ENVIRONMENT
An O2Marine company

Dredging and Sediment Management Plan

Ashburton Salt Project

O2 MARINE

CLIENT: K+S Salt Australia Pty Ltd

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Acronyms & Abbreviations

Acronym/Abbreviation	Description
Approval Holder	K+S Salt Australia Pty Ltd
ASS	Acid Sulfate Soil
ASSSMP	Acid Sulfate Soil and Sediment Management Plan
BCH	Benthic Communities & Habitat
BCHMP	Benthic Communities & Habitat Monitoring Program
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DoF	Department of Fisheries
DoTEE	Department of the Environment and Energy
DSMP	Dredging and Sediment Management Plan
DWER	Department of Water and Environment Regulation
EPA	Environmental Protection Authority
EPO	Environmental Protection Outcomes
EQC	Environmental Quality Criteria
ESD	Environmental Scoping Document
ha	Hectares
ktpa	Thousand tons per annum
M3	Cubic meters
mAHD	Meters Australian Height Datum
MEQ	Marine Environmental Quality
MFO	Marine Fauna Observer
MTs	Management Targets
Mtpa	Million tons per annum
MWQMP	Marine Water Quality Monitoring Program
PASS	Potential Acid Sulfate Soils
PER	Public Environmental Review
The Proponent	K plus S Salt Australia Pty Ltd
The Project	Ashburton Salt Project
SOW	Scope of Works
TMF	Tiered Management Framework

UAV	Unmanned Aerial Vehicle
ZoHI	Zone of High Impact
ZoMI	Zone of Moderate Impact
ZoI	Zone of Influence

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1. Introduction

1.1. Project Summary

K plus S Salt Australia Pty Ltd (K+S) propose to develop and operate a greenfield Solar Salt Project (the proposed Ashburton Salt Project) on the Western Australian coast, approximately 40 km south-west of the townships of Onslow, within the shire of Ashburton (Figure 1). The Ashburton Salt Project (the Project) will produce up to 4.7 million tonnes per annum (mtpa) of salt through solar salt farming, a process involving the evaporation of sea water using sunlight and wind.

The Project includes the construction of the solar evaporation and crystallisation ponds and associated infrastructure including:

- a seawater intake (comprising an intake sump, pipelines, pumps and channel)
- concentration and crystallisation ponds
- salt wash plant
- stockpiles and conveyors
- bitterns discharge infrastructure (including a dilution pond, pipeline and diffuser)
- jetty and product loading infrastructure
- access road, internal site roads and haul roads (for construction materials and, during operations for site maintenance and product transfer)
- borrow pits for extraction of clay and other construction materials
- drainage diversions
- dredging and onshore placement of dredged material
- buildings such as offices, storage and workshops
- sewage treatment
- water monitoring bores
- small desalination plant
- service corridors
- electricity and natural gas distribution
- equipment parking and laydown areas
- fuel storage and a refuelling station
- helipad.

The proposed Project layout is shown in Figure 2. The summary project description is detailed in Table 1, with key physical and operational elements of the Ashburton Salt Project identified in Table 2.

Table 1 Short Summary of the Project

Project Title	Ashburton Salt Project
Proponent Name	K plus S Salt Australia Pty Ltd
Short Description	It is proposed to construct and operate a solar salt Project approximately 40 km southwest of Onslow, WA. The Project includes the construction of solar salt evaporation and crystallisation ponds and associated infrastructure/activities (seawater intake pumps /

	channel / pipeline(s); seawater concentration ponds and salt crystallisation ponds; internal site roads; electricity generation and reticulation; fuel storage sites; a jetty and product loading facilities; a salt wash plant and associated ponds; salt stockpiles and conveyors; onsite buildings such as offices, storage, workshops and possibly accommodation; sewage treatment facilities and landfill; water management/monitoring bore(s); helipad; desalination plant; equipment parking and laydown areas; bitterns discharge infrastructure which includes a channel, dilution pond, pipeline and diffuser; drainage diversion/s and levees; access roads; borrow pit areas for rock, clay and other construction materials; and dredging and land based dredge spoil disposal).

Table 2 Location and proposed extent of physical and operational elements

Element	Location	Proposed Extent
Physical Elements		
Evaporation and crystallisation ponds	Figure 2	Disturbance footprint of no more than 10,397 ha within a 20,990 ha Ashburton Salt Project Development Envelope
Support infrastructure	Figure 2	Disturbance footprint of no more than 1,596 ha within a 20,990 ha Development Envelope (includes: seawater intake pumps/channel/pipeline(s); internal site roads; electricity generation and reticulation; fuel storage sites; a jetty and product loading facilities; dredging; land based dredge spoil disposal; a salt wash plant and associated ponds; salt stockpiles and conveyors; onsite buildings such as offices, storage, workshops and accommodation; sewage treatment facilities; landfill; water management/monitoring bore(s); equipment parking and laydown areas; bitterns discharge infrastructure which includes a channel, dilution pond, pipeline and diffuser; drainage diversion(s) and levees; borrow pits; helipad; and desalination plant.)
Access roads (including road upgrades and river crossing/bridge	Figure 2	Clearing of no more than 155 ha within a 20,990 ha Development Envelope (77 ha for main access road and 78 ha for internal site access roads)
Operational Elements		
Seawater intake	Figure 2	Seawater intake of no more than 250 GL per annum
Wastewater (bitterns)	Figure 2	Marine discharge of no more than 20 GL per annum (consists of no more than 10 GL per annum bitterns, diluted with seawater at a ratio of approximately 1 to 1)

1.2. Purpose of this Plan

The purpose of this Dredging and Sediment Management Plan (DSMP) is to support environmental approval for the Project, through demonstration of best-practice environmental management to achieve acceptable Environmental Protection Outcomes (EPOs). Specifically, the plan will:

1. Address the commitment of the Environmental Scoping Document to prepare a Dredging and Sediment Management Plan (DSMP).
2. Provide the framework for environmental management of the proposed dredging activities, including defining the EPOs and Management Targets (MTs) associated with the dredging and dredge material disposal that are to be achieved for the proposed development.
3. Define detailed management and monitoring actions to ensure that the project EPOs are achieved.
4. Provide the framework to guide the preparation of a detailed operational dredge management plan to be developed by the appointed dredge contractor(s) or included within specific contract conditions accepted by the dredge contractor(s), prior to the commencement of the dredging activities.

