU spaces. A floating walkway and a pontoon currently provide queuing facilities, although the pontoon also serves as a landing facility for deep-draught vessels and their tenders. Tingira St is very popular and frequently overcrowded. CTU parking is inadequate to fulfil the potential capacity of the existing marine infrastructure, and further expansion of the site is required to cope with demand. The facility is located on Strategic Port Land. On its southern boundary the reclaimed land is yet to be developed. Ports North has indicated that the existing undeveloped land is of commercial importance to them, and any expansion of the Tingira St facility would need to be offset by the creation of additional waterfront land made available for future development as port land or else any new boat facility be established on the reclaimed land.
Proposed works	Stage 1 (Priority 1 works) involves the expansion of the existing car parking area southwards to accommodate an additional 25 CTU. Reclamation of approximately 1.3 ha of land within Lot 4 on SP 218291 at the southern end of the Smiths Creek frontage will be required to offset the development area necessary for both stages of development.
Increase in effective lanes provided by works	Stage 1 – 1 lane (Priority 1 works)
Rationale	The Tingira St facility is centrally located for residents in the Cairns Council area, and has good proximity to main population areas. It is the only ramp in the central Cairns area with land suitable for expansion nearby, and with self-maintaining navigable water depths in the adjacent watercourse. An increase in capacity at this ramp improves the availability of access to open-water and to estuarine areas, and will allow demand for open-water access to be met for the medium term.
Environmental and planning constraints	Within a nationally important wetland – Port of Cairns and Trinity Inlet. As the works are likely to impact on MNES, a referral under the EPBC Act must be made to DEE. A registered native title claim is over the site under Cairns Regional Council #2. NNTT ref QN2014/008. TMR to undertake negotiations with registered traditional owners of the land to prepare and execute a CHMP for the works. Least concern remnant vegetation mapped over site. Exemptions apply for clearing native vegetation on land generally that is clearing for the construction or maintenance of community infrastructure mentioned in Shd 21, Part 1, Section 14 (b) of P Reg that is government supported transport infrastructure. Marine plants are established along the waterway and this area is mapped accordingly under the local planning scheme as an area of high ecological significance. Removal of marine plants will require an Operational Works permit for the

Site name	Tingira St, Smiths Creek, Portsmith, Cairns	
	removal, destruction or damage of marine plants under P Act (Shd 10 Part 17 Item 28 of P Reg). May be accepted development if works can comply with the requirements under Shd 7 Item 8 of the P Reg. The works for the car park expansion are located on SPL. These works are therefore exempt from assessment against the Cairns Plan 2016. Assessment will fall under the Cairns Port Authority Land Use Plan. Uses that are consistent with the port land use plan are considered exempt development and a development permit is not required under SP Act. The operational works for the car park are exempt from assessment against the Cairns Plan 2016 as the works would be undertaken by or on behalf of a public sector entity (TMR) (Shd 6 Part 3, Section 8 of P Reg). Therefore, the works for the car park will not trigger operational works under the Cairns Plan 2016. Lands lease tenure.	
Consultation feedback	None received	
Indicative cost (excl. GST) (to ±50%)	Water-based infrastructure	$ -
	Land-based infrastructure (excludes land acquisition costs)	$1,190,000



Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Populated Places
- State controlled road
- Cadastre
- Stage 1 of Works
- Stage 2 of Works
- Floating Walkway
- Boat Ramp
- Area for Proposed Reclamation

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number 41-30098
Revision A
Date 15 Dec 2016

Boating facility
Tingira Street, Portsmith

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Data source: GHD: Layout/2016; DNRM: Roads/2015, Populated Places, Local Government Area/2016; Cadastre/2016; TMR: Facilities/2016; Imagery (2013-2016). Created by: AJMS

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Table 21 – Priority 1 – Packers Camp (Redbank Rd, Mackey Creek)

Site name	Packers Camp (Redbank Rd, Mackey Creek)
Existing formal facility?	Yes
Location	Packers Camp, on the southern bank of Mackeys Creek
Current tidal status	Part-tide, depth-restricted open-water access
Site characteristics	This popular site is located in the upstream reaches of Trinity Inlet, on the tributary of Mackeys Creek. The existing site contains a single lane part-tide facility with a small number of informal car parking spaces. The site is being upgraded to become a near all-tide, 4-lane facility with a floating walkway in the 2016-17 to 2017-18 MIIP. Access to the ocean will still be restricted on the lowest tides. Two well-vegetated reserves adjoining the ramp have been identified by council as the proposed sites for future car parking.
Proposed works	Formalisation of 90 CTU spaces to match the upgraded ramp and floating walkway infrastructure. Cairns Regional Council has indicated it will increase the parking to 90 CTUs. It is expected that the car-trailer parking works will be implemented in stages.
Increase in effective lanes provided by works	3 lanes
Rationale	This facility is servicing the growing population areas to the south of Cairns. Upgrading this facility to be all tide at the ramp increases its availability, and as a result its popularity is expected to continue to increase. Parking to match the capacity provided by the new ramp lanes is required to leverage the most benefit from the current waterside upgrade. This facility provides access to the estuarine reaches of the creek and to the ocean at most tidal levels. Based on speed limits in the various waterways, for residents in the Gordonvale area the travel time from the ramp to open water is competitive with the combined driving/boating travel time from Tingira St. Expansion of Packers Camp can therefore also contribute to reducing pressure at the Tingira St facility.
Environmental and planning constraints	Low disturbance area – potential for impact to threatened flora and fauna species. If the works are likely to impact on MNES, a referral under the EPBC Act must be made to DEE. Category B, least concern remnant vegetation. Exemptions apply for clearing native vegetation on land generally that is clearing for the construction or maintenance of community infrastructure mentioned in Shd 21, Part 1, Section 14 (b) of P Reg that is government supported transport infrastructure. Marine plants (mangroves) are established along the waterway and this area is mapped accordingly under the local planning scheme as an area of high ecological significance. Removal of marine plants will require an Operational Works permit for the removal, destruction or damage of marine plants under P Act (Shd 10 Part 17 Item 28 of P Reg). May be accepted development if works can comply with the requirements under Shd 7 Item 8 of the P Reg. Potential for works in the tidal area. Operational Works for tidal works or works within a coastal management district is triggered under P Act for the works in the tidal area. Works are considered accepted development under the P Reg Shd

Site name	Packers Camp (Redbank Rd, Mackey Creek)	
	7 Part 3, Item 10 (b) for tidal works that is undertaken by TMR. Accepted development works are to comply with the requirements for the work prescribed under the Coastal Act, Section 167(5)(b). FHA management area A is located in the site area. Operational work completely or partly in a declared fish habitat area is assessable development, unless the work is accepted development under shd 7, part 3, section 7 of the P Reg. The proposed works are located within the following zones of the Cairns Plan 2016: • Rural Zone – formulisation of the existing use of the 90 CTU car parking spaces. • Special Purposes – priority area and boat ramp. • Open Space – Priority Area 2. • An MCU is likely to be triggered for the car park expansion under the Cairns City Plan. • The operational works for the car park are exempt from assessment against the Cairns Plan 2016 as the works would be undertaken by or on behalf of a public sector entity (TMR) (Shd 6 Part 3, Section 8 of P Reg). Therefore, the works for the car park will not trigger operational works under the Cairns Plan 2016. Reserve tenure.	
Consultation feedback	None received	
Indicative cost (excl. GST) (to ±50%)	Water-based infrastructure	$ -
	Land-based infrastructure	$2,320,000

Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Populated Places
- Carpark
- State controlled road
- Cadastre

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number	41-30098
Revision	A
Date	16 Dec 2016

Boating facility
Packers Camp (Redbank Road, Mackey Creek)

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Data source: GHD: Layout/2016, DNRM: Roads/2015, Populated Places, Local Government Area/2016, Cadastre/2016, Cadastre/2016, Cadastre/2016, TMR: Facilities/2016, Imagery (2013-2016). Created by: AJ/MS

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7.5 Priority 2 sites

Table 22 – Priority 2 – Tingira St, Portsmith

Site name	Tingira St, Smiths Creek, Portsmith, Cairns
Existing formal facility?	Yes
Location	Southern end of Tingira St, Smiths Creek, Portsmith, Cairns
Current tidal status	All-tide, open-water access
Site characteristics	The site is located approximately 1.2 km (0.65 nautical miles) upstream of the Fearnley St boat ramp. This facility contains 5 narrow ramp lanes served by 84 CTU spaces. A floating walkway and a pontoon currently provide queuing facilities, although the pontoon also serves as a landing facility for deep-draught vessels and their tenders. Tingira St is very popular and frequently overcrowded. CTU parking is inadequate to fulfil the potential capacity of the existing marine infrastructure, and further expansion of the site is required to cope with demand. The facility is located on Strategic Port Land. On its southern boundary the reclaimed land is yet to be developed. Ports North has indicated that the existing undeveloped land is of commercial importance to them, and any expansion of the Tingira St facility would need to be offset by the creation of additional waterfront land made available for future development as port land or else any new boat facility be established on the reclaimed land.
Proposed works	Stage 2 (Priority 2 works) involves the construction of a new 4 lane boat ramp plus floating walkway on the southern side of the existing pontoon, and construction of a parking area to accommodate 90 CTU – or alternatively, construction of the new 4-lane facility on reclaimed land further south.
Increase in effective lanes provided by works	Stage 2 – 4 lanes (Priority 2 works)
Rationale	The Tingira St facility is centrally located for residents in the Cairns Council area, and has good proximity to main population areas. It is the only ramp in the central Cairns area with land suitable for expansion nearby, and with self-maintaining navigable water depths in the adjacent watercourse. An increase in capacity at this ramp improves the availability of access to open-water and to estuarine areas, and will allow demand for open-water access to be met for the medium term.
Environmental and planning constraints	Least concern remnant vegetation mapped over site. Exemptions apply for clearing native vegetation on land generally that is clearing for the construction or maintenance of community infrastructure mentioned in Shd 21, Part 1, Section 14 (b) of P Reg that is government supported transport infrastructure. Marine plants are established along the waterway and this area is mapped accordingly under the local planning scheme as an area of high ecological significance. Removal of marine plants will require an Operational Works permit for the removal, destruction or damage of marine plants under P Act (Shd 10 Part 17 Item 28 of P Reg). May be accepted development if works can comply with the requirements under Shd 7 Item 8 of the P Reg. A registered native title claim is over the site. NNTT ref # QC2014/008.

Site name	Tingira St, Smiths Creek, Portsmith, Cairns	
	Within a nationally important wetland – Port of Cairns and Trinity Inlet, the works are likely to impact on MNES, a referral under the EPBC Act must be made to DEE. FHA management area B is located in the site area. Operational work completely or partly in a declared fish habitat area is assessable development, unless the work is accepted development under shd 7, part 3, section 7 of the P Reg. Operational Works for tidal works or works within a coastal management district is triggered under P Act for the works in the tidal area. Works are considered accepted development under the P Reg Shd 7 Part 3, Item 10 (b) for tidal works that is undertaken by TMR. Accepted development works are to comply with the requirements for the work prescribed under the Coastal Act, Section 167(5)(b). Environmental Relevant Activity 16 extracting and screening activities for dredging more than 1000 tonnes of material in a year may be triggered depending on works (P Reg Shd 10, Part 5, Div 2, Item 1). The works for the car park expansion and 4 lane boat ramp and floating walkway are located on Strategic Port Land. These works are therefore exempt from assessment against the Cairns Plan 2016. Assessment will fall under the Cairns Port Authority Land Use Plan. Uses that are consistent with the port land use plan are considered accepted development and a development permit is not required under P Act. The reclamation area is located outside the SPL and is located in the conservation zone of the Cairns Plan 2016. It is envisaged that this lot will be included within the SPL under the Transport Infrastructure Act. Therefore the approval triggers for the reclamation area would likely fall under Cairns Port Authority Land Use Plan. The operational works for the car park are exempt from assessment against the Cairns Plan 2016 as the works would be undertaken by or on behalf of a public sector entity (TMR) (Shd 6 Part 3, Section 8 of P Reg). Therefore, the works for the car park will not trigger operational works under the Cairns Plan 2016. Lands lease tenure next to existing facility. Reclamation area tenure is unallocated state land.	
Consultation feedback	None received	
Indicative cost (excl. GST) (to ±50%)	Water-based infrastructure	$1,940,000
	Land-based infrastructure (excludes land acquisition costs)	$3,630,000

Refer to Figure 4 for sketch.

Table 23 – Priority 2 – Ross Rd, Deeral

Site name	Ross Rd, Deeral
Existing formal facility?	Yes
Location	Ross Rd, Deeral, on the southern bank of the Mulgrave River
Current tidal status	Near all-tide, depth restricted open-water access
Site characteristics	This popular site is located a short distance upstream of the confluence with the Russell River. The existing site contains a three-lane ramp with a very small number of unmarked car parking spaces, but an area of roadside overflow parking. The site is adjoined by well-vegetated reserves and cultivated agricultural land.
Proposed works	Expansion of the ramp to include an additional lane and a floating walkway. Formalisation of 80 CTU spaces.
Increase in effective lanes provided by works	2.2 lanes
Rationale	This facility is increasing in popularity and is already frequently under pressure. It provides access to estuarine reaches of the Mulgrave and Russell Rivers, and open-water access at Russell Heads is possible under most tidal levels. Current ad hoc parking causes congestion at the facility and poses safety issues for other road users. Formalisation of parking and expansion of the facility to improve its efficiency will assist in meeting current and future demand.
Environmental and planning constraints	Within World Heritage and National Heritage area. Impacts on the WHA is likely to be minimal and can be managed. Low disturbance area – potential for impact to threatened flora and fauna species. If the works are likely to impact on MNES, a referral under the EPBC Act must be made to DEE. Regulated vegetation (of concern remnant vegetation) mapped over carpark area. Exemptions apply for clearing native vegetation on land generally that is clearing for the construction or maintenance of community infrastructure mentioned in Shd 21, Part 1, Section 14 (b) of P Reg that is government supported transport infrastructure. Within flora trigger area – The project site is mapped as a high risk site for protected plants and a low disturbance area. Mulgrave River is a major impact (purple) waterway and may therefore trigger operational works for waterway barrier works under P Act for the ramp and floating walkway. Operational Works for tidal works or works within a coastal management district is triggered under P Act for the works in the tidal area. Works are considered accepted development under the P Reg Shd 7 Part 3, Item 10 (b) for tidal works that is undertaken by TMR. Accepted development works are to comply with the requirements for the work prescribed under the Coastal Act, Section 167(5)(b). Marine plants (mangroves) are established along the waterway and this area is mapped accordingly under the local planning scheme as an area of high ecological significance. Removal of marine plants will require an Operational Works permit for the removal, destruction or damage of marine plants under P Act (Shd 10 Part 17 Item 28 of P Reg). May be accepted development if works can comply with the requirements under Shd 7 Item 8 of the P Reg. Environmental Relevant Activity 16 extracting and screening activities for dredging more than 1000 tonnes of material in a

Site name	Ross Rd, Deeral	
	year may be triggered depending on works (P Reg Shd 10, Part 5, Div 2, Item 1). The proposed works are located within the open space zone of the Cairns Plan 2016: • An MCU is likely to be triggered under the Cairns City Plan. • The operational works for the are exempt from assessment against the Cairns Plan 2016 as the works would be undertaken by or on behalf of a public sector entity (TMR) (Shd 6 Part 3, Section 8 of P Reg). Therefore, the works for the car park will not trigger operational works under the Cairns Plan 2016. Reserve tenure.	
Consultation feedback	None received	
Indicative cost (excl. GST) (to ±50%)	Water-based infrastructure	$1,000,000
	Land-based infrastructure	$1,290,000

Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Populated Places
- State controlled road
- Cadastre
- Carpark
- Floating Walkway
- Boat Ramp

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number	41-30098
Revision	A
Date	15 Dec 2016

Boating facility
Ross Road, Deeral

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Data source: GHD: Layout/2016; DNRM: Roads/2015, Populated Places, Local Government Area/2016, Cadastre/2016, Cadastre/2016, Cadastre/2016, Cadastre/2016; TMR: Facilities/2016; Imagery (2013-2016). Created by: AJ/MS

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Table 24 – Priority 2 – Abbott Street, Cairns

Site name	Abbott Street, Cairns
Existing formal facility?	No
Location	On Wharf St, Cairns, close to intersection with Abbott St, adjacent to Trinity Inlet
Current tidal status	All-tide, open-water access
Site characteristics	This site forms part of the parkland redevelopment adjacent to the Cairns Cruise Ship Terminal. This site is identified in the City Port Masterplan as being part of the major open space area. There is already a viewing platform on the Inlet in this location. The site provides direct and close access into the central business district of Cairns, with supermarkets, restaurants and other shops within 500m.
Proposed works	Installation of a pontoon for access by deep-draught vessels or their tenders.
Increase in effective lanes provided by works	0 lanes
Rationale	Stakeholder feedback has indicated a desire for a landing for deep draught vessels or their tenders to easily access Cairns CBD on a very short term basis. Trinity Inlet is a very popular anchorage, and currently vessel owners/residents are forced to travel upstream to Tingira St, where there is no easy access to shops or transportation. This facility can be incorporated into planning of the future marina berths intended for this section of the waterfront, without reducing the number of berths or the operations of the adjacent cruise ship terminal.
Environmental and planning constraints	A registered native title claim is over the site under Cairns Regional Council #2. NNTT ref QN2014/008. TMR to undertake negotiations with registered traditional owners of the land to prepare and execute a CHMP for the works. Within World Heritage and National Heritage area - GBR. If the works are likely to impact on MNES, a referral under the EPBC Act must be made to DEE. Within a nationally important wetland - Port of Cairns and Trinity Inlet. Operational Works for tidal works or works within a coastal management district is triggered under P Act for the works in the tidal area. Works are considered accepted development under the P Reg Shd 7 Part 3, Item 10 (b) for tidal works that is undertaken by TMR. Accepted development works are to comply with the requirements for the work prescribed under the Coastal Act, Section 167(5)(b). Marine plants (mangroves) are established along the waterway and this area is mapped accordingly under the local planning scheme as an area of high ecological significance. Removal of marine plants will require an Operational Works permit for the removal, destruction or damage of marine plants under P Act (Shd 10 Part 17 Item 28 of P Reg). May be accepted development if works can comply with the requirements under Shd 7 Item 8 of the P Reg. Environmental Relevant Activity 16 extracting and screening activities for dredging more than 1000 tonnes of material in a year may be triggered depending on works (P Reg Shd 10, Part 5, Div 2, Item 1).

Site name	Abbott Street, Cairns	
	The works for the pontoon are located on SPL. These works are therefore exempt from assessment against the Cairns Plan 2016. Assessment will fall under the Cairns Port Authority Land Use Plan. Uses that are consistent with the port land use plan are considered accepted development and a development permit is not required under P Act.	
	Lands lease tenure.	
Consultation feedback	None received	
Indicative cost (excl. GST) (to ±50%)	Water-based infrastructure	$620,000
	Land-based infrastructure	$ -

Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Populated Places
- Pontoon
- State controlled road
- Cadastre

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number	41-30098
Revision	A
Date	16 Dec 2016

Boating facility
Abbott Street, Cairns

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Data source: GHD: Layout/2016; DNRM: Roads/2015, Populated Places, Local Government Area/2016, Cadastre/2016, Cadastre/2016; TMR: Facilities/2016; Imagery (2013-2016). Created by: AJ/MS/JCM

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7.6 Priority 3 sites

Nil

7.7 Priority 4 sites

Table 25 – Priority 4 – Pine Creek Rd, East Trinity

Site name	Pine Creek Rd, East Trinity
Existing formal facility?	No
Location	Pine Creek Rd, East Trinity, on the eastern bank of Trinity Inlet, near Glen Boughton.
Current tidal status	All-tide, open-water access
Site characteristics	This existing block of State land is surrounded by existing boat related industries. Landside access to the block is available via an existing easement across freehold land. The block is heavily vegetated and contains mangroves.
Proposed works	New 4-lane ramp, floating walkway and 90 CTU spaces.
Increase in effective lanes provided by works	4 lanes
Rationale	New facilities to meet demand in the long term will be required. This site can provide direct access to the ocean for population areas to the south of Cairns, Yarrabah, and provides a protected alternative to the wave exposed Second Beach ramp. It also provides access into the estuarine reaches of Trinity Inlet.

Paper Size A3

0 12.5 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Populated Places
- State controlled road
- Cadastre

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number	41-30098
Revision	A
Date	16 Dec 2016

Boating facility
Pine Creek Road, East Trinity

G:\41\30098\GIS\Maps\Deliverables\MXD\ROADS\41_30098_143_Pine_Creek_Rd_RevA.mxd

Data source: GHD: Layout/2016; DNRM: Roads/2015, Populated Places, Local Government Area/2016, Cadastre/2016; TMR: Facilities/2016, Imagery (2013-2016). Created by: AJ/MS

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Table 26 – Priority 4 – Russell River Rd, Bellenden Ker

Site name	Russell River Rd, Bellenden Ker
Existing formal facility?	Yes
Location	At the eastern end of the Russell River Rd, Bellenden Ker, on the western bank of the Russell River
Current tidal status	Near all-tide, depth restricted open-water access
Site characteristics	This existing facility is located within the road reserve and contains 2 ramp lanes and a jetty. The vehicle manoeuvring area is sealed but parking is on the adjacent grass.
Proposed works	Formalisation and expansion of parking to achieve 45 CTU spaces.
Increase in effective lanes provided by works	1 lane
Rationale	This facility is increasing in popularity and is already occasionally under pressure. It provides access to estuarine reaches of the Mulgrave and Russell Rivers, and open-water access at Russell Heads is possible under most tidal levels. It is the closest road access point for residents of Russell Heads. Current ad hoc parking is inefficient and constrains the capacity of the facility. Formalisation of parking to improve its efficiency will assist in meeting future demand.

Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Populated Places
- State controlled road
- Cadastre

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number	41-30098
Revision	A
Date	16 Dec 2016

Boating facility
Russell River Road, Bellenden Ker

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Data source: GHD: Layout/2016, DNRM: Roads/2015, Populated Places, Local Government Area/2016, Cadastre/2016, TMR: Facilities/2016, Imagery:(2013-2016) Created by: AJMS

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Table 27 – Priority 4 – The Esplanade, Machans Beach

Site name	The Esplanade, Machans Beach
Existing formal facility?	Yes
Location	At the southern end of Christensen St, Machans Beach, on the northern bank of the Barron River
Current tidal status	Near all-tide, depth restricted open-water access
Site characteristics	This existing facility is located within the road reserve and contains 1 ramp lane. The vehicle manoeuvring area is sealed but limited parking is on the adjacent grass.
Proposed works	Pontoon or floating walkway and formalisation of 15 CTU spaces.
Increase in effective lanes provided by works	0.2 lanes
Rationale	This facility is a "locals ramp" that provides access into the Barron River, and limited open-water access heavily affected by shoals at the River mouth. However, usage of the existing facility is constrained by the availability and efficiency of parking. A pontoon or floating walkway would also assist launching and retrieval for single-handed launching.

Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Populated Places
- State controlled road
- Cadastre

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number	41-30098
Revision	A
Date	16 Dec 2016

Boating facility
The Esplanade, Machans Beach

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Data source: GHD: Layout/2016, DNRM: Roads/2015, Populated Places, Local Government Area/2016, Cadastre/2016; TMR: Facilities/2016, Imagery (2013-2016). Created by: AJ/MS

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Table 28 – Priority 4 – Acacia St, Holloways Beach

Site name	Acacia St, Holloways Beach
Existing formal facility?	Yes
Location	At the northern end of Acacia St, Holloways Beach, on the southern bank of Thomatis Creek
Current tidal status	Near all-tide, depth restricted open-water access
Site characteristics	This existing facility is located on a well vegetated Reserve at the end of Acacia St. It contains 1 ramp lane; the vehicle manoeuvring area is sealed and parking is available on the adjacent grass.
Proposed works	Pontoon or floating walkway.
Increase in effective lanes provided by works	0.2 lanes
Rationale	This facility is a "locals ramp" that provides access into Thomatis Creek, and limited open-water access heavily affected by shoals at the Creek mouth. However, the efficient usage of the existing facility would be improved by the provision of a pontoon or floating walkway to assist launching and retrieval for single-handed launching.

