Eramurra Solar Salt Project

Marine Environmental Quality Monitoring and Management Plan

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Version Register

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Acronyms and Abbreviations

Acronyms and Abbreviations	Description
°C	Degrees Celsius
%	Percent
ADCP	Acoustic Doppler Current Profiler
ANOVA	Analysis of Variance
ANZG	Australian and New Zealand Guidelines
AS	Australian Standard
ASTM	American Society for Testing Materials
BCH	Benthic Communities and Habitat
BTEXN	Benzene, toluene, ethylbenzene, xylenes and napthalene
CATAMI	Collaborative and Automated Tools for Analysis of Marine Imagery
CEO	Chief Executive Officer
CoC	Chain of Custody
CTD	Conductivity, Temperature, Depth
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEC	Department of Environment and Conservation
DLI	Daily Light Integral
DMIRS	Department of Mines, Industry Regulation and Safety
DO	Dissolved Oxygen
DWER	Department of Water and Environmental Regulation
EIA	Environmental Impact Assessment
EMS	Environmental Management System
ENSO	El Niño-Southern Oscillation
EPA	Environmental Protection Authority
EPBC Act	*Commonwealth Environmental Protection and Biodiversity Act 1999*
EQC	Environmental Quality Criteria
EQG	Environmental Quality Guideline
EQI	Environmental Quality Indicator
EQMF	Environmental Quality Management Framework
EQO	Environmental Quality Objective
EQP	Environmental Quality Plan

Acronyms and Abbreviations	Description
EQS	Environmental Quality Standard
ESD	Environmental Scoping Document
ESSP	Eramurra Solar Salt Project
EVs	Environmental Values
FLU	Fluorometer
GLpa	Gigalitre per annuum
GPS	Geographic Positioning System
ha	Hectares
HEPA	High Ecological Protection Area
IG	Infauna Grab
IOD	Indian Ocean Dipole
ISO	International Organization for Standardization
ISQG	Interim Sediment Quality Guideline
Km/hr	Kilometres per hour
Ktpa	Kilo tonnes per annum
LEP	Level of Environmental Protection
LEPA	Low Ecological Protection Area
LS	Leichhardt Salt Pty Ltd
m3	Meters cubed
MEPA	Moderate Ecological Protection Area
MEQ	Marine Environmental Quality
MEQMMP	Marine Environmental Quality Monitoring and Management Plan
MS	Ministerial Statement
MSL	Mean Sea Level
Mt	Million Tonne
Mtpa	Million tonnes per annum
NATA	National Association of Testing Authorities
nMD	Nonsense-mediated decay
NTU	Nephelometric Turbidity Units
O2M	O2 Marine Pty Ltd
PASS	Potential Acid Sulfate Soils
ppt	Parts per thousand

Acronyms and Abbreviations	Description
QA/QC	Quality Assurance / Quality Control
SDS	Safety Data Sheet
SPL	Species Protection Level
SWQMS	State Water Quality Management Strategy
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
TSS	Total Suspended Solids
uS/cm	Microsiemens per centimetre
WA	Western Australia
WAMSI	Western Australian Marine Science Institution
WET	Whole Effluent Toxicity
WQ	Water Quality
XEPA	Maximum Ecological Protection Area

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1. Introduction

Leichhardt Salt Pty Ltd (Leichhardt) is seeking to develop the Eramurra Solar Salt Project (the Proposal), a solar salt project east of Cape Preston, approximately 55 km west-south-west of Karratha in the Pilbara region of Western Australia (WA; Figure 1).The Proposal is an evaporative solar project that utilises seawater to produce raw salt as a feedstock for reprocessing to high purity salt. The Proposal aims for average annual production rates of 5.2 million tonnes per annum (Mtpa). To meet this production, the following infrastructure will be developed:

- Seawater intake, pump station and pipeline
- Concentration ponds totalling approximately 10,000 ha
- Crystallisers, totalling approximately 1,900 ha
- Drainage channels and bunds
- Process plant and product dewatering facilities
- Water supply (desalination plant)
- Bitterns disposal pipeline and outfall
- Pumps, pipelines, roads, and support buildings including offices and communications facilities
- Workshops and laydown areas
- Landfill, and
- Other associated infrastructure.

A general description of the of the Proposal is provided in Table 1, while the Proposal content elements (e.g. development, action, activities or processes) are summarised in Table 2). The Project location and marine elements are shown in Figure 1 and the Proposal development envelopes are shown in Figure 2.

Table 1 Short Summary of the Proposal

Project 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 kilometres (km) west-south-west of Karratha in Western Australia (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 concentration ponds, crystallisers and processing plant. Supporting infrastructure includes bitterns outfall, drainage channels, product dewatering facilities, desalination plant, 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 both offshore and onshore disposal of dredge spoil material.

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 Statement (MS) 949. Dredging 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 an offshore disposal location, or onshore within the Ponds and Infrastructure Development Envelope. The Cape Preston East Port jetty and associated stockpiles are excluded from the ESSP. The ESSP will produce a salt concentrate according to the following processes:

- Seawater will be pumped into the first concentration pond and commence progressive concentration by solar evaporation as it flows through successive concentration ponds
- Salt is deposited onto a pre-formed base of salt in the crystallisers
- Salt will be removed from the drained crystallisers by mechanical harvesters and stockpiled adjacent to the processing facilities
- Salt concentrate will be trucked to the trestle jetty approved by MS 949 for export, and
- A maximum of 5.9 GL of bitterns (at 410ppt salinity) will be generated in any given year and up to 0.65 GL (at 410ppt salinity) in a peak summer month. The bitterns will be diluted 1:1 by volume with local seawater prior to discharge via ocean outfall diffuser within the Marine Development Envelope.

The Proposal may be developed in its entirety, or the East concentration ponds may be developed at a later stage. O2 Marine was engaged by the proponent to undertake marine environmental investigations to help identify environmental risks of the ESSP, establish baseline conditions, help facilitate the environmental approvals process, and guide appropriate monitoring and management to minimise potential impacts to the marine environment during construction and operations. Table 2 outlines the extent of the physical and operational elements of the ESSP.

Table 2 Location and proposed extent of physical and operational elements

Element	Location	Proposed Extent
Physical Elements		
Pond and Infrastructure Development Envelope – Concentration ponds and crystallisers. Process plant, desalination plant, administration, water supply, intake, associated works (access roads, laydown, water supply and other services).	Figure 2	Disturbance of no more than 12,201 ha within the 20,160 ha Ponds Development Envelope.
Marine Development Envelope – Seawater intake and pipeline, dredge channel, bitterns pipeline, outfall diffuser and mixing zone.	Figure 2	Disturbance of no more than 53 ha within the 703 ha Marine Development Envelope.
Dredge Spoil Disposal Development Envelope – Disposal location for dredge spoil.	Figure 2	Disturbance of no more than 100 ha within the 285 ha Dredge Spoil Disposal Development Envelope.
Operational Elements		
Bitterns discharge	Figure 2	Discharge of up to 5.9 Gigalitres per annum (GL pa) of bitterns within a dedicated offshore mixing zone within the Marine Development Envelope
Dredge Volume	Figure 2	Approximately 400,000 m^3

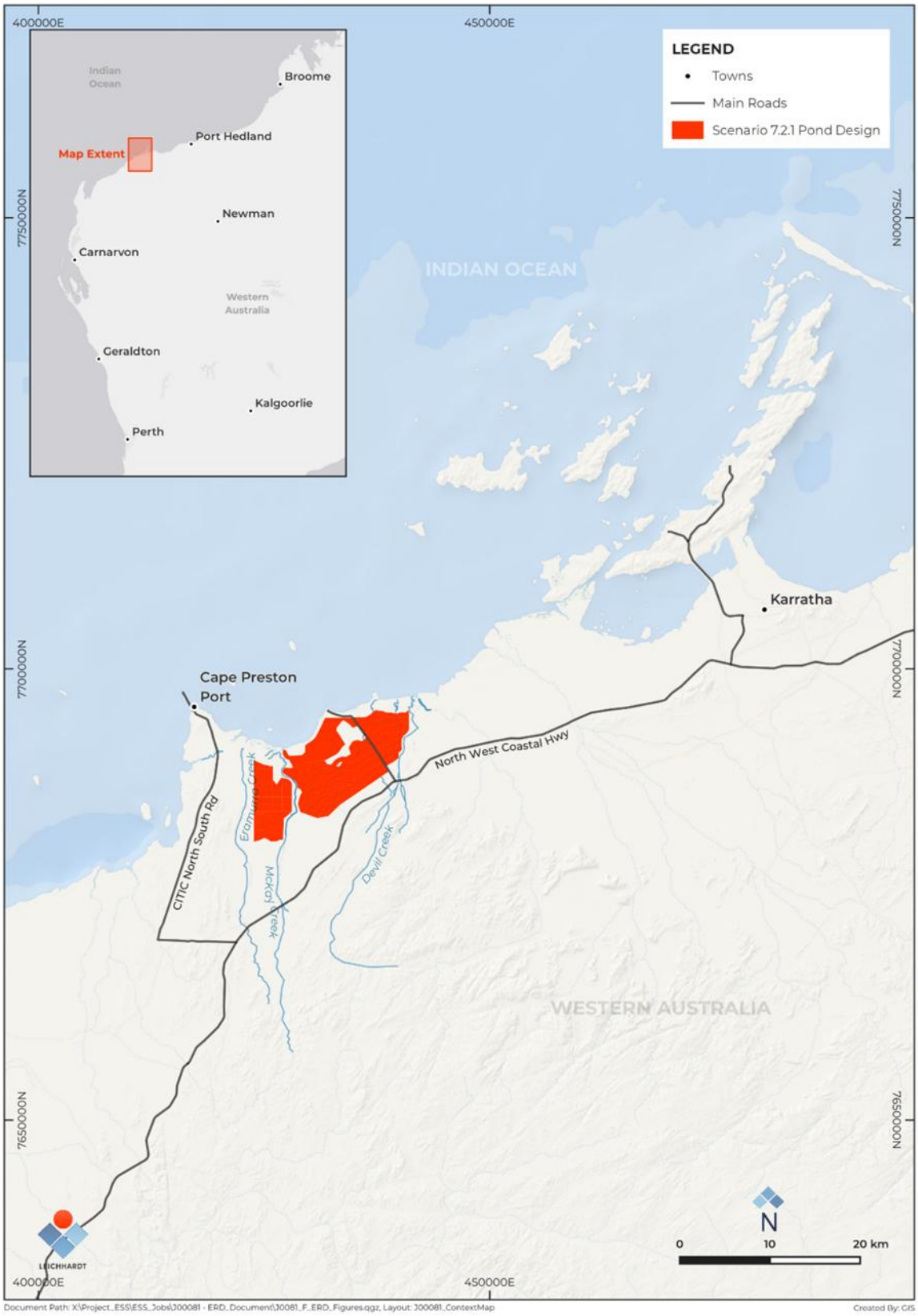

Figure 1 Project location and marine elements

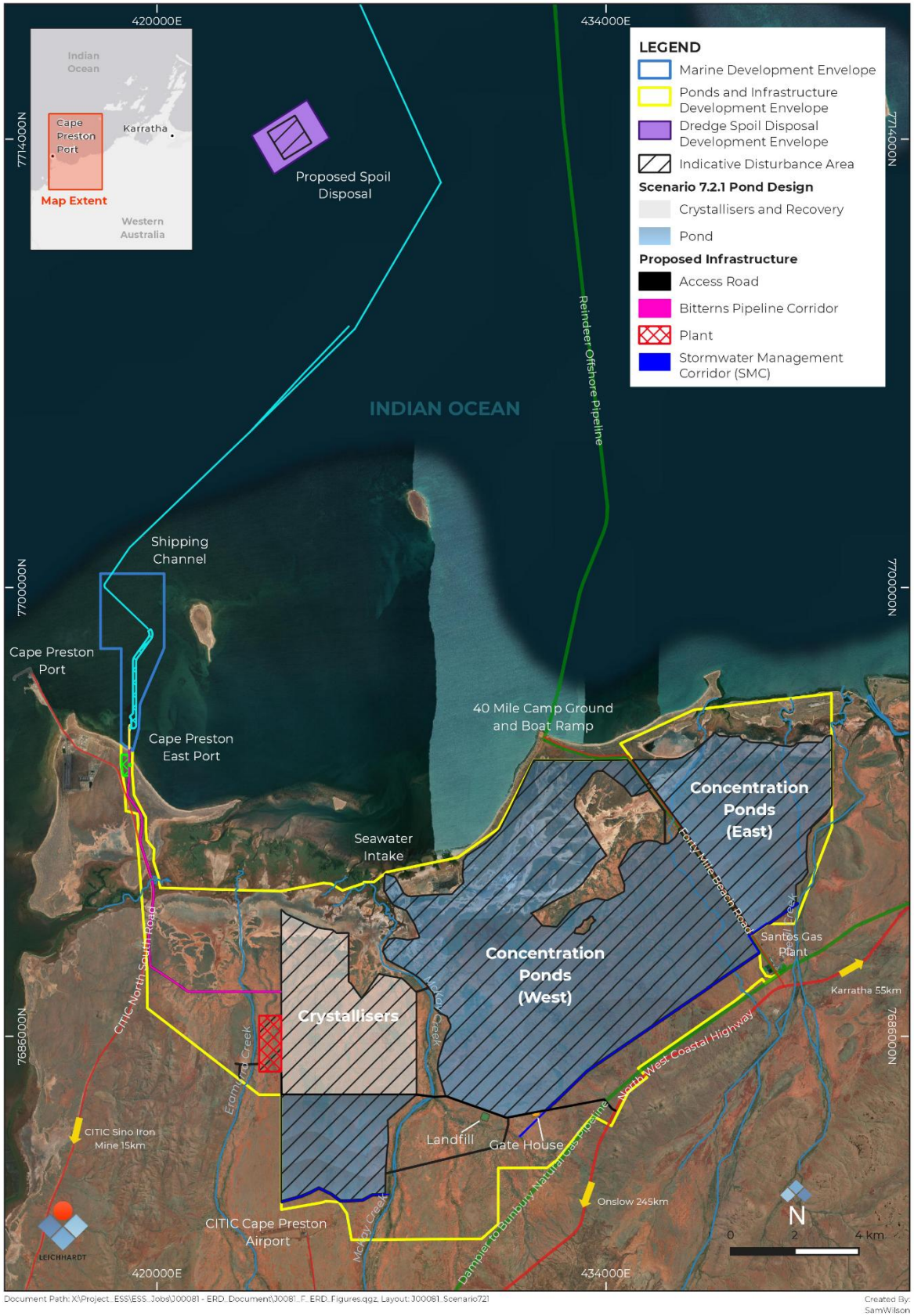

Figure 2 Proposed development envelopes and indicative layout.

1.1. Purpose of the Plan

The purpose of this Marine Environmental Quality Monitoring and Management Plan (MEQMMP) is to address the relevant work items within the Eramurra Solar Salt Project – Environmental Scoping Document (ESD) (Preston Consulting 2022). Table 3 outlines the specific requirements from the ESD that are required to be covered by this MEQMMP.

Table 3 Marine Environmental Quality Objectives from the ESSP ESD (Preston Consulting 2022).

ESD Item	Requirement	Comment / Report Section
ESD Item 42.	An outline of the Environmental Quality Management Framework, including an Environmental Quality Plan (EQP) that identifies the Environmental Values to be protected and spatially defines the Environmental Quality Objectives to be met, including Levels of Ecological Protection applicable to the Proposal. The EQP will be based on the updated Pilbara Coastal Water Quality Consultation Outcomes – Environmental Values and Environmental Quality Objectives (DoE, 2006).	Section 2.2
ESD Item 43.	Describe and map the key sensitive biological receptors likely to be affected by the discharges. Provide a figure showing the receptors as an overlay on the EQP;	Figure 4 and Appendix A
ESD Item 46.	Collect adequate baseline water quality, sediment quality and benthic community data to document background marine environmental quality (including spatial and temporal variation) within the receiving marine environment. Baseline data acquisition will be adequate for the derivation of draft environmental quality criteria for indicators relevant to the discharge(s) e.g., water, sediment and/or infauna quality indicators	Section 4.2 and Appendix A
ESD Item 47.	Undertake a baseline sediment quality assessment at the outfall location including physical (i.e., particle size) and chemical (metals, hydrocarbons) and biological (benthic infauna).	Section 4.2 and Appendix A
ESD Item 51.	Conduct whole effluent toxicity (WET) testing or use results from toxicity estimates based on publicly available WET test results for waste bitterns in the Pilbara region to determine and describe the toxic effects of the bitterns discharge and predict the number of dilutions required to meet the different levels of ecological protection surrounding the outfall. Specifically utilise available information to undertake a marine biota ecotoxicology assessment of local marine indicator species for proposed marine discharges;	Section 3.1
ESD Item 52.	Undertake a bitterns outfall modelling study, utilising the hydrodynamic model together with published bitterns ecotoxicity concentrations to determine an appropriate discharge regime	Section 3.1 A separate document details the Bitterns Modelling results (O2 Marine 2023)

ESD Item	Requirement	Comment / Report Section
	required to achieve the spatial levels of ecological protection defined in the proposed Marine Environmental Quality Monitoring and Management Plan (MEQMMP) described below. The modelling will utilise local conditions (bathymetry and tides) to determine: a) Dilution contours around the outfall, using several outfall designs if required b) Dilution that can be achieved by discharge velocity alone (no underlying currents) c) Predicted mixing zones required to meet the level of ecological protection of the waters surrounding the mixing zone.	
ESD Item 53.	Utilise the findings of the bitterns outfall modelling to the extent of the zone of influence of the bitterns plume and determine whether lower levels of ecological protection are justified and if so, proposed boundaries for these alternative levels of ecological protection;	Section 2.4 and Figure 5
ESD Item 54.	Prepare a MEQMMP in accordance with the EPA's Technical Guidance – Protecting the Quality of WA's Marine Environment (EPA, 2016b). The MEQMMP should include but not be limited to: a) A description and map of the key sensitive biological receptors likely to be affected by the discharges. Provide a figure showing the receptors as an overlay on the MEQMMP b) An outline of the Environmental Quality Management Framework, including identification of Environmental Values, Environmental Quality Objectives and Spatial Levels of Ecological Protection applicable to the Proposal c) Clear, measurable and auditable Environmental Quality Criteria (EQC) for each indicator and the statistical methods for interpreting monitoring data against the EQC d) Diffuser validation e) Description of marine environmental quality monitoring f) Management strategies in the event that environmental quality criteria are exceeded; and g) Emergency shut down procedures.	a) Figure 4 b) Section 2.2 c) Section 3.5 d) Section 4.3 e) Section 4.5 f) Section 5 g) Section 6.4
ESD Item 55.	Assess risks of product and hydrocarbon spillages into the marine environment and provide a specific management plan designed to manage spillages.	Product spillage is addressed in Section 4.5. Hydrocarbon spill management and response is covered in 4.6.

1.2. Scope of the Plan

The scope of the MEQMMP applies to the following operational activities related to the ESSP:

1. ESSP - Bitterns discharge, including the commissioning, validation and ongoing operational phases, and
2. ESSP - Product handling and storage operations within the ESSP development envelopes;
3. Cape Preston East Port (for reference only) - port operations in the nearshore berth facility and at the offshore mooring area.

Note that Cape Preston East Port operations are separate to the ESSP and details about the management of these activities are provided in this MEQMMP for reference only.

This MEQMMP sets out a process for monitoring and reporting operational impacts against acceptable limits of ecological change during the lifecycle of the ESSP. Where results outside the limits of acceptable change are reported, a pre-determined risk-based management response is triggered to ensure the Environmental Values (EVs) and Environmental Quality Objectives (EQOs) are not compromised. This MEQMMP has been prepared in accordance with the EPAs Technical Guidance – Protecting the Quality of WA's Marine Environment (EPA 2016a), and details the specific process for continual revision and improvement of the MEQMMP any time the ESSP progresses, or at any time key processes alter and new risks are identified.

To ensure the objectives of the MEQMMP are achieved the following key processes have been defined:

1. Pre-Project Baseline Data Collection
   - Derive locally relevant Environmental Quality Criteria (EQC) from baseline data to inform ongoing monitoring and management
2. Commissioning
   - Monitor and mitigate potential impacts to MEQ throughout the commissioning period.
3. Validation
   - Undertake further whole of effluent toxicity (WET) testing of the final bitterns during the commissioning phase to ensure the Species Protection Levels (SPL) within the outfall mixing zone and the designated Levels of Ecological Projection (LEP) are appropriate
   - Validate the accuracy of numerical modelling in predicting the extent of the mixing zone; and
   - Validate performance of the bitterns outfall diffuser during both commissioning and operational phases of the Proposal.
4. Ongoing MEQ Monitoring
   - Monitor and mitigate potential impacts to MEQ throughout the life of the ESSP.

2. Rational and Approach

2.1. Key Environmental Factors

The ESSP operations include multiple activities that, if left unmanaged, have the potential to impact natural MEQ of the area. These activities include both the release of bitterns, and the handling and storage of a high saline product.

The Environmental Protection Authority (EPA) outlines a series of environmental principles, factors, and objectives in EPA (2021a). The key environmental factor associated with this MEQMMP is MEQ. The Environmental Values (EVs) and Environmental Quality Objectives (EQOs) relevant to the ESSP are summarised in Table 4.

The Western Australia (WA) EPA's environmental objective for the factor MEQ is '*To maintain the quality of water, sediment and biota so that environmental values are protected*' (EPA 2016a).'

The relevant policy and guidance considered in the assessment of the MEQ factor are:

- Statement of Environmental Principles, Factors and Objectives (EPA 2021a)
- Instructions on how to prepare an Environmental Review Document (EPA 2021b)
- Environmental Factor Guideline – Marine Environmental Quality (EPA 2016a), and
- Technical Guidance – Protecting the Quality of Western Australia's Marine Environment (EPA 2016b).

Table 4 Key environmental factors, values, and objectives, relevant to the ESSP

EPA Factor	Environmental Values	Environmental Quality Objective	Pathway
Marine environmental quality	Ecosystem health	Maintenance of Ecosystem Integrity	The ESSP has the potential to modify water quality during the operational phase through processing and storage of seawater, and discharge of bitterns. Cape Preston East Port has the potential to modify water quality during the operational phase through operational activities associated with port operations.
	Recreation and aesthetics	Maintenance of Aesthetic values	Impacts to social surroundings and values may occur due to changes to water quality during the discharge of bitterns during the operational phase.

Other environmental factors, being Benthic Communities and Habitat (BCH) and Marine Fauna, have the potential to be impacted through changes in water quality, but these factors are protected through maintenance of MEQ.

2.2. Environmental Quality Management Framework

The Environmental Quality Management Framework (EQMF) was developed to implement the National Water Quality Management Strategy Guidelines No. 4 and 7 (ANZG 2018). In WA the EQMF process has been utilised as a guide to implement water quality monitoring and management after being incorporated into the State Water Quality Management Strategy No.6 (SWQMS 2004). The EPA provides further guidance for the development and application of the EQMF as a consistent and standardised approach for measuring and reporting on MEQ across other areas of WA's marine environment (EPA 2016b). The EQMF incorporates the following:

- Identifying EVs
- Establishing EQOs and spatially defining LEPs that need to be maintained to ensure the associated EVs are protected
- Monitoring and managing to ensure the EQOs are achieved and/or maintained in the long-term in the areas they have been designated
- Establishing EQC, which are quantitative benchmarks against which monitoring results can be compared.

There are two levels of EQC:

- Environmental Quality Guidelines (EQGs) are quantitative, investigative guidelines which signify low risk of an environmental effect if they are met, and trigger further investigations if an exceedance occurs; and
- Environmental Quality Standards (EQSs) are management guidelines based on multiple lines of evidence, which if exceeded signify that the Environmental Quality Objective is not being met and that a management response is required. EQS are generally based on a level of acceptable change in a biological or ecological indicator.

The key structural elements of the EQMF are shown in Figure 3.

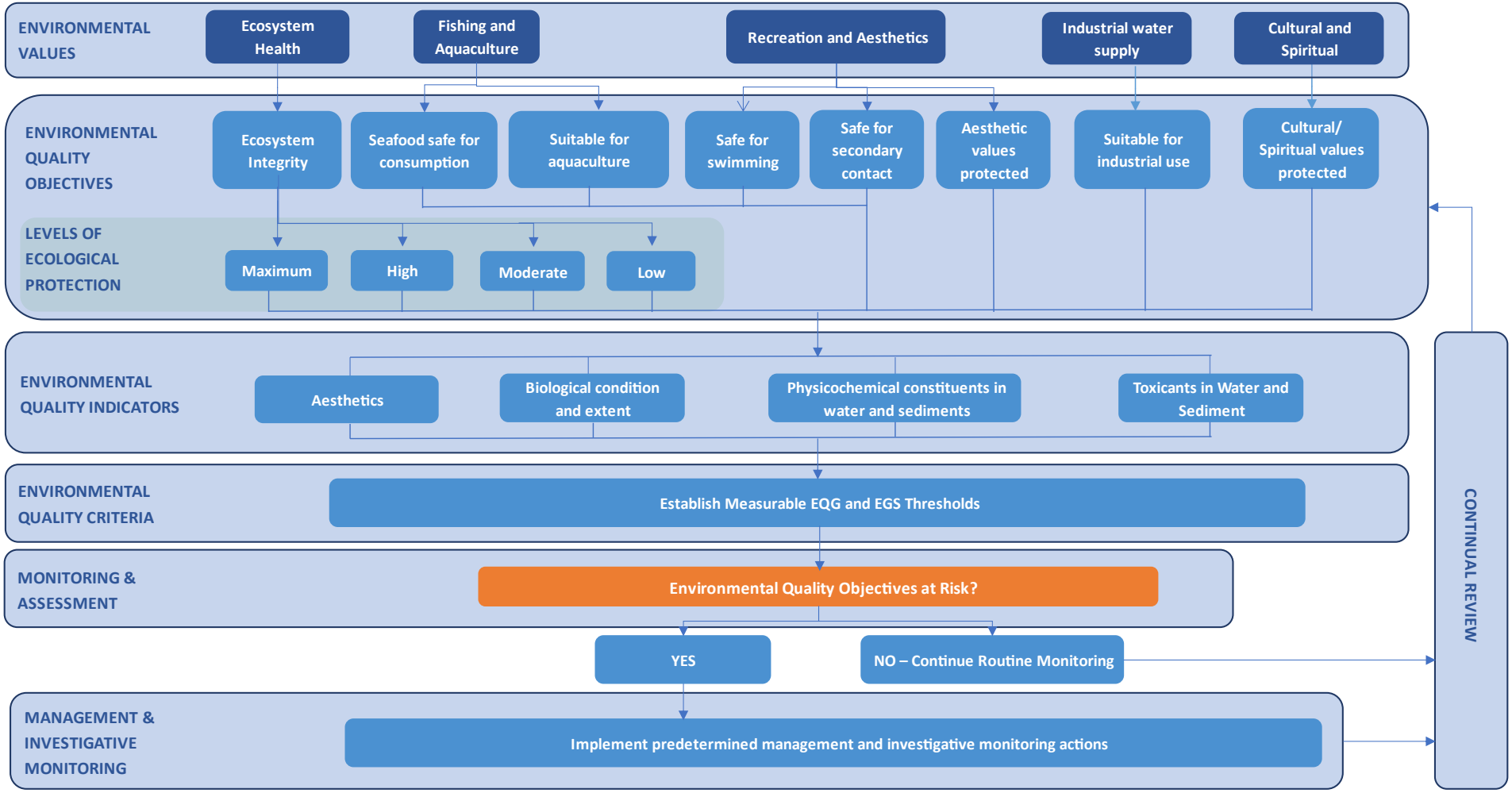

Figure 3 Environmental Quality Framework

2.3. Environmental Values and Environmental Quality Objectives

EVs are defined as "Particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits" (ANZG 2018). EQOs are high level management objectives that describe what must be achieved to protect each EV (EPA 2016a).

