Department of Transport

Port Hedland Spoilbank Marina Proposal

Referral Supplementary Information

Table

Version No.	Date	Prepared by	Issued to
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1. EXECUTIVE SUMMARY

1.1 Introduction

The purpose of the Referral Supplementary Information (RSI) is to support the referral of a proposal by the Department of Transport (DoT) to construct and operate the Port Hedland Spoilbank Marina Proposal (the Proposal), including marine and land-based components.

1.2 Assessment process

The *Environmental Protection Act 1986* (EP Act) is the primary legislative instrument for environmental assessment in Western Australia (WA). It specifies procedures for assessment and appeal processes, including responsibilities and functions of the WA Minister for the Environment and the Environmental Protection Authority (EPA). Under Part IV of the EP Act, the EPA is responsible for providing advice to the Minister for significant proposals assessed under Part IV of the EP Act.

The EPA lists several environmental factors that need to be considered in the Environmental Impact Assessment (EIA) process. DoT is of the view that the key environmental factors relevant for this Proposal include:

- Marine Fauna
- Marine Environmental Quality
- Benthic Communities and Habitats
- Air Quality.

Other environmental factors considered in the assessment process include:

- Coastal Processes.

1.3 Background and context

In June 2013, Amendment 56 to the Town of Port Hedland Town Planning Scheme 5 was referred to the EPA under section 48A of the EP Act. Amendment 56 sought to rezone land on the Spoilbank land formation, north of Sutherland Street, from 'Parks and Recreation' to 'Marina Development'. Amendment 56 proposed to facilitate the development of a public marina complex, with associated tourist, commercial and permanent residential developments.

The EPA determined on 19 February 2014 that Amendment 56 was, by its nature, incapable of being made environmentally acceptable due to potential health impacts from particulate matter (dust) exposure at the site. At the time, the EPA identified a number of other issues that may be relevant to development on the site, including noise, acid sulphate soils, coastal processes, marine water quality, stormwater management, drainage, threatened fauna and potential light spill onto a nearby turtle rookery.

The EPA's previous determination regarding the environmental acceptability of the development at the site has been acknowledged and the Proposal has subsequently been revised to include a reduced scope, which does not include residential development. DoT has been tasked with constructing and operating the Proposal, the subject of this referral submission.

1.4 Commonwealth determination

DoT referred the Proposal to the Commonwealth's Department of Environment and Energy (DoEE) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC

Act) on 22 August 2019. The Proposal was determined to be a 'Controlled Action' by a Delegate of the Commonwealth Minister for the EPBC Act on 21 January 2020 as it will, or is likely to have, a significant impact on the following Matters of National Environmental Significance (MNES):

- Listed threatened species and communities (section 18 and 18A)
- Listed migratory species (sections 20 & 20A).

To ensure further delays in the assessment process are minimised and that stringent State Government election commitment timeframes are met, DoT will be seeking an accredited assessment should a formal assessment be determined under Part IV of the EP Act.

1.5 Overview of proposal

The Proposal's key characteristics are outlined in Table ES-1. The Proposal's summary of the environmental review is provided in Table ES-2.

Table ES-1: Key proposal characteristics

Title	Port Hedland Spoilbank Marina Proposal
Proponent name	Department of Transport
Short description	The Proposal is for constructing and operating the Port Hedland Spoilbank Marina, located within the Town of Port Hedland, Pilbara. The Proposal includes: • dry-land excavation of the marina basin (maximum depth to -2m chart datum (-5.9m AHD)) • capital dredging works resulting in up to 900,000 cubic metres (m^3) of dredge spoil and dredged to a maximum depth of -2m chart datum (-5.9m AHD) • sand trap • construction of breakwaters and revetment walls • disposal of capital dredge spoil on land as fill material to raise the finished ground level prior to landscaping, with excess material disposed offsite. The Proposal also includes the ongoing management and maintenance of the marina water body and infrastructure.

Element	Location	Proposed Extent
Physical Marine Element		
Marina basin and entrance channel	Figure ES1	Ground disturbance and clearing of up to 12 ha
Breakwater and revetment wall	Figure ES1	Ground disturbance and clearing of up to 6 ha
Sand trap	Figure ES1	Ground disturbance and clearing of up to 8.5 ha
Physical Terrestrial Element		
Parking and trailer bays	Figure ES1	Ground disturbance and clearing of up to 5 ha
Public open space	Figure ES1	Ground disturbance and clearing of up to 5 ha
Road infrastructure	Figure ES1	Ground disturbance and clearing of up to 3 ha

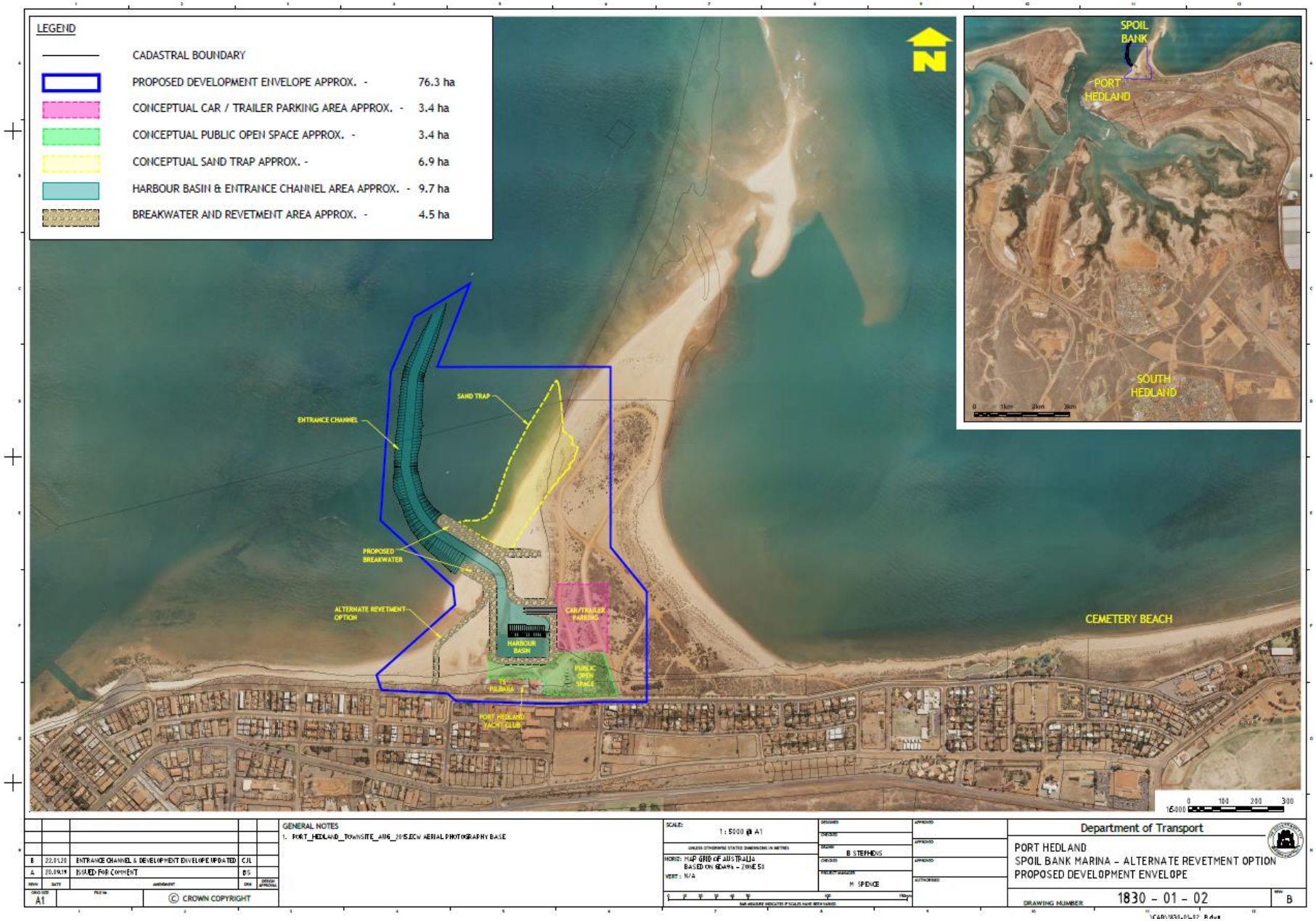

Figure ES1: Port Hedland Spoilbank Marina Proposal Development Envelope

Table ES-2: Summary of the environmental review

Factor	Marine Fauna
EPA objective	*To ensure the biological diversity and ecological integrity are maintained.*
Supporting studies and plans	DoT's environmental consultants undertook survey work within the development envelope and surrounding environment to support the Referral documentation, including: • Care for Hedland Environmental Association – Community Volunteer Turtle Monitoring Program (1 October 2019 to 31 March 2020) • Port Hedland Spoilbank Marina – Artificial Lighting Impact Assessment Report (RPS *et al*, 2020) (Appendix E) • Technical Memo – Spoilbank Marina Proposal: Review of Potential Impacts to Green Sawfish (Morgan *et al*, 2019) (Appendix I) • Technical Memo – Assessment of potential Impacts upon Migratory Waterbirds (Bamford, 2019) (Appendix J) • Technical Memo – Spoilbank Marina Proposal: Review of Potential Impacts to Flatback Turtles (PENV, 2019) • Technical Report – Spoilbank Marine Sawfish Risk Assessment Workshop Report (Teal *et al*, 2020a) (Appendix L) • Underwater Noise Modelling Report (Talis, 2020). (Appendix K) DevelopmentWA's (formally LandCorp) environmental studies for the original Spoilbank Marina Proposal as proposed in 2011, undertaken by RPS between 2011 and 2015 include: • Environmental Constraints Summary Report (RPS, 2011) • Marine Fauna Review (RPS, 2014a) • Waterbird Technical Review (RPS, 2014b) Consideration for BHP Billiton Iron Ore's environmental studies for the BHP Outer Harbour Development, located approximately 5 km west from the Spoilbank Marina project area, including: • Port Hedland Migratory Shorebird Survey Report and Impact Assessment (Bennelongia, 2011) • Marine Turtle Usage Within the Port Hedland Region and Impacts Assessment (PENV, 2009) • Marine Turtle Towed Video Surveys 2009-10 (BHP, 2009a) • Marine Mammal Management Plan (BHP, 2009b) • Flatback Turtle Tagging Program at Cemetery Beach 2009/2010 (PENV, 2010).
Receiving environment	The Port Hedland area is known to support a number of conservation significant marine fauna species, including marine reptiles, cetaceans, fish species and migratory shorebirds. Cemetery Beach, located approximately 2 km east of the development envelope, has been identified as a biologically important area for inter-nesting flatback turtles (*Natator depressus*). It is understood that Cemetery Beach supports a mid-sized community (approx. 200 – 500 individuals) that nest on the beach between late November and March, with key hatchling periods between January to March (PENV, 2020). The EPBC Act Protected Matters Search Tool (PMST) report (5 km buffer radius) identified a number of threatened and migratory marine fauna species that may frequent the area, including the blue whale, southern right whale, humpback whale, great white shark, whale shark, as well as dwarf, narrow and green sawfish. Green turtles have also been observed within the Port Hedland Harbour and surrounding mangrove creeks (PENV, 2009). Although juvenile and adult turtles utilise habitat within the Port Hedland area for foraging and breeding, regionally significant foraging sites are known to occur beyond the Port Hedland Inner Harbour (RPS *et al*, 2020).

	The green sawfish has been historically recorded in inshore marine waters and inhabits muddy bottom habitats and estuaries (Thorburn *et al,* 2007). The green sawfish is the most commonly distributed species of sawfish in Western Australian waters, occurring in areas with a muddy substrate and frequently found in shallow water. It commonly inhabits marine inshore waters, estuaries and lagoons. Most sawfish move into marine waters during or after the wet season and re-enter estuarine or fresher waters to breed (Morgan *et al,* 2011*)*. A large number of seabird and shorebird species (or species habitat) may occur within the vicinity of the proposed action; this includes species classified as threatened and migratory under the EPBC Act or specially protected under the WA *Biodiversity Conservation Act 2016*.
Potential impacts	**Direct impacts:** • Construction and operational light pollution impacts on flatback turtle community on Cemetery Beach. • Direct disturbance of benthic subtidal and intertidal communities and marine habitats due to construction activities, such as dredging and excavation works. • Potential impacts to marine fauna associated with vessel movements, including vessel strike and dredging equipment entrainment. **Indirect impacts:** • Impacts of dredging on marine fauna via habitat removal, water quality changes and underwater noise. • Localised reduction in marine water quality adjacent to the DMMA. • Introduction of marine pests as a result of marina vessel movements.
Mitigation	**Measures to avoid:** • The Proposal's dredging schedule will be designed to avoid critical nesting/hatchling periods for flatback turtles and migratory waterbird species (i.e. no dredging during the months December through March). • Dredging activities will occur within specified areas and only during daylight hours (i.e. 6am – 6pm) to avoid interacting with nocturnal sawfish species, as well as provide adequate visibility for the Marine Fauna Observers (MFOs) to monitor for marine fauna species. • Restricting construction activities to the western side of the Spoilbank land formation (away from biologically important nesting beaches at Cemetery Beach). **Measures to minimise:** • Best management practices for dredging operations will be implemented, including fitting the dredge equipment with turtle exclusion devices and turtle disturbance devices (such as chains). • Enforcing speed controls within the project area and the engagement of Marine Fauna Observers (MFOs) during construction to enforce shut-down and soft-start procedures (based on the below). • Noise management protocols to avoid permanent threshold shift (PTS) and temporary threshold shift (TTS) in marine fauna and minimise adverse behavioural responses. The protocols will be based on underwater acoustic modelling of noise generating activities that will inform an area (radius) around these activities to prevent PTS/TTS. The Construction Environmental Management Plan's (CEMP) Marine Fauna Monitoring Program commits the contractor and MFO to implement monitoring and management procedures and protocols during piling and dredging activities. • Pendoley Environmental has prepared the Proposal's Artificial Lighting Impact Assessment Report that guides the development of the Proposal's

	lighting design, which is developed in accordance with the *Environmental Assessment Guideline for Protecting Marine Turtles from Light Impacts (EPA, 2010), and Commonwealth's National Light Pollution Guidelines for Wildlife - including Marine Turtles, Seabirds and Migratory Shorebirds* (currently still in draft). Key management measures are detailed in Table 4 (pg. 35) of the Report and incorporated in the Proposal's preliminary lighting design (Appendix A), including: ○ Bollard lighting within the marina will either be shielded by the existing topography or the future breakwaters / internal revetment walls and will not be directly visible to turtles from the Cemetery Beach nesting area ○ Minimise pole mounted lights required to safely light the main access road and parking and when unavoidable, use low intensity amber LED lights. ○ Using lighting controls and / or motion sensors during turtle hatching (early December to mid-February) to keep areas dark when not in use and only providing light when active use of an area is required. ○ To further reduce the potential for increased hatchling disorientation: ▪ Shielding should be installed on the east facing side (i.e. side facing towards the Cemetery Beach nesting area) of the pole mounted lights along the main access road to assist in reducing the line of sight visibility of these lights to hatchlings within the Cemetery Beach nesting area ▪ As part of the preparation of the artificial light management plan, consideration should be provided to switching off the pole-mounted lighting during turtle hatching (early December to mid-February) when use is not required. Alternatively, a curfew time could be implemented for marina operations with the pole mounted lights being switched off from a particular time during turtle hatching ▪ As part of the preparation of the artificial light management plan, consideration should be provided to shielding on the eastern facing side of the pole mounted lights located within the parking and hardstand areas to the extent that compliance with AS/NZS 1158.3.1:2018 is not unreasonably compromised. • Implementing the Proposal's Environmental Quality Management Framework (EQMF) to ensure ongoing water quality in the marina is managed to meet environmental objectives and criteria for Ecosystem Health. • Protocols for invasive marine pest monitoring and management are provided for in the CEMP.
Predicted outcome	**<u>Flatback and Green Turtles</u>** DoT engaged Pendoley Environmental (PENV) in August 2019, as subject matter experts, to provide preliminary impact predictions and management recommendations regarding the Proposal's potential to significantly impact the flatback turtle population at Port Hedland (PENV, 2019). PENV concluded that the primary sources of potential significant impact to the flatback turtle population would be from dredging activities during construction (impact to reproductively active adult flatback turtles), and artificial light during operations (impacts to hatchling flatback turtles). It was PENV's view that through the implementation of adequate management measures, these significant impacts could be removed entirely, or minimised as much as possible to an acceptable level (PENV, 2019). Pendoley further concluded that through the implementation of the best practice lighting design principles, identified in the draft Light Pollution Guidelines (DoEE, 2019), and EAG 5 (EPA, 2010) key principles for lighting management, the lighting design for the proposed marina development will meet legislative and regulatory requirements for human safety whilst maintaining the biological diversity and ecological integrity of flatback turtles (RPS *et al,* 2020). The

	Artificial Light Spill Impact Assessment Report informs and commits the Proposal to implement adequate management measures. **Sawfish (including green, dwarf and narrow sawfish)** Predicted outcomes from DoT's Sawfish Risk Assessment Worksop concluded that risks to all three sawfish species, with considered management and monitoring mitigations introduced to reduce either the likelihood or the consequence of that risk, is unlikely to have a significant impact on protected sawfish at a species or population level, or significantly impact habitats critical to the survival of these species, or fragment / impede upon the migration of individual sawfish (Teal *et al*, 2020a). **Migratory shorebirds** Bamford concluded that the Spoilbank is not considered an important habitat or critical to the survival of any waterbird species in the Port Hedland area, but it may help support current numbers in the area (Bamford, 2019). Furthermore, Bamford noted that the proposed marina will only directly impact a small area used for roosting by small numbers of waterbirds, including listed Migratory species. It was stated that disturbance rather than habitat loss has been identified as a major concern for waterbirds in the Port Hedland area, and the marina proposal may provide the opportunity for the reduction of disturbance. Management of human access, such as restricting access to parts of the Spoilbank, would likely result in increased numbers of waterbirds using the site (Bamford, 2019). **Predicted outcomes** Noting the limited area of impact to benthic habitat (approximately 10 ha), temporary period for construction (~ 24 months) and current levels of disturbance in the Port waters, as well as the proposed management measures, including avoiding undertaking dredging activities during key nesting periods, employing marine fauna observers and no dredging at night-time, the potential impacts can be managed to acceptable levels. The Proposal is therefore unlikely to result in permanent or irreversible impacts to conservation significant marine fauna at a species or population level, and is unlikely to cause a population decline, impact critical ecological functions and breeding cycles, or remove habitat critical to the survival of marine fauna. DoT is of the view that the EPA's environmental objectives can be met for this Factor. Furthermore, noise modelling for piling and dredging activities indicated that noise contours will not extend east of the Spoilbank headland, removing a potential impact pathway on turtles nesting at Cemetery Beach (Talis, 2020).
Factor	**Marine Environmental Quality**
EPA objective	*To maintain the water, sediment and biota quality so environmental values are protected.*
Supporting studies and plans	DoT's environmental consultants undertook survey work within the development envelope and surrounding environment to support the Referral documentation, including: • Sediment Sampling and Analysis Plan Implementation Report (Teal *et al*, 2019a) (Appendix N) • Marine Environmental Quality Plan (Teal *et al*, 2020b) (Appendix F) • Water Quality Modelling Report (Baird, 2020a). (Appendix O) DevelopmentWA's (formally LandCorp) environmental studies for the original Spoilbank Marina Proposal as proposed in 2011, undertaken by RPS between 2011 and 2015: • Geotechnical Studies (Golder, 2009) • Preliminary Site Investigation (RPS, 2011) • Detailed Site Investigation (RPS, 2011) • Sampling and Analysis Plan for a Contaminated Site Investigation (RPS, 2013) • Water Quality Report (RPS, 2014c)

