Eramurra Solar Salt Project

Photo courtesy Pilbara Ports Authority

25 July 2022

Introduced Marine Pests Risk Assessment

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Key Acronyms and Abbreviations

Abbreviation	Definition
AFC	Anti-Foulant Coating
APMPL	Australian Priority Marine Pest List
ARMA	*Aquatic Resources Management Act 2016*
BCH	Benthic communities and habitat
BMP	Biofouling Management Plan
BWMC	Ballast Water Management Certificate
BWMP	Ballast Water Management Plan
CALM	Conservation and Land Management
CCIMPE	Consultative Committee on Introduced Marine Pest Emergencies
CSD	Cutter Suction Dredge
DAFF	Department of Agriculture Fisheries and Forestry (Australian)
DPIRD	Department of Primary Industries and Regional Development
ENSO	El Nino/Southern Oscillation
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority (Western Australia)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERASS	Equipment Risk Assessment Score Sheet
ERD	Environmental Review Document
ESD	Environmental Scoping Document
FRMA	*Fish Resources Management Act 1994*
IMO	International Maritime Organisation
IMP	Introduced Marine Pest
Leichhardt	Leichhardt Salt Pty Ltd
LEP	Level of Environmental Protection
MARS	Maritime Arrivals Reporting System
MDET	Monitoring Design Excel Template
MEQ	Marine Environmental Quality
MPSC	Marine Pest Sectoral Committee
MS	Ministerial Statement
Mtpa	Million tonnes per annum
NaCl	Sodium Chloride
NIMPIS	National Introduced Marine Pest Information System
NTU	Nephelometric Turbidity Unit
OGV	Ocean-Going Vessel
PAR	Pre-Arrival Report
PPA	Pilbara Ports Authority
PSU	Practical Salinity Units
TSV	Trans-Shipment Vessel
UVI	Unique Vehicle Identifier
VBRAMP	Vessel Biofouling Risk Assessment and Management Procedure
VRASS	Vessel Risk Assessment Score Sheet

EXECUTIVE SUMMARY

Leichhardt Salt Pty Ltd (Leichhardt) proposes to construct and operate the Eramurra Solar Salt Project, to extract up to 4.2 million tonnes per annum (Mtpa) of high-grade salt (Sodium Chloride (NaCl)) from seawater (the Proposal). The export of salt is proposed to be via a trestle jetty. The jetty and associated stockpiles will be located at the Cape Preston East Port approved by Ministerial Statements (MS) 949 and 1149. Potential environmental impacts associated with development of the Cape Preston East Port jetty and associated stockpiles are excluded from the current Proposal. Dredging of the proposed channel and berth pocket will be undertaken as part of the current Proposal. Bitterns will be transported as part of this Proposal by pipeline attached to the trestle jetty structure and discharged via a diffuser located off the trestle jetty.

Leichhardt has referred the Proposal to the Western Australian Environmental Protection Authority (EPA), under Section 38 of Part IV of the *Environmental Protection Act* 1986 (EP Act), and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) under a bilateral agreement. Leichhardt has developed an Environmental Scoping Document (ESD) for the Proposal to specify the form, content, indicative timing and procedure of an environmental review. The ESD identified marine environmental quality (MEQ) and marine fauna as one of the preliminary key environmental factors which has the potential to be impacted by the Proposal. To assess the potential impacts of Introduced Marine Pests (IMP) to MEQ, the EPA has recommended Leichhardt:

"Undertake a desktop Introduced Marine Pests (IMPs) investigation for dredge vessels, including an assessment of likely risks associated with the introduction of IMPs during dredging operations. The IMP investigation must also include a review to define baseline IMPs and a risk assessment for the introduction of IMPs during construction."

This document addresses the EPA recommendation, as outlined above. The methodology used to fulfill the EPA recommendation was to investigate the likelihood of introducing marine pests to the Proposal area based on existing data relevant to marine pests (oceanographic data, habitat data and target species lists), and information on Proposal-related dredging and marine construction plant provided by Leichhardt.

Detailed IMP risk assessments rely on very specific information (i.e. where the vessel/construction plant is mobilising from, voyage history, a precise duration of operation in an area etc). The dredging plant and other Proposal-related construction plant have not yet been contracted; thus, their port of origin and voyage history are unknown. As such, assessment of the likelihood of introducing marine pests was based on the assumption that contracted vessels/construction plant for the Proposal will meet Australian regulated biosecurity requirements, as implemented by Commonwealth and State agencies at the time of contracting.

The Department of Agriculture, Fisheries and Forestry (DAFF), under the *Biosecurity Act 2015,* is the lead agency responsible for the management of aquatic pests and diseases in Australian waters under the National Strategic Plan for Marine Pest Biosecurity 2018-2023. The Department of Primary Industries and Regional Development (DPIRD), under the *Fish Resources Management Act 1994* (FRMA), is the lead agency responsible for the management of aquatic pests and diseases in Western Australia. The Pilbara Ports Authority is also able to implement management requirements. Compliance with requirements from these agencies will be included within the Proposal's Dredging and Spoil Disposal Management Plan as set out in this document.

IMPs are non-native marine plants and animals that can cause harm to Australia's marine environment, social amenity or industries that use the marine environment. The majority of non-native marine species are introduced through the movement of ships and marine vessels, in ballast water and via hull fouling. A target list of 24 IMPs has been developed by Wells (2018) for species considered most likely to be capable of surviving in Pilbara waters if introduced. Despite considerable vessel traffic in and out of the

Cape Preston area, the baseline status of IMPs for the Proposal can be considered as zero species, based on two previous surveys conducted for the area (GHD 2013; URS 2009).

An assessment of the potential risks of introducing IMPs from the Proposal's dredging and marine construction vessels was completed following a five step process, informed by Proposal information received from Leichhardt. The five steps included identifying endpoints (introduction, spread and establishment of IMPs), identifying hazards (the 24 target IMPs), determining consequences, determining likelihood and calculating risk. Risk includes the consequence of introducing a marine pest species to an area dependent on the value and sensitivity of the receiving environment. While regionally significant arid zone mangrove communities assigned a Maximum Level of Ecological Protection are found adjacent to the Proposal's marine construction elements assessed here, these lie outside of distances over which IMPs have been noted to spread previously from points of introduction in the Pilbara. Relatively few IMP species are able to expand their range outside of the immediate port areas where they are introduced.

The risk assessment for the introduction of IMPs during dredging and construction concluded that all risk pathways were within the Low category following application of management for incoming plant and vessels.

1 INTRODUCTION

1.1 Proposal Description

Leichhardt Salt Pty Ltd (Leichhardt) proposes to construct and operate the Eramurra Solar Salt Project, to extract up to 4.2 million tonnes per annum (Mtpa) of high-grade salt (Sodium Chloride (NaCl)) from seawater, using a series of concentration and crystallisation ponds and processing plant, transport corridor, stockpiling and export from the Cape Preston East Port (the Proposal). The concentration and crystalliser ponds will be located on Mining Leases. The export of salt is proposed to be via a trestle jetty. The jetty and associated stockpiles will be located at the Cape Preston East Port which has been approved previously by Ministerial Statements (MS) 949 and 1149. Potential environmental impacts associated with development of the Cape Preston East Port jetty and associated stockpiles are excluded from the current Proposal.

Dredging of the proposed channel and berth pocket will be undertaken as part of this Proposal to remove high points at the Cape Preston East Port. Dredged material will either be disposed of at one or more offshore disposal locations, or onshore within the Ponds and Infrastructure Development Envelope. Bitterns will be transported as part of this Proposal by pipeline attached to the trestle jetty structure and discharged via a diffuser located off the trestle jetty.

The Proposal is located in the western Pilbara region of Western Australia (WA), approximately 55 km west-south-west of Karratha (Figure 1-1). The summary description of the Proposal has been provided in Table 1-1.

Table 1-1. Summary of Proposal

Proposal Title	Eramurra Solar Salt Project
Proponent Name	Leichhardt Salt Pty Ltd
Short Description	Leichhardt Salt Pty Ltd (Leichhardt) is seeking to develop a solar salt project in the Cape Preston East area, approximately 55 km west-south-west of Karratha in WA (the Proposal). The Proposal will utilise seawater and evaporation to produce a concentrated salt product for export. The Proposal includes the development of a series of concentrator and crystalliser ponds and processing plant. Supporting infrastructure includes bitterns outfall, drainage channels, product dewatering facilities, desalination plant and/or groundwater bores, pumps, pipelines, power supply, access roads, administration buildings, workshops, laydown areas, landfill facility, communications facilities and other associated infrastructure. The Proposal also includes dredging at the Cape Preston East Port and either offshore disposal of dredge material or the onshore use of dredge material within the Ponds and Infrastructure Development Envelope.