The EVs and associated EQOs for the Pilbara marine environment are already well established in the Pilbara Coastal Waters Consultation Outcome (DoE 2006). Five EVs and eight corresponding EQOs apply to the area surrounding and including the ESSP. These EVs and corresponding EQOs are presented in Table 5.

Note that while the five EVs and eight EQOs are relevant to the ESSP, indicators for EQO1 are typically more stringent and cover the breadth of sampling required for other EQOs, so indicators and EQC derived for EQO1 will protect many other EQOs and very few additional indicators are required to be monitored under this plan (if EQO1 is met). It is noted that there are no aquaculture facilities in the vicinity of the ESSP.

Table 5 Environmental Values and Environmental Quality Objectives applicable to the ESSP area

Environmental Values	Environmental Quality Objectives	Environmental Quality Indicators
Ecosystem Health	EQO1: Maintenance of ecosystem integrity. EQO1 is split into four sub-objectives, being: Maximum, High, Moderate and Low LEPs (Refer Section 3.3 below).	Yes
Fishing and Aquaculture	EQO2: Seafood (caught) is of a quality safe for human consumption.	Yes (Protection of Ecosystem Health will protect this EQO)
	EQO3: Water quality is suitable for aquaculture purposes.	Not relevant to this Project
Recreation & Aesthetics	EQO4: Water quality is safe for primary contact recreation (e.g., swimming and diving).	Yes (Protection of Ecosystem Health will protect this EQO)
	EQO5: Water quality is safe for secondary contact recreation (e.g., fishing and boating).	Yes (Protection of Ecosystem Health will protect this EQO)
	EQO6: Aesthetic values of the marine environment are protected.	Yes
Cultural & Spiritual	EQO7: Cultural and spiritual values of the marine environment are protected.	Yes (Protection of Ecosystem Health will protect this EQO)
Industrial Water Supply	EQO8: Water quality is suitable for industrial supply purposes.	Yes (Protection of Ecosystem Health will protect this EQO)

2.4. Levels of Ecological Protection

In accordance with EPA (2016b), the objective for 'Ecosystem Health' is spatially allocated into four LEPs: Maximum, High, Moderate and Low. Each LEP area is assigned an acceptable limit of change (EPA 2016b). The spatial distribution of the LEPs enables measurable EQOs to be allocated to areas in accordance with expectations for ecosystem health condition. For example, important areas for conservation are assigned a Maximum LEP and maintained within the limits of natural variation, whereas large changes from natural variation may be allowed in small areas assigned a Low LEP around a bitterns discharge (where EVs may not be protected).

LEP boundaries have been previously described for the waters in the Cape Preston area within DoE (2006). These existing LEP boundaries were reviewed and updated in the context of the proposed outfall and marine infrastructure, along with brine dispersion modelling results, and align with guidance provided in EPA (2016b). To provide context, the raw modelled dispersion results (worst case winter and summer) are shown in Figure 4, with mapped subtidal BCH. The final proposed LEP boundaries are shown in Figure 5, and included consideration of the following:

1. A Low LEP area (LEPA) was designated based on modelled predictions of the bitterns plume (Figure 5) which determined that a 90% SPL would be achieved at the Low Ecological Protection Area (LEPA)/Moderate Ecological Protection Area (MEPA) boundary (O2 Marine 2023). WET testing results presented in O2 Marine (2019) were used to inform the number of dilutions required to meet the 90% SPL.
2. The MEPA was designated for all waters (excluding the LEPA) based on modelled predictions of the bitterns plume (Figure 5) which determined that a 99% SPL would be achieved at the MEPA/High Ecological Protection Area (HEPA) boundary (O2 Marine 2023). WET testing results presented in O2 Marine (2019) were used to inform the number of dilutions required to meet the 99% SPL.
3. Existing LEPs as presented in DoE (2006) were retained for all other areas which include HEPA and Maximum Ecological Protection Areas (XEPA). Based on WET testing results presented in O2 Marine (2019), O2 Marine (2023) determined that a 99% SPL would be achieved at the MEPA/HEPA boundary.
4. LEP boundaries were slightly modified (rounded off) to provide clear boundaries for validation and impact monitoring and compliance auditing purposes.

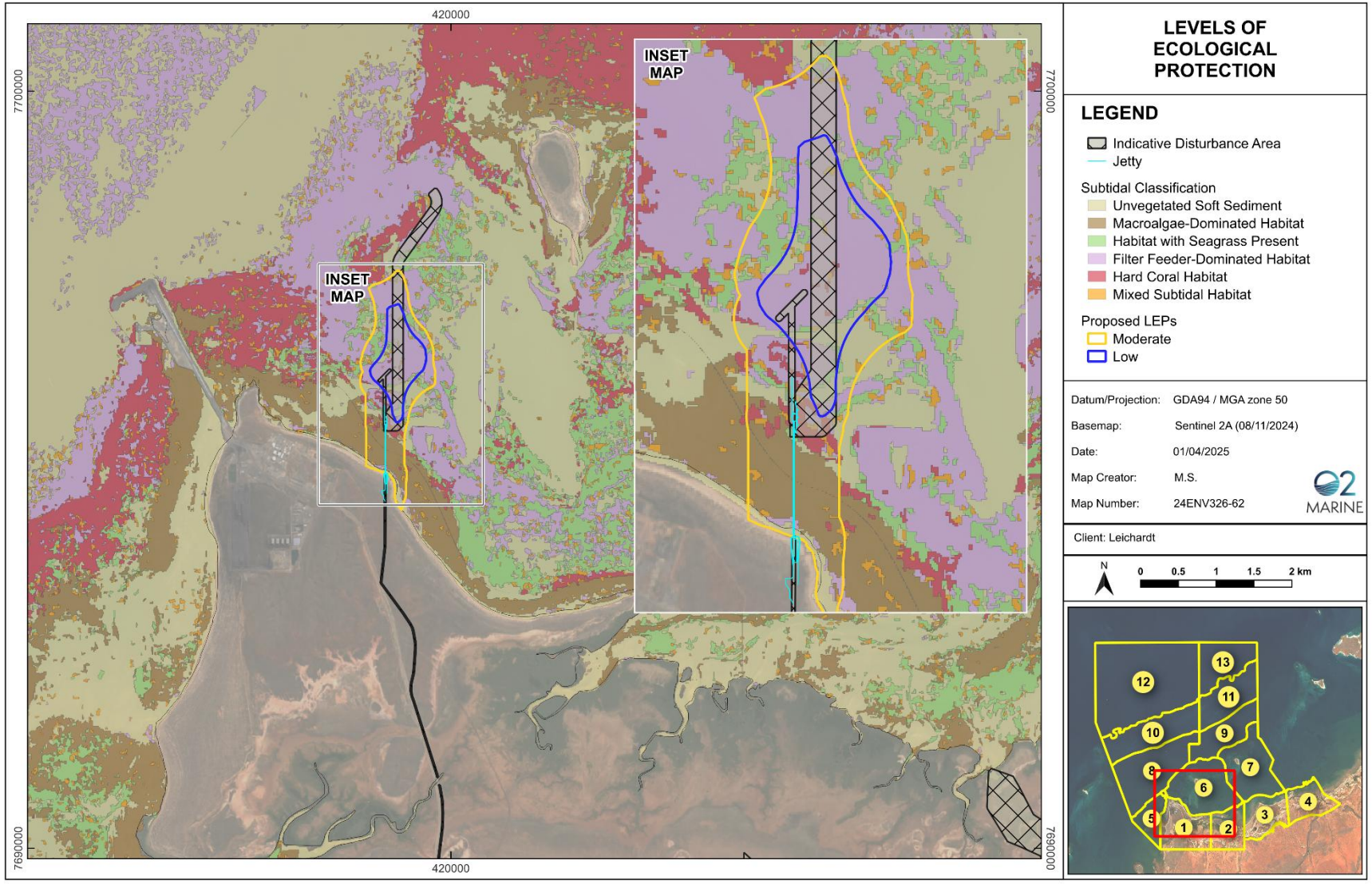

Figure 4 Bitterns dispersion modelling results (worst case) and resultant LEP boundaries.

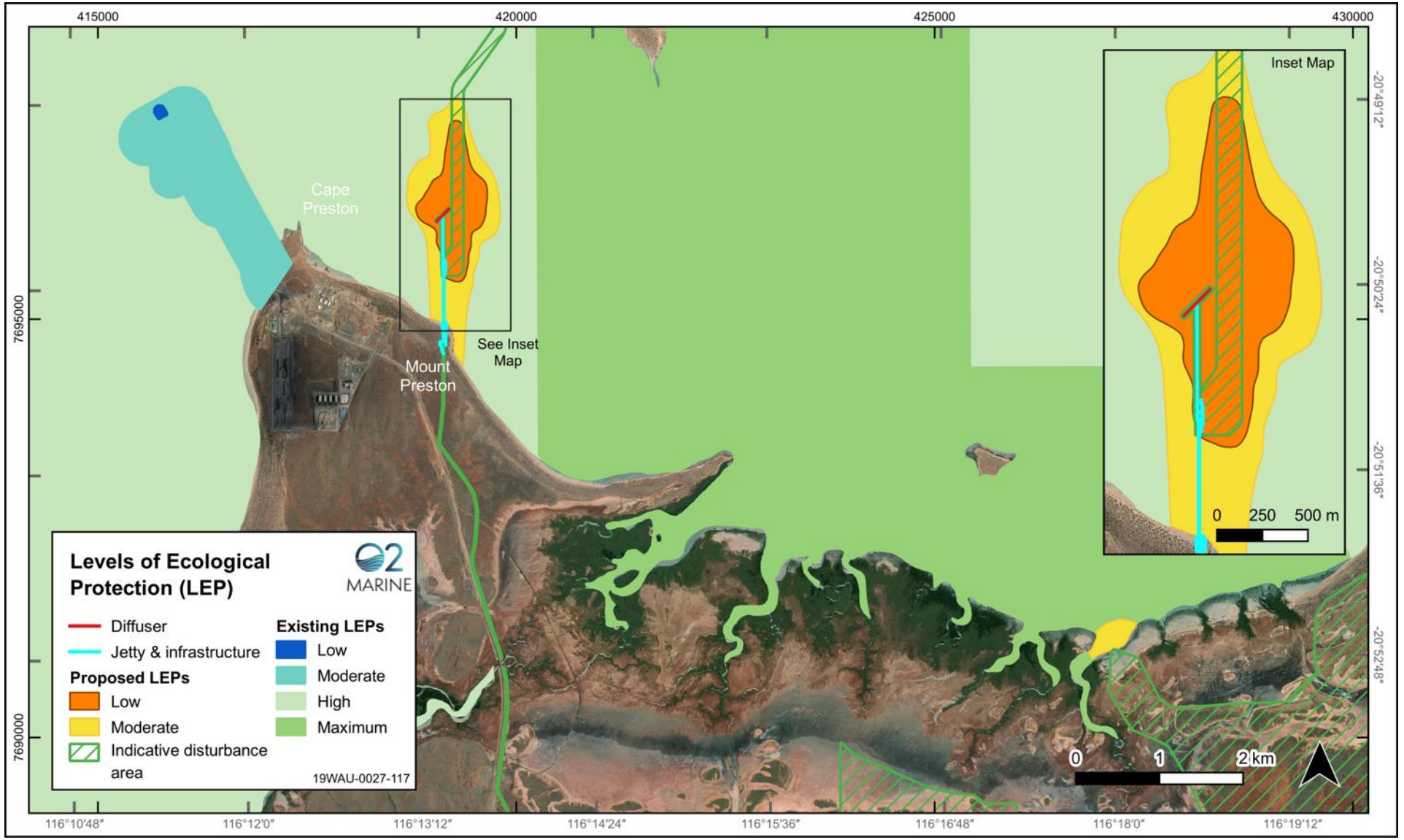

Figure 5 Proposed Levels of Ecological Protection for the ESSP outfall location

3. Key Operational Pressures on the Environment

3.1. Bitterns Discharge

The production process is predicted to produce a high-salinity bittern (410 ppt) that will be pre-diluted by 1-fold (by volume) with seawater and discharged into the marine environment through a diffuser extending from the end of the trestle jetty (Figure 5).

In the absence of a bitterns product at the early EIA stage of a proposal, the toxicity of the proposed discharge bitterns must be estimated by conducting a WET test of a surrogate sample. WET testing performed for approval of the Mardie Project, another solar salt proposal in the Pilbara approximately 40 km SW of the ESSP, using a surrogate bitterns collected from the solar salt processing facility at Onslow (O2M 2019). The surrogate sample provided to Ecotox Services Australia laboratory for analysis comprised a total dissolved solids (TDS) concentration of 420 g/L and a specific gravity of 1.25 at 25^{0}C, equivalent to an absolute salinity of 336 ppt. To estimate the ecotoxicity of the ESSP bitterns from the WET test results of the Onslow surrogate sample, it was assumed that toxicity scales linearly with TDS. Given that the TDS concentration expected in the ESSP bitterns is 529 g/L with a specific gravity of 1.29, yielding an absolute salinity of 410 ppt, a factor of 1.22 was applied to the dilution requirements derived for the surrogate sample.

Based on these results, it was determined that the following dilutions of the waste bitterns would need to be achieved to meet the required SPL for each of the designated LEPs:

- 90% SPL requires 321 dilutions (LEPA/MEPA Boundary); and
- 99% SPL requires 509 dilutions (MEPA/HEPA Boundary).

Key elements of the preliminary diffuser design and the discharge parameters are provided in Table 6.

Table 6 Indicative parameters for the ESSP outfall

Parameter / Feature	Value
Diffuser location	~600 m north of the jetty
Orientation	Northeast to southwest
Length of diffuser (m)	200
Number of nozzles	21
Diffuser depth (m below MSL)	6-8m
Predilution intake (sink) location	Longitude: 116.22618 E Latitude: 20.837647 S
Discharge regime	Constant discharge
Bitterns discharge volume – undiluted (m^3/month)	Summer: 650,000 Winter: 370,000
Bitterns discharge salinity – undiluted (ppt)	410
Pre-dilution (with 35.1 ppt)	1:1

Parameter / Feature	Value
Whole Effluent Toxicity Results	99% SPL requires 509 dilutions – target bitterns concentration 0.24%
	90% SPL requires 321 dilutions – target bitterns concentration 0.38%

3.2. Product Storage and Handling

An integral operational component of the ESSP is the storage and handling of a high saline product. It is a requirement to implement regular inspections and management to ensure all saline product is appropriately contained both on land, and within the marine environment[1]. Failure to adequately contain the high saline product has the potential to impact MEQ via four key operational components:

1. Spillage from the concentration and crystalliser ponds into drainage and creek systems
2. Spillage from trenches/culverts or transfer pipelines into drainage and creek systems
3. Spillage during product loading to transhipment vessels at the end of the trestle jetty *(CPE Port operations - provided for reference)*, and
4. Spillage during product loading from transhipment vessels to ocean going vessels at the offshore mooring areas *(CPE Port operations - provided for reference)*.

A spill or leak of bitterns from the ponds or pipelines could result in impacts to MEQ within the receiving environment. To help mitigate this risk, pipelines will utilise industry-standard materials to minimise the risk of leaks. Regular monitoring and inspection of facilities and equipment will be implemented to further reduce this risk. Ponds have been designed with adequate freeboard and overflow features to minimise the risk of unplanned overflows and bund wall failure.

The CPE Port operations include the export of bulk salt. The salt will be loaded onto a self-propelled, self-unloading transhipping vessel using typical conveyors and ship-loading infrastructure. The transhipping vessel will then travel offshore and re-load the salt onto an ocean-going vessel anchored offshore.

Although not directly related to this MEQMMP, it is important to note the potential environmental impacts from loading/transhipment of bulk salt material that may influence MEQ within the proposal area. Product spills may occur during the loading of vessels, however these volumes will be relatively low and intermittent. Maintenance operations along the conveyor system will be required to remove built up product over time. This activity results in a low risk of hypersaline runoff water entering the receiving environment. For reference only, the management of the risk for product spills are provided in Section 5.2.1 and a management plan is detailed in Appendix B.

3.3. Hydrocarbon Storage and Handling

The ESSP will have several chemical and hydrocarbon storage facilities (permanent and temporary) positioned at different locations throughout the project footprint. These facilities may include the following:

[1] It is noted that the loading and shipping of bulk material are operations that are already approved for the CPE Port, and as such, impacts related to these activities are provided in this MEQMMP as reference only.

- Diesel generators (pumps, lights and general project mobile power supply)
- Intake / Outlet pumps
- Refuelling station(s)
- Washdown areas
- Chemical storage area for plant maintenance and servicing.

Each of these facilities will need to be managed to prevent chemical or hydrocarbon spills to the environment.

Hydrocarbons are defined as organic compounds consisting of only hydrogen and carbon (e.g. diesel, oil and grease). Chemicals may be defined as any other hazardous or toxic chemical associated with construction and operations of the Proposal. An unplanned spill is defined as the accidental release of hydrocarbons and/or chemicals into the marine environment in a volume that may cause environmental harm. This may be an acute event or chronic release, as both have potential to cause environmental harm. Construction vessel operations result in risks to MEQ through hydrocarbon spills (bunkering and other vessel chemicals), antifoulant contamination from the hull of vessels, and vessel movements, which are likely to continually mobilise and redistribute fine sediments in the vicinity of the berth pocket. Management of the risk for hydrocarbon spills are provided in Section 5.2.2 and a management plan is detailed in Appendix C.

3.4. Pressure-Response Pathways

ESSP and CPE Port operational activities and their associated potential impact pathways are presented in Figure 6 and summarised in Table 7.

Table 7 Operational Activities and Potential Impact Pathways.

Facilities	Operational Activities	Potential Environmental Impact Pathway	EQO (EV) at Risk
Bitterns Discharge Operations	Discharge of bitterns to the marine environment.	Localised impact to water/sediment quality due to changed water quality conditions from the bitterns outfall. Risks to water and sediment quality are primarily associated with the diffuser not operating as expected or modelling predictions being incorrect.	EQO1 (Low/Moderate/High LEP) (Ecosystem Health)
Product Storage and Processing	Storage and handling of hydrocarbons and chemicals.	Contamination of water/sediment/biota resulting from a chemical/hydrocarbon spill/leak.	EQO1 (Maximum LEP) (Ecosystem Health)
	Product storage and processing	Direct impacts to water/sediment/biota resulting from leakage or failure of a pond bund wall/transfer pipes.	EQO1 (Low/Moderate LEP) (Ecosystem Health)
CPE Port Operations (provided for reference only	Vessel bunkering operations.	Contamination of water/sediment/biota resulting from a chemical/hydrocarbon spill/leak.	EQO1 (Low/Moderate/High LEP) (Ecosystem Health)
	Product loading operations.	Impact to water and sediment quality as a result of a product spill.	EQO1 (Low/Moderate LEP) (Ecosystem Health)
	General vessel and barge operations	Contamination of water/sediment/biota resulting from vessel antifoulant.	EQO1 (Low/Moderate/High LEP) (Ecosystem Health)
		Continual re-suspension of fine sediments resulting from vessel and barge movements may impact on BCH in the immediate vicinity.	EQO1 (Low/Moderate LEP) (Ecosystem Health)

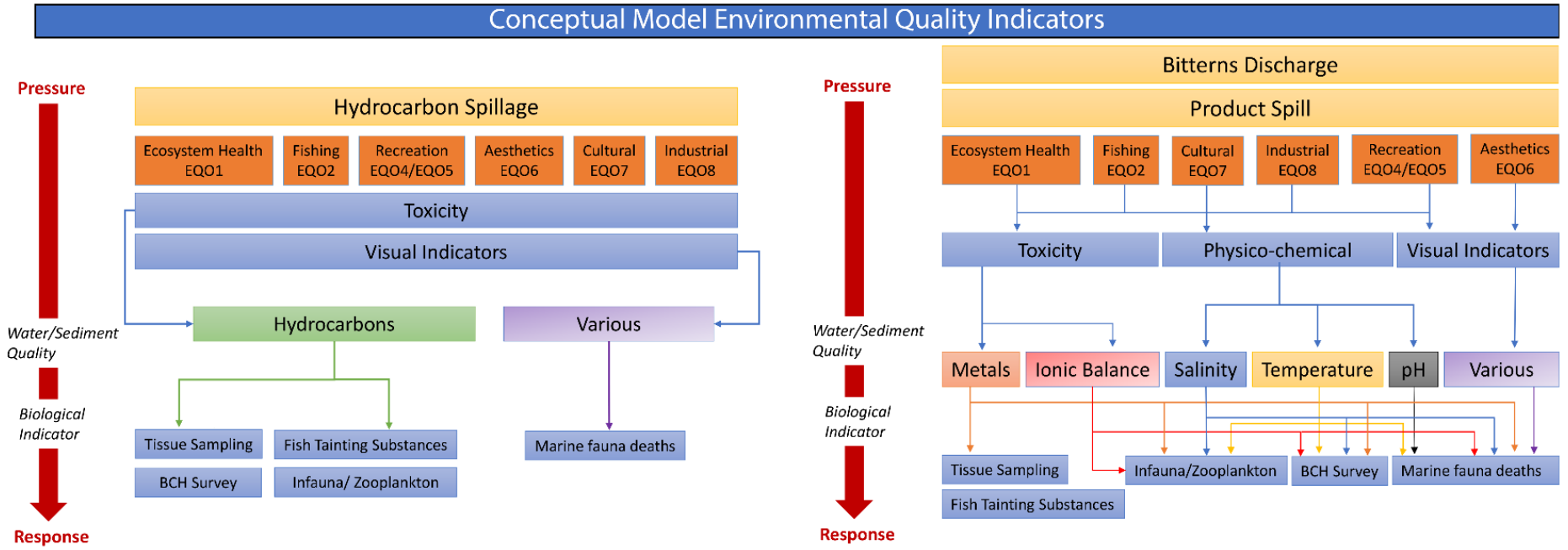

Figure 6 Conceptual model of the environmental quality indicators relevant to the Proposal

3.5. Environmental Quality Criteria

EQIs are measurable parameters selected to monitor changes in each EQO. The EQIs for the ESSP MEQMMP, combined with EQG and EQS developed for each EQI, are summarised in Table 8 and Table 9. The adopted approach to derive EQC is outlined within Figure 7.

3.5.1. Environmental Quality Guidelines

The preliminary water and sediment quality EQG values to be used during the commissioning, validation and operational monitoring phases are outlined in Table 8. EQGs will be reviewed and updated at the completion of the baseline monitoring program and again following the validation phase.

Table 8 Environmental Quality Guidelines (EQG) for the ESSP.

EQI	Constituents[1]	Low LEP	Moderate LEP	High LEP	Maximum LEP
Physicochemical stressors in water	Salinity[2]	No EQG Apply	95th percentile of natural background salinity concentration is achieved	80th percentile of natural background salinity concentration is achieved	No detectable change from background
	Dissolved oxygen[2] (DO)		95th percentile of natural background DO concentration is achieved	80th percentile of natural background DO concentration is achieved	
	pH		5th or 95th percentile of natural background pH conditions is achieved	20th or 80th percentile of natural background pH conditions is achieved	
	Temperature		5th or 95th percentile of natural background temperatures is achieved	20th or 80th percentile of natural background temperatures is achieved	
	Total Alkalinity as $CaCO^3$ Total Hardness as $CaCO^3$		5th or 95th percentile of natural background conditions is achieved	20th or 80th percentile of natural background conditions is achieved	
	Ionic balance		Ion balance <10%	Ion balance <5% or within 20th or 80th percentile of natural background	
Toxicants in water[3]	Dilutions[4]	No EQG Apply	321 dilutions	509 dilutions	No detectable change from natural background
	Aluminium	6150	4100	4100	
	Arsenic	20	20	20	
	Boron	To be calculated upon completion of the baseline monitoring program in accordance with Figure 7.			
	Cadmium	1.5	1.5	1.5	
	Copper	65	65	65	
	Lead	50	50	50	
	Mercury	0.15	0.15	0.15	
	Vanadium	54	36	36	
	Zinc	200	200	200	
	TRH2 C6-C14	250 25	250 25	250 25	

EQI	Constituents[1]	Low LEP	Moderate LEP	High LEP	Maximum LEP
	C15-C36	100	100	100	
	TPH3	280	280	280	
	BTEXN1 - Benzene - Toluene - Ethylbenzene - Xylene2 - Napthalene	To be calculated upon completion of the baseline monitoring program in accordance with Figure 7.			
Toxicants in sediment	Arsenic	-	20	20	No detectable change from natural background
	Cadmium	-	1.5	1.5	
	Copper	-	65	65	
	Boron	-	Median within 80th percentile of reference range		
	Lead	-	50	50	
	Mercury	-	0.15	0.15	
	Vanadium	-	Median within 80th percentile of reference range		
	Zinc	-	200	200	
	TRH	-	C6-C9: 25 C10-C14: 25 C15-C28: 100 C29-C36: 100 TRH: 250	C6-C9: 25 C10-C14: 25 C15-C28: 100 C29-C36: 100 TRH: 250	

[1]: This list of consituents for EQGs is considered preliminary based upon identified potential risks. These will be revised at the completion of the MEQ Validation Phase (Refer Section 4.4.3)

[2]: EQGs will apply for surface and bottom waters

[3]:Where no guidelines trigger values are available, or the toxicants are naturally occuring at high levels the EQG will be derived from the 95th percentile of natural background concentrations and applied within the HEPA and XEPA only.

[4]: Dilutions required will be revised through WET testing conducted on the bitterns produced following the commissioning phase

[5]: Except cobalt where the 95% species protection level value applies

[6]: Organics normalised to 1% Organic Carbon within the limits of 0.2 to 10%.

3.5.2. Environmental Quality Standards

The EQS in Table 9 are based on levels of acceptable change in biological or ecological indicators (EPA 2016). Sampling for assessment against EQS is reactive program required at any time that routine monitoring identifies exceedances above the EQG. EQS have been established from EQI constituents identified in Table 8 which include:

- Physico-chemical stressors in water (e.g., salinity, temperature, dissolved oxygen)
- Toxicants in water
- Toxicants in sediment

Additional EQS indicators have been established based on EVs relevant to seafood safe for human consumption (toxicants in seafood) and aesthetic values (fish tainting substances).

The EQS take into consideration the following biological conditions:

- Bioaccumulation/bioconcentration of toxicants in biota
- Condition of BCH
- Condition of benthic infauna
- Animal kills/ disease/ lesions.

Table 9 Environmental Quality Standards (EQS) for the ESSP.