	• Final Groundwater Monitoring Report (RPS, 2015).
Receiving environment	DoT's consultants undertook sediment sampling and analysis within the Proposal's development envelopment in October 2019. Sediment analysis indicated that all analytes were below the available ANZG (2018) guideline values, NEPM (2013) Health Investigation Levels (HILS) and NAGD (2009) Screening Levels. At six locations, aluminium and iron exceeded locally derived background levels, however these exceedances were determined to be natural occurrences (Teal *et al*, 2019a). All samples were screened for acid sulphate soils and selected samples were subject to chromium suite acid sulphate analysis. The chromium reducible sulphur concentration of three samples (C02, B12-2 and S29-B2) were above the action criteria of 0.03% sulphur. However, consideration of the acid neutralising capacity presented a positive net acidity, which indicated sufficient in-situ buffering capacity for any acid generated during handling. The analysis concluded that sediments were considered suitable for onshore disposal (Teal *et al,* 2019a). RPS undertook a 12-month groundwater monitoring program of the study area in 2015. The program consisted of salinity profiling to determine the presence and location of the saline interface, groundwater quality monitoring and an assessment of groundwater-tidal interactions. The study identified groundwater flowed in a northerly direction and discharged into the ocean at the coast. However, due to the presence of the Spoilbank, a minor north to south aligned groundwater mound developed, acting as a groundwater divide between the east and west boundaries of the site, directing flows towards both sides of the Spoilbank (RPS, 2014c). Groundwater quality investigations recorded exceedances in total iron and dissolved cadmium, copper, nickel and zinc. These recordings were similar throughout the entire monitoring period, with no spatial or temporal trend. RPS concluded that metal concentrations in groundwater can be considered reflective of natural conditions in the aquifer given the consistent concentrations across the site's hydraulic gradient, and the fact that no contamination sources were identified (RPS, 2014c).
Potential impacts	**Direct impacts:** • Disturbance of contaminants in sediments during dredging and tailwater discharge, which has the potential to deteriorate water quality and contaminate marine organisms. • Changes to the physico-chemical properties affecting water quality as a result of dredging and tailwater discharge. • Potential hydrocarbon release into the marine environment from vessel spills and bunkering operations. **Indirect impacts:** • Temporary and localised decline in water quality (i.e. increased total suspended solids, reduced benthic light availability) during dredging works. • Deterioration of water quality within the marina basin during ongoing operations within the marina basin.
Mitigation	**Measures to minimise** • DoT's consultants have developed the Proposal's Marine Environmental Quality Plan (MEQP). The MEQP includes a tiered monitoring and management approach, including quarterly water and sediment quality sampling regime in the marina and surrounding environment. • The MEQP presents a robust Environmental Quality Management Framework (EQMF) for the marina, and adjacent waters, that align with the Port of Port Hedland's proposed EQMF. The EQMF will spatially allocate environmental values, environmental quality objectives and levels of

	ecological protection that are consistent with State Guidelines and Technical Guidance documentation, which has been developed in consultation with State regulatory and environmental agencies. • The EQMF will aim to protect a range of environmental values in the area, including ecosystem integrity, seafood safe for human consumption, aesthetic values and recreation (primary and secondary contact).
Predicted outcome	DoT notes that the sediment analysis has indicated the sediment is clean and suitable for on-shore and off-shore disposal. DoT is of the view that the tiered monitoring and management approach presented in the Proposal's DEMP and MEQP will maintain the established environmental values in Port waters adjacent to the development envelope by maintaining ecosystem integrity and levels of ecological protection in the development envelope and surrounding environment. The Proposal is likely to meet the Environmental Quality Objectives s set out by the EQMF and is unlikely to compromise the environmental values of the Port Hedland Harbour marine environment.
Factor	**Benthic Communities and Habitat**
EPA objective	*To protect benthic communities and habitat so that biological diversity and ecological integrity are maintained.*
Supporting studies and plans	DoT's environmental consultants undertook survey work within the development envelope and surrounding environment to support the Referral documentation, including: • Dredge Environmental Management Plan (Teal *et al,* 2020c) (Appendix C) • Benthic Communities & Habitat Report (Teal *et al*, 2019b) (Appendix P) • Cumulative Loss Assessment Report (Teal *et al*, 2020d) (Appendix Q) DevelopmentWA's (formally LandCorp) environmental studies for the original Spoilbank Marina Proposal as proposed in 2011, undertaken by RPS between 2011 and 2015: • Intertidal and Subtidal Benthic Habitat Mapping (RPS, 2013) • Water Quality Report (RPS, 2014c) Consideration for BHP Billiton Iron Ore's environmental studies for the BHP Outer Harbour Development, located approximately 5 km west from the Spoilbank Marina project area, which included the near shore marine environment of the proposed action, including: • Intertidal Benthic Primary Producer Habitat Summary (BHP, 2009c) • Baseline Coral Health Monitoring Report Periods 1-13 (BHP, 2009d) • Subtidal Marine Benthic Habitats Impact Assessment (BHP, 2011)
Receiving environment	RPS undertook benthic habitat mapping of the foreshore, inter-tidal and sub-tidal area adjacent to the project area in 2014. The project area's foreshore environment is characterised by large areas of bare sandy substrate devoid of benthic communities and habitat. Approximately 1 km to the west of the project area, adjacent to the current boat ramp, is a stand of open canopy arid zone mangrove (*Avicennia Marina*) population that occupies the seaward margin of the foreshore. This population is characterised by low diversity and individual tree height, likely due to the extreme weather and salinity stresses that affect the intertidal zones of the Pilbara (RPS, 2014c). DoT's environmental consultants undertook validation survey work of subtidal BCH in October 2019, that resulted in the mapping of three broad BCH classes within the vicinity of the Development Envelope and broader Local Assessment Unit (LAU), which consisted of: • Bare sand • Mixed assemblage (corals, sponges, macroalgae, and hydrozoan) • Mixed assemblage with seagrass (sparse seagrass, sponges, macroalgae, and hydrozoan).

	The benthic cover was generally sparse to low across more than 95 per cent of the study area. All habitats identified within the LAU are considered to be widespread across the turbid nearshore environments of the Pilbara region and as such do not represent habitats of particular regional or conservation significance (Teal *et al*, 2019b). Sparse seagrass communities were observed in the vicinity of the Project area, and in the LAU to the west. Corals were also observed in proximity of the project area. These areas should be considered in future operations of the proposed Spoilbank marina facility and any future amendments to the Project should also aim to avoid impact to these areas (Teal *et al*, 2019b). The intertidal zone within the vicinity of the project area, including the navigation channel, is also characterised by bare substrate devoid of biota. Monitoring of coral health in Port Hedland associated with other projects in the region have shown that corals in the area are regularly exposed to low light (and no light) periods throughout the year of at least 14 days without signs of increased mortality (RPS, 2014c).
Potential impacts	**Direct impacts:** • Direct impacts of BCH due to removal of substrate associated with dredging the Proposal's navigational channel and sand trap footprint. **Indirect impacts:** • Indirect impacts (irreversible loss and recoverable impacts) on BCH due to increased turbidity, reduced light and sedimentation as a result of dredging activities and dredge return water discharge.
Mitigation	**Measures to Avoid** • The development envelope and marine dredging footprint has been minimised as much as practicable, to minimise direct impacts to BCH. **Measures to minimise** • A detailed Dredging Environmental Management Plan (DEMP) has been prepared for the Proposal's dredging and material handling campaign. The DEMP is informed by management-based provisions that clearly define management objectives, supported by appropriate monitoring programs that include management targets, management actions, adaptive management and reporting protocols. • The dredging schedule will be amended and adapted should management targets and environmental protection outcomes, outlined in the DEMP, not be met.
Predicted outcome	All benthic habitats identified within the Direct Mapping Zone and LAU are considered to be widespread across the turbid nearshore environments of the Pilbara region and are not considered to represent conservation significant habitat. DoT is of the view that the combined impacts of the Proposal activities and the consequent outcomes are not considered to pose significant residual risks to the protection of BCH and therefore biological diversity and ecological integrity can be maintained. In respect of the proposed design and management of the Proposal, the Proponent considers that the EPA's objective for BCH has been met.
Factor	**Air Quality**
EPA Objective	*To maintain air quality and minimise emissions so that environmental values are protected.*
Supporting Studies and Plans	DoT's environmental consultants undertook survey work within the development envelope and surrounding environment to support the Referral documentation, including:

	• Dust Management Plan (Strategen, 2020b), including a risk assessment, management measures and monitoring program.
Receiving environment	Port Hedland is the world's largest volume port for bulk materials export. Iron ore, salt, manganese, chrome and copper concentrates and other commodities, including cattle, fuel and chemicals pass through Port Hedland. Stockpiles containing iron ore, salt, manganese and copper are located relatively close to residential areas at Nelson Point. Heavy vehicles and ships, material stockpiling and handling and a predominantly dry, windy climate contribute to dust (particulate matter or PM) dispersal over the local residential areas (DoH, 2016). In 2013, peak levels of PM^{10} reached as high as 400 µg/m^3 at the Taplin St site and analysis of the data indicates that these exceedances were not due primarily to regional dust events but to local sources of dust in the Port Hedland area. The sandy environment of the Spoilbank land formation was identified as most likely to have contributed to exceedances at both the Taplin and Kingsmill Street monitors (DoH, 2016).
Potential impacts	**Direct Impacts:** • Dust generated by activities associated with the construction phases of the Project has the potential to impact on the amenity and health of the local residents and the project workforce. • Activities that generate dust, including earth moving, transport, loading and unloading of materials.
Mitigation	**Measures to avoid** To prevent or avoid excessive dust generation, the following wetting procedures of work area and haul roads will be undertaken: • dry spoil to be stockpiled will be actively wet down during active extraction • a total of three water carts (each minimum 10,000 L capacity) will be available in close proximity to the site entrance to enable pre-wetting of access roads and areas of the site where vehicle movements are anticipated will be carried out (pre-wetting and re-wetting requirements to be determined on-site by the Site Manager) • pre-wetting will be conducted to increase the moisture content of any dry material to be moved, e.g. during recontouring • areas to act as tipping receival surfaces will be wet down prior to commencement of tipping **Measures to minimise** To minimise excess dust generation the following management measures will be implemented: • neighbouring land occupiers, the Town of Port Hedland and DWER will be notified prior to construction activities commencing and supplied with contact information for the Site Manager • prior to commencement of any construction, wind fencing will be installed on the southern and eastern boundaries of the site and from the southwestern corner to the high watermark • water carts and canons will be available at the active work areas to provide contingency in the event of excessive dust generation • stockpiles in active use will be wet down to reduce wind erosion and displacement of dust upon the addition of more material. • stockpiles and cleared areas will be stabilised as required using a dust suppression crusting agent or other similar material • stockpiled spoil to remain to the north of the marina following completion of the Proposal will be stabilised by revegetation with suitable flora species

	• Should high wind speeds be forecast, site activities will be reviewed as deemed appropriate. **<u>Monitoring:</u>** In order to proactively manage any dust generated by the construction of the Proposal, a monitoring program will be established to disseminate dust impacts resulting from emissions generated at the site with background dust and emissions from other sources: • Site personnel and contractors will be required to record observations of visible dust emissions that appear to exit the boundary of the site, including date, time, location and extent of the visible plume. Those observations will be considered in relation to the measured dust concentrations and wind conditions, to inform management of site activities. • Monitoring of PM^{10} and wind parameters is required in order to ascertain the impacts of the construction activities and to inform effective management. It is proposed that the same monitoring methods employed for the baseline Spoilbank monitoring are used; specifically, BAM1020 monitors equipped with a real-time monitoring unit to yield both 1-hour and 10-minute averages as well as a wind sensor to record wind speed and direction on a 10-minute average basis. Monitoring sites will be equipped with telemetry in order to have access to real-time data via a web portal and to allow alarm notifications to be generated. • On-site monitoring is proposed to comprise of three monitors to be installed on the Spoilbank. Preliminary locations designed to record any dust with the potential to travel towards nearby residences are provided in the Proposal DMP. Final monitoring locations will be subject to a detailed site survey and any constraints identified.
Predicted outcome	Dust emitted during construction will be localised and temporary. The regular watering of unsealed roads, exposed surfaces and active construction areas will reduce and control these emissions. Major roads and access surfaces will be sealed and the restriction of vehicle movements will further reduce dust emissions from construction activities. As a result of the implementation of these management measures, dust emissions from construction activities will have a temporary, localised and low impact on public amenity.
Other Factors	**Coastal Processes**
EPA objective	*To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.*
Supporting studies and plans	DoT's coastal engineering consultants undertook the following studies to support the Proposal's detailed design as well as the Referral documentation, including: • Port Hedland Spoilbank Marina Metocean Design Criteria and Coastal Process Studies (Baird, 2020b) (Appendix R) • A morphological assessment of the Spoilbank to identify past and current sedimentation processes and support the numerical modelling. DoT collected the following data related to coastal processes to support these studies: • Wave, current and water level data at the site for approximately one year. This data was supplemented with existing data from the Pilbara Port Authority. • Suspended sediment concentrations, used to help assess expected siltation of the marina basin and channel. • Topography / bathymetry of the Spoil Bank and surrounding area at two occasions.

Receiving Environment	The Spoilbank is an artificial landform created from the disposal of dredge material during capital dredging of the Port Hedland and the Goldsworthy shipping channel in the late-1960s and early 1970s. Over the past 50 years, this artificially constructed area of land has migrated south and evolved from an offshore island to a shore-connected sandspit peninsula. Multiple regional scale geomorphology and coastal engineering assessments confirmed that the Spoilbank is highly vulnerable to hydrodynamic forces. This man-made land feature was initially accreting sediment onshore but has now stepped into a shrinking / eroding phase. Substantial erosion is anticipated to occur over forthcoming decades. Morphological changes are particularly pronounced during severe tropical cyclone storms, including the recent Tropical Cyclone Veronica event in March 2019. Since 2003, the land feature has been experiencing a clear erosional trend and with the absence of a sediment source to replenish the Spoilbank, the mechanisms for continued rotation of the northern shoreline and loss of the Spoilbank landmass continues unmitigated (Baird, 2020b). The Spoilbank evolution over the next 50-year period predicts a loss of over 50 per cent of its footprint as the erosional trend continues. Coastal environmental values located on, and adjacent to the Spoilbank land formation include conservation significant marine fauna habitat (including nesting, breeding or foraging habitat) intertidal and sub-tidal benthic communities, including a stand of open canopy arid zone mangrove (*Avicennia marina*) population that occupies the seaward margin of the foreshore located approximately 1 km to the south-west of the project area. The Spoilbank also provides the community of Port Hedland with a site for active and passive recreational activities, including fishing and 4WD activities. No unique landforms, significant cultural and aesthetic values, conservation significant flora and vegetation species occur on Spoilbank (Strategen, 2020a).
Potential Impacts	**Direct and indirect impact may include:** • Construction of the marina entrance breakwater and marina waterbody may locally alter wave dynamics and interrupt longshore sediment transport at the western side of the Spoilbank. • Construction of the breakwaters may trap sediment and cause localised loss of near-shore benthic communities and habitat at the sediment trap near the northern breakwater.
Mitigation	**Measures to minimise** • Location of the marina basin is relatively far south, extending the time that the marina basin will be impacted by naturally occurring erosion of the Spoil Bank. • A project-specific Coastal Hazard Risk Management and Adaptation Plan is being developed. This document will help prepare planning for long-term management of the continuing erosion at the project site.
Predicted outcome	• No impact on the wave climate is expected outside the immediate vicinity of marina structures and entrance channel. • Impact on tidal currents is expected to be minor and confined to the immediate vicinity of marina footprint and entrance channel. • The northern breakwater is expected to largely stop sediment moving towards the southwest along the Spoilbank's western shoreline. This is an intentional feature of the breakwater to help keep the channel and marina navigable. As a result, erosion of the beach south-west of the marina is likely to accelerate due to construction of the Spoilbank Marina. • The northern edge of the Spoilbank is currently eroding and rotating southward. Erosion is estimated to threaten the northern end of the Spoilbank Marina site by 2030-2040, at which time protection of the Spoilbank against further erosion may be considered. The erosion will

	cause the remnant rocky base at 1m to 1.5m below the natural seabed to be exposed as the shoreline recedes. • No significant impacts are likely to occur to natural communities and habitats that protect the coastline e.g. removal of foreshore or dune vegetation. • Impact on tidal currents and water levels are expected to be minor and confined to the immediate vicinity of marina footprint and entrance channel. • The accrual of problematic wrack is unlikely to occur.

2. INTRODUCTION

2.1 Purpose and scope

The purpose of the Referral Supplementary Information (RSI) is to support the referral of a proposal by the Department of Transport (DoT) to construct and operate the Port Hedland Spoilbank Marina Proposal (the Proposal), including both marine and land-based components.

The scope of the RSI includes a detailed description of the key components, identification of the preliminary key environmental factors and potential impacts to those factors arising from the Proposal. The RSI aims to demonstrate that potential impacts associated with construction and operational aspects of the Proposal can be avoided and minimised to acceptable levels, and therefore meet the EPA's environmental objectives.

DoT has undertaken site specific environmental studies and investigations that have informed project specific management plans, including:

1. Construction Environmental Management Plan (CEMP) (Appendix A), which includes:

- Dredge Environmental Management Plan (DEMP) (Teal *et al*, 2020c) (Appendix B), which includes dredge plume modelling (including spatially delineated Zones of Impact), ecological impact assessment (including benthic cumulative loss predictions). The DEMP is informed by management-based provisions that clearly define management objectives, supported by appropriate monitoring programs that include management targets, management actions, adaptive management and reporting protocols.
- Dust Management Plan (DMP) (Strategen, 2020b) (Appendix C), the principal objective of the DMP is to demonstrate, in accordance with the EPA's environmental factor guideline for Air Quality, that potential dust emissions during construction can be managed so that environmental values are protected and impacts to human health and amenity are minimised. The DMP provides for a site risk assessment that directs the required management measures and monitoring required to ensure fugitive dust emissions generated during construction can be minimised to as low as practicable.
- Marine Fauna Monitoring Program, detailing the management measures that direct the engagement of a suitability qualified marine fauna observers and provides for marine fauna exclusion zones delineated based on underwater noise modelling, and providing for appropriate monitoring and reporting procedures and protocols.