Paper Size A3

0 5 10 20 30 40 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Populated Places
- State controlled road
- Cadastre

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number	41-30098
Revision	A
Date	16 Dec 2016

Boating facility
Acacia St, Holloways Beach

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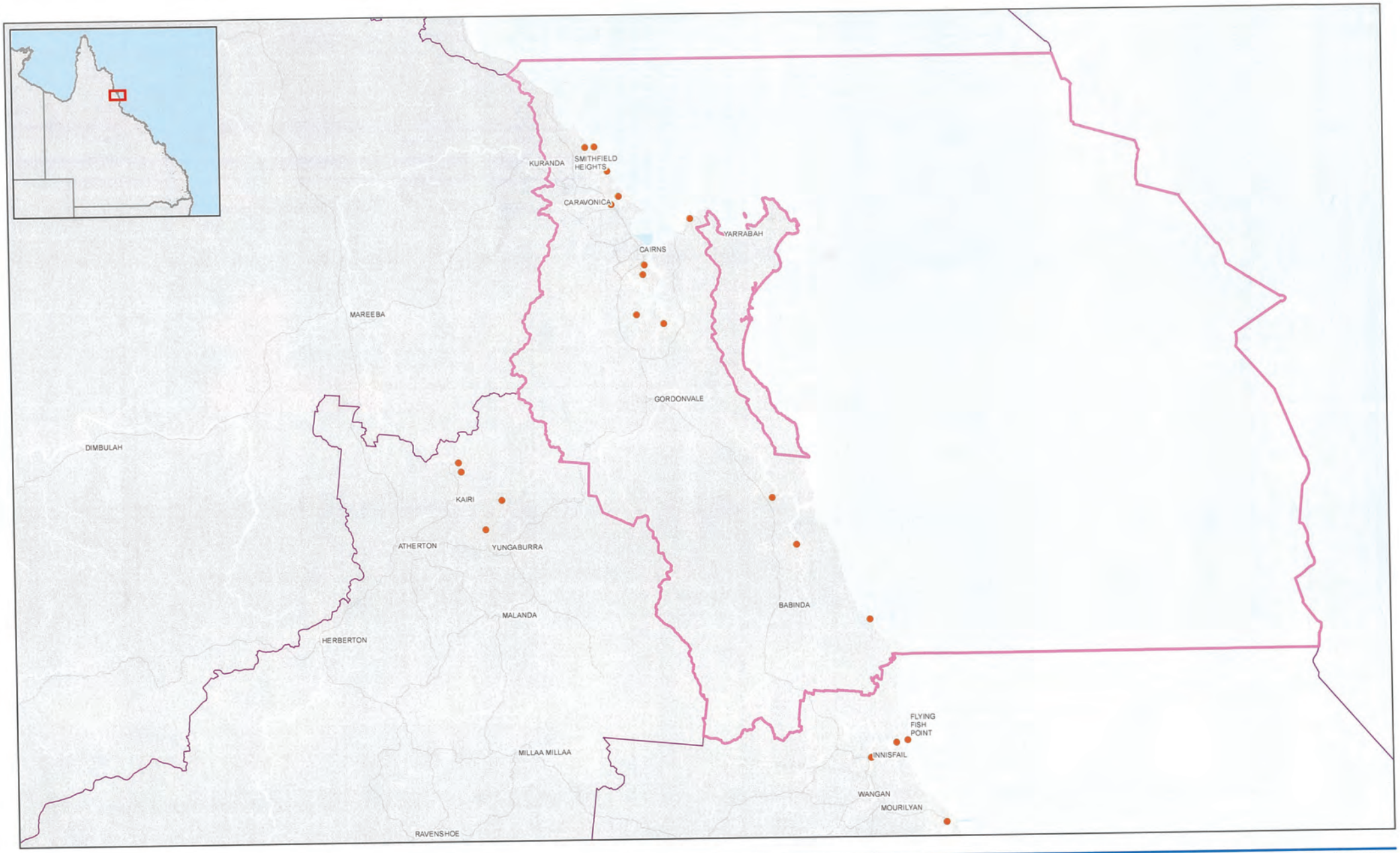
Data source: GHD: Layout/2016; DNRM: Roads/2015, Populated Places, Local Government Area/2016, Cadastre/2016; TMR: Facilities/2016; Imagery (2013-2016). Created by: AJMS

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Appendices

Appendix A – Locality plan, existing facilities



Paper Size A3

0 5 10

Kilometres

Horizontal Datum: GDA 1994
Grid: GCS GDA 1994

N

LEGEND

- Boating Facilty
- State controlled road
- Local Government Area
- Water

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number	41-30098
Revision	C
Date	20 Dec 2016

Cairns Regional Council

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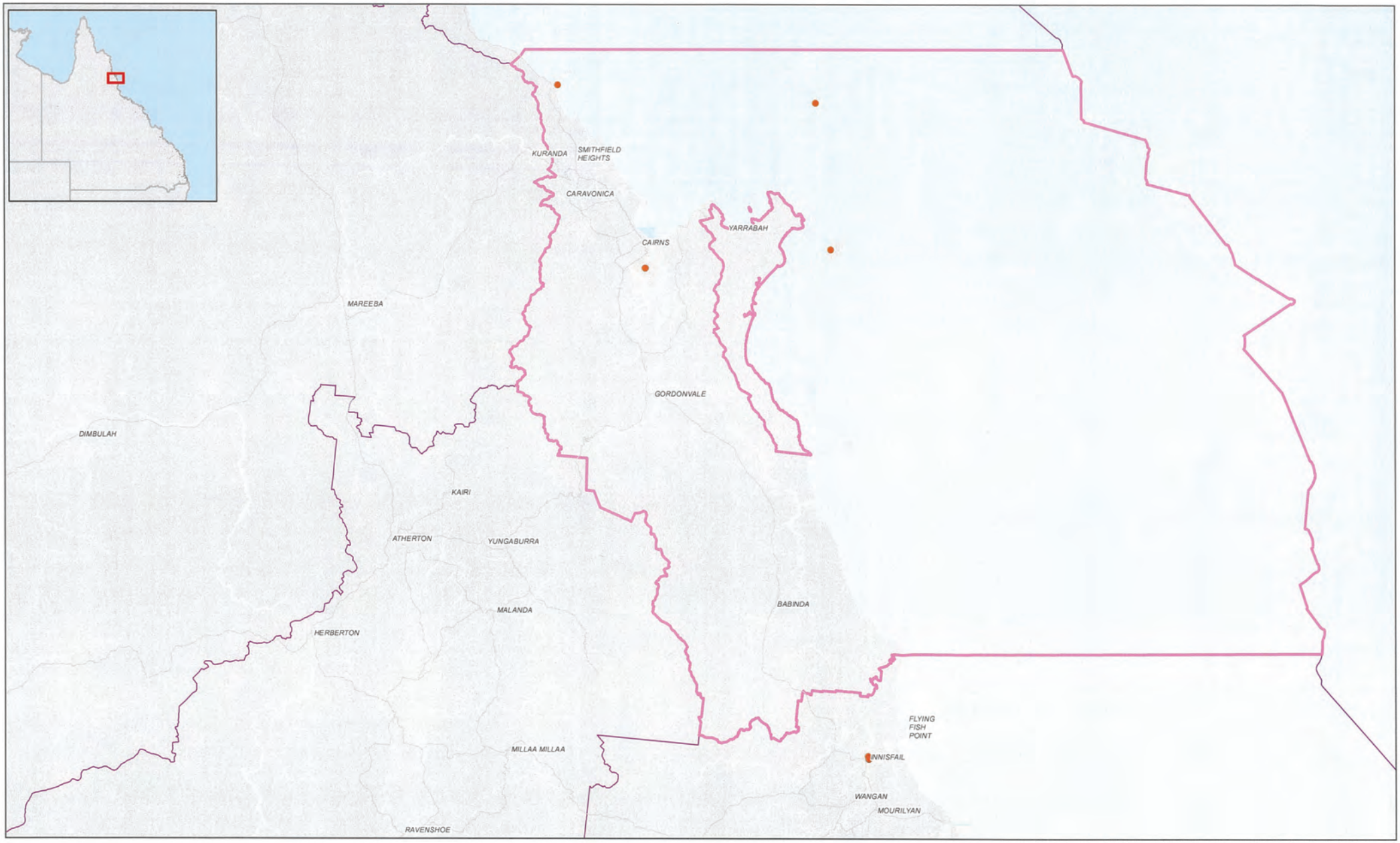
Data source: DNRM: Cadastre/2016, Populated Places, Local Government Area/2016; TMR: Facilities/2016, GA Mainland, Islands/2007. DTMR: State Controlled Road/2015. Created By: IH



Paper Size A3

0 5 10

Kilometres

Horizontal Datum: GDA 1994
Grid: GCS GDA 1994

N

LEGEND

- Deep-draught/tender landing
- State controlled road
- Local Government Area
- Water

Department of Transport and Main Roads
Queensland Recreational Boating Demand Study

Job Number 41-30098
Revision C
Date 21 Dec 2016

Cairns Regional Council

G:\41\30098\GIS\Maps\MXD\41_30098_166_LGA_Landings_RevC.mxd

Data source: DNRM: Cadastre/2016, Populated Places, Local Government Area/2016, TMR: Facilities/2016, GA Mainland, Islands/2007. DTMR: State Controlled Road/2015. Created By: IH

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Appendix B – Capacity assessment, existing facilities

Facility ID	Facility name*	Tidal access (at ramp)	# Existing lanes	Queuing facility	Effective lanes after tidal access adjustment	# CTU	Effective lanes after adjustment for tidal access, queuing facility and # CTUs		Constraint	Comment
							Waterside	CTU		
	Open-water access									
CN21	Fearnley Street, Cairns	All-tide	3	No	3	43	3	2	CTU	
	+ MIIP upgrades as at Dec 16	*All-tide*	*3*	*Floating walkway*	*3*	*43*	*4.5*	*2*	*CTU*	*No commitment for parking expansion currently exists*
CN22	Tingira Street, Portsmith, Cairns	All-tide	5	*Floating walkway*	5	84	7.5	4	CTU	
MG91	Buckley Street, Yorkeys Knob	All-tide	2	*Floating walkway*	2	37	3	1.8	CTU	
MG80	Trinity Park, Bluewater Marina	Near all-tide	2	No	1.6	48	1.6	2	Waterside	
	+ MIIP upgrades as at Dec 16	*Near all-tide*	*2*	*Floating walkway*	*1.6*	*48*	*2.4*	*2*	*CTU*	
	+ MIIP new facility as at Dec 16 Yorkeys Knob	*All-tide*	*4*	*Floating walkway*	*4*	*0*	*6*	*0*	*CTU*	*This is intended to be part of a larger future facility, however current funding has only been secured for the waterside components listed.*
	SUBTOTAL		***16***		***15.6***		***23.4***	***9.8****		

Facility ID	Facility name*	Tidal access (at ramp)	# Existing lanes	Queuing facility	Effective lanes after tidal access adjustment	# CTU	Effective lanes after adjustment for tidal access, queuing facility and # CTUs		Constraint	Comment
							Waterside	CTU		
	Depth-limited open-water access									
MG11	The Esplanade, Bramston Beach	Near all-tide	1	No	0.8	40	0.8	2	Waterside	
MG21	Ross Road, Deeral	Near all-tide	3	No	2.4	30	2.4	1.8	CTU	
MG31	Russell River Road, Bellenden Ker	Near all-tide	2	Jetty	1.6	20	1.6	1	CTU	Jetty is not generally used as a queuing structure
	+ MIIP upgrades as at Dec 16	*Near all-tide*	*2*	*Jetty*	*1.6*	*20*	*1.6*	*1*	*CTU*	
MG52	The Esplanade, Machans Beach, Barron River	Near all-tide	1	No	0.8	6	0.8	1	Waterside	
MG81	Acacia Street, Holloways Beach	Near all-tide	1	No	0.8	20	0.8	1	Waterside	
MG41	Packers Camp (Redbank Rd, Mackey Creek)	Part-tide	1	No	0.5	20	0.5	1	Waterside	
	+ MIIP upgrades as at Dec 16	*All-tide*	*4*	*Floating walkway*	*4*	*20*	*6*	*1*	*CTU*	*No commitment for parking expansion currently exists*
MG63	Fishermans Road, Edmonton	Near All-tide	2	No	1.6	40	1.6	2	Waterside	
	+ MIIP upgrades as at Dec 16	*Near All-tide*	*2*	*Floating walkway*	1.6	*40*	*2.4*	*2*	*CTU*	Form of queuing facility TBC
	SUBTOTAL		***12***		***10.4***		***14.8***	***9.8****		
	Limited open-water access – other infrastructure									
MG51	Greenbank Road, Barron River, Cairns	Near All-tide	3	Floating walkway	2.4	33	3.6	1.8	CTU	
	SUBTOTAL		***3***		***2.4***		***3.6***	***1.8****		

Facility ID	Facility name*	Tidal access (at ramp)	# Existing lanes	Queuing facility	Effective lanes after tidal access adjustment	# CTU	Effective lanes after adjustment for tidal access, queuing facility and # CTUs		Constraint	Comment
							Waterside	CTU		
	Beach ramps									
MG42	Yarrabah Road, Second Beach	Part-tide	1	No	0.5	15	0.5	1	Waterside	
	SUBTOTAL		***1***		***0.5***		***0.5***	***1****		
				Total effective capacity			***20.3****			

**Capacity following upgrades planned in the 2016-17 to 2017-18 MIIP are shown in italics.*

**CTU calculation does not include unformed or unmarked parking spaces.*

**The effective capacity of each facility is shaded.*

Appendix C – Demand assessment (Economic Associates)

Recreational Boating Facilities Demand Forecasting Study - 2016 Census Update

Final Report

December 2017

ECONOMIC ASSOCIATES

Recreational Boating Facilities Demand Forecasting Study - 2016 Census Update

Final Report

Prepared for:

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December 2017

16042

ECONOMIC ASSOCIATES

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1 INTRODUCTION

1.1 Purpose of study

Economic Associates (as a sub consultant to GHD Pty Ltd) were engaged by the Department of Transport and Main Roads (TMR) to undertake an assessment of the demand for recreational boating facilities at the local government area (LGA) level. Demand projections have been prepared at five year intervals to 2036 (that is, 2016, 2021, 2026, 2031 and 2036) and take into account current and future demand for recreational boat ramps and landings.

This study represents an update to the *Recreational Boating Facilities Demand Forecasting Study 2016*, taking into account 2016 Census data.

1.2 Report structure

The report has been structured as follows:

- Section 1: Introduction: Provides an outline of the purpose of the study and report structure
- Section 2: Projected size of recreational boating fleet: Provides an overview of the assumptions utilised in preparing estimates of the projected recreational boating fleet by LGA
- Section 3: Infrastructure demand assessment: Provides an overview of the assumptions utilised in preparing estimates of the demand for new or upgraded boat ramps and landings by LGA
- Section 4: References: Provides a summary of the references utilised in preparing this report.

1.3 Disclaimer

This report is based on the most up to date readily available information. Sources are documented in the report. Economic Associates has applied due professional care and diligence in accordance with generally accepted standards of professional practice in undertaking analysis and interpretation of source information. Economic Associates is not liable for damages arising from any errors or omissions arising from use of these information sources.

As this report involves future projections which can be affected by a number of unforeseen circumstances, it represent our best possible estimates and no warranty is given that these particular projections will eventuate.

2 PROJECTED SIZE OF RECREATIONAL BOATING FLEET

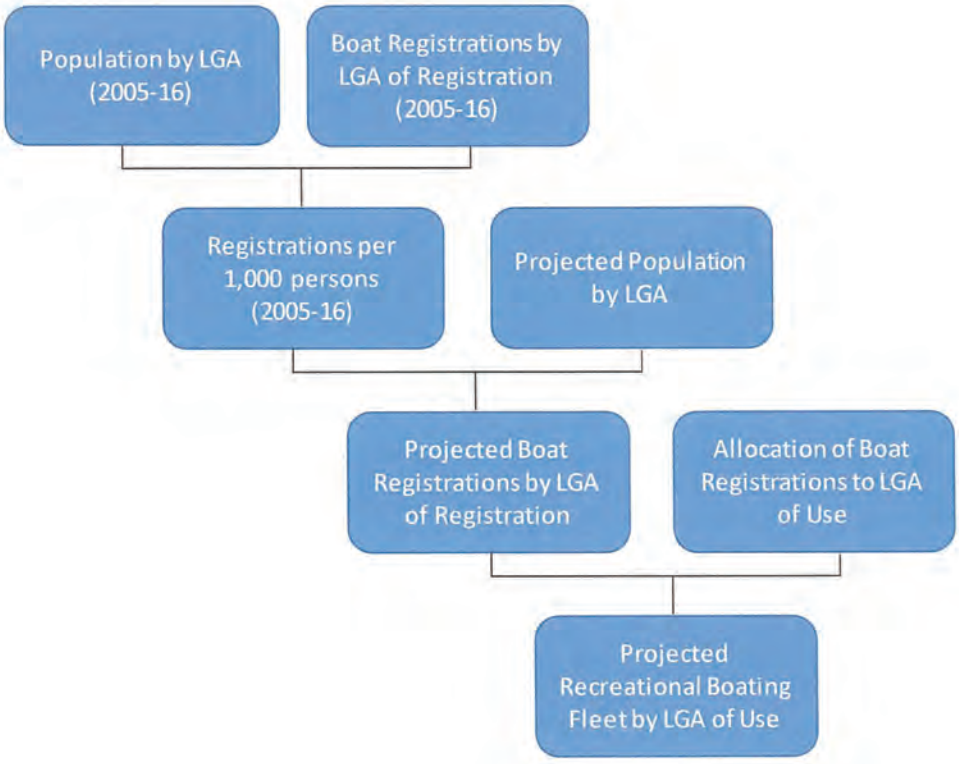
This section of the report provides a summary of the projected size of the recreational boating fleet by LGA, including a detailed explanation relating to the assumptions made in preparing the projections.

2.1 Methodology

In estimating the projected size of the recreational boating fleet, the assessment has made a number of assumptions relating to the current and projected size of the trailable and non-trailable fleet and the relationship between LGA of registration and LGA of waterway/facility use.

Figure 2.1 below outlines the methodology utilised in preparing the projected size of the recreational boating fleet by LGA of use.

Figure 2.1: Methodology utilised in projecting recreational boating fleet by LGA of use



2.2 Assumptions

2.2.1 Current size of recreational boating fleet

TMR provided data relating to historical boat registrations for the 2005 to 2016 period for the following categories:

- sail boats
- boats without sails, including:
  - motor boats without sails
  - speed boats
  - jet skis (or personal watercraft).

The data was provided by LGA of registration. This data was used to generate historical estimates of the size of the trailable and non-trailable boat fleet for each LGA, including the following sub-categories:

- trailable fleet, which comprises the following sub-categories:
  - boats up to 4.5 metres in length (including jet skis)
  - boats 4.5 – 8 metres in length
- non-trailable fleet (vessels most likely to be berthed at marinas or private moorings).

The trailable boat fleet has been estimated for two sub-classes to identify vessels that tend to be used inshore (vessels up to 4.5 metres in length) versus vessels which have the ability to travel offshore (vessels 4.5 – 8 metres in length). The 4.5 metre cut-off length was identified through consultation with LGA and port/water storage officers undertaken by GHD as part of this study, and confirmed by TMR officers as being reasonable and accepted for intended uses of the study.

Table 2.1 below summarises our assumptions in relation to the split of trailable boats and non-trailable boats based on the data provided by TMR. This assessment assumes that all boats greater than eight metres in length are non-trailable and that all jet skis are within the trailable boat fleet.

The incidence of trailable and non-trailable boats eight metres or less in length is consistent with the assumptions made in the *Recreational Boating Facilities Demand Forecasting Study 2011*.

Table 2.1: Estimated proportion of trailable and non-trailable boats, 2005-2016

Length	Trailable		Non-trailable	
	sail boats	Boats without sail	Sail boats	Boats without sail
<3 metres	100.0%	100.0%	0.0%	0.0%
3-5 metres	90.0%	100.0%	10.0%	0.0%
5-8 metres	50.0%	85.0%	50.0%	15.0%
8-10 metres	0.0%	0.0%	100.0%	100.0%
10-12 metres	0.0%	0.0%	100.0%	100.0%
12-15 metres	0.0%	0.0%	100.0%	100.0%
15-25 metres	0.0%	0.0%	100.0%	100.0%
>25 metres	0.0%	0.0%	100.0%	100.0%

Source: Economic Associates estimates

In 2016, there were 996 vessel registrations that were not assigned to an LGA in Queensland[1], comprising 983 interstate registrations, five overseas registrations and eight unknown registrations. For this assessment, the following assumptions have been made for the allocation of these registrations to the trailable and non-trailable boat fleets:

- *Interstate registrations:* Interstate registrations have been allocated in the manner outlined in Table 2.1 above, as it is considered likely that the majority of interstate registrations of a trailable length are within northern NSW.
- *Overseas and unknown registrations:* The assessment has assumed that all overseas and unknown registrations are of a non-trailable nature.

Based on the assumptions presented in Table 2.1 above and the allocation of interstate, overseas and unknown registrations, the estimated size of the recreational boating fleet in Queensland was 279,586 vessels in 2016, comprising:

- 184,835 trailable boats up to 4.5 metres in length (including jet skis)
- 73,462 trailable boats 4.5 – 8 metres in length
- 21,289 non-trailable boats.

Not surprisingly, the size of the recreational boating fleet was highest in a number of South-east Queensland councils, Mackay Regional Council, Townsville City Council, and Cairns Regional Council.

Table 2.2 below presents the estimated size of the recreational boating fleet in Queensland and each of the component LGAs in 2016.

Table 2.2: Estimated size of recreational boating fleet by LGA, Queensland, 2016

LGA of registration	Trailable		Non-trailable	Total
	Up to 4.5m	4.5-8m		
Aurukun (S)	9	9	0	18
Balonne (S)	229	93	14	336
Banana (S)	928	371	54	1,353
Barcaldine (R)	120	46	6	172
Barcoo (S)	22	7	2	31
Blackall-Tambo (R)	73	24	3	100
Boulia (S)	11	2	0	13
Brisbane (C)	18,600	7,539	3,009	29,148
Bulloo (S)	10	2	0	12
Bundaberg (R)	7,483	1,711	418	9,612
Burdekin (S)	2,560	887	123	3,570
Burke (S)	34	14	2	50
Cairns (R)	6,650	3,584	996	11,229
Carpentaria (S)	148	79	14	241
Cassowary Coast (R)	2,718	1,576	298	4,592
Central Highlands (R)	1,507	720	120	2,347
Charters Towers (R)	524	170	23	717
Cherbourg (S)	0	1	0	1
Cloncurry (S)	125	55	6	186
Cook (S)	304	177	67	548
Croydon (S)	11	4	0	15
Diamantina (S)	6	0	1	7

[1] The 996 vessel registrations not registered in an LGA in Queensland accounted for less than 0.4% of the total recreational fleet in 2016.

LGA of registration	Trailable		Non-trailable	Total
	Up to 4.5m	4.5-8m		
Doomadgee (S)	2	2	0	4
Douglas (S)	908	664	175	1,747
Etheridge (S)	38	12	1	51
Flinders (S)	83	30	7	120
Fraser Coast (R)	7,252	2,902	821	10,975
Gladstone (R)	5,148	2,435	538	8,121
Gold Coast (C)	24,407	8,121	3,739	36,266
Goondiwindi (R)	659	202	25	886
Gympie (R)	2,656	937	235	3,828
Hinchinbrook (S)	1,428	635	118	2,180
Hope Vale (S)	17	14	4	35
Ipswich (C)	4,537	1,630	282	6,449
Isaac (R)	1,381	611	111	2,103
Kowanyama (S)	8	1	0	9
Livingstone (S)	2,821	1,507	504	4,831
Lockhart River (S)	7	5	4	16
Lockyer Valley (R)	1,285	461	78	1,824
Logan (C)	8,691	3,593	789	13,074
Longreach (R)	191	59	7	257
Mackay (R)	9,909	3,515	814	14,238
McKinlay (S)	48	21	4	73
Mapoon (S)	8	5	0	13
Maranoa (R)	544	180	22	746
Mareeba (S)	838	353	79	1,270
Moreton Bay (R)	16,249	5,992	1,637	23,878
Mornington (S)	16	13	2	31
Mount Isa (C)	700	402	43	1,145
Murweh (S)	137	46	6	189
Napranum (S)	7	4	0	11
Noosa (S)	2,564	1,175	290	4,029
North Burnett (R)	633	182	26	841
Northern Peninsula Area (R)	25	46	9	80
Palm Island (S)	43	37	6	86
Paroo (S)	40	12	2	54
Pormpuraaw (S)	3	1	0	4
Quilpie (S)	32	8	1	41
Redland (C)	7,692	3,897	1,473	13,061
Richmond (S)	45	20	2	66
Rockhampton (R)	3,777	1,405	292	5,473
Scenic Rim (R)	1,300	490	122	1,912
Somerset (R)	1,037	356	68	1,461
South Burnett (R)	1,447	450	66	1,963
Southern Downs (R)	1,119	314	42	1,475
Sunshine Coast (R)	12,641	4,148	1,225	18,013
Tablelands (R)	1,695	704	150	2,548
Toowoomba (R)	4,522	1,593	250	6,365
Torres (S)	107	172	32	311
Torres Strait Island (R)	6	9	2	17
Townsville (C)	8,289	3,998	916	13,203
Weipa (T)	230	237	37	504
Western Downs (R)	1,525	643	86	2,254
Whitsunday (R)	3,387	1,904	750	6,041
Winton (S)	32	11	2	45
Woorabinda (S)	3	0	0	3
Wujal Wujal (S)	4	4	0	8
Yarrabah (S)	36	25	3	64
Interstate	560	201	223	983
Overseas	0	0	5	5
Unknown	0	0	8	8
Total	**184,835**	**73,462**	**21,289**	**279,586**

Note: All registrations with an overseas or unknown address were classified as non-trailable as they were likely to be stored in marinas or dry storage facilities. Source: Economic Associates estimates based on data provided by TMR.

2.2.2 Historical incidence of boat ownership

To determine the projected number of boat registrations in each LGA, the boat registration data, in conjunction with historical population data, has been analysed to calculate the historical incidence of boat ownership (that is, the number of boat registrations per 1,000 persons). The historical incidence of boat ownership was calculated for the trailable and non-trailable fleets, as defined in Section 2.1.1 above.

In the 2005 to 2016 period, the average incidence of boat ownership was as follows:

- trailable boats up to 4.5 metres in length (including jet skis): 0.00 – 140.93 boats/1,000 persons
- trailable boats 4.5 – 8 metres in length: 0.26 – 81.45 boats/1,000 persons
- non-trailable boats: 0.00 – 22.39 boats/1,000 persons.

The historical incidence of boat ownership is highest in coastal communities such as Hinchinbrook Shire, Burdekin Shire, Cook Shire, Douglas Shire, Cassowary Coast, Livingstone Shire, Town of Weipa, and Whitsunday. Of these coastal communities, only Cook Shire recorded a decline in the incidence of boat ownership between 2005 and 2016.

Table 2.3 below summarises the average historical incidence of boat ownership by vessel class in the 2005 to 2016 period, by LGA.

Table 2.3: Historical incidence of boat ownership (registrations / 1,000 persons) by LGA, 2005-2016

LGA of registration	Trailable		Non-trailable	Change in incidence of boat ownership, 2005-2016		
	Up to 4.5m	4.5-8m		Trailable up to 4.5m	Trailable 4.5-8m	Non-trailable
Aurukun (S)	10.04	4.02	0.38	Decrease	Decrease	Decrease
Balonne (S)	40.95	17.04	2.49	Increase	Increase	Increase
Banana (S)	57.80	21.42	3.19	Increase	Increase	Increase
Barcaldine (R)	35.58	11.60	1.44	Increase	Increase	Increase
Barcoo (S)	51.88	10.19	0.79	Increase	Increase	Increase
Blackall-Tambo (R)	33.64	10.24	1.24	Increase	Increase	Increase
Boulia (S)	24.48	7.22	1.21	Increase	Decrease	Decrease
Brisbane (C)	15.62	6.91	2.83	Decrease	Decrease	Decrease
Bulloo (S)	28.32	5.12	0.81	Increase	Increase	Increase
Bundaberg (R)	74.12	16.67	4.32	Increase	Increase	Increase
Burdekin (S)	140.93	42.78	5.86	Increase	Increase	Increase
Burke (S)	57.71	19.99	3.16	Increase	Increase	Increase
Cairns (R)	39.61	20.12	5.61	Increase	Increase	Increase
Carpentaria (S)	78.97	36.00	5.52	Decrease	Decrease	Increase
Cassowary Coast (R)	89.70	47.12	9.85	Increase	Increase	Increase
Central Highlands (R)	49.70	23.49	3.81	Increase	Increase	Increase
Charters Towers (R)	40.01	11.72	1.44	Increase	Increase	Increase
Cherbourg (S)	0.00	0.26	0.00	Decrease	Increase	Decrease
Cloncurry (S)	34.44	13.93	1.73	Increase	Increase	Increase
Cook (S)	95.67	50.50	17.49	Decrease	Decrease	Decrease
Croydon (S)	52.07	18.63	1.98	Increase	Increase	Increase
Diamantina (S)	4.63	3.52	3.97	Increase	Decrease	Increase
Doomadgee (S)	0.89	0.48	0.09	Increase	Increase	Increase
Douglas (S)	73.99	42.56	13.53	Increase	Increase	Increase
Etheridge (S)	37.89	10.53	1.15	Increase	Increase	Increase
Flinders (S)	46.87	13.61	2.29	Increase	Increase	Increase

LGA of registration	Trailable		Non-trailable	Change in incidence of boat ownership, 2005-2016		
Fraser Coast (R)	66.53	26.79	7.61	Increase	Increase	Increase
Gladstone (R)	79.06	35.29	8.60	Increase	Increase	Increase
Gold Coast (C)	37.91	15.37	6.89	Increase	Decrease	Increase
Goondiwindi (R)	56.75	16.61	1.96	Increase	Increase	Increase
Gympie (R)	53.76	19.88	5.72	Increase	Decrease	Decrease
Hinchinbrook (S)	127.50	47.34	8.75	Increase	Increase	Increase
Hope Vale (S)	9.23	12.70	2.24	Increase	Increase	Increase
Ipswich (C)	22.38	8.70	1.50	Increase	Decrease	Decrease
Isaac (R)	66.00	27.22	4.91	Decrease	Increase	Increase
Kowanyama (S)	12.03	1.04	0.19	Increase	Increase	Increase
Livingstone (S)	76.25	35.82	11.49	Increase	Increase	Increase
Lockhart River (S)	13.47	9.89	3.44	Increase	Increase	Increase
Lockyer Valley (R)	28.06	10.09	1.64	Increase	Increase	Increase
Logan (C)	24.97	11.89	3.11	Increase	Increase	Decrease
Longreach (R)	44.70	11.47	1.31	Increase	Increase	Increase
Mackay (R)	80.15	26.34	7.12	Increase	Increase	Increase
McKinlay (S)	44.64	21.46	2.75	Increase	Increase	Increase
Mapoon (S)	11.81	20.58	2.47	Increase	Increase	Increase
Maranoa (R)	33.16	10.21	1.05	Increase	Increase	Increase
Mareeba (S)	41.49	15.42	3.37	Decrease	Increase	Increase
Moreton Bay (R)	35.99	14.15	3.83	Increase	Increase	Increase
Mornington (S)	13.72	8.46	0.69	Increase	Increase	Increase
Mount Isa (C)	34.93	16.02	1.80	Increase	Increase	Increase
Murweh (S)	24.34	7.78	0.96	Increase	Increase	Increase
Napranum (S)	2.55	1.05	0.10	Increase	Increase	Increase
Noosa (S)	49.02	20.44	5.63	Increase	Increase	Decrease
North Burnett (R)	56.88	14.71	2.21	Increase	Increase	Increase
Northern Peninsula Area (R)	13.50	16.20	2.89	Increase	Increase	Increase
Palm Island (S)	16.22	10.97	1.26	Increase	Increase	Increase
Paroo (S)	18.54	4.45	0.68	Increase	Increase	Increase
Pormpuraaw (S)	8.67	1.63	0.46	Increase	Increase	Decrease
Quilpie (S)	31.95	4.81	1.14	Increase	Increase	Increase
Redland (C)	45.06	25.97	9.87	Increase	Increase	Increase
Richmond (S)	54.01	21.46	1.50	Increase	Increase	Increase
Rockhampton (R)	38.81	15.38	3.87	Increase	Increase	Increase
Scenic Rim (R)	29.04	11.75	3.48	Increase	Decrease	Decrease
Somerset (R)	36.11	11.96	2.16	Increase	Increase	Increase
South Burnett (R)	37.61	12.34	1.85	Increase	Increase	Increase
Southern Downs (R)	26.78	7.78	1.01	Increase	Increase	Increase
Sunshine Coast (R)	39.41	14.10	4.13	Increase	Increase	Increase
Tablelands (R)	59.99	22.48	4.76	Increase	Increase	Increase
Toowoomba (R)	24.81	8.34	1.32	Increase	Increase	Increase
Torres (S)	36.94	52.51	8.75	Decrease	Decrease	Decrease
Torres Strait Island (R)	1.24	2.16	0.38	Increase	Increase	Increase
Townsville (C)	45.60	19.29	4.71	Decrease	Increase	Increase
Weipa (T)	94.96	81.45	13.46	Increase	Increase	Increase
Western Downs (R)	39.52	16.37	2.15	Increase	Increase	Increase
Whitsunday (R)	95.32	47.25	22.39	Increase	Increase	Increase
Winton (S)	26.57	7.06	1.06	Increase	Increase	Increase
Woorabinda (S)	17.89	4.02	0.24	Increase	Decrease	Decrease
Wujal Wujal (S)	18.41	8.76	1.27	Increase	Increase	Increase
Yarrabah (S)	14.68	5.85	0.80	Increase	Increase	Increase

Note: Decrease - a decline in the incidence of boat ownership per 1,000 persons between 2005 and 2016, Increase - an increase in the incidence of boat ownership per 1,000 persons between 2005 and 2016.
Source: Economic Associates estimates based on data provided by TMR

2.2.3 Projected population by LGA

To project boat registrations by LGA, this analysis assumes that the incidence of new boat registrations post 2016 is consistent with the 2005-2016 average (as outlined in Table 2.3 above).