Indicators	Constituents[1]	Moderate LEP	High LEP	Maximum LEP
Physicochemical stressors in water	Benthic biological indicators (e.g., seagrass, coral, filter feeders)	Small loss or decline (10%) in absolute cover and no change in species diversity, richness of benthic habitat for MEPA that change can be demonstrably linked to natural pressure.	No change in cover, species diversity, richness or abundance of benthic habitat beyond natural variation within HEPA/XEPA unless can be demonstrably linked to natural pressure.	
	Biological indicator (e.g., benthic infauna)	Small decline (10%) in abundance, no decline in species diversity or richness outside of acceptable levels of change for MEPA that change can be demonstrably linked to natural pressure	No change in species diversity, richness or abundance from natural variation within HEPA/XEPA unless it can be demonstrably linked to natural pressure.	
	Marine Fauna	No deaths of marine organisms resulting from anthropogenically- sourced stress.		
	Salinity	Salinity concentrations below the maximum calculated from WET testing and bitterns sampling for each LEP boundary		
	Dissolved oxygen	60% saturation		
	pH	Median of sample concentration either from one sampling run or from a single site over an agreed period should not exceed the range 5 – 9 units		
Toxicants in Water[3]	Toxicants	TTM should not exceed 1 for chemical mixtures using median bioavailable contaminant concentrations from a single site or a defined area (either from one sampling run or all samples over an agreed period) and relevant environmental quality guidelines in the total toxicity of mixtures formula.		
	Toxicants	Selected toxicant concentrations below the maximum calculated from WET testing and bitterns sampling for each LEP boundary		
	Toxicity testing	There should not be a statistically significant effect (P <0.05) on chronic test results compared to reference control waters. OR	There should not be a statistically significant effect (P <0.05) on chronic test used compared to reference control waters. OR	

Indicators	Constituents[1]	Moderate LEP	High LEP	Maximum LEP
		Chronic test results protect at least 90% of species.	Chronic test results protect at least 99% of species.	
Toxicants in Sediment	Metals Antifoulants Hydrocarbons	High Guideline Values (GV-high) Or bioavailable concentrations above the EQG		
Toxicants for seafood	Bioaccumulation/ Bioconcentration of toxicants	No EQS Apply	80th percentile of tissue toxicant concentrations in filter feeders compared with suitable reference site	No detectable change in tissue toxicant concentrations from natural background levels
	Metal concentrations in flesh (mg/kg)	Median concentration should not exceed values below		
	Arsenic	Crustacea & Fish Molluscs & seaweed		2 1
	Cadmium	Molluscs		2
	Copper	Crustacea Fish Molluscs		20 2 30
	Lead	Fish Molluscs		0.5 2
	Mercury	Billfish Crustacea, Molluscs & other Fish		1 0.5
	Selenium	Crustacea & Molluscs Fish		1 2
	Zinc	Crustacea Fish Oysters		40 15 290
Fish tainting substances	Chemicals (mg/L)	The 95th percentile of sample concentrations, either from one sampling run or samples over an agreed period, should not exceed the EQS value provided below.		
	Copper	1		
	Ethylbenzene	0.25		
	Naphthalene	1		
	Zinc	5		

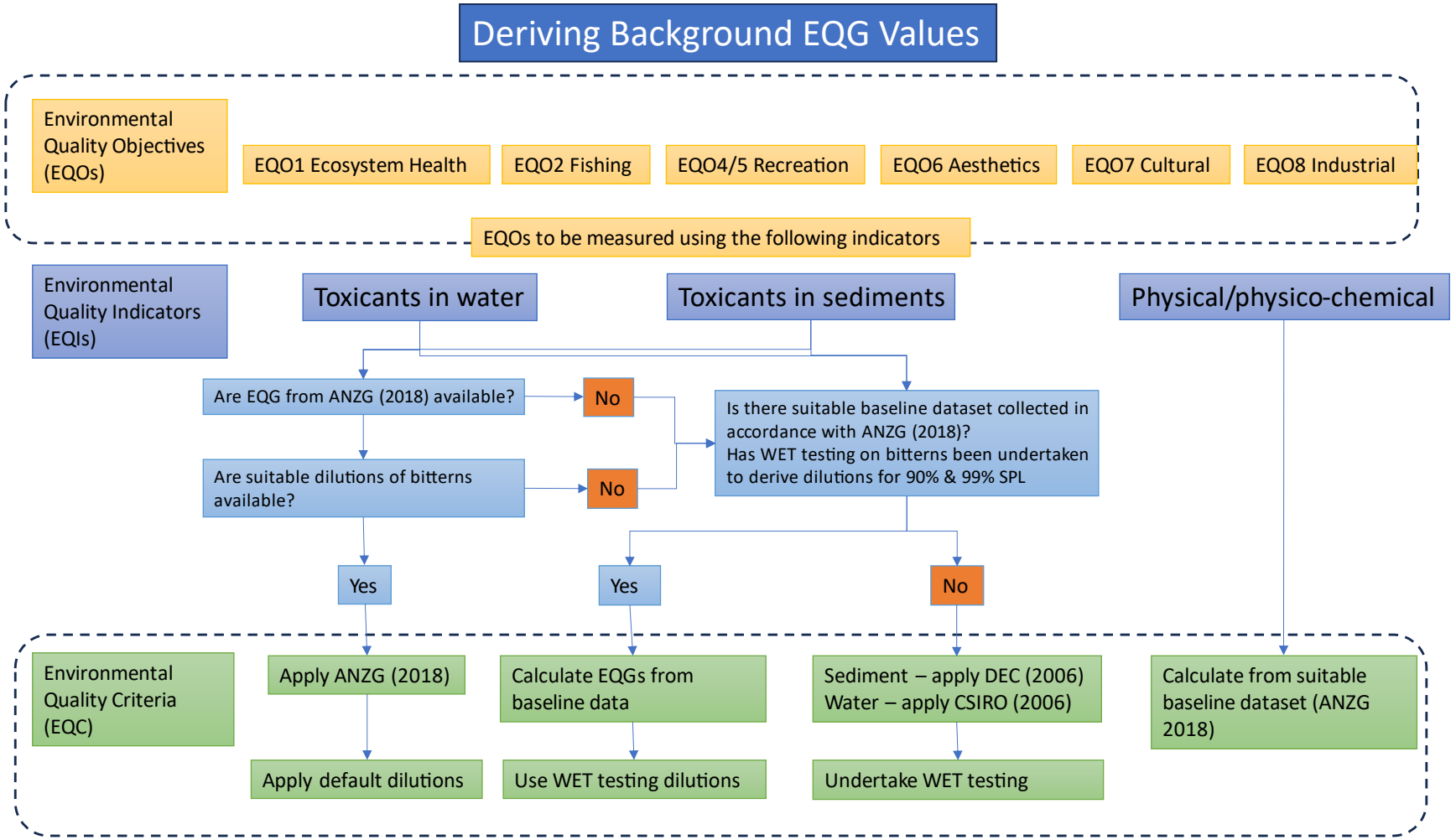

Figure 7 Method to Derive Preliminary Environmental Quality Guidelines.

4. Monitoring Programs

4.1. Summary of Monitoring Programs

To ensure that EVs and EQOs defined for the ESSP are not compromised through operational activities, comprehensive monitoring programs have been proposed. A description and rationale of these programs as they relate to potential MEQ impacts are presented in Table 10. A flow-chart of MEQ monitoring for the life of the Proposal is provided in Figure 8.

Monitoring will be undertaken during the commissioning and operations of the bitterns discharge to ensure compliance with the EQGs. Monitoring for the EQSs will be undertaken during operations only when there is significant risk that the associated EQO has not been achieved, and a management response is triggered. Therefore, monitoring for compliance with an EQS will be reactive, where the monitoring against the EQG shows an exceedance.

Table 10 Description and rational of the Marine Environmental Monitoring Programs.

Phase	Indicators	Rationale	Management Strategy
Baseline Monitoring	Aesthetic observation Water quality monitoring Infauna monitoring	To collect sufficient spatial and temporal data with a high level of replication from which site specific EQGs and EQS will be derived. Potential Project impacts have been identified to water and sediment quality, so monitoring has been designed in accordance with ANZG (2018) protocols for monitoring and assessment of these values.	Section 4.2
Commissioning Monitoring	Bitterns discharge monitoring	To implement a monitoring and management program for bitterns outfall diffuser commissioning that meets MEQ expectations. This program targets water quality at the boundaries of management zones to ensure compliance. If EQC of the discharge are not exceeded at boundaries of the management zones, then LEPs will be achieved.	Section 4.3
	Physicochemical monitoring	To evaluate required number of dilutions are achieved under variable outfall and environmental conditions during commissioning.	
Validation Monitoring	Whole Effluent Toxicity Testing	To identify the actual toxicity of the bitterns on locally relevant species. These results will be used with other monitoring results to validate modelled impact predictions and verify the LEPs and EQCs.	Section 4.4.2
	Hydrodynamic model validation	Evaluate whether the defined EQCs are being met at their respective LEPs and determine if the discharged bitterns conform with modelled predictions and required dilutions are being achieved at the LEPA/MEPA and MEPA/HEPA boundaries. These results will be used with other monitoring results to validate modelled impact predictions and verify the LEPs and EQCs	Section 4.4.3
Operational Monitoring	Bitterns Diffuser Outfall Water Quality	To ensure that design specifications for bitterns discharge constituents are achieved through the lifecycle of the Project.	Section 4.5
	Ongoing Marine Environmental Quality	To verify that impacts from operational activities associated with the ESSP, such as bitterns release, and product storage and handling do not impact MEQ outside the limits of acceptable ecological change associated with the defined LEPs.	
	Hydrodynamic model validation	To evaluate required number of dilutions are achieved under a comprehensive suite of environmental and outfall conditions and less frequently thereafter (e.g. annually and after a process change).	

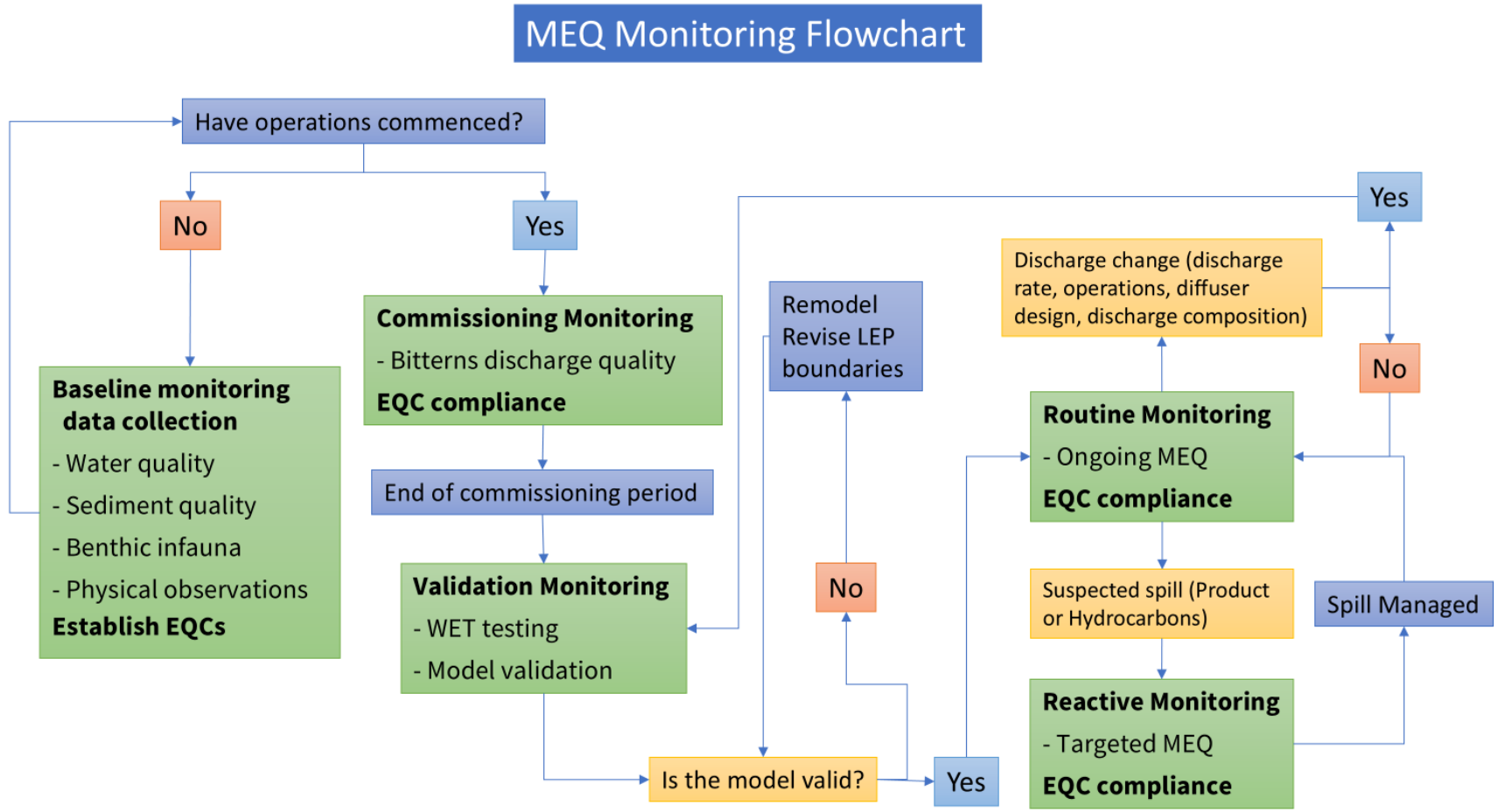

Figure 8 Conceptual monitoring flowchart for the lifetime of the Project

4.2. Baseline Monitoring Program

4.2.1. Rationale

To determine impacts upon MEQ from the ESSP a comprehensive set of EQCs need to be defined that are specific to the local area where the bitterns will be discharged. The purpose of the baseline monitoring program is to collect data from the local marine environment with which to derive site specific EQCs for which actual project impacts that can be measured against during subsequent phases of the ESSP. This program is typically comprised methods for the following indicators:

- Aesthetic observations
- Physicochemical water profiling
- Marine water quality sampling
- Sediment sampling
- Benthic biota sampling
- Benthic infauna sampling.

The baseline monitoring program will provide sufficient spatial and temporal data with a high level of replication from which site specific EQGs and EQS will be derived in accordance with ANZG (2018). Site specific EQGs and EQS will be used to define marine environmental performance during all phases of the ESSP lifecycle. In accordance with ANZG (2018), a two-year baseline monitoring period will provide a suitable data set for the intended purpose[2].

The baseline monitoring period will allow the fine tuning of sampling methodology to ensure the described practices are effective when applied during routine monitoring. Any lessons learnt, or alterations to the defined methodologies, will be included into a revised version of this MEQMMP.

An overview of the baseline monitoring program is detailed below in Table 11.

[2] It is noted that a 12-month water quality baseline data collection period, and a one-off sediment quality investigation have already been implemented between July 2020 and July 2021 for the ESSP (see Section 4.2.2).

Table 11 Baseline monitoring program overview.

Element	Sample Requirement	Parameters	Frequency	Duration	No. of Sites	No. Samples per site
Aesthetic Observation	Physical observations	Nuisance organisms Large-scale deaths Oil/Film Natural reflectance Objectionable odour Floating debris, rubbish, surface slicks	Monthly	2 years*	3	NA
Water Quality Monitoring	Physico-chemical water column profiling	Electrical conductivity Salinity Temperature pH Dissolved oxygen Turbidity	Monthly	2 years*	3	NA
	Water sampling	Hydrocarbons Ionic balance Metals and metalloids	Monthly	2 years*	3	1
Sediment Quality Monitoring	Sediment sampling	Particle size distribution Total organic carbon and moisture Metals and metalloids Hydrocarbons	Once only**	NA	10	1
Benthic Biota	Underwater image capture/analysis	Benthic cover Benthic composition	See baseline BCH surveys described in the Dredge and Spoil Disposal Monitoring and Management Plan (O2 Marine 2025e)			
Benthic infauna	Sediment grab sample	Lowest taxonomic level	Annual	2 years*	7	3

** Includes 1 year of baseline data already collected (refer Section 4.2.2)*

*** Baseline sediment quality sampling has been completed in 2021/2022 (refer Section 4.2.2).*

4.2.2. Sampling Design

To capture seasonal trends, and to compare with the existing 12-month water quality baseline period, monthly water quality sampling and profiling are proposed for a second 12-month period. Additional sediment quality assessments were undertaken in November 2021, September 2022, and March 2023, as such, no further sediment quality studies are proposed. Benthic infauna samples were collected as part of the initial sediment quality study, a second benthic infauna study will be required to analyse temporal variation.

The sampling programs for the existing water and sediment quality baseline investigations for the ESSP are detailed in the technical documents listed below, with summaries of the findings included in Appendix A.

- Eramurra Solar Salt Project. Marine Water Quality Baseline Report. Report prepared by O2 Marine for Leichhardt Salt Pty (O2 Marine 2022)
- Eramurra Solar Salt Project. Sediment Analysis Report. Report prepared by O2 Marine for Leichhardt Salt Pty (O2 Marine 2025a)

Additional baseline water quality and benthic infauna data will be collected in accordance with Table 12.

Table 12 Additional Marine Environmental Quality Monitoring Proposed for the baseline monitoring program.

Monitoring Event	Frequency	Additional Period	No. of Sampling Rounds	No. of Sites	No. of Samples/Readings Collected
Aesthetic Observation	Monthly	1 year	12	3	36
Physico-chemical Water Quality Profiling	Monthly	1 year	12	3	36
Water Sampling	Monthly	1 year	12	3	36
Benthic Infauna	One-off sampling event			7	21

Table 13 presents the monitoring/sampling sites and coordinates for the baseline monitoring program. Sample locations for baseline water quality and sediment are shown in Appendix A, Figure A7 and Figure A8, respectively. Seven sediment sites were sampled for the benthic infauna in November 2021 to represent baseline conditions at the LEPA/MEPA Boundary (O2 Marine 2022b). Sampling at these locations will be repeated for additional baseline data. General observations will be recorded at all sites during each sampling event (see Section 4.2.3).

Table 13 Baseline Water Quality and Benthic Infauna Monitoring Program Overview

Site Name	Site Description	Proposed Level of Ecological Protection	Easting	Northing	Routine Sampling Tasks			
					Aesthetic Observations	Physico-chemical Water Column Profiling	Water Sample Collection	Benthic infauna
NCP05	12 months of existing baseline water quality is available for this site. It is considered representative of local waters adjacent to the proposed diffuser.	High	419142	7697166	X	X	X	X
UNS05	This site is not expected to be impacted by operational activities and represents a reference site.	High	427167	7696410	X	X	X	
CR1	This site is located adjacent to the seawater intake within McKay Creek and allows assessment of potential impacts related to this activity.	High	426743	7690947	X	X	X	
IG1 – IG6	Infauna Grab (IG) sites have been selected to represent baseline conditions at the LEPA/MEPA Boundary. One round of benthic infauna sampling occurred at these sites in November 2021.	Moderate	419248 419078 419247 419173 419091 419287	7695757 7695738 7695666 7695656 7695534 7695381				X

4.2.3. Sampling Methodology

4.2.3.1.General Observations

The following field observations are to be recorded at each site during each sampling event:

- Date and time of sampling at each location
- Persons conducting the sampling
- Site reference
- GPS coordinates of sampling location
- Tides and water depth at the time of sampling
- Wind speed (km/hr) and direction
- Sea state (i.e., wave and swell heights), and
- General weather conditions (rain, storms, cloud cover, etc).

Digital photographs should also be taken throughout the monitoring event as weather conditions change and as required to document any notable site observations. Field logs are to be scanned and attached as an appendix in the quarterly and annual reports.

4.2.3.2.Aesthetic Observations

Observations of aesthetic water quality parameters should be recorded for each of the categories provided in Table 14 at designated locations. Aesthetic observations are to consider waters within an approximate 50 m radius of the survey vessel.

Table 14 Aesthetic observation assessment categories and ratings.

Parameter	1	2	3	4	5
Nuisance organisms (Surface coverage %)	Nil	1-10	11-50	51-80	100+
Large-scale deaths (Marine fauna)	Nil	1-10	11-51	51-81	100+
Oil/Film (Surface coverage)	Nil	1-10%	11-50%	51-80%	81-100%
Natural reflectance remaining	81-100%	51-80%	11-50%	1-10%	Nil
Objectionable odour	Nil	Slight	Moderate	Strong	Offensive
Floating debris, rubbish, surface slicks (Surface coverage %)	Nil	1-10	11-50	51-80	100+

4.2.3.3.Physico-chemical Water Quality Monitoring

A pre-calibrated, water quality profiler will be used to collect physico-chemical profiles at all three sampling locations identified within Table 13. As a minimum, the following parameters will be measured throughout the water column from 0.5 m below the surface to 0.5 m above the seabed:

- Depth (m)
- Water temperature (°C)
- pH

- Salinity (ppt)
- Electrical Conductivity (uS/cm)
- Turbidity (NTU), and
- Dissolved oxygen (% saturation & mg/L).

All recorded measurements will be downloaded to a secure server within 24 hours. The data should be immediately assessed to ensure validity and, any erroneous data should be removed from the analysis as appropriate.

4.2.3.4.Water Sampling

Sample Collection

Water samples will be collected at three sampling locations as identified within Table 13. Water samples will be collected into a pre cleaned container using a depth-integrated water sampler, pumping the required volume of water commencing at 0.5 m above the seabed to 0.5 m below the surface.

Water samples will be collected in suitable (laboratory supplied) bottles and immediately stored on ice for transport to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. All sampling equipment will be cleaned with Decon solution (or equivalent) between sample sites.

All sample containers will be marked with a unique identifier, the date/time and the sampler's name and clarification that the samples are marine water using a waterproof permanent maker. All samples will then be listed on a Chain of Custody (CoC) form to be included with the samples sent to the laboratories.

Laboratory Analysis

General water sample analysis will be performed on samples collected from three sampling locations. These samples are required to be analysed by a NATA accredited laboratory for the following:

- Ionic balance:
  - Alkalinity and Hardness
  - Calcium, magnesium, sodium, potassium cations
  - Chloride, fluoride and sulphate anions
- Hydrocarbons (TRH, TPH and BTEXN), and
- Dissolved Metals and Metalloids (Al, As, Bo, Cd, Cu, Hg, Pb, Zn, V).

Field Quality Assurance & Quality Control

All water quality meters are to be in calibration. If monitoring equipment is hired, calibration certificates are to be provided from the supplier. Calibration records are to be saved and attached as an appendix to compliance reports.

The following Quality Assurance & Quality Control (QA/QC) field samples should be collected as described below:

- A duplicate sample is to be collected at the same site as one of the primary monitoring samples. The purpose of the sample is to confirm that the primary laboratory can produce consistent results when analysing the same sample. The site where it was taken is to be recorded but not reported to the laboratory. Ideally it should be collected at a site that is expected to have higher levels of

contamination (based on historic data and potential sources of contamination) as this will confirm a wider range of analytes and reduce the level of instrument error when comparing larger concentrations.

- A field split sample is collected at the same site as the duplicates and sent to a secondary laboratory for analysis. The purpose of this sample is to confirm that intra-laboratory analysis of the sample produces consistent results.
- A rinsate sample is collected to confirm that cross contamination doesn't occur during the sampling processes in the field. The rinsate sample should be taken after the decontamination process of the sample collection container by running deionised water over the container and collecting it in laboratory provided bottles.

Laboratory Quality Assurance & Quality Control

The laboratory used for water sample analysis must be NATA accredited. Comprehensive QA/QC testing of water samples should be undertaken in accordance with NATA accreditation and include testing of laboratory control samples, method blanks, matrix spikes, laboratory duplicates and surrogate recovery outliers (where applicable).

4.2.3.5. Benthic Infauna

Sample Collection

Grab samples for benthic infauna analysis will be collected at all six locations identified within Table 13. Benthic infauna samples will be collected from a vessel using a sediment grab sampler such as a Van Veen grab or similar. Three replicate samples will be collected at each location to provide statistical replication required for adequate analysis of benthic infauna.

The following sample processing steps will occur:

- Once the sample has been recovered it will be released from the grab sampler into a suitable collection tray
- Weigh the sediment sample and record for post sampling data analysis purposes
- Sieve the sediment through a 500 µm sieve using the saltwater deck wash to remove fine sediment, and
- All material retained on the sieve, such as coarse sediment and benthic infauna, will be carefully rinsed into suitable pre-labelled containers and preserved with 95-100% ethanol solution.

This process will be replicated to ensure three individual sediment samples are collected from each location to provide sufficient statistical data to allow assessment of variability within each sample location.

Equipment required for the benthic infauna sediment sampling includes the following:

- Suitable sediment grab sampler
- Deck winch
- Deck wash hose
- Sample collection tray
- Funnel (x2)

- 500 µm sieve box
- Suitable sample containers
- Washing bottles
- Waterproof labelling pens
- Decon 90, and
- 95-100% Ethanol solution.

Laboratory Analysis

Laboratory picking is conducted under a dissecting-microscope, with all benthic infauna removed from the sediment. All picked benthic infauna will be stored in separate sample vials with 70% ethanol. Macroinvertebrates will be identified to Family taxonomic level using a compound microscope.

Laboratory Quality Assurance & Quality Control

Picking quality assurance checks are done on 10% of the total samples, with a 5% picking error rate. If the picking error is above 5% then previous samples are checked, until a satisfactory error rate is met.

4.2.4. Data Assessment and Reporting

4.2.4.1. Data Validation

All data is required to be validated prior to the release of any monitoring reports to confirm that data has been entered correctly. Data entry is to be checked and verified against raw data logs and laboratory reports by an independent person.

4.2.4.2. Quality Control

An assessment of quality control data needs to be undertaken and included in all reports including:

- Assessment of field contamination (rinsate blank)
- Assessment of site variability (duplicate)
- Assessment of lab variability (inter-laboratory split), and
- Laboratory QA/QC results.

4.2.4.3. Data Assessment

No project related operational activities will occur during this phase and data collected will not be required to be assessed against EQC.

At the completion of the two-year baseline data collection period, a review of the baseline data will be undertaken to derive and determine site specific EQG and EQS for the LEPA, MEPA and HEPA boundaries in accordance with EPA (2016) and ANZG (2018). Site specific EQC will be incorporated into a revised version of this MEQMMP once defined.

4.2.4.4. Reporting

A summary report of results will be prepared following each survey. A comprehensive report will be compiled at the completion of the two-year data collection period which will include, but is not necessarily limited to:

- Summary of the methods applied and any deviations from this MEQMMP
- Graphical figures summarising physicochemical water column profiles

- A table summarising laboratory analyses results
- Statistical summary of infauna (as per collection frequency)
- An assessment of all data collected against the EQCs
- Presentation of the calculated site specific EQG and EQS in accordance with ANZG (2018)
- Any actions or recommendations resulting from field implementation and assessment of monitoring data.

4.3. Commissioning Monitoring Program

4.3.1. Rationale

A commissioning period is required to test and consolidate equipment and processes prior to the operational phase. During commissioning, the bitterns being discharged may not meet the design criteria which was initially used to model the predicted dilutions. Therefore, monitoring during the commissioning phase is focused on compliance, where measurements for MEQ should not exceed EQC at spatially designated LEP boundaries.

The end of the commissioning period will be determined when engineering confirms typical operating conditions have been achieved for all facilities and associated infrastructure. Once the cessation of the commissioning period is confirmed, the commissioning monitoring program will be considered complete and 'Validation Monitoring' will commence.

A summary of the commissioning monitoring program is provided in Table 15.