2. Operational Environmental Management Plan (OEMP) (Appendix D), which includes:

- Artificial Lighting Impact Assessment Report (RPS *et al,* 2020) (Appendix E), guiding and directing the Proposal's lighting design, including management measures, developed in accordance with the *Environmental Assessment Guideline for Protecting Marine Turtles from Light Impacts (EPA, 2010)*, and the Commonwealth's *National Light Pollution Guidelines for Wildlife - including Marine Turtles, Seabirds and Migratory Shorebirds*.
- Marine Environmental Quality Plan (Teal *et al*, 2020b) (Appendix F), which includes spatially delineated areas of ecological protection and appropriate tiered monitoring and management approach to ensure the environmental values of Port Hedland are maintained.
- Provisions for future maintenance dredging of the marina basin, navigational channel and sand trap, which is proposed to be undertaken in accordance with DoT's *Maintenance Dredging Environmental Management Framework* (DoT, 2018).

Depending on the operational requirements, dredge material will be managed onsite and re-used were possible. If required, alternative disposal options will be investigated and appropriate approvals will be sought from State and Commonwealth departments.

2.2 Proponent

Proponent details	
Name:	Department of Transport
ABN:	27 285 643 255
Address:	1 Essex Street, Fremantle WA 6160
Key Contact (Role):	Mr Steve Jenkins, General Manager
Key Contact Details:	(08) 9435 7661 steve.jenkins@transport.wa.gov.au

2.3 Environmental Impact Assessment Process

The *Environmental Protection Act 1986* (EP Act) is the primary legislative instrument for environmental assessment in Western Australia. It specifies procedures for assessment and appeal processes, including responsibilities and functions of the Western Australian Minister for the Environment and the Environmental Protection Authority (EPA). Under Part IV of the EP Act, the EPA is responsible for providing advice to the Minister for significant proposals assessed under Part IV of the EP Act.

This RSI has been prepared in accordance with the EPA's Guidelines to support referral of the Proposal under Section 38 of the EP Act. In accordance with section 3.1.3 of the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016*, this RSI has been prepared to provide sufficient information for the EPA to set the level of assessment for the Proposal.

Consultation with Decision-Making Authorities (DMAs) has substantially commenced to support the Proposal.

2.4 Other Approvals and Regulations

Dust Management Plan

The Town of Port Hedland (ToPH) will require a Dust Management Plan (DMP) as part of the Joint Development Assessment Panel application for the Proposal.

The DMP will require actions to be undertaken that are the responsibility of the proponent and its contractors to implement for the life of the construction process of the Proposal. The ToPH will assess the DMP and required the proponent and contractors to comply with the specified management measures contained within the approved DMP, at all times to the satisfaction of the ToPH.

If complaints are received regarding dust, ToPH will take action accordingly in liaison with the proponent and its contractors to ensure compliance with the approved DMP. In the event of a complaint, failure by the proponent or its contractors to comply with reasonable requests by the ToPH to mitigate dust to ToPH's satisfaction, notices will be issued to cease works until satisfactory measures are put in place to mitigate the issue.

Other Decision-Making Authorities, Approvals and Regulation

Table 1 identifies the other key approvals and regulations that will apply to the proposed action. The relevant decision-making authorities have also been identified for each approval or regulation.

Table 1: Other Decision-Making Authorities, Approvals and Regulations

WA Portfolio / Agency	DMA role / Activity	DMA Address	Email address
Minister for Environment	*Biodiversity Conservation Act 2016* - Taking of flora and fauna	Minister for Environment C/- Director General, Department of Biodiversity, Conservation and Attractions Locked Bag 104 **BENTLEY DELIVERY CENTRE WA 6893**	Minister.Dawson@dpc.wa.gov.au
Director General, Department of Water and Environmental Regulation	*Environmental Protection (Clearing of Native Vegetation) Regulations 2014* - Native Vegetation Clearing Permit	Director General, Department of Water and Environmental Regulation Locked Bag 33 Cloisters Square **PERTH WA 6850**	info@dwer.wa.gov.au
Chief Executive Officer, Shire of Port Hedland	*Health Act 1911* and *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulation 1974* - Construction or installation of apparatus (public amenities)	Chief Executive Officer, Town of Port Hedland PO Box 41, **PORT HEDLAND WA 6721**	council@porthedland.wa.gov.au
Pilbara Ports Authority	Development application - navigational aids	*Marine Navigational Aids Act 1973*	

3. THE PROPOSAL

3.1 Background

The Department of Transport (DoT) propose to develop a marina complex on the western side of the 'Spoilbank' sand formation located in the town of Port Hedland, Pilbara region of Western Australia (WA) (Figure 1). The Spoilbank is a man-made coastal landform created in the late 1960's and early 1970's as a result of disposing dredge material associated with dredging activities within the Port Hedland Harbour and Goldsworthy shipping channel.

3.2 Justification

DoT considered several alternative locations while determining the Proposal's project area, which included Cooke Point, Six Mile Creek and Unknown Creek (not named). The western side of the Spoilbank site was considered the preferred site due to the least number of inherent environmental impacts. This is fundamentally due to the significant historical impacts associated with the creation of the Spoilbank land formation and the disturbed nature of the existing marine environment due to dredging and maintenance of the adjacent Port of Port Hedland's (PPH) shipping channel.

Noting the above, the Proposal aims to replace the existing boat ramp located on Richardson Street (which will be closed) and redirect boating activities away from the high-use areas of the PPH's navigation channel. DoT does not expect the net vessel movements in Port Hedland to significantly increase as a result of implementing the Proposal, but only result in the relocation of boating to a safer and less frequented environment to the north-east.

Figure 1 – Proposal Location

3.3 Proposal description

The Proposal involves ground disturbance of up to 40 hectares (ha) within a development envelope of approximately 77 ha. Clearing of up to 14 ha of Acacia Shrubland is proposed, which has been classed as being in degraded condition (Strategen, 2020a). The proposed extent of the physical and operational elements is detailed in Table 2, and summarised below:

- marina basin, mooring facilities (up to 80 pens), boat launching area, sand trap and entrance channel.
- capital dredging works resulting in up to 900,000 cubic metres (m^3) of dredge spoil and dredged to a maximum depth of -2m chart datum (-6m AHD). Dredge spoil will be used onsite as fill material to raise the finished ground level prior to landscaping - no ocean disposal of dredge material will occur as part of this Proposal.
- construction of the marina's breakwaters and revetments. Materials for the construction of these structures will be sourced from local and regional quarry operations.
- parking facilities, amenities (public and pen holders), public open space and upgrading of road infrastructure.

Ongoing maintenance of the marina basin, navigational channel and sand trap is proposed to be undertaken in accordance with DoT's *Maintenance Dredging Environmental Management Framework* (DoT, 2018). The Proposal's Operational Environmental Management Plan provides for consideration for future maintenance dredging and material handling options.

Table 2: Summary of the Proposal

Title	Port Hedland Spoilbank Marina Proposal
Proponent name	Department of Transport (WA)
Short description	The Proposal is for the construction of the Port Hedland Spoilbank Marina, located within the Town of Port Hedland, Pilbara. The proposal includes: • dry land excavation of the marina basin (maximum depth to -2m chart datum (-5.9m AHD)) • capital dredging works resulting in up to 900,000 cubic metres (m^3) of dredge spoil and dredged to a maximum depth of -2m chart datum (-5.9m AHD) • sand trap • construction of breakwaters and revetment walls • disposal of capital dredge spoil on land as fill material to raise the finished ground level prior to landscaping, with excess material disposed offsite. The Proposal also includes the ongoing management and maintenance of the marina water body and infrastructure.

Element	Location	Proposed Extent
Physical Marine Element		
Marina basin and entrance channel	Figure 2	Ground disturbance and clearing of up to 12 ha

Breakwater and revetment wall	Figure 2	Ground disturbance and clearing of up to 6 ha
Sand trap	Figure 2	Ground disturbance and clearing of up to 8.5 ha
Physical Terrestrial Element		
Parking and trailer bays	Figure 2	Ground disturbance and clearing of up to 5 ha
Public open space	Figure 2	Ground disturbance and clearing of up to 5 ha
Road infrastructure	Figure 2	Ground disturbance and clearing of up to 3 ha

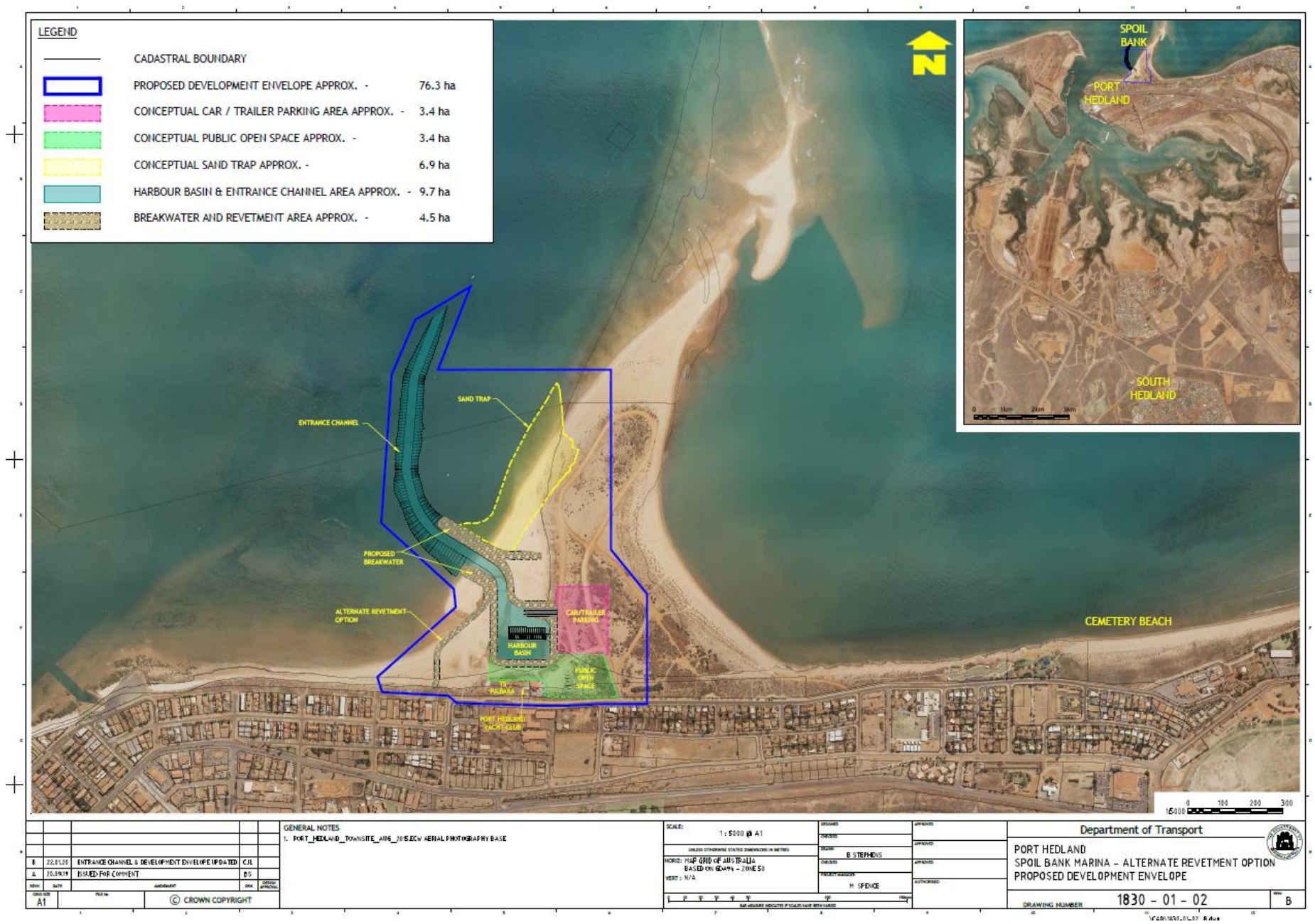

Figure 2: Port Hedland Spoilbank Marina Proposal Development Envelope

3.4 Local and regional context

Marine Environment

Port Hedland is located in the North-West Shelf marine region and occurs around the midpoint of the Pilbara coast. The marine environment is connected to the wider Indo-Pacific biogeographic region through the Leeuwin and Holloway Currents (BHP, 2011). The marine environment and metocean conditions have been extensively surveyed and are well understood.

The Proposal's nearshore and inshore environments are characterised by low relief, medium to coarse-grained shell fragments, strong tidal currents and turbid waters (RPS, 2013). Exposed limestone outcrops have resulted in the development of protected embayment, wide salt flats and several offshore islands with associated reef communities. The closest marine conservation areas are the Rowley Shoals Marine Park (approximately 300 km offshore to the north) and Eighty Mile Beach Marine Park (approximately 100 km east).

Marine waters within Port of Port Hedland (PPH) are typically well mixed and subjected to substantial variation in water quality following rainfall events and inflows from five shallow creek systems that discharge into the harbour (RPS, 2014c). The project area experiences a very high tidal range, which at times exceeds seven metres. Tidal impact on groundwater elevations occur in two main cycles – semi-diurnal cycles between high and low, and neap and spring tides occurring twice every lunar month. Salinity ranges between saline and hypersaline (5000 mg/L and 40,000 mg/L TDS). The Spoilbank displays no discernible surface water features or flow pathways, and surface expressions of groundwater at the site (RPS, 2014c).

Terrestrial Environment

DoT environmental consultants undertook a flora and vegetation desktop assessment and reconnaissance site survey work in February 2019 (Appendix G), in accordance with EPA's guidelines. It was noted that the site is characterised by predominantly bare sediment with areas of sparsely covered patches of colonising coastal shrubs and grasses (dominant species Buffel grass). No Threatened or Priority Ecological Communities were recorded, and no species of conservation significance were found. The vegetation was generally in degraded condition, being dominated by Buffel grass, and was fragmented by many four-wheel-drive tracks (Strategen, 2020a).

DoT's consultants concluded that the Spoilbank Reserve is characterised by a low diversity of vascular flora species and high densities of aggressive weeds. The vegetation does not meet criteria for conservation significance, and no Priority Flora species were identified at the site (Strategen, 2020a).

Land-use

Port Hedland and the wider region has historically been the subject of numerous large-scale infrastructure developments, including extensive and periodic capital and maintenance dredging campaigns.

The Wedgefield Industrial Area (WIA) contains a variety of light and service industry premises. The WIA is home to the Boodarie Strategic Industrial Area, which is ideally positioned to accommodate downstream resource processing industries related to the iron ore and gas resources of the region.

Mining

The Port of Port Hedland predominantly serves the mining industry of the Pilbara, however, similarly important to the regional economy are exports of salt, manganese, copper concentrates, livestock and spodumene.

Shipping

The Pilbara Ports Authority (PPA) recorded a record annual tonnage of 697.2 million tonnes in 2018/19, with 513.3 million tonnes from Port Hedland. A record monthly throughput of 49.3 million tonnes was recorded in June 2019 (PPA, 2019).

Heritage

The Kariyarra people are the traditional owners of the land on which the marina complex is proposed to be located. The Kariyarra people live around the town of Port Hedland area in the northwest of Western Australia - from Port Hedland West to the Sherlock River and south to the Yule River. The Kariyarra country is bound by Ngarla country to the north, Nyamal to the east and Ngarluma to the southwest. Engagement and consultation undertaken with the Kariyarra Traditional Owners is detailed in Section 3.5.

3.5 Potential sensitive receptors

DoT has identified the key sensitive receptor requiring specific management to be the biologically important population of flatback turtles (*N. depressus*) located at Cemetery Beach, approximately 2 km east of the development envelope. The flatback turtle is considered a Matter of National Environmental Significance and is protected under the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the State's *Biodiversity Conservation Act 2016*.

DoT has identified the key impact pathways for the species to be from construction and operational light spill / pollution, vessel strikes and dredging equipment entrainment, water quality changes and underwater noise. DoT has outlined a robust management approach as part of this RSI and is of the view that the impacts associated with the Proposal could be avoided entirely or minimised to an acceptable level. DoT's impact predictions are supported by technical experts, including Pendoley Environmental (PENV, 2019).

In addition to marine fauna, DoT has identified fugitive dust emissions generated during construction activities to be a key environmental issue for the Proposal. To manage fugitive dust emissions, a Dust Management Plan (DMP) has been developed to inform the proposal's management measures, monitoring requirements and reporting protocols.

4. STAKEHOLDER ENGAGEMENT

4.1 Key stakeholders

All stakeholders listed below have been consulted during the design stages, and will be further consulted during the construction and operational stages of the Proposal:

- DoEE – regarding submission of EPBC Referral, potential impacts on MNES
- DWER (WA) – Part IV EP Act assessment process
- DBCA (WA) – threatened and priority ecological communities and marine fauna
- DPLH (WA) – potential impacts to Aboriginal heritage sites, heritage surveys
- Pilbara Development Commission
- DevelopmentWA (formally LandCorp)
- Kariyarra Traditional Owners
- Pilbara Ports Authority
- Local Government Authority – Town of Port Hedland
- Spoilbank Community Reference Group consists of the following:
    - Port Hedland Yacht Club
    - RSL
    - TS Pilbara
    - Kariyarra Traditional Owners
    - PH Fishing Club
    - PH Volunteer Marine and Sea Rescue
    - PH Chamber of Commerce
    - Hedland Collective
    - PH Seafarers Centre
    - Care for Hedland
    - GT Diving
    - Pilbara Tourism
    - Jayrow Helicopter

4.2 Stakeholder engagement process

DoT's objective is to continue to build long term and meaningful relationships with the community of Port Hedland. Consultation is expected to be ongoing with stakeholders throughout the construction and operational phases of the proposed action, generally through direct engagement, steering committee meetings, public presentations and project reporting requirements.

DoT's stakeholder consultation undertaken to inform the Proposal's referral information is provided for in Table 3.

Kariyarra Engagement Plan

DevelopmentWA (DevWA) is leading the consultation process with the Kariyarra People and has developed the Kariyarra Engagement Plan (KEP) in partnership and collaboration with the Kariyarra Aboriginal Corporation (KAC) Prescribed Body Corporate representatives

(Traditional Owners) and the Town of Port Hedland (Stakeholder). The aim of the KEP is to provide a living document to be used as an instrument to negotiate better outcomes for the Kariyarra People on the back of the Spoilbank Marina Proposal.

The KEP provides for ongoing collaboration through the project design development, construction, and ongoing operation of the Proposal. Collaborations will include developing partner relationships with local industry, local, state and federal government bodies and authority representatives. A collaborative partnership approach will develop a positive relationship with the Kariyarra People to ensure project cultural heritage and economic outcomes, delivering wider benefits to the Port Hedland community and visitors.