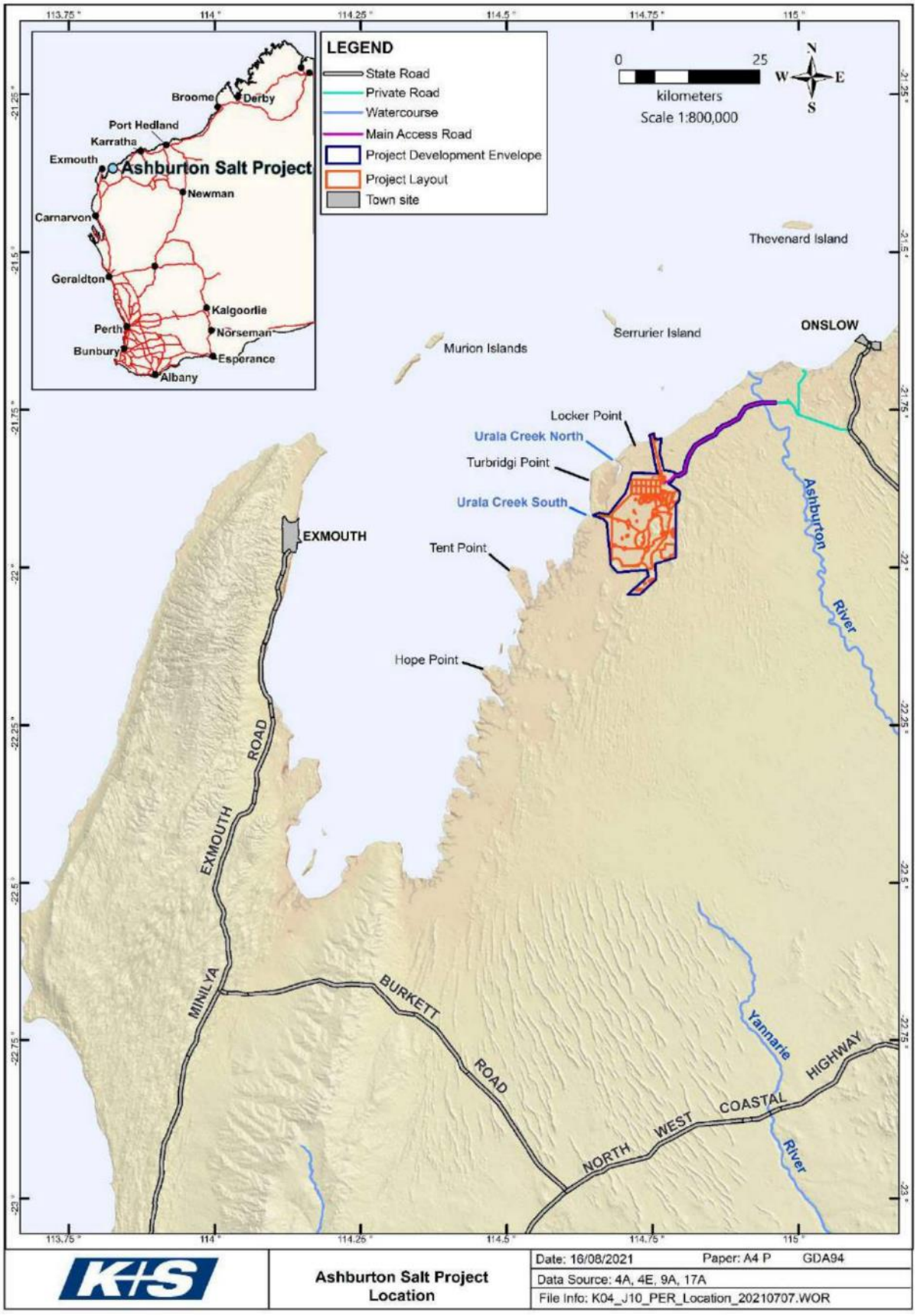

Figure 1 Regional location of the Project

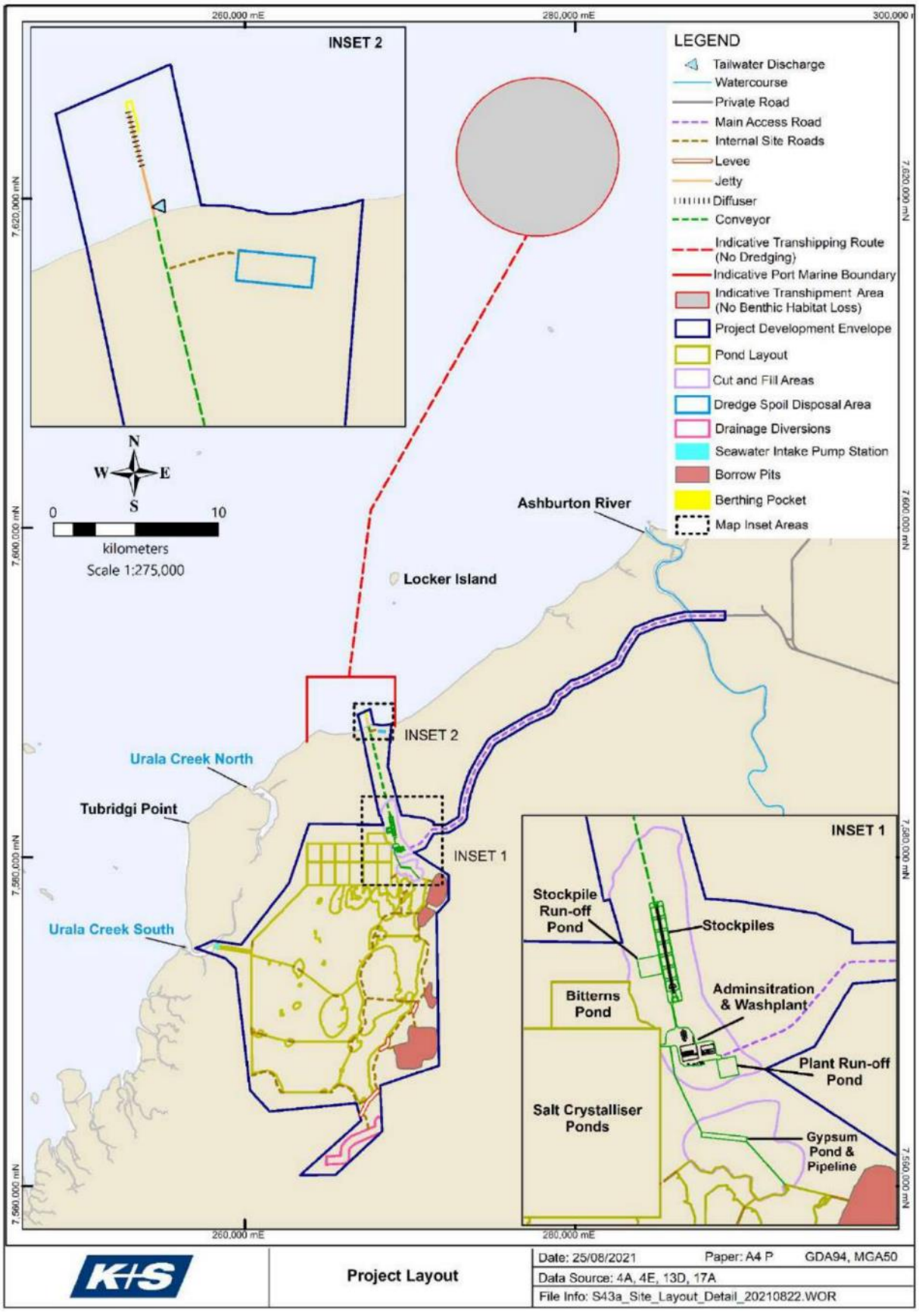

Figure 2 Proposed Development Envelopes and indicative layout

1.3. Objectives

The general objective of the DSMP is to identify potential impacts and to assign appropriate management targets and management actions, where necessary, to ensure that state Environmental Protection Outcomes (EPOs) can be achieved. The specific EPOs defined in this DSMP are presented in Table 8 and are aligned with the environmental objectives presented with the Western Australian EPA State Guidance which are summaries below and explain in greater detail in Section 7:

- To protect benthic communities and habitat (BCH) so that biological diversity and ecological integrity are maintained
- To maintain the quality of water, sediment and biota so that environmental values are protected
- To protect marine fauna so that biological diversity and ecological integrity are maintained.

1.4. Scope of the Plan

The scope of the DSMP applies to dredging and disposal related activities carried out during the marine construction phase of the Project, that have the potential to impact on benthic communities and habitats (BCH), marine environmental quality (MEQ) and marine fauna within the surrounding marine environment of the Project. The DSMP applies to the following operational activities of the Project:

- Capital dredging activities associated with creation of a transhipment berthing pocket
- Placement of dredged material onshore and tailwater discharge.

Project activities associated with (off-shore and on-shore) construction are managed through the dedicated Construction Environmental Management Plan (CEMP), whilst marine operational activities (i.e., brine discharge and/or cargo loading) are managed through implementation of the Marine Environmental Quality Monitoring and Management Plan (MEQMMP). The threat of introduced marine pests (IMPs) during dredging is also managed through implementation of a stand-alone Introduced Marine Pest Monitoring and Management Plan (IMPMP). Other potential non-dredging impacts to marine fauna (e.g. from piling and operations) are managed through implementation of the Marine Fauna Management Plan (MFMP).

Impacts from the Project's above-mentioned construction (non-dredging) and/or operational activities are covered by management and monitoring programs specific to these activities and are not addressed further within the scope of this DSMP.

The DSMP considers EPA's *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* and details the specific process for continual revision and improvement of the Plan any time the Project progresses, or at any time key processes alter and new risks are identified.

1.4.1. Other potential sources of sediment plume not within scope of the Plan

Other potential sources of marine/intertidal sediment plumes (e.g. construction activity in the intertidal zone, excavation activities in the path of surface runoff) are not considered to be significant. Potential sources of Project-related marine/intertidal waters sediment deposition are likely to be very localised and limited to (AECOM, 2022a):

- A temporary and localised increase in the turbidity of tidal waters of Urala Creek South during construction of the seawater intake inlet well. Background turbidity concentrations along the Onslow coastline are high under existing conditions and intertidal environments in the area already cope with periods of very high turbidity during flood events. In this context, it is unlikely that any temporary increases to turbidity from the seawater intake construction works would result in additional sedimentation at a scale that could threaten the tidal creek habitat or mangrove communities. Spoil from the excavation of the inlet well will be contained within the seawater intake channel embankments, with water evaporated and sediment used in construction works (i.e. there will be no tailwater discharge into the creek). Sedimentation reduction measures will be included in the Construction Environmental Management Plan (CEMP) such as silt curtains.
- Construction of the outer or western levees for the pond system and intake channel. Prior to the containment of the levee fill materials by the placement of rock armour on sides of levees, there is the potential for some fill material to be washed into intertidal areas. Localised sediment run-off during construction works within sensitive areas can be managed by employing appropriate sediment run-off measures and erosion control measures as part of the CEMP. These include the following:
    - Incorporate a buffer area between the outer disturbance boundary and the outer construction boundary (e.g. toe of the perimeter bund)
    - Containment of sediment within perimeter levee walls in sensitive areas by use of geofabric and rock armour.

2. Approvals & Legislation

2.1. Approval Conditions

HOLD FOR APPROVAL CONDITIONS WHERE APPROPRIATE

2.2. Approval Holder Details

Details of the holder of the approvals relevant to this Plan are provided in Table 3.

Table 3 Approval holder details

Company Name:	K+S Salt Australia Pty Ltd
Australian Business Number (ABN):	Australian Company Number: 607 033 447
Address:	Level 27 Number 44 St Georges Terrace Perth WA 6000
Key Contact (Role):	Gerrit Goedecke
Key Contact Details:	Gerrit.goedecke@k-plus-s.com (08) 6316 4589

2.3. Legislation, Regulations and Guidelines

The potential environmental impacts of the Project were considered at Commonwealth, State and Local Authority level with each Authority providing guidance on the level of assessment required. This DSMP forms a key documented process and is a tool for recognising and managing the various conditions and requirements of the environmental approvals and the various legislation as listed below.

2.3.1. Commonwealth

Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) has determined that this Project is a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In early 2017 it was determined that the Project will be assessed under the EPBC Act by the WA EPA as an accredited assessment.

Other Commonwealth legislation, regulation, and guidelines

Other applicable Commonwealth legislation and guidelines include, but are not limited to, the following Acts, Regulations (and relevant amendments):

- *Protection of the Seas (Prevention of Pollution from Ships) Act 1983*
- Australian Ballast Water Management Requirements Version 8 2020
- *Biosecurity Act 2015*
- *Biosecurity Regulations* (2016)
- National Water Quality Management Strategy (Commonwealth Government of Australia 2018)
- The National Assessment Guidelines for Dredging (NAGD), 2009 (NAGD 2009)
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018).

The following Threat Abatement Plans for marine species were also considered:

- Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE 2018)

2.3.2. State

Environmental Protection Act 1986

In October 2016, the Project was referred to the WA Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* (EP Act). In November 2016, the EPA determined that the Project would require assessment via a Public Environmental Review.

This document has been prepared in consideration of the relevant guidelines for this Project, which apply to the management and assessment of dredging programs in Western Australia. These include, but are not limited to:

- Technical Guidance – Environmental Impacts Assessment of Marine Dredging Proposals (EPA 2021)
- Technical Guidance: Protecting the Quality of Western Australia's Marine Environment (EPA 2016)

Other State legislation, regulation, and guidelines

The key Western Australian legislation, regulation, and guidelines relevant to dredging within the Port (conveyor, jetty, berth pocket and dredge spoil disposal activities) include:

- *Biodiversity Conservation Act 2016*
- *Port Authorities Act 1999*
- *Navigable Waters Regulations 1958*
- *Shipping and Pilotage (Port and Harbour) Regulations 1966*
- *Western Australian Marine Act 1982*
- *Pollution of Waters by Oil and Noxious Substances Act 1986*
- *Marine and Harbours Act 1981*
- *Environmental Protection Regulations 1987.*

3. Roles and Responsibilities

The roles and responsibilities for the implementation of the DSMP are summarised in Table 4.

Table 4 Project Roles and Responsibilities

Position	Responsibility
Proponent (as principal)	• Overall responsibility for implementation of this DSMP • Overall responsibility for complying with relevant legislation, standards, and guidelines • Ensures dredging activities are conducted in an environment safe for both site personnel and the public • Reports on environmental performance for the project to key stakeholders • Responsible for the implementation of the environmental monitoring program and inspections • Prepares environmental monitoring reports • Responsible for environmental compliance reporting in accordance with Ministerial Conditions (pending) • Responsible for reporting all environmental non-compliance incidents in accordance with Ministerial Conditions (pending)
Dredging Contractor	• Undertakes dredging and excavation works • Prepares and implements an environmental management plan in accordance with the requirements of this DSMP • Implements the management actions of this DSMP • Ensures adequate training of all staff within their area of responsibility • Ensures all equipment is adequately maintained and correctly operated • Responsible for reporting all environmental incidents to Proponent Environmental Advisor within 24 hours in accordance with incident reporting procedures

All persons involved in the project	• Comply with the requirements of this DSMP • Comply with all legal requirements under the approval's documents and relevant Acts • Exercise a Duty of Care to the environment at all times • Report all environmental incidents

4. Existing Environment

4.1. General Environment

4.1.1. Climate & Oceanography

The climate at the Project site is classified as hot, semi-arid with potentially significant rainfall occurring during late January through March and then May through July (K+S, 2021a). The dry season occurs from late August through to December. There is a tropical cyclone season that runs from the middle of December to April, with a peak occurring in the months of February and March. Climate data is collected at Onslow Airport, approximately 40 km north-east of the Project. Mean maximum daily temperatures are typically highest in January and February with 36.5°C, and lowest in July with 25.6 °C (BoM, 2022).

Winds are generally south or south-westerly for most of the year, with more south-westerly winds common during the summer months around the Exmouth Gulf region. During the cyclone season (mid-December to April), wind patterns are similar, though higher winds are typically blowing from westerly and north-westerly directions (K+S, 2021a).

Sea surface temperature around the project site varies from 20°C in August to a maximum of 30°C in March. Salinity levels measured in-situ at Locker Point between December 2018 and October 2020, ranged from 36.3 PSU to 41.6 PSU, with a median of 40 PSU (Water Technology, 2021a).

Wave energy in the area is typically relatively low, with typical directions of west to north-northeast and generally sheltered from swell wave energy from the south-west by the North West Cape. Swells can also be generated during cyclones or storms further away and these are more likely to come from the north and northeast (Water Technology, 2021a). Water movement is primarily driven by a combination of tidal and wind, in addition to the various currents influencing the area (Water Technology, 2021a). At the Project site, tides are semidiurnal with a mean spring tidal range of approximately 0.89 m as measured at Exmouth and Onslow, with a general consistency of tidal height within Exmouth Gulf and along the coast.

4.1.2. Geomorphology

The Project area is located inshore on supratidal salt flats, adjacent to the northeast shore of Exmouth Gulf and the Onslow Coastal Tract, encompassing geomorphic features from both regional scale units. The area extends from a coastal shoreline comprised of either a tidal mangrove zone (i.e. fringing the northern more extent of Exmouth Gulf) or sandy beaches (i.e. that extend east from Tubridgi Point), across the salt flats of the Onslow Plain to where this plain abuts the terrestrial habitats of the Carnarvon Dunefield on the mainland (AECOM, 2021).

4.1.3. Marine Water Quality

Nearshore waters within and around the Project area are characterised by variable turbidity. Data was collected at Locker Point (near the proposed jetty), and at Urala Creek (near the proposed seawater intake), between December 2018 and February 2020 (K+S, 2021). Data was collected both in-situ and samples for NATA accredited laboratory analysis. Laboratory ranged from 0.6 Nephelometric Turbidity Units (NTU) to 8.3 NTU at Locker Point, and a smaller range at Urala Creek with a minimum of 0.7 NTU and 6.7 NTU. Turbidity in-situ was

found to be more variable within the sites, with Locker Point ranging from 0.29 to 13.4 NTU, and Urala Creek ranging from 0.12 to 14.3 NTU. Generally the region also experiences high variability in turbidity due to storm events and cyclones, which found median data within the Wheatstone project area increase to 77 NTU, in a site usually showing a median of 1 to 3 NTU (MScience, 2009).