Table 15 Commissioning monitoring program overview

Element	Sample Requirement	Parameters	Frequency	Duration	No. of Sites	No. Samples per site
Bitterns Discharge Monitoring	Sensor readings prior to discharge	Flow Rate	Continuous (hourly)	Commissioning*	1	NA
	Sensor readings OR Laboratory samples prior to discharge	Temperature Salinity (or equivalent: Conductivity/total dissolved solids)	Continuous (hourly) OR Intermittent (minimum weekly)	Commissioning*	1	1
	Laboratory samples	Physicochemical Ionic Balance Nutrients Metals and Metalloids	Monthly	Commissioning*	1	1
MEQ monitoring	Physico-chemical water column profiling	Electrical conductivity Salinity Temperature pH Dissolved oxygen Turbidity	Monthly	Commissioning*	24	NA

* Nominally assumed to extend for approximately 12 months

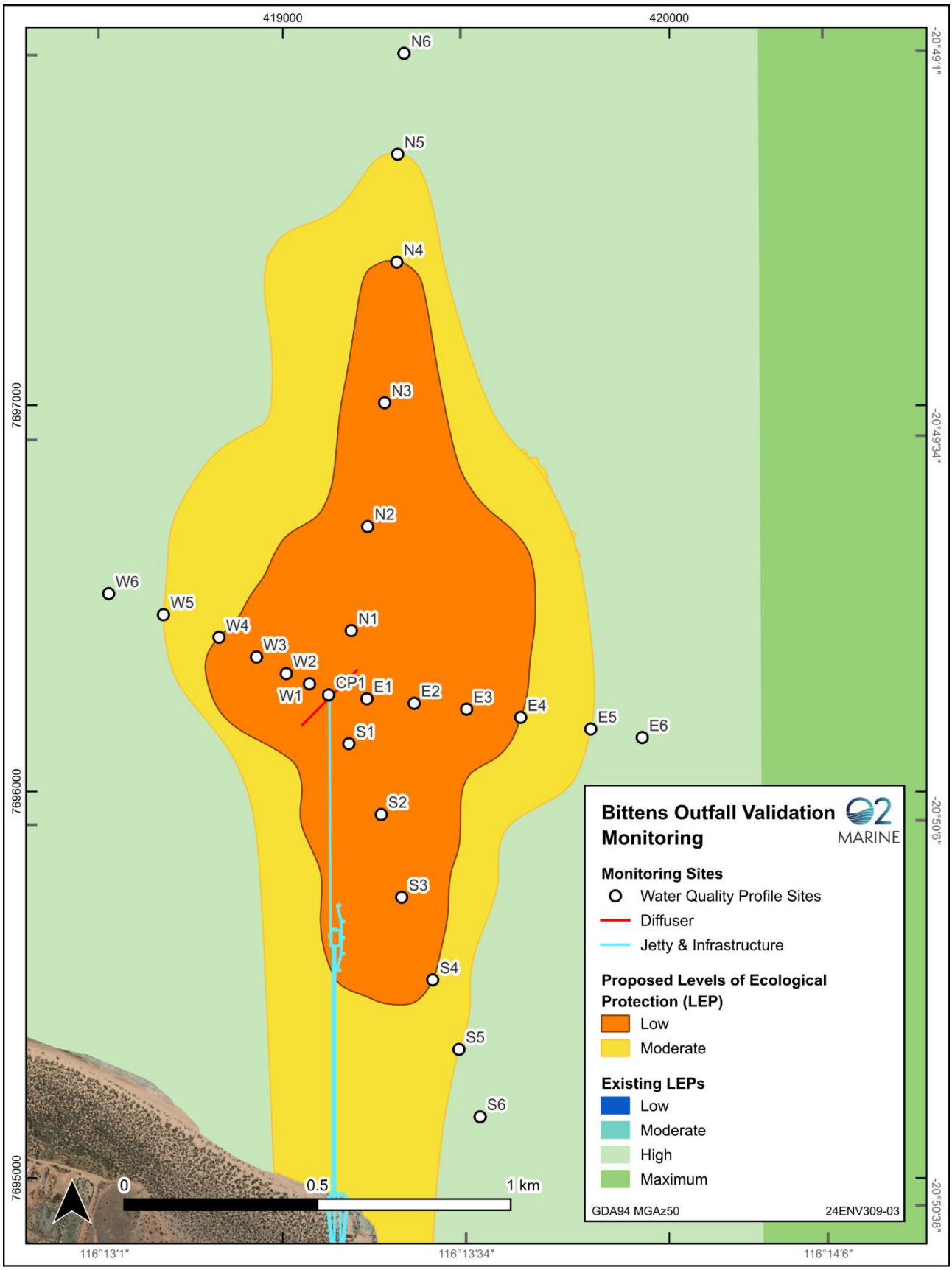

Figure 9 Indicative Marine Water Quality Monitoring Locations.

4.3.2. Sampling Methodology

The commissioning monitoring program will include the following sampling:

- Continuous in-line flow rate monitoring
- Frequent (minimum weekly) monitoring of TDS/salinity in the bitterns dilution pond (prior to discharge)
- Monthly physico-chemical water column profiling, physical and aesthetic observations in the marine environment.

Bitterns MEQ monitoring during commissioning will commence from first discharge through the outfall until the bitterns discharge is within expected design specifications.

4.3.2.1. In-line Flow Rate

A flow rate sensor, or similar, will be installed in the outfall pipeline to monitor continuous hourly or maximum instantaneous flow rates discharged from the outfall. Sampling will be conducted continuously throughout the commissioning period. Regular maintenance will be undertaken in accordance with manufacturers recommendations to ensure the function and reliability of the sensor.

4.3.2.2. Bitterns Dilution Pond Sampling

A minimum of weekly measurements for temperature and salinity (or conductivity/ total dissolved solids) will be collected over the commissioning period. Measurements will be obtained from the bitterns dilution pond prior to release. Samples are likely to be collected and sent to a laboratory for analysis, although measurements from instruments such as a refractometer may be used to collect data more frequently (i.e. daily).

The bitterns dilution channel will also be sampled periodically (i.e. monthly) to investigate temporal variability in constituents, which will include repeat sampling of the following parameters:

- Other physico-chemical parameters
- Ionic Balance
- Nutrients
- Metals and Metalloids

These measurements are not collected for compliance to compare against EQC. The purpose of sampling is to gather context for possible changes required to the monitoring program.

4.3.2.3. Physicochemical Water Column Profiling

Water quality profiling will occur monthly over a 12-month period. Profiles will be undertaken from 0.5 m below the surface to 0.5 m above the seabed as described for baseline in Section 4.2.3. Water temperature, salinity, pH and dissolved oxygen will be collected at each location along four gradient transects and water quality instrument calibration will be performed in accordance with manufacturer specifications and appropriate QA/QC protocols.

The preliminary EQGs for the validation phase are presented in Table 8[3]. These are intended as a guide only and are subject to review at the completion of the Baseline Monitoring Program.

It is intended that the baseline dataset will be used to calculate EQGs based on their percentiles as relevant to the intended LEP area in accordance with Table 8. Reference site data will be incorporated for comparison against EQGs to account for any natural or seasonal variability encountered during sampling (outside the baseline dataset percentiles or established SPLs). This would account for events such as a marine heatwave or a fresh water flushing event that could significantly alter marine conditions.

4.3.3. Data Assessment and Reporting

All data is required to be validated prior to the release of any monitoring reports to confirm that data has been analysed correctly. Compliance with the performance targets will be conducted as follows:

- Flow rates sensor measurements compared directly against Performance Target 1
- Daily/weekly bitterns temperature and salinity concentrations will be compared directly with Performance Target 2
- Water column profiles will be interrogated to compared directly against the Performance Target 4

A 'Water Quality Commissioning Report' will be compiled at the completion of the commissioning phase which will include, but not be limited to:

- A summary of the methods applied and any deviations to the method presented herein
- Timeseries graphs and tables of physicochemical parameters
- An assessment of data collected against performance targets
- A review of performance target exceedances, investigations and remedial actions implemented, and
- Any actions or recommendations arising from the validation phase.

4.4. Validation Monitoring Program

4.4.1. Rationale

To refine predicted impacts from project related activities, a comprehensive MEQ validation monitoring program is required at the completion of the commissioning phase. This program is broken into several smaller components, each of which has different objectives, methodologies and contingency actions. These components are:

- Whole Effluent Toxicity (WET) testing to determine the dilutions required for species protection
- Bitterns testing to characterise the typical effluent and flow rate of discharge
- Hydrodynamic model validation involving dye studies and delta salinity gradient sampling to compare design dilutions against measured dilutions

[3] Only EQG for physico-chemical parameters are required during the commissioning phase. EQC for toxicants in water will be used to compare water samples collected during the Ongoing Marine Environmental Quality Monitoring phase (Section 4.5.3).

- MEQ monitoring at strategically positioned locations surrounding the outfall to allow an assessment against defined site specific EQC.

The validation monitoring is targeted to refine and consolidate the modelling and management of the discharge based on monitoring data collected during typical operations of the plant. This recognises that the work undertaken for approvals was based on using available information at the time of preparation to predict the outcomes, while data collected during this phase will be used to refine the management process through data collected during operations.

A summary of the validation monitoring program is provided in Table 16.

Table 16 Validation monitoring program overview

Element	Sample Requirement	Parameters	Frequency	Duration	No. of Sites	No. Samples per site
WET testing	20 L bitterns sample Background marine water sample for dilution	Ecotoxicity testing (minimum six species from five taxa groups)	Once	One sample	1	1
	Bitterns Chemical characterisation	Physico-chemical Hydrocarbons Ionic balance Metals and metalloids Nutrients	Once	One sample	1	1
Hydrodynamic Model Validation	Dye tracer study	Drogue deployment (x5) with GPS positioning	2 surveys/yr >3 readings/min	2 years	5	NA
		ADCP deployment			1	NA
		Fluorometer sensor profiles			24[1]	NA
		Multispectral drone imagery			Whole area	NA
	Physico-chemical water column profiling	Temperature Salinity pH[2] Dissolved oxygen[2]	Monthly (when dye study not undertaken)	2 years	24[1]	NA

[1] Approximate sample numbers depend on drogue direction

[2] Not essential parameters

4.4.2. Whole Effluent Toxicity Testing

WET refers to the aggregate toxic effect to aquatic organisms from all pollutants contained in the bitterns. WET tests measure the bitterns effect on locally representative test organisms' ability to survive, grow and reproduce. WET testing results provide an assessment of the dilution factors required to achieve SPLs applicable within the LEP areas.

4.4.2.1.Sampling Design

WET testing will be undertaken as soon as the bitterns discharge is within design specifications, and therefore representative of bitterns characteristics during routine operations. WET testing will be conducted from samples taken directly from the raw bitterns and the results will be analysed in accordance with ANZG (2018) toxicity sampling and testing protocols. Chemical characterisation testing will also be undertaken of the bitterns to assist with interpretation of the toxicity of the effluent.

Additional WET testing will also be required at any time during which the operational process is altered, or if constituents of the bitterns are expected to have changed, thus potentially altering the toxicity of the discharge stream.

Toxicity testing is proposed to be undertaken on a minimum of six relevant species from five taxonomic groups, which is one test species and taxa group above the minimum specified in ANZG (2018). Suggested tests (based on those currently available) for WET testing are listed below:

1. 48-hour larval development test: *Saccostrea scyphophilla* (Milky Oyster)
2. 96-hr toxicity test: *Melita plumulosa* (Amphipod)
3. 8-day Sea anemone pedal lacerate development test: *Aiptasia pulchella*
4. 72-hr sea urchin larval development test: *Heliocidaris tuberculata*
5. 96-hr fish imbalance toxicity test using Yellow-tail kingfish *Seriola lalandi*
6. 7-hr Fish Imbalance and biomass toxicity test: *Seriola lalandi*
7. 72-hr marine algal growth test: *Nitzschia closterium*.

Testing will be undertaken in accordance with laboratory NATA accredited methodologies and in accordance with ANZG (2018) toxicity sampling and testing protocols. This includes the preferred use of ‘chronic’ over ‘acute’ testing.

The WET tests will be confirmed closer to the time in collaboration with the preferred laboratory to ensure appropriateness of the selected tests and to determine availability of the selected species.

4.4.2.2.Sampling Methodology

Samples for WET and chemical testing will be collected directly from the raw bitterns prior to any dilutions, at the point directly before it enters the discharge pipe. Samples will be collected in laboratory supplied sample containers and in accordance with sampling instructions and ANZG (2018) protocols. Typically, this involves filling sample bottles from the bitterns sump once normal operational processes and discharges are established. Samples are typically required to be chilled and transported to the laboratory within stipulated timeframes. Diluent water will be collected from a source within the HEPA that has been determined to have no impacts from the outfall discharge (i.e., through interpreting modelling results), from a depth equal to the

outfall diffuser. Samples will be transported directly to the laboratory to ensure ecotoxicity testing can occur as soon as practicable after sample collection.

Water sample analysis will be performed on the bitterns by a NATA accredited empirical laboratory for the following:

- Physico-chemical parameters
- Ionic balance:
  - Alkalinity and Hardness
  - Calcium, magnesium, sodium, potassium cations
  - Chloride, fluoride and sulphate anions
- Nutrients (TN, TKN, NH_3, NO_x, TP, PO_4)
- Hydrocarbons (TRH, TPH and BTEXN)
- Dissolved Metals and Metalloids (Al, As, Bo, Cd, Cu, Hg, Pb, Zn, V).

4.4.2.3. Data Assessment and Reporting

Ecotoxicity testing results will be entered into a software program (i.e., Burrlioz) to calculate the value required to achieve a 90% SPL at the boundary of the LEPA/MEPA and a 99% SPL at the boundary of the MEPA/HEPA. WET testing results will be assessed against predicted dilution contours to ensure that actual dilution contours required to achieve the 90% and 99% SPLs are being achieved. These results will be used to validate the spatial area of predicted dilutions from the outfall, or as a basis for review and refinement of operational parameters.

At the completion of each round of WET testing, a validated laboratory report and summary report will be compiled which will include, but not be limited to:

- A summary of the methods applied and any deviations from the proposed methods
- A table summarising the laboratory results
- An interpretation of the species sensitivity distribution (SSD) outputs from the statistical software program (i.e., Burrlioz) and protection level concentrations
- Calculation of the dilutions represented by the 90% and 99% SPL concentrations
- Interpretation of the key potential toxicants based on the chemical characterisation of the bitterns
- Any actions or recommendations.

4.4.3. Hydrodynamic Model Validation

Field surveys will be undertaken to assess if the algorithms applied within the hydrodynamic model adequately characterise the dilution, advection and dispersion of the bitterns discharge. This will be conducted using a dye tracer study due to the scale of the area and number of dilutions required. Prior to implementing the program, the model outputs should be reviewed, and discussions held with engineers to estimate and determine the following aspects of the dye exercise before the design can be finalised:

- The quantity of dye required.
- The dye injection flow rate.
- The diameter of the discharge pipe.
- The location(s) for the dye release exercise.

- The depth the dye is released from.
- The duration dye monitoring will be required
- The approximate length of transects required.

During months when dye tracer studies are not performed within the 2-year validation phase, physico-chemical profiles will be undertaken using a similar gradient sampling design to characterise the dilutions from the bitterns discharge using delta salinity as a key indicator.

4.4.3.1.Sampling Equipment

A dye tracer study will require the following sampling equipment:

- Vessel
- Rhodamine Water Tracer (Rhodamine WT) fluorescent dye
- Five drogues with real-time GPS positioning and set to different depths
- Acoustic Doppler Current Profiler (ADCP)
- Fluorometer (FLU), salinity and current, temperature and depth (CTD) sensor loggers
- Drone with multispectral camera

Physico-chemical sampling undertaken will require a single drogue (near seabed) and a physico-chemical sensor able to reliably detect elevated salinity/conductivity concentrations.

4.4.3.2.Sampling Methodology

An ADCP instrument will be deployed close to the outfall prior to release of dye to measure currents during the field trial. Rhodamine WT will be injected into the discharge stream. Drogues will be deployed at the outfall to identify the direction of plume dispersion. FLU and CTD profiles will be undertaken in a gradient design gradually sampling at greater distances from the outfall with the trajectory of the drogues. Indicative sampling sites are presented in Figure 9 to depict the gradient design. A drone with multispectral camera will capture imagery of the surface dye tracer plume. Following completion of the transect in the direction of the plume, a second transect will be undertaken in the opposite direction to the currents for background comparison. Then the transects will be repeated over the course of the day to determine the effects of dye dispersion and decay over time.

Two separate surveys will be undertaken each year which aims to represent distinct seasonal weather conditions and tides. Within each survey, the field sampling process would be repeated at least on three occasions.

Between dye tracer studies, physico-chemical gradient transects will be undertaken monthly, which involves deployment of a drogue and profiles collected in a gradient design in the direction of the current and in the opposite direction using the distances identified in Figure 9 (or any amendments to these distances based on revised WET testing). Water temperature and salinity will be collected at each location (Table 19 and Figure 10), while pH and dissolved oxygen may also be useful for interpretation. Profiles will be undertaken from 0.5 m below the surface to 0.5 m above the seabed.

Delta salinity may be used to measure a high number of dilutions, although based on modelling the upper 95th percentile of time for toxicants to meet a 90% and 99% SPL, delta salinity will rarely be detectable above background at the LEP boundary (i.e. only 5% of the time). So monitoring is not likely to coincide with the

worst case scenario where the number of dilutions are required. In this case, sampling would continue until salinity reaches background concentrations. Further, concentrations closer to the outfall may be above that which can be measured using sensor readings *in-situ*. Therefore, consideration of using conductivity or TDS has been suggested as an alternative in the event salinity concentrations are above the range of the sensor.

Water quality instrument calibration will be performed in accordance with manufacturer specifications and appropriate QA/QC protocols.

4.4.3.3.Data Analysis and Reporting

The survey of FLU and CTD vertical profile data will be interpolated to determine the three- dimensional (3D) extent of the dye plume and water density as reference. The 3D plume extent will be generated for the repeated profiles to provide a measure of dissipation and decay over time. Drogue and ADCP data will be analysed for current drift and assessment of plume dissipation. The FLU/CTD, current and multispectral imagery will be used to validate and calibrate dilution, advection and dispersion modelling through model scenarios run of similar conditions.

Modelling simulations of the original scenarios used to develop the LEP boundaries will be re-run using the revised WET test results and hindcast model outputs. These outputs will define the LEPA/MEPA and MEPA/HEPA boundaries for the ongoing routine monitoring and management.

A brief field report will be prepared following each survey. A final hydrodynamic model validation report will be compiled at the completion of the validation phase which will include, but not be limited to:

- A summary of the methods applied and any deviations the method presented herein
- Spatial graphs and tables of dilutions achieved through dye tracer studies and delta salinity
- An assessment against performance target 3
- A review of performance target exceedances, investigations and remedial actions implemented, and
- Any actions or recommendations arising from the validation phase.

If the LEPs need to be adjusted, this MEQMP will be revised based on the outcomes from this report. If performance target 3 is not achieved within defined LEPs, then contingency management response will be investigated (see Section 6.2).

4.5. Operational Monitoring Program

4.5.1. Rationale

The operational monitoring program will be implemented at the end of the commissioning phase, which overlaps the validation monitoring program during the first two years, then ongoing monitoring for the remainder of the ESSP lifecycle.

This phase comprises the following three components:

1. Bitterns discharge quality against design specifications
2. MEQ monitoring (water quality and sediment quality) to ensure that potential impacts from operational activities are occurring within the limits allocated within each spatial LEP.
3. Annual hydrodynamic model validation

Monitoring during ongoing operations will be focused on ensuring EQCs are met on the spatial LEP boundaries and therefore protect the associated EVs and EQOs. Where desired levels are not being achieved, contingency management actions will be implemented to ensure the impacts are restricted, investigated and remediated (see Section 6.3). Operational monitoring is also undertaken to measure the cumulative effects of other identified risks to MEQ such as product or hydrocarbon spills both nearshore and offshore for transshipment.

A summary of the operational monitoring program is provided in Table 17.

Table 17 Operational monitoring program overview.

Element	Sample Requirement	Parameters	Frequency	Duration	No. of Sites	No. Samples per site
Bitterns Discharge Monitoring	Sensor readings prior to discharge	Flow Rate	Continuous (hourly)	2 years	1	NA
	Sensor readings OR Laboratory samples prior to discharge	Temperature Salinity (or equivalent: Conductivity/total dissolved solids)	Continuous (hourly) OR Intermittent (minimum weekly)	2 years	1	1
MEQ Monitoring	Aesthetic observations	Nuisance organisms Large-scale deaths Oil/Film Natural reflectance Objectionable odour Floating debris, rubbish, surface slicks	Quarterly	2 years	12	NA
	Physico-chemical water column profiling	Electrical conductivity Salinity Temperature pH Dissolved oxygen Turbidity	Quarterly	2 years	7	NA

Element	Sample Requirement	Parameters	Frequency	Duration	No. of Sites	No. Samples per site
	Marine water sampling	Hydrocarbons Ionic balance Metals and metalloids	Quarterly	2 years	7	9
	Sediment sampling	Particle size distribution Total organic carbon and moisture Metals and metalloids Hydrocarbons	Annually	2 years	5	7
Hydrodynamic Model Validation	Physico-chemical water column profiling	Electrical conductivity Salinity Temperature pH[2] Dissolved oxygen[2] Turbidity[2]	Monthly (when dye study not undertaken)	2 years	24[1]	NA

[1] Approximate sample numbers depend on drogue direction

[2] Not essential parameters

4.5.2. Bitterns Discharge Monitoring

The purpose of the bitterns discharge monitoring is to ensure that design specifications for bitterns discharge constituents, as verified through bitterns discharge and flow rate monitoring, are achieved through the lifecycle of the ESSP.

4.5.2.1. Sampling Design and Methodology

A flow rate sensor, or similar, will be installed to monitor hourly or maximum instantaneous flow rates representative of the diffuser outfall. Sampling will be maintained continuously throughout the ESSP lifecycle.

Daily (minimum weekly) measurements of temperature and salinity (or Conductivity/TDS) will also be collected. Measurements/samples will be obtained from the bitterns prior to release, either using a pre-calibrated water quality meter, an appropriate inline sensor or samples collected and sent to a NATA accredited laboratory.

4.5.2.2. Data Assessment and Reporting

Data collected will be compared against relevant Performance Targets.

All data is required to be validated prior to the release of any monitoring reports to confirm that data is accurate, and that sensors or sampling equipment is properly functioning and calibrated.

A bitterns discharge monitoring report will be developed quarterly. The report will include, but not necessarily limited to:

- Summary of the methods applied and any deviations from this MEQMMP
- An assessment of all data collected against performance targets
- A review of performance targets exceedances investigations and remedial actions implemented
- Any actions or recommendations required because of field implementation of the MEQMMP and assessment of monitoring data.

An annual compliance report will be produced and include a summary of all monthly operational reports and outline any key findings and recommendations. In the event of any EQG or EQS exceedances, an exceedance investigation report will be compiled and submitted to the regulator within one month following a recorded exceedance.

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4.5.3. Routine MEQ Monitoring

The purpose of the routine MEQ monitoring program is to collect quantitative data to assess against performance targets to collect data that can be compared to EQG to protect MEQ within the limits for each LEP. The key ESSP operational activities that have potential to put MEQ at risk include:

1. Outfall discharge of bitterns.
2. Product storage and handling (bund failure, runoff)

Potential impacts specific to the CPE Port operations include:

1. Product loading/spill (nearshore and offshore)
2. Vessel operations (hydrocarbon spills, sediment disturbance, antifoulant)

4.5.3.1.Sampling Design

The MEQ monitoring will commence following the completion of the commissioning phase. This monitoring program involves the collection of aesthetic observations, physico-chemical profiles, water sampling and sediment sampling. Table 18 shows the MEQ monitoring events and sampling frequencies, number of monitoring sites and commencement timeframe.

Lower frequency of sampling based on the validation program provides confidence in the outputs of the modelling that the discharge can be managed by meeting the concentrations prior to discharge. In addition, the risk of impact from spills and other pressures from the Project are relatively minor.

Table 18 Monitoring Events and Frequency for the Ongoing Marine Environmental Quality Monitoring.

Monitoring Event	Frequency	No. Sample Sites	Commencement
Physical Observations	Quarterly	12	Post Commissioning
Physico-chemical Water Quality Profiling	Quarterly	7	Post Commissioning
Water Sampling	Quarterly	7	Post Commissioning
Sediment Sampling	Annually	5	Post Commissioning

Details of the ongoing MEQ monitoring sites are presented in Table 19 and shown in Figure 10.

Table 19 Ongoing Marine Environmental Quality Monitoring Locations.

Site Reference	Site Name	Easting	Northing	LEP	Monitoring Parameters			
					Physical observations	Water column Profiling	Water Sampling	Sediment Sampling
<u>MEQ Sampling Sites</u> These sites will monitor potential impacts from brine release operations. One monitoring site (IC1) is located adjacent to the proposed seawater intake infrastructure. Two reference sites have been included for comparative purposes. These sites will also allow monitoring (for reference only) of CPE Port operations such as hydrocarbon spills, nearshore product loading and sediment disturbance from vessels.	MEQ1 MEQ2 MEQ3 MEQ4 IC1 REF1 REF2	419162 419405 419382 418872 426751 427168 417892	7695334 7695631 7696507 7695987 7690947 7696413 7696822	MEPA MEPA LEPA MEPA XEPA HEPA HEPA	X	X	X	X
For reference only – CPE Port Operations <u>Sediment Sampling for Product Spill</u> Annual sediment samples will be undertaken at locations SS1 – SS4 to assess potential toxicants in sediment resulting from product spill Sites SS4 and SS5 will only be sampled after a confirm product spill. Note these offshore monitoring locations are indicative as anchor locations may vary. Sampling will occur at the identified spill location.	SS1 SS2 SS3 SS4 SS5	419174 419176 419184 424851 425537	7695702 7695649 7695570 7717655 7717446	MEPA MEPA MEPA HEPA HEPA	X			X

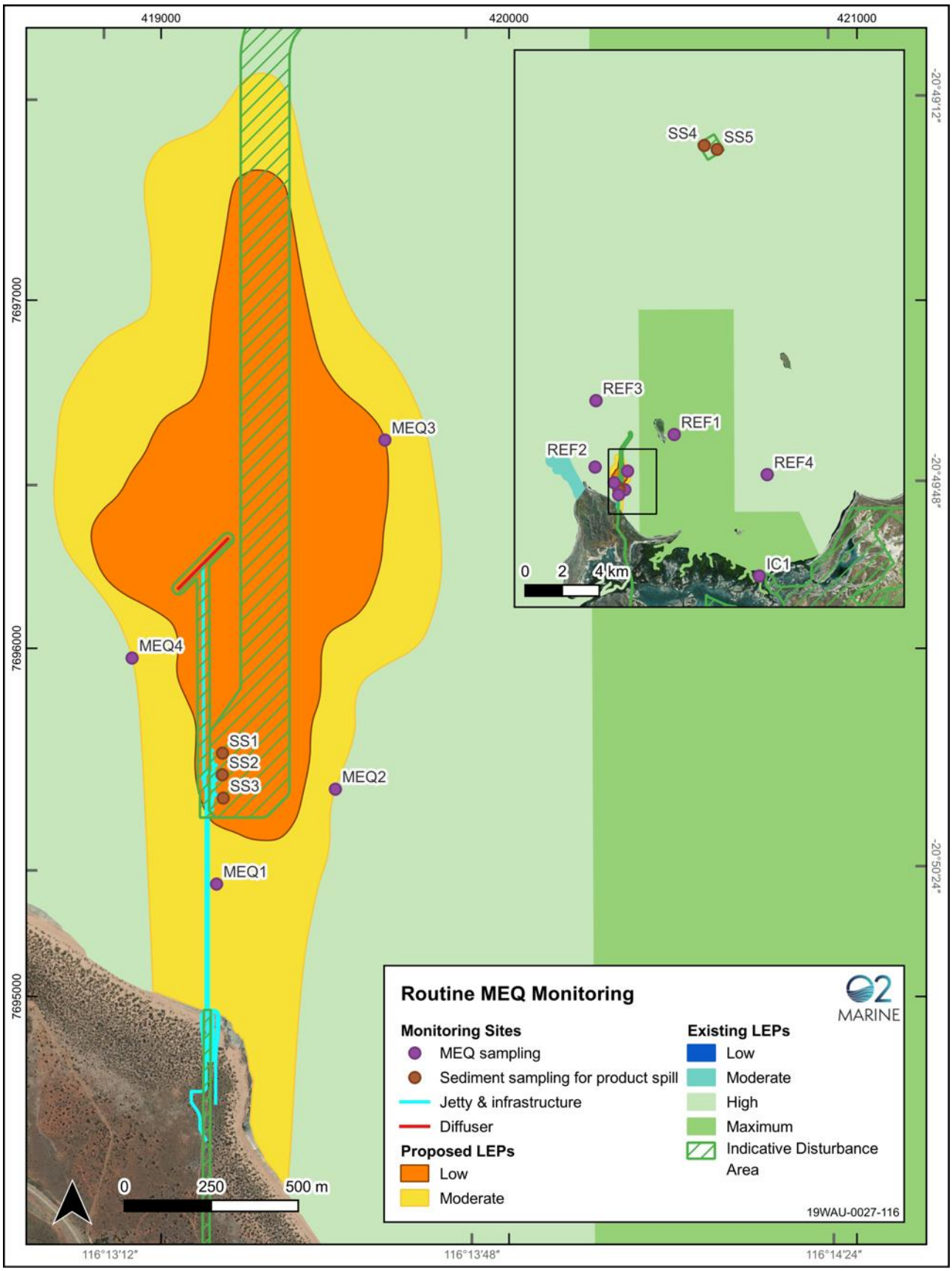

Figure 10 Location of the Ongoing Marine Environmental Quality Monitoring Sites

4.5.3.2. Sampling Methodology

Sampling methodologies for aesthetic observations, physico-chemical profiling and water sampling will be conducted in accordance with methodologies outlined in Section 4.2.3. Procedures for sediment sampling are detailed below, although do not include benthic infauna or any other sampling for comparison of EQS which will be undertaken reactively (see Section 4.5.4).