The Plan provides opportunity for industry and levels of government to confidently support and partner with Kariyarra to provide broad long-term benefits for the town, community and visitors. Future engagement opportunities are identified throughout the proposal's lifecycle, including:

- The Detail Design Phase initiatives are recommended to be addressed and followed up by the Town of Port Hedland immediately following adoption of the masterplan to continue inclusion of Kariyarra in the detail design development of the project.
- The Construction Phase recommends an opportunity for Kariyarra People to be involved in the public realm, including art, interpretation and landscape components. This would also include opportunities for youth involvement - e.g. South Hedland youth working on tree planting in South Hedland Town Centre (DevWA, UDLA and Yarra).
- The Operation Phase is to consider numerous business and employment opportunities, both passive and future active economic opportunities, such as marina and public realm maintenance, tourism services and hospitality ventures for Kariyarra People. Economic opportunities that arise are to be considered early with KAC. The operation phase will also provide for a Kariyarra ranger sea-base component within the marina complex. An established Kariyarra Land and Sea Rangers program will provide numerous services for the marina, Port Hedland community and Pilbara Port Authority.

Table 3: Stakeholder Consultation

Stakeholder	Date	Engagement	Summary	Key issues/Outcomes
Pre-Referral Stage				
DWER (Marine Ecosystems Branch)	16 July 2019	Meeting	Marine studies/investigations discussion with technical experts from DWER. Key discussion points included: • Initial discussions introducing the Proposal. • Discussed the Proposal's key components, activities and potential impact pathways that could potentially affect Marine Environmental Quality and Benthic and Communities factors within the development envelope and surrounding environment, during both construction and operational phases. • Discussed EPA guidelines and WAMSI Dredging node research reports that were appropriate for the Proposal. • Potential impacts to marina fauna were also discussed, particularly regarding green sawfish, during construction.	Marine Environmental Quality studies should include: • Development of two key environmental plans – Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP). • CEMP should include the Dredge Material Management Plan developed in accordance with the EPA's Technical Guidance (EIA for Dredge Material). • Operational EMP should include Environmental Quality Management Framework developed in accordance with EPA Technical Guidance (Protection of Marine Environmental Quality). Benthic Communities and Habitat studies should include: • Further survey work focused on ground-truthing to confirm habitat mapping undertaken in previous studies in the region completed for past projects (i.e. BHP Outer Harbour).

				• Survey work greater than five years should be used as a guide and not to inform impact predictions. • Undertake dredge plume modelling to predict the zones of impact before determining the BCH survey area. • Undertake Ecological Impact Modelling to predict changes (permanent and recoverable) to sensitive receptors.
DBCA	23 July 2019	Meeting	Discussion focused on biodiversity and conservation aspects of the Proposal, specifically the potential impacts to marine fauna (i.e. flatback turtles). Key discussion points included: • Initial discussions introducing the Proposal. • Identify critical habitat and key breeding windows for threatened marine fauna in the proximity of the proposal area, including conservation-significant or locally important marine fauna (including marine reptiles and migratory coastal birds). • Discussed the presence and population dynamics of marine fauna in the proximity of the proposal area, including marine mammals and reptiles, as well as other conservation-significant or locally important marine fauna. • Identified key impact pathways and threats to the flatback turtle population located at Cemetery Beach.	Marine fauna - DBCA Advice / Comments: • Spoilbank appears to be a barrier to turtle movement and migration, with no known sightings of hatchlings on the western side of Spoilbank. • Key nesting areas located along Cemetery Beach began from the playground moving eastward away from Spoilbank. • The population at Cemetery Beach is considered a mid-sized community with approx. 200 – 500 females. Key hatching times are between January and March. • Hatchling mobility and movement is heavily affected by currents and tides, and little is known about their movements after entering the ocean. • Important breeding seasons occur between October to March.

				Management measures that should be considered, include: • Consider cumulative impacts of marina light spill and other sources of light in the surrounding environment. • Consider surveying/monitoring for turtles in the dredge footprint during peak hatching, peak nesting and migration to determine whether turtles use the area around the project.
Commonwealth DoEE	25 July 2019	Telephone	Pre-referral meeting held in accordance with DoEE's prescribed processes. Key discussion points included: • Initial discussions introducing the Proposal. • Identify the construction and operational elements of the proposal that may affect Matters of National Environmental Significance, including threatened and migratory species. • Outlined the environmental investigations and survey work that was proposed and being undertaken to inform the referral of the action to the DoEE. • Discussed management measures and commitments that would lead to minimising potential impacts to MNES.	DoEE provided support for four key management measures and commitments that were proposed, including: • The commitment to avoid marine dredging activities during key breeding and nesting months of the flatback turtle population (i.e. no dredging between 1 December and 31 March). • Commitment to ensure dredging best management practices were implemented, including turtle exclusion devices and engaging marine fauna observers. • Implement a turtle-sensitive lighting approach guided by state and national guidelines. • No ocean disposal of dredge material to occur.

DWER (EPA Services)	1 August 2019	Meeting	Pre-referral meeting held in accordance with DWER's prescribed process. Key discussion points included: • Initial discussions introducing the Proposal. • Discussed the Commonwealth's pre-referral meeting outcomes. • Discussed the key environmental factors that required attention and consideration in the Proposal's impact predictions, management measures. • Outlined the environmental investigations and survey work that was proposed and being undertaken to inform the referral of the Proposal. • Discussed preliminary findings from survey work and outlined the preliminary management measures and commitments.	DWER provided advice on the following matters: • Preliminary factors that required attention included marine fauna, marine environmental quality, benthic communities and habitats and air quality. • Where DoT identified areas of uncertainty it is advisable that expert opinion and comment is sought. • The assessment strategy should consider referral to the Commonwealth under the EPBC Act prior to the EPA under Part IV of the EP Act – timeline identified late August 2019. • Consider providing the Chairman of the EPA a pre-referral briefing prior to referral to close off on the issues identified in the previous EPA determination.
EPA Chairman & DWER (EPA Services)	10 December 2019	Meeting	Meeting held with the Chairman of the EPA (including DWER). Key discussion points included: • Changes to the proposal's scope since referral to the EPA in 2013. • Identified the key factors for the Proposal and the current investigations and surveys undertaken to date. • Discussed the preliminary findings, consultation undertaken and the referral timeframes.	Key issues and outcomes included: • Marina Fauna and Air Quality were identified as the key factors relating to the Proposal. • Survey work, impact predictions and management measures were considered adequate to provide certainty in meeting the EPA's Environmental objectives for Marine Fauna. • Dust Management Plan would be required to ensure fugitive dust

				emissions associated with construction activities are controlled, mitigated and monitored. • Referral to the EPA under section 38 of the EP Act was considered the appropriate pathway for the Proposal.
Port Hedland Industry Council (PHIC)	12 December 2019	Telephone / Emails	• Initial discussions introducing the Proposal. • Discussed the Air Quality Issues relating to the Proposal.	PHIC advised that dust mitigation measures should be discussed with Brad Kitchen due to his experience and background with dust management in Port Hedland.
Pilbara Ports Authority	10 & 31 January 2020 14 February 2020	Meeting	Consultation focused on management of air quality impacts associated with construction activities.	Key issues and outcomes included: • Consistency in air quality monitoring and management approaches should be a focus of the Dust Management Plan (DMP). • PPA provided site specific contextual information and management measures that would be built into the Proposal's DMP. • It was noted that very few complaints regarding dust were reported annually to the PPA.
Department of Primary Industries and Regional Development, Teal Solutions, O2 Marine. Technical Review by Harry Butler Institute, Murdoch University.	5 February 2020	Sawfish Risk Assessment Workshop	A risk assessment workshop was held with technical experts to identify the Proposal's impact pathways (mitigated and unmitigated) to sawfish, as well at the consequence of the potential impacts, and the likelihood of the consequence occurring to sawfish.	The Risk Assessment concluded that the risk rating for the Proposal was 'Low'. It was therefore agreed amongst the technical experts that the Spoilbank Marina Proposal is unlikely to have a significant impact on protected sawfish species.

5. ENVIRONMENTAL PRICIPLES AND FACTORS

5.1 Identification of key factors and their significance

Potential direct and indirect impacts may occur during construction and operational activities as a result of vessel strikes / dredging equipment entrainment, deterioration of water quality (including turbidity, sedimentation and mobilisation of contaminants), operational light spill / pollution, habitat destruction / removal, hydrocarbon spills and underwater noise emissions.

The EPA lists a number of environmental factors that need to be considered in the Environmental Impact Assessment (EIA) process (EPA 2018b). The key factors relevant to this Proposal are considered in Table 4.

Table 4: Key environmental factors, their significance and relationship to the Proposal

EPA Theme	EPA Factor	Significance	Relationship to Proposal
Sea	**Benthic Communities and Habitats**	**Key environmental factor**	**The Proposal comprises the construction of marine infrastructure which will require the removal of benthic habitat.** **Construction and operation of the Proposal may result in changes to marine water quality, which can impact on benthic communities and habitats.**
	Coastal Processes	**Other environmental factor**	
	Marine Environmental Quality	**Key environmental factor**	**Marine construction activities may temporarily affect water quality due to increased turbidity and the release of contaminants in sediments.**
	Marine Fauna	**Key environmental factor**	**Potential direct impacts through vessel strikes, loss of habitat and the construction and operational phase light spill.**
Land	Flora and Vegetation	Not considered a key environmental factor	
	Landforms	Not considered an environmental factor	
	Subterranean Fauna	Not considered an environmental factor	
	Terrestrial Environmental Quality	Not considered an environmental factor	
	Terrestrial Fauna	Not considered an environmental factor	

Water	Inland Waters	Not considered an environmental factor	
Air	**Air Quality (Construction Fugitive Dust Emissions)**	**Key environmental factor**	**Potential construction impacts to the amenity of residents and recreational users in the surrounding area from fugitive dust emissions associated with construction activities.**
People	Social Surroundings (Human Health)	Not considered an environmental factor	

5.2 Environmental principle consideration

The EP Act identifies a series of principles for environmental management. The environmental principles are the highest assessment level a Proposal or scheme must meet in order to be found environmentally acceptable by the EPA. DoT has considered these principles in relation to the development and implementation of the Proposal (Table 5).

Table 5: Environmental Principles

Principle	Consideration
The precautionary principle *Where there are threats of serious irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In the application of the precautionary principle, decisions should be guided by:* *a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* *b) an assessment of the risk weighted consequences of various options.*	DoT has identified several environmental factors that are relevant to the Proposal. The Proposal has been designed to avoid, as far as practicable, any serious environmental harm. Specialist studies have been undertaken and used to supplement information from existing surveys and investigations, to inform the understanding of the existing environment and identify the potential impacts from the Proposal. Where there were areas of uncertainty regarding potential impacts, conservative assumptions were made. Management measures and actions to address residual impacts and ensure impacts are as predicted, are proposed to be addressed within the Proposal's management plans. DoT considers that the Proposal meets the application of the precautionary principle, and therefore is of the view that the Proposal presents no threat of serious or irreversible harm.
The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.*	DoT considers that the Proposal meets the principle of intergenerational equity, and therefore is of the view that that the environmental values will be protected and that the health, diversity and productivity of the environment will be maintained for the benefit of future generations.
The principle of the conservation of biological diversity and ecological integrity	DoT has identified four key environmental factors relevant to the Proposal.

Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Detailed investigations have been undertaken to identify potential impacts and mitigation options to minimise the impact of the Proposal and align with the EPA objective for each environmental factor. No long-term impact on environmental values of the marine or terrestrial environment are expected to occur. DoT considers that the Proposal meets the principle of conservation of biological diversity and ecological integrity. DoT is of the view that given the nature of the impacts and management approach presented, it will ameliorate the impacts of the loss of biological diversity and ecological integrity.
Improved valuation, pricing and incentive mechanisms *1) Environmental factors should be included in the valuation of assets and services.* *2) The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement.* *3) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.* *Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, which benefit and/or minimise costs to develop their own solutions and responses to environmental problems.*	DoT accepts that costs for environmental mitigation and management are part of the overall Proposal costs. DoT considers that the Proposal meets the principle of improved valuation, pricing and incentive mechanisms
The principle of waste minimisation *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	The Proposal's approach to waste is consistent with the waste management (avoid, recover, disposal) principles. DoT considers that the Proposal meets the principle of waste minimisation.

5.3 Key Environmental Factor – Marine Fauna

5.3.1 EPA Objective

The EPA's Environmental Objective for this factor is *'to protect marine fauna so that biological diversity and ecological integrity are maintained'.* The Proposal's potential impacts (identified below) will be avoided and mitigated to demonstrate that the EPA's Environmental Objective for this factor can be met.

5.3.2 Policy and Guidance

DoT has taken into consideration the following environmental policies and guidance document during the assessment for this factor:

- Statement of Environmental Principles, Factors and Objectives (EPA, 2018)
- Environmental Factor Guideline – Marine Fauna (EPA, 2016a)
- Environmental Assessment Guideline for Protecting Marine Turtles from Light Impacts (EPA, 2010)
- Commonwealth *Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999*, Department of Sustainability, Environment, Water, Population and Communities (DoEE, 2013)
- Commonwealth's *National Light Pollution Guidelines for Wildlife - including Marine Turtles, Seabirds and Migratory Shorebirds (Draft)* (DoEE, 2019)

5.3.3 Receiving Environment

DoT undertook an EPBC Act Protected Matters Search Tool (PMST) across the development envelope (including a 5 km buffer zone) in August 2019 (Appendix H). Based on the EPBC Act PMST Report, DoT identified a number of threatened and migratory species in the study area and surrounding environment, protected under both State and Commonwealth legislation. Key species of concern included marine reptiles, cetaceans, protected fish species and migratory shorebirds. In consultation with relevant environmental and regulatory agencies, DoT has identified the Flatback Turtle (*N. Depressus*), Green Turtle (*Chelonia mydas*), Green Sawfish (*Pristis zijsron*), Dwarf Sawfish (*Pristis clavata*) and Narrow Sawfish (*Anoxypristis cuspidata*), as well as a number of migratory shorebird species to be a key concern for the Proposal.

Spoilbank Land Formation – East (Cemetery Beach and Pretty Pool)

DoT is aware of Cemetery Beach's regional significance as a biologically important inter-nesting beach that supports the flatback turtle's Pilbara population. Cemetery Beach is located approximately 2 km east of the development envelope (Figure 3) and it is understood to support a medium sized community (approx. 200 – 500 individuals) that nest on the beach between late November and March, with key hatchling periods from January to March (PENV, 2019). Other nesting sites in Port Hedland include Pretty Pool Beach situated approximately 6 km east of the marina and over 7 km from the Port Hedland town centre. The population of female turtles nesting on Pretty Pool Beach ranges between 31 to 222 females per season (RPS *et al*, 2020).

Figure 3 - Regional context - Port waters, Cemetery Beach and Pretty Pool

In a regional context, satellite tagging of flatback turtle individuals was undertaken by BHP in 2008/9 and 2011 and have shown a key migratory path eastward towards key foraging habitat located on North Turtle Island and the De Grey River (approximately 70 km from the proposed action) (Figure 4) (BHP, 2011). Furthermore, a regionally significant flatback turtle rookery occurs at Mundabullangana (approximately 1,800 females per annum) approximately 55 km west of the development envelope (RPS *et al*, 2020).

Spoilbank Land Formation and Pilbara Ports Authority waters

The western side (including Port waters) of the Spoilbank landform is known to be frequented by flatback and green turtles, however only in low numbers when considered in a local and regional context. Anecdotal evidence suggests that the Spoilbank landform is a natural barrier to the migration of hatchlings westward from Cemetery Beach, and hatchling migration appears influenced by tidal currents that move eastward along the Pilbara coast away from the project area.

To provide DoT with a snapshot of turtle activity on the Spoilbank landform, Care for Hedland Environmental Association (CHEA) expanded their 2019/2020 Community Volunteer Turtle Monitoring Program to include both western and eastern foreshores of the Spoilbank landform. Monitoring on the Spoilbank commenced on 1 October 2019, and resulted in 18 recorded events (including false crawls and nesting events) occurring to 9 February 2020 (Table 6). When considering total turtle activity across the Port Hedland region, including Cemetery Beach and Pretty Pool, the activity on the Spoilbank represented < 1 per cent of the region's recorded activity, as well as a contribution of 0.3 per cent of the total nests hatched during the monitoring period.

CHEA also provided DoT with an observation made during the monitoring period, noting a key assumption for the lower activity recorded on the eastern foreshore being a result of high levels of on-going anthropogenic disturbance deterring the opportunistic nesting attempts of flatback turtles along this stretch of foreshore (CHEA 2020, personal comms, dated 11 February).

Table 6 – Total Flatback Turtle Activity Record (CHEA, 1 Oct 2019 – 9 Feb 2020)

Location	False Crawls	Nests (Hatched)	Total Activity
Spoilbank – West	11	4 (0)	15
Spoilbank - East	0	3 (1)	3
Cemetery Beach	1,026	779 (296)	1,805
Pretty Pool	67	80 (21)	147

Green turtles have been observed within the Port Hedland Harbour and surrounding mangrove creeks (PENV, 2009). Although juvenile and adult turtles utilise habitat within the Port Hedland area for foraging and possibly breeding, regionally significant areas occur beyond the Port Hedland Harbour, including areas identified as key foraging habitat at North Turtle Island and the De Grey River (approximately 70 km east of the development envelope) (Figure 4) (RPS *et al*, 2020).

It is understood the nearshore environment of the Proposal's development envelopment provides habitat for conservation significant fish species, including the green, dwarf and narrow sawfish. To understand the importance of the Proposal's marine environment, DoT sought expert advice from Murdoch University, including experts from the Harry Butler Institute (Dr David Morgan), Sharks and Rays Australia and the Sawfish Conservation Society (Appendix I) (Morgan *et al,* 2019). In the absence of targeted sawfish surveys in the immediate vicinity of the Proposal, Morgan *et al* collated recent records (occurring after 2010) of sawfish from the Pilbara region between 80 Mile Beach and south to Karratha (a range of approximately 400 km), noting a total of 66 sightings recorded. Within Port Hedland, a total of 16 individual sawfish were recorded, 11 of which were positively identified as green sawfish. Locations in Port Hedland included two records off the Spoilbank and one caught at the Port Hedland jetty at the entrance of the inner harbour. The sawfish ranged in length from ~0.6 m to 3 m and were thus considered to be pups, juveniles or sub-adults, suggesting the development envelope and wider intertidal area may be a key nursery habitat for the species (Morgan *et al*, 2019).

DoT engaged Bamford Consulting (Bamford) in August 2019, as subject matter experts on migratory shorebird species along the Pilbara coast (Appendix J). Bamford commented that the Spoilbank is not considered important habitat, or habitat critical to the survival of any waterbird species found in the Port Hedland area, but may help to support current numbers in the area. Bamford noted that within the Port Hedland region, the coastline from Pretty Pool to Six Mile Creek, 5 km east of Port Hedland is of most importance for waterbirds, with foraging mostly focused on tidal flats and roosting on beaches where access is limited (Bamford, 2019).