As previously stated, salinity data has also been collected for the assessment of this Project between December 2018 and February 2020. In addition to this, Total Dissolved Solids (TDS) was also measured which is a good indicator of salinity. During the monitoring period, salinity ranged between 36.3 PSU and 41.6 PSU, with a median of 40 PSU and 80th percentile of 40.7 PSU. TDS ranged between 35,621 and 40,155 mg/L, with a median of 38,755 mg/L and 80th percentile TDS of 39,456 mg/L. Water samples were also taken within the project area approximately once a month during the monitoring period, and laboratory testing of TDS was conducted by a NATA accredited laboratory. TDS was found to show similar results between the two methods, with the laboratory TDS ranging from 36,000 to 41,000 mg/L, a median of 39,000 mg/L and an 80th percentile of 41,000 mg/L (Water Technology, 2021a).

Dissolved metals in water were measured approximately once a month at Locker Point between December 2018 and February 2020. Most metals analysed were found to be below the recommended Environmental Quality Criteria (EQC) specified for the protection of North West Shelf ecosystems (99% species protection levels or all metals, except cobalt which is set at 95% species protection) (K+S, 2021). The Laboratory Practical Quantitation Level (PQL) of Aluminium was set at 0.01 mg/L by the laboratory used, which was above the low reliability screening level of 0.0005 mg/L. This was the lowest PQL that could be achieved without onerous additional validation work which was not considered necessary given the proposed bitterns discharge characteristics (K+S, 2021). Aluminium exceeded the EQC of 0.002 mg/L on two occasions. Zinc exceeded the ANZG (2018) EQC 99% species protection level of 0.007 mg/L on two occasions. The laboratory PQL for copper was set above the ANZG (2018) EQC 99% species protection level of 0.0003 mg/L, at 0.001 mg/L, and results exceeded the level of 0.0003 mg/L on two occasions. The laboratory was able to lower the PQL for further testing in 2021, and samples taken in February, March and April 2021 were all found to exceed the ANZG (2018) EQC 99% species protection level of 0.0003 mg/L, ranging between 0.0006 mg/L in February, and 0.0008 mg/L in April 2021. This indicates that copper may be naturally higher than the 99% species protection level within the project area.

The EPA recently published default trigger levels for Suspended Sediment Concentrations (SSC) (EPA 2021). which will be used to inform monitoring and management during dredging.

4.1.4. Benthic Communities & Habitat

A range of studies to assess impacts to benthic communities and habitats have been conducted for the Ashburton Project (K+S, 2021; AECOM, 2022a). The benthic habitat types which have been identified across the Ashburton Project area include:

- Soft sediment (potential seagrass habitat), macroalgae dominated reef and macroalgae and sparse coral reef in the Subtidal zone
- Mangroves, transitional mudflats, algal mats, sandy beaches and tidal creeks in the Intertidal zone

- Salt flats and samphire in the Supratidal zone (note that the Supratidal zone is not mapped within the LAU boundaries as it is not considered part of the scope of EPA Technical Guidance – Protection of Benthic Communities and Habitats (EPA 2016a).

Three Local Assessment Units (LAUs) have been proposed in consultation with Department of Water and Environment Regulation (DWER) Marine Ecosystems Branch around the Project site as shown in Figure 3 (AECOM 2022a). The three LAUs include one nearshore/subtidal LAU, and two intertidal LAUs, named LAU North and LAU South. Justification for the boundaries for these are given in AECOM (2022a).

The intertidal LAUs were mapped using existing maps, recent high-resolution satellite imagery and ground-truthing fieldwork (AECOM 2022a). The habitat types within these areas were identified as:

- Mangroves
- High tidal mud flats
- Algal mats
- Salt flats
- Sandy beaches
- Sand bars and shoals at the mouth of tidal creeks.

The mangrove and algal mat habitats have been mapped and shown in Figure 3.

The subtidal LAU area was mapped by AECOM using towed video transect data, aerial imagery, LiDAR bathymetry data and Sonar transect data (Figure 4, AECOM 2022a). It was found that the LAU consisted of the following three habitat types:

- Soft sediment: the majority of the LAU was found to be unconsolidated sediment consisting of predominantly sand and silt. Some locations viewed as potential seagrass habitat; however, this potential seagrass habitat will remain after dredging. Also seagrass in the Pilbara is dormant in winter when the dredging is scheduled so no impacts to seagrass would occur if it was present
- Macroalgae: found to occur nearshore on the reef pavement extending from the beach along the coast. There was found to be a mixed assemblage of *Sargussum* sp. (prominent), *Caulerpa* and *Halimeda*
- Macroalgae and sparse coral: this habitat type occurred on the seaward edge of the reef pavement extending offshore along the coast, and another patchy area approximately 2 km offshore in the south western portion of the LAU. Along with the macroalgae species, scattered corals, sponges, hydroids and ascidians were also found to exist within this habitat.

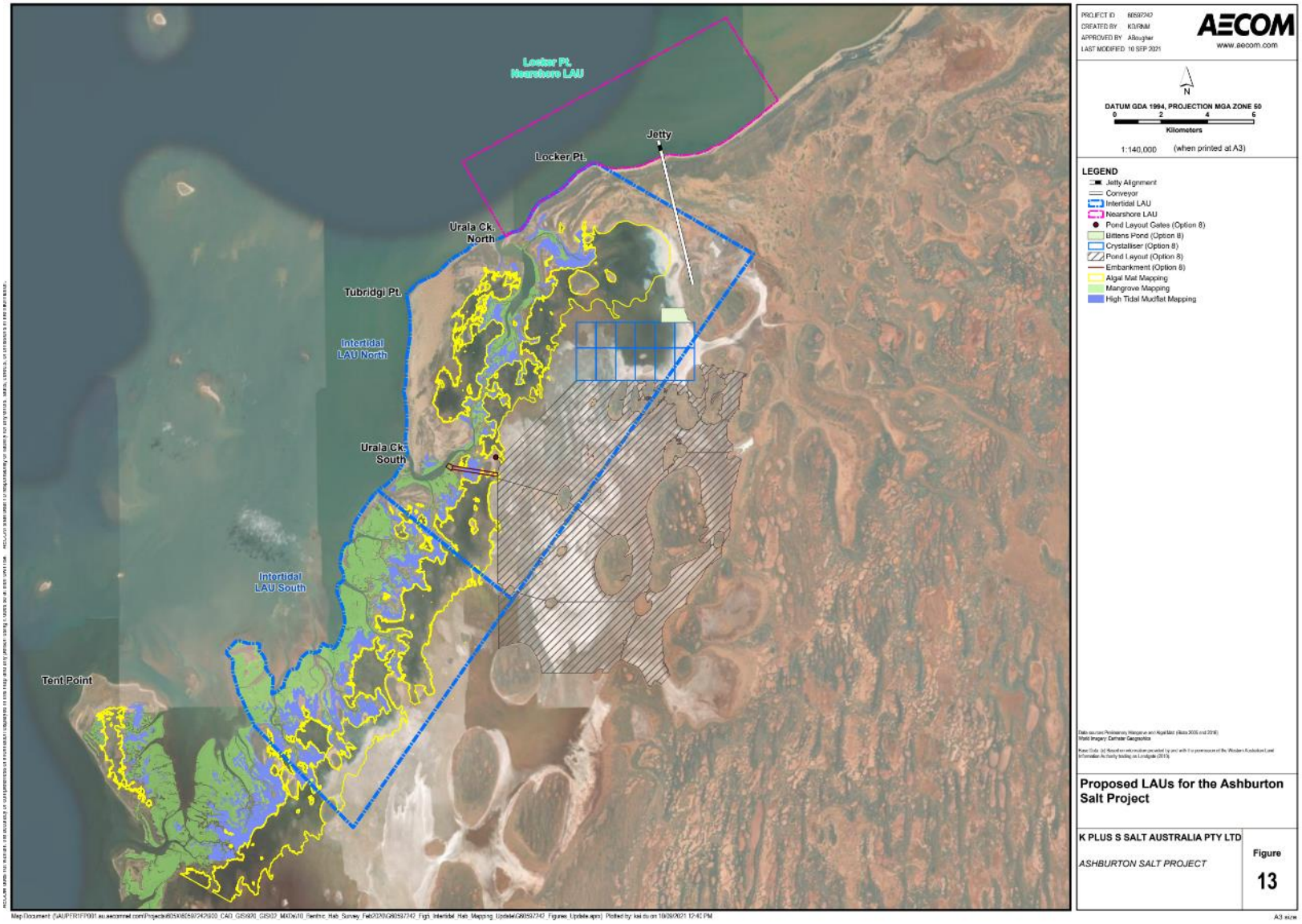

Figure 3 Proposed LAUs for the Ashburton Salt Project (AECOM, 2022a)

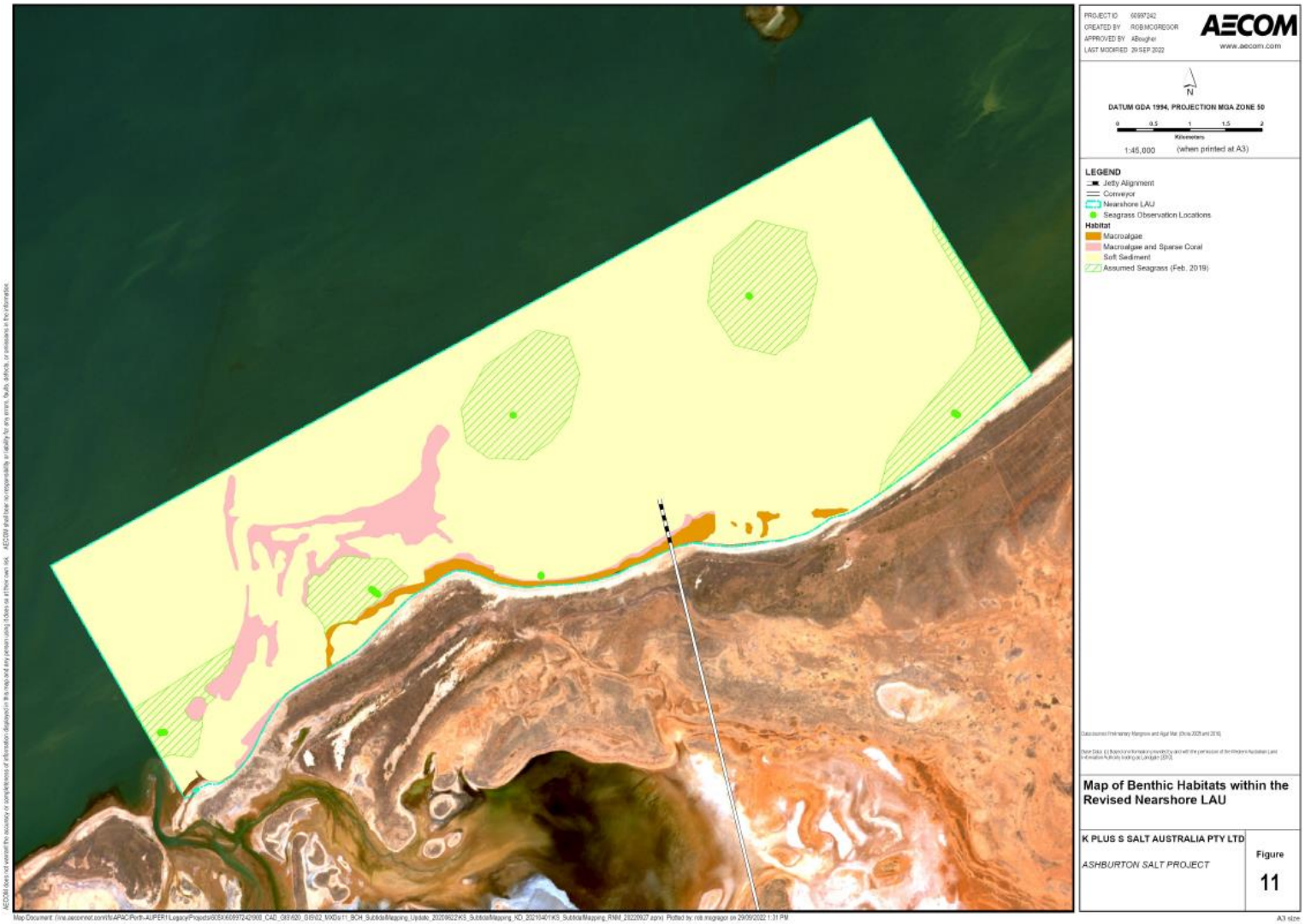

Figure 4 Subtidal BCH mapping (AECOM, 2022a)

4.1.5. Marine Fauna

A marine fauna impact assessment was undertaken for the Project by AECOM (2022b) which collated desktop literature review and gap analysis information, and field survey data. Identification of 'key' species as those with the highest conservation value, which could be impacted by the Project ensures that the correct level of attention is paid to those at greatest potential risk. The key conservation significant species were identified based on their status and likelihood of occurrence in the Project area. Key species that were identified as 'likely to occur' within the project area are:

- Green sawfish
- Green guitarfish
- Bottlenose wedgefish
- Nervous shark
- Humpback whale
- Australian humpback dolphin
- Dugong
- Hawksbill turtle
- Flatback turtle
- Green turtle
- Loggerhead turtle

Ecological windows which construction activities should aim to avoid have been identified for these key species and presented in Table 5. Other management measures will also indirectly protect other, similar, species.