The assessment has relied on the latest projections prepared by the Queensland Government Statistician's office (Queensland Government 2015, Population Projections by LGA, medium series), rebased to take into consideration the 2016 population estimates published by the Australian Bureau of Statistics (released subsequent to the 2016 Census of Population and Housing).

Table 2.4 below outlines the projected population of each LGA in Queensland.

Table 2.4: Projected population by LGA, medium series, 2016-2036

	2016	2021	2026	2031	2036
Aurukun (S)	1,323	1,348	1,429	1,508	1,583
Balonne (S)	4,480	4,424	4,391	4,370	4,360
Banana (S)	14,607	14,871	15,147	15,394	15,610
Barcaldine (R)	2,909	2,917	2,930	2,944	2,961
Barcoo (S)	272	260	250	241	233
Blackall-Tambo (R)	1,924	1,936	1,957	1,978	2,004
Boulia (S)	437	431	426	419	413
Brisbane (C)	1,184,215	1,253,917	1,313,403	1,382,062	1,442,700
Bulloo (S)	360	346	332	319	306
Bundaberg (R)	94,453	99,443	105,027	110,562	116,082
Burdekin (S)	17,313	17,584	17,932	18,237	18,482
Burke (S)	342	366	390	414	436
Cairns (R)	162,451	176,549	192,763	209,532	226,125
Carpentaria (S)	2,051	2,066	2,088	2,112	2,136
Cassowary Coast (R)	29,396	29,217	29,215	29,362	29,623
Central Highlands (R)	28,783	30,502	32,128	33,686	35,239
Charters Towers (R)	12,074	12,228	12,368	12,536	12,697
Cherbourg (S)	1,296	1,327	1,370	1,423	1,475
Cloncurry (S)	3,114	3,129	3,164	3,212	3,250
Cook (S)	4,424	4,460	4,489	4,500	4,501
Croydon (S)	300	303	311	318	324
Diamantina (S)	297	290	283	276	270
Doomadgee (S)	1,474	1,554	1,639	1,724	1,811
Douglas (S)	11,997	12,618	13,350	14,121	14,903
Etheridge (S)	819	801	797	793	789
Flinders (S)	1,569	1,523	1,482	1,443	1,409
Fraser Coast (R)	102,953	109,451	117,758	126,200	133,958
Gladstone (R)	63,288	71,179	79,595	88,257	96,407
Gold Coast (C)	576,918	637,516	716,113	800,916	888,608
Goondiwindi (R)	10,837	10,911	11,014	11,125	11,241
Gympie (R)	50,292	52,742	55,650	58,570	61,556
Hinchinbrook (S)	10,990	10,588	10,172	9,728	9,274
Hope Vale (S)	967	1,042	1,118	1,191	1,263
Ipswich (C)	200,123	239,761	312,287	397,611	494,461
Isaac (R)	21,563	22,822	24,381	26,033	27,637
Kowanyama (S)	984	1,016	1,049	1,082	1,115
Livingstone (S)	37,055	40,446	44,904	49,930	55,691
Lockhart River (S)	747	833	926	1,021	1,115
Lockyer Valley (R)	39,486	43,477	47,824	52,301	56,757
Logan (C)	313,785	343,395	386,764	432,492	493,469
Longreach (R)	3,727	3,622	3,530	3,441	3,360
Mackay (R)	117,703	126,031	136,237	147,596	159,564
McKinlay (S)	810	830	849	865	879

	2016	2021	2026	2031	2036
Mapoon (S)	322	333	345	357	369
Maranoa (R)	12,928	13,611	14,438	15,292	16,147
Mareeba (S)	22,157	22,293	22,459	22,581	22,684
Moreton Bay (R)	438,313	484,280	536,815	584,862	627,462
Mornington (S)	1,196	1,277	1,358	1,435	1,511
Mount Isa (C)	19,332	20,060	20,821	21,553	22,266
Murweh (S)	4,391	4,306	4,235	4,167	4,109
Napranum (S)	1,001	1,025	1,049	1,068	1,086
Noosa (S)	54,033	55,976	58,591	60,599	62,406
North Burnett (R)	10,623	10,454	10,367	10,273	10,169
Northern Peninsula Area (R)	2,952	3,153	3,352	3,537	3,707
Palm Island (S)	2,602	2,724	2,854	2,981	3,105
Paroo (S)	1,686	1,605	1,534	1,468	1,408
Pormpuraaw (S)	785	828	874	919	964
Quilpie (S)	833	798	766	735	706
Redland (C)	151,987	162,352	173,030	180,987	185,065
Richmond (S)	800	761	730	703	680
Rockhampton (R)	81,589	85,694	90,105	94,555	99,104
Scenic Rim (R)	40,975	45,769	51,157	57,608	63,336
Somerset (R)	25,173	27,640	30,367	33,183	35,991
South Burnett (R)	32,747	34,237	36,000	37,783	39,542
Southern Downs (R)	35,622	36,827	38,046	39,262	40,452
Sunshine Coast (R)	303,389	338,162	379,049	423,122	467,945
Tablelands (R)	25,312	26,192	27,315	28,489	29,659
Toowoomba (R)	164,595	173,366	183,672	194,109	204,314
Torres (S)	3,789	3,900	4,028	4,161	4,301
Torres Strait Island (R)	4,785	4,836	4,898	4,958	5,022
Townsville (C)	192,058	211,600	233,015	255,311	278,025
Weipa (T)	4,024	4,373	4,646	5,008	5,347
Western Downs (R)	34,197	35,682	37,248	38,794	40,283
Whitsunday (R)	34,626	37,290	40,187	42,964	45,873
Winton (S)	1,156	1,118	1,085	1,055	1,028
Woorabinda (S)	992	1,014	1,045	1,077	1,114
Wujal Wujal (S)	296	303	310	316	321
Yarrabah (S)	2,703	2,835	3,006	3,184	3,363
Total	**4,848,877**	**5,246,746**	**5,728,030**	**6,240,301**	**6,764,941**

Source: Queensland Treasury (2016), ABS (2017b)

2.3 Projected size of recreational boating fleet

2.3.1 Projected size of fleet by LGA of registration

Based on the assumptions outlined above, the projected size of the recreational boating fleet registered in Queensland is projected to increase from 279,586 boats in 2016 to 381,988 boats in 2036, with the composition in 2036 anticipated to be as follows:

- 251,600 trailable boats up to 4.5 metres in length
- 100,795 trailable boats 4.5 – 8 metres in length
- 29,594 non-trailable boats.

Growth in the number of registrations is anticipated to be highest in a number of South-east Queensland councils, Cairns Regional Council, Townsville City Council and Mackay Regional Council.

Table 2.5 below summarises the projected size of the recreational boating fleet in Queensland by LGA of registration, between 2016 and 2036.

Table 2.5: Projected size of recreational boating fleet by LGA of registration, 2016-2036

	Trailable Fleet up to 4.5 metres					Trailable Fleet 4.5 - 8 metres					Non-Trailable Fleet				
	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036
Aurukun (S)	9	9	10	11	12	9	9	9	9	10	0	0	0	1	1
Balonne (S)	229	227	225	225	224	93	92	92	91	91	14	14	14	14	14
Banana (S)	928	943	959	973	986	371	377	382	388	392	54	55	56	57	57
Barcaldine (R)	120	120	121	121	122	46	46	46	46	47	6	6	6	6	6
Barcoo (S)	22	21	21	20	20	7	7	7	7	7	2	2	2	2	2
Blackall-Tambo (R)	73	73	74	75	76	24	24	24	25	25	3	3	3	3	3
Boulia (S)	11	11	11	11	10	2	2	2	2	2	0	0	0	0	0
Brisbane (C)	18,600	19,688	20,615	21,686	22,630	7,539	8,022	8,436	8,914	9,337	3,009	3,207	3,377	3,573	3,746
Bulloo (S)	10	10	9	9	8	2	2	2	1	1	0	0	0	0	0
Bundaberg (R)	7,483	7,853	8,267	8,677	9,086	1,711	1,794	1,887	1,980	2,072	418	440	464	488	511
Burdekin (S)	2,560	2,598	2,647	2,690	2,724	887	899	914	927	937	123	125	127	128	130
Burke (S)	34	35	37	38	39	14	14	15	15	16	2	2	3	3	3
Cairns (R)	6,650	7,208	7,850	8,514	9,172	3,584	3,867	4,194	4,531	4,865	996	1,075	1,166	1,260	1,353
Carpentaria (S)	148	149	151	153	155	79	80	81	81	82	14	14	14	14	14
Cassowary Coast (R)	2,718	2,702	2,702	2,715	2,739	1,576	1,567	1,567	1,574	1,586	298	296	296	298	300
Central Highlands (R)	1,507	1,592	1,673	1,751	1,828	720	761	799	836	872	120	126	132	138	144
Charters Towers (R)	524	530	536	542	549	170	172	174	176	177	23	23	23	24	24
Cherbourg (S)	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0
Cloncurry (S)	125	126	127	128	130	55	55	56	56	57	6	6	6	6	6
Cook (S)	304	307	310	311	311	177	179	180	181	181	67	68	68	69	69
Croydon (S)	11	11	12	12	12	4	4	4	4	4	0	0	0	0	0
Diamantina (S)	6	6	6	6	6	0	0	0	0	0	1	1	1	1	1
Doomadgee (S)	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
Douglas (S)	908	954	1,008	1,065	1,123	664	691	722	755	788	175	183	193	204	214
Etheridge (S)	38	37	37	37	37	12	11	11	11	11	1	1	1	1	1
Flinders (S)	83	81	79	77	75	30	30	29	28	28	7	7	7	7	6
Fraser Coast (R)	7,252	7,685	8,237	8,799	9,315	2,902	3,076	3,299	3,525	3,733	821	870	933	997	1,056
Gladstone (R)	5,148	5,772	6,437	7,122	7,766	2,435	2,713	3,010	3,316	3,604	538	606	679	753	823
Gold Coast (C)	24,407	26,704	29,684	32,899	36,224	8,121	9,052	10,260	11,564	12,911	3,739	4,156	4,698	5,282	5,887
Goondiwindi (R)	659	663	669	675	682	202	203	204	206	208	25	26	26	26	26
Gympie (R)	2,656	2,787	2,944	3,101	3,261	937	986	1,044	1,102	1,161	235	249	266	282	299
Hinchinbrook (S)	1,428	1,376	1,323	1,267	1,209	635	616	596	575	553	118	114	111	107	103
Hope Vale (S)	17	18	18	19	20	14	15	16	17	18	4	4	4	4	4
Ipswich (C)	4,537	5,423	7,046	8,955	11,122	1,630	1,975	2,606	3,349	4,192	282	342	450	578	723
Isaac (R)	1,381	1,464	1,567	1,676	1,782	611	646	688	733	777	111	117	124	132	140
Kowanyama (S)	8	8	9	9	10	1	1	1	1	1	0	0	0	0	0
Livingstone (S)	2,821	3,079	3,419	3,803	4,242	1,507	1,628	1,788	1,968	2,174	504	543	594	652	718
Lockhart River (S)	7	8	9	11	12	5	6	7	8	9	4	4	4	5	5
Lockyer Valley (R)	1,285	1,397	1,519	1,644	1,770	461	501	545	590	635	78	85	92	99	106
Logan (C)	8,691	9,431	10,514	11,655	13,178	3,593	3,945	4,461	5,005	5,730	789	881	1,016	1,158	1,347
Longreach (R)	191	186	182	178	175	59	58	57	56	55	7	6	6	6	6
Mackay (R)	9,909	10,577	11,395	12,305	13,265	3,515	3,734	4,003	4,302	4,617	814	873	946	1,027	1,112
McKinlay (S)	48	49	50	50	51	21	21	22	22	22	4	4	4	4	4
Mapoon (S)	8	8	8	8	9	5	5	5	5	6	0	0	1	1	1
Maranoa (R)	544	567	594	622	651	180	187	196	204	213	22	23	23	24	25
Mareeba (S)	838	844	851	856	860	353	355	358	360	361	79	79	80	80	80

	Trailable Fleet up to 4.5 metres					Trailable Fleet 4.5 - 8 metres					Non-Trailable Fleet				
	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036
Moreton Bay (R)	16,249	17,903	19,793	21,523	23,056	5,992	6,642	7,386	8,065	8,668	1,637	1,813	2,014	2,198	2,361
Mornington (S)	16	17	18	19	20	13	13	14	15	15	2	2	2	2	2
Mount Isa (C)	700	725	752	778	802	402	413	425	437	449	43	45	46	47	49
Murweh (S)	137	135	133	131	130	46	46	45	45	44	6	6	6	5	5
Napranum (S)	7	7	7	7	7	4	4	4	4	4	0	0	0	0	0
Noosa (S)	2,564	2,659	2,787	2,886	2,974	1,175	1,214	1,268	1,309	1,346	290	301	316	327	338
North Burnett (R)	633	623	618	613	607	182	180	178	177	175	26	26	25	25	25
Northern Peninsula Area (R)	25	28	30	33	35	46	49	52	55	58	9	10	10	11	11
Palm Island (S)	43	45	47	49	51	37	38	40	41	42	6	6	6	7	7
Paroo (S)	40	38	37	36	35	12	11	11	11	10	2	2	2	2	2
Pormpuraaw (S)	3	3	4	4	5	1	1	1	1	1	0	0	0	0	0
Quilpie (S)	32	31	30	29	28	8	8	8	8	7	1	1	1	1	1
Redland (C)	7,692	8,159	8,640	8,998	9,182	3,897	4,166	4,444	4,650	4,756	1,473	1,575	1,680	1,759	1,799
Richmond (S)	45	43	41	40	39	20	19	18	17	17	2	1	1	1	1
Rockhampton (R)	3,777	3,936	4,107	4,280	4,456	1,405	1,468	1,536	1,604	1,674	292	307	325	342	359
Scenic Rim (R)	1,300	1,439	1,596	1,783	1,949	490	547	610	686	753	122	139	157	180	200
Somerset (R)	1,037	1,126	1,224	1,326	1,428	356	386	419	452	486	68	73	79	85	91
South Burnett (R)	1,447	1,503	1,569	1,636	1,702	450	469	490	512	534	66	69	72	75	78
Southern Downs (R)	1,119	1,151	1,184	1,216	1,248	314	323	333	342	351	42	44	45	46	47
Sunshine Coast (R)	12,641	14,011	15,623	17,360	19,126	4,148	4,638	5,214	5,836	6,468	1,225	1,368	1,537	1,720	1,905
Tablelands (R)	1,695	1,748	1,815	1,885	1,956	704	723	749	775	801	150	154	159	165	170
Toowoomba (R)	4,522	4,739	4,995	5,254	5,507	1,593	1,666	1,752	1,839	1,924	250	262	276	289	303
Torres (S)	107	111	116	121	126	172	177	184	191	198	32	33	34	36	37
Torres Strait Island (R)	6	6	6	6	6	9	9	9	10	10	2	2	2	2	2
Townsville (C)	8,289	9,180	10,156	11,173	12,209	3,998	4,375	4,788	5,218	5,656	916	1,008	1,109	1,214	1,321
Weipa (T)	230	263	289	323	356	237	265	287	317	344	37	42	46	50	55
Western Downs (R)	1,525	1,584	1,646	1,707	1,766	643	667	693	718	743	86	89	92	96	99
Whitsunday (R)	3,387	3,641	3,917	4,182	4,459	1,904	2,030	2,167	2,298	2,436	750	809	874	936	1,002
Winton (S)	32	31	30	29	29	11	11	11	10	10	2	2	2	2	2
Woorabinda (S)	3	3	4	5	5	0	0	0	0	0	0	0	0	0	0
Wujal Wujal (S)	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0
Yarrabah (S)	36	38	40	43	46	25	26	27	28	29	3	3	3	3	4
Interstate	560	563	566	570	573	201	202	203	205	206	223	224	226	228	229
Overseas	0	0	0	0	0	0	0	0	0	0	5	5	5	5	5
Unknown	0	0	0	0	0	0	0	0	0	0	8	8	8	8	8
Total	**184,835**	**198,834**	**215,790**	**233,554**	**251,600**	**73,462**	**79,223**	**86,171**	**93,430**	**100,795**	**21,289**	**23,068**	**25,180**	**27,382**	**29,594**

Source: Economic Associates estimate, derived from Table 2.3 and Table 2.4

2.3.2 Allocation of recreational boating fleet to LGA of use

The projected recreational boating fleet estimates presented in Table 2.4 above outline the projected number of boat registrations in each LGA in Queensland, that is, the number of boat registrations by place of residence. However, boat owners may utilise their boat in multiple LGAs, including LGAs other than their place of residence.

In allocating boat registrations to LGA of use, the assessment undertook a review of the distribution of boating infrastructure throughout Queensland and was informed by consultation with LGA and port/water storage officers undertaken by GHD as part of this project.

Two matrices were compiled which outline the distribution of boat registrations to the relevant LGA/s of use, one for trailable boat registrations and the other for non-trailable boat registrations. These two matrices are presented in Appendix A.

In the case of trailable boat registrations, allocations were made only to those LGAs with identified public boating infrastructure. Based on information provided by GHD, the following LGAs in Table 2.6 did not appear to have any public boating infrastructure, and hence were not allocated any boat registrations for use in that LGA.

Table 2.6: LGAs with no boating infrastructure for trailable vessels

Barcoo (S)	Flinders (S)
Blackall-Tambo (R)	Longreach (R)
Boulia (S)	Mareeba (S)
Bulloo (S)	Paroo (S)
Cherbourg (S)	Quilpie (S)
Cloncurry (S)	Richmond (S)
Croydon (S)	Winton (S)
Etheridge (S)	Woorabinda (S)

Non-trailable boats, on the other hand, were assumed to be used only in the coastal LGAs listed in Table 2.7 below.

Table 2.7: Coastal LGAs capturing non-trailable boat registrations

Brisbane (C)	Gold Coast (C)	
Bundaberg (R)	Gympie (R)	Northern Peninsula Area (R)
Burdekin (S)	Hinchinbrook (S)	Palm Island (S)
Burke (S)	Hope Vale (S)	Redland (C)
Cairns (R)	Isaac (R)	Rockhampton (R)
Carpentaria (S)	Livingstone (S)	Sunshine Coast (R)
Cassowary Coast (R)	Lockhart River (S)	Torres (S)
Cook (S)	Mackay (R)	Torres Strait Island (R)
Douglas (S)	Moreton Bay (R)	Townsville (C)
Fraser Coast (R)	Mornington (S)	Whitsunday (R)
Gladstone (R)	Noosa (S)	Yarrabah (S)

2.3.3 Projected size of fleet by LGA of use

Based on 2016 data, the size of the recreational boating fleet in Queensland is projected to increase from 272,472 boats in 2016 to 371,328 boats in 2036. The size of the recreational boating fleet in Queensland is approximately 3% lower than total boats registered in Queensland

as a result of vessel registration leakage, predominantly from the Gold Coast to northern New South Wales.

A number of LGAs are anticipated to record significant registration inflows, including:

- Redland City Council (net inflow of 8,740 vessels in 2016, increasing to 14,247 vessels in 2036)
- Gold Coast City Council (net inflow of 4,594 vessels in 2016, increasing to 7,844 vessels in 2036)
- Somerset Regional Council (net inflow of 3,075 vessels in 2016, increasing to 3,697 vessels in 2036)
- Sunshine Coast Regional Council (net inflow of 1,966 vessels in 2016, increasing to 2,314 vessels in 2036)
- Hinchinbrook Shire Council (net inflow of 1,894 vessels in 2016, increasing to 2,858 vessels in 2036)
- Scenic Rim Regional Council (net inflow of 1,559 vessels in 2016, increasing to 1,608 vessels in 2036)
- Cassowary Coast Regional Council (net inflow of 1,131 vessels in 2016, increasing to 1,350 vessels in 2036).

Table 2.8 below summarises the projected size of the recreational boating fleet by LGA of use, between 2016 and 2036.

Table 2.8: Projected Size of Recreational Boating Fleet by LGA of Use, 2016-2036

	Trailable fleet up to 4.5 metres					Trailable fleet 4.5 - 8 metres					Non-trailable fleet				
	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036
Aurukun (S)	9	9	10	11	12	9	9	9	9	10	0	0	0	1	1
Balonne (S)	46	45	45	45	45	19	18	18	18	18	0	0	0	0	0
Banana (S)	450	460	471	481	491	184	189	193	197	201	0	0	0	0	0
Barcaldine (R)	281	275	269	264	260	91	90	88	87	86	0	0	0	0	0
Barcoo (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackall-Tambo (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boulia (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brisbane (C)	15,698	16,831	18,050	19,401	20,712	6,292	6,779	7,298	7,871	8,426	2,761	2,959	3,156	3,374	3,578
Bulloo (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bundaberg (R)	7,454	7,837	8,267	8,695	9,118	1,810	1,906	2,013	2,119	2,224	456	480	508	535	562
Burdekin (S)	2,853	2,937	3,035	3,130	3,219	1,060	1,091	1,128	1,164	1,199	184	191	199	208	216
Burke (S)	34	35	37	38	39	14	14	15	15	16	2	2	3	3	3
Cairns (R)	7,171	7,713	8,339	8,986	9,627	3,785	4,058	4,373	4,700	5,023	1,058	1,134	1,223	1,314	1,405
Carpentaria (S)	469	478	489	501	512	248	252	257	262	267	65	66	68	69	70
Cassowary Coast (R)	3,447	3,460	3,496	3,546	3,605	1,878	1,883	1,899	1,922	1,950	398	401	406	413	421
Central Highlands (R)	927	973	1,018	1,060	1,103	431	453	474	494	513	0	0	0	0	0
Charters Towers (R)	347	347	348	349	350	118	118	118	118	118	0	0	0	0	0
Cherbourg (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cloncurry (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cook (S)	509	514	519	521	523	264	267	269	270	271	11	11	11	11	11
Croydon (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamantina (S)	6	6	6	6	6	0	0	0	0	0	0	0	0	0	0
Doomadgee (S)	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
Douglas (S)	1,388	1,450	1,523	1,599	1,675	873	907	947	989	1,031	338	354	370	388	406
Etheridge (S)	0	0	0	0	0	12	11	11	11	11	0	0	0	0	0
Flinders (S)	0	0	0	0	0	30	30	29	28	28	0	0	0	0	0
Fraser Coast (R)	7,467	7,902	8,454	9,015	9,533	2,912	3,083	3,302	3,524	3,729	847	897	961	1,025	1,084
Gladstone (R)	5,514	6,108	6,743	7,396	8,011	2,499	2,760	3,039	3,326	3,597	558	622	690	760	826
Gold Coast (C)	26,541	29,038	32,440	36,153	40,195	9,501	10,545	11,964	13,509	15,198	4,818	5,322	5,985	6,705	7,473
Goondiwindi (R)	690	693	698	704	710	219	220	222	223	225	0	0	0	0	0
Gympie (R)	2,916	3,083	3,284	3,489	3,694	1,041	1,103	1,178	1,254	1,330	297	316	339	362	386
Hinchinbrook (S)	2,609	2,702	2,806	2,914	3,023	1,205	1,246	1,292	1,340	1,389	260	271	284	297	310
Hope Vale (S)	17	18	18	19	20	14	15	16	17	18	4	4	4	4	4
Ipswich (C)	1,179	1,410	1,832	2,328	2,892	424	514	678	871	1,090	0	0	0	0	0
Isaac (R)	1,715	1,822	1,953	2,093	2,232	730	772	824	879	934	153	162	173	185	197
Kowanyama (S)	8	8	9	9	10	1	1	1	1	1	0	0	0	0	0
Livingstone (S)	3,230	3,492	3,822	4,188	4,602	1,639	1,760	1,914	2,085	2,277	539	578	627	682	743
Lockhart River (S)	7	8	9	11	12	5	6	7	8	9	4	4	4	5	5
Lockyer Valley (R)	450	489	532	576	619	161	175	191	207	222	0	0	0	0	0
Logan (C)	2,173	2,358	2,628	2,914	3,295	898	986	1,115	1,251	1,432	0	0	0	0	0
Longreach (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mackay (R)	9,185	9,803	10,558	11,396	12,279	3,299	3,505	3,756	4,034	4,327	787	843	913	989	1,069
McKinlay (S)	48	49	50	50	51	21	21	22	22	22	0	0	0	0	0