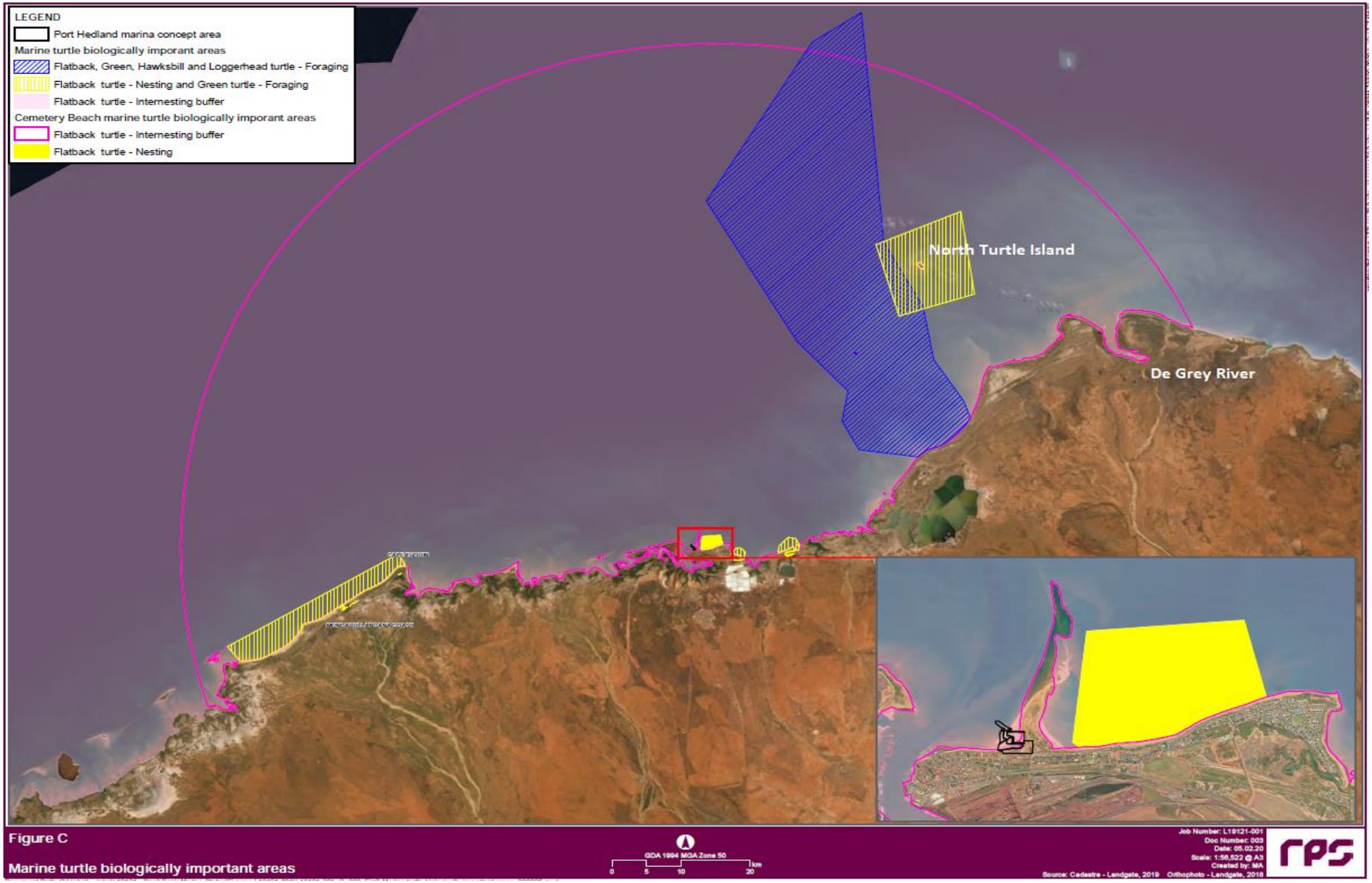

Figure 4 – Marine Turtle Biologically Important Areas (RPS *et al*, 2020)

Cumulative Night-time Light Environment

The industrialised landscape of Port Hedland's West End is home to the world's largest bulk export port, which primarily facilitates the export of iron ore. Shipping operations, together with processing, stockpiling and loading activities surrounding and servicing the port collectively contribute significantly to the cumulative artificial light emissions experienced in Port Hedland's night environment. Several other problematic point sources of light are also visible from Cemetery Beach, including the water tower, street lights, floodlights at the aquatic centre and adjacent council buildings, and offshore vessels (Figure 5) (RPS *et al,* 2020).

Figure 5 – Aerial Drone Footage (RPS *et al* (2020), taken 31 September 2019)

DoT's environmental consultants conducted light measurements and benchmark survey work in late September 2019, to characterise the Cemetery Beach night environment, with specific reference site located on Cemetery Beach (Figure 6) (RPS *et al,* 2020). The survey work informed the development of the Proposal's Artificial Lighting Impact Assessment Report (RPS *et al*, 2020) that concluded the artificial light generated by the operation of the Proposal can be managed so that flatback turtles are not disrupted within, nor displaced from, important habitat, as well as prevented from undertaking critical behaviours such as reproduction and dispersal.

The benchmark light survey involved the collection of light data from the main area used by flatback turtles for nesting on Cemetery Beach using PENV's Sky42™ cameras, which are globally recognised as a leading tool in artificial light measurement and management. The survey work determined the sky brightness at Cemetery Beach to be typical of an urban night sky and considered to consist of a high (artificial light impacted) recording (RPS *et al,* 2020). Located 5 km east of the Cemetery Beach, Pretty Pool's sky brightness profile was considered typical of a suburban night sky and considered to be a moderate (artificial light impacted) recording (RPS *et al,* 2020).

Figure 6 – Light Benchmark Camera Locations (RPS *et al,* 2020)

5.3.4 Potential Impacts

Marine fauna could potentially be impacted, either directly or indirectly, through:

- potential light pollution impacts to flatback turtles on Cemetery Beach
- direct disturbance of benthic subtidal and intertidal communities and marine habitats due to construction activities, specifically dredging and excavation works
- localised reduction in marine water quality within the marina
- potential impacts to marine fauna associated with vessel movements, including vessel strike and dredge equipment entrainment
- underwater noise from dredging and pile driving
- introduction of marine pests as a result of vessel movements.

5.3.5 Assessment of Impacts

DoT have identified the key impact pathways for the proposal to result from construction phase dredging of the navigation channel (including marine fauna entrainment with dredging equipment and habitat destruction) and ongoing operational light emissions from land-based activities and infrastructure.

Construction Phase

DoT is of the view that potential impacts to marine fauna during construction of the marina and approach channel will be temporary, localised and the associated impacts can be managed (avoided and/or minimised) to ensure the extent, severity and duration are managed to acceptable levels. Expert advice received from DoT's consultant supported its impact predictions and have also noted that with implementation of adequate management measures (as detailed in Section 5.3.6), the impacts can be minimised as much as possible to an acceptable level and meet the EPA's Environmental Objectives for this factor.

DoT notes that cetaceans and marine reptiles may transit the development envelope during construction but are likely to occur in small numbers. Well documented migratory paths and foraging habitat are known to occur north of the development envelope and within deeper waters off the Port Hedland coastline, including North Turtle Island and the De Grey River (Figure 5). Furthermore, key sawfish nursey habitat sites occur within their home range in King Sound and Fitzroy River (Morgan *et al*, 2019). Monitoring data collected to date supports the conclusion that a low abundance of conservation significant marine fauna occurs in the development envelope, including:

- monitoring data and records collected by CHEA (18 records on the Spoilbank to 9 February 2020)
- PENV/BHP marine reptile tagging program conducted in 2009/2010 (PENV, 2010)
- low historic records of Green Sawfish catch data in the area (two known records caught off the Spoilbank landform) (Morgan *et al,* 2020).
- Bamford's review of migratory shorebird activity on the Spoilbank land formation (Bamford, 2019).

DoT is of the view that, although construction activities may result in a temporary and localised disturbance to individuals, no long-term decrease in any population size is considered likely. Furthermore, with implementation of dredging best management practices, the impacts can be minimised to as low as practicable, or even removed altogether.

DoT's environmental studies and investigations (see section 5.5) concluded that benthic communities and habitat surrounding the intertidal and sub-tidal areas of the navigational channel do not represent important habitat for listed conservation significant species, or critical habitat to their survival. Considering the limited area of disturbance of marine habitat (approximately 10 ha), it is unlikely that any habitats will be reduced to the extent that conservation significant marine fauna species will be impacted or show population decline.

Furthermore, habitats for marine reptiles are distributed widely across the project area and the wider region, including areas identified as key foraging habitat at the North Turtle Island, De Grey River and tidal creek systems within the inner harbour (RPS *et at*, 2020). Noting this, it is not considered likely that implementing the proposal will fragment any conservation significant marine fauna populations. PENV also concluded that due to the known locations of flatback and green mating, nesting, inter-nesting, and foraging habitats, there are no activities associated with the proposed action that could significantly impact these areas of habitat (considered critical to the survival of the flatback turtle population), their occupancy within their habitat, or fragment the population into two or more populations (PENV, 2019). Furthermore, PENV is of the view that there is no potential for the proposed activities to introduce disease that may cause the flatback turtle population to decline or result in a harmful invasive species being established within the flatback turtle habitat (PENV, 2019).

Although construction activities will not be undertaken at night-time, site lighting has been noted as providing a potential pathway for an impact to hatchling flatback turtles situated onshore. In considering this impact pathway, PENV concluded that the relatively short timeframe associated with construction, as well as taking the management measures into account, there will be no significant impact to the overall population from artificial lights during construction (PENV, 2019).

Potential construction impacts (i.e. turbidity, vessel strikes) are considered limited to juvenile Green Sawfish that may be transiting the inshore waters adjacent to the project area. However, offshore migratory pathways and primary nursey sites occurring at King Sound and Fitzroy River are highly unlikely to be affect by the nearshore and sub-tidal construction

activities (Morgan *et al*, 2019). Habitat within, and adjacent, to the Proposal's development envelope may support juveniles of sawfish species, but when considered at a population level, as well as in a regional context, it is considered highly unlikely that a long-term decrease in the size of an important population of sawfish will occur (Teal *et al,* 2020a).

Operational Phase – Point Source Light Pollution

The EPA's *Environmental Assessment Guideline (EAG) for Protecting Marine Turtles from Light Impacts* (EPA 2010), identifies Cemetery Beach as being exposed to significant artificial lighting from existing and planned residential development and iron ore shipping. The relative density of nests between 2004 to 2013, as recorded by CHEA's Community Volunteer Turtle Monitoring Program, indicated that turtles prefer the eastern side of Cemetery beach, where the dunes are higher and less exposed to onshore artificial light sources (RPS *et al,* 2020).

Prominent sources of problematic sky glow in the Port Hedland night environment included emissions from the town and the port itself, which extend over a significant portion of the horizon (shown in Figures 7 and 8) obscuring the view of any potential light emission emitted from the Proposal area (RPS *et al,* 2020). PENV's environmental investigations concluded that considering the large amount of existing artificial sky glow currently occurring in Port Hedland, it is unlikely there would be any detectable impact from the Proposal on the Cemetery Beach night environment (RPS *et al,* 2020).

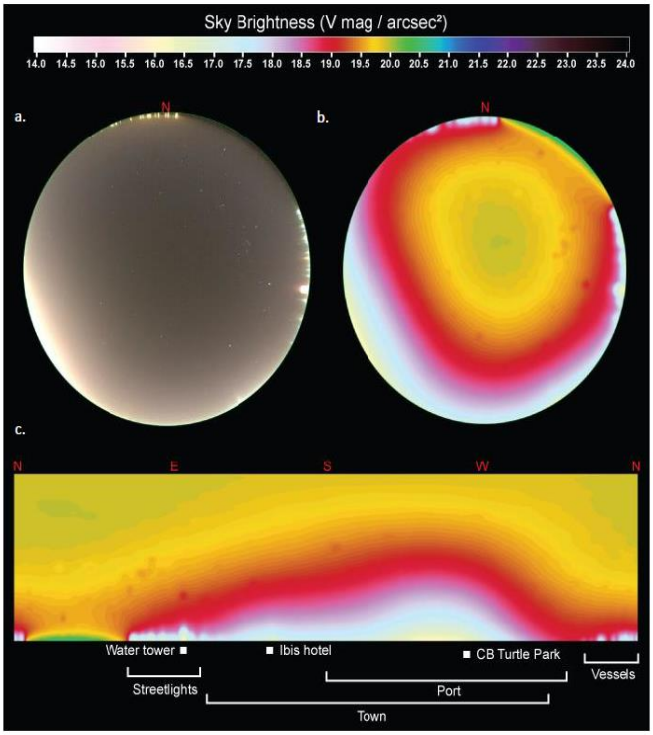

Figure 7 - Cemetery Beach (West) (RPS *et at,* 2020)

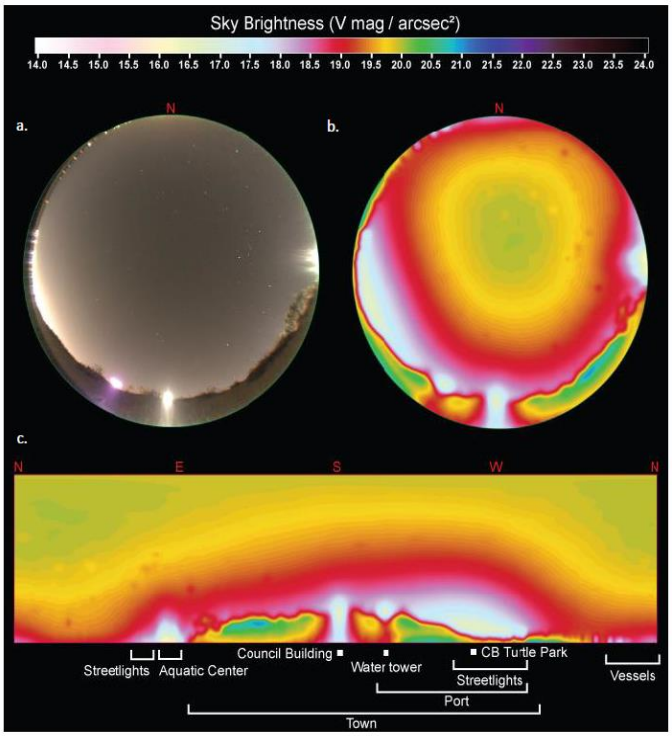

Figure 8 - Cemetery Beach (East) (RPS *et al,* 2020)

Through the implementation of the best practice lighting design principles identified in the *draft National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds* (DoEE, 2019), DoT is of the view that potential impacts to hatchlings from new point sources of artificial light associated with the Proposal (i.e. pole mounted street lighting) are unlikely to result in disorientation or mis-orientation of hatchling movements at Cemetery Beach.

5.3.6 Mitigation and Management

DoT has applied the mitigation hierarchy and reduced its impact as much as possible by reducing the size of the development envelope and avoiding the eastern foreshore of the Spoilbank land formation.

Construction phase

DoT's environmental consultants undertook underwater noise modelling to inform the Proposal's underwater noise monitoring and management protocols (Appendix K). A Marine Fauna Monitoring Program that delineates exclusion zones for monitoring and management of marine fauna will be established and implemented throughout the construction phase of the Proposal. The exclusion zones will be monitored with the aim of avoiding acoustic trauma (i.e. permanent threshold shift (PTS) and temporary threshold shift (TTS)) in marine fauna, and minimising adverse behavioural responses while undertaking piling and dredging activities. The monitoring protocols have been incorporated into the Proposal's CEMP, which were based on underwater acoustic modelling that informed the area (radius) around noise generating activities, as well as standard operating procedures to prevent PTS/TTS (i.e. soft start-up procedures) (Talis, 2020).

DoT has proposed a number of management procedures within the Proposal's DEMP. The DEMP has included a dredging and dry land excavation strategy that is based on avoiding and reducing disruption to critical life-cycle periods for flatback turtles, as well as peak periods for migratory waterbird species (i.e. providing a commitment to avoiding dredging during the months December to March). The DEMP further commits the dredging contractor to implement dredging best practice by ensuring Turtle Exclusion Devices and disturbance chains are fitted to dredging equipment and soft start procedures are applied at the commencement of activities.

The Proposal's CEMP provides for monitoring and management measures for invasive marine species. All vessels are in compliance with the DPIRD biosecurity procedures and protocols. The completion of the DPIRD risk assessment tool for any vessels working on or entering the marina from international or interstate waters will be a requirement. The recommendations from the tool will be implemented.

Operational phase

DoT environmental consultants developed the Proposal's Artificial Light Impact Assessment Report (RPS *et al,* 2020). The Report is based on the environmental objectives and principles for best practice turtle sensitive lighting approaches developed in accordance with the best practice lighting design principles identified in the draft *National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds* (DoEE, 2019).

The Report outlines a number of robust management measures that aim to minimise the potential for disorientation and / or mis-orientation to occur from light sources that are directly visible to hatchlings, whilst also reducing sky glow across the marina development envelope. The following management measures are proposed to be implemented:

- minimising the number of lights needed
- using lowest intensity lighting to meet safety requirements
- using Amber lighting (i.e. primarily long wavelength emitting lighting)

- installing shields on the lighting or directional lighting to avoid lighting anything but the target area or object thereby preventing upward or horizontal light spill, particularly in an easterly direction towards Cemetery Beach.

5.3.7 Predicted Outcomes

The Spoilbank landform is an artificial man-made feature that does not support large numbers of conservation significant marine fauna species. The western side of the Spoilbank is particularly devoid of habitat that is utilised by conservation significant marine fauna species. This is evident from the recent and historic monitoring data and catch records showing low number of flatback turtles, sawfish and migratory shorebirds frequenting the project area and Port Hedland inner harbour.

Flatback and Green Turtles

DoT engaged PENV in August 2019, as subject matter experts, to provide preliminary impact predictions and management recommendations regarding the Proposal's potential to significantly impact the flatback turtle population at Port Hedland (Appendix L). PENV concluded that the primary sources of potential significant impact to the flatback turtle population would be from dredging activities during construction (impact to reproductively active adult flatback turtles), and artificial light during operations (impacts to hatchling flatback turtles). It was PENV's view that through the implementation of adequate management measures (as detailed in Section 4), these significant impacts could be removed entirely, or minimised as much as possible to an acceptable level.

Pendoley further concluded that through the implementation of the best practice lighting design principles identified in the draft Light Pollution Guidelines (DoEE 2019), and EAG 5 (EPA, 2010) key principles for lighting management, the lighting design for the proposed marina development will meet legislative and regulatory requirements for human safety whilst maintaining the biological diversity and ecological integrity of flatback turtles.

Green, Dwarf and Narrow Sawfish

DoT received expert commentary from the Harry Butler Institute, Murdoch University regarding the potential to impact and outcomes to Green Sawfish in the vicinity of the development envelope. Morgan *et al* (2019) concluded that some fragmentation of juvenile habitat may occur as a result of the development, although the main port is potentially a greater cause of any fragmentation should it be occurring. There is some likelihood that disturbance of the Spoilbank through construction of the marina may disturb sawfish in the immediate vicinity of the impact site, however it is unlikely to reduce the area of occupancy of an important population.