The Project footprint also intersects with a number of commercial fisheries boundaries. However, most are unlikely to be affected as the Project does not occur within the fishing target areas or due to size of the Project and the relative size of the fishery (K+S, 2021). Only two fisheries have been identified to be considered potentially impacted by the project. These are:

- Exmouth Gulf Prawn Fishery
- North Coast Prawn Fishery including Onslow Prawn Managed Fishery (OPMF)

The target species of the Exmouth Gulf Prawn Fishery have been identified as being impacted in the larval stage within the proposed Project seawater intake in Urala Creek South. The proportion of nursery area likely to be influenced by the Project has been modelled and predicted to be 0.39% of the total size of the Nursery area (Water Technology 2018). Therefore, it is unlikely to be a significant impact on the fishery. The OPMF occurs to the immediate north of the Project site and the Project is considered to have minimal impact on the fishery (K+S, 2021).

Table 5 Key Conservation Species' Ecological Windows* (AECOM 2022b)

Species	J	F	M	A	M	J	J	A	S	O	N	D	Data Source
Green sawfish													Morgan et al. (2017)
Giant guitarfish													
Bottlenose wedgefish													
Humpback whale – northern migration (Jurien Bay to Montebello)													CALM (2005); Environment Australia (2002), Jenner et al. (2001); McCauley and Jenner (2001)
Humpback whale – southern migration (Jurien Bay to Montebello)													McCauley and Jenner (2001)
Spotted bottlenose dolphin													
Australia humpback dolphin													
Dugong													
Hawksbill turtle – various nesting areas													Commonwealth of Australia (2017); CALM (2005); DSEWPaC (2012); DAWE (2021a)
Flatback turtle – various nesting areas													Commonwealth of Australia (2017); CALM (2005); DSEWPaC (2012); DAWE (2021b)
Green turtle – various nesting areas													Commonwealth of Australia (2017); CALM (2005); DSEWPaC (2012)
Loggerhead turtle – various nesting areas													Commonwealth of Australia (2017); CALM (2005); DSEWPaC (2012); DAWE (2021c)

* Dark Blue represents species likely to be present in the region, Light Blue represents peak period: presence of animals reliable and predictable each year

4.2. Sediment Characteristics

4.2.1. Proposed Dredge Area

4.2.1.1. Physical Characteristics

Sediment samples were taken at three locations within the intertidal zone to particle size analysis in 2017 (Water Technology 2021c). As shown in Table 6, all sediment samples were classified to be fine sand.

Table 6 Particle size sediment sampling locations and results

Location	GPS Coordinates	Sample Date/Time	Median particle size (mm)	Soil Classification
Outfall (Locker Point)	$21^0$47.664'S 114^0 46.224'E	12/9/2017 12:45	0.213	Fine sand
Urala Creek South	$21^0$55.049'S 114^0 38.719'E	13/9/2017 15:10	0.154	Fine sand
Urala Creek North	$21^0$49.823'S 114^0 40.839'E	12/9/2017 15:15	0.158	Fine sand

In February 2020, a further three sediment samples were analysed for particle size distribution, and these indicated that initial surface samples (maximum 0.7 m depth) were typically less than 0.63 mm.

4.2.1.2. Chemical Characteristics

Following a desktop review of the potential for Acid Sulfate Soil in the Project area, soil and sediment sampling was undertaken within the onshore and offshore footprints. In February 2020, a vibracore was used to obtain sediment samples at 13 locations (including one refusal location), with depths of up to 2.4 m (GHD 2021a).

Table 7 Sampling analysis of sediments (taken from GHD 2021a)

Analysis	Number of samples analysed
pH screening (pH_{LAB} and pH_{FOX})	25
Chromium Reducible Sulfur	15
SPOCAS	15
Physical Properties (PSD, Radionuclides (NORMS))	3
Metal and Metalloids (Arsenic, antimony, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc)	15
Organic Compounds (PAH, BTEX, TRH, PCB and organochlorine pesticides)	3

Results for the sediment metal analyses indicated all samples analysed were below the ISQG (low value) for metals and metalloids with the exception of arsenic, which presented on sample slightly in excess of the guideline value at 23 mg/kg (GHD 2021a). Organic compounds were found to be below the laboratory limit of reporting for all analytes. Radionuclides were present in all samples analysed, but all below the ISQG (low value) for radionuclides.

ASS analysis found the following:

- pHLAB values presented limited variability between the samples submitted for analysis, with a population variance of 2.90 pH units. Of the samples submitted for pH screening the following were reported: maximum pHLAB of 9.2, minimum of 4.6 and average concentration of 8.0.
- pHFOX values presented limited variability between the samples submitted for analysis, with a population variance of 0.33 pH units. Of the samples submitted for pH screening the following were reported: maximum pHFOX of 9.2, minimum of 7.7 and average concentration of 8.5.
- The acid based accounting for the sediments indicated that net acidity (utilising chromium reducible sulfur method) ranged between 220 mol H+ /tonne and less than the laboratory limit of reporting.
- Material analysed was dominated by potential acidity due to the sub-oxic and potentially anoxic conditions.
- Suspension Peroxide Oxidation Combined Acidity ad Sulphur (SPOCAS) suite indicated slightly increased net acidity values likely due to the presence of organic sulfur forms within the sediment profile.

- Acid Neutralising Capacity (ANC) ranged between 140 and 3400 mol H+ /tonne (utilising SPOCAS method) indicating a significant potential for neutralisation within sediments less than 2 mm (GHD, 2021a).

These results indicate that sediments contained relatively low net acidity in excess of the DER ASS criteria. Sediments (< 2 mm) also presented significant acid neutralising capacity (ANC). Whilst the effective ANC of the sediment is likely to be varied due to particle size and armouring within the natural environment, the material is considered most likely to be hyposulfidic (GHD 2021a). Neutralising material will be added to the dredged material as necessary to treat any ASSS detected. Decant water will be retained for a suitable time to allow appropriate water quality standards to be met (confirmed by monitoring) prior to release to the marine environment. Solids will be tested to ensure appropriate environmental standards are met, then will be reclaimed and used in on-site embankment construction.

4.2.2. Proposed Onshore Disposal

Dredge spoil disposal will occur on land near the jetty at the location shown in Figure 5. A designated area will be prepared to contain the dredged spoil and tailwater (draw off water) to allow the dredged spoil to become 'spadable' and enable it to be blended and neutralised before the tailwater is allowed to be discharged. Management of the spoil material will be undertaken in accordance with the ASSSMP (GHD 2021b).

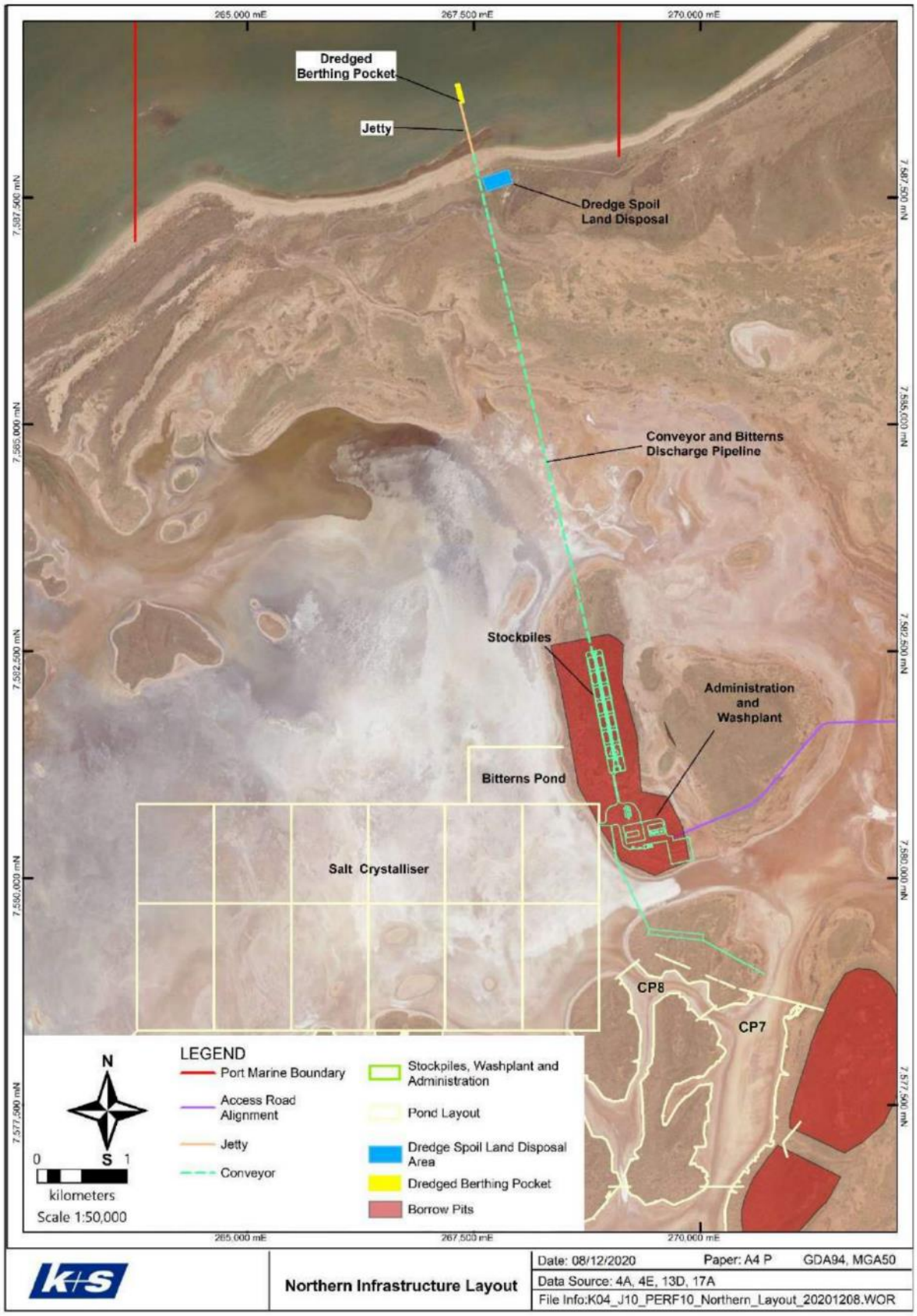

Figure 5 Northern Infrastructure Layout

5. Dredging & Spoil Disposal Activities

5.1. Proposed Dredging Activities

Dredging of a berth pocket at the end of the jetty is required to allow the transhipper adequate water depth to remain within the berth pocket without tidal restriction. The berth pocket is required to be of sufficient depth, length and width to allow the loaded transhipper adequate under keel clearance to enable unhindered navigation out of the berth pocket. According to the marine facility's pre-feasibility study and concept design, the proposed transhipment barge will have a ballast draft of 3.5 m and 5 m once fully loaded. The planned dimensions of the berth pocket are 200 m x 35 m x 6 m of water depth (LAT) – this requires dredging of approximately 2.5 m of seabed. Total dredge volume is estimated to be 17,000 m^3.

The dredging program will take approximately 2 weeks to complete. The location for the dredged berth pocket is provided in Figure 5. K+S acquired information from dredge suppliers to facilitate conceptualisation of the dredging program. Based on the water depth requirement and a geotechnical survey of bed material, a small to medium sized cutter suction dredge will likely be suitable to undertake the proposed dredging works. Based on this advice, K+S have confirmed the use of a cutter suction dredge for this project.