	Trailable fleet up to 4.5 metres					Trailable fleet 4.5 - 8 metres					Non-trailable fleet				
	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036
Mapoon (S)	8	8	8	8	9	5	5	5	5	6	0	0	1	1	1
Maranoa (R)	326	340	356	373	390	108	112	117	123	128	0	0	0	0	0
Mareeba (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moreton Bay (R)	15,743	17,253	18,933	20,506	21,904	5,804	6,395	7,053	7,669	8,216	1,649	1,814	1,997	2,169	2,322
Mornington (S)	16	17	18	19	20	13	13	14	15	15	2	2	2	2	2
Mount Isa (C)	526	544	562	581	598	294	302	311	319	327	0	0	0	0	0
Murweh (S)	263	258	254	250	247	82	81	80	79	78	0	0	0	0	0
Napranum (S)	7	7	7	7	7	4	4	4	4	4	0	0	0	0	0
Noosa (S)	2,923	3,071	3,259	3,426	3,586	1,251	1,309	1,382	1,447	1,509	339	356	378	397	416
North Burnett (R)	534	527	523	519	514	156	154	153	152	151	11	11	11	11	11
Northern Peninsula Area (R)	25	28	30	33	35	46	49	52	55	58	9	10	10	11	11
Palm Island (S)	43	45	47	49	51	37	38	40	41	42	6	6	6	7	7
Paroo (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pormpuraaw (S)	3	3	4	4	5	1	1	1	1	1	0	0	0	0	0
Quilpie (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redland (C)	13,870	14,948	16,310	17,667	18,993	6,030	6,549	7,187	7,805	8,389	1,901	2,062	2,256	2,437	2,602
Richmond (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rockhampton (R)	4,228	4,439	4,674	4,917	5,169	1,669	1,757	1,855	1,957	2,063	418	442	469	496	525
Scenic Rim (R)	2,570	2,736	2,924	3,134	3,328	901	962	1,032	1,110	1,183	0	0	0	0	0
Somerset (R)	3,327	3,529	3,747	3,972	4,191	1,209	1,280	1,356	1,435	1,511	0	0	0	0	0
South Burnett (R)	1,302	1,353	1,412	1,473	1,532	406	423	442	462	482	0	0	0	0	0
Southern Downs (R)	1,319	1,373	1,433	1,494	1,554	556	577	601	625	648	0	0	0	0	0
Sunshine Coast (R)	13,897	15,342	17,026	18,808	20,593	4,685	5,209	5,820	6,465	7,110	1,397	1,551	1,730	1,920	2,110
Tablelands (R)	678	699	726	754	782	281	289	299	310	321	0	0	0	0	0
Toowoomba (R)	904	948	999	1,051	1,101	319	333	350	368	385	0	0	0	0	0
Torres (S)	107	111	116	121	126	172	177	184	191	198	32	33	34	36	37
Torres Strait Island (R)	6	6	6	6	6	9	9	9	10	10	2	2	2	2	2
Townsville (C)	7,073	7,785	8,566	9,379	10,207	3,359	3,660	3,990	4,333	4,683	779	853	933	1,017	1,103
Weipa (T)	230	263	289	323	356	237	265	287	317	344	0	0	0	0	0
Western Downs (R)	1,095	1,132	1,173	1,215	1,255	440	455	471	486	502	0	0	0	0	0
Whitsunday (R)	3,900	4,180	4,490	4,795	5,115	2,039	2,170	2,315	2,457	2,605	754	814	879	942	1,008
Winton (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Woorabinda (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wujal Wujal (S)	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0
Yarrabah (S)	36	38	40	43	46	25	26	27	28	29	3	3	3	3	4
Total	**179,803**	**193,341**	**209,700**	**226,820**	**244,200**	**71,825**	**77,399**	**84,104**	**91,102**	**98,196**	**20,844**	**22,580**	**24,638**	**26,781**	**28,932**

Source: Economic Associates estimates, derived from Table 2.5, Table A.1 and Table A.2

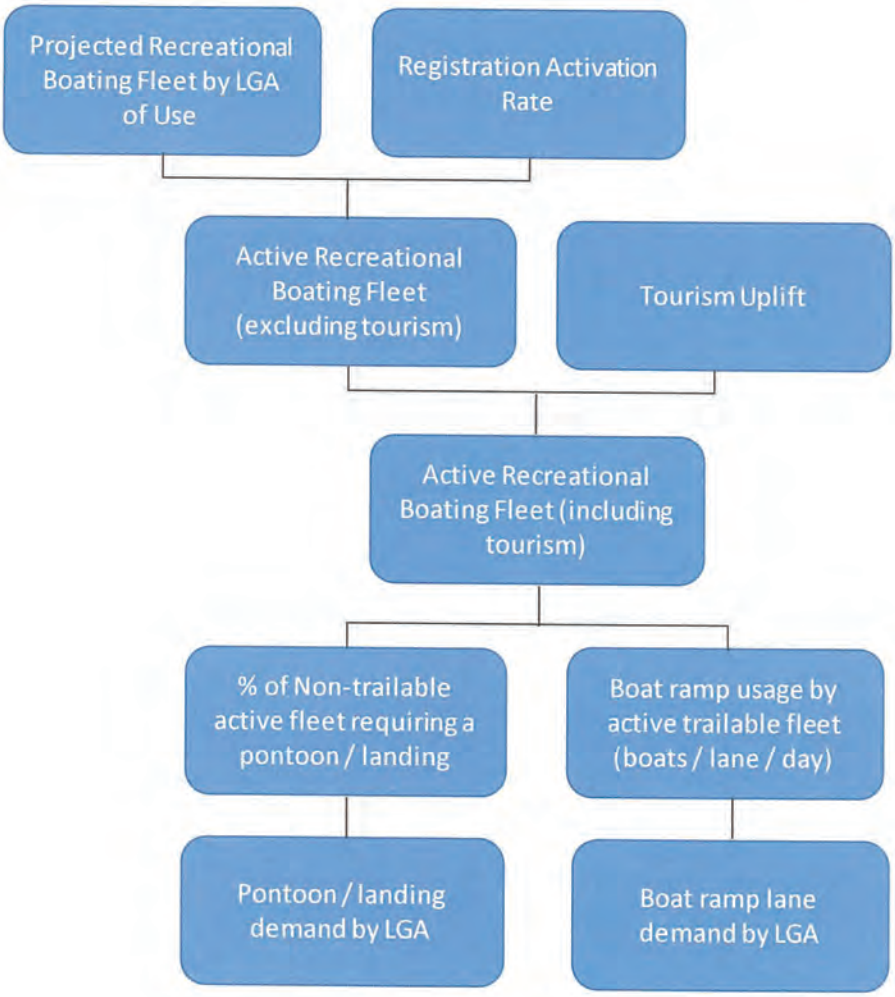
3 INFRASTRUCTURE DEMAND ASSESSMENT

This section converts recreational boating fleet projections into infrastructure demand projections for boat ramp lanes and landings (i.e. publically accessible deep-draught vessel pontoons) at the LGA level.

In determining infrastructure demand, the assessment estimates the likely number of boats being utilised on a day of average demand. This estimate is described as the active fleet. From here, assumptions are made relating to the relationship between trailable boats and boat ramp lane demand, and the relationship between non-trailable boats and likely landings demand.

Figure 3.1 below outlines the methodology utilised to calculate boat ramp lane and landings demand.

Figure 3.1: Methodology to calculate boat ramp lane and landings demand at the LGA level



3.1 Size of active fleet assumptions

3.1.1 Registration activation rate

TMR recognises three levels of demand for marine facilities, namely:

- off-peak demand – typical weekday usage
- average demand – taken to be demand for a facility on weekends (and, for certain regional locations, other busy periods)
- peak demand – demand for a facility at peak holiday periods or for special events.

The *Recreational Boating Facilities Demand Forecasting Study 2011* identified the proportion of the recreational boating fleet likely to use boating facilities for each level of demand (referred to herein as the registration activation rate):

- off-peak demand: 8%
- average demand: 14%
- peak demand: 20%.

TMR policy on catering for marine facility demand is as follows:

> *TMR expects off-peak demand at a given facility to be met in almost all circumstances. Its program of works is aimed at satisfying average demand.*
>
> *TMR does not cater for peak demand. This is because funds (provided largely by collection of recreational boat registration fees) are stretched meeting demand for basic marine infrastructure such as dredging, landings, breakwaters and boat ramps around the state, and local managing authorities cannot allocate sufficient resources (land and funds) for peak demand days. Scarce foreshore land is in intense demand for other purposes, as is funding.*

An initial assessment of demand identified that applying the average demand activation rate state-wide substantially overestimated the current and projected demand for facilities in some LGAs, based on complaints and observed levels of congestion at various facilities in those LGAs.

Therefore, unlike the *Recreational Boating Facilities Demand Forecasting Study 2011*, this study has considered differing registration activation rates by LGA.

This approach has been taken to recognise that the level of boat usage is likely to differ by LGA, depending on a range of factors, including access to recreational boating facilities, the range of recreational activities other than boating available to the community, the recreational time available to boat users (for example, retirees are likely to have more available time to undertake boating activities than persons employed on a fulltime basis), and nature of employment (for example, persons who finish work in the early afternoon are likely to have more available time to undertake boating activities than persons who finish work in the evening).

The consultation with LGA and port/water storage managers undertaken by GHD as part of this study indicated that recreational boaters typically use their boat to go fishing. A literature review was undertaken to identify the socio-economic and demographic characteristics of persons who participated in recreational fishing.

Ormsby, Jayne (2004) undertook a survey to identify the social, motivational and experiential aspects of recreational fishing by anglers from Queensland. The survey identified that just under

a quarter of respondents were classified as tradespersons and related workers, significantly higher than any other occupational class.

The Australian Bureau of Statistics (ABS) (2010) considers the participation rate of Australians in a number of sports, including fishing. This research identified that the participation rate for fishing was highest for the 55-64 year age cohort, followed by the 45-54 year age cohort. Interestingly, this result directly contradicts the findings of Department of Agriculture and Fisheries (2014), which identifies recreational fishing participation rates as being highest for the 5-14 year age cohort, and lowest for the 60+ year age cohort.

Participation rates in both studies represent the proportion of persons that participate in fishing in a given year, but do not provide insight as to the frequency of participation in that year. This means that while a certain age cohort may have a high participation rate, these persons may only go fishing once a year, while other age cohorts might have lower participation rates but higher frequency of participation. The literature review did not identify any information in relation to the frequency of participation in fishing or recreational boating by age cohort.

Our assessment has assumed that a higher average age is likely to correspond with a higher frequency of recreational boat usage, due to the greater availability of time for recreational pursuits, such as fishing and boating.

Within each LGA, the following factors were considered in refining the appropriate registration activation rate.

- incidence of blue collar employment (based on 2016 Census)
- average age of residents (based on 2016 Census)
- remoteness classification by local government area (Accessibility/Remoteness Index of Australia (ARIA+))
- whether the LGA was coastal.

ARIA+ is an index of remoteness derived from measures of road distances between populated localities to each of five categories of service centre, namely:

- distance between populated locality and population centre of 250,000+ persons
- distance between populated locality and population centre of 48,000-249,999 persons
- distance between populated locality and population centre of 18,000-47,999 persons
- distance between populated locality and population centre of 5,000-17,999 persons
- distance between populated locality and population centre of 1,000-4,999 persons.

The five distance measurements, one to each level of service centre, is recorded for each populated locality and standardised to a ratio. The ratio is calculated by dividing the measured distance for a given locality by the Australian average (mean) for that category. After applying a threshold of three to each of the ratios, all ratios are summed to produce the ARIA+ score for each populated locality across Australia. An interpolation procedure is then used to derive the index values for larger geographic areas such as LGAs.

ARIA+ is the endorsed measure of remoteness utilised by the ABS.

The fit between the ARIA+ remoteness classifications and our classification is summarised in Table 3.1 below.

Table 3.1: Fit between ARIA+ remoteness classification and EA classification

ARIA+ remoteness classification	EA classification
Highly accessible / accessible	Metropolitan
Moderately accessible	Regional centre
Remote	Remote
Very remote	Very Remote

To determine the appropriate registration activation rate, the following steps were taken:

- All LGAs with an ARIA+ classification of highly accessible or accessible (we have called metropolitan) were assigned a registration activation rate of 8%.
- All LGAs with an ARIA+ classification of moderately accessible (we have called regional centre) were assigned a registration activation rate as follows:
  - If the LGA has a higher incidence of blue collar workers and a higher average age than Queensland – registration activation rate is 12%.
  - For all other LGAs – registration activation rate is 10%.
- All LGAs with an ARIA+ classification of remote were assigned a registration activation rate as follows:
  - If the LGA has a higher incidence of blue collar workers and a higher average age than Queensland – registration activation rate is 14%.
  - All other LGAs – registration activation rate is 12%.
- All LGAs with an ARIA+ classification of very remote were assigned a registration activation rate of 14%.

After completing this first assessment, the registration activation rates were then adjusted to reflect whether the LGA was coastal or not. If the LGA was coastal, the registration activation rate remained unchanged. However, if the LGA was non-coastal, the registration activation rate was adjusted downwards by 2% (for example, if the registration activation rate was 12% and the LGA was non-coastal, the adjusted activation rate was 10%). This adjustment was made to reflect the extra travel distance required to access recreational boating facilities relative to persons who resided in coastal LGAs. It is considered that the further a person has to travel to access recreational boating facilities, the less often these facilities will typically be utilised. If the registration activation rate was already 8%, the rate remained unchanged.

A further reduction in activation was applied to a number of coastal LGAs in South-east Queensland with a broad offering of recreational activities, including boating, where it was determined that the appropriate registration activation rate was in the order of 6%-7%.

Based on the above criteria, Table 3.2 below summarises the activation rates applied to each LGA in Queensland.

Table 3.2: Assumed activation rate by LGA, Queensland

	% Blue collar workers	Average age	Remoteness	Coastal?	Activation rate
Aurukun (S)	33.6%	29.2	Very Remote	y	14%
Balonne (S)	35.1%	38.9	Remote	n	12%
Banana (S)	45.5%	37.5	Remote	n	10%
Barcaldine (R)	35.1%	39.6	Very Remote	n	12%
Barcoo (S)	50.0%	41.4	Very Remote	n	12%
Blackall-Tambo (R)	34.7%	42.9	Very Remote	n	12%
Boulia (S)	54.1%	34.1	Very Remote	n	12%
Brisbane City	22.0%	36.8	Metropolitan	y	6%
Bulloo (S)	42.5%	33.8	Very Remote	n	12%
Bundaberg (R)	37.7%	42.9	Regional Centre	y	12%
Burdekin (S)	42.9%	42.5	Regional Centre	y	12%
Burke (S)	38.8%	39.3	Very Remote	y	14%
Cairns (R)	30.5%	37.3	Regional Centre	y	10%
Carpentaria (S)	41.2%	37.1	Very Remote	y	14%
Cassowary Coast (R)	44.1%	41.7	Remote	y	14%
Central Highlands (R)	47.9%	33.4	Remote	n	10%
Charters Towers (R)	40.3%	39.3	Remote	n	12%
Cherbourg (S)	30.0%	25.2	Very Remote	n	12%
Cloncurry (S)	48.8%	35.6	Very Remote	n	12%
Cook (S)	38.3%	39.1	Remote	y	14%
Croydon (S)	40.7%	35.6	Very Remote	n	12%
Diamantina (S)	45.3%	32.9	Very Remote	n	12%
Doomadgee (S)	27.2%	23.7	Very Remote	y	14%
Douglas (S)	35.7%	41.4	Regional Centre	y	12%
Etheridge (S)	43.0%	39.5	Very Remote	n	12%
Flinders (S)	37.2%	40.5	Very Remote	n	12%
Fraser Coast (R)	34.4%	44.7	Regional Centre	y	12%
Gladstone (R)	46.8%	35.6	Regional Centre	y	10%
Gold Coast (C)	29.8%	39.1	Metropolitan	y	6%
Goondiwindi (R)	37.8%	39.2	Regional Centre	n	10%
Gympie (R)	40.1%	42.9	Metropolitan	y	8%
Hinchinbrook (S)	40.9%	46.1	Remote	y	14%
Hope Vale (S)	42.2%	28.3	Very Remote	y	14%
Ipswich (C)	37.7%	34.2	Metropolitan	n	8%
Isaac (R)	55.6%	32.0	Remote	y	12%
Kowanyama (S)	34.8%	29.8	Very Remote	y	14%
Livingstone (S)	38.2%	40.6	Very Remote	y	14%
Lockhart River (S)	35.3%	25.6	Very Remote	y	14%
Lockyer Valley (R)	43.4%	38.7	Metropolitan	n	8%
Logan (C)	40.3%	35.4	Metropolitan	n	8%
Longreach (R)	32.0%	39.6	Very Remote	n	12%
Mackay (R)	43.4%	37.5	Regional Centre	y	10%
McKinlay (S)	40.2%	36.6	Very Remote	n	12%
Mapoon (S)	26.8%	32.6	Very Remote	y	14%
Maranoa (R)	35.4%	37.4	Remote	n	10%
Mareeba (S)	36.6%	41.4	Remote	n	12%
Moreton Bay (R)	33.4%	38.0	Metropolitan	y	7%
Mornington (S)	30.8%	29.1	Very Remote	y	14%
Mount Isa (C)	47.2%	32.4	Very Remote	n	12%
Murweh (S)	37.6%	38.8	Very Remote	n	12%
Napranum (S)	52.3%	28.7	Very Remote	y	14%
Noosa (S)	30.8%	44.9	Metropolitan	y	8%
North Burnett (R)	40.3%	43.7	Regional Centre	n	10%
Northern Peninsula Area (R)	32.3%	26.0	Very Remote	y	14%
Palm Island (S)	28.0%	27.4	Very Remote	y	14%
Paroo (S)	28.0%	41.2	Very Remote	n	12%
Pormpuraaw (S)	33.3%	30.5	Very Remote	y	14%
Quilpie (S)	40.0%	37.9	Very Remote	n	12%
Redland (C)	32.0%	40.3	Metropolitan	y	6%
Richmond (S)	39.6%	34.9	Very Remote	n	12%
Rockhampton (R)	38.1%	37.5	Regional Centre	y	10%

	% Blue collar workers	Average age	Remoteness	Coastal?	Activation rate
Scenic Rim (R)	37.9%	41.8	Metropolitan	n	8%
Somerset (R)	43.1%	40.4	Metropolitan	n	8%
South Burnett (R)	39.2%	42.5	Regional Centre	n	10%
Southern Downs (R)	39.5%	42.6	Regional Centre	n	10%
Sunshine Coast (R)	31.6%	41.6	Metropolitan	y	6%
Tablelands (R)	35.0%	43.6	Remote	n	12%
Toowoomba (R)	34.1%	39.1	Metropolitan	n	8%
Torres (S)	26.6%	30.6	Very Remote	y	14%
Torres Strait Island (R)	30.3%	27.7	Very Remote	y	14%
Townsville (C)	32.2%	36.0	Regional Centre	y	10%
Weipa (T)	56.5%	30.4	Very Remote	y	14%
Western Downs (R)	39.8%	37.8	Regional Centre	n	8%
Whitsunday (R)	43.7%	38.8	Remote	y	14%
Winton (S)	36.2%	44.2	Very Remote	n	12%
Woorabinda (S)	30.4%	25.3	Very Remote	n	12%
Wujal Wujal (S)	25.0%	32.7	Remote	y	12%
Yarrabah (S)	26.6%	26.8	Regional Centre	y	10%
Queensland	31.8%	38.2			

Note: Highlighted cells have a higher incidence of blue collar workers / higher average age than Queensland

3.1.2 Tourism Adjustment

The following LGAs were considered to record a significant uplift in boating infrastructure demand as a result of tourism activity:

- first tier LGAs:
  - Douglas Shire
  - Cairns Regional Council
  - Whitsunday Regional Council
- second tier LGAs:
  - Townsville City Council
  - Fraser Coast Council
  - Mackay Regional Council
  - Livingstone Shire Council.

The assumed uplift in boat lane demand was assumed to be as follows:

- first tier LGAs: 20% uplift in boat ramp lane and pontoon/landing demand
- second tier LGAs: 10% uplift in boat ramp lane and pontoon/landing demand.

Consultation also identified that the northern coastal LGAs of Burke, Cook and Carpentaria Shire record significant increases in demand for boating infrastructure during winter, with significant inflows of grey nomads. However, it was also identified that boating infrastructure within these LGAs was more than sufficient to accommodate these inflows.

3.2 Projected size of active fleet

Based on the above assumptions, the projected size of the active fleet in Queensland on a day of average demand is projected to increase from 24,298 vessels in 2016 to 32,524 vessels in 2036.

The size of the active fleet on a day of average demand is anticipated to be largest in the following LGAs, reflecting the large population residing in the South-east Queensland area:

- Gold Coast City Council (2,442 vessels in 2016, increasing to 3,764 vessels in 2036)
- Moreton Bay Regional Council (1,628 vessels in 2016, increasing to 2,268 vessels in 2036)
- Brisbane City Council (1,480 vessels in 2016, increasing to 1,969 vessels in 2036)
- Redland City Council (1,314 vessels in 2016, increasing to 1,803 vessels in 2036)
- Sunshine Coast Regional Council (1,195 vessels in 2016, increasing to 1,783 vessels in 2036).

Table 3.3 below summarises the size of the active fleet on a day of average demand between 2016 and 2036.

Table 3.3: Projected size of active fleet on a day of average demand, 2016-2036

	Trailable Fleet up to 4.5 metres					Trailable Fleet 4.5 - 8 metres					Non-Trailable Fleet				
	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036
Aurukun (S)	1	1	1	2	2	1	1	1	1	1	0	0	0	0	0
Balonne (S)	5	5	5	5	5	2	2	2	2	2	0	0	0	0	0
Banana (S)	45	46	47	48	49	18	19	19	20	20	0	0	0	0	0
Barcaldine (R)	34	33	32	32	31	11	11	11	10	10	0	0	0	0	0
Barcoo (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackall-Tambo (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boulia (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brisbane (C)	942	1,010	1,083	1,164	1,243	378	407	438	472	506	160	180	180	200	220
Bulloo (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bundaberg (R)	894	940	992	1,043	1,094	217	229	242	254	267	60	60	60	60	60
Burdekin (S)	342	352	364	376	386	127	131	135	140	144	20	20	20	20	20
Burke (S)	5	5	5	5	6	2	2	2	2	2	0	0	0	0	0
Cairns (R)	860	925	1,001	1,079	1,156	454	487	524	564	602	120	140	140	160	160
Carpentaria (S)	66	67	69	70	72	35	35	36	37	37	0	0	0	0	0
Cassowary Coast (R)	483	484	489	496	505	263	264	266	269	273	60	60	60	60	60
Central Highlands (R)	93	97	102	106	110	43	45	47	49	51	0	0	0	0	0
Charters Towers (R)	42	42	42	42	42	14	14	14	14	14	0	0	0	0	0
Cherbourg (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cloncurry (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cook (S)	71	72	73	73	73	37	37	38	38	38	0	0	0	0	0
Croydon (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamantina (S)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Doomadgee (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Douglas (S)	200	209	220	230	241	126	131	137	143	149	40	40	40	40	40
Etheridge (S)	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0
Flinders (S)	0	0	0	0	0	4	4	3	3	3	0	0	0	0	0
Fraser Coast (R)	986	1,043	1,115	1,190	1,258	384	407	436	465	493	120	120	140	140	160
Gladstone (R)	551	611	674	740	801	250	276	304	333	360	60	60	60	80	80
Gold Coast (C)	1,592	1,742	1,946	2,169	2,412	570	633	718	811	912	280	320	360	400	440
Goondiwindi (R)	69	69	70	70	71	22	22	22	22	23	0	0	0	0	0
Gympie (R)	233	247	263	279	296	83	88	94	100	106	20	20	20	20	40
Hinchinbrook (S)	365	378	393	408	423	169	174	181	188	194	40	40	40	40	40
Hope Vale (S)	2	2	3	3	3	2	2	2	2	3	0	0	0	0	0
Ipswich (C)	94	113	147	186	231	34	41	54	70	87	0	0	0	0	0
Isaac (R)	206	219	234	251	268	88	93	99	105	112	20	20	20	20	20
Kowanyama (S)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Livingstone (S)	497	538	589	645	708	252	271	295	321	351	80	80	80	120	120
Lockhart River (S)	1	1	1	1	2	1	1	1	1	1	0	0	0	0	0
Lockyer Valley (R)	36	39	43	46	50	13	14	15	17	18	0	0	0	0	0
Logan (C)	174	189	210	233	264	72	79	89	100	115	0	0	0	0	0
Longreach (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mackay (R)	1,010	1,078	1,162	1,254	1,351	363	385	414	443	476	80	80	120	120	120
McKinlay (S)	6	6	6	6	6	2	3	3	3	3	0	0	0	0	0
Mapoon (S)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0

	Trailable Fleet up to 4.5 metres					Trailable Fleet 4.5 - 8 metres					Non-Trailable Fleet				
	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036
Maranoa (R)	33	34	36	37	39	11	11	12	12	13	0	0	0	0	0
Mareeba (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moreton Bay (R)	1,102	1,208	1,325	1,435	1,533	406	448	494	537	575	120	120	140	160	160
Mornington (S)	2	2	3	3	3	2	2	2	2	2	0	0	0	0	0
Mount Isa (C)	63	65	67	70	72	35	36	37	38	39	0	0	0	0	0
Murweh (S)	32	31	30	30	30	10	10	10	10	9	0	0	0	0	0
Napranum (S)	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0
Noosa (S)	234	246	261	274	287	100	105	111	116	121	20	20	40	40	40
North Burnett (R)	53	53	52	52	51	16	15	15	15	15	0	0	0	0	0
Northern Peninsula Area (R)	4	4	4	5	5	6	7	7	8	8	0	0	0	0	0
Palm Island (S)	6	6	7	7	7	5	5	6	6	6	0	0	0	0	0
Paroo (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pormpuraaw (S)	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
Quilpie (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redland (C)	832	897	979	1,060	1,140	362	393	431	468	503	120	120	140	140	160
Richmond (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rockhampton (R)	423	444	467	492	517	167	176	186	196	206	40	40	40	40	60
Scenic Rim (R)	206	219	234	251	266	72	77	83	89	95	0	0	0	0	0
Somerset (R)	266	282	300	318	335	97	102	108	115	121	0	0	0	0	0
South Burnett (R)	130	135	141	147	153	41	42	44	46	48	0	0	0	0	0
Southern Downs (R)	132	137	143	149	155	56	58	60	62	65	0	0	0	0	0
Sunshine Coast (R)	834	921	1,022	1,129	1,236	281	313	349	388	427	80	100	100	120	120
Tablelands (R)	81	84	87	90	94	34	35	36	37	38	0	0	0	0	0
Toowoomba (R)	72	76	80	84	88	25	27	28	29	31	0	0	0	0	0
Torres (S)	15	16	16	17	18	24	25	26	27	28	0	0	0	0	0
Torres Strait Island (R)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Townsville (C)	778	856	943	1,032	1,123	370	403	439	476	515	80	80	120	120	140
Weipa (T)	32	37	40	45	50	33	37	40	44	48	0	0	0	0	0
Western Downs (R)	88	91	94	97	100	35	36	38	39	40	0	0	0	0	0
Whitsunday (R)	655	702	755	805	859	342	365	389	413	438	120	140	140	160	160
Winton (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Woorabinda (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wujal Wujal (S)	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
Yarrabah (S)	4	4	4	4	5	2	3	3	3	3	0	0	0	0	0
Total	**15,987**	**17,118**	**18,476**	**19,892**	**21,333**	**6,571**	**7,042**	**7,599**	**8,180**	**8,771**	**1,740**	**1,860**	**2,060**	**2,260**	**2,420**

Source: Economic Associates estimates

3.3 Relationship between active fleet and boating infrastructure demand

3.3.1 Conversion of active trailable fleet to boat ramp lane demand

Converting active trailable fleet estimates into boat ramp lane demand has been undertaken based on throughput rates of ramps. In SKM (1988) and Rose et. al. (2009), a rate of 30 boats per lane per day is considered to provide unhampered overall amenity, whereas a rate of 50 boats per lane per day represents congested operations.

It has been assumed that the midpoint (40) between unhampered overall amenity (30 boats per lane per day) and congested operations (50 boats per lane per day) would represent the ideal scenario, as it balances the needs and wants of trailable boat owners against the costs incurred by local governments, port authorities, water storage managers, state governments and the private sector in providing boat ramps.