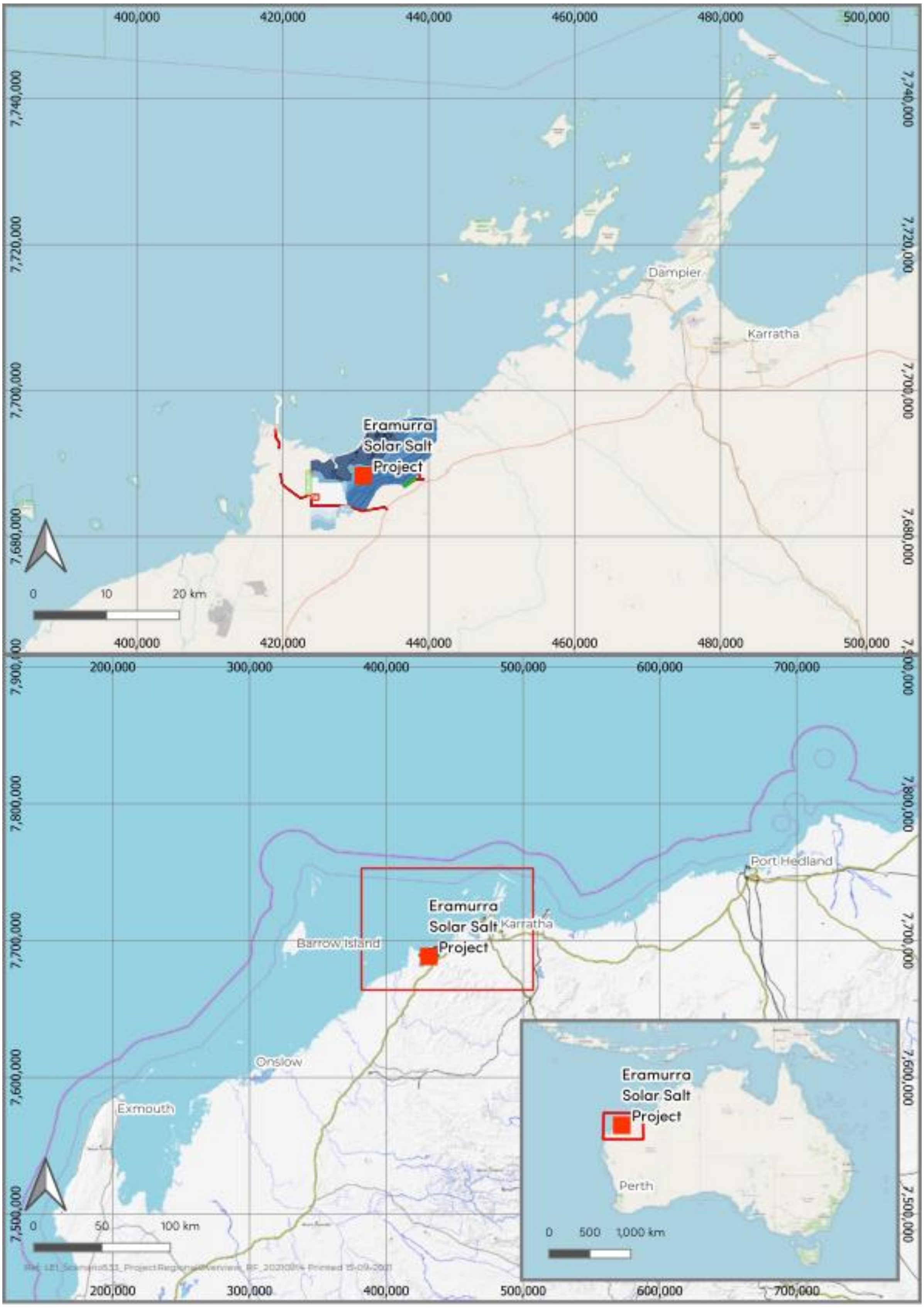

Figure 1-1. Proposal location

1.1.1 Marine Construction Elements

The majority of marine construction activity for the current Proposal will be associated with the dredging and transport of spoil material to the proposed disposal locations (Figure 1-2). Dredging is required to develop the proposed berth pocket, transhipment vessel (TSV) channel and anchorages, and the bitterns pipeline channel. The current Proposal design does not require any dredging along the selected channel route for the oceangoing vessels (OGVs). It is anticipated 314,000 m^3 of material (in situ volume) will be dredged for the Proposal, utilising a single medium sized Cutter Suction Dredge (CSD) and two split hopper barges (each with a capacity of ~1,500 m^3) to dispose of the dredge material. The details of the dredging contractor and dredge vessel/dredge plant to be engaged, including its port of origin, will be dependent on the availability of dredging plant during the construction phase of the Proposal. Dredging will continue for 24 hours per day, seven days per week and is estimated to last for a period of up to 105 days. The split-hopper barges are expected to transit between the CSD and the disposal grounds every eight hours. As barges will load directly from the CSD, no piping has been considered.

Post-dredging, a 15 – 25 m survey vessel will complete a bathymetric survey (~1,200 km of survey line) of the TSV channel, the OGV anchorages and the approach channel.

Construction activities for this Proposal include the laying of the bittern's pipeline that will extend along the seabed out from the Cape Preston East Multi-Commodity Export Facility jetty (the jetty, approved under MS 949/1149). It is anticipated that these works will utilise up to two barges and two workboats operating close to shore.

Marine delivery of machinery, construction equipment or materials for this Proposal is expected to be minimal.

1.1.2 State and Commonwealth Approvals

Leichhardt has referred the Proposal to the Western Australian Environmental Protection Authority (EPA), under Section 38 of Part IV of the *Environmental Protection Act* 1986 (EP Act), and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) under a bilateral agreement.

The EP Act is the primary legislative instrument for environmental assessment in WA. Under Part IV of the EP Act, the EPA is responsible for providing advice to the WA Minister for the Environment on proposals assessed under Part IV of the EP Act and considered by the EPA as likely to have significant impact on the environment.

The EPA decision on the Proposal referral information was 'Assess – Public Environmental Review'. Prior to developing the Environmental Review Document (ERD), Leichardt has developed an Environmental Scoping Document (ESD) for the Proposal to specify the form, content, indicative timing and procedure of the environmental review. The EPA has provided comments and recommendations for further work to be included in the ESD for the Proposal.

1.2 Purpose of this Document

The ESD identified marine environmental quality (MEQ) and marine fauna as preliminary key environmental factors (EPA 2021) which has the potential to be impacted by the Proposal. To assess the potential impacts of Introduced Marine Pests to MEQ and marine fauna, the EPA has recommended Leichhardt:

"Undertake a desktop Introduced Marine Pests (IMPs) investigation for dredge vessels, including an assessment of likely risks associated with the introduction of IMPs during dredging operations. The IMP investigation must also include a review to define baseline IMPs and a risk assessment for the introduction of IMPs during construction."

This document addresses the EPA recommendation, as outlined above.

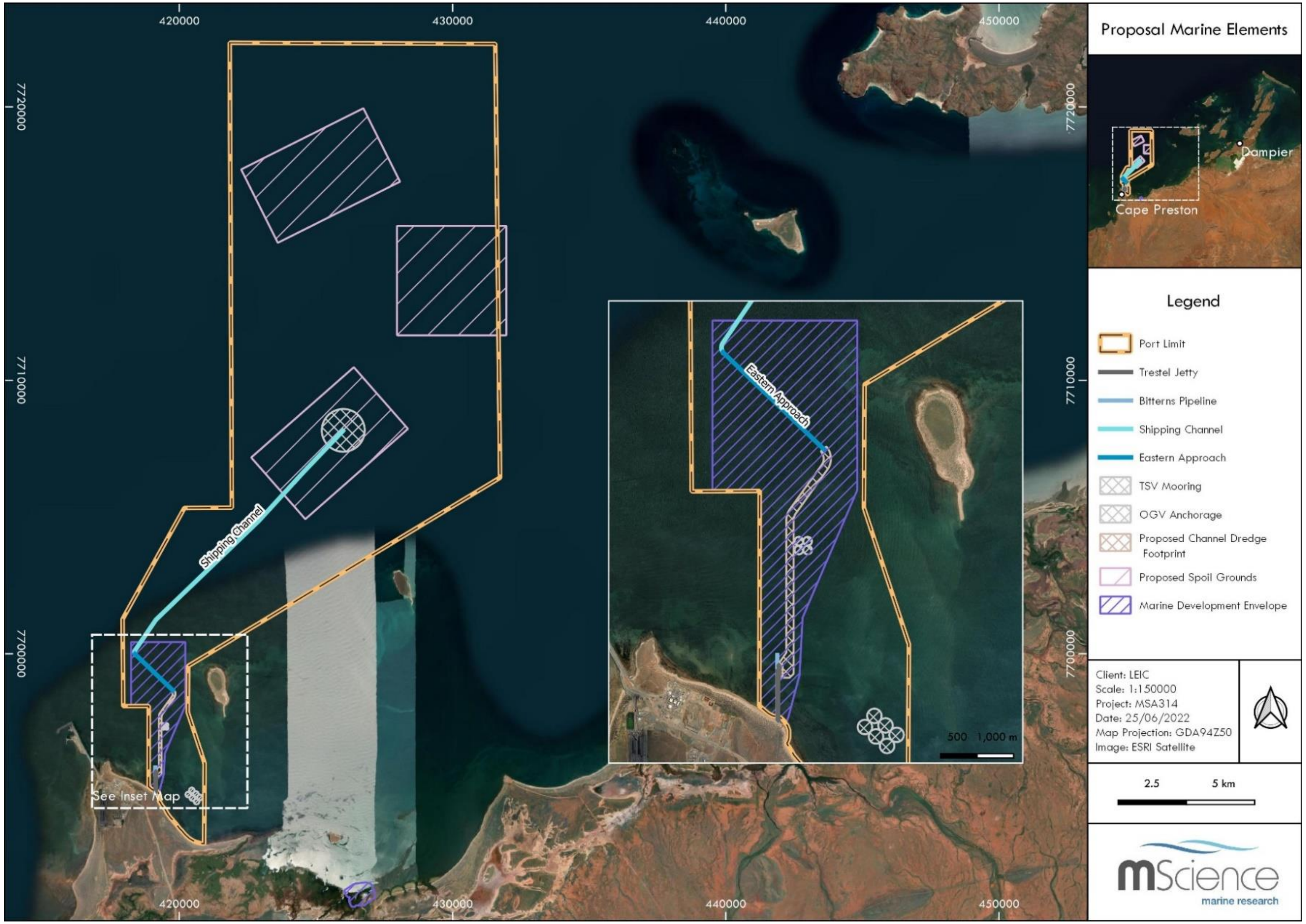

Figure 1-2. Proposal marine elements

1.3 Document Objectives

The assessments in this document are based on information existing at the time of writing. Detailed IMP risk assessments rely on specific information, including origins of the vessel/construction plant mobilised, voyage history and a precise duration of operation in an area. The dredging plant and other Proposal-related construction plant have not yet been contracted; thus, their ports of origin and voyage histories are not known at this time. As such, risks of introducing marine pests are based on the assumption that contracted vessels/construction plant for the Proposal will meet Australian biosecurity requirements (refer to Acts, Regulations and Guidelines listed in Section 3.1).

This document identifies relevant management/mitigation measures to ensure that the assumptions of risk of IMP translocation used in the document are met. Those measures are intended to be implemented in the Dredging and Spoil Disposal Management Plan.

To fulfil the ESD requirement, this document provides a desktop assessment covering:

- A description of the of the existing marine environment at Cape Preston as context for the introduction of marine pests;
- A discussion of the management measures in place to restrict the introduction of marine pests to Australia;
- A review of the history and current status of IMPs in WA, the Pilbara and Cape Preston to provide a baseline IMP status for the Project area;
- The risk assessment framework used to identify the potential for introducing marine pests during dredging and construction;
- An assessment of the potential impacts, and likelihood of occurrence, associated with the introduction of IMPs during dredging operations and marine construction activities; and
- Identification of relevant mitigation measures to reduce the assessed risk.

2 MARINE ENVIRONMENTAL SETTING

IMP risk assessments must consider the marine ecology of the Proposal area. Water temperature and salinity data are used to assist in identifying species that can survive in the Proposal location. Marine habitat data is used to assist in the identification of areas where target species are likely to establish based on habitat preference.

The physical and biological characteristics of the marine environment of the Proposal area have been described in documents developed by O2 Marine (O2 Marine 2021a; O2 Marine 2021b; O2 Marine 2022a; O2 Marine 2022b; O2 Metocean 2022). The following information is based on those references, unless cited otherwise.

2.1 Physical Characteristics

2.1.1 Climate

Cape Preston is located within the Pilbara region in northern Western Australia (Figure 1-1). The Pilbara experiences very hot summers, mild winters and variable rainfall, and is prone to cyclones (Sudmeyer 2016).