Sediment Quality Sampling

Sediment samples will be collected at all five sampling locations described in Table 19. Sampling will involve the collection of sediment using a surface grab via a Van Veen grab sampler (or similar). The grab, plastic tray and other equipment in contact with the sediment will be rinsed with Decon solution and seawater prior to sampling each site to reduce potential for contamination. Where insufficient sediment is collected (i.e., less than one-third of grab volume), the grab will be redeployed. The volume of sediment collected in the Van Veen grab will be recorded, prior to emptying the contents into a plastic tray and homogenising. A photograph of each sample will be taken once emptied into the plastic tray. The sample will then be placed into appropriate sample jars/ containers provided by laboratory. Containers should be refrigerated or placed into an esky with ice bricks before being frozen at the completion of each sampling day and sent to a NATA approved laboratory.

All sample containers will be marked with a unique identifier, the date/time and the sampler's name and clarification that the samples are marine water using a 'Wet-write' permanent maker. All samples will then be listed on a CoC form which will accompany the samples sent to the laboratories.

All sediment samples will be analysed by a NATA accredited laboratory for the following analytical suite:

- Particle size distribution (PSD)
- Total organic carbon (TOC)
- Moisture
- Metals and metalloids (Al, As, Bo, Cd, Cu, Hg, Pb, Zn, V)
- Hydrocarbons (TRH, TPH and BTEXN), and
- Antifoulant Compounds (Diuron, Chlorothalonil).

Field Quality Assurance & Quality Control

Disposable nitrile gloves should be used during handling of the sediment sample and all equipment in contact with the sediment should be washed down with Decon solution prior to each sample being taken. The following QA/QC Samples should be collected as described below:

- Triplicate samples (i.e., three separate samples taken with the sediment grab at the same location) should be taken at one (1) site to determine the site variability of the sediment physical and chemical characteristics
- A field split sample (i.e., one sediment grab sample thoroughly mixed and then split into three sub-samples) should be collected at collected at one (1) site to assess inter and intra-laboratory variation, with one of the three samples sent to a second laboratory
- A transport blank (acid-washed silica sand) in a sealed jar should be provided by the laboratory and taken to site but not opened. The transport blank is sent back to the laboratory with the other samples

and analysed. This blank is used to assess if any contamination is already present in the acid-washed sand or container, and

- A method blank (acid-washed silica sand) should be used to assess the potential for contamination during the sampling process. The method blank should be placed into the Van Veen grab and processed identically to the usual sediment samples. The method blank should be sent to the laboratory and analysed with the other samples to assess presence of contamination during the processing procedures.

4.5.3.3. Laboratory Quality Assurance & Quality Control

Laboratories used for water and sediment toxicity sample analysis must be NATA accredited. Comprehensive QA/QC testing of samples should be undertaken in accordance with NATA accreditation and include testing of laboratory control samples, method blanks, matrix spikes, laboratory duplicates and surrogate recovery outliers (where applicable).

4.5.3.4. Data Assessment and Reporting

All data will be validated prior to the release of any monitoring and assessment reports. Data used or otherwise presented in the reports is to be checked and verified against raw data logs and laboratory reports.

An assessment of data quality control will be undertaken, which includes:

- Assessment of field contamination (rinsate, transport blank and method blank)
- Assessment of field variability (duplicate and triplicate)
- Assessment of lab variability (triplicate), and
- Laboratory QA/QC results.

Laboratory samples and *in-situ* results will be compared with the performance targets as soon as practicable to ensure that the appropriate reactive monitoring programs are implemented immediately following any EQG exceedance.

A routine MEQ monitoring report will be prepared at the completion of each monitoring round. The report will include, but not be limited to:

- Summary of the methods applied and any deviations from this MEQMMP
- Timeseries graphs of physicochemical water column profiles
- A table summarising laboratory analysis result
- Timeseries graphs of laboratory analysis results
- An assessment of all data collected against performance targets
- A review of performance targets exceedances investigations and remedial actions implemented
- Any actions or recommendations resulting from field methodologies and or assessment of results.

In the event of any EQG exceedances, an investigation report will be compiled in accordance with LS's EMS (or similar).

Contingency compliance reporting will be required to identify exceedances and associated EQOs at risk, any contingency actions implemented, and any proposed changes to management actions. These reports will be

submitted as required to the regulator. An overview of the monitoring and management proposed during routine operations of the ESSP is included in Table 25.

4.5.4. Hydrocarbon Model Validation

Physico-chemical profiles will be undertaken annually using the gradient sampling design to characterise the dilutions from the bitterns discharge using delta salinity as a key indicator as conducted during the validation monitoring program.

Physico-chemical sampling undertaken will require a single drogue (near seabed) and a physico-chemical sensor able to reliably detect elevated salinity/conductivity concentrations.

Sampling involves deployment of a drogue and profiles collected in a gradient design in the direction of the current and in the opposite direction using the distances identified in Figure 9 (or any amendments to these distances based on revised WET testing). Water temperature and salinity will be collected at each location (Table 19 and Figure 10), while pH and dissolved oxygen may also be useful for interpretation. Profiles will be undertaken from 0.5 m below the surface to 0.5 m above the seabed.

Water quality instrument calibration will be performed in accordance with manufacturer specifications and appropriate QA/QC protocols.

The survey of FLU and CTD vertical profile data will be interpolated to determine the three- dimensional (3D) extent of the dye plume and water density as reference. The 3D plume extent will be generated for the repeated profiles to provide a measure of dissipation and decay over time. Drogue and ADCP data will be analysed for current drift and assessment of plume dissipation. The FLU/CTD, current and multispectral imagery will be used to validate and calibrate dilution, advection and dispersion modelling through model scenarios run of similar conditions.

Modelling simulations of the original scenarios used to develop the LEP boundaries will be re-run using the revised WET test results and hindcast model outputs. These outputs will define the LEPA/MEPA and MEPA/HEPA boundaries for the ongoing routine monitoring and management.

A brief field report will be prepared following each survey. A final hydrodynamic model validation report will be compiled at the completion of the validation phase which will include, but not be limited to:

- A summary of the methods applied and any deviations the method presented herein
- Spatial graphs and tables of dilutions achieved through dye tracer studies and delta salinity
- An assessment against performance target 3
- A review of performance target exceedances, investigations and remedial actions implemented, and
- Any actions or recommendations arising from the validation phase.

If the LEPs need to be adjusted, this MEQMP will be revised based on the outcomes from this report. If performance target 3 is not achieved within defined LEPs, then contingency management response will be investigated (see Section 6.2).

4.5.5. Reactive Marine Environmental Quality Monitoring

If monitored values meet the EQG then the EQO are considered to have been met and MEQ protected. If an EQG is exceeded, there is an increased risk that the associated EQO may not be achieved and assessment

against the EQS may be required. If an EQS is exceeded, it is considered there is a significant risk that the associated EQO has not been achieved, and a management response is required to ensure the EQO is achieved.

Assessment against the EQS involves reactive sampling required at any time the routine monitoring program identifies exceedances above the EQGs. Reactive sampling programs are required to determine the extent and severity of any impact and provide an assessment of whether the EQOs are compromised and if the EVs are at risk.

4.5.5.1. Toxicant Bioavailability Assessment

Elevated toxicants in sediment may be present in a variety of forms, however, only the bioavailable fraction will impact organisms. Bioavailability testing assesses the availability of elevated toxicants present within sediments for the uptake of organisms. Where total toxicants from routine sediment analysis identify exceedances of EQGs (Table 8), a bioavailability analysis will be undertaken for assessment against an EQS (Table 9).

Bioavailability tests may comprise dilute acid extraction of toxicants or sampling of elutriate testing of absorbed pollutants in seawaters exposed to sediment under laboratory conditions. Therefore, additional samples may be collected during routine sediment sampling to facilitate any additional testing that may be required. If toxicant concentrations from bioavailability tests exceed the EQGs further ecotoxicity or bioaccumulation testing may be required for comparison against established EQS.

Results from dilute acid extraction should be compared to EQG values whilst elutriate concentrations will be compared to relevant marine water DGVs at the SPL associated with the LEP the sample was collected from.

4.5.5.2. Toxicants in Biota

The objective of bioaccumulation monitoring is to determine if toxicants are bioaccumulating at a rate that could affect marine life and/or result in seafood being not safe for human consumption.

Initially, a desktop study will be undertaken to determine the risk of contaminant bioaccumulation across the ESSP study area. The desktop study will review the concentrations of any contaminant(s) that have exceeded the bioavailable EQSs, and whether the contaminant is likely to bioaccumulate in locally relevant species. Guidance procedures and assessment for bioaccumulation testing will follow Simpson et al. (2005) and in the American Society for Testing Materials (ASTM) International guide E1688 (2016), Standard Guide for Determination of the Bioaccumulation of Sediment-Associated Contaminants by Benthic Invertebrates.

One or both of the following methods will be used for monitoring toxicants in biota, as appropriate:

- Field collected and caged/transplanted organisms; and
- Laboratory based bioaccumulation test sampling.

Direct field collected and caged/transplanted organisms can be tested for any toxicants accumulating in tissues of organisms at the affected site, then comparing results with organisms of the same species located at one or more reference sites. Field collected samples rely on existing information on the concentrations of contaminants that have exceeded the relevant EQSs prior to the detection of elevated levels, whereas caged/transplanted organisms involve the deployment of relevant species (usually filter-feeding bivalves) at the affected and reference sites to measure the change in the contaminants that have exceeded the relevant

EQC over time. An appropriate gut depuration interval is generally required (typically 24 hours) prior to analysis although the specific requirements should be discussed with the laboratory.

Laboratory bioaccumulation tests generally run for 28 days and use several test species. At least two bioaccumulation tests are to occur, preferably on a bivalve mollusc and burrowing polychaete (Simpson et al., 2005). The requirements for these species are like toxicity testing, where each species should provide adequate biomass for analysis, ingest water/sediments and be efficient metabolisers of contaminants. However, the organisms do not need to be sensitive to the contaminants that are under investigation for bioaccumulation potential.

The location, nature and frequency of reactive monitoring required will be tailored on advice from appropriate specialists for the collection of the appropriate information required to inform any management responses to specific exceedance events. Consideration will be given to the utilisation of historical data as well as physical and chemical sediment data.

For any contaminant where bioaccumulated concentrations are statistically greater than that measured in the controls, an investigation into the source of the contaminant will be conducted. Where environmental and public health risks are identified as a possibility, the appropriate government agencies will be notified accordingly.

Benthic Infauna

Benthic infauna sampling may be conducted in accordance with the methods and at the sample locations presented within Section 4.2.3.5 where water or benthic sediment quality exceeds the EQG.

Data obtained during the sampling will be assessed against the EQS presented in Table 9.

4.5.5.3. Benthic Communities and Habitat

BCH monitoring will be required if it is identified that relevant EQGs have been exceeded. A thorough review of the ESSP Subtidal BCH Assessment Report (O2 Marine 2025b) will be undertaken to understand monitoring locations, methodologies and baseline conditions. Additional monitoring sites may be required to adequately assess specific impacted areas. Monitoring typically involves qualified divers recording photos and taxonomic information over repeatable and measured transects. It should be noted that BCH is known to have natural seasonal variability, as such, multiple BCH surveys (including suitable reference sites) may be required to accurately determine natural or anthropogenic changes.

The proposed coral and seagrass monitoring methodologies are outlined below and are based off the baseline surveys implemented for the ESSP project (O2 Marine 2025b).

Monitoring locations

Table 20 and Figure 11 outline the previously established coral monitoring sites (five) and seagrass monitoring sites (seven) to be surveyed in the event of reactive BCH monitoring. These monitoring sites were chosen in order to complement previous literature, and to assess the status of benthic communities in areas that are likely to be heavily impacted (e.g. intake and outfall sites and direct Proposal footprint).

Table 20 Depth and location of targeted coral and seagrass monitoring surveys (after GHD 2013).

Site	Location	Description	Depth (m LAT)	Lat (°)/ Northing (m)	Long (°)/ Easting (m)
Coral 1	1.5 km offshore within 100 m of proposed jetty	Coral, sponge, and soft coral habitat on sand and limestone veneer pavement. Dominated by Dendrophylidae	5.3	-20.82578	116.22580
Coral 2	1.5 km SE of South West Regnard Island	Large coral bommies dominated by Poritidae and Mussidae	3.5	-20°827306	116°255944
Coral 3	E side of South West Regnard Island	Shallow fringing reef with high coral cover dominated by Faviidae	0.5	-20.814500	116.250444
Coral 4	E side of Sino Iron port facility	Coral and macroalgae habitat on limestone rock substratum dominated by Dendrophylidae, Faviidae, and Acroporidae	6.0	-20.821167	116.200111
Coral 5	0.4 km offshore within 100 m of proposed jetty	Coral and macroalgae habitat on limestone rock dominated by Dendrophylidae	2.5	-20.83771667	116.2226
Seagrass E14a	1 km W of South West Regnard Island	Sand with patchy sparse to moderate seagrass and occasional macro algae	6.0	-20.80745	116.23175
Seagrass E16a	1.5 km SW of South West Regnard Island	Sand with patchy sparse to moderate seagrass and occasional macro algae	4.5	-20.81908333	116.2322333
Seagrass E16b	1.5 km SW of South West Regnard Island	Sand overlying limestone platform with sparse to moderate seagrass, macroalgae and sessile invertebrates	4.5	-20.81953333	116.2322333
Seagrass ERASG2	4 km SE of South West Regnard Island	Sand, patchy sparse seagrass and sessile invertebrates	5.5	-20.8507	116.26153
Seagrass I13b	5 km E of 40 Mile Beach Campground	Sand with patchy sparse to moderate seagrass and occasional macro algae	6.5	-20.84193333	116.3080667
Seagrass W7a	2.5 km E of Cape Preston jetty	Sand with patchy sparse seagrass and occasional macro algae	5.1	-20.82868333	116.22105
Seagrass W8a	2 km E of Cape Preston jetty	Sand with sparse seagrass, filter feeders and macroalgae	6.0	-20.82581667	116.2175667

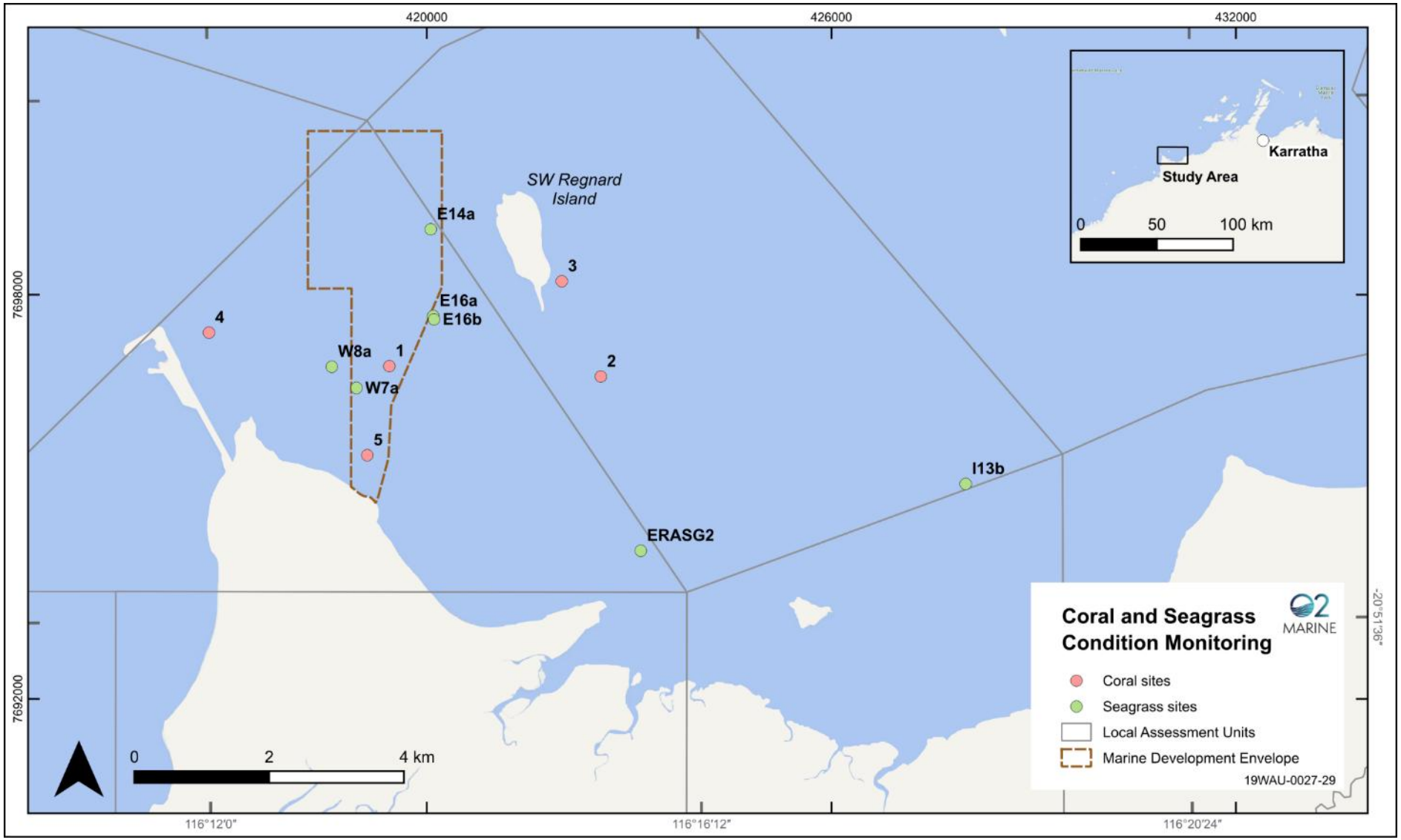

Figure 11 Subtidal BCH (coral and seagrass) monitoring locations.

Survey Methodology

At each of the coral monitoring sites, a shot weight and surface float are used to mark the central point of the monitoring site, with coordinates recorded with a handheld GPS. From this central point, a fiberglass measuring tape is used to measure 5 x 20 m long transects across the coral communities. Five transects are spaced radially at evenly spaced intervals (approximately 72° apart) from the central shot weight.

Once the tape is positioned, divers swim along each transect and capture a series of clear photographs using an underwater digital still camera, at approximately 1 m above the seafloor. Using the measuring tape as reference, the diver records a series of 1 x 1.3 m overlapping images along the transect length for later analysis. In this way, benthic cover images are collected at each monitoring location comprising a total seabed area of approximately 130 m^2 (i.e. 5 transects x 20 m long x 1.3 m wide).

The nominated survey method is designed to adequately describe the abundance (as percentage cover) and diversity of the benthic community at each site. This technique is designed to detect any composition and health differences between sites and can also be repeated to detect temporal changes. The method also provides a rapid assessment that does not rely on any infrastructure to remain in the marine environment.

The six seagrass monitoring locations range in depth from 4.5 m to 6 m. At each site, three 50 m transects are established radiating from a central point. Transects are surveyed using SCUBA and photographs of 25 x 25 cm quadrats are taken every metre along the transect. Seagrass cover is visually estimated to ~1% within each photograph, in addition records of ascidians, corals, macroalgae, and sponges are noted. Seagrass is identified to genus-level (e.g. *Cymodocea* sp., *Halodule* sp., *Halophila* sp., *Syringodium* sp.) or species-level where possible (e.g. *Halophila decipiens, Halophila ovalis, Halophila spinulosa*). To capture seasonal changes in seagrass cover, baseline surveys implemented twice: once in the dry season (July 2020) and again in the following wet season (March 2021). Any reactive monitoring should also consider surveys over two different seasons to capture natural variation in seagrass cover.

Data Analysis

Changes in hard coral and seagrass cover will be assessed against reference conditions using a range of univariate and/or multivariate analyses. As a general approach, data will be summarised and examined for any obvious differences. Following this, a series of appropriate analyses (e.g. ANOVA) will be used to statistically compare new data against historical data. Where changes in the community structure are needed to be examined, a series of multivariate analyses (e.g. nMDS and Permutational Analysis of Variance) will be undertaken. Prior to analysis, all data will be checked for normality and heterogeneity of variances and, where necessary, will be appropriately transformed to meet the assumptions of any tests.

Coral Cover Analysis

Benthic cover images are to be analysed to provide an assessment of the benthic community at each of the five-coral monitoring sites and compare against baseline results. Multiple images (approximately 15) are chosen at random from each of the five transects at each site (i.e. a total of 75 images per site; or a total area of ~97.5 m^2). Benthic cover at each site is then assessed by plotting 25 points over each frame in a 'stratified-random' distribution for assessment with a suitable image analysis software program (i.e. ReefCloud or similar). This image analysis method is consistent with those used in other Pilbara benthic habitat assessment projects in a similar manner to Stoddart and Stoddart (2005).

During the image analysis, benthic taxa are recorded within the image software and grouped based on the following classifications:

- All hard corals are identified and grouped at the family level
- All other observed benthic taxa are broadly classified (i.e. Algae, Hard substrate, other invertebrates, Rubble, Soft substrate)
- An assessment of coral health
- The percentage cover of each benthic group for each of the five transects is used to calculate a mean value for each site
- The above classifications are consistent with those used in similar studies to describe marine benthic communities in the Pilbara and therefore are amenable to comparisons with previous studies.

Seagrass Cover Analysis

For the seagrass monitoring sites, desktop post-hoc analysis of the still images from each transect are undertaken using a visual estimate of the composition of the various BCH types within each 25 x 25 cm quadrat. Every quadrat image is individually assessed through an image viewing application, with filter enhancements being made when the visual quality is limited. The images are to be captured in high resolution so close inspection of the smaller or unidentified features within the quadrat through the zoom function can be undertaken. The CATAMI system will be utilised for classification, with the cover of each biotic feature to be recorded to the highest taxonomic level practicable. The BCH biotic cover data for each image will be compiled in Excel to provide the estimate percent cover summary statistics for each transect and site. The broad classifications utilised includes Macroalgae, Seagrass, Coral and Non-Coral.

4.5.5.4.Animal Deaths and Disease

Records of animal deaths or disease will occur primarily from the following sources:

- Aesthetic observations undertaken during routine sampling programs
- Any reported incidents from operation or ESSP related personnel.

Any animal deaths or disease will require investigation in accordance with the contingency management procedure outlined in Section 6.3.

5. Management Procedures

5.1. Rationale

Potential impacts to MEQ can be either planned, such as the discharge of bitterns as part of routine activities, or unplanned, stemming from unexpected spills or accidents. The former planned activities require monitoring of the environment to manage the effects to acceptable levels. The monitoring involves EQC as performance targets and thresholds to help identify where contingency management activities are required. Monitoring may also be undertaken for spills or accidents, for which routine monitoring measures the cumulative effects of minor anthropogenic inputs, or reactive monitoring offers an emergency response in the event of a large spill. However, the risks associated with unplanned activities can be mitigated through development of thorough design and process driven actions. Effective management of spills will therefore involve regular preventative inspections, procedures and controls to ensure the risk of a spill event to MEQ remains low, which is separate to contingency management of the planned discharge.

5.2. Spill Management

5.2.1. Product Storage and Handling

An overview of the Product Storage and Handling Monitoring and Management program is outlined in Table 21. Product spills will be managed in accordance with a Part V EP Act licence administered by DWER, as well as a separate Product Spill Risk Assessment and Management Plan (Appendix B).

During ESSP operations, periodic inspections (via inspection checklists) will be undertaken for all facility infrastructure involved in the storage and handling of high saline product. Inspections will include, but not be limited to:

- Bund walls
- Pipelines
- Pump stations
- Drainage infrastructure

Regular audits (at a frequency to be stipulated by approval conditions) will be implemented to ensure inspections are occurring, inductions and training have been provided to appropriate personnel, plant and equipment are readily available for spill management, and that any corrective actions have been actioned in acceptable timeframes. Audits will also ensure all processes and system documentation are up to date and available to all operational personnel.

Incident reporting will be undertaken to the ISO 14001:2015 Standard.