Morgan *et al* (2019) noted that it is unknown as to the importance of the Spoilbank sub-tidal benthic habitat as Green Sawfish habitat. It was noted that the shallow, sandy substrate appears suitable as feeding grounds during high and low tides. Noting, there are similar suitable habitats along the Pilbara coast. Home range of Green Sawfish increases with growth, and therefore the impact to resident sawfish is most likely applicable to small juveniles of green sawfish only (<1.2 m total length). As the key movement periods of green sawfish were found to be between 18:00 and 09:00 in the southern Pilbara, any proposed dredging should occur during daylight hours so as to not impact upon these generally nocturnal fish (Morgan *et al*, 2019).

Furthermore, DoT's risk assessment (Appendix M), supported by technical experts, concluded that risks to sawfish evaluated from Spoilbank Marina construction and operational activities, with considered management and monitoring mitigations introduced to reduce either the likelihood or the consequence of that risk, have been allocated a risk rating

of ‘Low’. It is therefore considered that the Proposal is unlikely to have a significant impact on protected sawfish, including Green Sawfish (*P. zijsron*), Dwarf Sawfish (*P. clavata*) and Narrow Sawfish (*A. cuspidata*), or significantly impact habitats critical to the survival of these species, or impede upon the migration of individual sawfish (Teal *et al,* 2020a).

Migratory Shorebirds

DoT engaged Bamford Consulting (Bamford) in August 2019, as subject matter experts, to provide preliminary advice and recommendations on the proposed action’s potential to significantly impact the migratory shorebirds at Port Hedland. Bamford concluded that the Spoilbank is not considered an important habitat or critical to the survival of any waterbird species in the Port Hedland area, but it may help support current numbers in the area (Bamford, 2019).

Furthermore, Bamford noted that the proposed marina will only directly impact a small area used for roosting by small numbers of waterbirds, including listed migratory species. It was stated that disturbance rather than habitat loss has been identified as a major concern for waterbirds in the Port Hedland area, with the possible exception of the loss of the old sewage ponds, and the marina proposal may provide the opportunity for the reduction of disturbance. Management of human access, such as restricting access to parts of the Spoilbank, would likely result in increased numbers of waterbirds using the site (Bamford, 2019).

5.4 Key Environmental Factor – Marine Environmental Quality

5.4.1 EPA Objective

The EPA’s Environmental Objective for this factor is *‘to maintain the quality of water, sediment and biota so that environmental values are protected’*. The Proposal’s potential impacts (identified below) will be avoided and mitigated to demonstrate that the EPA’s Environmental Objective for this factor can be met.

5.4.2 Policy and Guidance

DoT has considered that the following current environmental policy and guidance is relevant to its assessment of the proposal for this factor:

- Statement of Environmental Principles, Factors and Objectives (EPA, 2018)
- Environmental Factor Guideline – Marine Environmental Quality (EPA, 2016b)
- Technical Guidance – Protecting the Quality of Western Australia’s Marine Environment (EPA, 2016c)
- Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA, 2016d)
- Commonwealth’s National Assessment Guidelines for Dredging (NAGD, 2009)
- WAMSI Dredging Science Node Theme 4 | Synthesis report: Defining thresholds and indicators of coral response to dredging-related pressures (Jones et al, 2019)

5.4.3 Receiving Environment

Sediment Quality

DoT’s environmental consultants undertook survey work across the Proposal’s development envelope in 2019, to characterise the physio-chemical composition of the marine sediment

(Appendix N) (Teal *et at*, 2019a). Sampling was undertaken in accordance with the National Assessment Guidelines for Dredging (NAGD) (DoEE, 2009) and were analysed for particle size distribution, total organic carbon, metals, organotins and acid sulfate soils. Thirteen of these sites were also selected for additional analysis of the following volatile chemical constituents: total recoverable hydrocarbon; benzene, toluene, ethylbenzene, xylenes, naphthalene, polycyclic aromatic hydrocarbons, organophosphate and organochlorine pesticides.

Analysis determined the analytes were below the available ANZG guideline values (ANZ, 2018), NEPM Health Investigation Levels (NEPM, 2013) and NAGD Screening Levels. At six locations, aluminium and iron exceeded locally derived background levels, however these exceedances were determined to be largely natural occurrences (Teal *et al*, 2019a).

All samples were screened for acid sulfate soils and selected samples were subject to chromium suite acid sulfate analysis. The chromium reducible sulfur concentration of three samples (C02, B12-2 and S29-B2) were above the action criteria of 0.03% sulfur. However, consideration of the acid neutralising capacity presented a positive net acidity, which indicated sufficient in-situ buffering capacity for any acid generated during handling. The analysis concluded that sediments were considered suitable for onshore disposal (Teal *et al,* 2019a).

Environmental Quality Management Framework (Pilbara Ports Authority)

In 2006, the then Department of Environment (DoE) published the *Pilbara Coastal Water Quality Consultation Outcomes Report* (DoE, 2006) to provide an Environmental Quality Management Framework (EQMF) for protecting the marine environmental quality of Pilbara coastal waters. The report established the existing Environmental Values (EV), Environmental Quality Objectives (EQO) and Levels of Environmental Protections (LEP) for the waters off Port Hedland. DoE's consultation strategy involved a comprehensive community and stakeholder engagement process to seek public input into how the EQOs and their LEPs should be allocated spatially throughout the region to protect the EVs held by the Port Hedland community.

In 2020, the Pilbara Ports Authority (PPA) engaged 02 Marine to develop the Port of Port Hedland Marine Environmental Quality Sampling and Analysis Plan (PHMEQSAP) (O2 Marine, 2020) for the inner harbour and wider Port waters. The PHMEQSAP provides an update of the original EQMF (DoE, 2006), which provides further consideration for the significant developments that have occurred within the Port of Port Hedland since 2006.

The EVs and associated EQOs for the port waters identified in the PHMEQSAP include four EVs and six corresponding EQOs, as presented in Table 7, which will be adopted by DoT and incorporated into the Proposal's EQMF.

Table 7 Environmental Values and Environmental Quality Objectives applicable to the Port of Port Hedland and surrounding waters

Environmental Values	Environmental Quality Objectives
Ecosystem Health	EQO1: Maintenance of ecosystem integrity. EQO1 is split into four sub-objectives, being: Maximum, High, Moderate and Low Levels of Ecological Protection (LEPs) (Refer Section 2.2 below).
Fishing & Aquaculture	EQO2: Seafood (caught) is of a quality safe for human consumption.
Recreation & Aesthetics	EQO3: Water quality is safe for primary contact recreation (e.g. swimming and diving). EQO4: Water quality is safe for secondary contact recreation (e.g. fishing and boating). EQO5: Aesthetic values of the marine environment are protected.
Cultural & Spiritual	EQO6: Cultural and spiritual values of the marine environment are protected.

LEP boundaries have been previously described for Port Hedland and surrounding waters in the Pilbara Coastal Water Quality Consultation Outcomes (DoE, 2006) and PHMEQSAP. These LEP boundaries have been applied to the Project using the current EPA spatial dataset (accessed 27/11/2019) and are displayed in Figure 9. The 'Ecosystem Health' EQO is spatially allocated into four LEPs, including 'Maximum', 'High', 'Moderate' and 'Low'. Each LEP is assigned an acceptable limit of change, allowing for areas important for conservation to be maintained within the limits of natural variation, whilst recognising that societal uses may preclude either a 'Maximum' or 'High' LEP from being achieved in those areas.

DoT's environmental consultants have prepared the Proposal's EQMF, as detailed in the Proposal's Marine Environmental Quality Plan (MEQP), to ensure consistency with the EVs, EQOs and LEPs defined in the *Pilbara Coastal Water Quality: Consultation Outcomes Report* (DoE, 2006) and O2 Marine (2020). The Proposal's EVs, EQOs and LEPs therefore represent the stakeholder's outcomes from DoE (2006) and O2 Marine (2016). As the Proposal is located within port waters, DoT's EQMF has adopted the framework approach applied within the PHMEQSAP. DoT is committed to working closely with PPA to co-implement a common EQMF that aims to protect and maintain the quality of the marine environment with respect to identified pressures from both the Proposal and the Port of Port Hedland. The Proposal's EQMF is detailed further in Section 5.5.6.

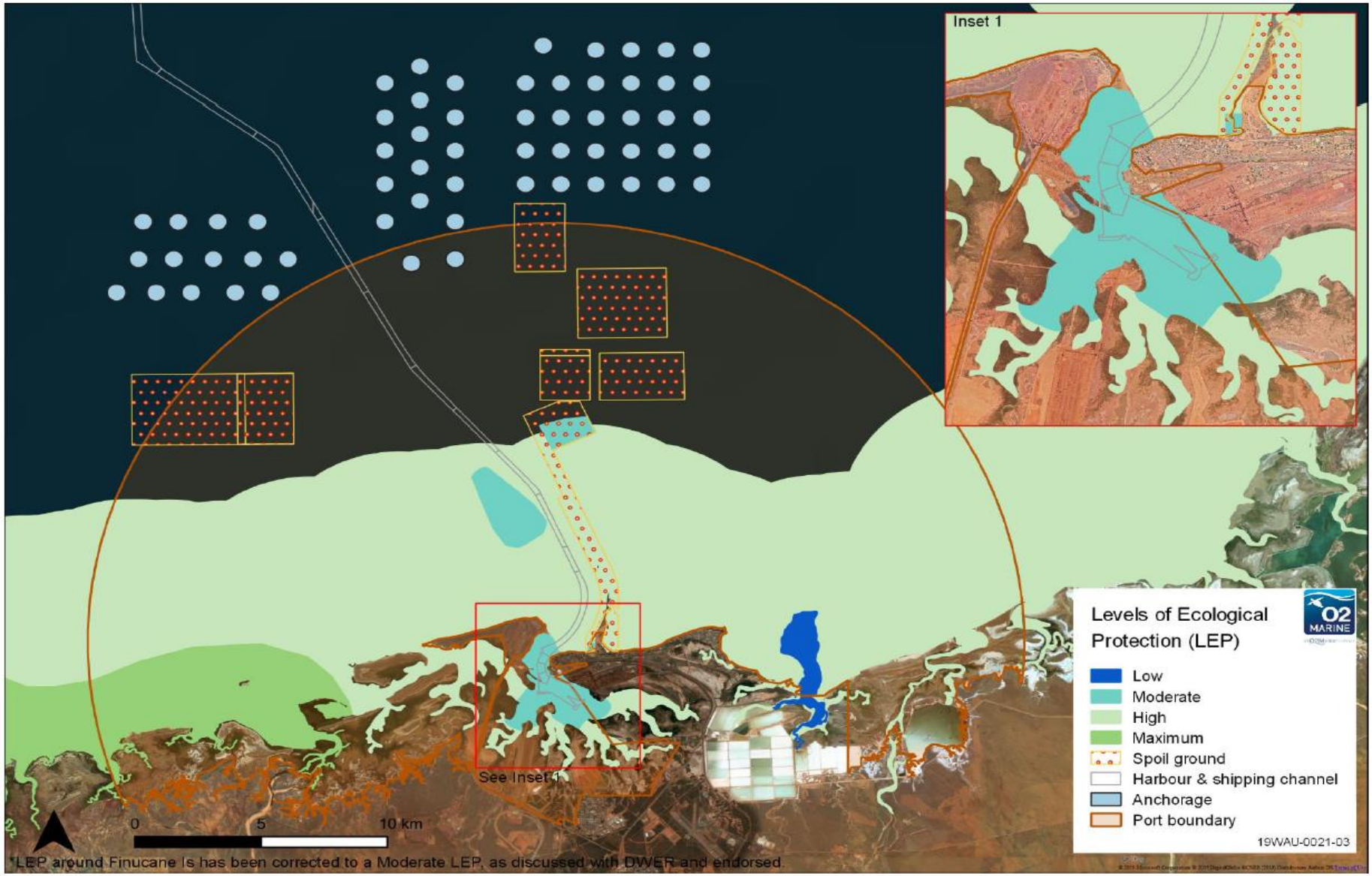

Figure 9 - Pilbara Ports Authority Spatially Delineated Levels of Ecological Protection (02 Marine, 2020)

5.4.4 Potential Impacts

Marine Environmental Quality could potentially be impacted, either directly and indirectly, through:

- disturbance of contaminants in sediments during dredging and tail water discharge from the Dredge Material Management Area (DMMA), which has the potential to deteriorate water quality and contaminate marine organisms.
- temporary and localised decline in water quality from increased turbidity levels (i.e. increased total suspended solids, reduced benthic light availability) during dredging works.
- potential hydrocarbon release into the marine environment from vessel spills and bunkering operations.
- deterioration of water quality within the marina basin during on-going operations.

5.4.5 Assessment of Impacts

The key risks and impact pathways that potential affect this factor relate to deterioration of the water and sediment quality within the marina basin during the operational phase of the Proposal. The on-going operational marina water quality will be managed in the context of the EQMF, consistent with the approach adopted by PPA to manage on-going water, sediment and biota quality to ensure the environmental values in port waters are protected (Teal *et al*, 2020b).

Although the Proposal's EQMF has been developed specifically to manage on-going water and sediment quality in the marina basin, DoT is aware that some construction activities could temporarily impact water quality in port waters, specifically while dewatering of dredge material through the outfall of the Dredge Material Management Area (DMMA). DoT's Dredge Environmental Management Plan (DEMP) provides for adequate management targets and actions to ensure the decline is temporary and returns to a standard that meets the high LEP on cessation of dewatering activities. Furthermore, sediment sampling and analysis undertaken by DoT's consultants has determined that the sediment is inert and suitable for offshore ocean disposal, therefore the mobilisation and release of contaminates is not expected.

The flushing characteristics of the marina were determined using the Delft3D hydrodynamic modelling suite (Baird, 2020a). The model was used to estimate the e-folding time of the Marina basin based on release of a conservative tracer and a number of different tidal and wind conditions. The average e-folding time varied from 0.9 day (Spring Tide with typical dry season wind regime) to 2.1 days (extreme Neap Tide with no winds). The key driver of the flushing times was the tidal range with wind having a relatively small effect. In summary, the flushing times were found to be rapid with little recirculation (intake of water which had exited the marina during the flood tide on the subsequent ebb tide) of marina water at the entrance.

Recreational boating movements and activities within the marina and approach channel presents a potential risk for accidental hydrocarbon spills into the marine environment. Although unlikely, should spills occurs, the small volumes that would be released from the standard recreational vessel would be limited, and the overall extent of the impact area would be small, with limited exposure to sensitive receptors occurring with appropriate oil spill response procedures and protocols. Furthermore, it should be noted that no refuelling stations are proposed to service vessels in the marina, eliminating a key risk pathway for major spill events.

5.5.6 Mitigation and Management

To management construction dewatering from the Dredge Material Management Area (DMMA), DoT's DEMP provides for a water quality and monitoring program adjacent to the discharge points to ensure a high level of ecological protection is achieved in these areas consistent with the Pilbara Coastal Water Quality: Consultation Outcomes Report (DoE, 2006). The DEMP is further detailed in Section x-x (Benthic Communities and Habitat).

For the operational phase, DoT's environmental consultants have prepared the Proposal's MEQP, which aims to ensure the marina, once constructed, does not impact the environmental values within the Port of Port Hedland. As noted previously, the MEQP aligns with the *Pilbara Coastal Water Quality: Consultation Outcomes Report* (DoE, 2006) and the Port's PHMEQSAP (O2 Marine, 2020), which was developed in the context of an Environmental Quality Management Framework (EQMF), as defined in the EPA *Technical Guidance for Protecting the Quality of Western Australia's Marine Environment* (EPA 2016a) for the port and surrounding waters.

The Proposal's MEQP provides a framework to monitor, characterise and report long-term trends in marine water and sediment quality within the Proposal's development envelope and surrounding marine environment (Teal *et al,* 2020b). The MEQP forms part of the Operational Environmental Management Plan (OEMP) for the Proposal and includes the following management measures:

- water quality monitoring program and tiered management framework to manage on-going water quality within the marina's basin
- monitoring and management for hydrocarbons spills to the marine environment through the implementation of standard hydrocarbon management practices.

Noting the above, two Levels of Ecological Protection (LEPs) are spatially delineated for 'Ecosystem Health' in the vicinity of the Proposal's development envelope, including 'High' and 'Moderate' (Figure 10). DoT has committed to maintaining the EQO for ecosystem integrity as per the existing PHMEQSAP and has committed to water quality monitoring program and contingency management measures within the MEQP that meet the EQC within these LEPs.

To demonstrate the above can be met, the Proposal's EQMF provides for the implementation of an adaptive monitoring and management program, which has been divided into two phases, including:

- Phase I (Years 0-3) – Initial Baseline Data Collection
- Phase II (Ongoing) – Monitor, Investigate and Review.

During Phase I, this plan is entirely focussed on baseline data collection and is not intended as a tool to elicit a management response. However, future iterations of the Plan may include investigation options to inform development of appropriate management strategies as required to be in line with an EQMF approach. The baseline data collection monitoring program will incorporate the following sites within the baseline monitoring program:

- One within the High LEP; and
- One within the Moderate LEP

Details of the monitoring locations and associated routine sampling tasks to be completed at each location are provided in Figure 10.

Phase II will include annual water and sediment quality sampling, along with a reactive monitoring program (response to incidents or notifications) and tiered level of assessment against derived EQS. Monitoring methodologies for Phase II routine water and sediment quality sampling will be undertaken in accordance with the methods identified within the PHMEQSAP, including any revised processes associated with the Phase I review. In addition, Phase II monitoring will also include:

- a reactive monitoring program to be developed in response to observed or notified incidents, such as: oil spill, algae bloom, fish kills and/or nuisance odours; and
- targeted investigation in the event routine sampling indicates exceedances of the EQGs. Investigation should facilitate assessment against EQS and ultimately assess impacts against EQOs.

DoT has proposed that Phase II marine environmental quality sampling and analysis program will align with Port Hedland's marine monitoring program (Teal *et al,* 2020b).

5.4.7 Predicted Outcomes

DoT is of the view that the management approach presented in the Proposal's DEMP and MEQP will maintain the established environmental values in the water off Port Hedland and maintain ecosystem integrity and levels of ecological protection in the development envelope and surrounding environment. The Proposal is likely to meet the EQOs set out by the EQMF and is unlikely to compromise the environmental values of the Port Hedland Harbour marine environment.

Figure 10 – Spoilbank Marina Marine Environmental Quality Sampling (Teal *et al,* 2020b)

5.5 Key Environmental Factor – Benthic Communities and Habitat

5.5.1 EPA Objective

The EPA's Environmental Objective for this Factor is *'to protect benthic communities and habitats so that biological diversity and ecological integrity are maintained'.* The Proposal's potential impacts (identified below) will be avoided and mitigated to demonstrate that the EPA's Environmental Objective for this factor can be met.