This assumption is consistent with the assumption made in the *Recreational Boating Facilities Demand Forecasting Study 2011*.

3.3.2 Relationship between active non-trailable fleet and pontoon/landing demand

The literature review did not uncover any literature relating to public pontoon/landing demand.

Public pontoon/landing demand is driven by the size of the non-trailable fleet. The assessment has assumed that on a given day, an estimated 5% of the active non-trailable fleet is anticipated to demand a public pontoon/landing.

3.4 Projected boat ramp lane demand

Total boat ramp lane demand in Queensland is projected to increase from 563 lanes in 2016 to 757 lanes in 2036 (refer to Table 3.4 below). The LGAs anticipated to record the highest demand for boat ramps are:

- Gold Coast City Council (54 boat ramp lanes in 2016, 83 boat ramp lanes in 2036)
- Moreton Bay Regional Council (38 boat ramp lanes in 2016, 52 boat ramp lanes in 2036)
- Brisbane City Council (33 boat ramp lanes in 2016, 44 boat ramp lanes in 2036)
- Redland City Council (30 boat ramp lanes in 2016, 42 boat ramp lanes in 2036)
- Mackay Regional Council (34 boat ramp lanes in 2016, 46 boat ramp lanes in 2036)
- Fraser Coast Regional Council (34 boat ramp lanes in 2016, 44 boat ramp lanes in 2036)
- Cairns Regional Council (33 boat ramp lanes in 2016, 45 boat ramp lanes in 2036)
- Townsville City Council (29 boat ramp lanes in 2016, 42 boat ramp lanes in 2036)
- Sunshine Coast Regional Council (28 boat ramp lanes in 2016, 42 boat ramp lanes in 2036)
- Bundaberg Regional Council (27 boat ramp lanes in 2016, 34 boat ramp lanes in 2036).

Table 3.4 below identifies that some LGAs have demand for less than one boat ramp lane. These LGAs currently have either little or no public boating infrastructure but recorded vessel registrations.

Table 3.4: Projected boat ramp lane demand by LGA, 2016-2036

	Trailable Fleet up to 4.5 metres					Trailable Fleet 4.5 - 8 metres					Total				
	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036
Aurukun (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Balonne (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Banana (S)	1	1	1	1	1	<1	<1	<1	1	1	1	1	1	2	2
Barcaldine (R)	1	1	1	1	1	<1	<1	<1	<1	<1	1	1	1	1	1
Barcoo (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Blackall-Tambo (R)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Boulia (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Brisbane (C)	24	25	27	29	31	9	10	11	12	13	33	35	38	41	44
Bulloo (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bundaberg (R)	22	24	25	26	27	5	6	6	6	7	27	30	31	32	34
Burdekin (S)	9	9	9	9	10	3	3	3	4	4	12	12	12	13	14
Burke (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cairns (R)	22	23	25	26	29	11	12	13	14	16	33	35	38	40	45
Carpentaria (S)	2	2	2	2	2	1	1	1	1	1	3	3	3	3	3
Cassowary Coast (R)	12	12	12	12	13	7	7	7	7	7	19	19	19	19	20
Central Highlands (R)	2	2	3	3	3	1	1	1	1	1	3	3	4	4	4
Charters Towers (R)	1	1	1	1	1	<1	<1	<1	<1	<1	1	1	1	1	1
Cherbourg (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cloncurry (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cook (S)	2	2	2	2	2	1	1	1	1	1	3	3	3	3	3
Croydon (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Diamantina (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Doomadgee (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Douglas (S)	5	5	6	6	6	4	4	4	4	4	9	9	10	10	10
Etheridge (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Flinders (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Fraser Coast (R)	24	26	28	30	32	10	10	11	12	12	34	36	39	42	44
Gladstone (R)	14	15	17	19	20	6	7	8	8	9	20	22	25	27	29
Gold Coast (C)	40	44	49	54	60	14	16	18	20	23	54	60	67	74	83
Goondiwindi (R)	2	2	2	2	2	1	1	1	1	1	3	3	3	3	3
Gympie (R)	6	6	7	7	7	2	2	2	3	3	8	8	9	10	10
Hinchinbrook (S)	9	9	10	10	11	4	4	5	5	5	13	13	15	15	16
Hope Vale (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ipswich (C)	2	3	4	5	6	1	1	1	2	2	3	4	5	7	8
Isaac (R)	5	5	6	6	7	2	2	2	3	3	7	7	8	9	10
Kowanyama (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Livingstone (S)	12	13	14	17	18	7	7	8	8	9	19	20	22	25	27
Lockhart River (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lockyer Valley (R)	1	1	1	1	1	<1	<1	<1	<1	<1	1	1	1	1	1
Logan (C)	4	5	5	6	7	2	2	2	3	3	6	7	7	9	10
Longreach (R)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mackay (R)	25	28	29	32	34	9	10	10	11	12	34	38	39	43	46
McKinlay (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

	Trailable Fleet up to 4.5 metres					Trailable Fleet 4.5 - 8 metres					Total				
	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036	2016	2021	2026	2031	2036
Mapoon (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Maranoa (R)	1	1	1	1	1	<1	<1	<1	<1	<1	1	1	1	1	1
Mareeba (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Moreton Bay (R)	28	30	33	36	38	10	11	12	13	14	38	41	45	49	52
Mornington (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mount Isa (C)	2	2	2	2	2	1	1	1	1	1	3	3	3	3	3
Murweh (S)	1	1	1	1	1	<1	<1	<1	<1	<1	1	1	1	1	1
Napranum (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Noosa (S)	6	6	7	7	7	3	3	3	3	3	9	9	10	10	10
North Burnett (R)	1	1	1	1	1	<1	<1	<1	<1	<1	1	1	1	1	1
Northern Peninsula Area (R)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Palm Island (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Paroo (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pormpuraaw (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Quilpie (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Redland (C)	21	22	24	27	29	9	10	11	12	13	30	32	35	39	42
Richmond (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Rockhampton (R)	11	11	12	12	13	4	4	5	5	5	15	15	17	17	18
Scenic Rim (R)	5	5	6	6	7	2	2	2	2	2	7	7	8	8	9
Somerset (R)	7	7	8	8	8	2	3	3	3	3	9	10	11	11	11
South Burnett (R)	3	3	4	4	4	1	1	1	1	1	4	4	5	5	5
Southern Downs (R)	3	3	4	4	4	1	1	2	2	2	4	4	6	6	6
Sunshine Coast (R)	21	23	26	28	31	7	8	9	10	11	28	31	35	38	42
Tablelands (R)	2	2	2	2	2	1	1	1	1	1	3	3	3	3	3
Toowoomba (R)	2	2	2	2	2	1	1	1	1	1	3	3	3	3	3
Torres (S)	<1	<1	<1	<1	<1	1	1	1	1	1	1	1	1	1	1
Torres Strait Island (R)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Townsville (C)	20	21	23	25	29	9	10	11	12	13	29	31	34	37	42
Weipa (T)	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
Western Downs (R)	2	2	2	2	3	1	1	1	1	1	3	3	3	3	4
Whitsunday (R)	17	18	19	20	22	8	10	10	11	11	25	28	29	31	33
Winton (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Woorabinda (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wujal Wujal (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Yarrabah (S)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total	**401**	**425**	**464**	**496**	**536**	**162**	**176**	**190**	**207**	**221**	**563**	**601**	**654**	**703**	**757**

Note: Economic Associates estimates, derived from Table 3.3

3.5 Projected pontoon/landing demand

In Queensland, total pontoon/landing demand is projected to increase from 87 pontoons/landings in 2016 to 121 pontoons/landings in 2036.

The LGAs anticipated to have the most significant demand for pontoons/landings are Gold Coast City, Brisbane City, Redland City, Sunshine Coast Regional Council, Cairns Regional Council, Fraser Coast Regional Council and Whitsunday Regional Council.

Table 3.5 below summarises the projected pontoon/landing demand by LGA between 2016 and 2036.

Table 3.5: Projected pontoon / landing demand by LGA, 2016-2036

	2016	2021	2026	2031	2036
Aurukun (S)	0	0	0	0	0
Balonne (S)	0	0	0	0	0
Banana (S)	0	0	0	0	0
Barcaldine (R)	0	0	0	0	0
Barcoo (S)	0	0	0	0	0
Blackall-Tambo (R)	0	0	0	0	0
Boulia (S)	0	0	0	0	0
Brisbane (C)	8	9	9	10	11
Bulloo (S)	0	0	0	0	0
Bundaberg (R)	3	3	3	3	3
Burdekin (S)	1	1	1	1	1
Burke (S)	<1	<1	<1	<1	<1
Cairns (R)	6	7	7	8	8
Carpentaria (S)	<1	<1	<1	<1	<1
Cassowary Coast (R)	3	3	3	3	3
Central Highlands (R)	0	0	0	0	0
Charters Towers (R)	0	0	0	0	0
Cherbourg (S)	0	0	0	0	0
Cloncurry (S)	0	0	0	0	0
Cook (S)	<1	<1	<1	<1	<1
Croydon (S)	0	0	0	0	0
Diamantina (S)	0	0	0	0	0
Doomadgee (S)	0	0	0	0	0
Douglas (S)	2	2	2	2	2
Etheridge (S)	0	0	0	0	0
Flinders (S)	0	0	0	0	0
Fraser Coast (R)	6	6	7	7	8
Gladstone (R)	3	3	3	4	4
Gold Coast (C)	14	16	18	20	22
Goondiwindi (R)	0	0	0	0	0
Gympie (R)	1	1	1	1	2
Hinchinbrook (S)	2	2	2	2	2
Hope Vale (S)	<1	<1	<1	<1	<1
Ipswich (C)	<1	<1	<1	<1	<1
Isaac (R)	1	1	1	1	1
Kowanyama (S)	0	0	0	0	0
Livingstone (S)	4	4	4	6	6
Lockhart River (S)	<1	<1	<1	<1	<1
Lockyer Valley (R)	0	0	0	0	0
Logan (C)	<1	<1	<1	<1	<1
Longreach (R)	0	0	0	0	0
Mackay (R)	4	4	6	6	6
McKinlay (S)	0	0	0	0	0
Mapoon (S)	0	0	0	0	0

	2016	2021	2026	2031	2036
Maranoa (R)	0	0	0	0	0
Mareeba (S)	0	0	0	0	0
Moreton Bay (R)	6	6	7	8	8
Mornington (S)	<1	<1	<1	<1	<1
Mount Isa (C)	0	0	0	0	0
Murweh (S)	0	0	0	0	0
Napranum (S)	0	0	0	0	0
Noosa (S)	1	1	2	2	2
North Burnett (R)	0	0	0	0	0
Northern Peninsula Area (R)	<1	<1	<1	<1	<1
Palm Island (S)	<1	<1	<1	<1	<1
Paroo (S)	0	0	0	0	0
Pormpuraaw (S)	0	0	0	0	0
Quilpie (S)	0	0	0	0	0
Redland (C)	6	6	7	7	8
Richmond (S)	0	0	0	0	0
Rockhampton (R)	2	2	2	2	3
Scenic Rim (R)	0	0	0	0	0
Somerset (R)	0	0	0	0	0
South Burnett (R)	0	0	0	0	0
Southern Downs (R)	0	0	0	0	0
Sunshine Coast (R)	4	5	5	6	6
Tablelands (R)	0	0	0	0	0
Toowoomba (R)	0	0	0	0	0
Torres (S)	<1	<1	<1	<1	<1
Torres Strait Island (R)	<1	<1	<1	<1	<1
Townsville (C)	4	4	6	6	7
Weipa (T)	<1	<1	<1	<1	<1
Western Downs (R)	0	0	0	0	0
Whitsunday (R)	6	7	7	8	8
Winton (S)	0	0	0	0	0
Woorabinda (S)	0	0	0	0	0
Wujal Wujal (S)	0	0	0	0	0
Yarrabah (S)	<1	<1	<1	<1	<1
Total	**87**	**93**	**103**	**113**	**121**

Source: Economic Associates estimates, derived from Table 3.3

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APPENDIX A

DISTRIBUTION OF BOAT REGISTRATIONS TO LGAS OF USE

Table A.1: Distribution of boat registrations to LGAs of use, trailable boat registrations

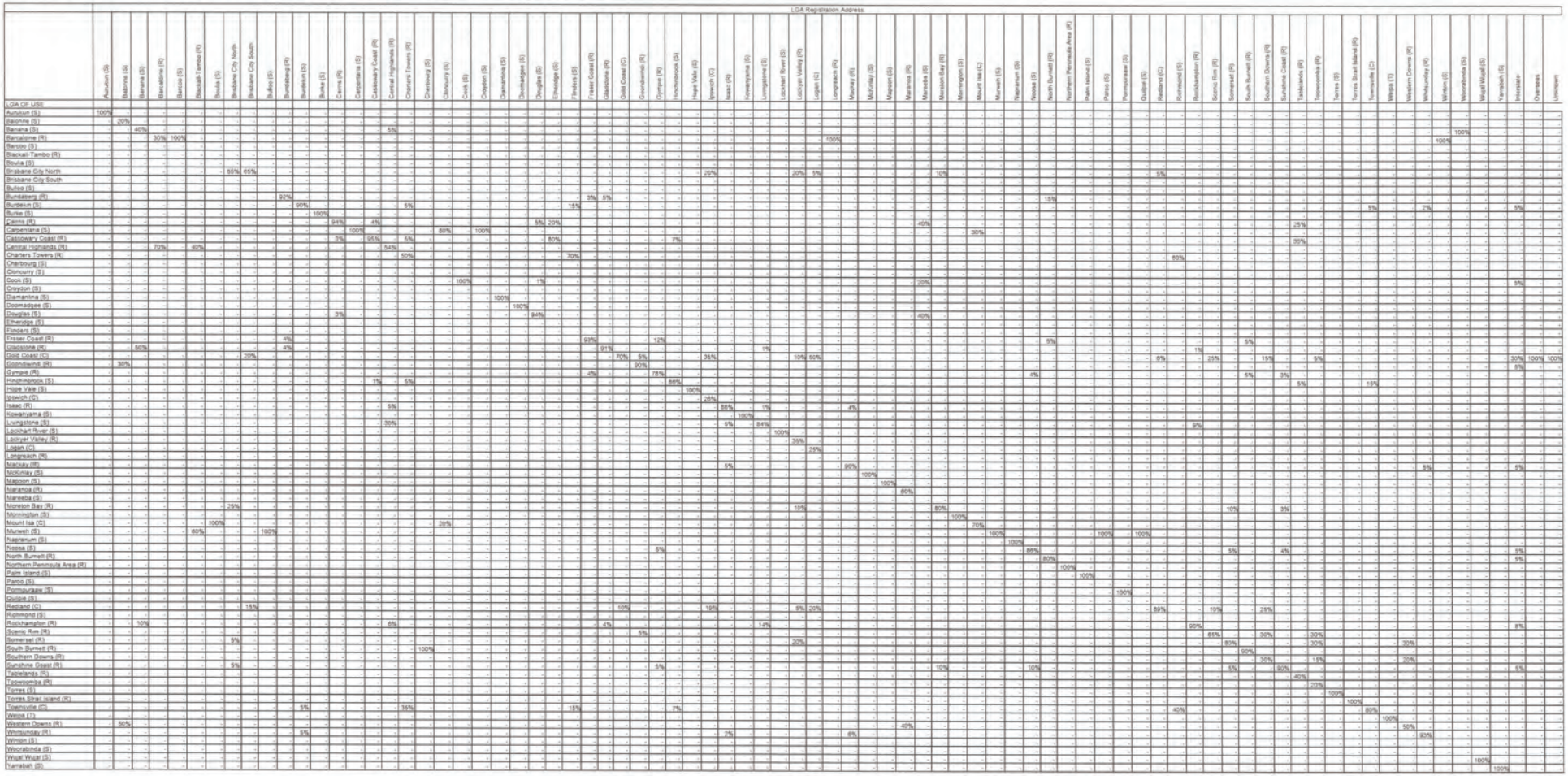

Table A.2: Distribution of boat registrations to LGAs of use, non-trailable boat registrations

LGA Registration Address

	Aurukun (S)	Balonne (S)	Banana (S)	Barcaldine (R)	Barcoo (S)	Blackall-Tambo (R)	Boulia (S)	Brisbane City North	Brisbane City South	Bulloo (S)	Bundaberg (R)	Burdekin (S)	Burke (S)	Cairns (R)	Carpentaria (S)	Cassowary Coast (R)	Central Highlands (R)	Charters Towers (R)	Cherbourg (S)	Cloncurry (S)	Cook (S)	Croydon (S)	Diamantina (S)	Doomadgee (S)	Douglas (S)	Etheridge (S)	Flinders (S)
Aurukun (S)	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Balonne (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Banana (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barcaldine (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barcoo (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Blackall-Tambo (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Boulia (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Brisbane City North	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Brisbane City South	0%	0%	0%	0%	0%	0%	0%	75%	75%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bulloo (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bundaberg (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	92%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Burdekin (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	90%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Burke (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cairns (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	94%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	20%	0%
Carpentaria (S)	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%	100%	100%	0%	0%	0%	0%
Cassowary Coast (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	95%	0%	5%	0%	0%	0%	0%	0%	0%	0%	80%	0%
Central Highlands (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Charters Towers (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cherbourg (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cloncurry (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cook (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Croydon (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Diamantina (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Doomadgee (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
Douglas (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	94%	0%	0%
Etheridge (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Flinders (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fraser Coast (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Gladstone (R)	0%	0%	80%	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Gold Coast (C)	0%	100%	0%	0%	0%	0%	0%	0%	20%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Goondiwindi (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Gympie (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	30%	0%	0%	0%	0%	0%	0%	0%	0%
Hinchinbrook (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hope Vale (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Ipswich (C)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Isaac (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Kowanyama (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Livingstone (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	70%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lockhart River (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lockyer Valley (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Logan (C)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Longreach (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mackay (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
McKinlay (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mapoon (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Maranoa (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mareeba (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Moreton Bay (R)	0%	0%	0%	0%	0%	0%	0%	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mornington (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mount Isa (C)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Murweh (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Napranum (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Noosa (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	70%	0%	0%	0%	0%	0%	0%	0%	0%
North Burnett (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Northern Peninsula Area (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Palm Island (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paroo (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Pormpuraaw (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Quilpie (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Redland (C)	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Richmond (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Rockhampton (R)	0%	0%	20%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Scenic Rim (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Somerset (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
South Burnett (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Southern Downs (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sunshine Coast (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Tablelands (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Toowoomba (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Torres (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Torres Strait Island (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Townsville (C)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	75%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Weipa (T)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Western Downs (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Whitsunday (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Winton (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Woorabinda (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wujal Wujal (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Yarrabah (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

	Fraser Coast (R)	Gladstone (R)	Gold Coast (C)	Goondiwindi (R)	Gympie (R)	Hinchinbrook (S)	Hope Vale (S)	Ipswich (C)	Isaac (R)	Kowanyama (S)	Livingstone (S)	Lockhart River (S)	Lockyer Valley (R)	Logan (C)	Longreach (R)	Mackay (R)	McKinlay (S)	Mapoon (S)	Maranoa (R)	Mareeba (S)	Moreton Bay (R)	Mornington (S)	Mount Isa (C)	Murweh (S)	Napranum (S)	Noosa (S)	North Burnett (R)
Aurukun (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Balonne (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Banana (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barcaldine (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barcoo (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Blackall-Tambo (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Boulia (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Brisbane City North	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Brisbane City South	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	0%	0%	40%	5%	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%	0%	0%	0%
Bulloo (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bundaberg (R)	3%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	75%
Burdekin (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Burke (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cairns (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%
Carpentaria (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%
Cassowary Coast (R)	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Central Highlands (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Charters Towers (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cherbourg (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cloncurry (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cook (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Croydon (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Diamantina (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Doomadgee (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Douglas (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%
Etheridge (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Flinders (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fraser Coast (R)	93%	0%	0%	0%	12%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%
Gladstone (R)	0%	91%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Gold Coast (C)	0%	0%	85%	100%	0%	0%	0%	50%	0%	0%	0%	0%	25%	65%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%
Goondiwindi (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Gympie (R)	4%	0%	0%	0%	78%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%
Hinchinbrook (S)	0%	0%	0%	0%	0%	86%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hope Vale (S)	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Ipswich (C)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Isaac (R)	0%	0%	0%	0%	0%	0%	0%	0%	85%	0%	1%	0%	0%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Kowanyama (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Livingstone (S)	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	84%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lockhart River (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lockyer Valley (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Logan (C)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Longreach (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mackay (R)	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
McKinlay (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mapoon (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Maranoa (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mareeba (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Moreton Bay (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	0%	0%	0%	0%	0%	80%	0%	0%	0%	0%	0%	0%
Mornington (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%
Mount Isa (C)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Murweh (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Napranum (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%
Noosa (S)	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	86%	0%
North Burnett (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Northern Peninsula Area (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Palm Island (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paroo (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Pormpuraaw (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Quilpie (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Redland (C)	0%	0%	5%	0%	0%	0%	0%	25%	0%	0%	0%	0%	10%	30%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Richmond (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Rockhampton (R)	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	14%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Scenic Rim (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Somerset (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
South Burnett (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Southern Downs (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sunshine Coast (R)	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%	0%	10%	0%
Tablelands (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Toowoomba (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Torres (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Torres Strait Island (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Townsville (C)	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Weipa (T)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Western Downs (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Whitsunday (R)	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Winton (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Woorabinda (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wujal Wujal (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Yarrabah (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

	Northern Peninsula Area (R)	Palm Island (S)	Paroo (S)	Pormpuraaw (S)	Quilpie (S)	Redland (C)	Richmond (S)	Rockhampton (R)	Scenic Rim (R)	Somerset (R)	South Burnett (R)	Southern Downs (R)	Sunshine Coast (R)	Tablelands (R)	Toowoomba (R)	Torres (S)	Torres Strait Island (R)	Townsville (C)	Weipa (T)	Western Downs (R)	Whitsunday (R)	Winton (S)	Woorabinda (S)	Wujal Wujal (S)	Yarrabah (S)	Interstate	Overseas	Unknown
Aurukun (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Balonne (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Banana (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barcaldine (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Barcoo (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Blackall-Tambo (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Boulia (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Brisbane City North	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Brisbane City South	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bulloo (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bundaberg (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Burdekin (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	2%	0%	0%	0%	0%	5%	0%	0%
Burke (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cairns (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	40%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Carpentaria (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cassowary Coast (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Central Highlands (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Charters Towers (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cherbourg (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cloncurry (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cook (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Croydon (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Diamantina (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Doomadgee (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Douglas (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Etheridge (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Flinders (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fraser Coast (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Gladstone (R)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Gold Coast (C)	0%	0%	100%	0%	100%	0%	0%	0%	100%	0%	0%	100%	0%	0%	50%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	30%	100%	100%
Goondiwindi (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Gympie (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hinchinbrook (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hope Vale (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Ipswich (C)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Isaac (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Kowanyama (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Livingstone (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%
Lockhart River (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lockyer Valley (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Logan (C)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Longreach (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mackay (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	5%	0%	0%
McKinlay (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mapoon (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Maranoa (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mareeba (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Moreton Bay (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mornington (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mount Isa (C)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Murweh (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Napranum (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Noosa (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%
North Burnett (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Northern Peninsula Area (R)	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Palm Island (S)	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Paroo (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Pormpuraaw (S)	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Quilpie (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Redland (C)	0%	0%	0%	0%	0%	80%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Richmond (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Rockhampton (R)	0%	0%	0%	0%	0%	0%	0%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%
Scenic Rim (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Somerset (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
South Burnett (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Southern Downs (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sunshine Coast (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%
Tablelands (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Toowoomba (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Torres (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Torres Strait Island (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Townsville (C)	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	80%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
Weipa (T)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Western Downs (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Whitsunday (R)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	93%	0%	0%	0%	0%	0%	0%	0%
Winton (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Woorabinda (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wujal Wujal (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%
Yarrabah (S)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	M Mikelat K O'Malley-Jones	K O'Malley-Jones		S Vivian		December 2017

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Appendix F Protected Matters Search Tool Report for Project Area and Surrounds (1 October 2020)

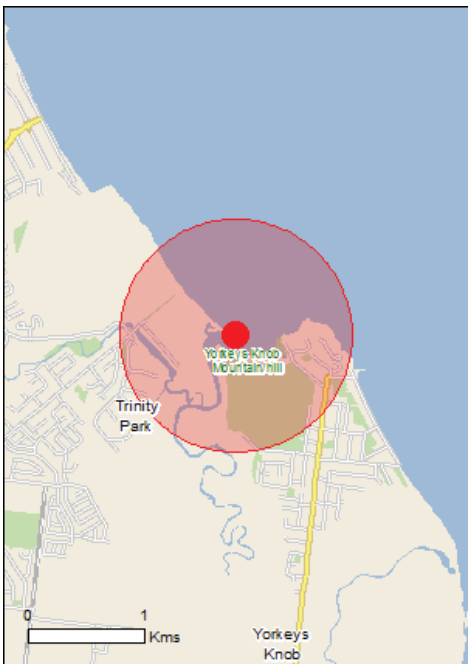
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 01/10/20 16:09:29



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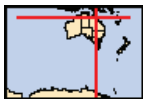

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	43
Listed Migratory Species:	45

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	96
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	28
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
Great Barrier Reef	QLD	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
Great Barrier Reef	QLD	Listed place

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Broad leaf tea-tree (Melaleuca viridiflora) woodlands in high rainfall coastal north Queensland	Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Casuarius casuarius johnsonii Southern Cassowary, Australian Cassowary, Double-wattled Cassowary [25986]	Endangered	Species or species habitat known to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Stiphodon semoni Opal Cling Goby [83909]	Critically Endangered	Species or species habitat may occur within area
Frogs		
Litoria dayi Australian Lace-lid, Lace-eyed Tree Frog, Day's Big-eyed Treefrog [86707]	Vulnerable	Species or species habitat likely to occur within area
Litoria nannotis Waterfall Frog, Torrent Tree Frog [1817]	Endangered	Species or species habitat may occur within area
Litoria rheocola Common Mistfrog [1802]	Endangered	Species or species habitat likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Dasyurus maculatus gracilis Spotted-tailed Quoll (North Queensland), Yarri [64475]	Endangered	Species or species habitat may occur within area
Hipposideros semoni Semon's Leaf-nosed Bat, Greater Wart-nosed Horseshoe-bat [180]	Vulnerable	Species or species habitat may occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Mesembriomys gouldii rattoides Black-footed Tree-rat (north Queensland), Shaggy Rabbit-rat [87620]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Pteropus conspicillatus Spectacled Flying-fox [185]	Endangered	Species or species habitat known to occur within area
Rhinolophus robertsi Large-eared Horseshoe Bat, Greater Large-eared Horseshoe Bat [87639]	Vulnerable	Species or species habitat likely to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped	Vulnerable	Species or species

Name	Status	Type of Presence
Sheathtail Bat [66889]		habitat likely to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
Plants		
Bruguiera hainesii Haines's Orange Mangrove [88756]	Critically Endangered	Species or species habitat likely to occur within area
Canarium acutifolium [23956]	Vulnerable	Species or species habitat may occur within area
Myrmecodia beccarii Ant Plant [11852]	Vulnerable	Species or species habitat likely to occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area
Phaius pictus [22564]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding likely to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding likely to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Foraging, feeding or related behaviour known to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat known to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Bulbonaricus davaoensis Davao Pughead Pipefish [66190]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys sculptus Sculptured Pipefish [66197]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys ocellatus Orange-spotted Pipefish, Ocellated Pipefish [66203]		Species or species habitat may occur within area
Corythoichthys paxtoni Paxton's Pipefish [66204]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus maxweberi Maxweber's Pipefish [66209]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Festucalex gibbsi Gibbs' Pipefish [66215]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus macrorhynchus Whiskered Pipefish, Ornate Pipefish [66222]		Species or species habitat may occur within area
Halicampus mataafae Samoan Pipefish [66223]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippichthys spicifer Belly-barred Pipefish, Banded Freshwater Pipefish [66232]		Species or species habitat may occur within area
Hippocampus bargibanti Pygmy Seahorse [66721]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus zebra Zebra Seahorse [66241]		Species or species habitat may occur within area
Micrognathus andersonii Anderson's Pipefish, Shortnose Pipefish [66253]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Micrognathus brevirostris thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area
Microphis brachyurus Short-tail Pipefish, Short-tailed River Pipefish [66257]		Species or species habitat may occur within area
Nannocampus pictus Painted Pipefish, Reef Pipefish [66263]		Species or species habitat may occur within area
Phoxocampus diacanthus Pale-blotched Pipefish, Spined Pipefish [66266]		Species or species habitat may occur within area
Siokunichthys breviceps Softcoral Pipefish, Soft-coral Pipefish [66270]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area