Pearce *et al.* (2003) reported monthly mean air temperatures across the region ranging from 20°C in July to 32°C in January/February; with monthly mean maximum and minimum temperatures at 36.1°C (in February) and 13.6°C (in July), respectively. More recent records show March to have the highest mean maximum temperature of 34.8°C, with July the lowest mean maximum of 25.8°C (BOM 2022). On average, over two hundred days per annum exceed 30°C, five of which exceed 40°C. January has the highest mean minimum temperature of 26.6°C with July further recording the lowest mean minimum temperature of 17.3°C.

Across the Pilbara, rainfall is spatially and temporally variable. Annual rainfall declines from 300-350 mm in the north-east, to less than 250 mm in the southwest (including Cape Preston). Rainfall is greatest during summer and autumn, with cyclonic events historically triggering the most extreme rainfall - 25-34% of the total annual rainfall near the coast (Sudmeyer 2016).

2.1.2 Winds

In the Pilbara, prevailing winds are west to south westerly during the warmer months (September to April) and easterly during the cooler months (May to August). During the warmer months wind strength tends to increase throughout the day and are strongest in the afternoons, whilst the opposite occurs in the cooler months (BOM 2022).

Tropical cyclones generally occur between November and April in the Pilbara. Winds in excess of 250 km/hr, torrential rain, storm surges, large waves and substantial movement of coastal sediments can be experienced during cyclones.

2.1.3 Tides, Waves and Currents

The tide levels analysed from data collected near the Proposal location found the mean spring tide range exceeds 3.5 m and the maximum tide range is ≈ 5.1 m. This is consistent with studies completed by Pearce *et al.* (2003) for the nearby Dampier Archipelago. The shallow waters of the Archipelago are strongly influenced by climate and seasonal-scale processes, meteorological events and diurnal forcing. Tides are semidiurnal with a well-defined spring-neap lunar cycle; the mean neap and spring tidal ranges are 1m and 3.6m, respectively. The highest astronomical tides can reach 5m in height, but storm surges (especially during cyclones) can raise sea levels well above the predicted tidal height.

The northwest coastline of Western Australia is subject to waves generated from three areas: Indian Ocean swell, locally generated waves and those from tropical cyclones. Typically, swell and waves approach the Pilbara coast from the north and north-west as a result of Southern Ocean swell refracted by the regional bathymetry and islands of the North West Shelf (Semeniuk 1996). Seas and swell on the open shelf off Dampier are generally heaviest in the winter and lightest in the summer. Only 10% of significant wave heights exceed 1.2 m, and the median height is about 0.7 m (Pearce *et al.* 2003).

The Indian Ocean's eastern boundary current off Western Australia, known as the Leeuwin Current, is atypical of other southern hemisphere continents as it has a pole-ward flowing coastal current, transporting warm tropical water south (Pearce and Griffiths 1991). During the summer months, the Leeuwin Current is at its weakest, and a counter current, the Ningaloo Current becomes noticeable. The Ningaloo Current is a wind-driven northward-flowing nearshore current, with cooler waters flowing as far north as Cape Preston and the Montebello Islands (Bancroft and Long 2008).

El Nino/Southern Oscillation (ENSO) events are associated with cooler shelf water and lower sea levels (partly linked with changes in the strength of the Leeuwin Current), while there is correspondingly warmer water and higher sea levels during La Niña periods.

2.1.4 Salinity

Simpson (1988) found salinity across the Pilbara region to be higher, and slightly more variable, on inshore reefs in shallow water (35.8 to 37.1‰) than on offshore reefs (35.4 to 36.1‰), with some seasonal variation and higher salinities during summer months. Salinity data was recorded at two nearshore locations within the Proposal area for 56 weeks. Salinity ranged between 32.0 to 38.6 practical salinity units (PSU) and was similar to the salinity range previously reported by CALM (2005) for the coastal Pilbara region.

2.1.5 Water temperature

Seasonal water temperatures across the Pilbara range from 18°C in winter to 31°C in summer, with measured extremes of about 20°C to 33°C. Diurnal variation in surface water temperature can reach 4°C on shallow inshore waters where fluctuations are at their greatest (Gilmour *et al.* 2006; Simpson 1988). Water temperature data collected for the Proposal over a 60-week period showed temperatures ranged between 20.1 and 32.5 °C. The warmest waters were experienced during January, with the coolest waters in June, July and August. Water temperatures were warmer during the wet season than the dry season, with the average temperatures approximately 5°C warmer during the wet season.

2.1.6 Turbidity

Wind speeds, wave heights, tidal currents and the amount of sediment on the substrata all influence levels of turbidity, with nearshore waters typically being more turbid than deeper, offshore waters (Gilmour *et al.* 2006). In Cape Preston in particular, the shallow waters (< 5m) around the rocky shores of the northern tip are exposed to reasonably large-water movement (Campey and Gilmour 2000). Tide can also have an influence on turbidity, particularly during high spring tides, due to the increased water flow (Jones *et al. 2015)*. Highly turbid waters can limit light penetration into the water column and affect life within it. Corals, for example, require relatively low turbid waters due to light penetration required for photosynthesis of coral's symbiotic algae, zooxanthellae. A study by Evans *et al.* (2020) showed coral recovery in the Pilbara region can be slower in areas of high turbidity.

Turbidity data collected over 54 weeks in the nearshore environment for the Proposal showed the 24 hour rolling mean for turbidity at the monitoring locations to remain below 3 NTU, with a number of sharp increases associated with intense weather events.

2.2 Marine Habitats

2.2.1 The Pilbara

The Pilbara region covers 507,896 square kilometres of unique natural landscapes of high marine and terrestrial biodiversity (Wells 2018). In 2013, an extensive biodiversity mapping and characterisation study was completed across the region via towed video (~18,700 km^2) by the University of Western Australia and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Pitcher *et al.* 2016). Sand dominated much of the study area, with coral reef areas found around offshore islands, such as Barrow Island and the Montebello Islands (Figure 2-1). The Pilbara includes a complex mix of physical and biological coastal and shallow water marine habitats (≤ 50 m) between Coral Bay and Port Hedland. The western Pilbara coastline is characterised by mangrove communities, supratidal flats behind the mangroves, intertidal creeks and mudflats and sandy flat habitats (IMCRA 1998).

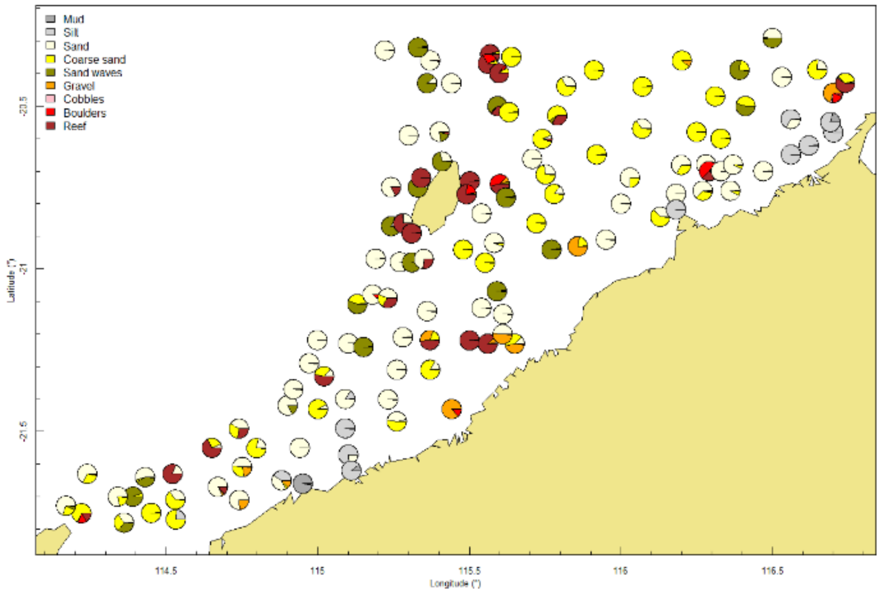

Figure 2-1. Characterisation of Pilbara substrates by Pitcher et al. (2016)

2.2.2 Cape Preston

Cape Preston is a rocky headland located approximately 60km southwest of Karratha. This rocky habitat extends from the Cape's shore for approximately 100m (Campey and Gilmour 2000). Campey and Gilmour (2000) conducted a baseline benthic marine community survey around Cape Preston which showed a high abundance and diversity of algae dominated by *Sargassum spp.* (~25%). Coral cover proved to be low (<10%) but with a wide diversity of benthic organism's present including sponges, zoanthids, ascidians and soft corals. In the northern region of Cape Preston and around Preston Island, a strip of coral reef was located with a high coral diversity and coral cover (~40%) (Campey and Gilmour 2000). This area was noted as being more characteristic of mid- to outer-coral reef environments with corals from the families Dendrophylliidae, Poritidae, Faviidae and Acroporidae most common.

Recent intertidal and subtidal benthic community and habitat (BCH) surveys have been completed for the Proposal. The outcome of these surveys have been detailed by O2 Marine (O2 Marine 2022a; O2 Marine 2022b). The following key BCH were identified:

Intertidal BCH:

- Algal mats;
- Foreshore mudflat / tidal creek;
- Mangroves;
- Rocky shores;
- Samphire / samphire mudflats;
- Sandy beaches; and
- Mudflats / salt flats.

Nearshore subtidal BCH:

- Bare sand;
- Low-moderate seagrass/macroalgae;
- Low-moderate filter feeders/macroalgae/hard coral;
- Low-moderate hard corals;
- High/dense hard corals;
- High/dense macroalgae; and
- High/dense filter feeders/coral (mixed habitat).

Three associated substrate types were also identified in the nearshore subtidal zone:

- Coarse sand;
- Rubble; and
- Rock.

The intertidal and subtidal BCH have been mapped and presented in Figure 2-2 and Figure 2-3, respectively.