Table 21 Overview of the Product Storage and Handling Monitoring and Management Program

Management Targets	Management Actions	Monitoring	Timing/frequency of actions	Reporting
Achieve zero spills of brine water into the marine environment from concentration ponds and crystallisers.	• Ensure concentration pond design includes materials to limit brine seepage and rip rap protection where necessary to prevent wave action from causing a breach to the external walls. • Ensure external walls have been designed with sufficient internal freeboard to contain brine depth variations and rainfall from extreme weather events. • Ensure ponds are constructed and operated in accordance with approval conditions under the *Mining Act 1978* and Part V of the EP Act. • General Works department to operate earthmoving equipment to undertake levee repairs as necessary. • Develop and implement a site environmental monitoring and measurement programme as part of an EMS aligned to the ISO 14001:2015 Standard. Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.	**Operational monitoring**: • Scheduled inspections of pond walls, pond freeboard and drainage ditches and levees. **Environmental monitoring**: • Internal Audit Programme. **Contractor management:** • Monitor earthmoving contractors' obligations in accordance with contracts. • Monitoring in accordance with Licence/Approval conditions.	Operational and closure phase. **Operational monitoring**: • Minimum of quarterly inspections **Environmental monitoring**: • Monitoring in accordance with Licence/Approval conditions. **Contractor management:** • In accordance with contracts. • In accordance with conditions.	**Internal**: • Incident reporting (as required). • Operations reporting (quarterly). **External**: Routine regulatory reporting as required by approvals under *Mining Act 1978* and Part IV and Part V of the EP Act (DMIRS & DWER, Annual). **Contractor:** General foreman/contractor: Monthly reports that include, but are not limited to: • Earthmoving volumes. • Safety statistics including reportable

Management Targets	Management Actions	Monitoring	Timing/frequency of actions	Reporting
				incidents, near misses, and interventions. • Issues and innovations.
Achieve zero spills of brine water into the marine environment from transfer trenches, culverts and/or pipelines.	• Ensure trenches have been designed with sufficient internal freeboard to contain brine depth variations and rainfall from extreme weather events. • Ensure level monitoring systems are adopted to measure trench levels, and flow controls are installed. • Ensure pipeline pressure/flow leak detection monitoring is installed for routes outside of the ponds. • Develop and implement a site environmental monitoring and measurement programme as part of an EMS aligned to the ISO 14001:2015 Standard. Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.	**Operational monitoring:** • Scheduled inspections of transfer trenches, culverts and pipelines. **Environmental monitoring:** • Internal Audit Programme. **Contractor management:** • Monitor earthmoving contractors' obligations in accordance with contracts. Monitoring in accordance with Licence/Approval conditions.	Operational phase. **Operational monitoring:** • Minimum of quarterly inspections **Environmental monitoring:** • In accordance with Approval conditions. **Contractor management:** • In accordance with contracts. • In accordance with conditions.	**Internal:** • Incident reporting (as required). • Operations reporting (quarterly). **External:** Routine regulatory reporting as required by approvals under *Mining Act 1978* and Part IV and Part V of the EP Act (DMIRS & DWER, Annual). **Contractor:**

Management Targets	Management Actions	Monitoring	Timing/frequency of actions	Reporting
				Earthworks service provider/contractor: Monthly reports that include, but are not limited to: • Earthmoving volumes. • Safety statistics including reportable incidents, near misses, and interventions. • Issues and innovations.
CPE Port operations – for reference only. Achieve zero spills of salt product into the marine environment from product loading system to transhipping vessels.	• Ensure engineering control systems are designed to ensure the loading system cannot discharge unless transhipping vessels are moored alongside the product loading jetty. • Ensure discharge chutes are designed and operated to minimise windborne salt dust. • Ensure diligent operation to ensure that loading is immediately ceased if spillage occurs. • Ensure spillage at the loading jetty is minimised through the use of conveyor belt scrapers at conveyor transfer/discharge	Operational monitoring: • Scheduled inspections and routine maintenance of product loading systems and vessels. Environmental monitoring: • Internal Audit Programme. • Sediment sampling to test for toxicants, with results compared against EQC in Table 8 and Table 9.	Operational phase. Operational monitoring: • Weekly inspections during loading Environmental monitoring: • In accordance with Approval conditions. • Annually	Internal: • Incident reporting (as required). • Operations reporting (quarterly). • Annual MEQ report summarising all water and sediment quality results. External: Routine regulatory reporting as

Management Targets	Management Actions	Monitoring	Timing/frequency of actions	Reporting
	points. Significant spillages to be recycled via dry handling back into product. • Develop, implement, and maintain risk identification procedures and operational controls through an EMS aligned to the ISO 14001:2015 Standard. • Develop and implement a site environmental monitoring and measurement programme as part of an EMS aligned to the ISO 14001:2015 Standard. • Implement sediment sampling at 'Sediment Sampling Sites for Product Spillage' in Figure 10, with the methodologies and frequency outlined in Section 4.5.3.2 Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.			required by approvals under *Mining Act 1978* and Part IV and Part V of the EP Act (DMIRS & DWER, Annual).
CPE Port operations – for reference only. Achieve zero spills of salt product into the marine environment from product loading system from transhipping vessels to ocean-going vessels.	• Ensure transhipping vessels have an enclosed recovery system for product pick-up from the hold through to the integral boom discharge into the ocean-going vessel. • Ensure product loading only takes place when weather conditions allow safe mooring of the transhipping vessel	**Operational monitoring:** • Scheduled inspections and routine maintenance of product loading systems and vessels. **Environmental monitoring:** • Internal Audit Programme. • Sediment sampling to test for toxicants, with results compared against EQC in Table 8 and Table 9.	Operational phase. **Operational monitoring:** • Weekly during loading **Environmental monitoring:** • In accordance with Approval conditions. • Annually	**Internal:** • Incident reporting (as required). • Operations reporting (quarterly). • Annual MEQ report summarising all water and sediment quality results. **External:** Routine regulatory reporting as required by

Management Targets	Management Actions	Monitoring	Timing/frequency of actions	Reporting
	alongside the ocean-going vessel to ensure controlled product discharging can occur. • Develop, implement, and maintain risk identification procedures and operational controls through an EMS aligned to the ISO 14001:2015 Standard. • Develop and implement a site environmental monitoring and measurement programme as part of an EMS aligned to the ISO 14001:2015 Standard. • Implement sediment sampling at 'Sediment Sampling Sites for Product Spillage' in Figure 10, with the methodologies and frequency outlined in Section 4.5.3.2 Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.			approvals under *Mining Act 1978* and Part IV and Part V of the EP Act (DMIRS & DWER, Annual).

5.2.2. Hydrocarbon Storage and Handling

An overview of the Hydrocarbon Storage and Handling Monitoring and Management program is outlined in Table 22. The storage and management of hydrocarbons will be conducted in accordance with the Part V EP Act licence, as well as a separate Hydrocarbon and Chemical Spill Risk Assessment and Management Plan (HCSRAMP) (Appendix C).

The approach applied in the HCSRAMP is designed to prevent or minimise the potential for an unplanned spill. During ESSP construction and operation phases, routine inspections (via inspection checklists) will be undertaken for all plant, refuelling stations, washdown stations and chemical storage and waste disposal areas to ensure a reduced risk of spills to the environment.

Regular audits (at a frequency to be stipulated by approval conditions) will be implemented to ensure procedures have been developed, inductions and training have been provided to appropriate personnel, inspections are occurring, equipment is readily available for spill, and corrective actions have been actioned within acceptable timeframes. Audits will also ensure all processes and system documentation are up to date and available to all operational personnel.

A spill response procedure is to be implemented in the event of any chemical or hydrocarbon spill.

Table 22 Overview of the Hydrocarbon Storage and Handling Monitoring and Management Program

Management Targets	Management Actions	Monitoring	Timing/frequency of actions	Reporting
Achieve correct storage and handling of chemicals and hydrocarbons	• Ensure relevant personnel and contractors involved in chemical and hydrocarbon handling and storage activities are provided with appropriate training and equipment. • Conduct a risk assessment for each chemical or hydrocarbon product introduced for use on site • Maintain a stock register and site holdings for all stored chemicals and hydrocarbons • Ensure up to date material Safety Data Sheets (SDS) are available for all chemicals on site • Chemicals and hydrocarbons should be stored in accordance with Australian Standard (AS) 1940, AS 3833 or AS 3780 to minimise the potential for environmental harm. Storage should only be in designated areas • Store chemicals and hydrocarbons in accordance with licence conditions under the EP Act. Where a storage facility is not required to be licenced, store chemicals and hydrocarbons, other than goods classified as minor storage, in bunded compounds with a capacity of 110% of the volume of the largest vessel and at least 25% of the total volume in accordance with AS 1940, AS 3833 and AS 3780 • Chemical or hydrocarbon waste is appropriately separated, stored and disposed in accordance with the *Environmental Protection (Controlled Waste) Regulations 2004*.	Conduct routine inspections of chemical and hydrocarbon storage areas to ensure at a minimum: • All required documentation is available on site (risk registers, training/induction registers, stock register and SDSs) • Chemicals and hydrocarbons are appropriately stored, separated and bunded • Chemical waste (oily water, equipment parts, rags and empty chemical containers etc) are separated from general waste, stored and bunded appropriately and disposed of with controlled waste tracking forms.	• Quarterly inspection of management procedures, registers and SDSs • Weekly inspection of chemical/hydrocarbon storage areas, refuelling stations, generators and waste facilities. Corrective actions are to be implemented and re-inspected no later than one week following identification.	Routine inspection checklists Compliance audit reports

Management Targets	Management Actions	Monitoring	Timing/frequency of actions	Reporting
Achieve zero spills of chemicals or hydrocarbons into the environment from construction plant.	• Ensure an approved spill response procedure is developed and that relevant personnel have been inducted and trained in accordance with said procedure • Regularly maintain construction plant to reduce the likelihood of chemical or hydrocarbon spills during construction • Ensure adequate spill response kits are stocked and readily available near construction plant • Chemical or hydrocarbon containers are to be adequately bunded (at a minimum bunding should have 110% capacity of storage vessel) • Washdown and servicing areas are to have adequate drainage and bunding to capture any chemical or hydrocarbon by-product or spills. • Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.	Conduct routine inspections of: • Chemical and hydrocarbon management procedures, personnel inductions, and training records • Evidence of prestart checklists of construction plant • Construction plant maintenance /service records • Spill kits – ensure appropriate placement in relation to construction activities and that kits are fully stocked • Integrity and correct capacity of bunding.	• Quarterly inspection of management procedures, induction and training registers • Daily prestart checklists of construction plant • Weekly inspection of plant maintenance/service records, spill kits and bunding. Corrective actions are to be implemented and re-inspected no later than one week following identification.	Routine inspection checklists Compliance audit reports
Achieve zero spills of chemicals or hydrocarbons into the environment from operational plant.	• Ensure an approved spill response procedure is developed and that relevant personnel have been inducted and trained in accordance with said procedure • Regularly maintain project intake and outfall pump equipment to reduce the likelihood of chemical or hydrocarbon spills during construction. • Regularly maintain operational project plant (i.e. vehicles, trucks, earthmoving equipment)	Conduct routine inspections of: • Chemical and hydrocarbon management procedures,	• Quarterly inspection of management procedures, induction and training registers • Daily prestart checklists of operational plant • Weekly inspection of plant maintenance/service records, spill kits and bunding. Corrective actions are to be implemented and re-inspected	Routine inspection checklists Compliance audit reports

Management Targets	Management Actions	Monitoring	Timing/frequency of actions	Reporting
	to reduce the likelihood of chemical or hydrocarbon spills during operations • Ensure adequate spill response kits are stocked and readily available near project plant • Where applicable, ensure adequate bunding is in place (at a minimum bunding should have 110% capacity of storage vessel) • Ensure all operational plant (specifically intake and outfall pumps) have an approved emergency shutdown procedure • Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.	personnel inductions, and training records • Evidence of prestart checklists and maintenance records of project plant • Intake/outfall pump maintenance /service records • Spill kits – ensure appropriate placement in relation to key operational/maintenance activities and that kits are fully stocked. • Integrity and correct capacity of bunding	no later than one week following identification.	

5.3. Performance Targets and Thresholds

Performance targets and thresholds have been established to inform when contingency management measures need to be actioned. Contingency measures are presented in Section 6 and typically involve investigation into the possible causes of the exceedance, then implementing appropriate corrective actions to eliminate or reduce re-occurrence.

Performance Targets are based upon instantaneous flow rates, the salinity/TDS within the raw bitterns discharge, meeting EQC concentrations on the LEP boundaries and meeting the predicted number of dilutions required. A Performance Threshold is defined based upon an exceedance of an EQS and identifies the point where the EQOs may not be met and the EVs are considered at risk from the ESSP operational activities. Where these are exceeded, compliance investigation and reporting are required as detailed below.

Performance Targets apply to all three stages of commissioning, validation and operations they are described once. However, the following summarises their application:

- PT1, PT2 and PT4 apply to commissioning monitoring
- PT1, PT2 and PT3 apply to the validation monitoring
- PT1, PT2, PT4 and the performance threshold will apply to routine MEQ monitoring.

Commissioning and validation performance targets were developed for assessing and managing performance, not compliance. Therefore, performance thresholds (related to EQS) do not apply during the commissioning and validation phase.

Performance Target 1

Performance Target 1 will be based upon the maximum instantaneous or averaged flow rate (daily or hourly) to be determined based upon final production design. Performance Target 1 will be triggered if the instantaneous or averaged flow rate is exceeded for three consecutive days, thus enacting contingency management as presented below.

Performance Target 2

Performance Target 2 is based upon back-calculated maximum salinity/TDS parameters in the bitterns assuming predicted dilutions are achieved to meet EQC concentrations at the LEP boundaries. The calculation applied is as follows:

$$PT2 = [(Dilution \times (EQC - Baseline)] + Baseline$$

Performance Target 2 will be triggered if salinity/TDS parameters exceed the maximum concentrations for three consecutive days, thus enacting contingency management as presented below.

Performance Target 3

Performance Target 3 is defined as an exceedance of an EQG based upon assessment against MEQ sampling results recorded from the LEPA/MEPA and MEPA/HEPA boundaries which is also higher than reference sites. MEQ data recorded from the designated monitoring locations are to be assessed against an EQG (see Table 8) and reference sites. Where these criteria are not met, contingency management as described in Section 6 will be required to be implemented.

Performance Target 4

Performance Target 4 is based on meeting the minimum number of dilutions defined by WET testing to achieve 90% and 99% species protection levels at the LEPA/MEPA and MEPA/HEPA boundary, respectively. Contingency management as presented in Section 6 is required where the minimum number of dilutions are not being achieved within defined LEP boundaries.

Performance Threshold

The Performance Threshold is defined as an exceedance of an EQS. MEQ samples and data collected from designated sampling locations are to be assessed against EQS as identified in Table 9. Where an exceedance of an EQS occurs, an investigation, contingency management and compliance reporting will be required.

6. Contingency Management

Where performance targets and thresholds are not being achieved at LEP boundaries, contingency actions will be required. Performance targets and thresholds have been designed which provide assurance around protecting EVs. Contingency management actions, such as alterations to the process or design, are implemented in response to not meeting performance targets and thresholds to reduce the potential for long-term issues. Contingency management measures typically involve investigation into the possible causes of the exceedance, then implementing appropriate corrective actions to eliminate or reduce re-occurrence.

6.1. Commissioning Phase

An overview of the contingency management framework for bitterns discharge during the commissioning phase is presented in Figure 12. Performance thresholds (related to EQS) do not apply during the commissioning phase.

If the performance targets are not achieved during the commissioning phase the management response may include, but is not necessarily limited to, the following actions:

- Investigate the cause of the exceedance or potential sources of exceeding physico-chemical parameters
- Undertake equipment inspection, maintenance and calibration as required
- If possible, review and adjust operational process to amend bitterns toxicity
- Increase the dilution ratio of bitterns water prior to discharge, and
- Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) where possible.
- Emergency shutdown (see Section 6.4)

An overview of the contingency management response is outlined below in Table 23. Management response actions are required to be implemented with seven days of notification of a performance target exceedance.

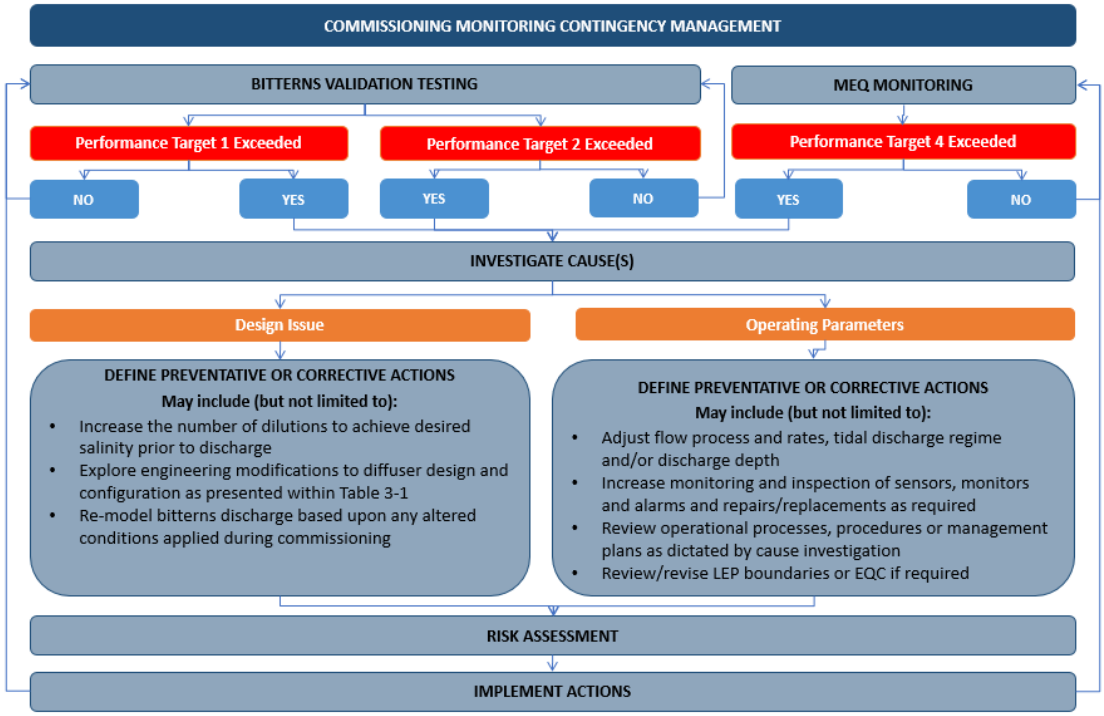

Figure 12 Contingency Management Framework for Bitterns Discharge Commissioning phase.

Table 23 Management proposed during commissioning phase of the ESSP.

Rationale	Approach	Timing / Frequency	Performance Target	Management Response	Reporting
Bitterns Discharge Monitoring	Measurement of outfall bitterns salinity and temperature prior to release together with measurement of discharge flow rate.	Continuous or minimum weekly	Physical properties and flow rates prior to release meet Performance Targets 1 & 2 (presented in Section 5.3)	If the performance target is not achieved, management response within 7 days will include, but should not necessarily be limited to: > Investigate the potential sources of higher than predicted salinity, temperature or flow rates > Review and adjust processing to reduce bitterns concentrations > Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration).	Water Quality Commissioning Report compiled within two months of the completion of the commissioning phase
Marine Environmental Quality Monitoring	Undertake MEQ monitoring as per Section 4.3.1	Monthly	Assess MEQ results against Performance Target 4 in Section 5.3	If the performance target(s) are not achieved, then the management response within 7 days will include, but should not necessarily be limited to: > Investigate the cause of exceedance	Water Quality Commissioning Report compiled within two months of the completion of the commissioning phase

Rationale	Approach	Timing / Frequency	Performance Target	Management Response	Reporting
				> Undertake inspection, maintenance and calibration as required > Review and adjust processing to reduce bitterns concentrations > Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) where possible.	

6.2. Validation Phase

Management during validation is focused on ensuring that predicted impacts are commensurate with actual impacts within the respective spatial LEPs, therefore protecting the associated EVs and EQOs. Performance thresholds (related to EQS) do not apply during the validation phase.

If the performance targets are not achieved during the validation phase, then the management response will include, but is not necessarily limited to, the following actions:

- Investigate the cause of the exceedance or potential sources of the exceedance
- Undertake equipment inspection, maintenance and calibration as required
- If possible, review and adjust operational process to amend bitterns toxicity
- Increase the dilution ratio of bitterns water prior to discharge
- Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) where possible.
- Emergency shutdown (see Section 6.4)

An overview of the contingency management response is outlined below in Table 24. Management response actions are required to be implemented with seven days of notification of a performance target exceedance.

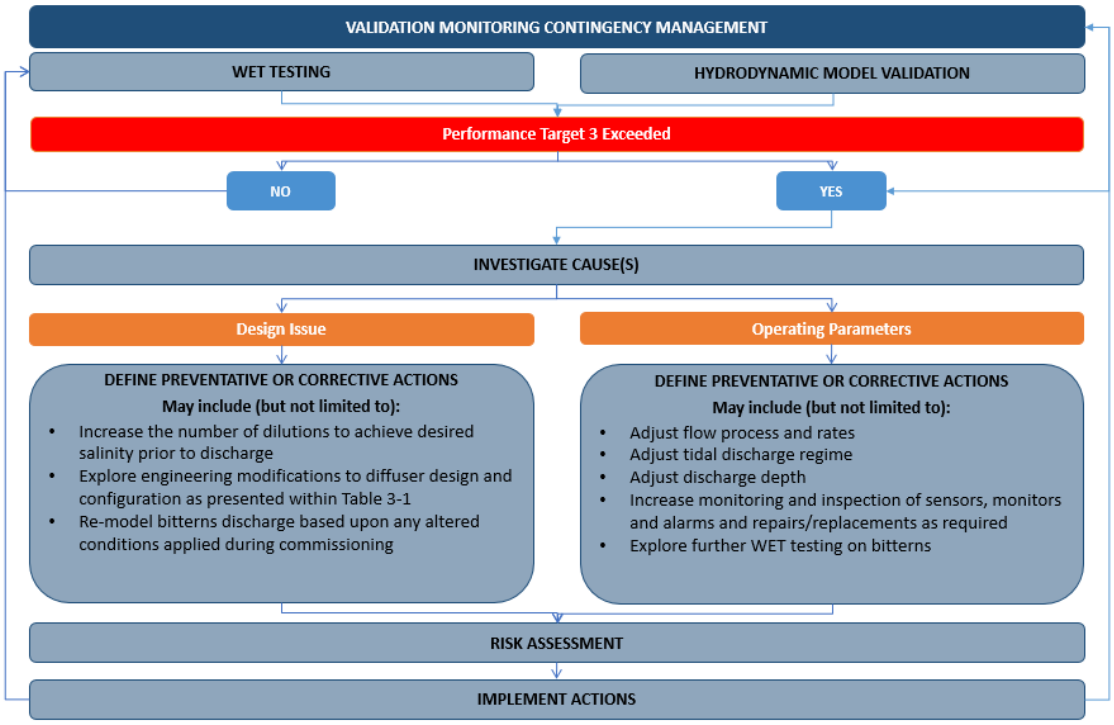

Figure 13 Contingency Management Framework for Validation monitoring.

Table 24 Management proposed for the validation phase of the ESSP.

Rationale	Approach	Timing / Frequency	Performance Target	Management Response	Reporting
Whole of effluent toxicity (WET) testing	Undertake WET testing to confirm toxicity of raw bitterns and calculate dilution factors for species protection.	Following processing plant completion, as soon as bitterns sample is available. AND Whenever composition of bitterns has been permanently changed.	Minimum level of dilution as defined by WET testing to achieve a 90% and 99% SPL at the LEPA/MEPA and MEPA/HEPA boundary (refer to Performance Target 4 in Section 5.3)	If the performance target is not achieved, then the management response within 7 days will include, but should not necessarily be limited to: > Investigate the potential sources of higher than predicted toxicity (i.e., chemicals) > If possible, review and adjust processing to reduce bitterns toxicity > Increase the dilution ratio of bitterns water prior to discharge Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) where possible.	WET testing results will be included and discussed in the commissioning assessment report, which will be completed within two months following completion of commissioning.
Bitterns dispersion modelling validation	Dye tracer study with measurements of flow rate, drogues tracking, fluorometer & physico-chemical profiles radiating outwards from the	Program should be implemented during commissioning and will include: > Measurements at a location prior to	<u>Prior to Release</u> > Bitterns physical properties and flow rates to be advised based on plant engineering specification (refer to	If the performance target(s) are not achieved, then the management response within 7 days will include, but should not necessarily be limited to:	Monitoring results will be included and discussed in the commissioning assessment report, which will be completed within two months following

Rationale	Approach	Timing / Frequency	Performance Target	Management Response	Reporting
	outfall and multispectral drone imagery. AND Measurement of flow rate and physico-chemical parameters (including salinity and temperature) of bitterns water prior to release AND Water column profiles measuring salinity, temperature and depth radiating outwards from the outfall.	release daily for 12-months > Water column profiles are required to be taken monthly over the 12-month validation period.	Performance Targets 1 & 2 in Section 5.3) LEPA/MEPA Boundary > Physico chemical parameters meet EQG criteria defined in Table 8.	> Investigate the cause of exceedance > Undertake equipment inspection, maintenance and calibration as required > Adjust dilution ratio of bitterns water prior to discharge > Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) where possible.	completion of commissioning.

6.3. Operational Phase

If an ESSP operational related activity contributes to an exceedance of the defined performance targets, a tiered risk-based investigative process will be required as defined in Figure 14. The management contingency processes are outlined in Table 25. There are several potential operational and design solutions which may be used as contingency measures in response to performance target exceedances, examples of these operational and design modifications are summarised in Figure 16.

Once the cause(s) is determined then appropriate corrective or preventative actions need to be put into place to ensure re-occurrence does not occur. This investigation process, and the implementation of remedial actions are required to be implemented within three days of notification of a performance target exceedance to ensure that optimal environmental performance continues through the lifecycle of the ESSP. In the event of an EQS exceedance, the CEO of Department of Water and Environmental Regulation (DWER) will be notified and a report provided to the CEO within three months describing any subsequent investigations, implemented management actions, and an assessment of the success of these actions in returning MEQ to acceptable levels.

Figure 14 presents the relationship between EQG exceedances and EQS reactive sampling programs which are required to be implemented. Reactive sampling programs are required to determine the extent and severity of any impacts and provide an assessment of whether the EQOs are compromised and if the EVs are at risk.

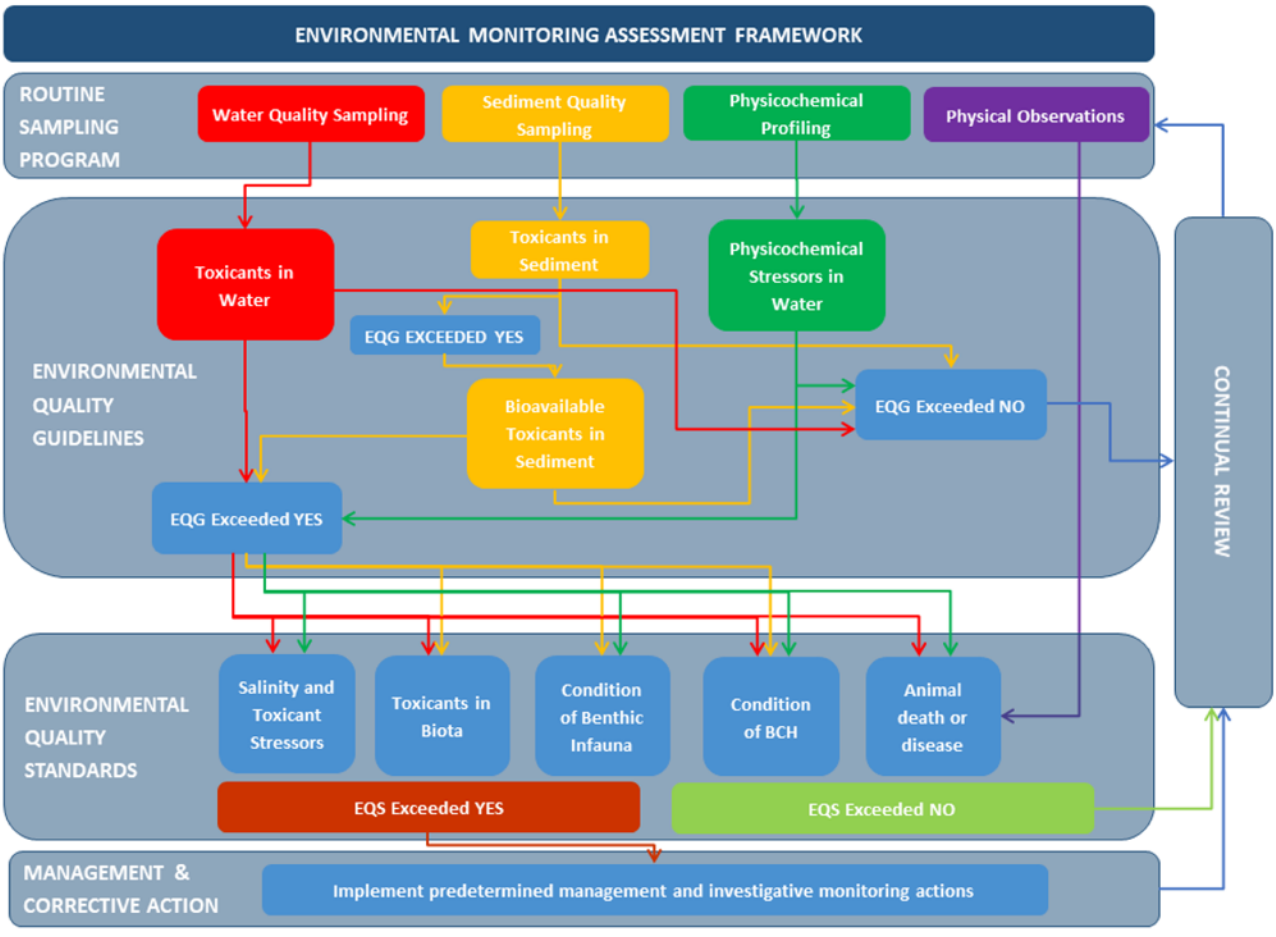

Figure 14 Operational MEQ Monitoring and Assessment Framework

Table 25 Management proposed during the operational phase of the ESSP.