5.2. Dredging Volume & Rate

K+S have indicated the berthing pocket will be about 200 m in length (i.e., 150 m berth length plus 50 m extension beyond the jetty), 35 m in width and 6 m in depth at low tide. The area has an approximate water depth of around 5.2 m Mean Sea Level (MSL). The berthing pocket requires a dredge depth of about 2.5 m, subject to variation of bed levels along the jetty. Based on these specifications the total volume of material to be removed is estimated to be around 17,000 m^3.

It is intended to achieve a target production rate of about 1,200 m^3 per day so the dredging campaign can be finished within 14 days (assuming 8 hours operation per day).

5.3. Dredging Methods

Dredging of the berthing pocket along the eastern end of the export jetty is required to allow adequate water depth for the transhipper to remain within the berthing pocket without tidal restriction. The berthing pocket is required to be of sufficient depth, length and width to allow the loaded transhipper sufficient under keel clearance to remain in the berthing pocket under all tide conditions.

A small to medium sized cutter suction dredger will likely be used to carry out the proposed dredging work. For example, Cooper Dredging (http://www.cgcgroup.com.au/equipment-specifications/mudlark-i.html) has a cutter suction dredger with the following specifications:

- 7 m dredging depth.
- 300 mm diameter discharge pipe.
- Hydraulic cutter up to 9 kw bucket wheel or crown head options.
- Designed to be transported on road trailer that meet the road transport regulation.
- Self-contained for launching and retrieval by specially designed trailer.

5.4. Dredging Schedule

It is predicted that approximately 14 days dredging time will be needed to achieve the required dredging depths and extent based on 8 working hours per day from 8 am to 4 pm. Dredging activities will be undertaken outside of key ecological windows for marine fauna (collectively September to January) to minimise impacts.

5.5. Dredge Material Management

Dredge spoil is proposed to be disposed onshore within the designated spoil ground shown in Figure 5. The spoil will be sent onshore to a bunded area, to allow dewatering and treatment of acid sulfate sediment within the spoil. Where possible the dewatered solid material will be used for site construction material. Water from the dewatering process will be clarified, allowing particles to settle on the bottom, before being piped back into the ocean. The onshore disposal area will be located immediately inshore from the jetty location. Neutralising material will be added to the dredged material as necessary to treat any acid sulfate sediment detected. Tailwater will be retained for a suitable time to allow appropriate water quality standards to be met (confirmed by monitoring) prior to release to the marine environment. Solids will be tested to ensure appropriate environmental standards are met, then will be reclaimed and used in on-site embarkment construction.

6. Predicted Impacts from Dredging

During the dredging phase of the Project, which is expected to be less than 14 days, the following activities and resulting impacts have the potential to adversely affect BCH:

- direct loss of BCH by removal or burial in the immediate vicinity of the development
- indirect impacts on BCH from the effects of sediments introduced to the water column by the dredging and disposal.

K+S undertook dredge plume modelling (Water Technology 2021a) to evaluate the environmental impact associated with dredging and dredge plume disposal associated with the Project. Modelling was required to determine the extent, duration and severity of dredging related impacts to BCH.

Water Technology (2021a) adopted coral mortality thresholds presented by Fisher et al (2019) as the basis for predicting dredging impacts to BCH. These take into account the potential exposure of BCH to increased SSC in terms of both frequency (represented by Water Technology [2021a] as the '20% cumulative probability/80th percentile') and intensity (represented by Water Technology [2021a] as the '28 days running average'). The use of hard coral thresholds was deemed appropriate for this assessment due to these communities, as mixed coral and macroalgae communities, being the closest BCH sensitive to reduced light conditions to the project disturbance footprint.

The entire dredging footprint and majority of the LAU was found to be unconsolidated sediment consisting of predominantly sand and silt. While soft sediments in certain locations within the LAU have been assumed as potential seagrass habitat (Figure 6), no seagrass was observed within 1.8 km of the proposed jetty nearshore adjacent to the intertidal rock platform and not within approximately 2.3 km from the end of the jetty in an offshore direction during surveys (Geo Oceans 2019). The soft sediment and potential seagrass habitat will remain after dredging. Although there may be some seagrass in closer proximity to the jetty and berth pocket which may not have been identified during surveys, seagrass in the Pilbara is dormant and has the lowest cover and biomass in winter (Vanderkilft et al. 2017), when the dredging is scheduled, so no irreversible or recoverable impacts from dredging related increased turbidity or reduced light would be predicted to occur even if seagrass was present. The applied monitoring thresholds for coral during dredging will also provide additional protection to potential seagrass which is less sensitive to increased turbidity and reduced light, particularly during winter.

A summary of the predicted impacts to BCH and dredge plume modelling assessment is provided in this Section.

6.1. Zones of Impact

Zone of High Impact (ZoHI): Impacts to any BCH in this zone areas are predicted to be severe and often irreversible (i.e. lacking a capacity to return or recover to a state resembling that prior to being impacted within a timeframe of five years or less [EPA 2016c]). Water Technology (2021a) defined this boundary of this zone to be where thresholds corresponding to a high probability of observing non-zero coral mortality were exceeded (SSC/TSS >6.9 mg/L for frequency, SSC/TSS >13.2 mg/L for intensity).

Zone of Moderate Impact (ZoMI): Within this zone, damage to benthic habitats and mortality of benthic biota may occur, primarily as a result of the indirect impacts from increased turbidity and sedimentation that may occur at times within the zone. Impacts within this zone are predicted to occur, but the disturbed areas may recover (after completion of the dredging). It is expected that there will be no long-term modification of the benthic habitats in this zone. The outer boundary of the ZoMI was defined by Water Technology (2021a) to be where the following thresholds were no longer exceeded - SSC/TSS >5 mg/L for frequency, SSC/TSS >9.3 mg/L for intensity.

Zone of Influence (ZoI): This zone includes the areas in which, at some time during the dredging works, benthic communities may experience (detectable) changes in sediment-related environmental quality outside the natural ranges that are normally expected. However, the intensity, duration and frequency of these changes is such that any damage to benthic habitats is likely to be reversible, and no mortality of benthic biota is expected to occur. The outer boundary of this zone was defined by Water Technology (2021a) to be where TSS was predicted to no longer exceed 2 mg/L. This is a highly conservative threshold in which the plume would not be visually discernible, yet the influence may be detected in monitoring and where detectible impacts to stable benthic habitat would be highly improbable. The predicted combined ZoI (presented in Figure 6) appears quite large but at any point in time the dredge plume is likely to be restricted to a relatively small portion of it. The intent of the predicted ZoI is to indicate to regulators and the public where visible plumes may be present, albeit only occasionally, if the Project is implemented.

6.2. Direct Irreversible Impact - Development Envelope

Direct impacts are certain to occur within and immediately adjacent to the proposed dredging footprint. Direct impacts typically involve irreversible loss. It is assumed conservatively that any BCH within 20m of the dredging footprint will be permanently lost (or seriously damaged) such that the impact is irreversible.

6.3. Indirect Impacts (Irreversible and Recoverable)

In addition to direct physical removal, EPA (2021) states that the critical indicators of dredging pressure on photosynthetic BCH are light limitation caused by the shading effects of the sediment suspended through the water column and sediment deposition on BCH as those sediments settle out. Indirect impacts to BCH can be caused due to increased Suspended Sediment Concentration (SSC), resulting in increased turbidity, reduction in available benthic light and localised increase in sedimentation.

The dredge plume modelling assessment (Water Technology 2021a) modelled a small CSD dredge. The SSC threshold values adopted for the dredge plume impact assessment (Water Technology 2021a) relate to the impact of dredging on corals as that is the primary BCH type mapped through numerous studies in the vicinity of the dredge area. As such the Zone of Moderate Impact (ZoMI) and Zone of High Impact (ZoHI) SSC threshold values for corals were adopted.

The modelling results for the ZoMI and ZoHI for the proposed dredging and tailwater discharge are presented in Figure 6. These were derived from the modelling outputs from Water Technology (2021a) in the following manner:

- For each zone in each season, the model outputs for frequency and intensity, and for surface and bottom of the water column, were overlaid.
- The zone boundaries shown in Figure 6 were delineated to show the greatest distance from the dredging area and tailwater discharge location of the 'combined' model outputs.

Therefore, the figures show the largest areas over which impacts to BCH are predicted to potentially occur, whether due to the frequency or intensity of elevated SSC, and whether elevations occur in the surface layer or the bottom layer of the water column.

6.4. Intersection of Zones of Impact and Mapped BCH

- The dredging ZoHI, which includes direct and indirect impacts, is limited in extent to an area of 'soft sediment' habitat in the general vicinity of the dredging footprint. There is evidence (albeit from very conservative modelling using SSC only and not benthic light) of a predicted ZoHI in the immediate vicinity of the tailwater discharge, extending over the macroalgae habitat at that location.
- The dredging ZoMI is predicted to extend no further than approximately 0.5 km from the dredging footprint, well offshore from the nearshore macroalgae and coral habitats. The ZoMI associated with the tailwater discharge is predicted to extend only marginally further from shore than the ZoHI, with minimal encroachment upon mixed macroalgae and coral habitat.
- The dredging ZoI is predicted to extend some 3 km westwards from the dredging footprint, though not encroaching upon the macroalgae and coral habitats offshore from Locker Point. In combination with the ZoI associated with the tailwater discharge, though, the ZoI is predicted to extend across macroalgae and coral habitats up to approximately 0.5 km either side of the base of the jetty.
- With respect to sedimentation, the modelling by Water Technology (2021a) predicts that sediment deposition of >1 mm will only occur over 'soft sediment' habitat within 100 m of the dredging footprint.

In summary when the zones of impact are overlapped with mapped BCH across the Project area the dredge plume modelling does not predict any indirect irreversible impact or permanent loss (ZoHI) or recoverable impact (ZoMI) to BCH from dredging the berthing pocket. Direct irreversible impact or permanent loss is assumed in the dredging and tailwater discharge ZoHIs, however, actual loss of BCH is only predicted for the tailwater discharge ZoHI as the dredging ZoHI contains no mapped BCH. In recognition of the conservative modelling, however, K+S considers that the Project can be managed to ensure protection of all BCH from dredging and tailwater discharge.

In this context it is considered that an appropriate Environmental Protection Outcome (EPO) for BCH should be 'No irreversible loss, or serious damage to BCH outside of the ZoHI (Figure 6).

An appropriate Management Target (MT) should be 'No irreversible loss, or serious damage to BCH as a result of dredging or tailwater discharge.'

7. Environmental Factors & Objectives

7.1. Key Environmental Factors

The key environmental factors and objectives to be managed under this DSMP have been derived from the Statement of Environmental Principles, Factors and Objectives (EPA 2018), which outlines objectives aimed at protecting all environments (Themes) including: Sea, Land, Water, Air and People.

The Key Environmental Factors and EPA Objectives to be managed under this DSMP were identified through the EIA of the Project. These are listed below:

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

The Project specific Environmental Protection Outcomes (EPOs) and Management Targets (MTs) for each of the key marine environmental factors (benthic communities and habitats, marine environmental quality, and marine fauna) and are outlined in Table 8.