Name	Threatened	Type of Presence
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Laticauda colubrina a sea krait [1092]		Species or species habitat may occur within area
Laticauda laticaudata a sea krait [1093]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area

Name	Status	Type of Presence
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Foraging, feeding or related behaviour known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Annona glabra Pond Apple, Pond-apple Tree, Alligator Apple, Bullock's Heart, Cherimoya, Monkey Apple, Bobwood, Corkwood [6311]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Lepidodactylus lugubris Mourning Gecko [1712]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-16.80129 145.71471

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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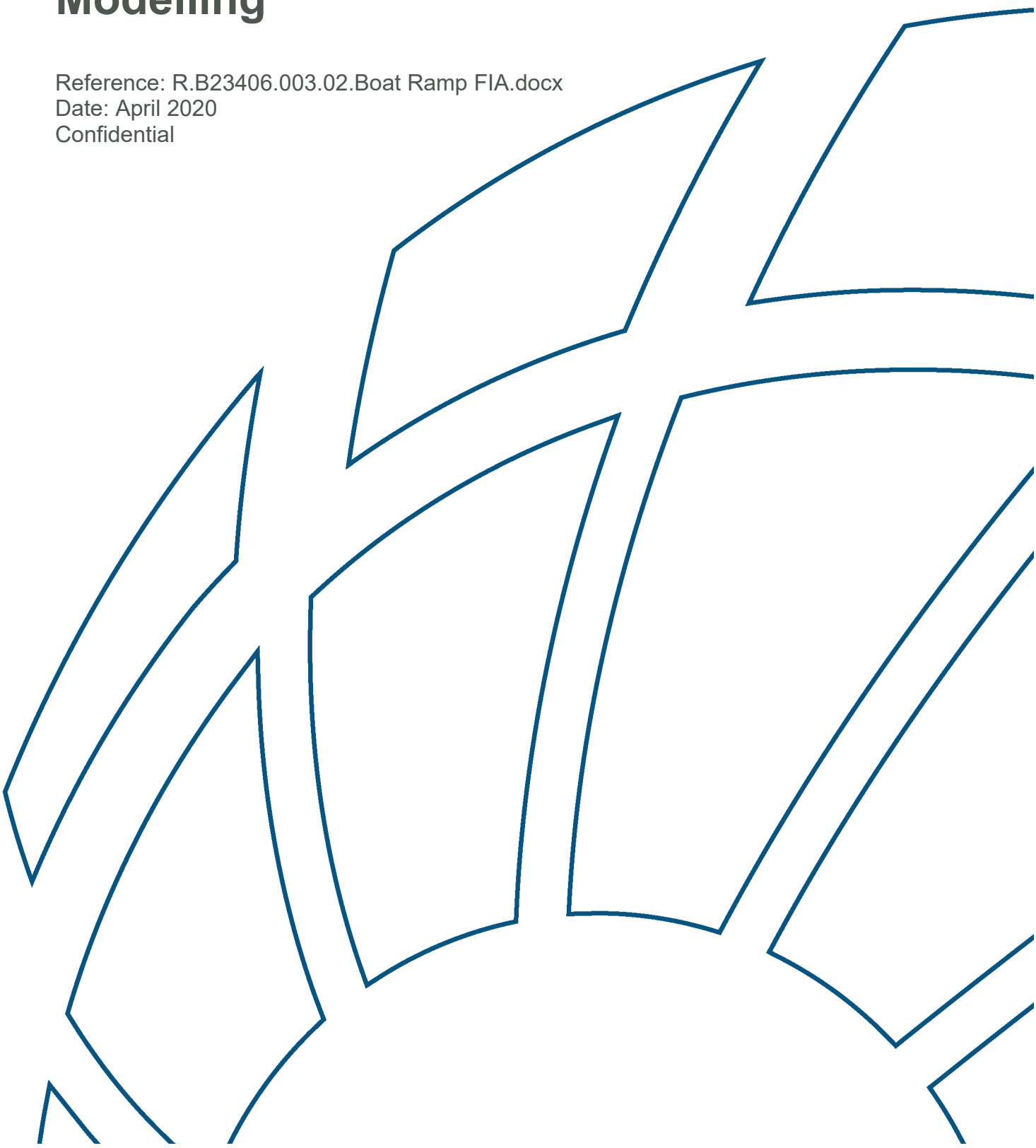
Appendix G Modelling Studies

Yorkeys Knob Boating Infrastructure Project - Detailed Design 151138 Flood Modelling

Reference: R.B23406.003.02.Boat Ramp FIA.docx
Date: April 2020
Confidential



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Document:	R.B23406.003.02.Boat Ramp FIA.docx
Title:	Yorkeys Knob Boating Infrastructure Project - Detailed Design 151138 Flood Modelling
Project Manager:	Matthew Barnes
Author:	Nigel Hardie
Client:	Qld Department of Transport and Main Roads
Client Contact:	
Client Reference:	

Synopsis: **Detailed flood modelling of the proposed Boating Infrastructure Project**

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
0	26th March 2020	IQC		MPB	
1	23rd April 2020	IQC		NH	
2	27th April 2020	IQC		MPB	

DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
Qld Department of Transport and Main Roads	PDF	PDF	PDF								
BMT File	PDF	PDF	PDF								
BMT Library	PDF	PDF	PDF								

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Contents

1 Introduction

1.1 Background

As part of a strategic assessment of boat launching needs in North Queensland, DTMR identified a site a Yorkeys Knob for further investigation. BMT was commissioned to develop an understanding of the metocean and environmental design criteria, including a description of the biophysical environment, legislative context and approval requirements. As part of this investigation, BMT provided numerical modelling of the potential flooding impacts of the conceptual development.

Recommendations of the conceptual design investigation included a detailed assessment of the potential flooding impacts, noting that the relatively low-resolution modelling approach adopted at the conceptual layout stage was likely to be overstating the potential impacts.

From our perusal of the tender brief and knowledge gained through previous relevant investigations at the site (BMT 2019), the key stages of further work related to flooding include:

- Detailed flood modelling to support the refined boat ramp facility design to ensure no negative impacts within the Half Moon Creek catchment including adjacent properties
- Sizing of the proposed creek culvert crossing to ensure:
    - No adverse flooding impacts on adjacent properties
    - The culverts maintain fish passage
    - The culverts maintain tidal flows to the upstream wetland

The approach adopted is outlined below and accords with the requirements of the DTMR *Guidelines for Hydraulic and Hydraulic Modelling*.

1.2 Scope

BMT was commissioned to provide a detailed design assessment of the potential flooding impact of the boat ramp facility. The investigation included the following elements:

- ***Half Moon Creek Local Catchment Hydrologic Assessment****:* A XP Rafts hydrologic model of the local catchment was established to provide inflow hydrographs to the hydraulic model
- ***Local Catchment Hydraulic Assessment****:* A two-dimensional model of the local catchment was established to determine the impacts of the boat ramp facility on local catchment flooding
- ***Barron River Regional Catchment Hydraulic Assessment****:* Using the hydraulic model established for the local catchment, flows from Council's Barron River Delta Mike 21 Flood model were applied as inflow boundary conditions to determine the potential impacts on regional catchment flooding
- ***Tidal Transfer Assessment:*** Using the hydraulic model, apply a dynamic tidal boundary condition to simulate a 'normal spring' and 'king' tidal cycles to determine the impacts of the boat ramp facility on tidal transfer.

2 Site Description

2.1 Proposed Development

The facility will consist of additional breakwaters, six-lane boat ramp with two floating walkways, and associated reclamation parking area. A new access road, creek crossing, and intersection is proposed from Buckley Street.

A plan of the proposed development is presented in Figure 2-1.

2.2 Location

The proposed boat ramp facility is located adjacent to the mouth of Half Moon Creek, alongside the existing Half Moon Bay Marina, and to the north of the Half Moon Bay Golf Club.

The location of the site is presented in Figure 2-2.

2.3 Topography and Drainage

The location of the proposed facility is subject to flooding and storm tide influences. The proposed access road also crosses a tidal waterway, adjoining the existing golf course to the south.

Flooding can occur from the 3,500-hectare Half Moon Creek catchment as well as from Barron River regional flood events.

The site of the proposed carpark and boat ramp includes areas of existing reclamation (1.3ha) with ground elevations up to 4.2 m AHD.

The proposed access road crosses a tidal waterway with an invert of approximately -0.3m AHD. Along the proposed location of the access road ground elevations vary between 1.8m to 2.6m AHD.

Topography of the site and surrounding areas is presented in Figure 2-3.

Legend

Proposed Development

Title:

Plan of the Proposed Development

Drawing: 2-1

Rev: A

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Report Figures_023\Fig 2-1 Plan of the Proposed Development.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

Site Location

Drawing: 2-2

Rev: A

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 150 300 m

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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Report Figures_023\Fig 2-2 Site Location.qgz

LEGEND

- Boat Ramp Facility
- Roads
- Cadastral Boundaries

Title:

Topography of Site and Surrounding Areas

Figure: **2-3**

Rev: **A**

N

0 300 600 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Report Figures_023\Fig 2-3 Topography of Site and Surrounding Areas.qgz

3 Hydrologic Assessment

3.1 Overview

This section provides a description of the hydrologic model of the local catchment that was established to provide runoff hydrographs suitable for use in the hydraulic model.

3.2 Hydrologic Model Setup

3.2.1 Catchment

To represent the hydrologic behaviour of the catchment, 38 sub-catchments were created using CatchmentSIM software and modelled using XP Rafts. The sub-catchment layout is presented in Figure 3-1. The area of each sub-catchment is presented in Table 3-1.

Table 3-1 Sub-Catchment Areas

Sub-catchment Name	Area (ha)	Sub-catchment Name	Area (ha)
Sub2	50.99	Sub20	188.86
Sub3	143.22	Sub21	116.09
Sub4	126.6	Sub22	59.15
Sub5	124.00	Sub23	42.13
Sub6	63.41	Sub24	85.18
Sub7	94.07	Sub25	120.47
Sub8	78.49	Sub26	67.74
Sub9	188.00	Sub27	110.88
Sub10	60.67	Sub28	55.43
Sub11	90.61	Sub29	42.4
Sub12	47.68	Sub30	55.17
Sub13	141.85	Sub31	31.07
Sub14	85.23	Sub32	112.40
Sub15	82.34	Sub33	62.16
Sub16	135.02	Sub34	102.25
Sub17	54.68	Sub35	105.32
Sub18	152.13	Sub36	154.49
Sub19	135.93	Sub37	70.83
		Sub38	61.95
		Total	**3498.90**

3.2.2 Land Use Fraction Imperviousness

The fraction imperviousness was determined using aerial photography. The corresponding QUDM fraction imperviousness was then adopted for each land use, as outlined in Table 3-2.

Table 3-2 Land Use Impervious Area

Land Use	Impervious Area (%)
Dense Vegetation	0%
Mangroves	0%
Urban Residential	75%
Rural Residential	20%
Waterbodies	100%

3.2.3 Rainfall Parameters

The rainfall parameters used in the XP Rafts model were extracted from *Australian Rainfall and Runoff* (Institution of Engineers Australia, 2016) for the Yorkeys Knob area. The adopted parameters are presented in Table 3-3.

Table 3-3 AR&R 2016 IFD Design Rainfall Depth (mm)

Duration	Annual Exceedance Probability (AEP)						
	63.20%	50%	20%	10%	5%	2%	1%
1 min	2.85	3.15	4.03	4.58	5.09	5.71	6.15
2 min	5.22	5.77	7.45	8.53	9.54	10.8	11.8
3 min	7.27	8.04	10.4	11.9	13.2	15	16.3
4 min	9.11	10.1	13	14.8	16.5	18.6	20.1
5 min	10.8	11.9	15.3	17.4	19.4	21.9	23.6
10 min	17.7	19.5	24.9	28.2	31.3	35	37.7
15 min	23	25.3	32.3	36.6	40.6	45.4	48.8
20 min	27.3	30.2	38.5	43.7	48.4	54.1	58.2
25 min	31.1	34.3	43.9	49.8	55.2	61.8	66.5
30 min	34.4	38	48.6	55.2	61.3	68.8	74.1
45 min	42.5	47.1	60.5	69	76.8	86.5	93.5
1 hour	48.9	54.2	70.1	80.1	89.5	101	110
1.5 hour	58.8	65.4	85.3	98.1	110	125	136
2 hour	66.5	74.2	97.5	113	127	145	158
3 hour	78.4	87.9	117	136	154	177	194
4.5 hour	91.7	103	139	163	186	216	238
6 hour	102	116	158	185	212	247	274
9 hour	119	136	187	222	255	300	334
12 hour	133	152	212	252	291	344	384
18 hour	156	179	251	301	350	417	469
24 hour	174	201	284	342	399	478	541
30 hour	191	220	313	377	441	532	604
36 hour	205	237	338	408	478	580	660
48 hour	230	266	381	462	543	661	758
72 hour	270	312	448	544	641	788	909
96 hour	300	346	496	603	712	879	1020

Duration	Annual Exceedance Probability (AEP)						
120 hour	323	372	533	648	765	946	1100
144 hour	341	393	560	681	803	994	1150
168 hour	355	408	581	704	830	1030	1190

3.2.4 Hydrologic Parameters

Rainfall losses were accounted for using an initial loss/ continuing loss model. The rainfall losses adopted for use in the XP Rafts model were derived from *Australian Rainfall and Runoff* (Institution of Engineers Australia, 2016), they are as follows:

- Initial loss (pervious areas): 43 mm
- Initial loss (impervious areas): 0.0 mm
- Continuing loss (pervious areas): 4.9 mm (absolute)
- Continuing loss (impervious areas): 0.0 mm/h

3.2.5 Critical Design Storm Events

Following the DTMR *Guidelines for Hydraulic and Hydraulic Modelling*, critical design storms were chosen based on:

- At the location under consideration (the mouth of Half Moon Creek) the critical duration of each AEP design event is defined as the duration that results in the highest mean peak flow rate of the associated temporal pattern ensembles.
- The critical flow rate was then chosen to be the mean peak flow rate of the critical temporal pattern ensemble.

The resultant design storm events considered are presented in Table 3-4. The critical design storms are shown highlighted grey.

Table 3-4 Critical Design Storm Events

AEP	Mean Peak Flow (m^3/s)	Mean Storm duration	Mean Storm Temporal Pattern
63.2%	112.4	1hr	Temporal Pattern 6
	184.0	1.5hr	Temporal Pattern 9
	231.1	2hr	Temporal Pattern 3
	114.5	3hr	Temporal Pattern 3
	113.7	4.5hr	Temporal Pattern 9
	101.4	6hr	Temporal Pattern 7
50%	128.2	1hr	Temporal Pattern 1
	211.4	1.5hr	Temporal Pattern 9
	265.7	2hr	Temporal Pattern 3
	139.6	3hr	Temporal Pattern 4
	136.5	4.5hr	Temporal Pattern 9
	124.0	6hr	Temporal Pattern 2

AEP	Mean Peak Flow (m^3/s)	Mean Storm duration	Mean Storm Temporal Pattern
20%	94.7	1hr	Temporal Pattern 10
	223.9	1.5hr	Temporal Pattern 9
	239.4	2hr	Temporal Pattern 8
	207.7	3hr	Temporal Pattern 4
	206.5	4.5hr	Temporal Pattern 9
	193.6	6hr	Temporal Pattern 7
10%	237.0	1.5hr	Temporal Pattern 5
	236.7	2hr	Temporal Pattern 4
	252.3	3hr	Temporal Pattern 7
	242.0	4.5hr	Temporal Pattern 3
	258.8	6hr	Temporal Pattern 8
	228.6	9hr	Temporal Pattern 10
5%	266.7	1.5hr	Temporal Pattern 5
	259.1	2hr	Temporal Pattern 8
	296.1	3hr	Temporal Pattern 7
	288.1	4.5hr	Temporal Pattern 3
	309.2	6hr	Temporal Pattern 8
	271.8	9hr	Temporal Pattern 10
2%	341.8	1.5hr	Temporal Pattern 4
	380.4	2hr	Temporal Pattern 3
	371.7	3hr	Temporal Pattern 1
	387.9	4.5hr	Temporal Pattern 7
	380.3	6hr	Temporal Pattern 3
	330.7	9hr	Temporal Pattern 9
1%	388.3	1.5hr	Temporal Pattern 4
	425.3	2hr	Temporal Pattern 6
	420.0	3hr	Temporal Pattern 1
	438.6	4.5hr	Temporal Pattern 8
	433.4	6hr	Temporal Pattern 3
	379.5	9hr	Temporal Pattern 4

3.2.6 Rational Method Verification

Due to the absence of a stream gauge on the watercourses that drain through the study area, it was not possible to calibrate the hydrologic models to historic flood events.

In lieu of calibration data, recourse was made to the Rational Method as per the DTMR guidelines.

The Rational Method assessment was completed in accordance with the procedures nominated in Section 4 of QUDM, with the parameters presented in Table 3-5 adopted for the catchment.

Table 3-5 Rational Method Parameters

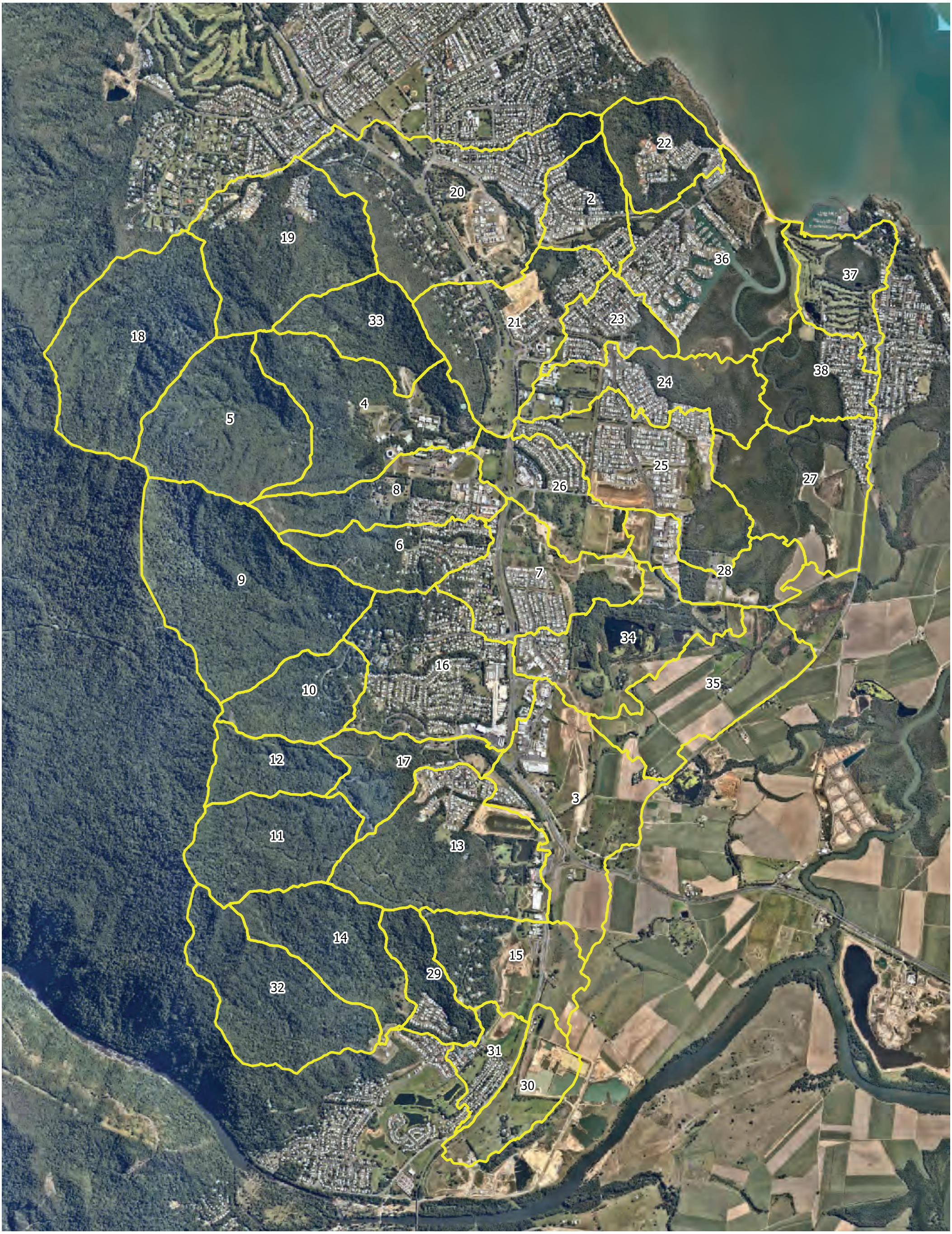
Parameter	Existing Catchment
Catchment Area (ha)	3498.90
Fraction Impervious (%)	20%
Channel Length (m)	12.5 km
Average Stream Velocity	0.7 m/s
Time of Concentration (min)	5 hours
Runoff Coefficient (C_{10})	0.74

A comparison of the peak flow predicted using the Rational Method and that calculated by the XP Rafts model is presented in Table 3-6.

Table 3-6 Rational Method Comparison

AEP	Rational Method	XP Rafts	% Difference
10%	247.3	258.8	4%
5%	296.3	309.2	4%
2%	376.9	387.9	3%
1%	434.3	438.6	1%

Based on the results presented in Table 3-6 above, it is considered that a reasonable correlation exists between the XP Rafts model and the Rational Method and that therefore the model can be used with confidence to define runoff hydrographs for use in the hydraulic model.



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Sub-catchments

Title:

Hydrologic Model Sub-Catchments

Drawing: 3-1

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4 Hydraulic Assessment

4.1 Overview

To confirm that the development will not cause an impact on adjacent properties, detailed flood modelling of the local catchment was undertaken.

For the analysis, a TUFLOW two-dimensional model of the local catchment was established. The model included a detailed representation of the surface drainage network via a two-dimensional grid, linked with one-dimensional elements representing the underground (pipe) drainage network proposed for the new access road.

This section provides a description of the assessment undertaken and the results obtained from the simulation.

The key hydraulic model features are presented in Figure 4-3.

4.2 Existing Case Model Setup

4.2.1 Local Model Extent and Topography

The TUFLOW model created for this assessment covers the area from the Captain Cook Highway to Half Moon Bay (1505 ha). The downstream extent of the model was chosen to ensure that the tailwater conditions at the downstream end of the model do not affect results at the site.

Ground level data for the model was obtained from 2014 LIDAR survey data provided by DNRM and bathymetry data used in Council's Barron River Delta Mike Flood model.

To provide a suitable level of detail and provide model stability in areas of water depth greater than 5m, a hydraulic model with a 7.5m grid cell size was used in the 2D domain.

4.2.2 Regional Model Extent

The local model boundary was truncated to provide a suitable location to apply the Barron River inflows. This location was found to be approximately 2 km upstream from the river mouth.

4.2.3 Roughness

A roughness map representing the Manning 'n' roughness coefficients was based on a review of aerial photography and Council's flood model. To confirm that the adopted values were reasonable, a comparison was made between the adopted values and those presented in Australian Rainfall and Runoff Project 15, *Two-Dimensional Modelling of Urban and Rural Floodplains* (AR&R, 2012). Based on the comparison, it was concluded that the adopted values were appropriate. Table 4-1 presents the adopted roughness coefficients for the model.

Table 4-1 Roughness Values

Land Use	Manning's Roughness
Dense Vegetation / Mangroves	0.125
Urban Residential	0.12
Waterbodies	0.025
Pavement	0.015

4.2.4 Inflow Boundary Conditions

Hydrographs for the critical design storm events, calculated from the local hydrologic model discussed in Section 3, were applied as inflow boundary conditions to the local hydraulic model.

For the regional flood assessment, the following inflows were extracted from the Council's flood model.

- 1% AEP with Tailwater at 1.0 AHD
- 1% AEP with Tailwater at 2.1m AHD

4.2.5 Static Downstream Boundary Conditions

For the flood assessment, a range of static downstream tailwater conditions were applied to the model as a Height vs Time boundary. Those conditions are outlined in Table 4-2.

Table 4-2 Downstream Tailwater Conditions

Tailwater Designation	Tailwater Level	Notes
MSL	0.057 m AHD	Mean Sea Level
TWL0000	0.0 m AHD	From the Council MIKE Model
TWL1000	1.0 m AHD	From the Council MIKE Model
TWL2100	2.1 m AHD	From the Council MIKE Model

4.2.6 Dynamic Downstream Boundary Conditions

For the tidal transfer assessment, two 48-hour tidal cycles were considered:

- Normal Spring Tidal Range – Mean High Water Spring (MHWS, 0.98m AHD) to Mean Low Water Spring (MLWS, -0.86m AHD)
- King Tide Tidal Range – Highest Astronomical Tide (HAT, 1.86m AHD) to Lowest Astronomical Tide (LAT, -1.643m AHD).

Tidal data for these two ranges was obtained from the Qld Department of Environment and Science tide gauge for the November to December 2018. Timeseries plots for these two ranges are provided in Figure 4-1 and Figure 4-2.