Pressure (Indicator)	Monitoring Program		Performance Target (EQG)	Trigger Exceedance Response	Performance Threshold (EQS)	Threshold Exceedance Response	Reporting
	Approach	**Timing/ Frequency**					
Physical constituents in water Toxicants in Water	<u>Ongoing Bitterns Discharge Monitoring</u>						
	Measurement of bitterns salinity and temperature prior to release together with measurement of bitterns and dilution flow rates.	Continuous or minimum weekly	Physical properties and flow rates prior to release meet Performance Targets 1 & 2 presented in Section 5.3	In the event of <u>EQG exceedance</u>, management response may include, but should not necessarily be limited to: Investigate the cause of exceedance within 24 hours. > Undertake asset performance monitoring, maintenance and calibration as required > Adjust dilution ratio of bitterns prior to discharge, and > Adjust discharge regime (e.g., timing, flow rate, volume,	Performance Threshold is based on final EQS (Section 5.3)	In the event of <u>EQS exceedance</u>, management responses within 3 days will include, but not be limited to: Investigate the cause of exceedance. > Review and adjust operational process to reduce bitterns toxicity > Increase the dilution ratio of bitterns water prior to discharge, and	Routine > Monitoring results to be included in routine operational reports – monthly. > Operational reports to be included with annual compliance report Investigative > An EQG investigation report will be prepared and submitted one month following

Pressure (Indicator)	Monitoring Program		Performance Target (EQG)	Trigger Exceedance Response	Performance Threshold (EQS)	Threshold Exceedance Response	Reporting
	Approach	**Timing/ Frequency**					
				diffuser configuration) where possible.		> Slow down or stop discharge operations.	EQG exceedance. > DWER CEO will be notified within 24 hours of confirmation of an EQS exceedance. > An EQS exceedance investigation report will be prepared and submitted to the regulator one month following a recorded exceedance.
	<u>Ongoing Marine Environmental Quality Monitoring</u>						
	Undertake MEQ monitoring as	As per frequency outlined in Table 18.	Assess MEQ results against	In the event of <u>EQG exceedance</u>, conduct and investigation to the	Performance Threshold is based on final	In the event of <u>EQS exceedance</u>, undertake investigative	Routine > Quarterly summary

Pressure (Indicator)	Monitoring Program		Performance Target (EQG)	Trigger Exceedance Response	Performance Threshold (EQS)	Threshold Exceedance Response	Reporting
	Approach	**Timing/ Frequency**					
	per Section 4.5.3		Performance Target 3 in Section 5.3	likely cause within 24 hours. Re-sample MEQ sites within 1 week if source of exceedance not identified.	EQS (Section 5.3).	monitoring program (benthic infauna and BCH – refer Section 4.5.4 within 4 weeks of confirmed EQG exceedance from reactive monitoring program	reports will be provided one month following receipt of laboratory results. Investigative > An EQG investigation report will be prepared and submitted one month following EQG exceedance. > DWER CEO will be notified within 24 hours of confirmation of an EQS exceedance. > AN EQS exceedance investigation report will be

Pressure (Indicator)	Monitoring Program		Performance Target (EQG)	Trigger Exceedance Response	Performance Threshold (EQS)	Threshold Exceedance Response	Reporting
	Approach	Timing/ Frequency					
							prepared and submitted to the regulator one month following a recorded exceedance.
Toxicants in Sediments	Routine Collection of sediment samples from all sites presented in Figure 10 to monitor impacts from bitterns discharge and port operations. Raw metals results are compared to the EQGs	Sediment samples collected annually for three years following commissioning and then five yearly thereafter.	Routine Performance Target 3 (Section 5.3) requires pooled raw metals and normalized hydrocarbon data to be compared against the EQGs which are the ANZG (2018) default guideline values. Reactive Performance Target 3 (Section 5.3) requires elutriate and bioavailability data to be	In the event of EQG exceedance, management response may include, but should not necessarily be limited to: Investigative Monitoring Conduct investigative monitoring for benthic infauna within 4 weeks of confirmed EQG exceedance from reactive monitoring program Product Handling Operations	Performance Threshold is based on final EQS (Section 5.3). Investigative monitoring data collected is to be compared against EQS.	In the event of EQS exceedance, management responses will include, but not be limited to: > Investigate the cause of exceedance > Review product handling parameters (weather, load rates, dust suppression, product moisture etc)	Routine/Reactive - EQG > Annual or five yearly sampling summary report to be completed within three months of field sampling activities, Investigative > An EQG investigation report will be prepared and submitted one month following

Pressure (Indicator)	Monitoring Program		Performance Target (EQG)	Trigger Exceedance Response	Performance Threshold (EQS)	Threshold Exceedance Response	Reporting
	Approach	**Timing/ Frequency**					
	<u>Reactive</u> EQG exceedance triggers elutriate and bioavailability testing. These results are compared against the EQGs.		compared against the EQGs which are the ANZG (2018) default guideline values.	> Conduct operational audit to ensure compliance with document processes > Conduct facility inspection, and > Review product handling parameters (weather, load rates, dust suppression, product moisture etc).		> Conduct operational audit to ensure compliance with document processes, and > Conduct facility inspection.	EQG exceedance. > DWER CEO will be notified within 24 hours of confirmation of an EQS exceedance. > AN EQS exceedance investigation report will be prepared and submitted to the regulator one month following a recorded exceedance.

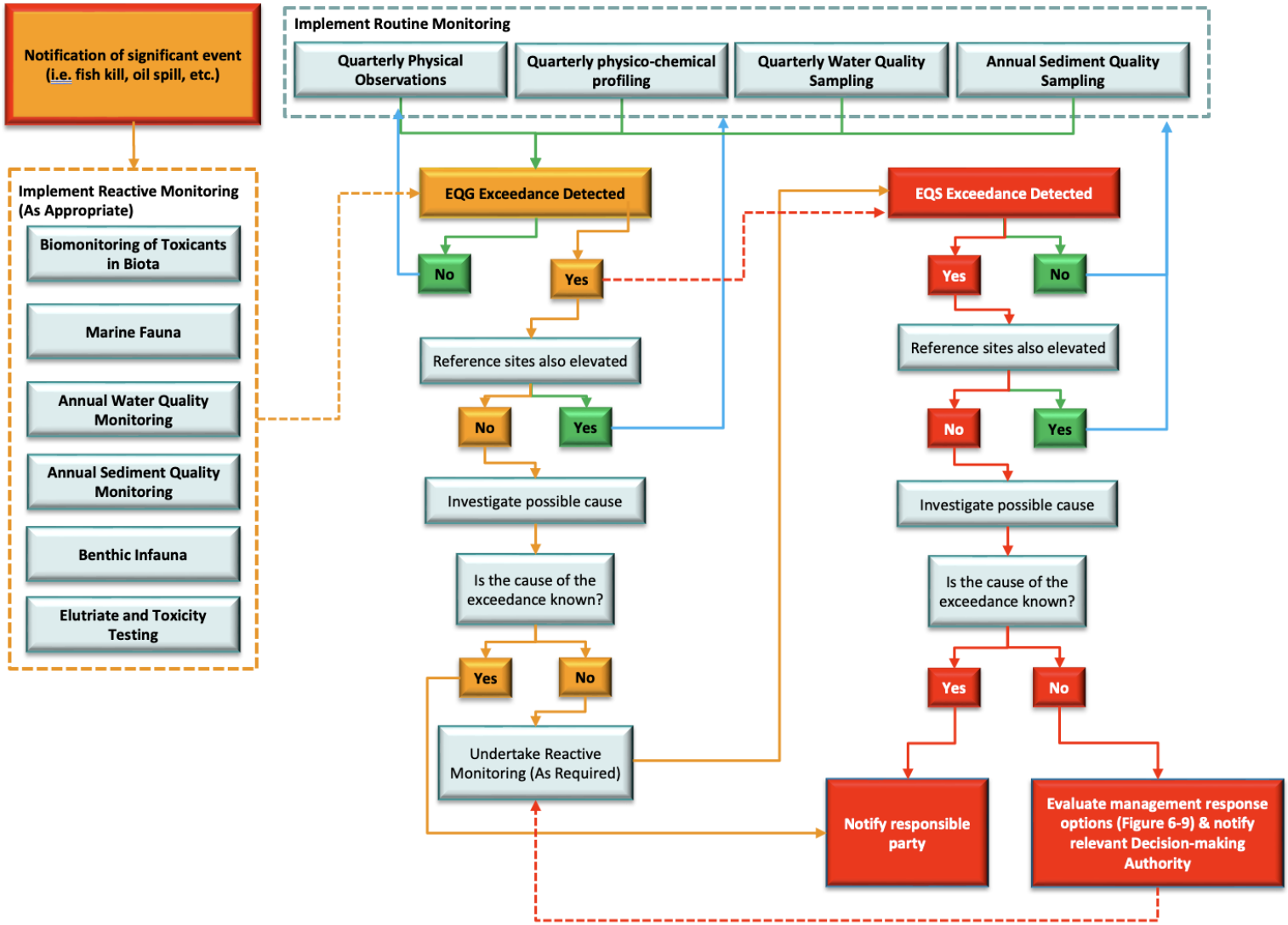

Figure 15 Management Response Framework from the Ongoing Marine Environmental Monitoring Program.

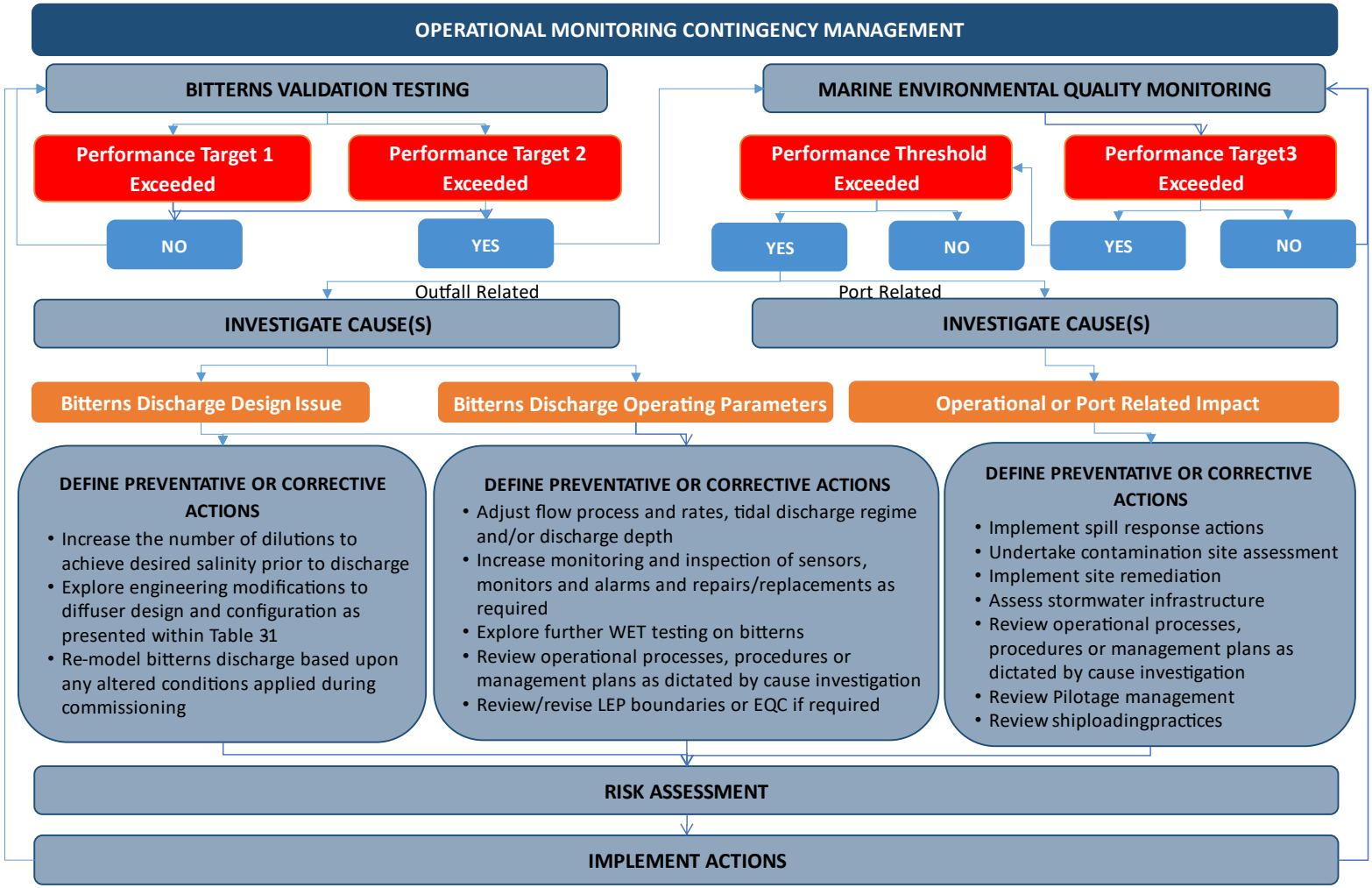

Figure 16 Contingency Actions for the Bitterns Marine Environmental Quality Monitoring Program.

6.4. Emergency Shutdown Procedure

The bitterns discharge pipeline and the seawater intake will be engineered and designed to be able to shut down immediately (or as soon as operationally possible) in the event of an emergency. A detailed 'Emergency Shutdown Procedure' specific to the ESSP intake and bitterns diffuser operations will be developed following the final design and specifications of this infrastructure are known, but prior to operation commencement. Reasons why emergency shutdown may be required are:

- Shut all operations for personnel safety reasons
- Avoid the intake of a hydrocarbon spill/algal bloom from the marine environment into pond infrastructure
- Avoid the release of hydrocarbons or chemicals that may inadvertently enter the pond infrastructure or processing plant release pipes
- When all contingency measures have been ineffective at maintaining bitterns water to acceptable levels relevant to EQC (i.e., physico-chemical and toxicant parameters)
- To protect equipment from damage during operational malfunction.

7. Review

This MEQMMP is a living document and will be regularly reviewed in accordance with Table 26 to ensure it remains relevant to the ESSP and aligns with industry best practice.

Table 26 MEQMMP Review Timeframes for the ESSP.

Timing	Rationale
Scheduled Review	
Upon receipt of Approval Conditions	The Ministerial Statement approval conditions obtained will necessitate a comprehensive review of this MEQMMP to ensure all relevant aspects are covered within this Plan to ensure compliance.
Upon completion of Pre-commissioning Baseline Data Monitoring Program	This review is required to derive the site specific EQCs for the ongoing assessment of ESSP impacts, along with any other findings that require update upon completion of the baseline data collection phase.
Upon Completion of Commissioning	This will typically be required to update management triggers associated with the discharge design for the bitterns.
Upon Completion of Validation assessment	A comprehensive review of the LEPs and EQC will be required based upon data obtained during this phase. A comprehensive review of the entire MEQMMP will be required to ensure adequacy for management of the ongoing MEQ with respect to the final operational processing facility.
Annually during routine operations	At the completion of annual reporting requirements any recommendations for alteration of the MEQMMP will need to be incorporated into a revised version suitable for the next 12 months of operations.
Ad-Hoc Review	
Any time operational activities significantly alter	Operational changes to the project may result in an altered risk profile. Therefore, the MEQMMP will require a review to ensure that it remains fit-for-purpose for altered operational conditions.
Any time Bitterns discharge quality or regime alters	Process or design alterations changes to the bitterns discharge may result in an altered risk profile. Therefore, the MEQMMP will require a review to ensure that it remains fit-for-purpose for altered operational conditions.

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Appendix A. Existing Environment

The following description of the existing environment is based on a desktop review of historical information, and baseline environmental investigations conducted between 2020 and 2022 as part of the environmental impact assessment process for the ESSP.

Coastal Setting

The Pilbara coast is noted to be a region of extremes, an arid environment where sediment is delivered periodically to the coast through networks of rivers and streams and where significant events such as tropical cyclones bring episodic flooding and inundation impacts that drive geomorphic changes along its coastal landforms. Semeniuk (1993) describes the dominant drivers for coastal processes and ecology within the study area as typically wave dominated, with a lesser dominant driver associated with meso-tides experienced in the region with a range exceeding 3.5 m.

The coastal area of the Pilbara is composed of an ancient hard-rock terrain over which the deposition of sediment from sources including coral reefs, flood plains and river deltas has occurred for 2 million years. The shoreline at the Proposal site is generally northwest facing with the inter-tidal region generally described as quaternary mudflat deposits, clay, salt and sand (Elliot et al 2013).

A series of major tidal creeks lined by mangroves and salt marsh extend from the shoreline through the intertidal area, with branches that convey tidal flows across the tidal flats. Beyond the mangrove areas, large areas of clay pan and expansive tidal flat areas. During neap tides, the high tide water level is generally contained within the creeks through the intertidal areas and there is little to no inundation of the tidal flats. During spring tides, a large proportion of the intertidal area becomes inundated, whereby tidal water can remain on the surface for days after.

Climate and Wind

The Pilbara is an arid region with pronounced wet and dry seasons, influenced by the Indonesian-Australian monsoon and the meridional migration of the equatorial and subtropical pressure belts. The wet season (November-April) is characterised by high temperatures, higher than average rainfall, and lower atmospheric pressures (over the land). The dry season (May to October) is characterised by warm temperatures, clear skies, limited thunderstorm activity, very low rainfall, and higher atmospheric pressures. Over 1991-2020 the maximum daily temperatures at Mardie (closest available station with historic statistics) averaged 34.0 °C, with the monthly average peaking at 37.9 °C in January and falling to 28.3 °C in July (Figure A-1).

During the southeast monsoon (approximately the dry season), winds are predominantly easterly to southerly, coincident with the trade winds (Figure A-2). During the northwest monsoon (approximately the wet season) winds are predominantly west to south-westerly (Figure A-2). These seasonal trends are modulated year-round by a diurnal land-sea breeze system, which intensifies in the wet season.

The region is exposed to tropical storms and cyclones during the wet season. The Karratha to Onslow coastline is the most-cyclone prone section of the Australian coast, with one cyclone making landfall every two years on average. Cyclones affecting the Pilbara typically form in the tropical waters between the Kimberley and the

Timor Sea and intensify as they propagate westward and poleward, though tracks of significant cyclones impacting Cape Preston within the last 30 years are varied Figure A-3. In addition to tropical storms, troughs of low pressure also bring rain, strong winds, and sharp changes in wind direction.

The annual average rainfall is only 315 mm, though this value can be exceeded in a single day during an extreme tropical storm. The mean monthly rainfall (top section in Figure A-1) has a bimodal distribution with one peak in February and a second peak in June. Tropical storms dominate this first peak, while frontal systems from the south can contribute to the rainfall in the middle of the year. Very little rain falls between August and October (Figure A-1). The maximum daily rainfall per month is displayed in the middle graph of Figure A-1, while the monthly mean maximum daily temperature (red) and monthly mean minimum daily temperature (blue) are shown in the bottom graph.

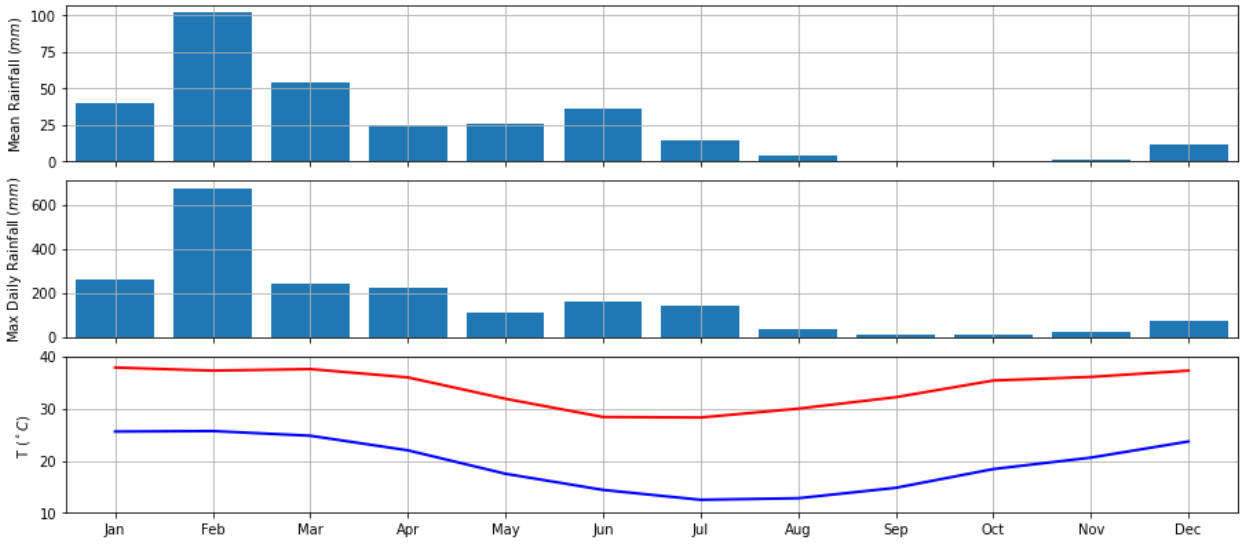

Figure A-1 Climate Statistics for BOM Mardie weather station over ten years of 1991 to 2020 (BOM 2025).

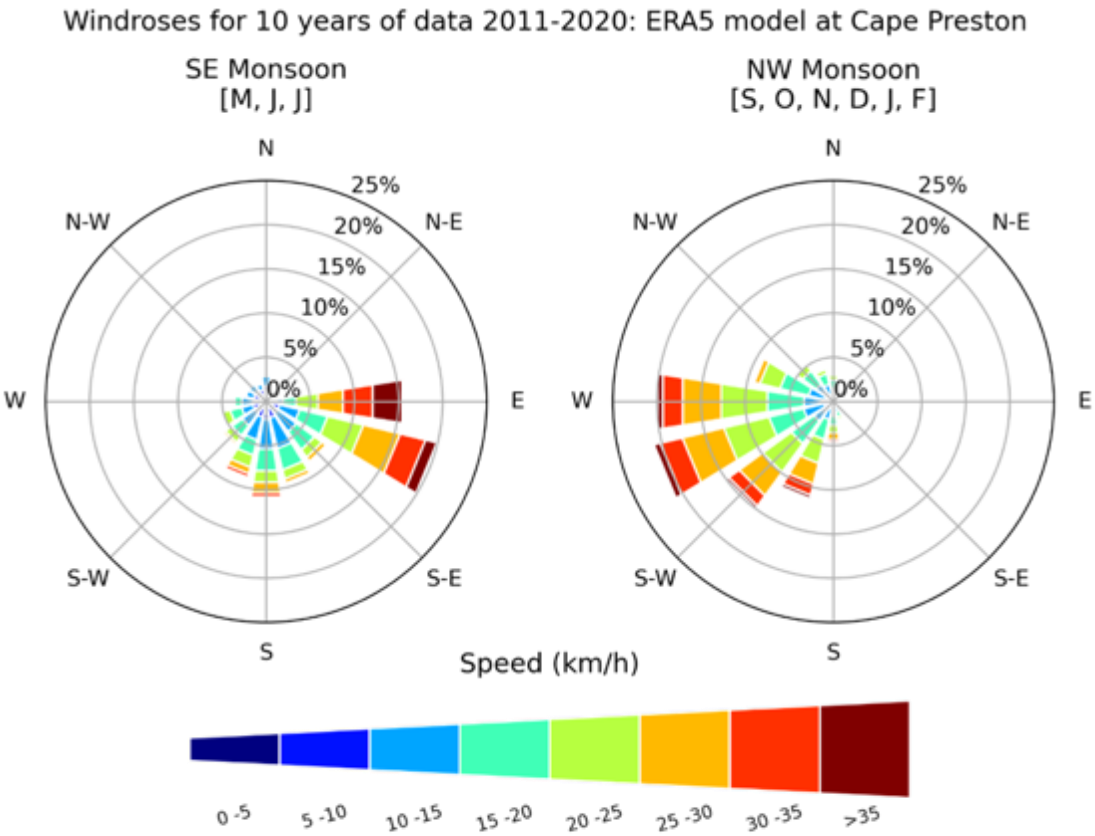

Figure A-2 Wind Rose plots for SE Monsoon (left) and NW Monsoon Months (right) based on analysis of the 10 years of modelled data from near Cape Preston.

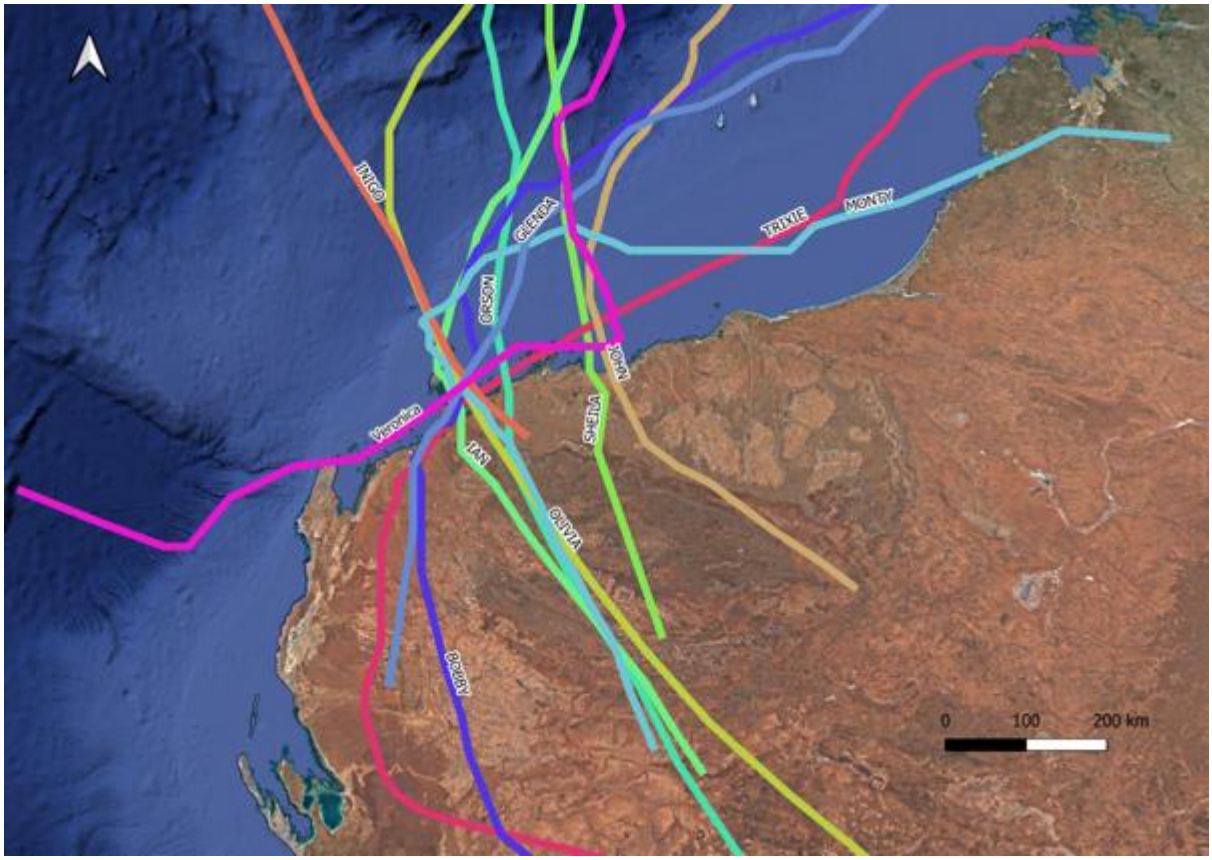

Figure A-3 Tracks of notable cyclones impacting Cape Preston from the last 30 years.