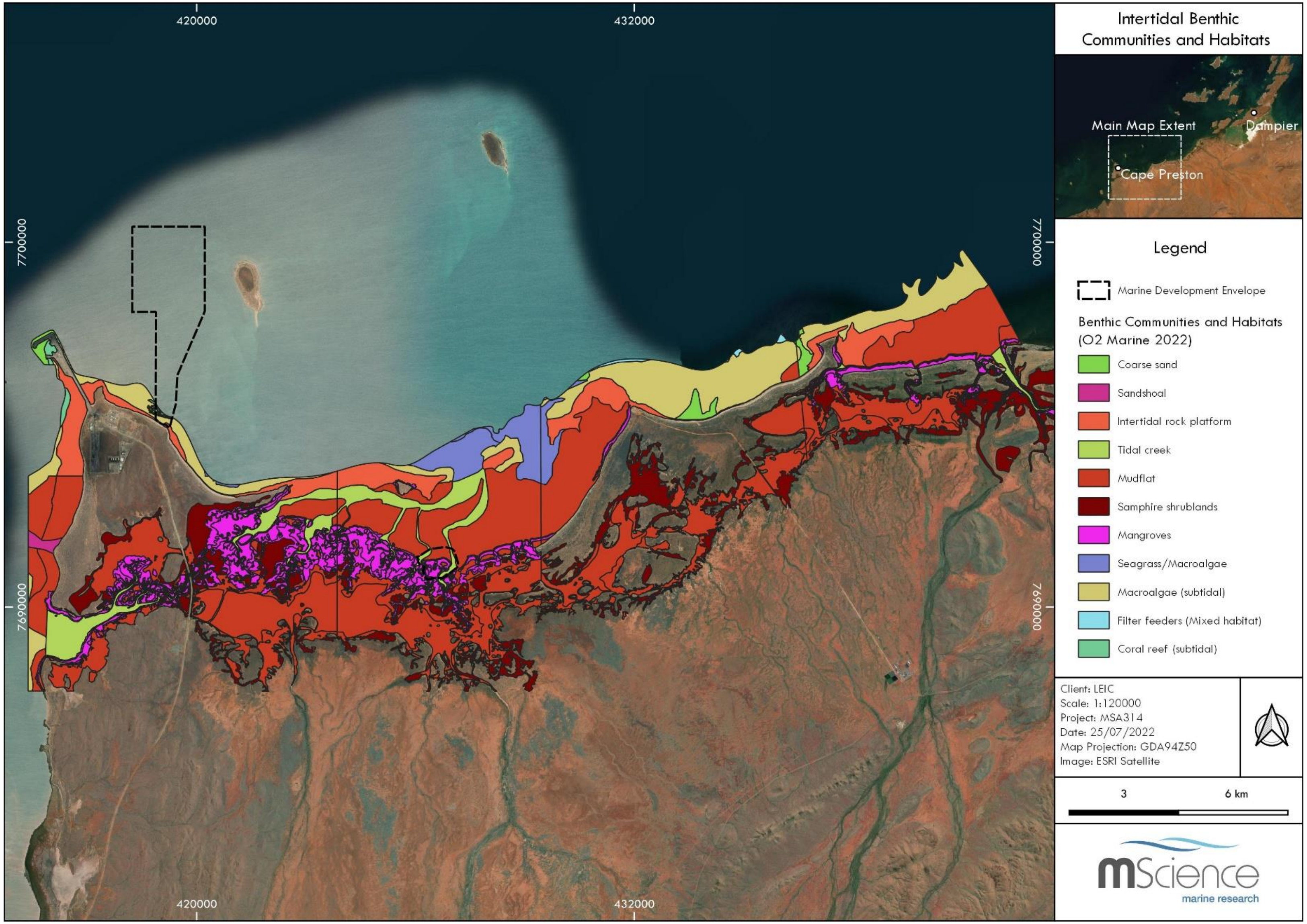

Figure 2-2. Intertidal benthic communities and habitats

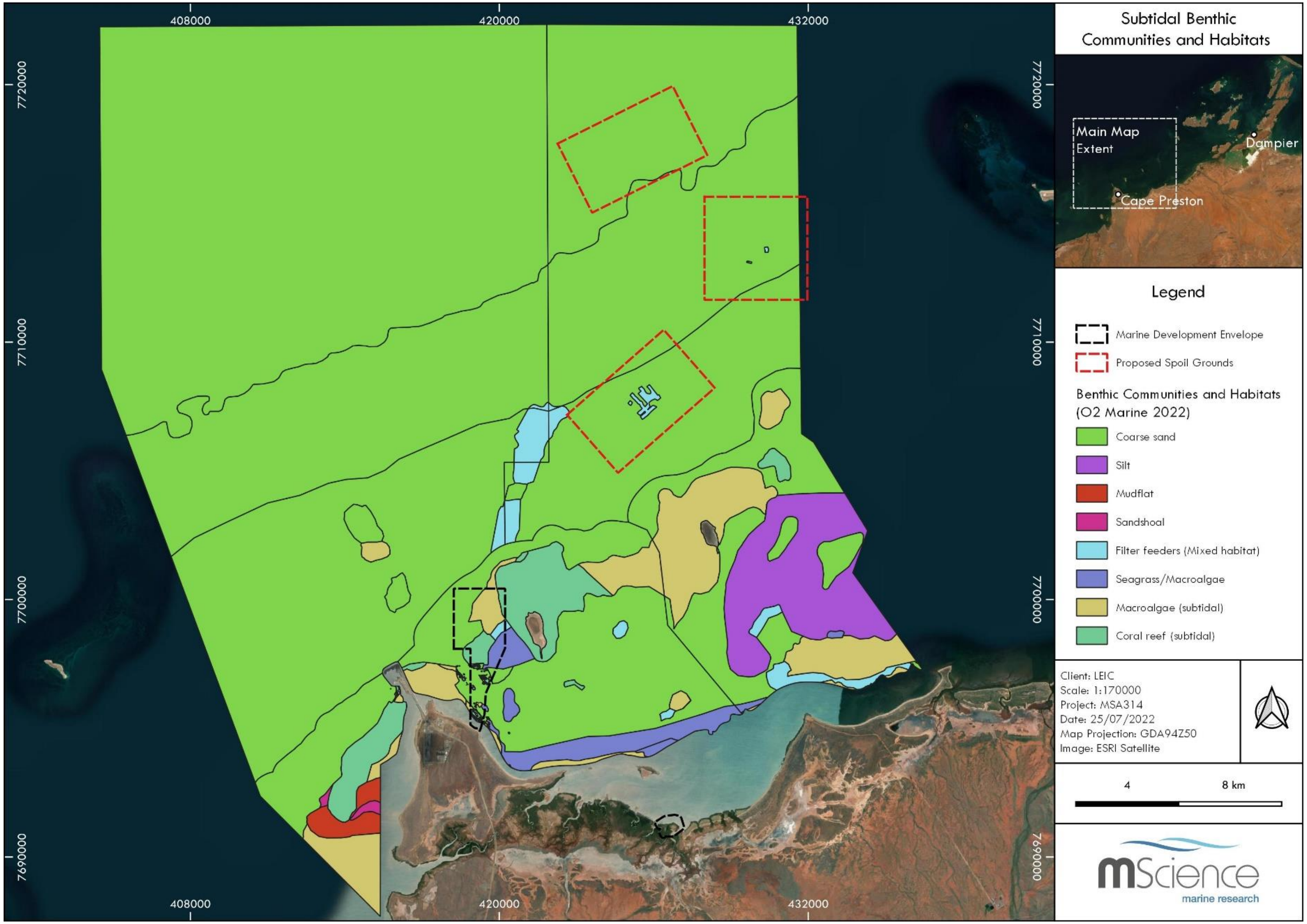

Figure 2-3. Subtidal benthic communities and habitats

3 INTRODUCED MARINE PESTS

3.1 Marine Pest Management in Australia

3.1.1 National System for Marine Pest Management

The Australian Government, through the Department of Agriculture, Fisheries and Forestry (DAFF), is the lead agency responsible for coordinating the development of practical policy approaches to address the issue of IMPs in Australian waters. The Marine Pest Sectoral Committee (MPSC) has developed The National Strategic Plan for Marine Pest Biosecurity 2018-2023 (the National System) (Commonwealth of Australia 2018) and the National Marine Pest Surveillance Strategy (Commonwealth of Australia 2019), which outline the national priorities for marine pest biosecurity and enhancing surveillance of marine pests in Australia.

The National Introduced Marine Pest Information System (NIMPIS) provides information on the biology, ecology and the distribution of marine pests either established or that pose a risk of future introduction to Australia. A database was constructed on 1582 species worldwide that had been introduced into new areas through anthropogenic activities (Commonwealth of Australia 2022a). NIMPIS provides biosecurity managers with information to assist in developing emergency response plans, stop the spread of marine pests in Australia and share marine pest surveillance data in their areas.

Previous work to determine priority marine pests and diseases has resulted in the development of numerous priority, target and trigger lists (see **Appendix A**). Review of National marine pest biosecurity in 2015 identified the need to revise the approach to the National System to better reflect the current understanding of marine pest impacts and pathways. Subsequently, MPSC developed a new list of priority marine pest species, which includes both exotic and established species (MPSC 2018). The Australian Priority Marine Pest List (APMPL) identifies 10 of Australia's significant marine pests. This list includes three established and seven exotic species (Commonwealth of Australia 2022b).

The established marine pests of national significance are:

- *Undaria pinnatifida* (Japanese kelp);
- *Carcinus maenas* (European shore crab); and
- *Asterias amurensis* (northern Pacific seastar).

The proposed exotic marine pests of national significance are:

- *Eriocheir sinensis* (Chinese mitten crab);
- *Rhithropanopeus harrisii* (Harris' mud crab);
- *Perna viridis* (Asian green mussel);
- *Perna perna* (brown mussel);
- *Mytella strigata* (Charru mussel)
- *Perna canaliculus* (New Zealand green-lipped mussel); and
- *Mytilopsis sallei* (black-striped false mussel).

The following Federal Acts, Regulations and Guidelines are relevant when enforcing biosecurity in Australian waters:

- *Biosecurity Act 2015 and Regulations 2016;*
- *Biosecurity Amendment (Ballast water and other measures) Act 2017;*
- *Biosecurity (ballast water and sediments) Determinations 2017*; and
- *Australian Ballast Water Management Requirements 2017*.

DAFF also represents Australia at the International Maritime Organization (IMO) on ballast water and biofouling matters:

- International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004 (the ballast water management convention); and
- International Convention on the Control of Harmful Antifouling Systems on Ships.

3.1.2 WA System for Marine Pest Management

The Department of Primary Industries and Regional Development (DPIRD) is the lead agency responsible for the management of aquatic pests and diseases in WA. DPIRD administers several WA acts, the most important of which is the WA *Fish Resources Management Act 1994* (FRMA) and accompanying *Fish Resources Regulations 1995*. Other relevant Acts and Regulations for biosecurity in WA include:

- *Biodiversity Conservation Act 2016*;
- *Biosecurity and Agricultural Management Act 2007*;
- *Environmental Protection Act 1986*;
- *Pearling Act 1990;* and
- *Ports Authority Act 1999 and Regulations 2001*.

The *Aquatic Resources Management Act 2016* (ARMA) will replace the FRMA and the *Pearling Act 1990*, to become the primary legislation used to manage aquatic resources in WA. Final amendments to the ARMA passed on 19 August 2021 but regulations to implement the Act are not yet public.

Currently, DPIRD lists 83 marine species of concern which may be spread by biofouling or ballast water and become potential pests within the marine environment (DPIRD 2016).