5.5.2 Policy and Guidance

DoT has considered that the following current environmental policy and guidance is relevant to its assessment of the proposal for this factor:

- Statement of Environmental Principles, Factors and Objectives (EPA, 2018)
- Environmental Factor Guideline – Benthic Communities and Habitats (EPA, 2016e)
- Technical Guidance – Protection of Benthic Communities and Habitats (EPA, 2016f)
- Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA, 2016d)
- WAMSI Dredging Science Node Theme 4 | Synthesis report: Defining thresholds and indicators of coral response to dredging-related pressures (Jones *et al*, 2019)

5.5.3 Receiving Environment

Existing Environment

RPS undertook benthic habitat mapping of the Spoilbank foreshore environment's inter-tidal and sub-tidal area in 2014. RPS characterised the intertidal zone as bare substrate devoid of biota, and the sub-tidal areas beyond the project area as displaying higher diversity and abundance of benthic communities and primary producer, including hard and soft corals, macro-algae and soft sponges (RPS, 2014). RPS noted at the time that monitoring of coral health in Port Hedland associated with other projects in the region have shown that corals area regularly exposed to low light (and no light) periods throughout the year of at least 14 days without signs of increased mortality (RPS, 2014b).

DoT understands that a number of these studies are older than five years and the findings may be considered out of date or obsolete. DoT's environmental consultants undertook ground truthing surveys and targeted survey work in 2019 (Appendix P), in accordance with *Technical Guidance, Protection of Benthic Communities and Habitats* (EPA, 2016e) and the Western Australian Marine Science Institution Dredging Science Node (WAMSI DSN), across two key areas, including:

1) Detailed Mapping Zone (Figure 11): immediately adjacent to the proposed Spoilbank Marina and has an area of 115 ha; and
2) Local Assessment Unit (LAU) (Figure 12): 1) Spoilbank LAU: A project-specific Local Assessment Unit (LAU) (which includes the Detailed Mapping Zone) developed in accordance with EPA Guidelines; and 2) Inner Harbour LAU: The existing LAU for the Port Hedland Inner Harbour. Justification for these LAUs are detailed below.

The Proposal's subtidal BCH assessment mapped three broad BCH classes within the Detailed Mapping Zone and LAU, including:

- Bare Sand

- Mixed assemblage (Corals, Sponges, Macroalgae, and Hydrozoan)
- Mixed assemblage with seagrass (sparse Seagrass, Sponges, Macroalgae, and Hydrozoan)

The benthic cover was found to be generally sparse to low across more than 95 per cent of the study area. Small areas of low to medium-density mixed assemblage habitat were typically found on consolidated or semi-consolidated substrate generally in shallow water and/or in the intertidal zone and mostly along the shoreline. Areas of mixed assemblage with seagrass were found in slightly deeper water (>3 m) generally in areas with coarse sediment substrate. All habitats identified within LAUs are considered to be widespread across the turbid nearshore environments of the Pilbara region and did not represent conservation significant habitat (Teal *et al*, 2019b).

In the vicinity of the development envelope mixed assemblage habitat were present on low profile reefs and patches of very sparse ephemeral seagrass on sand were also observed. Sparse seagrass communities were observed in the vicinity of the Project area, and in the coastal LAU to the west. Survey work also observed corals occurring in proximity of the Proposal's development envelope.

Figure 11 – Benthic Communities and Habitat of the Development Envelope

Spoilbank Marina Local Assessment Units

To assess the cumulative loss of benthic habitat and provide an ecological impact assessment for the Proposal, DoT's consultants developed a project specific Local Assessment Unit (LAU) in accordance with EPA Guidelines. This Spoilbank LAU is to be used in conjunction with the already defined Inner Harbour LAU.

The EPAs guidance suggests that a LAU should be defined with reference to the local geomorphology and biophysical characteristics of the area and should typically cover an area of ~50 km^2; larger or smaller LAUs will be considered if well justified.

DoT's consultants reviewed two previous studies that defined LAUs, which covered the area of the proposed Spoilbank Marina:

- BHP Outer Harbour Development Environmental Impact Assessment (BHP, 2011):
    - Five separate LAUs were defined, the LAU covering the Spoilbank area was based on the inner harbour LAU (as shown in EPA, 2016), but extended offshore in parts track the shoreline or cut across embayment's.
- Cooke Point Marina, Port Hedland – Preliminary Environmental Assessment Report (RPS, 2014):
    - Similar to the BHP (2011) LAU but separated into an 'onshore' and 'offshore' LAU. The northern boundary of the 'offshore' generally followed the LAT level and therefore excludes areas of subtidal BCH and the landward boundary did not include Pretty Pool Beach which represents an important costal habitat in the area.

DoT's consultants proposed to use a modified version of the Cooke Point 'offshore' LAU. The offshore boundary of this LAU has been extended to a consistent depth of -2 m CD (chart datum) to ensure inclusion of subtidal BCH and the landward boundary (Teal *et al,* 2019b).

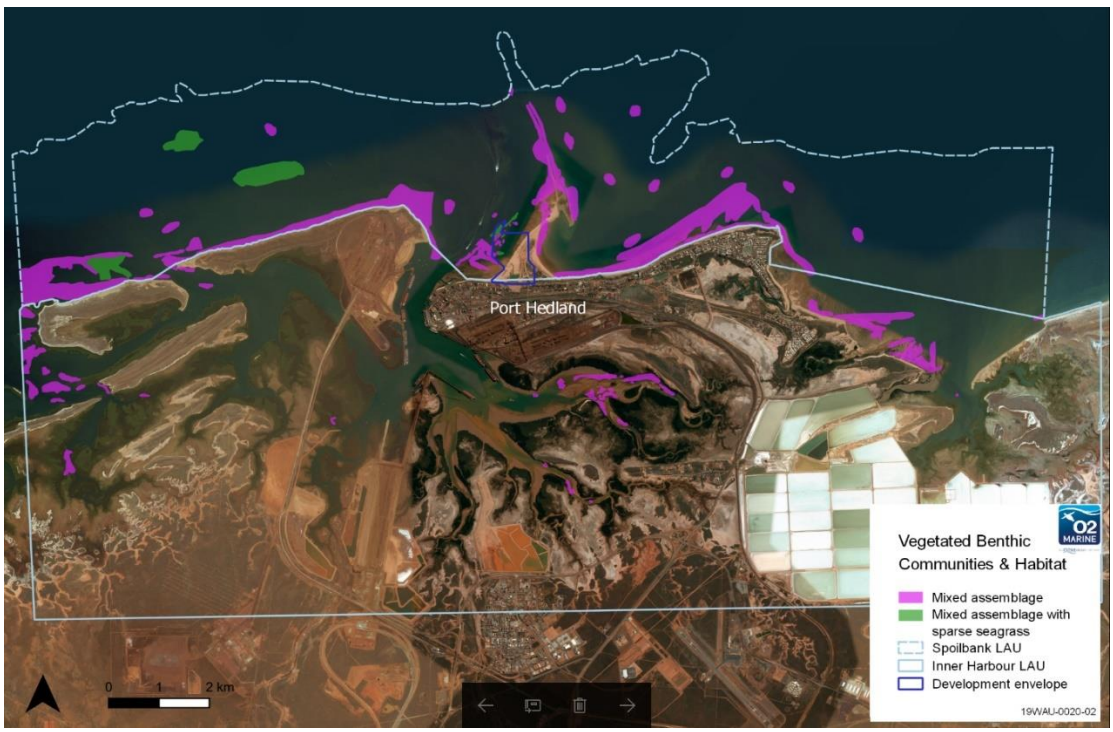

Figure 12 – Proposed LAUs and associated BCH classes

5.5.4 Potential Impacts

Construction Phase Impacts

Benthic Communities and Habitats (BCH) could be potentially impacted, either through:

- Direct impacts to BCH through removal from within the dredging footprint; and
- Indirect impacts (irreversible loss and recoverable impacts) on BCH due to increased turbidity, reduced light and sedimentation as a result of dredging activities and dredge return water discharge.

Post-construction / Operational Phase Impacts

There will be an ongoing requirement for maintenance dredging of the channel during the lifetime of the Proposal from infill of sediment. However, maintenance dredging occurs regularly in Port Hedland and there is little evidence of historic impacts to BCH as a result of these activities. Furthermore, any maintenance dredging works will be managed in accordance with the DoT Maintenance Dredging Environmental Management Framework and impacts will be assessed on a case by case basis. Therefore, potential minor recoverable impacts to BCH as a result of maintenance dredging are not discussed further as part of this proposal.

5.5.5 Assessment of Impacts

A BCH cumulative loss assessment (CLA) (Teal *et al.* 2020d) was undertaken to evaluate the extent and severity of the direct and indirect impacts of the proposal on BCH. The key findings of this assessment are summarised below.

Direct removal (irreversible loss) of subtidal BCH within the proposed dredging footprint

The proposed dredging will result in the permanent loss of 12.6 ha (2.2%) of BCH mapped as ‘mixed assemblage’ and 2.3 ha (2.6%) of ‘mixed assemblage with seagrass’ in the Spoilbank LAU. Both BCH types are locally and regionally widespread within the Pilbara and do not constitute critical habitats for any species of conservation significance.

Indirect potential impacts (irreversible loss and recoverable impacts) on subtidal BCH through increased turbidity, reduced light and sedimentation

In accordance with guidance provided in EPA (2016d), a dredge plume modelling study was undertaken to develop predictions of the Zone of High Impact (ZoHI), Zone of Moderate Impact (ZoMI) and Zone of Influence (ZoI) for BCH in the Proposal Area (Baird 2020a). The ZoHI represents the predicted area of irreversible loss and the ZoMI represents the predicted recoverable impacts of BCH and the ZoI represents an area where dredging may cause a change in environmental quality but no detectable impact on BCH.

Separate zones of impact were modelled based on suspended sediment concentration (SSC) tolerance limits for coral as published by Fisher *et al*. (2019). Model scenarios presented in (Baird 2020a) are generally conservative to enable some flexibility in production rates, size of dredging plant and variability in sediment composition (i.e. per cent of rock flour). Furthermore, as stated in Fisher *et al.* (2019), it should be noted that the WAMSI thresholds to estimate for coral response from dredge-related pressures were derived based on impacts to clear-water coral communities and may not be as applicable for turbid nearshore coral communities such as those present in Port Hedland.

The “best case” and “worst case” ZoHI and ZoMI are predominantly located over bare substrate, however, areas of BCH mapped as ‘mixed assemblage’ and ‘mixed assemblage

with seagrass' are also predicted to be impacted (Table 8 and in Figure 13). It is noted that both of these habitat types include sparse cover of coral, therefore this was considered to be the BCH at most risk from the proposed dredging activities. Furthermore, thresholds published for coral (Fisher *et al*. 2019) are sufficiently conservative to allow for consideration of impacts to the seagrass species present within the mapped BCH 'mixed assemblage with seagrass'.

The estimated irreversible loss of BCH within the ZoHI of 14.9 ha (2%) is comprised of direct impacts from the construction of the channel of 2 ha and further indirect impacts of 12.9 ha from the effects of dredged generated sediments in the nearfield (i.e. ZoHI).

In the absence of historical information on BCH prior to development in Port Hedland, the proportion of mixed assemblage has been estimated to occur, so cumulative loss of BCH is limited to the irreversible loss occurring from the proposal. This predicted irreversible loss of BCH represents a relatively small percentage of the Spoilbank LAU and is likely to be within the range of error inherent in mapping BCH in these highly variable and turbid environments.

Figure 13 Predicted dredge plume impact scenarios

Table 8 Predicted *recoverable impacts* and *irreversible loss* of BCH from the proposal and cumulative loss (% is the proportion of BCH class lost within each LAU)

LAU	Loss Assessment	Benthic Communities & Habitats (ha and %)			
		Mixed Assemblage		Mixed Assemblage with Seagrass	
Spoilbank LAU	Pre-European Extent	576.2	**-**	90.1	**-**
	Current Extent	516.2	-	90.1	-
	Irreversible Loss	12.6	2.2%	2.3	2.6%
	Recoverable Impact	18.8	3.3%	3.2	3.6%
	Cumulative Loss	**12.6**	**2.2%**	**2.3**	**2.6%**
Inner Harbour LAU	Pre-European Extent	**151.7**	**-**	**0**	**-**
	Current Extent	**141.7**	**-**	**0**	**-**
	Irreversible Loss	**0**	0%	**0**	**0%**
	Recoverable Impact	**2.9**	1.9%	**0**	**0%**
	Cumulative Loss	**0**	**0%**	**0**	**0%**
TOTAL	Pre-European Extent	*727.9*	-	*90.1*	-
	Current Extent	*657.9*	-	*90.1*	-
	Irreversible Loss	*12.6*	*1.7%*	*2.3*	*2.6%*
	Recoverable Impact	*21.7*	*3.7%*	*3.2*	*3.6%*
	Cumulative Loss	***12.6***	***1.7%***	***2.3***	***2.6%***

5.5.6 Mitigation and Management

The management approach taken is risk-based and developed around the mitigation hierarchy to ensure impacts to benthic communities and habitat areas have been avoided or minimised to as low as reasonably possible.

Avoid

DoT has applied the mitigation hierarchy and reduced its impact as much as possible by reducing the size of the development footprint. Where possible, infrastructure locations are preferentially located within areas of bare sediment to reduce the amount of BCH removal required.

Minimise

DoT has developed a Dredge Environmental Management Plan (DEMP) (Appendix C) to manage impacts to BCH, which includes the following:

- impact zonation scheme including environmental protection outcomes and management targets
- water quality monitoring program to be implemented prior to, during and post dredging to give early warning before potential impacts occur to the coral communities, ensuring that the environmental protection outcomes and management targets are achieved
- a risk-based management trigger hierarchy based on indicators along the pressure response pathways and proposed adaptive management actions
- plume extent monitoring, such as MODIS imagery analysis to inform dredge monitoring and management.

The DEMP (Appendix C) includes project specific Management Targets (MTs) to mitigate the potential impacts on BCH and subsequently ensure that the EPA's objective for BCH is met and the predicted Environmental Protection Outcomes (EPOs) are achieved. The project specific MTs for BCH include:

- Dredging operations do not occur outside the defined dredge footprint.
- Recovery of BCH within the ZoMI worst-case scenario within 3 years following disturbance.
- No detectable impact on BCH within the predicted Zone of Influence (ZoI) best-case scenario.
- Manage water quality to achieve a High Level of Ecological Protection at the DMMA Tail water discharge.

For each of the above project specific MTs, a comprehensive set of monitoring and management actions and environmental performance measures have been established and are described in the DEMP.

5.5.7 Predicted Outcomes

All benthic habitats identified within the designated LAU are considered to be widespread across the turbid nearshore environments of the Pilbara region and are not considered to represent regionally significant BCH. Furthermore, limited distribution and low cover of BCH observed within the LAU suggests that their contribution to ecosystem services in a regional context is limited.

In consideration of the proposed monitoring and management described in the DEMP, the following specific Environmental Protection Outcomes (EPOs) are predicted as a result of the Project:

- irreversible loss within the ZoHI (including the dredging footprint) within the coastal LAU of:
    - 12.6 ha (2.2% of BCH within the LAU) of mixed assemblage BCH; and
    - 2.3 ha (2.6% of BCH type within the LAU) mixed assemblage with sparse seagrass BCH.
- potential recoverable impact within the predicted ZoMI the coastal LAU of:
    - 18.8 ha (3.3% of BCH type within the LAU) of mixed assemblage (including coral) BCH; and

    - 3.2 ha (3.6% of BCH type within the LAU) mixed assemblage (including coral) with sparse seagrass BCH.
- Potential recoverable impact within the predicted ZoMI the inner harbour LAU of:
    - 2.9 ha (1.9% of BCH type within the LAU) of mixed assemblage BCH.
- No loss of regionally significant BCH; and
- No Loss of BCH that constitutes critical habitat for any species of conversation significance.

The combined impact of the Proposal activities and the consequent outcomes are not considered to pose significant residual risks to the protection of BCH and therefore biological diversity and ecological integrity can be maintained. In respect of the proposed design and management of the Proposal, the Proponent considers that the EPA's objective for BCH has been met.

5.6 Key Environmental Factor – Air Quality

5.6.1 EPA Objective

The EPA's Environmental Objective for this factor is *'to maintain air quality and minimise emissions so that environmental values are protected.* The Proposal's potential impacts (identified below) will be avoided and mitigated to demonstrate that the EPA's Environmental Objective for this factor can be met.

5.6.2 Policy and Guidance

DoT has considered that the following current environmental policy and guidance is relevant to its assessment of the proposal for this factor:

- Statement of Environmental Principles, Factors and Objectives (EPA, 2018)
- Environmental Factor Guideline – Air Quality (EPA, 2016g)
- Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities (DEC, 2011)
- Port Hedland Air Quality Health Risk Assessment for Particulate Matter (DoH, 2016)
- Managing Dust in Port Hedland - Industry Regulation Fact Sheet (DoH, 2018)

5.6.3 Receiving Environment

Port Hedland is the world's largest volume port for bulk materials export. Iron ore, salt, manganese, chrome and copper concentrates and other commodities, including cattle, fuel and chemicals pass through Port Hedland. Stockpiles containing iron ore, salt, manganese and copper are located relatively close to residential areas at Nelson Point. Heavy vehicles and ships, material stockpiling and handling and a predominantly dry, windy climate contribute to dust (particulate matter or PM) dispersal over the local residential areas (DoH, 2016).

In early 2009, the Environmental Protection Authority expressed concern that 24 hour PM^{10} dust concentrations regularly exceeded the air National Environmental Protection Measure (air NEPM) of 50 $\mu g/m^3$ (+ 5 exceedances for natural events) and that existing planning arrangements allowed for residential development in the West End. In response, the Port Hedland Dust Management Taskforce (the Taskforce) reporting to the Premier was

convened by the Department of State Development in May 2009. The Port Hedland Dust and Noise Management Plan (DNMP) was prepared and released in March 2010.

The Port Hedland Industries Council (PHIC) was established in parallel to the Taskforce to facilitate whole-of-industry cooperation with the target guideline specifically and the DNMP generally and to develop an integrated approach to air-quality (and noise management). This has included the establishment of a network of 8 ambient air quality monitoring stations across the area. Two located in close proximity to the development envelope at Kingsmill and Taplin Street.

The monitoring data collected in 2012-2014 at the Port Hedland and South Hedland sites show that with the exception of PM^{10} and $PM^{2.5}$ all other pollutants meet the air quality standards and guidelines adopted for the HRA. The risk characterisation has shown that the pollutant that is having the greatest impact on public health in both Port Hedland and South Hedland is PM^{10}

In 2013, peak levels of PM^{10} reached as high as 400 µg/m^3 at the Taplin St site and analysis of the data indicates that these exceedances were not due primarily to regional dust events but to local sources of dust in the Port Hedland area. The sandy environment of the Spoilbank land formation was identified as most likely to have contributed to exceedances at both the Taplin and Kingsmill Street monitors (DoH, 2016).

In June 2013, Amendment 56 to the Town of Port Hedland Town Planning Scheme 5 was referred to the EPA under section 48A of the EP Act. Amendment 56 sought to rezone land on the Spoilbank land formation, north of Sutherland Street, from 'Parks and Recreation' to 'Marina Development'.