Table 8 Potential environmental impacts from dredging and disposal and associated project specific Environmental Protection Outcomes and Management Targets

Environmental Factor	EPA Objective	Potential Environmental Impact Pathway	Environmental Protection Outcome (EPO)	Management Target (MT)	Risk Management Strategy
Benthic Communities and Habitats	To protect BCH so that biological diversity and ecological integrity are maintained	Direct impacts of BCH due to removal within the dredging and disposal footprint	No irreversible loss, or serious damage to BCH outside of the Zone of High Impact (ZoHI) (Figure 6)	Dredging operations do not occur outside the defined dredging footprint (Figure 6).	Refer to Table 10
				Disposal operations do not occur outside the defined spoil grounds	

Environmental Factor	EPA Objective	Potential Environmental Impact Pathway	Environmental Protection Outcome (EPO)	Management Target (MT)	Risk Management Strategy
		Indirect impacts of BCH due to reduction in available light caused by increase in suspended sediments released into the water column during dredging.		No irreversible loss, or serious damage to BCH as a result of dredging activities.	
Marine Environmental Quality (MEQ)	To maintain the quality of water, sediment and biota so that environmental values are protected.	Disturbance of contaminants in sediments during dredging has the potential to deteriorate water quality and contaminate marine organisms	Within one month following cessation of dredging and disposal activities water quality will return to the established Levels of Ecological Protection for Exmouth Gulf as determined by DWER (2019).	The extent and duration of increased turbidity as a result of construction activities will be minimised as far as practicable.	By managing short term dredging impacts (turbidity) to BCH no additional management for MEQ is required. Refer to Table 10
		Short term changes to the physico-chemical properties of the water column as a result of dredging			
		Hydrocarbon release into the marine environment from a vessel spill and or bunkering operations		No hydrocarbons spill to the marine environment.	
Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.	Injury or death of marine fauna as a result of dredge operations.	No reported negative impacts on marine fauna attributable to dredging works. No irreversible loss, or serious damage to marine fauna habitat outside of the ZoHI.	No incidences of marine fauna injury or death as a result of dredge operations	Refer to Table 11.
		Injury or death of marine fauna due to vessel movement (strike).		No incidences of marine fauna injury or death as a result of vessel strike	
		Disturbance to turtle nesting due to dredging work (noise).		No disturbance to turtle nesting as a result of marine construction works	
		Turbidity impacts on marine fauna.		No incidences of marine fauna injury or death as a result of turbidity impacts	

8. Monitoring and Management

Where it is considered necessary, the potential environmental impacts in Table 8, have been assigned environmental monitoring and management (EMM) actions to measure compliance against the EPOs and MTs. Management actions have been separated into Tier 1, which specifically address dredging impacts to BCH and marine fauna; and Tier 2, which relate to the overall works and can be managed through standard operating procedures (including IMPs, hydrocarbons and waste).

No EMM table is provided for MEQ as any impacts from turbidity will be short-term and also managed through the EMM actions to protect BCH.

Note EPOs identified in Table 8 are not presented in the following tables as it is assumed that if the MT is achieved then the corresponding EPO will also be achieved.

Table 9 provides the framework for EMM tables.

Table 9 Environmental monitoring and management framework

Element	Description
Objective	What is intended to be achieved.
Management Action	The actions required to assist in meeting the objective. These can be single actions or multiple liked actions to address the objective.
Responsibility	Who is responsible for implementing the actions.
Timing	The time period when the management actions need to be implemented.
Measures	The metrics for recording the outcomes.
Reporting	The way in which the compliance with the management actions and outcomes are reported.
Target	The thresholds, which, if exceeded, require differed management actions (contingency) to be implemented.
Contingency	Actions to be undertake if the management action is not met.

8.1. Benthic Communities and Habitats

The proposed dredging and tailwater discharge are not expected to result in the irreversible loss of BCH outside of the ZoHI (Figure 6). K+S is confident that the MTs and EPOs can be achieved and does not consider in situ telemetered water quality monitoring and associated reactive coral monitoring during dredging is required to protect BCH from indirect dredging related effects. This is considered reasonable for the following reasons:

- the small size, duration and intensity of the proposed dredging and tailwater discharge (dredging of 17,000 m^3 of seabed material in under 14 days)
- the conservative predictive modelling for dredging and tailwater discharge (i.e., using SSC thresholds only for assumed dredge period simulation of 30 days, which is approximately twice what is proposed)
- the ZoHI is limited in extent to an area of 'soft sediment' habitat around the dredging footprint
- the very low proportion of macroalgal and coral habitat outside the dredging footprint within the nearshore LAU that is predicted to be affected by any turbidity generating activities
- Tailwater in bunded disposal area must have turbidity ≤7.3 NTU or SSC ≤13.2 mg/L prior to marine discharge
- natural tolerance and resilience of local BCH to turbidity and low light
- application of EPA Technical Guidance for predicting impacts to BCH from dredging.

8.1.1. Dredge Plume Monitoring Program - Satellite Remote Imagery Analysis

K+S proposes to undertake satellite remote sensing as a powerful and cost-effective tool for mapping and monitoring the spatial extent of sediment plumes and associated water quality parameters experienced during dredging activities. This method utilises two broad classes of satellite imagery. The first is the high spatial resolution (~20m) imagery (i.e. Landsat / Sentinel 2A) which is available approximately every 5 days, depending on cloud cover and satellite view angle. These types of images are useful for resolving surface sediment concentration and shallow waters in fine detail within coastal waters.

The second type of imagery is coarser resolution (~250m), however there are up to two images per day. Furthermore, this type of imagery can be processed in a Near-Real-Time fashion, typically 1 to 4 hours after overpass. This imagery provides rapid synoptic information which allows for a quantitative measure of suspended sediment concentrations. Historical pre-dredge archive data can be analysed to establish seasonally adjusted baselines from which more accurate anthropogenic change can be assessed during dredging.

The importance of this type of information has been recognized by a number of capital dredging projects around Australia and has been valuable to environmental managers for understanding magnitude, spatial spread, movement and dispersion of sediment plumes on a daily basis.

The Satellite Remote Imagery Analysis involves the following steps:

- Setup of high spatial resolution (~20m) imagery (i.e. Landsat / Sentinel 2A) and Near-Realtime (NRT) acquisition and processing platform

- Measurement of total suspended solids (TSS) twice daily for a period of one month (as per dredge timing) via satellite imagery acquisition and analysis to map and validate the dredge plume extent and compare with predicted zones of impact, using EPA (2021) probable running mean SSC thresholds for coral.
- Collect weekly replicate water samples and YSI water column profiling at each water quality sampling site (Figure 6) during dredging to allow for calibration with satellite imagery analysis
- Automated daily upload of raw and processed satellite imagery for QA/QC, download and to inform compliance assessment
- Daily sketches using satellite imagery on pre-prepared templates that show the zones and then compare actual plume extent with predicted.
- Supply of satellite imagery analysis results summary in weekly and final Dredge Plume Summary Reports.

Following implementation of proposed dredge plume monitoring and management, the predicted irreversible impact to BCH and cumulative loss from dredging and tailwater discharge associated with the Project is not considered to pose a significant risk to ecological integrity and biological diversity within the LAU or the broader Port environment, nor is it expected to result in significant regional impacts to these communities, to other benthic communities that may be associated with them (e.g. benthic invertebrates) or to ecosystem function.

A summary of Tier 1 measures proposed to minimise potential impacts on the environmental factor 'Benthic Communities and Habitats' and achieve the MTs are described in Table 10.

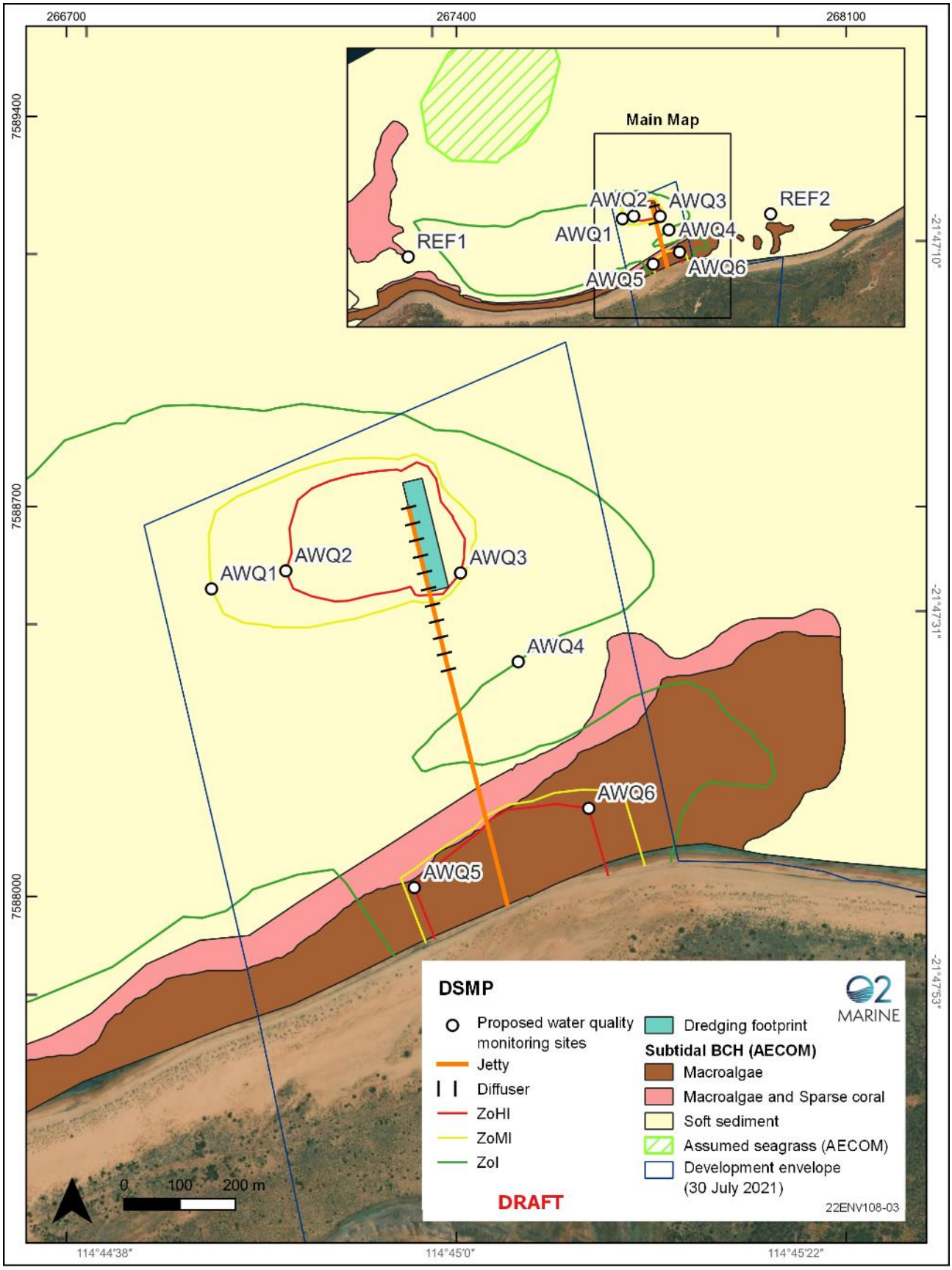

Figure 6 Water quality sampling sites and predicted zones of impact to coral communities during winter dredging scenario (AECOM 2022a)

Table 10 Management actions to minimise impacts on Benthic Communities and Habitats.

Task	Action	Timing
Performance Objective	To ensure the dredging and disposal activities are managed to protect nearshore benthic communities.	Throughout project
Management Actions	Employ high-resolution positioning system to control dredge and disposal operations.	Prior and throughout project
	Use of suitable dredging plant and equipment to minimise turbidity and other sources of sediment release .	Throughout project
	Monitoring of weather and sea conditions.	Throughout project
	Reduce/cease dredging and tailwater discharge if monitored turbidity plumes exceed predictions	Throughout project
	Tailwater in bunded disposal area must have turbidity ≤7.3 NTU or SSC ≤13.2 mg/L prior to marine discharge.	Throughout project.
	Dredge spoil to only be disposed within the allocated onshore bunded disposal area.	Throughout project.
	Implementation of the dredge plume monitoring program.	Throughout project.
Monitoring	• Setup of high spatial resolution (~20m) imagery (i.e. Landsat / Sentinel 2A) and Near-Realtime (NRT) acquisition and processing platform • Measurement of total suspended solids (TSS) twice daily for a period of one month (as per dredge timing) via satellite imagery acquisition and analysis to map and validate the dredge plume extent. • Collect weekly replicate water samples and YSI water column profiling at each water quality sampling site (Figure 6) to allow for calibration and validation with satellite imagery analysis • Apply EPA (2021) probable running mean SSC thresholds for coral to determine actual zones of impact for comparison with predicted. • Automated daily upload of raw and processed satellite imagery for QA/QC, download and to inform compliance assessment • Daily sketches using satellite imagery on pre-prepared templates that show the zones and then compare actual plume extent with predicted.	Daily image analysis for one month pre, during and post dredging. Weekly water quality sampling.