3.2 Defining Introduced Marine Pests

IMPs have been defined in the National System as "non-native marine plants and animals that can cause harm to Australia's marine environment, social amenity or industries that use the marine environment" (Commonwealth of Australia 2018). The majority of non-native marine species are introduced through the movement of ships and marine vessels (Molnar *et al.* 2008), in ballast water and via hull fouling (Bax *et al.* 2003). This has been exacerbated by the shift to the use of ocean water as ballast over rubble and solid ballast since World War Two (Wells *et al.* 2009). Higher concentrations of IMP concentrations tend to align with receiving nodes of high human activity such as ports, harbours and estuaries (Huisman *et al.* 2008).

In ecological and economic terms IMPs, which may be translocated in ballast water or as biofouling, can (Carlton 1996):

- Out-compete, prey upon, or otherwise displace native species;
- Alter natural ecological and bio-physical processes;
- Act as vectors for pathogens which can impact upon ecological or human health;
- Degrade or cause the collapse of commercial fisheries and aquaculture enterprises, either through direct competition with target species or via the introduction of a pathogen; and
- Cause problems for industrial infrastructure and navigation aids, for example, by blocking seawater intakes/outlets, impairing the operation of undersea valves, or causing buoys to sink, resulting in increased costs associated with cleaning and maintenance.

It has been argued that IMPs are one of the greatest threats to native marine biodiversity of the world's oceans (Molnar et al. 2008) and account for the greatest loss of biological diversity after habitat destruction (Vitousek *et al.* 1997).

3.3 History and Status of Introduced Marine Pests in WA

3.3.1 IMPs in Western Australia

Australia relies heavily on its marine infrastructure, with shipping vessels the primary pathway for the movement of goods, carrying up to 95% of trade volume (Commonwealth of Australia 2018). With this reliance comes a heightened risk of the introduction of marine pests. Every Australian port surveyed has reported an exotic marine species (Thresher 1999). Many IMPs have not been able to establish self-sustaining populations due to inadequate environmental conditions at their port of discharge (Thresher 1999). However, when conditions are optimal, the subsequent loss of biodiversity is an inevitable result of pest intrusions (Wyatt *et al.* 2005). The most invasive groups have been found to be bryozoans (15 species), crustaceans (13 species) and molluscs (9 species) (Huisman *et al.* 2008).

Within WA, a study by Wells *et al.* (2009) concluded the greatest concentration of IMPs has been in the southwest of the state, mainly due to the number of ports in the region. Fremantle, for example, is the busiest port with the largest number of vessel movements and has seen 46 introduced species, followed by Albany (25) and Bunbury (24).

Huisman *et al.* (2008) found WA has, so far, remained relatively free of established marine pests. Just 66 marine species are known to have been introduced to the state through anthropogenic activity. Most (37) were temperate species that have been found from Geraldton south.

3.3.2 IMPs of the Pilbara Region, including Cape Preston

There have been more introduced marine species surveys conducted across the Pilbara than anywhere else in Australia (Wells 2018). Bridgwood and McDonald (2014) completed a likelihood analysis of the introduction of marine pests to WA ports via commercial vessels. The study identified the Port of Dampier at highest risk of inoculation and establishment of IMPs compared to other ports in the Pilbara Region.

Seventeen IMP species have been recorded in the Pilbara (Table 3-1) (Bridgwood *et al.* 2014; Huisman et al. 2008). Despite the extensive monitoring of nearshore marine environments, the only IMP known to have established a self-sustaining population is the tunicate *Didemnum perlucidum* (Wells 2018). First reported in Perth, WA, in 2010, *D. perlucidum* has since been well documented to have spread across 2,800 km of coastline to Exmouth and Dampier in the north (Bridgwood *et al.* 2014). Due to its established populations and widespread distribution, DPIRD has determined that eradication of this species from Australian waters is now unlikely.

Table 3-1. Records of Introduced Marine Species in the Pilbara adapted form Huisman et al. (2008)

Group	Species	Pilbara Distribution *
Bryozoans	*Amathia distans*	PH
	Amathia vidovici	PH
	Bowerbankia gracilis	PH
	Bugula neritina	D, PH
	Bugula stolonifera	PH
	Savignyella lafontii	BI, PH
	Tricellaria occidentalis	BI
	Zoobotryon verticillatum	PH

Group	Species	Pilbara Distribution *
Crustaceans	*Amphibalanus Amphitrite*	D, PH, OC
	Amphibalanus reticulatus	BI, D, PH, OC
	Megabalanus ajax	BI, D, OC
	Megabalanus rosa	BI, D, PH, OC
	Megabalanus tintinnabalum	BI, D, PH, OC
Hydroids	*Antenella secundaria*	PH, OC
Ascidians	*Botryllus schlosseri*	OC
	Styela plicata	OC
	Didemnum perlucidum	BI, D

*PH = Port Hedland, BI = Barrow Island, D = Dampier, OC = Open Coast

IMPs on the current DPIRD biosecurity alerts list (Table 3-2) and species on the APMPL have been detected previously at the Port of Dampier, ~55 km east-north-east of Cape Preston. The Asian green mussel (*Perna viridis)* was reported during inspections of the dredge vessel, *Volvox Australia,* in 2006 and a mobile platform in 2011 (Wells 2018). None of the species listed in Table 3-2 currently have a self-sustaining population in the Pilbara but do have potential to be detrimental to the local marine environment.

Previous IMP surveys completed at Cape Preston did not detect any marine pest species on the priority/target lists current at the time of the surveys (GHD 2013; URS 2009).

Table 3-2. WA biosecurity alerts list

Species	Common Name
Perna viridis	Asian green mussel
Mytilopsis Sallei	Black striped false mussel
Charybdis japonica	Asian paddle crab
Carcinus maenas	European green crab
Undaria pinnatifida	Japanese Kelp
Asterias amurensis	Northern Pacific seastar
Cherax quadricarinatus	Redclaw crayfish
Leiopotherapon unicolor	Spangled Perch

3.4 Target IMP Species for Cape Preston

The common method used to develop a target IMP list for a specific location is to screen existing IMP lists and then match known salinity and temperature tolerances of each species with the conditions at that location. Under the National System, the design of IMP monitoring surveys, including species selection, must be accredited prior to implementation (Commonwealth of Australia 2010a). The Australian marine pest monitoring manual and guidelines (with associated toolkit) were developed to aid in the design of IMP monitoring surveys conducted in Australia (Commonwealth of Australia 2010a; Commonwealth of Australia 2010b). The toolkit includes an optional Monitoring Design Excel Template (MDET) which provides environmental tolerance ranges for listed IMPs to aid in species selection. The MDET is conservative, with a number of criteria to estimate whether a species could survive in an area, primarily temperature and salinity. It is important to note that it is possible for a species to tolerate a wider range in temperature and salinity values than is currently known or reported.

Wells (2018) used methods detailed in the Australian marine pest monitoring manual to select species on the associated marine pest monitoring target species list (Commonwealth of Australia 2010a; Commonwealth of Australia 2010b) that were considered most likely to be capable of surviving in Pilbara waters if they were introduced. Wells (2018) identified a list of 24 IMPs (Table 3-3). The IMPs listed in Table 3-3 have been used as the target IMP species for Cape Preston in this assessment, on the basis that the environmental tolerance ranges used by Wells (2018) for the Pilbara would be representative of Cape Preston (see Section 2, environmental conditions at Cape Preston are typical of the Pilbara Region). The same species proposed here were considered target IMPs for the nearby Mardie Salt Project (O2 Marine 2020).

Table 3-3. IMPs likely to be able to survive in the Pilbara region (Wells 2018)

Group	Species
Dinoflagellates	*Alexandrium monilatum* *Pfiesteria piscicida*
Diatoms	*Chaetoceros concavicornis* *Chaetoceros convolutus*
Ctenophorans	*Beroe ovata* *Mnemiopsis leidyi*
Algae	*Bonnemaisonia hamifera* *Caulerpa taxifolia* *Codium fragile* *Grateloupia turuturu* *Womersleyella setacea*
Cnidarians	*Blackfordia virginica*
Polychaetes	*Hydroides dianthus*
Barnacles	*Amphibalanus eburneus*

Group	Species
Crabs	*Hemigrapsus takanoi* *Hemigrapsus penicillatus* *Hemigrapsus sanguineus* *Rhithropanopeus harrisii*
Gastropods	*Crepidula fornicata*
Bivalves	*Magallana gigas* *Mya arenaria* *Mytilopsis sallei* *Perna viridis*
Ascidians	*Didemnum sp.*

3.5 IMP Vectors and Nodes

3.5.1 Vectors

Transport mechanisms, often referred to as vectors in marine biosecurity, have facilitated the translocation of multiple marine pest species and often entire assemblages of tens to hundreds of species between disparate bioregions (Hewitt *et al.* 2011). Marine pest species can be transported via a variety of mechanisms including:

- Boring into wooden-hulled vessels;
- Biofouling of organisms on vessel hulls and in niche areas including sea-chests and internal pipe work;
- Ballast water transport of planktonic and pelagic organisms, including species fragments;
- Intentional transfers of aquaculture organisms, specifically oysters;
- Unintentional movement of associated organisms including pathogens, parasites, epifaunal and infaunal organisms;
- Deliberate transfers of aquaculture food products such as live, fresh or frozen materials;
- Biofouling of aquaculture gear;
- Transfer of live, fresh, frozen and dried food products and live aquarium products;
- Use of biological material for packing; and
- Transport of species for scientific research.

Ballast water and biofouling have long been recognised as the vectors most likely to be responsible for marine species invasions (Hayes *et al.* 2019). For dredge plant, sediment remaining from previous dredging represents a significant vector if not removed prior to port entry.

3.5.2 Nodes

Nodes are the locations from which a potential marine pest is transported. Potential nodes include:

- Elements of commercial trading ports (wharves, anchorages, channel, tug pen, barges, other services);
- Marinas, boat ramps, recreational anchorages;

- Boat yards, slipways, drydocks; and
- Navigational buoys; and
- aquaculture leases.

4 RISK ASSESSMENT FRAMEWORK

Science-based risk assessment has been identified as a key element of Australia's biosecurity system and underpins the nation's biosecurity policies (Commonwealth of Australia 2018).

4.1 Risk Assessment Approach

An assessment of the potential likelihood of introducing IMPs from the Proposal's dredging and marine construction vessels was completed following the methods developed by Hewitt *et al.* (2011), informed by Proposal information received from Leichhardt. These methods were adopted by DPIRD to assess the likelihood of IMPs being translocated by commercial vessels into WA state waters (Bridgwood and McDonald 2014).

Hewitt *et al.* (2011) followed a five-step process:

- Identifying endpoints;
- Identifying hazards;
- Determining consequences;
- Determining likelihood; and
- Calculating risk.

4.1.1 Identifying Endpoints

From a biosecurity perspective the overall likelihood of the introduction of a marine pest to any location is based on three key factors: the likelihood of inoculation (introduction), the likelihood of infection (spread) and the likelihood of establishment (Bridgwood and McDonald 2014).