In 2016, the Taskforce and Department of Health undertook a health risk assessment (HRA) for Port Hedland to guide future planning and development decisions for the town. The HRA has calculated the risks posed to the residents of Port Hedland and South Hedland from exposure to ambient air pollution including PM^{10}, $PM^{2.5}$, NO^2, SO^2, respirable crystalline silica, asbestos fibres, manganese, copper and iron oxide. The HRA identified the Spoilbank as a key local source of dust emissions currently caused by wind erosion and from recreational vehicles (DoH, 2016).

DoT notes that the Taskforce's recommendation for a current interim guideline of 24-hour PM^{10} of 70 µg/m^3 continues to apply to residential areas of Port Hedland and that measures should be introduced to cap (and if possible, reduce) the number of permanent residents in dust-affected areas of Port Hedland.

5.6.4 Potential Impacts

Air Quality could be potentially impacted, either directly and indirectly, through the generation of fugitive dust emissions through the following construction activities:

- clearing land for the laydown sites, public open space and carpark - wind-borne dust from exposed surfaces
- Material stockpiling in the dredge material management area
- earth moving, transport, stockpiling or loading of materials.

5.6.5 Assessment of Impacts

Sources of Dust

Emissions of dust from construction of the proposed marina may result from three main processes:

- wind erosion
- materials handling
- vehicular movements.

The dust-generating sources and activities associated with the construction of the Proposal are described in Table 1 of the Dust Management Plan (Appendix C).

Risk Assessment

DoT's environmental consultants undertook a site risk assessment/classification in accordance with the framework provided in the DEC (2011) guidance to determine the level of dust management and monitoring required for the Proposal. The site classification chart (below) for uncontaminated dust was used to inform the risk assessment and associated management and monitoring requirements.

Part A Nature of site

Item	Comment	Score
Nuisance potential of soil when disturbed	Soils are expected to be uncontaminated particles predominantly larger than 50 µm diameter; therefore, the nuisance potential is considered primarily to amenity	2
Topography and protection provided by undisturbed vegetation	There is no protection provided by the topography or undisturbed vegetation	18
Area of site disturbed by the works	More than 10 ha	9
Type of work being done	Bulk earthworks	9
Total part A score		**38**

Part B Proximity of site to other land uses

Item	Commentary	Score
Distance of other land uses from site	The nearest residence is within 100 m	18
Effects of prevailing wind direction (at time of construction) on other land uses	The residential areas will be affected by winds coming from the north-west	9
Total Part B score		**27**

The site classification score is the product of the Part A and Part B score (38 x 27 = 1026). A site classification score over 800 is considered high risk. Therefore, the Proposal is considered high risk for potential dust impacts. The risk rating has informed the selection of appropriate management measures and monitoring for the Proposal's construction phase.

5.6.6 Mitigation and Management

To mitigate and manage construction dust emissions, DoT's environmental consultants developed the Proposal Dust Management Plan (DMP) (Strategen, 2020b). The DMP provides for a suite of management measures and monitoring protocols to be implemented during construction activities/

Avoid

DoT's environmental consultants have developed the Proposal's Dust Management Plan that has been prepared in consultation with the Pilbara Ports Authority (as a member of the

Port Hedland Industry Council). Dust management at the Site shall comply with Guidelines for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities (DEC, 2011).

To prevent or avoid excessive dust generation, the following wetting procedures of work area and haul roads will be undertaken:

- dry spoil to be stockpiled will be actively wet down during active extraction
- a total of three water carts (each minimum 10,000 L capacity) will be available in close proximity to the site entrance to enable pre-wetting of access roads and areas of the site where vehicle movements are anticipated will be carried out (pre-wetting and re-wetting requirements to be determined on-site by the Site Manager)
- pre-wetting will be conducted to increase the moisture content of any dry material to be moved, e.g. during recontouring
- areas to act as tipping receival surfaces will be wet down prior to commencement of tipping.

Minimise

To minimize excess dust generation the following management measures will be implemented:

- neighbouring land occupiers, the Town of Port Hedland and DWER will be notified prior to construction activities commencing and supplied with contact information for the Site Manager
- prior to commencement of any construction, wind fencing will be installed on the southern and eastern boundaries of the site and from the southwestern corner to the high watermark, if required
- water carts and canons will be available at the active work areas to provide contingency in the event of excessive dust generation
- stockpiles in active use will be wet down to reduce wind erosion and displacement of dust upon the addition of more material.
- stockpiles and cleared areas will be stabilised as required using a dust suppression crusting agent or other similar material
- stockpiled spoil to remain to the north of the marina following completion of the Proposal will be stabilised by revegetation with suitable flora species
- Should high wind speeds be forecast, site activities will be reviewed as deemed appropriate.

Monitoring

In order to proactively manage any dust generated by the construction of the Proposal, a monitoring program will be established to disseminate dust impacts resulting from emissions generated at the site with background dust and emissions from other sources:

- Site personnel and contractors will be required to record observations of visible dust emissions that appear to exit the boundary of the site, including date, time, location and extent of the visible plume. Those observations will be considered in relation to the measured dust concentrations and wind conditions, to inform management of site activities.

- Monitoring of PM^{10} and wind parameters is required in order to ascertain the impacts of the construction activities and to inform effective management. It is proposed that the same monitoring methods employed for the baseline Spoilbank monitoring are used (Section 2.8); specifically, BAM1020 monitors equipped with a real-time monitoring unit to yield both 1-hour and 10-minute averages as well as a wind sensor to record wind speed and direction on a 10-minute average basis. Monitoring sites will be equipped with telemetry in order to have access to real-time data via a web portal and to allow alarm notifications to be generated.
- On-site monitoring is proposed to comprise of three monitors to be installed on the Spoilbank. Preliminary locations designed to record any dust with the potential to travel towards nearby residences are provided in the Proposal DMP. Final monitoring locations will be subject to a detailed site survey and any constraints identified.

5.6.7 Predicted Outcomes

Dust emitted during construction will be localised and temporary. The regular watering of unsealed roads, exposed surfaces and active construction areas will reduce and control these emissions. Major roads and access surfaces will be sealed and the restriction of vehicle movements will further reduce dust emissions from construction activities. As a result of the implementation of these management measures, dust emissions from construction activities will have a temporary, localised, low impact on public amenity. Therefore, emissions during construction have not been assessed further.

6. OTHER FACTORS AND MATTERS

6.1 Other Environmental Factor – Coastal Processes

6.1.1 EPA Objective

The EPA's Environmental Objective for this factor is '*to maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected'.* The Proposal's potential impacts (identified below) will be avoided and mitigated to demonstrate that the EPA's Environmental Objective for this factor can be met.

6.1.2 Policy and Guidance

DoT has considered that the following current environmental policy and guidance is relevant to its assessment of the proposal for this factor:

- Statement of Environmental Principles, Factors and Objectives (EPA, 2018)
- Environmental Factor Guideline – Coastal Processes (EPA, 2016h)
- State Planning Policy No. 2.6, State Coastal Planning Policy, Western Australian Planning Commission (WAPC, 2006)
- Sea Level Change in Western Australia – Application to Coastal Planning (DoT, 2010)

6.1.3 Receiving Environment

The Spoilbank is an artificial landform created from the Port Hedland inner harbour and shipping channel dredging sediment disposal in the mid-1960s and early 1970s. Over the past 50 years, this artificially constructed area of land has migrated south and evolved from an offshore island to a shore-connected sandspit peninsula.

Multiple regional scale geomorphology and coastal engineering assessments confirmed that the Spoilbank is highly vulnerable to hydrodynamic forces. This man-made land feature was initially accreting sediment onshore but has now stepped into a shrinking/eroding phase. Substantial erosion is anticipated to occur over forthcoming decades. Morphological changes are particularly pronounced during severe tropical cyclone storms, including the Tropical Cyclone Veronica event in March 2019.

Coastal environmental values located on, and adjacent to the Spoilbank land formation include conservation significant marine fauna habitat (including nesting, breeding or foraging habitat) and intertidal and sub-tidal benthic communities, including a stand of open canopy arid zone mangrove (*Avicennia marina*) population that occupies the seaward margin of the foreshore located approximately 1 km to the west of the project area. The Spoilbank also provides the community of Port Hedland with a site for active and passive recreational activities, including fishing and 4WD activities (GHD, 2019). No unique landforms, significant cultural and aesthetic values, conservation significant flora and vegetation species occur on Spoilbank (Strategen, 2020a).

Furthermore, the western foreshore is devoid of foreshore or dune vegetation that provides stabilisation of the landform. A reef platform is also present from the base of the landform

extending towards the inner harbour that is subjected to high tidal ranges, natural variations in sedimentation and exposure at low tides.

6.1.4 Potential Impact

Coastal processes could be potentially impacted, either directly and indirectly, through the construction and placement of temporary structures along the western foreshore of the spoilbank land formation, including:

- construction of the marina entrance, breakwater and marina waterbody potentially altering wave energy and dynamics, current patterns and interrupt longshore sediment transport.
- construction of the breakwaters potentially trapping trap sediment and causing changes to the morphology of the coastal zone and potentially impacting near-shore benthic communities and habitat.

6.1.5 Assessment of Impacts

In assessing the impacts to the coastal environmental values supported by the Spoilbank land formation, DoT notes the landform's history as a man-made coastal landform created in the late 1960's and early 1970's as a result of disposing dredge material associated with dredging activities within the Port Hedland Inner Harbour and Goldsworthy shipping channel. Since 2003, the land feature has been experiencing a clear erosional trend and with the absence of a sediment source to replenish Spoilbank, the mechanisms for continued rotation of the westerly shoreline and loss of the Spoilbank landmass continues unmitigated (Baird, 2020). The Spoilbank evolution over the next 50-year period predicts a loss of more than 50 per cent of its footprint as the erosional trend continues (Figure 14).

Unmitigated, the coastal features of the Spoilbank will likely return to a state similar to the pre-1960's baseline state into the future. This is based on the assumption a remnant rocky base at 1m to 1.5m below the natural seabed will remain as the shoreline recedes.

The Proposal's infrastructure that has the potential to impact coastal processes include the breakwaters and revetments that alters wave energy and current patterns, and interrupt longshore sediment transport change erosion/accretion patterns. Baird Australia, commissioned by DoT, has completed a coastal processes assessment for a Proposal. DoT consultants concluded that this Proposal will cause only localised changes to the hydrodynamic and wave regime on the western side of the Spoilbank. The key findings from the studies included:

- The Spoilbank being in a clear erosional trend from around 2003 and with the absence of a sediment source to replenish Spoilbank, the mechanisms for continued rotation of the westerly shoreline and loss of the Spoilbank landmass is clear.
- Estimates of the Spoilbank evolution over a 50-year period predict a loss of more than 50 per cent of its footprint as the erosional trend continues (Figure 14).
- The northern breakwater is expected to largely stop sediment moving towards the southwest along the Spoilbank's western shoreline. This is an intentional feature of the breakwater to help keep the channel and marina navigable. As a result, erosion of the beach southwest of the marina is likely to accelerate due to construction of the Spoilbank Marina.
- The northern edge of the Spoilbank Marina is currently eroding and moving southward. Erosion is estimated to threaten the northern end of the Spoilbank Marina site by 2030-2040, at which time protection of the Spoilank against further erosion may be considered.

A project-specific Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) is being developed for the Proposal. The CHRMAP will inform future planning to prepare for long-term management of the continuing erosion at the project site. The CHRMAP will aim to confirm the specific extent of coastal hazards, evaluate the risks associated with the proposal and establish and provide guidance on the present and future risk management and adaption measures.

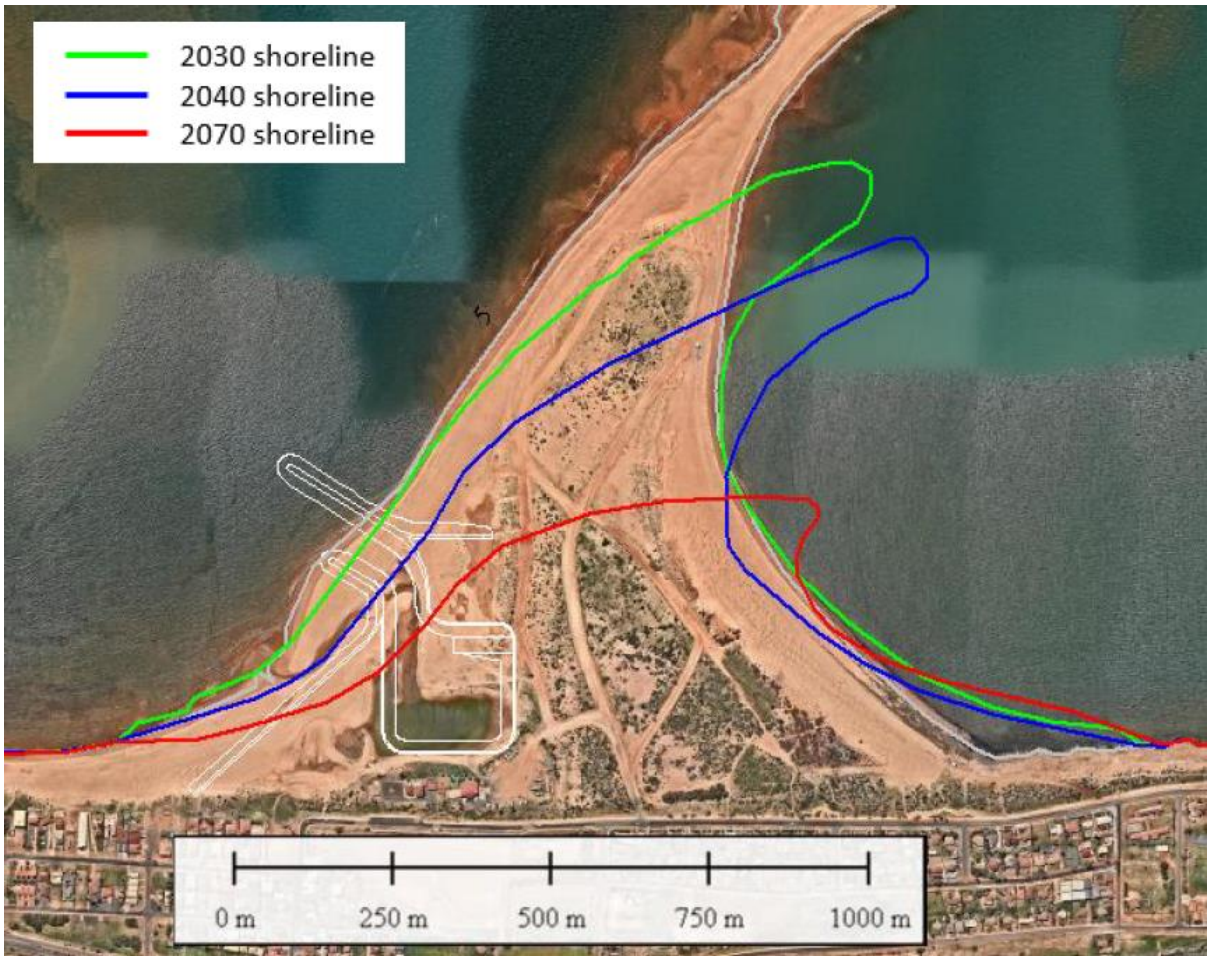

Figure 14 – Spoilbank Marina Coastal Processes 2030 – 2070 (Baird, 2020b)

6.1.6 Mitigation and Management

The management approach taken is risk-based and developed around the mitigation hierarchy to ensure impacts to the environmental values supported by the coastal landform have been avoided or minimised to as low as reasonably possible.

Avoid

DoT has applied the mitigation hierarchy and reduced its impact as much as possible by positioning the marina as far southward as possible and away from the eastern side of the Spoilbank land formation. Modifications to the recreational area along the eastern foreshore will be avoided and additional recreational sites adjacent to the marina will be enhanced and open to the public post-construction of the marina.

Minimise

DoT is currently developing a project-specific Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) for the Proposal. The CHRMAP will aim to confirm the specific extent of coastal erosion, evaluate the risks associated with the proposal and establish and provide guidance on the present and future risk management and adaption measures. The CHRMAP will inform future planning to prepare for long-term management of the continuing erosion at the project site. Location of the marina basin in the relatively far south area of the Spoilbank provides DoT with time to develop an adequate management approach to ensure the Proposal is managed to mitigate the impact of erosion and accretion activities on the Spoilbank landform.

6.1.7 Predicted Outcomes

Predicted outcomes of placement of the marina on Spoilbank includes:

- Impacts during construction expected to be minimal and confined to the immediate construction footprint.
- It is expected that the erosion of the beach southwest of the marina breakwaters will erode towards the reefs that formed the coastline prior to when the Spoilbank was created. Building the breakwaters will interrupt the sediment flow towards this beach and thus speed up the erosion.
- No significant impacts are likely to occur to natural communities and habitats that protect the coastline e.g. removal of foreshore or dune vegetation.
- No impact on the wave climate is expected outside the immediate vicinity of marina structures and entrance channel.
- Impact on tidal currents and water levels are expected to be minor and confined to the immediate vicinity of marina footprint and entrance channel.
- No problematic wrack accumulation is likely to occur.

7. OFFSETS

DoT are of the view that there will be no significant residual impacts as a result of implementing the Proposal and therefore, do not consider that offsets are warranted.

8. REFERENCES

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9. APPENDICES

Appendix A – Construction Environmental Management Plan

Appendix B – Dredge Environmental Management Plan (Teal *et al,* 2020)

Appendix C – Dust Management Plan (Strategen, 2020)

Appendix D – Operational Environmental Management Plan

Appendix E – Technical Memo – Spoilbank Marina Proposal: Artificial Lighting Impact Assessment Report (RPS, 2020)

Appendix F – Marine Environmental Quality Plan (Teal *et al*, 2019)

Appendix G – Flora and Vegetation Reconnaissance Survey Report (Strategen, 2020)

Appendix H – EPBC Protected Matters Search Report, dated 13 August 2019

Appendix I – Technical Memo – Spoilbank Marina Proposal: Review of Potential Impacts to Green Sawfish (Morgan *et al*, 2019)

Appendix J – Technical Memo – Assessment of Potential Impacts to Migratory Waterbirds (Bamford, 2019)

Appendix K – Underwater Noise Modelling Report (Talis, 2020)

Appendix L – Technical Memo – Spoilbank Marina Proposal: Review of Potential Impacts to Flatback Turtles (PENV, 2019)

Appendix M – Technical Report – Spoilbank Marina Proposal: Sawfish Risk Assessment Workshop Report (Teal *et al,* 2020)

Appendix N – Sediment Sampling and Analysis Report (Teal *et al*, 2019)

Appendix O – Water Quality Modelling Report (Baird, 2020)

Appendix P – Spoilbank Marina Benthic Communities and Habitat Report (Teal *et al*, 2019)

Appendix Q – Spoilbank Marina Cumulative Loss Assessment (Teal *et al*, 2020)

Appendix R – Metocean Design Criteria and Coastal Processes Studies (Baird, 2020)