Reporting/Evidence	Supply of satellite imagery analysis results summary in weekly and final Dredge Plume Summary Reports.	Weekly
	Plotting sheets or a certified extract of the ship's log which shall include (as a minimum): • the dates and times of when dredging commenced and finished • the track of all dredge vessels (as determined by GPS) during: (a) dredging activities, and (b) disposal activities	Throughout project.
	Documented report provided to the nominated K+S manager on the incident (i.e. dredging or dumping outside footprint), including (as a minimum) details of the incident, the measures taken, the success of those measures in addressing the incident or risk and any additional measures proposed to be taken.	Throughout project.
Contingency	Revision of dredging strategy, including potential relocation of the dredge(s) and alterations to operational mode if turbidity exceeds predicted ranges and are considered to impact upon coral communities. Notification to the DWER, if water quality exceeds the predicted trigger values, for consideration of need for any corrective action.	Throughout project as necessary
Relevant References/Standards	• Environmental Protection Authority. Technical Guidance - Protection of Benthic Communities and Habitats	N/A
Management Target	No irreversible loss, or serious damage to BCH as a result of dredging or tailwater discharge.	Throughout project.

8.2. Marine Fauna

The (Tier 1) Management actions proposed to minimise potential dredging impacts on the environmental factor 'Marine Fauna' are described in Table 11.

Table 11 Management actions to minimise impacts on marine fauna

Task	Action	Timing
Management Actions	Internal training of Marine Fauna Observer(s) (MFO), which provides clear direction on: • The area that comprises the 'monitoring zone'[1], being the area within a 300 metre radius of the dredge vessel • How to identify marine megafauna (i.e. whales, dolphins, dugong, turtles) that are known or likely to be encountered within the Port • The actions to be undertaken by the MFO in the event of marine fauna being sighted within the monitoring zone • The actions to be undertaken by the MFO in the event of an incident resulting in injury or death of a marine species.	Prior to commencement of dredging project
	Minimise impacts of the dredge through underwater noise through proper maintenance of equipment.	At all times throughout dredging project
	Minimise impacts of light on fauna through the minimisation of unnecessary light sources not required for safe operation of the dredge.	At all times throughout dredging project
	Prior to the commencement of the dumping activities, the dredging contractor must ensure that a check is undertaken, using binoculars from a high observation platform, for marine megafauna within the 'monitoring zone'. If any marine megafauna is sighted in the 'monitoring zone', dumping activities must not commence until the marine megafauna is no longer observed in the monitoring zone, or the vessel is to move to another area of the disposal site to maintain a minimum distance of 300 metres between the vessel and any marine species.	Prior to dredging activities, during daylight hours only

[1] Refers to the area within a 300 metre radius of the vessel

Task	Action	Timing
	Dredge pumps will be stopped as soon as practicable after the cutter head is lifted from the sea floor to minimise potential for intake of marine megafauna, and then only re-engaged once in close proximity to the seabed floor.	During dredging
	Ongoing internal training of MFOs as required to ensure that a trained MFO is always available.	At appropriate times throughout dredging project
Measures	Number of reported incidents involving marine megafauna.	During Dredging
Reporting / Evidence	MFO training package and training/attendance record for each MFO.	Prior to and throughout project
	A log detailing all marine fauna observations within the monitoring zone (during daylight operations only) shall be maintained. The log shall include (as a minimum) the following information: date, name of MFO, time (commencement of pre-dumping observations), time (completion of pre-dumping observations), whether marine megafauna was sighted in the monitoring zone during the pre-dumping monitoring period, type of marine species identified (where possible), general comments on animal behaviour, description of mitigation measures undertaken (e.g. location of fauna monitored until it exited the monitoring zone. Dumping did not occur until fauna exited the monitoring zone), time (commencement of dumping) and time (completion of dumping).	Throughout dredging and disposal activities
	Report any incidents involving the dredging or dumping activities that result in injury or death to any marine megafauna to approval holder as soon as practicable but within 12 hours. Record the date, time and nature of each incident as well as a description of the species involved.	As soon as practicable after an incident is observed, but within 12 hours
	Notify DBCA and DCCEEW of any incidents involving the dredging or dumping activities that result in injury or death to any marine megafauna.	Within 48 hours from the time that the incident occurred.
Management Target	No incidences of marine fauna injury or death as a result of dredge operations.	Throughout the project

8.2.1. Trained Marine Fauna Observers

8.2.1.1. Training and Qualifications

Trained MFOs are crew members trained in marine fauna species observations and mitigation measures, consistent with the Project environmental management plans. Trained MFOs will be on duty on Project vessel during dredging. There will be always at least one Trained MFO on duty during dredging.

All vessel crews engaged in by K+S for the marine construction and operations of the Project will attend a minimum of one marine fauna induction to become familiar with the range of conservation significant marine fauna that could be present in the Project area and the risks the dredging may present to this fauna. All commitments made by the Client to manage dredging activity with conservation significant marine fauna will be included in the induction. The content of the induction will be updated as required to ensure it remains current and reflects the marine fauna being observed in the Project area and any vessel interactions with marine fauna that has occurred. This marine fauna induction can be combined with other crew inductions that may be required.

8.2.2. Protocols and Procedures

8.2.2.1. Dredging Noise Management

The monitoring protocols and procedures for marine fauna observations during dredging activities have been informed by the underwater noise modelling undertaken by Talis (2021) to determine the best practice observation and exclusion zones for marine mammals and marine turtles. Noise management zones are presented in Table 12 and Figure 7.

Table 12 Noise management zones for marine mammals (whales, dolphins and dugong) and marine turtles

Activity	Observation Zone (metres)	Exclusion Zone (metres)
Dredging	350	170

Observation zones have been determined based on the modelled Temporary Threshold Shift (TTS) onset distance for marine fauna and exclusion zones are based on the modelled Permanent Threshold Shift (PTS) onset distance for marine fauna (AECOM 2022b). It is predicted from underwater sound modelling that the noise management zone distances for marine mammals and turtles (Table 12), would be more than adequate to avoid the onset of injury (predicated as the threshold for the onset of TTS and PTS) and the avoidance of adverse behavioural effects. Noise management zones have been derived using worst case (most sensitive) fauna group threshold levels (sawfish and marine turtles at high tide) for noise sources (i.e., impact piling and dredging) (AECOM 2022b).

8.2.2.2. Dredging

It is predicted from underwater sound modelling that the dredging noise management zone distances for marine mammals and turtles (Table 12), would be more than adequate to avoid the onset of injury (predicated as the threshold for the onset of TTS and PTS) and adverse behavioural effects. Noise management zones have been derived using worst case (most sensitive) fauna group threshold levels (sawfish and marine turtles at high tide) for dredging noise.

To mitigate potential impacts of dredging works on significant marine fauna the Contractor must implement the following management and monitoring protocols during dredging and disposal works:

- Where practicable, dredging operations will be undertaken outside key ecological windows for protected marine species, e.g.
  - Dredging will avoid the sawfish pupping window (September – November).
  - Dredging will avoid the turtle mating, nesting and hatching window (October - February).
  - Dredging will avoid the southern migration of Humpback Whales (August-December).
- Implementation of dredging noise mitigation measures.
- From ten minutes prior to the commencement of any dredging activities, a dedicated MFO[1] will monitor the observation and exclusion zones to check for the presence of any protected marine species. If any protected species are observed within these zones, dredging activities will not commence until they are observed to have left the observation zone, or until ten minutes have elapsed since the last sighting, and no other protected species have entered the zone during this period.
- On each occasion that a dredge has been non-operational for a period exceeding 30 minutes, a visual assessment will be undertaken of the observation and exclusion zones by the MFO for a period of ten minutes. Dredging will not recommence until no protected marine species have been sighted within the observation zone for a period of ten minutes.
- Once dredging has commenced, the MFO will maintain ongoing visual scanning of the observation and exclusion zones for protected marine fauna and, every 30 minutes, will dedicate a period of five minutes for observation (from an elevated position) for protected marine fauna. Dredging activities will be temporarily suspended if an individual of a protected marine species encroaches within the pertinent exclusion zone. Dredging will not recommence until no protected marine species have been sighted within the observation zones for a period of ten minutes.
- Dredging operations will be undertaken during daylight hours where practicable.

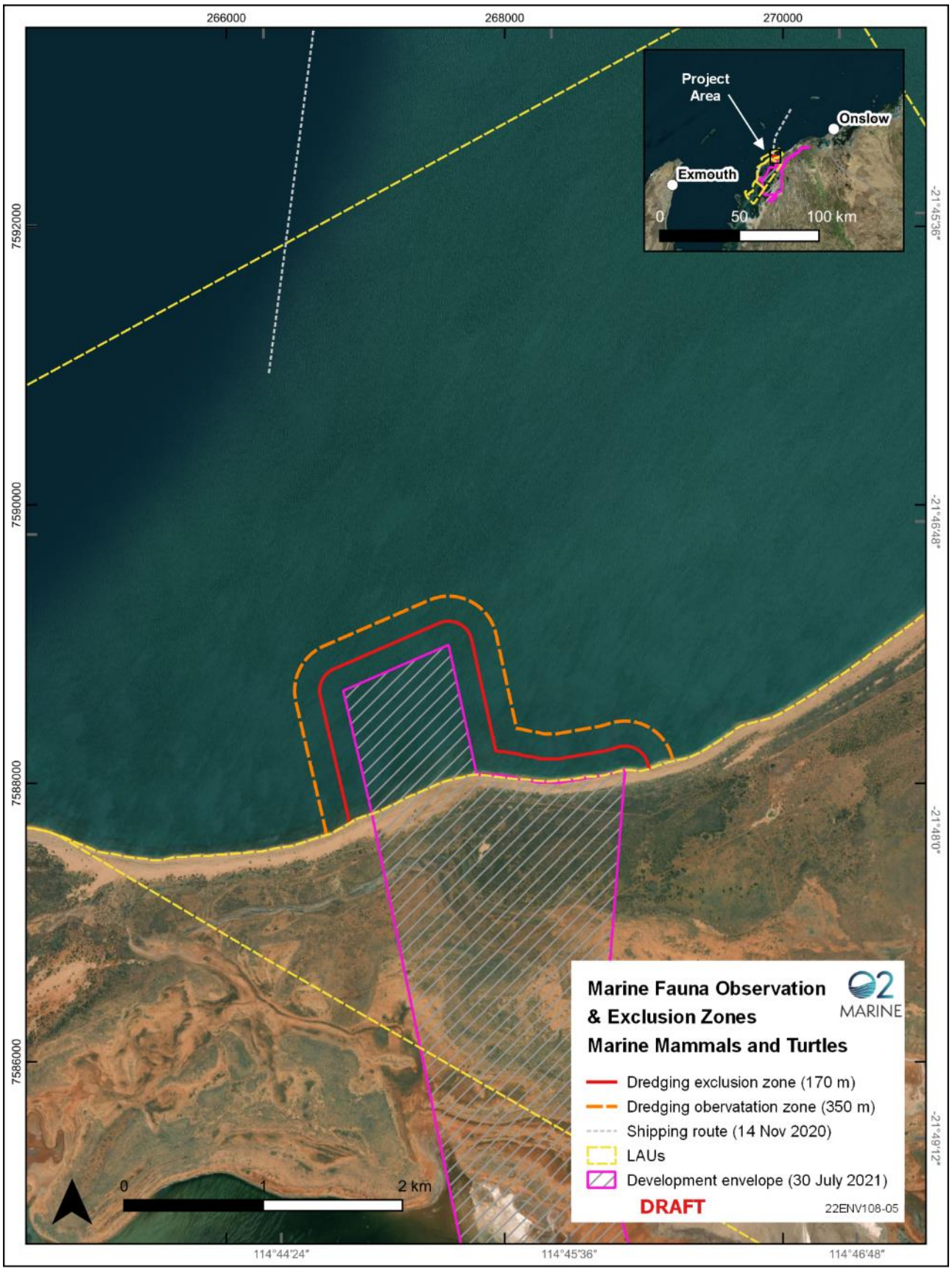

Figure 7 Observation and exclusion zones for marine mammals and turtles

8.3. Hydrocarbon Management

The (Tier 2) management actions proposed to minimise potential impacts associated with hydrocarbon spill are described in Table 13.