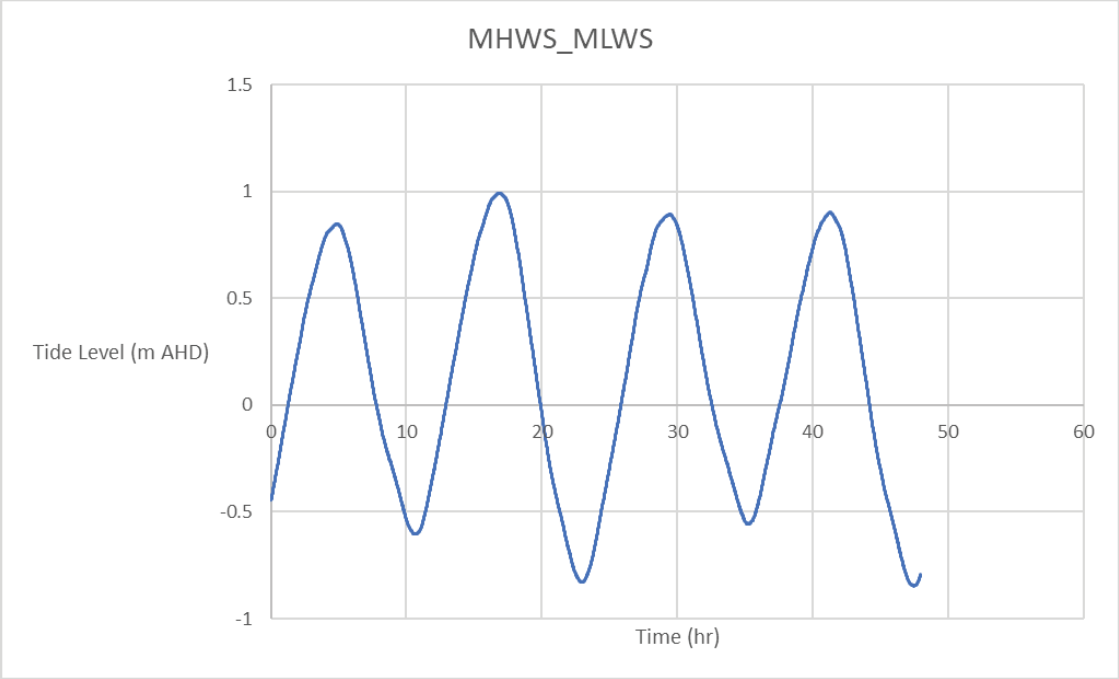

Figure 4-1 MHWS – MLWS Timeseries

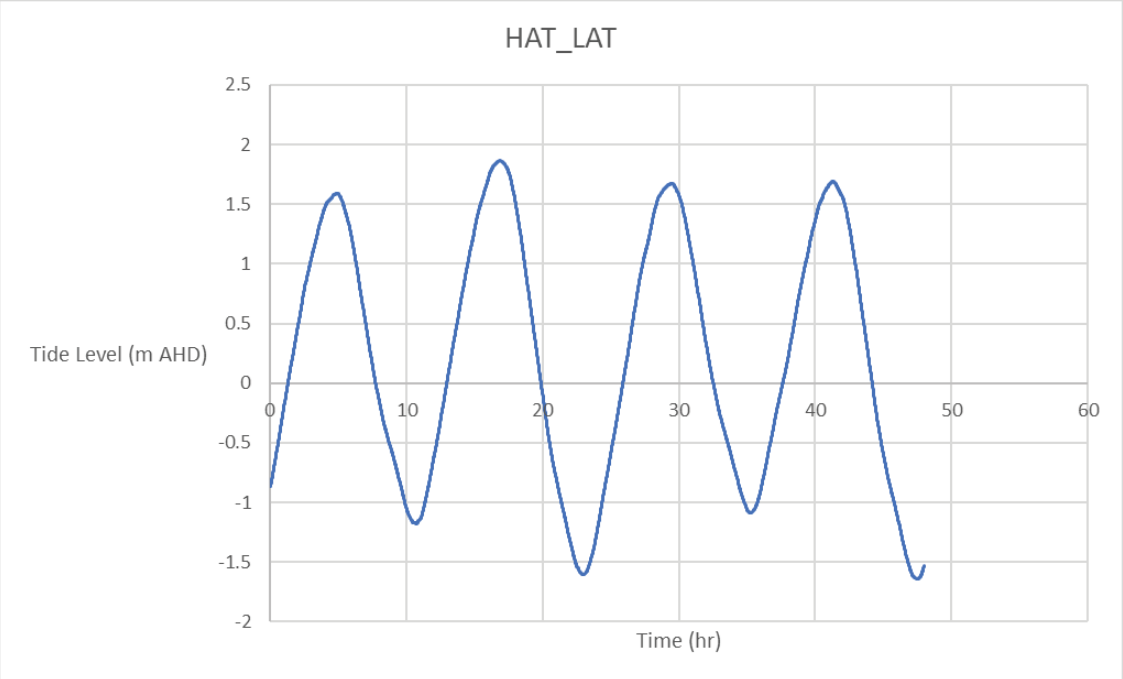

Figure 4-2 HAT – LAT Timeseries

4.3 Developed Case Hydraulic Model Setup

The hydraulic model was adjusted to reflect the proposed developed outlined previously in Figure 2-1. Adjustments to the hydraulic model included:

- Update the digital elevation model to include the proposed breakwaters, boat ramp, carpark and access road
- Addition of 3 x 3.6w x 2.7h RCBC culverts under the access road.

An iterative approach was adopted to determine the optimum culvert size and quantity. An assessment of all the local, regional and tidal events revealed two critical events for culvert sizing, the regional 1% AEP with a 2.1m tailwater, and the HAT-LAT tidal transfer event.

The assessment indicated that if these two events were not considered, the culvert quantity could be reduced to 2 cells rather than 3.

Legend

- Regional Inflow
- Local Model Inflows
- Regional Barron River Inflow
- Tailwater Boundary
- Regional Hydraulic Model Boundary
- Local Hydraulic Model Boundary

Title:

Hydraulic Model Features

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4.4 Hydraulic Model Results

To ensure that the proposed boat ramp facility does not cause an impact to flood levels or tidal transfer, the hydraulic model was used to calculate water levels for both the pre-developed and developed cases for a range of flood and tidal events.

Due to the limitations of modelling accuracy, an increase or decrease in water level more than 10mm is deemed as a change. The afflux plots included in the results appendices use this measure to indicate changes in water level.

4.4.1 Regional Model Results

For the regional catchment assessment, the hydraulic model was used to calculate flood levels, depths and velocities for both the pre-developed and developed case for the 1% AEP design storm event with a tailwater of 1m AHD and 2.1 m AHD.

The resultant regional pre-developed case mapped peak flood levels, depths and velocities for the 1% AEP storm events are presented in Appendix A in the following figures:

- Figure A-1 1% AEP Regional Peak Flood Level TWL2100 – Existing Case
- Figure A-3 1% AEP Regional Peak Flood Level TWL1000 – Existing Case
- Figure A-8 1% AEP Regional Peak Flood Depth TWL1000 – Existing Case
- Figure A-9 1% AEP Regional Peak Flood Depth TWL2100 – Existing Case
- Figure A-14 1% AEP Regional Peak Flood Velocity TWL1000 – Existing Case
- Figure A-15 1% AEP Regional Peak Flood Velocity TWL2100 – Existing Case

The resultant regional post-developed case mapped peak flood levels, depths and velocities for the 1% AEP storm events are presented in Appendix B. in the following figures:

- Figure B-1 1% AEP Regional Peak Flood Level TWL1000 – Developed Case
- Figure B-2 1% AEP Regional Peak Flood Level TWL2100 – Developed Case
- Figure B-7 1% AEP Regional Peak Flood Depth TWL1000 – Developed Case
- Figure B-8 1% AEP Regional Peak Flood Depth TWL2100 – Developed Case
- Figure B-13 1% AEP Regional Peak Flood Velocity TWL1000 – Developed Case
- Figure B-14 1% AEP Regional Peak Flood Velocity TWL2100 – Developed Case

To confirm that the Tuflow model produces comparable results to the Council MIKE model, a comparison of peak water levels for the 1% AEP, 2.1m tailwater condition was made. The peak water level maps for the Tuflow model and the MIKE model are presented in Figure A-1 and Figure A-2 respectively. A comparison of peak water levels, at the comparison point indicated on the maps, is provided in Table 4-3.

Table 4-3 Regional 1% AEP TW2100 Peak Water Level Comparison

Reporting Point	Council Model Peak Water Level (m AHD)	BMT Model Peak Water Level (m AHD)	Difference (m)
Point 1	4.178	4.062	-0.116
Point 2	3.932	3.776	-0.156
Point 3	3.550	3.414	-0.136
Point 4	3.590	3.462	-0.128
Point 5	3.843	3.662	-0.181
Point 6	2.643	2.127	-0.516
Point 7	2.100	2.103	+0.003

From the above table a good correlation exists between the two models. Particularly given that the Tuflow model has more recent LIDAR data and a reduced model grid cell size.

To gauge the effect of the development on regional water levels, afflux maps have been created from the above results. The maps are presented in Appendix C in the following figures:

- Figure C-1 1% AEP Regional Peak Flood Afflux TWL1000
- Figure C-2 1% AEP Regional Peak Flood Afflux TWL2100

The afflux map for the 1% AEP 1.0m AHD tailwater condition indicates a slight reduction in water level on the golf course upstream of the proposed access road and culverts. Additionally, a small area of reduction is seen upstream of the Half Moon Creek mouth. This reduction is most likely due to the increased velocity in the channel mouth due to the improved channel alignment associated with the boat ramp facility breakwaters.

The afflux map for the 2.1m AHD tailwater condition indicates a very small area of 10-20mm increase in water level immediately upstream of the proposed road crossing. Like the 1.0m tailwater event, an area of water level decrease is seen upstream of the creek mouth. For the 2.1m tailwater event this area extends significantly upstream due to the increased water due to the increased tailwater level.

4.4.2 Local Model Results

For the local catchment assessment, the model hydraulic model was used to calculate flood levels, depth and velocities for the 1%, 2%, 5%, and 10% AEP critical design storm events.

The resultant local pre-developed case mapped peak flood levels, depths and velocities are presented in Appendix A in the following figures:

- Figure A-4 1% AEP Local Peak Flood Level MSL – Existing Case
- Figure A-5 2% AEP Local Peak Flood Level MSL – Existing Case
- Figure A-6 5% AEP Local Peak Flood Level MSL – Existing Case
- Figure A-7 10% AEP Local Peak Flood Level MSL – Existing Case
- Figure A-10 1% AEP Local Peak Flood Depth MSL – Existing Case

- Figure A-11 2% AEP Local Peak Flood Depth MSL – Existing Case
- Figure A-12 5% AEP Local Peak Flood Depth MSL – Existing Case
- Figure A-13 10% AEP Local Peak Flood Depth MSL – Existing Case
- Figure A-16 1% AEP Local Peak Flood Velocity MSL – Existing Case
- Figure A-17 2% AEP Local Peak Flood Velocity MSL – Existing Case
- Figure A-18 5% AEP Local Peak Flood Velocity MSL – Existing Case
- Figure A-19 10% AEP Local Peak Flood Velocity MSL – Existing Case

The resultant local developed case mapped peak flood levels, depths and velocities are presented in Appendix A in the following figures:

- Figure B-3 1% AEP Local Peak Flood Level MSL – Developed Case
- Figure B-5 5% AEP Local Peak Flood Level MSL – Developed Case
- Figure B-6 10% AEP Local Peak Flood Level MSL – Developed Case
- Figure B-9 1% AEP Local Peak Flood Depth MSL – Developed Case
- Figure B-10 2% AEP Local Peak Flood Depth MSL – Developed Case
- Figure B-11 5% AEP Local Peak Flood Depth MSL – Developed Case
- Figure B-12 10% AEP Local Peak Flood Depth MSL – Developed Case
- Figure B-15 1% AEP Local Peak Flood Velocity MSL – Developed Case
- Figure B-16 2% AEP Local Peak Flood Velocity MSL – Developed Case
- Figure B-17 5% AEP Local Peak Flood Velocity MSL – Developed Case
- Figure B-18 10% AEP Local Peak Flood Velocity MSL – Developed Case

To gauge the effect of the development on local water levels, afflux maps have been created from the above results. The maps are presented in Appendix C in the following figures:

- Figure C-3 1% AEP Local Peak Flood Afflux MSL
- Figure C-4 2% AEP Local Peak Flood Afflux MSL
- Figure C-5 5% AEP Local Peak Flood Afflux MSL
- Figure C-6 10% AEP Local Peak Flood Afflux MSL

The afflux maps indicate a slight reduction in water level on the golf course for all local design storm events simulated.

4.4.3 Tidal Transfer Results

For the tidal transfer assessment, the model hydraulic model was used to calculate tide levels, and depths for the HAT-LAT and MHWS-MLWS tidal events, for both pre- and post-development scenarios.

The resultant developed case mapped peak tide levels and depths are presented in Appendix D in the following figures:

- Figure D-1 MHWS to MLWS Tidal Peak Level – with Boat Ramp Facility
- Figure D-2 HAT to LAT Tidal Peak Level – with Boat Ramp Facility
- Figure D-3 MHWS to MLWS Tidal Peak Depth – with Boat Ramp Facility
- Figure D-4 HAT to LAT Tidal Peak Depth – with Boat Ramp Facility

To gauge the effect of the development on tidal transfer, afflux maps were created from the above results. The maps are presented in Appendix D in the following figures:

- Figure D-5 MHWS to MLWS Tidal Afflux
- Figure D-6 HAT to LAT Tidal Afflux

The afflux maps indicate no significant change (<10mm) in tidal transfer for both events.

5 Conclusion

It is proposed to develop a boat ramp facility at Yorkeys Knobs in the Cairns Regional Council area. The facility will consist of additional breakwaters, six-lane boat ramp with two floating walkways, and associated reclamation parking area. To provide access to the facility a new road, creek crossing, and intersection is proposed from Buckley Street.

Detailed consideration has been given to the regional and local flooding impacts of the proposed development. The outcome of the investigation can be summarised as follows.

- ***Half Moon Creek Local Catchment Hydrologic Assessment****:* A XP Rafts hydrologic model of the local catchment was established to provide inflow hydrographs to the hydraulic model. The 3498-hectare model extended from the Macalister Range to the mouth of Half Moon Creek.
- ***Local Catchment Hydraulic Assessment****:* A two-dimensional model of the local catchment was established to determine the impacts of the boat ramp facility on local catchment flooding. The model utilised the hydrographs generated from the XP Rafts model for 1%, 2%, 5% and 10% AEP design storm events. Afflux mapping of the proposed development indicated that no significant (greater the 10mm) increase in local flood levels will occur.
- ***Barron River Regional Catchment Hydraulic Assessment****:* Using the hydraulic model established for the local catchment, flows from Council's Barron River Delta Mike Flood model were applied as inflow boundary conditions to determine the potential impacts on regional catchment flooding. Using two tailwater conditions from the Council model (1.0m AHD and 2.1m AHD), the 1% AEP storm event was simulated. A comparison of the calculated existing case water levels with those of the Council model indicated a good correlation. Afflux mapping of the proposed development indicated that the 2.1m tailwater condition 1% AEP event results in a very small area of water level rise between 10-20mm immediately upstream of the proposed road crossing. The 1.0m tailwater condition did not lead to an increase water level.
- ***Tidal Transfer Assessment:*** Dynamic tidal boundary conditions were applied to the hydraulic model to simulate the normal spring and king tidal cycles. Modelling of the pre- and post-development scenarios indicated that the development will not have a significant (greater or less than 10mm water level change) impact on tidal transfer.

The flood modelling results indicate that the design does not cause any significant increase in flood level or change in tidal transfer.

Appendix A Existing Case Hydraulic Model Results

Legend

Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Level TW2100 - Existing Case

Drawing: A-1

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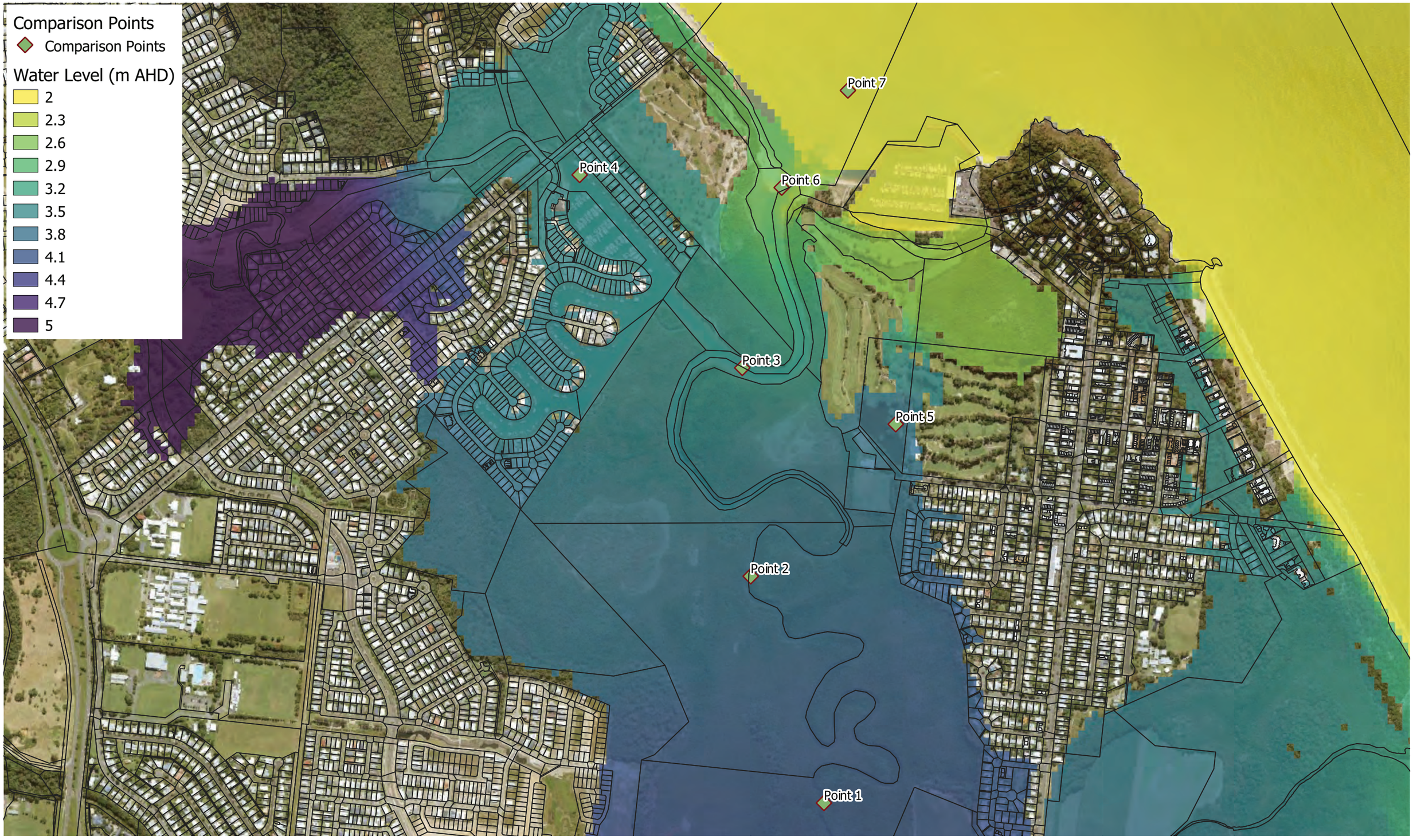

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Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Level TW2100 - Council Mike Model

Drawing: **A-2**

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Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Level TW1000 - Existing Case

Drawing: A-3

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Cadastral Boundaries

Title:

1% AEP Local Peak Flood Level MSL - Existing Case

Drawing: **A-4**

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Cadastral Boundaries

Title:

2% AEP Local Peak Flood Level MSL - Existing Case

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Cadastral Boundaries

Title:

5% AEP Local Peak Flood Level MSL - Existing Case

Drawing: **A-6**

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0 200 400 m

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Water Level (m AHD)
- 0
- 0.35
- 0.7
- 1.05
- 1.4
- 1.75
- 2.1
- 2.45
- 2.8
- 3.15
- 3.5

Legend

Cadastral Boundaries

Title:

10% AEP Local Peak Flood Level MSL - Existing Case

Drawing: A-7

Rev: A

0 200 400 m

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Water Depth (m)
- <= 0.4
- 0.4 - 0.8
- 0.8 - 1.2
- 1.2 - 1.6
- 1.6 - 2
- 2 - 2.4
- 2.4 - 2.8
- 2.8 - 3.2
- 3.2 - 3.6
- 3.6 - 4
- 4 - 4.4
- 4.4 - 4.8
- 4.8 - 5.2
- 5.2 - 5.6
- > 5.6

Legend

Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Depth TW1000 - Existing Case

Drawing: **A-8**

Rev: **A**

0 200 400 m

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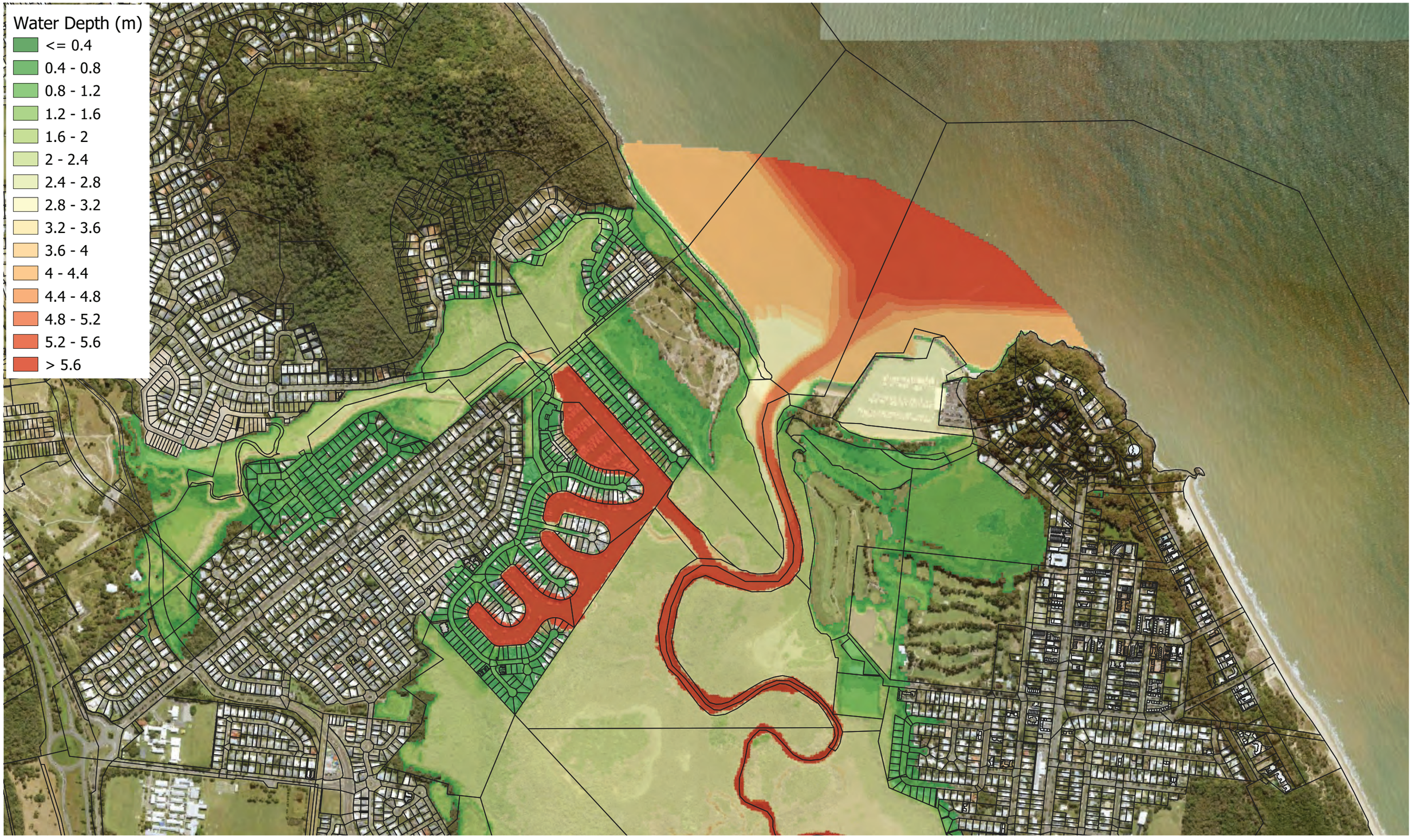

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Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Depth TW2100 - Existing Case

Drawing: **A-9**

Rev: **A**

0 200 400 m

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Cadastral Boundaries

Title:

1% AEP Local Peak Flood Depth MSL - Existing Case

Drawing: **A-10**

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Cadastral Boundaries

Title:

2% AEP Local Peak Flood Depth MSL - Existing Case

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Cadastral Boundaries

Title:

5% AEP Local Peak Flood Depth MSL - Existing Case

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Cadastral Boundaries

Title:

10% AEP Local Peak Flood Depth MSL - Existing Case

Drawing: A-13

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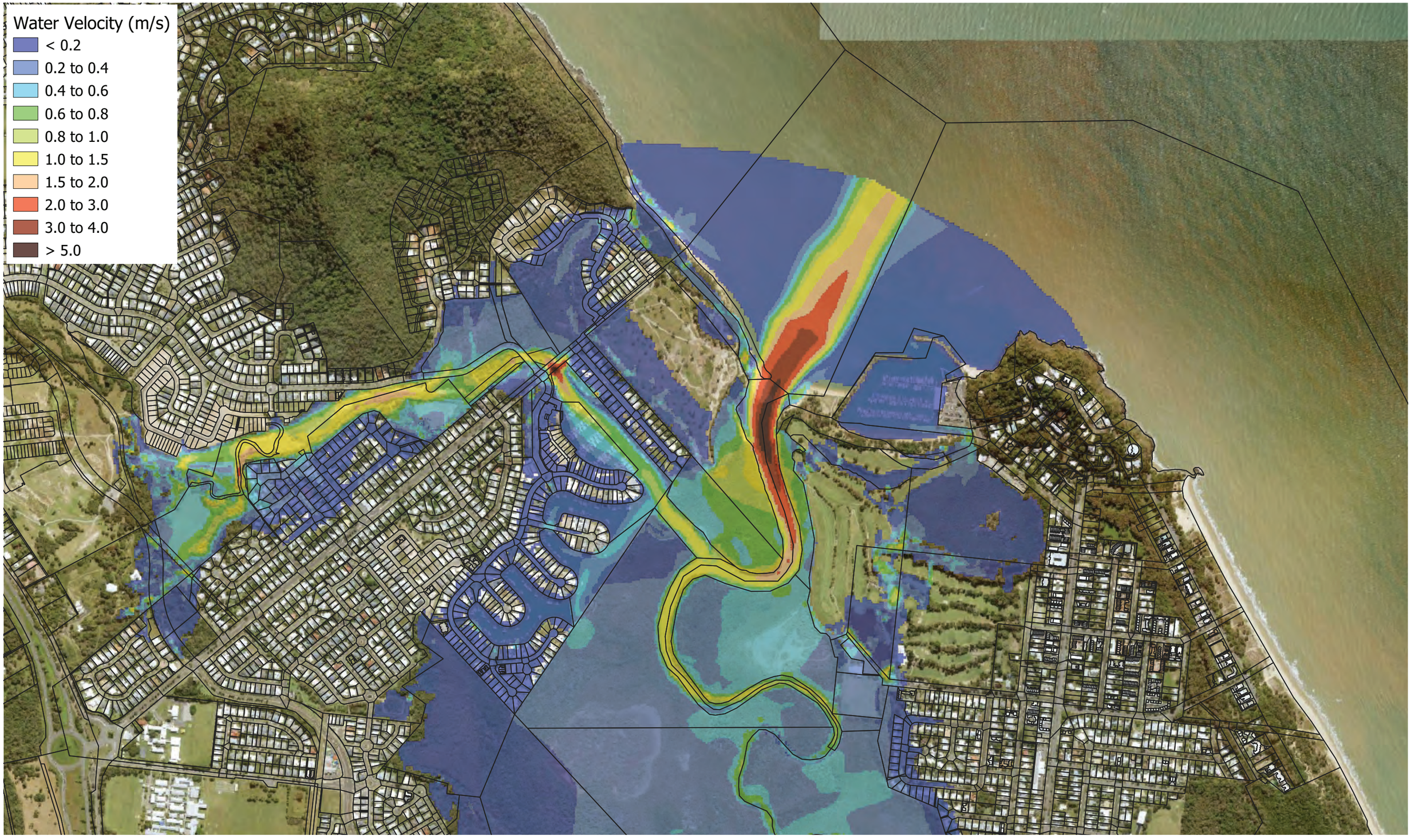

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Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Velocity TW1000 - Existing Case