The current risk assessment focused primarily on the entry of vessels to the Proposal area and their characteristics (ports of origin) with less extensive evaluations of establishment and spread. Studies referenced above for Pilbara IMPs have identified that (apart from *D. perlucidum*) IMPs have not spread beyond the immediate area of ports where they have been introduced.

4.1.2 Identifying Hazards

Key hazards for Cape Preston were deemed to be those marine pest species identified by Wells (2018) as most likely to be capable of surviving in Pilbara waters if they were introduced. Species association with biofouling was assessed on the basis of life history characteristics. All target species, with the exception of *Caulerpa taxifolia*, have at least one planktonic life history stage with the potential to be translocated in vessel ballast water.

4.1.3 Determining Consequences

4.1.3.1 IMP INTRODUCTION

The consequence of introducing a marine pest species to an area is dependent on the value and sensitivity of the receiving environment. The Pilbara Coastal Water Consultation Outcomes (Department of Environment 2006) spatially defines the Levels of Ecological Protection (LEP) for the Cape Preston area (Figure 4-1). Areas around the Proposal's marine development envelope are generally assigned a high level of ecological protection. Regionally significant arid zone mangrove communities, that have been assigned a Maximum LEP, and conservation significant marine fauna (O2 Marine 2022c) are also found adjacent to the Proposal's marine construction elements relevant to this assessment (refer to Section 1.1.1).

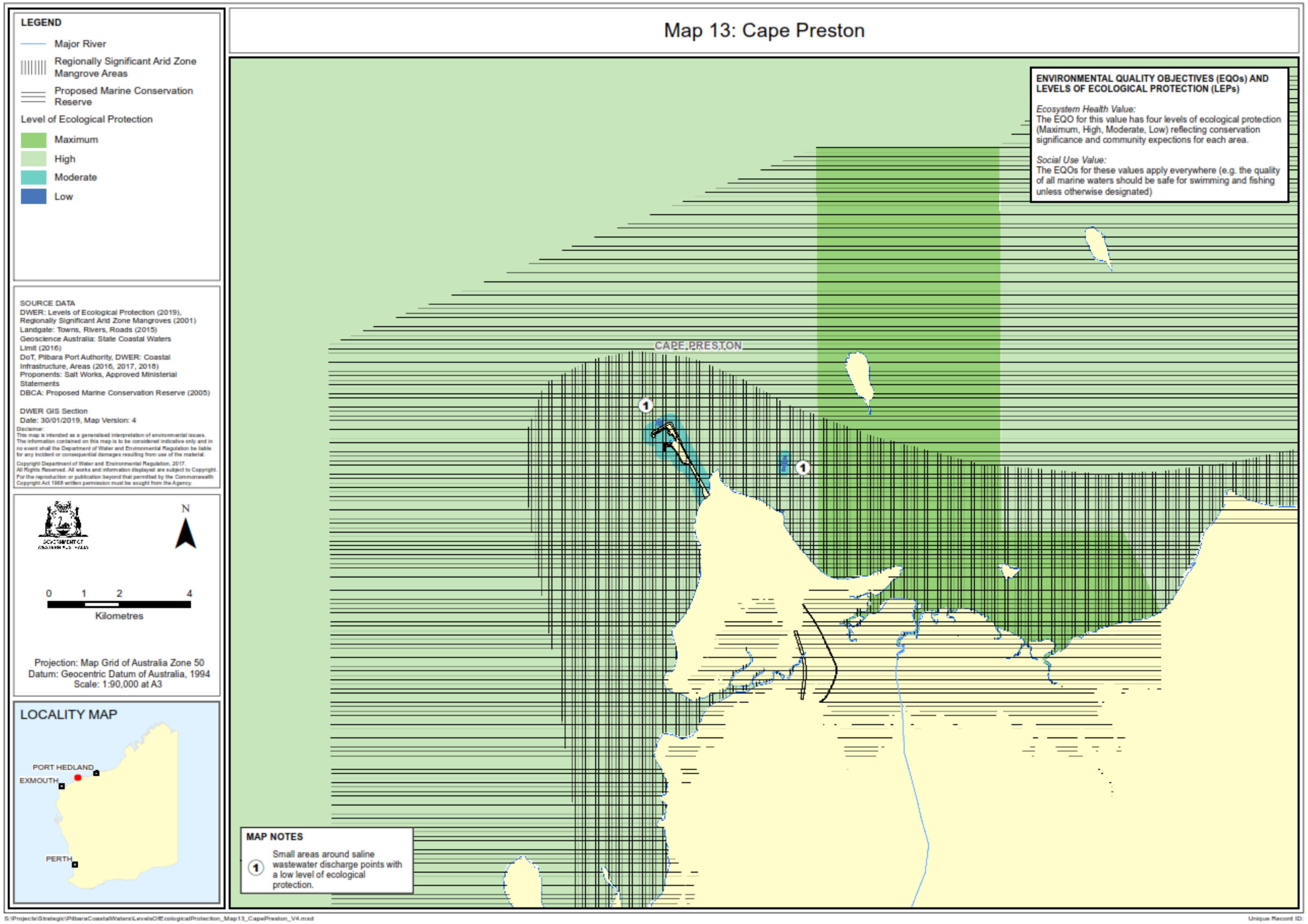

Figure 4-1. Cape Preston levels of ecological protection (Department of Environment 2006)

4.1.3.2 IMP ESTABLISHMENT AND SPREAD

The impact of introducing marine pests was assessed for relevant marine pest species on three core values of the environment, economics and social/cultural factors, based on information derived from published literature. Overall, relevant species had neither demonstrable nor inferred impacts stated in the published literature, significantly decreasing the ability to assess risk. Bridgwood and McDonald (2014) provide information on the impacts for 12 species identified from international and domestic sources that presented the greatest likelihood of infection and establishment to the nearby Port of Dampier (Table 4-1).

4.1.4 Determining Likelihood

4.1.4.1 IMP INTRODUCTION

The assumption underpinning most IMP assessments is that the risk of IMPs being brought into the receiving environment increases with the number of vessel visits from a source with IMPs. In the current case, it has been assumed that dredging plant enters the Proposal area on only one occasion, remains, then departs.

The dredging plant and other Proposal-related construction plant have not yet been contracted; thus, their port of origin is unknown. The dredge vessel and/or marine construction vessels may be sourced domestically or internationally. For the purposes of this assessment, internationally sourced vessels were assumed to be compliant with Australia's mandatory Ballast Water Management Requirements (Commonwealth of Australia 2020) and had completed an inspection and cleaning, at a minimum. As such the risk associated with an internationally and domestically sourced vessel was considered the same. In addition, it has been assumed that marine construction/dredge plant will arrive and depart the Pilbara/Cape Preston area only once during construction. On this basis, the current assessment focussed on the type and risk rating of Proposal-related construction vessels.

Using established risk determination methods (Bridgwood and McDonald 2014), the Proposal-related vessel types were categorised into: (1) low risk, (2) moderate risk, and (3) high risk. This categorisation included consideration of the following factors:

- Mean dead weight tonnage (DWT) a proxy for biofouling potential. Assumption: the bigger the vessel the greater the surface area for biofouling.
- Number and range of niche areas e.g. sea chests, anodes and stabilisers. Assumption: the more niche areas the greater the potential for retaining biofouling.
- Port duration time Assumption: the longer the duration of stay the greater the likelihood of inoculation of the recipient environment.
- Working speed of the vessel Assumption: the slower the vessel the greater the likelihood that an IMP can settle on the hull.
- Antifouling coating (AFC) wear and tear rate Assumption: vessels that have an operating profile that causes increased wear and tear on the AFC will have an increased likelihood of IMP settlement on the hull.
- Maintenance constraints Assumption: vessels that have structural profiles that inhibit effective maintenance of AFC application will have an increased likelihood of IMP settlement on the hull.
- Contact with seabed Assumption: vessels that have an operating profile that causes contact with the seabed have a greater likelihood of IMPs settling directly on the hull or being entrained along with sediment.

For each factor a value of 0, 1, 2 or 3 was assigned to a vessel type. The values were then averaged across the factors and rounded to the nearest whole number. This provided the overall level of risk for each vessel type. The risk rating for Proposal-related construction vessels has been provided in Table 4-2 and a general description of these vessel types, based on a review undertaken by Kinloch *et al.* (2003), is provided in **Appendix B.**

Table 4-1. Impacts for species which presented the greatest likelihood of infection and establishment to the Port of Dampier by Bridgwood and McDonald (2014)

IMP species	Impacts
Carcinus maenas (crab)	This is a voracious predator, known to negatively impact population size and structure of many species especially shellfish and crabs. In the US, financial losses to the shellfish industry have been reported at USD$22.6 million and this is predicted to rise significantly.
Eriocheir sinensis (crab)	Large economic costs following the introduction of this species have been reported (EUR€80 million in Germany since 1912). These costs arise from ongoing management requirements to stabilise river banks damaged by the crabs, losses to commercial fisheries (predation by crabs), installation of barriers and ramps to prevent further crab migration and population control methods.
Undaria pinnatifida (algae)	This is an extremely fast-growing algae with two forms of efficient reproduction that result in a competitive advantage over native species for space.
Balanus improvisus (barnacle)	This is a fast-growing barnacle that can outcompete native species for space and foul aquaculture species and infrastructure resulting in higher maintenance costs.
Crepidula fornicata (limpet)	This limpet is known to increase sedimentation rates, creating muddy anoxic conditions that negatively impact endofauna, outcompete and negatively impact the density of other species and negatively modify benthic communities.
Brachidontes pharaonic (mussel)	There is no impact information available for this mussel and the taxonomic status of the species is complex. As such, the species is currently considered cryptogenic.
Mytilopsis sallei (mussel)	In the Great Lakes and Mississippi river region in the USA, *M. sallei* has caused physical damage to vessels and artificial structures through fouling and by changing a pelagic dominated system to a benthic/pelagic system and affected the food web structure and productivity at higher trophic levels.
Perna viridis (mussel)	This mussel can potentially displace native bivalves and many other species, by dominating the benthic habitat and causing subsequent changes in trophic relationships, benthic ecology and community structure. Economic impacts arise from the mussels blocking water intake pipes and reducing efficiency of mechanical structures through heavy fouling. As this mussel is a filter feeder, it can pose a hazard for shellfish poisoning (paralytic shellfish poison (PSP) toxins).
Hemigrapsus sanguineus (crab)	This is an aggressive crab that can outcompete and displace native crabs and other native species, thus altering ecosystem functioning.
Rhithropanopeus harrisii (crab)	Can compete with native crabs and benthic feeding fishes for food, alter food webs, foul water intake pipes, cause economic losses to gill net fisheries by spoiling fish caught in the fill nets and can carry strains of the extremely virulent white spot baculovirus that can cause disease in other crustaceans.
Sargassum muticum (algae)	This algae is known to outcompete native species (e.g. algae and seagrass) for space and through exclusion (i.e. shading), it can heavily foul marine equipment, clog intake pipes, increase the rate of sedimentation as it slows the water flow (dense stands) and reduce the social amenity of an area (floating mats and through decay).
Ulva pertusa (algae)	Information on negative impacts is limited, other than it may modify benthic communities purely by its presence and reduce social amenity when it decomposes and releases nutrients, resulting in eutrophication.