Table 13 Management actions to minimise the risk of Hydrocarbon Pollution

Activity	General Vessel Operations					
Potential Impacts	• Altering of the diversity, geographic distribution and viability of fauna at the species and population levels • Degradation of the structure, function, distribution, diversity and viability of benthic communities and habitat at local and regional scales.					
Management Targets	Management Actions		Environmental Performance			
	Item	Actions	Responsibility	Reporting/Evidence	Timing	Contingency
Manage vessel bunkering, chemical storage and spill response to ensure no adverse impacts to the marine environment.	5.1	Document vessel bunkering management, including appropriately licensed bunkering facilities	Contractor	Vessel management procedures	Prior to dredge entering Western Australian Waters from overseas or interstate.	Dredge operations not to commence prior to development and Proponent approval of vessel bunkering management procedure
	5.2	Undertake vessel maintenance and bunkering in accordance with dredging contractors approved vessel management systems	Contractor	Vessel management procedures	For the duration of dredging	Vessel bunkering management systems to be reviewed and refined (if required) in the event of an identified procedural breach or hydrocarbon spill
	5..3	Implement industry standard hydrocarbon management practices (chemical handling, storage, segregation and spill response)	Contractor	Vessel management procedures Approval holder and DoT are to be notified immediately in the event of a hydrocarbon spill of any volume	Prior to commencement of dredging	Dredge operations not to commence prior to development and approval of vessel management procedures Investigate spill event and review management actions and responses

	5.4	Undertake an environmental inspection of all dredging vessels	Contractor	Vessel management procedures	Prior to the commencement of dredging	Dredge operations not to commence prior to development and approval of vessel management procedures

8.4. Waste Management

The (Tier 2) management actions proposed to minimise potential impacts that waste management may have on the environment are listed in Table 14.

Table 14 Management actions to manage Waste

Activity	Incorrect or accidental disposal from a vessel					
Potential Impacts	• Impacts on the MEQ (both sediment and water) and marine fauna due presence of foreign materials					
Management Targets	Management Actions		Environmental Performance			
	Item	Actions	Responsibility	Reporting/Evidence	Timing	Contingency
Manage waste in compliance with approval holder requirements and in accordance with MARPOL 73/78 Convention Annex IV (sewage) and Annex V (garbage).	6.1	Dredging contractor to establish a sewage and implement a garbage disposal plan in accordance with approval holder requirements and MARPOL 73/78	Contractor	Plan – one week prior to dredging Incident - Within 12 hours of a reportable incidence	Prior to commencement of dredging Duration of dredging operations	Approval holder to approve Plan prior to commencement of dredging Plan and procedures to be revised to prevent recurrence of incident Approval holder to audit performance during dredging if/as required
Manage the correct onshore disposal and reporting systems	6.2	Only a licenced Controlled Waste Carrier to be used for any controlled waste discharged ashore	Contractor	Controlled waste tracking forms to be completed as soon as possible	Duration of dredging operations	Approval holder to audit performance during dredging if/as required
	6.3	All forms of waste need to be stored in appropriately labelled drums or tanks and	Contractor	Approval certification and tracking forms to be	Duration of dredging operations	Vessel management plan/procedures to be reviewed and endorsed by

		be correctly disposed of and not discharged to the environment		completed as soon as possible Vessel waste management plan/procedures		approval holder prior to dredging Approval holder to audit performance during dredging if/as required
	6.4	Reporting of any type of spillage within the marine environment directly to the Vessel Traffic Services	Contractor	As soon as possible, within 24 hours	During the duration of dredging operations	Revise associated management plans or procedures to ensure no incident recurrence Approval holder to audit performance during dredging if/as required

9. Reporting

9.1. Compliance Reporting

A summary of the reporting requirements for the project are provided in Table 15.

Table 15 Compliance reporting requirements

Report	Content	Timeframe	Responsibility	Recipient
Environmental Incidents or Environmental Risks Report	Report any environmental incident or environmental risk Detail the incident or risk, the measures taken, the success of those measures in addressing the incident or risk and any additional proposed to be taken Document any incidents involving the dumping activities that result in injury or death to any marine species. The date, time and nature of each incident and the species involved, if known, must be recorded.	Within 12 hours	Contractor	Approval Holder PPA / DoT – Reportable Oil Spill/POLREP DBCA – Reportable wildlife incident
Non-compliance Summary Report	Identify which EPO has not been achieved Detail the monitoring results that identified the EPO was not being achieved Describe the investigation being undertaken into the cause of the EPO not being achieved Identify any corrective or contingency management actions proposed to be implemented or being implemented	Within 7 days of determining that an EPO has not been achieved	Proponent	DWER DCCEEW
Non-compliance Investigation Report	Identify which EPO has not been achieved Detail the findings of the investigations undertaken into the cause of the EPO not being achieved	Within 30 days of determining that any EPO has not been achieved	Approval Holder	DWER DCCEEW
Close-out Report	Report which evaluates the performance of monitoring and management in achieving the EPOs.	Within 12 months following completion of dredging	Approval Holder	DWER DCCEEW
HOLD: All reporting commitments under approval conditions must be included within this Table				

9.2. Additional Reporting

A summary of the additional reports that are expected to inform compliance reporting commitments (Table 15) are listed in Table 16.

Table 16 Additional reporting requirements required to demonstrate compliance

Topic	Content	Timeframe	Responsibility	Recipient
Dredge Plume Monitoring Program Reporting	• Weekly Reports • Monitoring Summary Report	• Monitoring reports to be issued weekly during dredging • Monitoring summary report to be issued with Close-out report	Approval Holder	DWER DCCEEW
Site and vessel inspection checklists / logs	• Vessel Environment, Safety & Health inspection – (e.g., equipment inspection, navigation equipment systems, speed, MFO personnel, bunkering log). • Dredge operation log – (e.g., operations times, types of operations, GPS positioning, dredge volumes). • Marine fauna observation Logs – (e.g., dredge operation time, name of observer, fauna species, distance/direction from vessel, management response)	• Daily during dredging	Contractor	Approval Holder
Pollution Incidents	All marine pollution incidents shall be reported to Approval Holder as an environmental incident. Approval Holder will coordinate the state reporting requirement to the DoT Maritime Environmental Emergency Response (MEER) duty officer (24 hours) on (08) 9480 9924 and followed by an online Pollution Report Form (POLREP), which is available at: http://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-PollutionReport.pdf.	• All marine incidents (including pollution) to be reported to the Approval Holder immediately and to DoT within 24 hours.	Contractor Approval Holder	Approval Holder DoT
Complaints	Approval Holder to be notified of any complaints received in relation to the dredging activities. Notification should detail the nature of the complaint and how it was resolved.	• Within 72 hours of any complaint received	Contractor	Approval Holder

10. Availability of the DSMP

This DSMP is available on the EPA and K+S websites and will further be made available to the public or stakeholders upon request.

11. Audit and Review

K+S will undertake audits of the dredge contractor and their operations as required throughout the project, to assess compliance against this DSMP. The performance of the dredging operations against these requirements will be reported.

This DSMP is a living document and will be reviewed in accordance with Table 17. Any significant changes must be documented in Appendix A.

K+S are committed to continual improvement and will conduct regular review of the content and implementation of this DSMP.

Table 17 DSMP Review Schedule

Timing	Rationale
Upon Receipt of approval conditions	Regulator (DWER/DCCEEW) approval conditions obtained will necessitate a comprehensive review of this DSMP to ensure all relevant commitments are covered within this Plan to ensure compliance.
Prior to commencement of action	To ensure that the contractor and approval holder implement all commitments accordingly and that no operational details are non-compliant
Any time operational activities significantly alter	Operational changes to the project may result in an altered risk profile. Therefore, the DSMP will require a review to ensure that it remains fit-for-purpose for altered operational conditions. Any significant change in environmental risk will require the DSMP to be resubmitted to DWER for endorsement
Following any significant incidents or non-compliance events	To ensure that the management actions and controls in place are adequate to ensure no re-occurrence of incidents or non-compliances

During review of the DSMP, consideration will be given, but not limited to:

- Overall effectiveness of the Plan
- Changes in schedule
- Changes to monitoring trigger values, where determined to be ineffective or inappropriate
- Any changes in methodology or equipment used.

12. References

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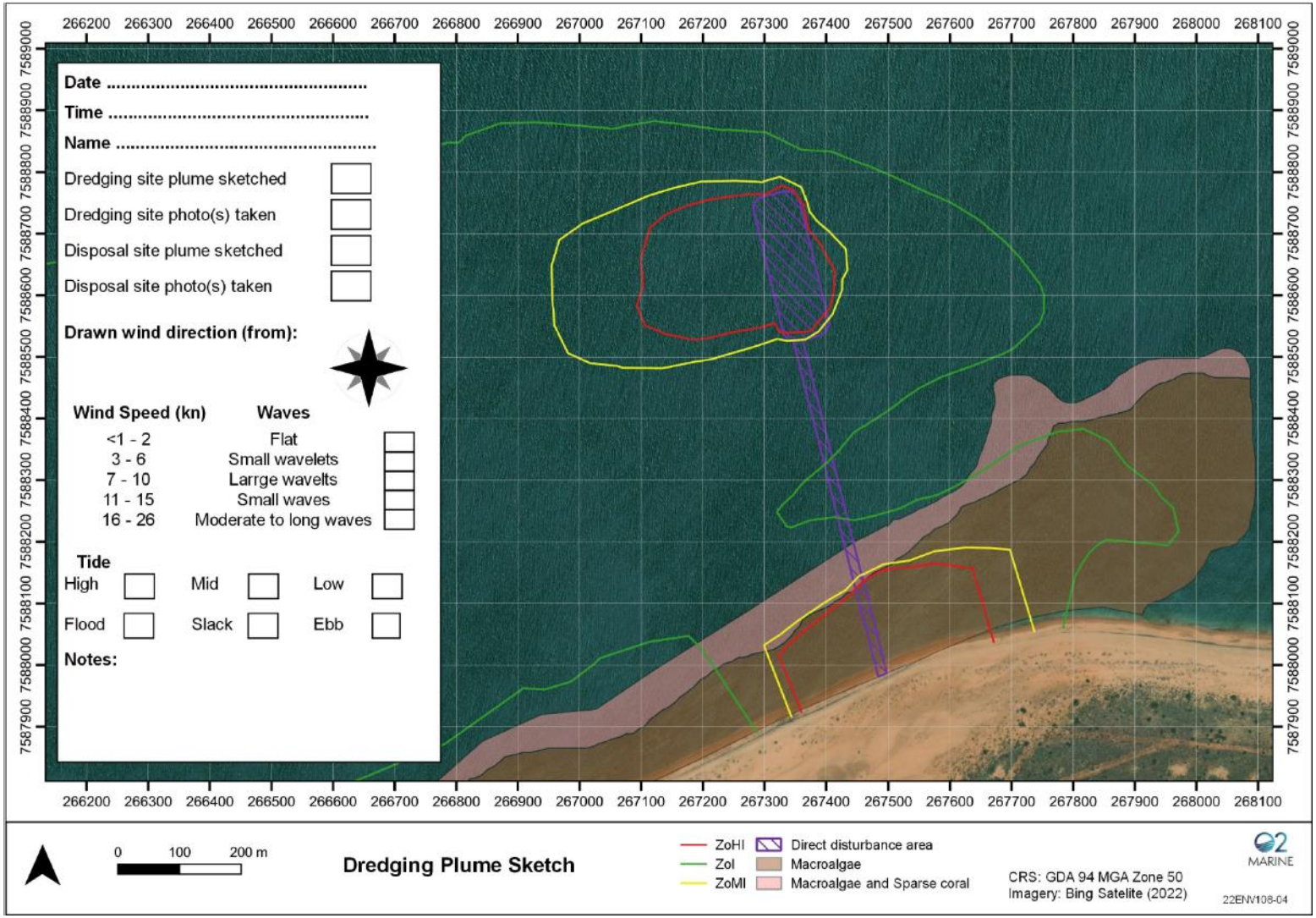
Appendix A. Plan Amendments

Appendix A.1. Document Change Register

Organisation	Date	Comment	Response

Appendix B. Dredging Plume Sketch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Time .....
Name .....
Dredging site plume sketched
Dredging site photo(s) taken
Disposal site plume sketched
Disposal site photo(s) taken
Drawn wind direction (from):
Wind Speed (kn)
Waves
<1 - 2
Flat
3 - 6
Small wavelets
7 - 10
Larrge wavelts
11 - 15
Small waves
16 - 26
Moderate to long waves
Tide
High
Mid
Low
Flood
Slack
Ebb
Notes:
266200 266300 266400 266500 266600 266700 266800 266900 267000 267100 267200 267300 267400 267500 267600 267700 267800 267900 268000 268100
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Direct disturbance area
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