Drawing: A-14

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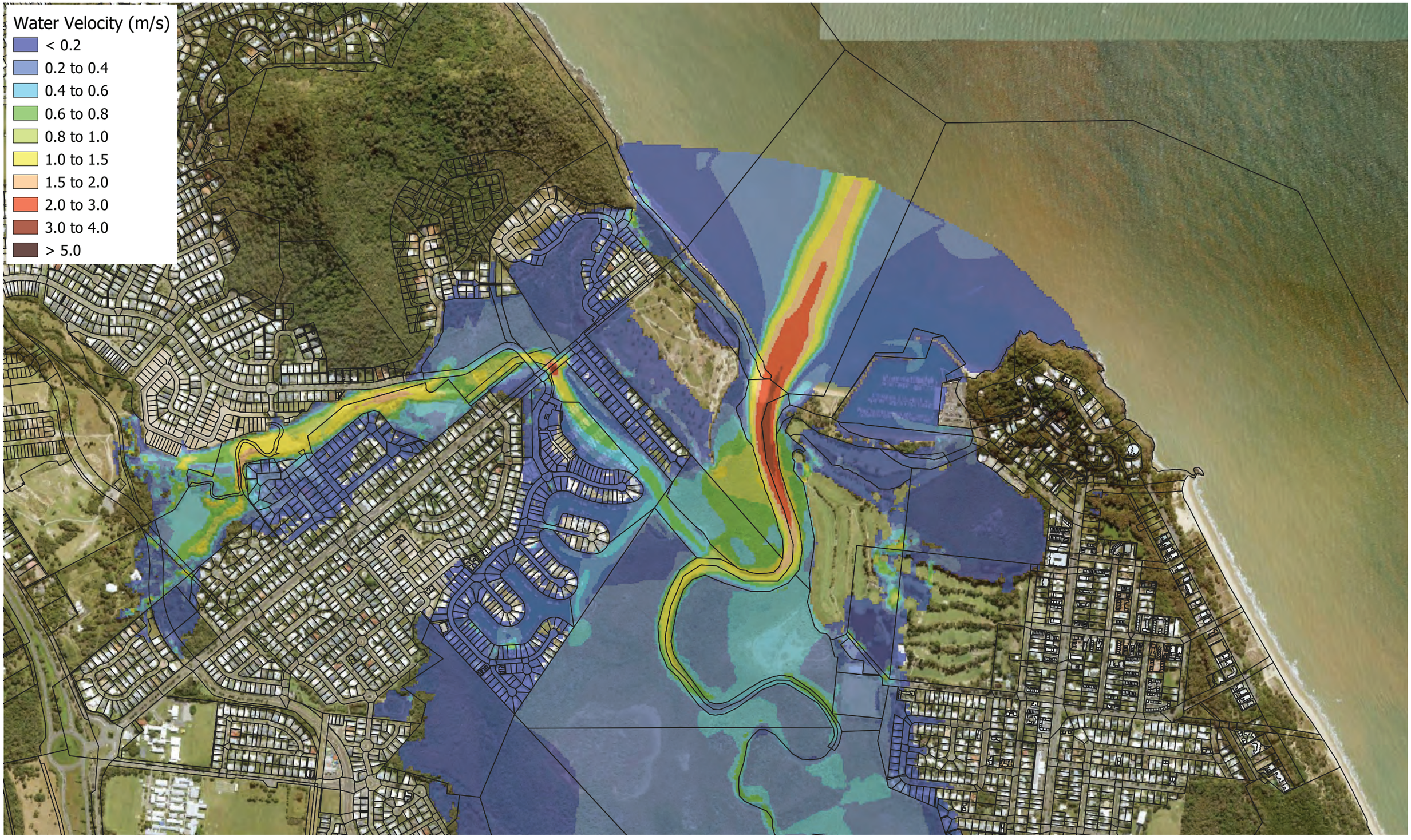

Legend

Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Velocity TW2100 - Existing Case

Drawing: A-15

Rev: A

0 200 400 m

BMT
www.bmt.org

Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Existing_Case_Results_023\Existing_Case_Results.qgz

Legend

Cadastral Boundaries

Title:

1% AEP Local Peak Flood Velocity MSL - Existing Case

Drawing: **A-16**

Rev: **A**

0 200 400 m

BMT
www.bmt.org

Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Existing_Case_Results_023\Existing_Case_Results.qgz

Legend

Cadastral Boundaries

Title:

2% AEP Local Peak Flood Velocity MSL - Existing Case

Drawing: **A-17**

Rev: **A**

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Existing_Case_Results_023\Existing_Case_Results.qgz

Legend

Cadastral Boundaries

Title:

5% AEP Local Peak Flood Velocity MSL - Existing Case

Drawing: **A-18**

Rev: **A**

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Existing_Case_Results_023\Existing_Case_Results.qgz

Legend

Cadastral Boundaries

Title:

10% AEP Local Peak Flood Velocity MSL - Existing Case

Drawing: **A-19**

Rev: **A**

0 200 400 m

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Appendix B Developed Case Hydraulic Model Results

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Level TW1000 - Developed Case

Drawing: B-1

Rev: A

0 200 400 m

BMT
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Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Level TW2100 - Developed Case

Drawing: B-2

Rev: A

0 200 400 m

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Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Local Peak Flood Level MSL - Developed Case

Drawing: **B-3**

Rev: **A**

0 200 400 m

BMT
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Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

2% AEP Local Peak Flood Level MSL - Developed Case

Drawing: **B-4**

Rev: **A**

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Developed_Case_Results_023\Developed_Case_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

5% AEP Local Peak Flood Level MSL - Developed Case

Drawing: **B-5**

Rev: **A**

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Developed_Case_Results_023\Developed_Case_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

10% AEP Local Peak Flood Level MSL - Developed Case

Drawing: **B-6**

Rev: **A**

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Developed_Case_Results_023\Developed_Case_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Depth TW1000 - Developed Case

Drawing: **B-7**

Rev: **A**

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Developed_Case_Results_023\Developed_Case_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Depth TW2100 - Developed Case

Drawing: **B-8**

Rev: **A**

0 200 400 m

BMT
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Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Local Peak Flood Depth MSL - Developed Case

Drawing: **B-9**

Rev: **A**

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Developed_Case_Results_023\Developed_Case_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

2% AEP Local Peak Flood Depth MSL - Developed Case

Drawing: **B-10**

Rev: **A**

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Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

5% AEP Local Peak Flood Depth MSL - Developed Case

Drawing: **B-11**

Rev: **A**

0 200 400 m

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Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

10% AEP Local Peak Flood Depth MSL - Developed Case

Drawing: **B-12**

Rev: **A**

0 200 400 m

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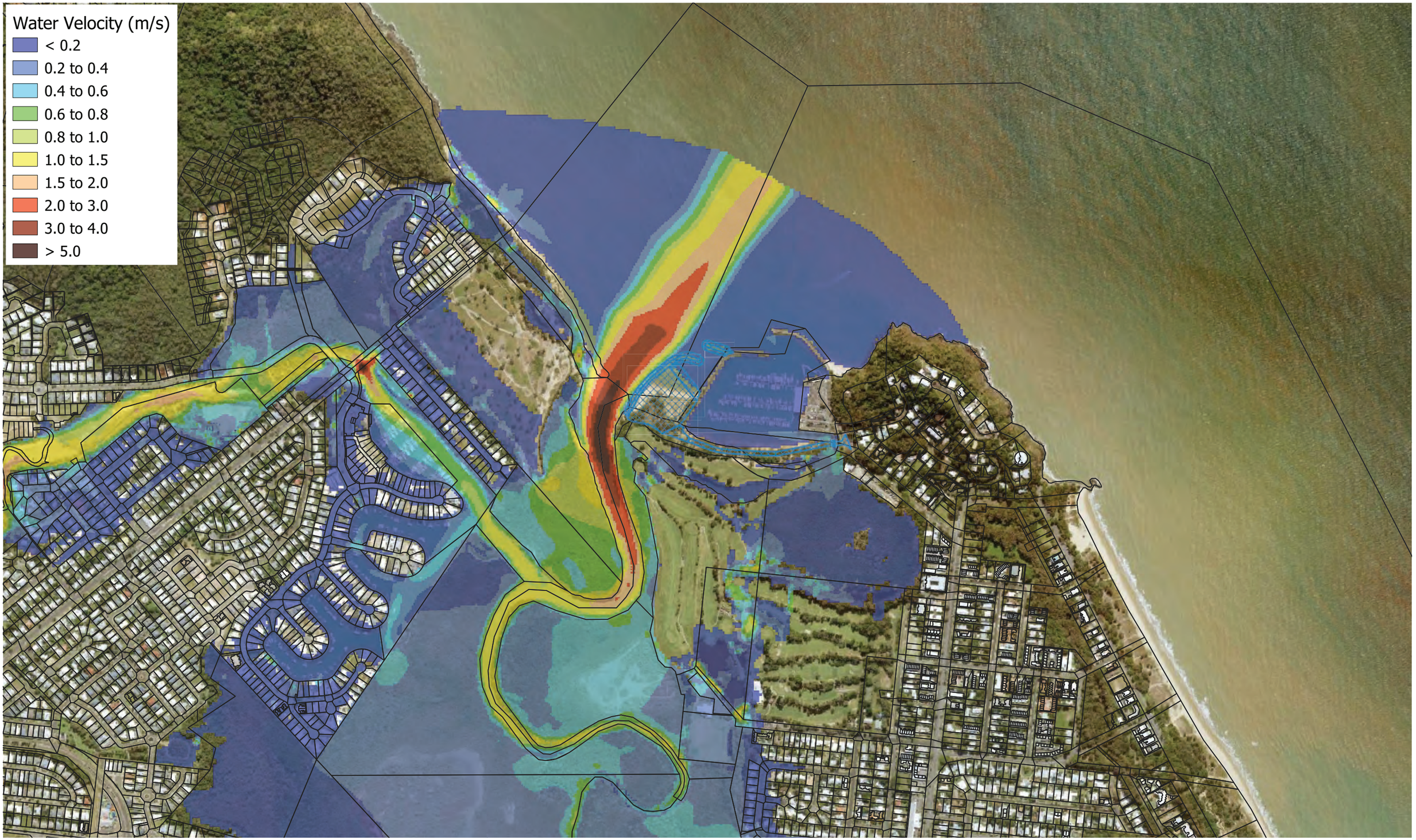

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Velocity TW1000 - Developed Case

Drawing: **B-13**

Rev: **A**

0 200 400 m

BMT
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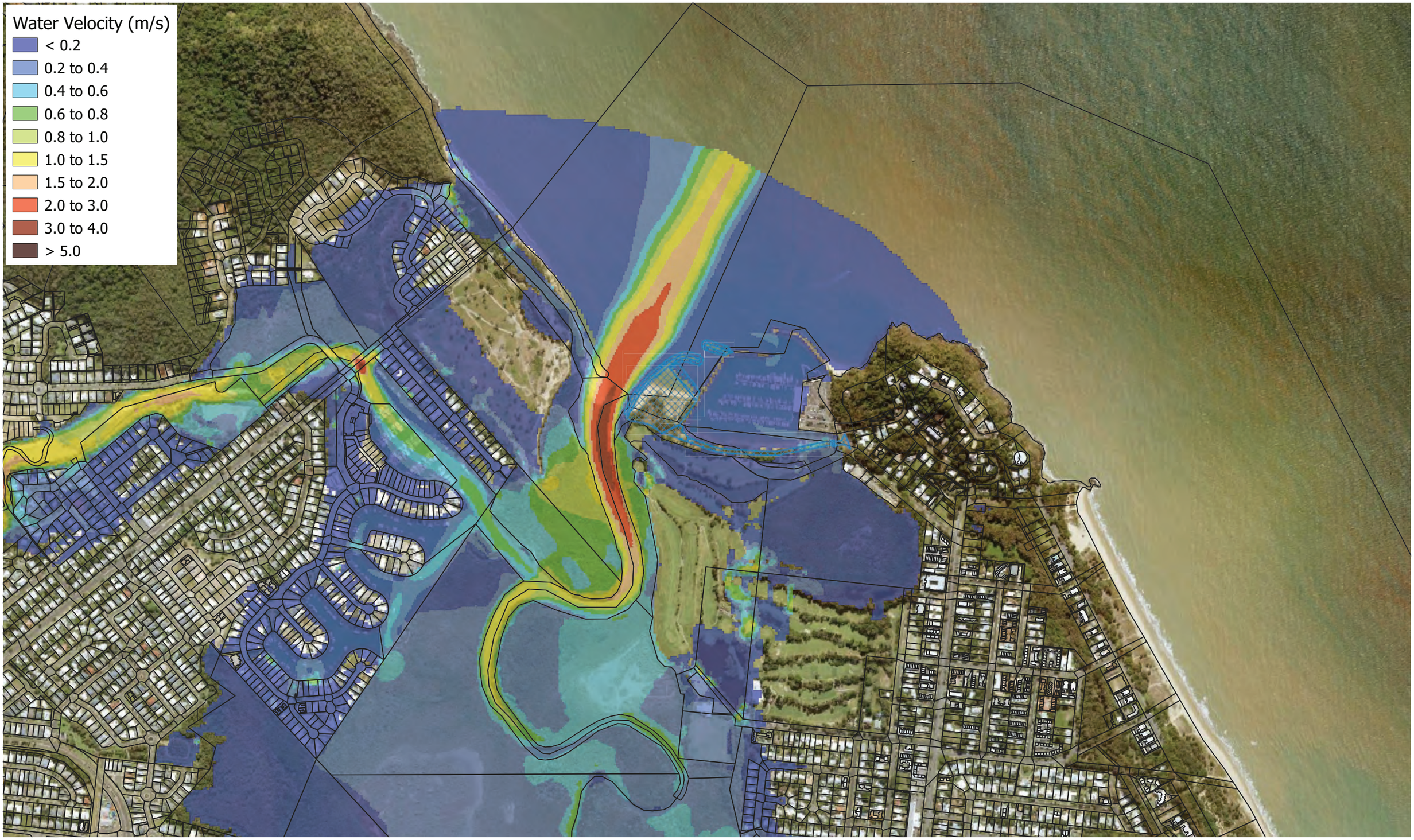

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Velocity TW2100 - Developed Case

Drawing: **B-14**

Rev: **A**

0 200 400 m

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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Developed_Case_Results_023\Developed_Case_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Local Peak Flood Velocity MSL - Developed Case

Drawing: **B-15**

Rev: **A**

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Developed_Case_Results_023\Developed_Case_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

2% AEP Local Peak Flood Velocity MSL - Developed Case

Drawing: **B-16**

Rev: **A**

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Developed_Case_Results_023\Developed_Case_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

5% AEP Local Peak Flood Velocity MSL - Developed Case

Drawing: B-17

Rev: A

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Developed_Case_Results_023\Developed_Case_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

10% AEP Local Peak Flood Velocity MSL - Developed Case

Drawing: **B-18**

Rev: **A**

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Developed_Case_Results_023\Developed_Case_Results.qgz

Appendix C Flood Afflux Results

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Afflux TWL1000

Drawing: C-1

Rev: A

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Afflux_Results_023\Afflux_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Regional Peak Flood Afflux TWL2100

Drawing: C-2

Rev: A

0 200 400 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Afflux_Results_023\Afflux_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

1% AEP Local Peak Flood Afflux MSL

Drawing: C-3

Rev: A

0 200 400 m

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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Afflux_Results_023\Afflux_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title: 2% AEP Local Peak Flood Afflux MSL

Drawing: C-4

Rev: A

0 200 400 m

BMT
www.bmt.org

Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Afflux_Results_023\Afflux_Results.qgz

Change in Innundation Extent
Was Wet Now Dry
Was Dry Now Wet
Water Level Afflux (mm)
<= -10
-10 to 10
10 to 20
20 to 50
50 to 100
100 to 200
>200

Legend

Boat Ramp Facility
Cadastral Boundaries

Title:
5% AEP Local Peak Flood Afflux MSL

Drawing: C-5
Rev: A

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0 200 400 m

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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Afflux_Results_023\Afflux_Results.qgz

Legend

- Boat Ramp Facility
- Cadastral Boundaries

Title:

10% AEP Local Peak Flood Afflux MSL

Drawing: C-6

Rev: A

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0 200 400 m

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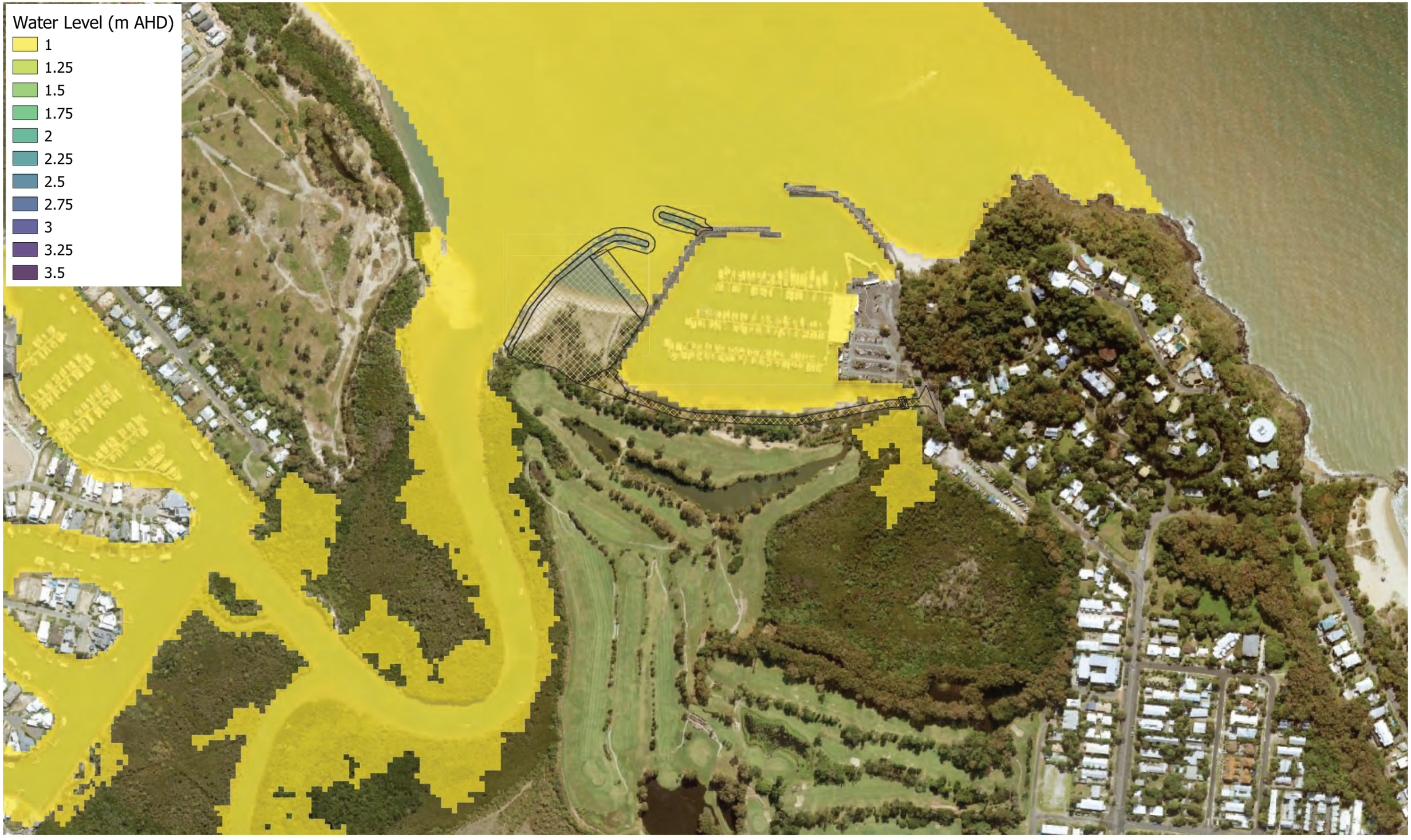
Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Afflux_Results_023\Afflux_Results.qgz

Appendix D Tidal Results



Legend

Boat Ramp Facility

Title:

MHWS TO MLWS Tidal Peak Level - with Boat Ramp Facility

Drawing: D-1

Rev: A

0 100 200 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Tidal_Results_023\Tidal_Results.qgz

Legend

Boat Ramp Facility

Title:

HAT TO LAT Tidal Peak Level - with Boat Ramp Facility

Drawing: D-2

Rev: A

0 100 200 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Tidal_Results_023\Tidal_Results.qgz

Legend

Boat Ramp Facility

Title:

MHWS TO MLWS Tidal Peak Depth - with Boat Ramp Facility

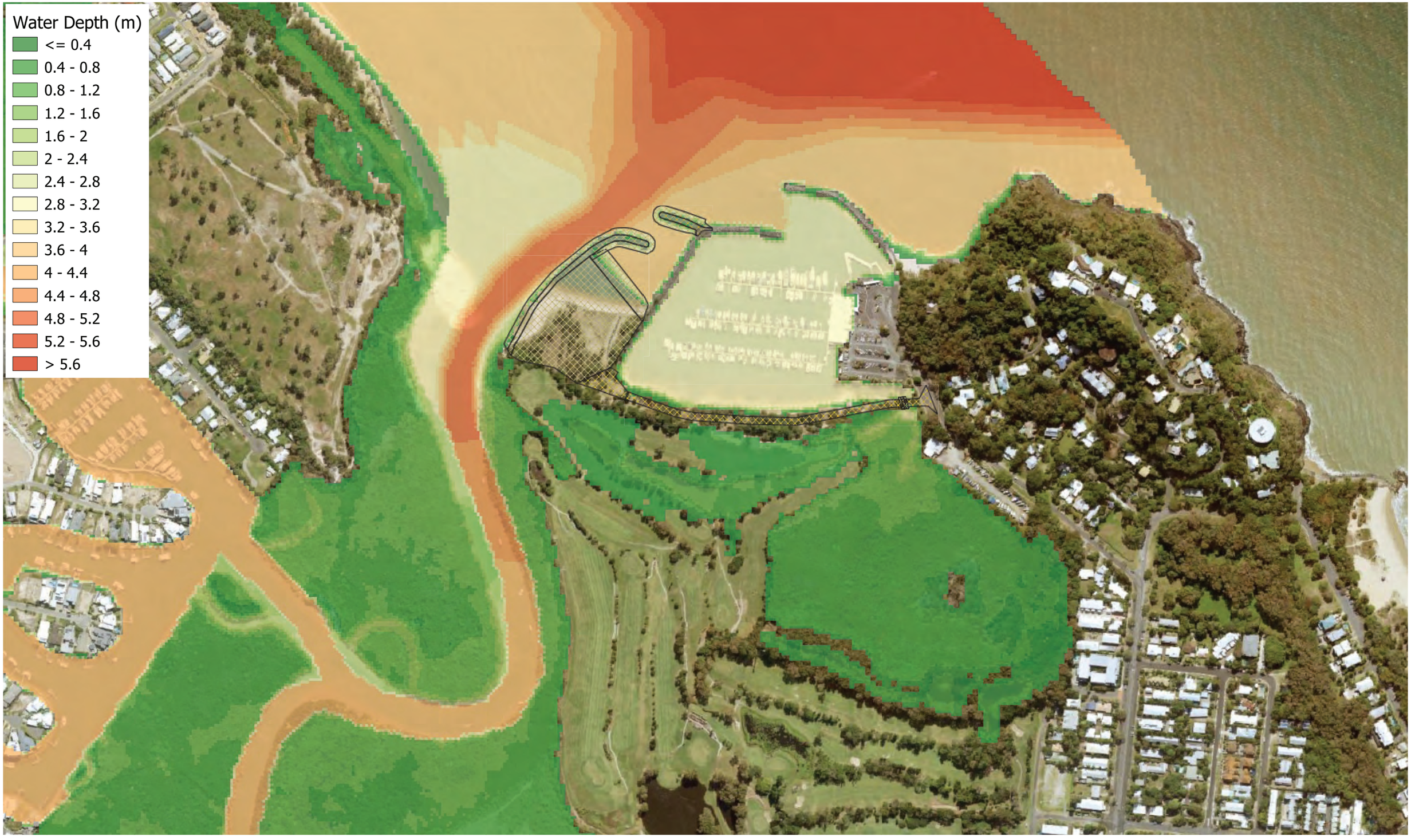
Drawing: **D-3**

Rev: **A**

0 100 200 m

BMT
www.bmt.org

Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Tidal_Results_023\Tidal_Results.qgz



Legend

Boat Ramp Facility

Title:

HAT TO LAT Tidal Peak Depth - with Boat Ramp Facility

Drawing: D-4

Rev: A

0 100 200 m

BMT
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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Tidal_Results_023\Tidal_Results.qgz

Legend

Boat Ramp Facility

Title:

HAT TO LAT Tidal Afflux

Drawing: D-5

Rev: A

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0 100 200 m

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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Tidal_Results_023\Tidal_Results.qgz

Legend

Boat Ramp Facility

Title:

MHWS TO MLWS Tidal Afflux

Drawing: D-6

Rev: A

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0 100 200 m

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Filepath: I:\B23406_I_mpb_TMR_Yorkeys&Newell\QGIS\Figure_Generator_200115\Tidal_Results_023\Tidal_Results.qgz

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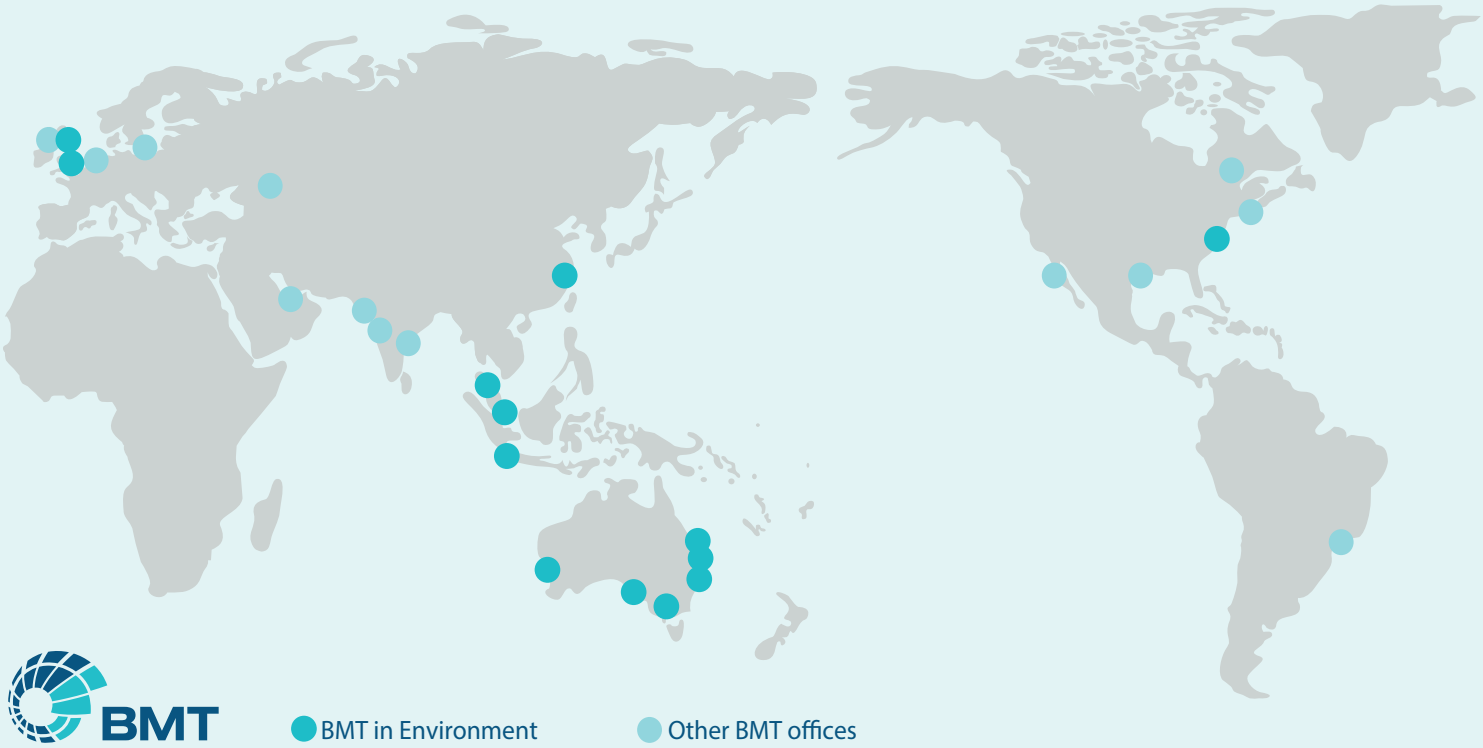

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