Table 4-2. Proposal-related construction vessel risk rating

Vessel Type	Risk Rating
Cutter Suction Dredge	3
Barge/Tug	2
Workboat / Research vessel (i.e. hydrographic survey vessel)	2

4.1.4.2 IMP SPREAD AND IMPACT

The Project area where vessels and plant will operate is restricted and sits inside port limits. Based on the previous demonstrations that spread of IMPs in the Pilbara is essentially nil, the regionally significant mangrove systems that have been assigned a Maximum LEP to the east of the Proposal are unlikely to be considered at risk.

4.2 Risk Assessment of Potential Impacts

The risk assessment was undertaken using a systematic approach, based on international best practice standards (AS/NZS ISO 31000:2018: Risk Management – Guidelines), of assigning a consequence and probability to potential negative outcomes.

Risk ratings were assigned to each impacting activity using the risk matrix in Table 4-3.

The assessment of inherent risks has assumed all Proposal-related construction vessels contracted for the Proposal would comply with Australian standards. Vessels must adhere to the Australian Biofouling Management Requirements (Commonwealth of Australia 2009). Vessels entering Australian Territorial Waters must complete a Pre-Arrival Report (PAR) and Maritime Arrivals Reporting System (MARS) report (for international arrivals). All vessels must provide a Biofouling Management Plan (BMP) or cleaning report or implement a pre-approved alternative biofouling management method.

Ballast carrying vessels must adhere to the Australian Ballast Water Management Requirements (Commonwealth of Australia 2020) which include a Ballast Water Management Plan (BWMP) and a valid Ballast Water Management Certificate (BWMC). Chapter five of the *Biosecurity Act 2015* specifies the general requirements of compliance with ballast water management plans and certificates.

Pilbara Ports Authority (PPA) mandates that specified vessels (IMO registered vessels such as dredges, barges and multi-cats) must submit a Vessel Biofouling Risk Assessment and Management Procedure (VBRAMP), including DPIRD Biosecurity Vessel Check Biofouling Risk Assessment (DHI 2021) within 14 days of arriving in a PPA controlled port. Vessels exempt from this include non-trading commercial vessels under the unique vehicle identifier (UVI) system, trailerable vessels, crew transfer, pilot and tug vessels based in the Pilbara region.

Table 4-4 presents the outcomes of the risk assessment, including the inherent and residual risks after proposed mitigation measures.

Mitigation measures (to be required in the Dredging and Spoil Disposal Management Plan) will be informed by a Proposal-specific vessel risk assessment program based on a standard Vessel Risk Assessment Score Sheet (VRASS) and Equipment Risk Assessment Score Sheet (ERASS) (for immersible equipment) system, as detailed in **Appendix C**.

Table 4-3. Risk assessment matrix

	Consequence	1-Minor Localised harm to the environment that is confined to the operating footprint, affects no sensitive receptors and can be rectified or reversed within a day	2-Medium Localised harm to the environment that is confined to the operating footprint, affects no sensitive receptors and can be rectified or reversed within weeks of work effort or natural recovery	3-Serious Harm to a regionally significant sensitive receptor that can be rectified or reversed within weeks to months of work effort or natural recovery	4-Major Harm to a nationally significant sensitive receptor that can be rectified or reversed within months to years of work effort or natural recovery	5-Catastrophic Widespread harm to a globally significant sensitive receptor that can be rectified or reversed within years to decades of work effort or natural recovery
Likelihood	**A-Almost certain** Recurring event during the lifetime of an operation/project. Occurs more than twice per year	Moderate	High	Critical	Critical	Critical
	B-Likely Event that may occur frequently during the lifetime of an operation/project. Typically occurs once or twice per year	Moderate	High	High	Critical	Critical
	C-Possible Event that may occur during the lifetime of an operation/project. Typically occurs in 1-10 years	Low	Moderate	High	Critical	Critical
	D-Unlikely Event that is unlikely to occur during the lifetime of an operation/project. Typically occurs in 10-100 years	Low	Low	Moderate	High	Critical
	E-Rare Event that is very unlikely to occur during the lifetime of an operation/project. Greater than 100-year event	Low	Low	Moderate	High	High

Table 4-4. Likely risk of Proposal-related dredging and construction introducing marine pests

Source		Potential Impact	Existing Controls	Consequence	Likelihood	Inherent Risk	Mitigation Measures	Consequence	Likelihood	Residual Risk
Type	**Risk Rating**									
DREDGING										
Cutter Suction Dredge	3	Introduction of IMPs through: • Biofouling, via internal niches (pumps, piping, cutter heads, hoppers, chain and cable fouling, muds and sediments). • De-ballasting. Disturbance and creation of new hard substrates provides new habitats for IMPs to colonise. Redistribute existing IMPs to new areas.	• Vessel check report (under MARS for international vessels). • Ballast water record book. • International BWMC. • Biofouling record log. • BMP. • Biofouling management certificate. • Maintaining a treatment routine for internal seawater systems. • Maintaining AFC.	2	C	Mod	• Source vessel within Australia. • Verify VRASS and ERASS risk assessment. • Reject or replace any high-risk vessels. • Ensure hoses, hoppers, cutters, ladders etc. have been cleaned and flushed. • Ensure anchors and cables have been cleaned of muds, sediments, fouling and seaweeds. • Complete an independent IMP survey prior to arrival. • Verify BWMP and BWMC. • Verify biofouling record log. • Verify BMP and biofouling management certificate. • Verify AFC is <30 days old. • Ensure AFC is suited to vessel activity and speed. • Transport equipment dry where possible. • Potential for existing IMPs very low – thus no relocation risk.	2	E	Low

Source		Potential Impact	Existing Controls	Consequence	Likelihood	Inherent Risk	Mitigation Measures	Consequence	Likelihood	Residual Risk
Type	Risk Rating									
Barge (Dredge Hopper or Dumb Barge) / Tugs	2	Introduction of IMPs through: • Dislodgment of biofouling at wharfs and on bottom contact. • Muds sediments and biofouling on anchors and mooring lines. High biofouling potential due to speeds and towage.	• Vessel check report. • AFC maintained. • Dry docking history with desiccation time maximised. • Flat bottom with negligible niches reduces exterior biofouling.	2	C	Mod	• Verify VRASS risk assessment. • Reject or replace any high-risk vessels. • Ensure sediments, muds and biota are not retained from previous campaigns. • Source locally from the Pilbara where possible. • Minimise time between out of water inspection and mobilisation. • Maintain AFC applications before mobilisation.	2	E	Low
CONSTRUCTION										
Outfall pipeline	1	• Introduce organisms. • Provide a novel habitat for settlement of IMPs.	• All pipe sections and fittings will be new and not reused from previous deployments. • Biofouling levels of native species in the nearshore Pilbara are high and will rapidly cover new substrate, reducing the likelihood of IMPs biofouling in the same location.	1	D	Low	• N/A	1	D	Low

Source		Potential Impact	Existing Controls	Consequence	Likelihood	Inherent Risk	Mitigation Measures	Consequence	Likelihood	Residual Risk
Type	Risk Rating									
Support vessels	2	Vessels introduce IMPs through biofouling.	• Minimal use of vessels required. • Use local vessels where possible.	2	C	Mod	• Any non-local vessels will comply with IMP management measures as for dredging.	1	D	Low
GENERAL										
Research Vessel	2	Introduction of IMPs through: • Biofouling dislodgement from vessel hulls, particularly during anchoring, mooring and/or berthing. • Scientific equipment may harbour IMPs.	• Maintain AFC. • Periodic cleans and inspections.	2	D	Mod	• Verify VRASS/ERASS. • Reject or replace any high risk vessels. • Inspect scientific equipment, clean muds, sediments, seaweeds and barnacles. • Source locally from the Pilbara where possible. • Source trailerable vessel where possible. • Maintain AFC.	2	E	Low

5 DISCUSSION

The Environmental Scoping Document (ESD) prepared to support environmental impact assessment of Leichhardt Salt Pty Ltd's Eramurra Solar Salt Project proposed for Cape Preston identified marine environmental quality (MEQ) and marine fauna as preliminary key environmental factors (EPA 2021). As one component of assessment for the MEQ factor, the ESD proposed an examination of the potential for the Proposal to increase the risk from Introduced Marine Pests (IMPs). Following comments from the Environmental Protection Authority on that ESD, the current aim is to:

"Undertake a desktop Introduced Marine Pests (IMPs) investigation for dredge vessels, including an assessment of likely risks associated with the introduction of IMPs during dredging operations. The IMP investigation must also include a review to define baseline IMPs and a risk assessment for the introduction of IMPs during construction."

This document provides a review of the IMP baseline within the project area and conducts a risk assessment for both the dredging and construction components of the proposal: the latter being construction of a bitterns outfall.

Western Australia's Pilbara is one of the most studied areas for IMPs in Australia (Wells 2018) and the Cape Preston area has been subject to several previous on-ground surveys for IMPs (GHD 2013; URS 2009). Despite the high traffic of vessels associated with Western Australia's resources exports contributing a number of documented IMP introductions to the Pilbara nearshore environment, only one IMP species has self-sustaining populations (Bridgwood *et al*. 2014) and no IMP species have been found at Cape Preston in the above surveys.

In assessing the risks of dredging and construction vessels and plant introducing IMPs, it was noted that a key risk factor is the origin of vessels and the routes they use to travel to the project area. As the project has not yet commenced, no contracts are in place for dredging or construction plant and vessel details are unknown. In this regard, this document sets out the comprehensive management regulations and procedures required under the National Strategic Plan for Marine Pest Biosecurity 2018-2023 (Commonwealth of Australia 2018) and its implementation by Australian, State and ports authorities to minimise the potential for IMP introduction through biofouling and ballast water.

Risk assessments conducted for dredging and construction have assumed that vessel and plant used for the project will be subject to these management procedures. Such requirements will be included within the Dredging and Spoil Disposal Management Plan (See **Appendix C**). Risk assessments were based on the potential species identified as target IMPs for this area and used procedures recognised nationally for the categorisation of risk from dredging vessels. Risks were assessed as inherent risk (unmanaged) and residual risk (after management or mitigation). In all cases, once the probability of introduction had been lowered as a result of the barrier management measures, risks were assessed as Low.

While dredging plant has been shown historically to contain a high probability of introducing IMPs, management measures to present barriers to such introductions have been greatly improved with new developments to the National Strategy arsenal. Implementation of those measures for this project should result in a low risk of introducing marine species to an area, which despite considerable existing vessel visitations, shows no evidence of IMPs.

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APPENDIX A – NATIONAL MARINE PEST LISTS

List adapted from MPSC (2018)

Marine Pest List	List details	No. of marine species on list
Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE) trigger list	It includes species exotic to Australia, species established in Australia but not widespread and holoplankton alert species. This list is no longer active, but is still commonly referenced.	35
CCIMPE watch/notification list	An additional eight species are on the CCIMPE watch/notification list.	8
Marine ballast water decision support system	This is based on the ballast water risk assessment framework developed by CSIRO Marine Research, which includes species established in Australia that may be transferred from one Australian port to another Australian port via ballast water	7
Marine pest monitoring target species list	The monitoring list of target species is listed in the Australian marine pest monitoring guidelines. These are species that have been identified as high risk for Australia as a whole, based on their invasion and impact potential, and human health impacts (Commonwealth of Australia 2010a; Commonwealth of Australia 2010b). The list includes: • species for which ballast water management is required (currently seven species) • species on the priority pest list (domestic) in Hayes *et al*.(2005), that are ranked as a high or medium priority for management; or low priority with a human health impact • species on the next pest list (international) in Hayes *et al*. (2005) that are ranked as a high or medium priority for management; or low priority with a human health impact • species on the trigger list of introduced marine pests used in emergency management by the CCIMPE.	55
Species of biofouling concern list	A list of species that have been determined by risk assessment to have a high probability of arrival to Australia, with the potential to cause moderate to extreme impacts on the environment, economy, social/cultural values and/or human health (Hewitt *et al.* 2011). **This list was developed under previous legislative frameworks (Quarantine Act 1908), but with the introduction of the Biosecurity Act 2015 is no longer part of current national policy.**	56
NIMPIS list	A central repository of information on invasive marine pest species, including species introduced and exotic to Australia (Commonwealth of Australia 2022a).	100+

APPENDIX B- PROPOSAL-RELATED VESSEL DESCRIPTION

Adapted from Kinloch *et al*. (2003)

Dredge Vessels

Dredges are flat bottomed, steel hulled vessels specifically constructed to excavate the seabed. The Cutter Suction Dredge (CSD) is relevant to the Proposal. While operational the dredging equipment is almost continuously in contact with the seabed in shallow inshore marine environment frequently within port areas. Dredges are rich in niche areas found among pumps, piping and hoppers, and there is the risk of heavy biofouling as the vessels work continuously, often in shallow productive inshore waters travelling at slow speeds.

Construction Barges

Construction barges are flat bottomed, square fronted vessels designed to carry freight. During loading the hull is in close proximity and sometimes in contact with the seabed in inshore waters, this creates opportunities for organisms to settle on the hull. In addition, construction barges can remain for extended periods in ports, therefore, acquiring biofouling.

Research and Diving Support Vessels

Research vessels are involved in activities that have close interaction with the marine environment (including the water column and the seabed). Activities involve deploying instruments and sampling equipment that if left for long periods of time could become fouled; however, it is standard practice to clean equipment between trips and even between sampling locations. There is a dichotomy between small research vessels that typically have high home port fidelity and conduct short day trips within 30 nautical miles versus large research vessels that have two-to-three-week trip duration, traversing hundreds to thousands of kilometres and visiting other ports. Typically, the smaller vessels are transported via trailer between trips allowing the vessels to dry out between trips. However, the larger vessels remain in the water and can be stationary in ports for long periods of time. Therefore, the larger vessels have a higher possibility of translocating IMPs both between ports as well as from ports to offshore waters or islands and translocated between sample sites, rarely visited by other craft.

APPENDIX C - MANAGEMENT MEASURES

The following measures are to be included within the Dredging and Spoil Disposal Management Plan.

All vessels and plant contracted by the Eramurra Solar Salt Project will be subject to the management provisions specified under the National Strategic Plan for Marine Pest Biosecurity 2018-2023 by the Australian Department of Agriculture Forests and Fisheries and the Western Australian Department of Primary Industries and Resources Development current at the time of contracting.

Each vessel or piece of submersible equipment will complete a specific Vessel Risk Assessment Score Sheet (VRASS) / Equipment Risk Assessment Score Sheet (ERASS) and undertake the management identified therein.

A VRASS requires specific detail about the history and maintenance of the individual dredging, construction and support assets proposed to be contracted. The outcomes of a VRASS are used to inform the management controls required to avoid and minimise IMP introduction. A VRASS considers:

- vessel type;
- inspection history;
- internal treatment/inspection history;
- vessel desiccation period during mobilisation;
- presence and age of fouling control coating;
- presence or absence of internal treatment systems;
- internal treatment history;
- climatic region of operation;
- stationary or slow periods of operation and climatic region;
- type of vessel activity; and
- adherence to Australian biosecurity ballast water requirements.

An example of the likelihood and mitigation measures applied to different VRASS risk score levels, and a typical VRASS template, has been provided below:

VRASS Risk Score	Risk Category	Likelihood	Mitigation Measures
<50	LOW	Low likelihood of IMPs (no additional management measures required.	• Confirm that the vessel's operational history, AFC and ballast/trim water details, as used by the VRASS, are accurate and reliable.
50 - 100	UNCERTAIN	Likelihood of IMPs is not apparent (precautionary approach adopted, additional management measures required.	• Limited Exposure. • Reject Vessel. • Replace Vessel. • Inspection in/out of water. • Treatment of internal systems. • Alternative Approval (State).
>100	HIGH	Identified as a potential risk (additional management measures required).	• Reject Vessel. • Inspection. • Alternative Approval.

Eramurra Solar Salt Vessel Risk Assessment Score Sheet (VRASS)

Insert Vessel Name:		
IMP Infection Risk - Location within Project Area		
If the vessel will enter Cape Preston, Project Area or IMP Management Area - **Proceed with VRASS**		
If activity occurs outside the CPE project area and vessel does not enter the IMP Management Area (12 nm/50 m contour) - **No vessel IMP assessment is required**		
No vessel assessment is required for locally sourced vessels, 'new build vessels' lauched immediately prior to mobilisation (less than 14 days).		
See map for Invasive Marine Pest Management Area (IMPMA) - *Refer IMP Management Area Map Tab*		
Vessel Type IMP Infection Risk Rating		
IMP infection risk - Vessel Type		
Type of vessel	Insert Vessel Type Factor *(Refer Vessel Risk Score Tab or Appendix J - IMSMP)*	
IMP Infection Risk - Inspection and Period Out-of-Water		
Recent IMP Inspection, Cleaning/Dessication History		x
No inspection, cleaning or out-of-water period prior to date of contract commencement =	1.0	
Previous IMP inspection* (and clean if required), or out-of-water period > 21 days, or new build vessel - Within Six Months Prior to Mobilisation =	0.85	
One independent **in-water** IMP inspection (and clean if required) - Within 21 Days Prior to Mobilisation =	0.75	
One independent **out-of-water** IMP inspection* (and clean if required), or out-of-water period > 21 days, or new build vessel - Within 21 Days Prior to Mobilisation =	0.50	
IMP Inspection - Vessel Internal Niches		x
Independent IMP inspection of all internal niches (ie. seawater system flushing, strainers, anchor cable locker) undertaken or new build vessel launched within 21 days prior to mobilisaion	Yes = 0.75 No = 1.00	
Vessel Out-of-water Period Prior to Mobilisation		x
Continuous total out-of-water period immediately prior to arrival within the IMPMA by either deck cargo, hard stand, or road freight that is:	<7 days or not applicable = 1.0 7-14 days = 0.8 >14-28 days = 0.3 >28 days = 0.1	
IMP Infection Risk - Age of Anti-Foulant Coating (AFC)		
Age and Suitability of AFC at Mobilisation Date		x
AFC type is unknown, unsuited or absent	5.00	
AFC type is known, suited to activity and speed and documented age of AFC at mobilisation will be:	> 24 months= 4.00 >12 - 24 months = 2.00 >9-12 months = 1.00 >6-9 months = 0.85 >3-6 months = 0.75 1-3 months = 0.40 <1 month = 0.25	
IMP Infection Risk - Vessel Internal Treatment History		
Internal Treatment System(s)		+
Vessel has a functional internal treatment system	Yes = 0.50 No = 1.0	
Internal Treatment History		x
Vessel internal systems treated using suitable chemical treatment (such as Rydlyme, Conquest or other agreed treatment) *Note: Where an internal treatment system has been confirmed in the risk factor above, a null value of 1 should be assigned to this risk assessment factor.*	>12 months or unknown 2.00 >6-12 months = 1.00 >3-6 months = 0.50 1-3 months = 0.40 <1 month = 0.25	
IMP Infection Risk - Vessel Location History		
Vessel origin and proposed area of operation		x
Climatic relationship of highest scoring operational region, in relation to proposed region of operation, since last clean and inspection or inspection alone *(Refer to Regions of the World Map Tab)* **	Similar climatic region = 3.00 Adjacent climatic region = 1.50 Separate climatic region = 0.80	
Number of stationary / slow speed periods over 7 days		+
Total # of 7 day periods of rest or at slow speeds (<3kn) in port or coastal waters (<50 metres depth or within 12 nautical miles) since last AFC or independent Inspection*	Total # of stationary periods > 4 = 3.00 Total # of stationary periods >2 - 4 = 2.00 Total # of stationary periods between 1 and 2 = 1.00 Stationary period is < 1 week = 0.75	
Region of the stationary/slow speed periods		x
Region/s of the primary operations where above stationary or slow speed periods occurred: *(Refer to Regions of the World Map Tab)* *(Insert highest scoring region only)*	Similar climatic region = 3.00 Adjacent climatic region = 1.50 Separate climatic region = 0.80 If not applicable = 0.00	
IMP Infection Risk -Planned Activity		
Type of Activity - Contact with Seafloor		x
(Insert highest score only)	Planned activity will have direct contact with seafloor (other than anchoring) (ie dredge / drilling) = 2.0 Planned activity will have direct contact with seafloor (anchoring only) (ie. research) = 1.2 No anchoring or activities contacting seafloor (ie Seismic) = 1.0	
IMP Infection Risk -Ballast Water		
Ballast / trim tank seawater		+
Ballast/trim water origin: *(Refer to Regions of the World Map Tab)*	No ballast/trim water or no discharge required = 0.0 Seawater sourced from similar or adjacent climatic region - discharge required = 3.0 Seawater from separate climatic region - discharge required = 2.0	x
Ballast Water Management Requirements adhered:	Intended = 0.0 Not possible = 10.0	0
	Vessel Risk Score =	**TOTAL**
If score **<25** = Low risk: Vessel details require checks/confirmation only, documents to be retained for auditing		
If score **25-80** = Moderate risk: precautionary principal applied: Confirmatory independent inspection and/or potential actioning required		
If score **>80** = High risk: premobilisation inspection actions required		