Drivers of climate variability

Over short timescales (i.e., decades), the main driver of interannual climate variability in Northern Australia and the Pilbara region is the El Nino Southern Oscillation (ENSO). The positive phase of ENSO, known as La Nina, is characterised by a strengthening of the trade winds over the tropical Pacific (Figure A-4). This intensification drives more warm water over the western Pacific, leading to less stable atmospheric conditions and increased rainfall over northern and eastern Australia, warmer than average conditions over the Cape York Peninsula, and cooler than average conditions over southern Australia. The negative phase, El Nino, has approximately opposite effects. Compared to the Pacific coast, the effects of ENSO over the Pilbara coast are less dramatic, and often less consistent, though La Nina years are linked to an increase in both the number and intensity of tropical cyclones in the Pilbara, despite distance from the direct effects of the Pacific Ocean trade winds.

The Indian Ocean Dipole (IOD) is another empirically defined oscillation which impacts interannual climate in the Indian ocean, modulating the effects of ENSO. A negative IOD reflects an intensification of the standard atmospheric circulation in the upper Indian ocean. This is associated with warmer ocean temperatures and increased atmospheric instability over northern Australia, reinforcing La Nina conditions. Conversely, a positive IOD reflects a weakening or disruption to this circulation, associated with more stable atmospheric conditions over northern Australia, reinforcing the effects of El Nino.

The contemporary warming trend in the ocean and atmosphere (global warming) are another source of long-term climate variability, though significant effects are generally measured (and predicted) over timescales larger than the life of many engineering projects.

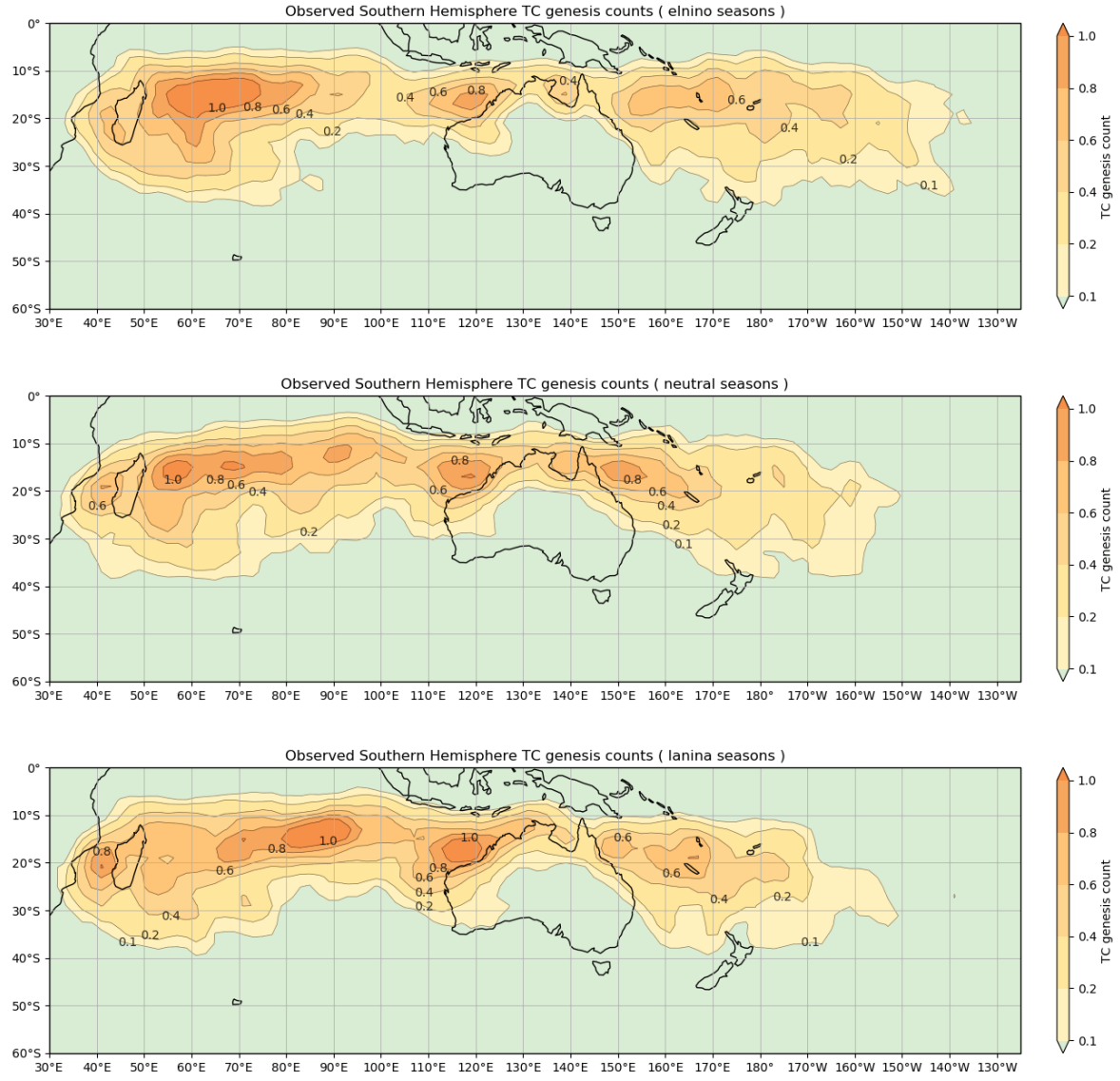

Figure A-4 Tropical Cyclone genesis for El Nino (top), Neutral (middle) and La Nina (bottom) seasons (source: BOM 2022)

Temporal context of the present observations

The ENSO and IOD states for the recent period are shown in Figure A-5 and Figure A-6 respectively, with respect to longer term records of the indices. The 2020-2021 wet season was characterised by mild La Nina conditions and a neutral IOD, while the 2021 dry season was characterised by neutral ENSO conditions and a mild negative IOD. The Southern Oscillation Index (SOI) is one indicator of the state of the El Nino Southern Oscillation, with large positive conditions (blue region) indicating La Nina conditions, large negative values (red region) indicating El Nino conditions (Figure A-6).

Despite the presence of La Nina, cyclone impacts in the Pilbara region were very mild during the 2020-2021 cyclone season. The only storms reaching cyclone classification were TC Marian (21 February – 9 March 2021), and the interacting systems Seroja (3 – 12 April 2021) and Odette (3 – 10 April 2021), though each of these reached full intensity far to the west of Cape Preston. In addition to these extreme events there were numerous other weaker tropical storms in the region (e.g., TL02U 6 – 12 December 2000; TL08U 15 – 23 January 2001, and TL12U 28 January – 5 February 2001).

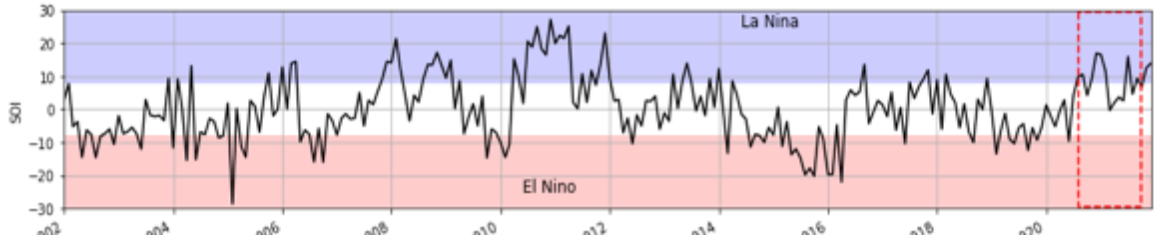

Figure A-5 Monthly Southern Oscillation Index (SOI) from 2002 to 2021.

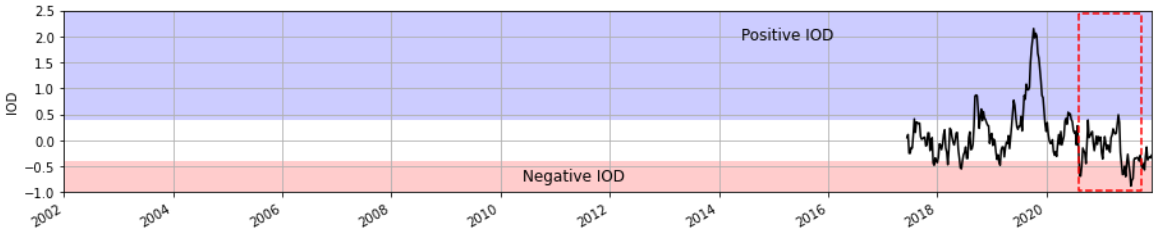

Figure A-6 Monthly Indian Ocean Dipole Index from (IOD) 2017 to 2021.

Geomorphology

The Pilbara has a very broad continental shelf, ranging from around 100 km at the western extent to 300 km in the east. To the west (i.e., offshore from Barrow Island) the shelf breaks gradually onto the Exmouth Plateau, while in the east (i.e., offshore from the Rowley Shoals), the shelf breaks much more rapidly into deeper waters. Barrow Island, the Montebello Islands, and the shoals to the south of Barrow are significant features of the inner shelf that influence waves, tidal currents, and wind driven circulation in the region. Between North-West Cape and the Dampier Archipelago, many smaller islands lie inside the 30 m depth contour, providing further shelter for the coastline. These islands introduce heterogeneity in the ambient hydrodynamic conditions along the coast, which in turn promotes heterogeneity in the marine habitat.

Regnard Bay is bound by Cape Preston to the West and the Dampier Archipelago to the East. Offshore, the bay is bound by a series of islands (e.g., Southwest Regnard, Northeast Regnard and Eaglehawk Islands), the line of which mark a step change in bathymetry from the relatively shallow bay to the deeper waters offshore. Cape Preston has been extended and fortified by the construction of the Cape Preston marine offloading facility. The consequences for sediment fluxes into the bay are unknown.

Lebrec et al. (2021) characterise the seabed between the Regnard Islands and the 20 m isobath as a submerged sandplain. The authors do not characterise the bay itself, though the satellite derived bathymetry product of Lebrec et al. (2021) indicates several distinct systems of ridges within the bay. The region behind (i.e., to the

south of) Southwest Regnard Island is particularly shallow, which is expected to introduce complex friction controlled tidal flows through the channel to the west.

The mainland Pilbara coastline is characterised by extensive beaches, mud flats, mangroves, and tidal creeks seaward of an ancient hard-rock terrain. Marine sediments are delivered and deposited through the action of wave and tides, while terrigenous sediments are delivered to the coast episodically through flood plains and river deltas - the largest river within Regnard Bay being the Maitland River to the East of the proposed site. Island coastlines are predominantly rocky marine sediments. A beach coastline stretches east from Cape Preston through to an intertidal sandbar connecting Great Sandy Island. Behind this sand bar, the shoreline consists of tidal creeks, mangrove habitat and extensive algal mats. Cyclones, and the associated extreme high-water levels, waves, and freshwater discharge are likely to be a significant driver of coastal geomorphic changes in the region (Elliot et al 2013).

Water levels

Water levels along the Pilbara coast are dominated by the semidiurnal lunisolar tides, with the eastern Pilbara classified as macro-tidal, and the western Pilbara as meso-tidal (Table A-1). At the ESSP site the mean spring tide range exceeds 3 m, and the maximum tide range is approximately 4.5 m. The presence of Barrow Island and the shallow waters to the south strongly affect the westward propagation of semidiurnal and diurnal tidal energy, introducing complex non-linear tidal flows to the west of Barrow Island.

Wind, pressure and wave-setup in the Pilbara are typically low in comparison to the tidal variability, though they can be significant under tropical cyclone forcing, particularly in partially closed water bodies (i.e., marine embayment). Appreciable inundation of coastal areas occurs under these conditions, and wave action can be highly destructive. No long-term records of water levels exist within Regnard Bay to estimate peak storm water levels.

Table A-1 Tidal Planes at Dampier, Barrow Island, Onslow and Cape Preston [datum mean sea level].

Water level	Onslow [m]	Dampier [m]	Cape Preston [m]	Barrow Island West [m]	Barrow Island East [m]
HAT	1.29	2.46	2.25	1.30	2.20
MHWS	0.85	1.76	1.71	0.89	1.50
MHWN	0.26	0.46	0.38	0.26	0.41
MSL	0	0	0	0	0
MLWN	-0.25	-0.46	-0.38	-0.25	-0.40
MLWS	-0.84	-1.48	-1.45	-0.94	-1.33
LAT	-1.29	-2.66	-2.19	-1.32	-2.21

Ocean Currents

Instantaneous currents on the inner shelf are dominated by barotropic tides, with wind-driven currents, steric currents and continental shelf waves playing a lesser role (Godfrey and Mansbridge, 2000; Condie and Andrewartha, 2008; Ridgway and Godfrey, 2015; Sun and Branson, 2018). Persistent large-scale currents (e.g., the Holloway current) are typically constrained to water depths greater than 100 m. Sub-tidal circulation is seasonally variable, and driven predominantly by winds (Condie and Andrewartha, 2008). During the wet season these low-frequency wind-driven currents typically flow towards the east, while in the dry season they typically flow towards the west.

Waves

Waves on the Pilbara shelf can be broadly classified into three primary generation mechanisms: Southern Indian Ocean swell, locally generated wind-waves, and tropical cyclone waves. Indian ocean swells lose appreciable energy as they refract around Northwest Cape and onto the Northward facing Pilbara coastline. Though consistently mild, this swell climate is stronger in the dry season owing to stronger Indian Ocean swells in the winter months. Non-cyclonic waves are thus dominated by high-frequency wind waves. These seas vary appreciably in magnitude, period, and direction along the Pilbara coastal waters, but typically have a north-westerly aspect in the wet-season, and a north-easterly aspect in the dry season (O2 Marine 2023). The largest waves are associated with cyclone forcing, and again vary greatly across the coast, influenced by the proximity, intensity, and travel speed of the cyclone.

Little is known of the wave climate within Regnard Bay itself, though it is expected that the Cape, Archipelago and Regnard Islands would provide some natural protection from waves propagating onshore. Shoaling and dissipation of waves will vary appreciably as a function of the tide. The impact of cyclonic waves on the study site will be dependent on the storm-enhanced water level.

Water Quality

A baseline marine water quality monitoring program was implemented in coastal waters adjacent to the proposed ESSP development between July 2020 and October 2021. Two *in-situ* monitoring stations (NCP05 and UNS05), shown in Figure A-7, recorded physico-chemical data (temperature, salinity, dissolved oxygen, pH, turbidity and light). Twelve marine water sampling events were implemented during the monitoring period, to test for a range of analytes and potential toxicants. The following key observations were made:

- Inshore monitoring sites showed diurnal temperature variation and appeared to be affected by ambient air temperature/solar radiation. Temperature declines at both sites of 3-4 °C in the space of a few days was associated with the timing of low-pressure systems passing through the area. Mean water temperature in nearshore areas was ~24°C during the dry season and ~29°C during the wet season.
- Salinity levels were comparable to previous studies from nearshore Pilbara waters. Higher salinity was recorded at UNS05 than NCP05 between September and December 2020, which may indicate that evaporative inshore waters have greater exchange with UNS05, while NCP05 is more influenced by offshore waters.

- Salinity at both sites appeared to be reduced by a series of low-pressure systems that caused significant rainfall across the area between December 2020 and March 2021.
- High turbidity events that lasted several days were generally associated with intense weather systems that caused high wind and wave conditions and rainfall.
- Higher turbidity (and TSS) levels at the creek (SIC02) and near shore monitoring stations (NCP05 and UNS05) were recorded in comparison to the offshore location (OCP20). This is likely related to tidal influences across mudflats continuously introducing fine silts to these nearshore areas. For this same reason, nutrient concentrations, in general, were found to be in higher concentrations at nearshore sampling sites when compared to OCP20, a result of proximity to nutrient sources such as decomposing vegetation and fauna matter and freshwater runoff.
- The WAMSI (Jones et al. 2019) DLI thresholds for possible and probable effects on coral were found to be unsuitable as criteria for monitoring dredging effects in the nearshore areas adjacent to Cape Preston, with natural baseline conditions exceeding the possible effects thresholds for corals on three occasions. It is noted that Jones et al. (2019) recognises these potential limitations of the thresholds and advises that WAMSI is in the process of developing thresholds for turbid water coral communities. Once these new turbid water thresholds are available, they should be evaluated against the baseline data collected in this program.
- Comprehensive sampling of marine waters at four locations at monthly intervals over the monitoring period has established a database of 70 analytes including metals/metalloids, nutrients, hydrocarbons and other analytes at background levels for the waters adjacent to the project. This provides valuable baseline data to inform modelling, planning and aid the identification of potentially harmful levels of toxicants.
- No significant temporal patterns were identified from the laboratory analysis. There were two sampling events where multiple analytes recorded minimum concentrations (24/3/2021) and maximum concentrations (28/9/2020), however, no natural events (rainfall/tide/swell) were observed during these times that would have influenced these results
- Laboratory analysis of marine water samples showed minimal evidence of contamination and the current allocation of maximum and high levels of ecological protection are appropriate for the marine waters at Eramurra.

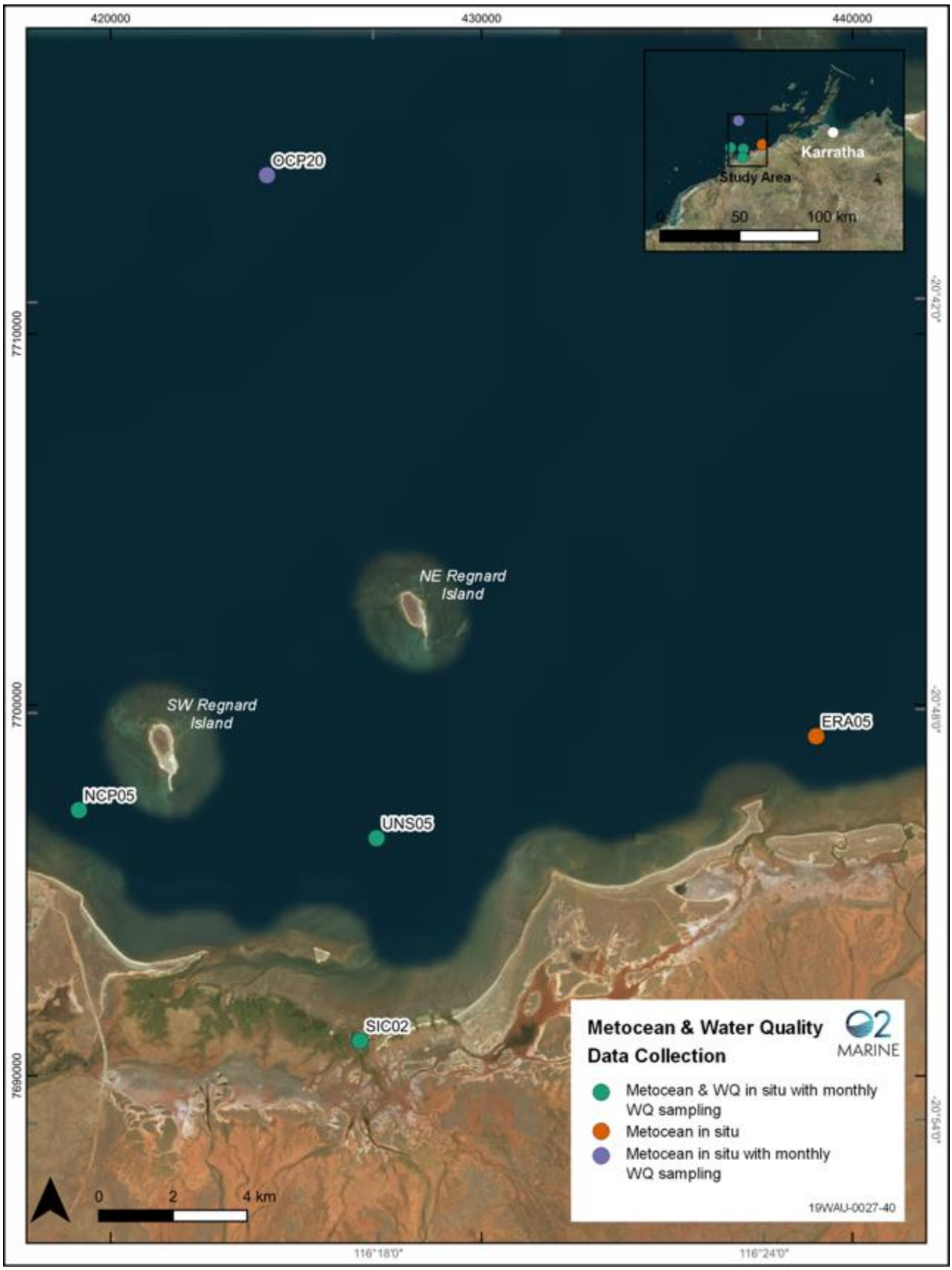

Figure A-7 Baseline water quality monitoring locations from July 2020 to October 2021.

Sediment Quality

Sediment sampling within and adjacent to the proposed dredge channel was undertaken in November 2020. Samples were collected using push corers at seventeen (17) locations, and with a vibrocorer at six (6) locations. Samples were analysed for particle size distribution, total organic carbon, metals, total petroleum hydrocarbon, polyaromatic hydrocarbon, organotins, potential acid sulfate soils and benthic infauna by a NATA accredited laboratory. The contaminant results were compared against recommended screening levels in the National Assessment Guidelines for Dredging (NAGD 2009), Australian and New Zealand Environment and Conservation Council Guidelines (ANZG 2018) and Assessment levels for Soil, Sediment and Water (DEC 2010). Tests for potential acid sulfate soils were compared against the action criteria in Department of Water and Environmental Regulation (DER 2015).

Whilst using the vibrocorer, all but two sites (V7 and V8) encountered refusal 0.5m, therefore only the top layer of sediment was collected. V7 and V8 recorded tow horizons (0.5 and 1m) before refusal.

The proposed dredge area was dominated by sand fractions (62 – 2000 µm). All samples reported metal concentrations below the available ANZG (2018) guideline values and the NAGD (2009) screening levels. All hydrocarbons and organic compounds were below the laboratory Limit of Reporting.

The screening acid sulfate test did not detect the presence of Potential Acid Sulfate Soils (PASS).

Sediment results were found to be comparable to that identified in “Background quality of the marine sediments of the Pilbara coast” (DEC 2006).

Benthic infauna results recorded a total of 267 individuals from 14 morphological species across six samples. The three most common taxa across all sites were *Polychaeta, Cirratulidae*, *Ostracoda* and *Tanaidacea Pseudozeuxoidae*. The distribution and abundance of benthic infauna taxa were found to be heterogeneous, and there was no observable difference in species richness, diversity or composition identified across sites.

Both field and laboratory Quality Assurance/ Quality Control (QA/QC) procedures produced results that indicate reliable and accurate results.

Based on these results, all sediment samples indicate they were acceptable for offshore or onshore disposal, and do not pose a safety or environmental risk. Due to restrictions on sampling depth, a definitive conclusion of the presence of PASS to full dredge depth could not be determined from this study.

Sediment sampling within the proposed offshore dredge spoil disposal ground was undertaken in March 2023. Five samples were analysed for standard metals, PAH, TRH, BTEXN, Organotin, PSD, TOC and moisture. All hydrocarbons and organic compounds were below the laboratory Limit of Reporting, with metal concentrations each below the ANZG (2018) guideline values and comparable to the DEC (2006) background values for the Pilbara region. PSD results for all samples recorded medium to coarse grained sand. In summary the proposed offshore dredge spoil ground was found to be uncontaminated and comparable to the natural Pilbara sediments as identified in DEC (2006). Figure A-10 identifies the sediment sampling locations collected between November 2020 and March 2023.

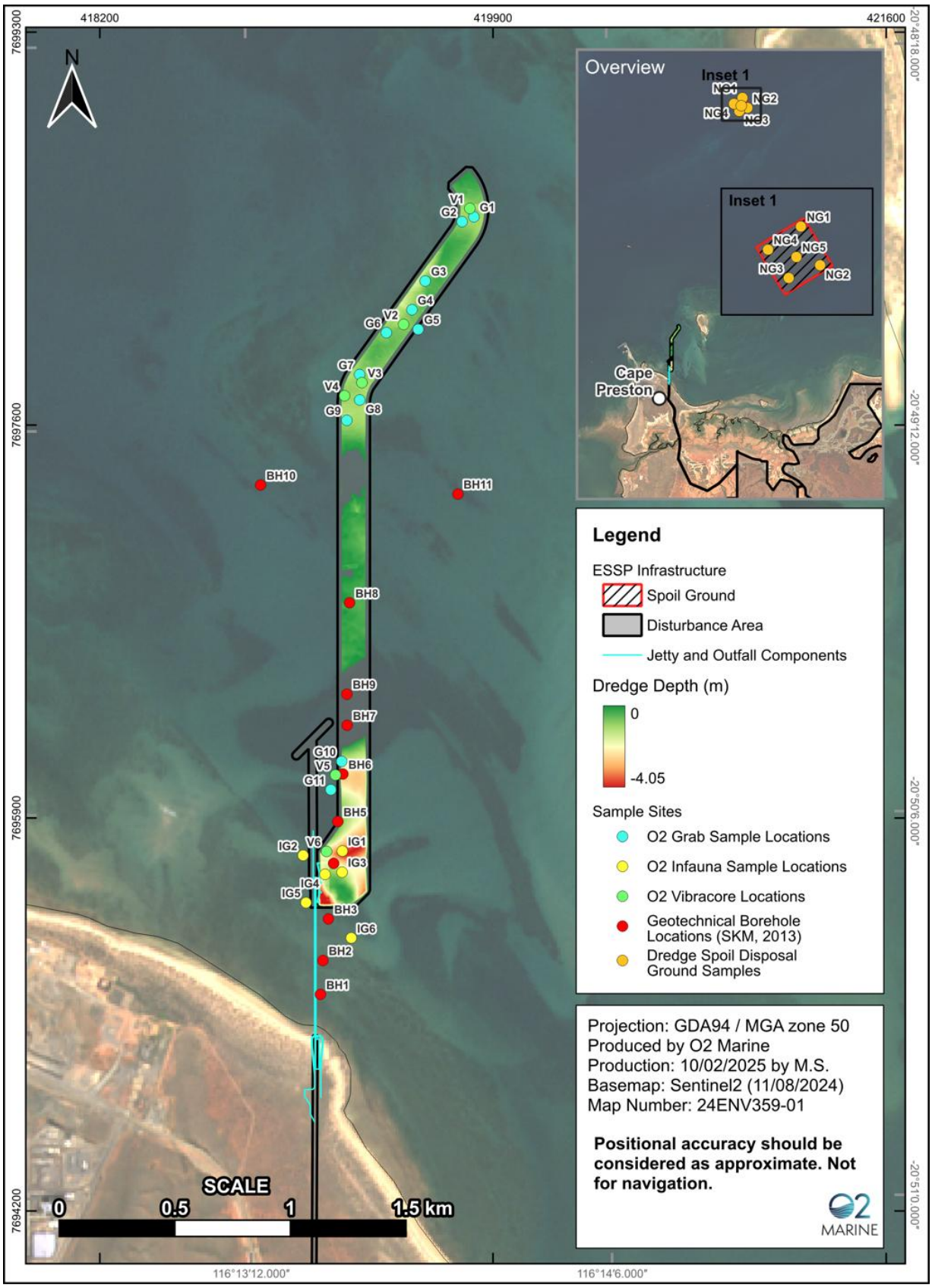

Figure A10 Sediment sampling locations for the November 2020 and September 2022 Sediment studies

Benthic Communities and Habitat

Subtidal BCH

O2 Marine undertook baseline subtidal BCH mapping and monitoring studies between July 2018 and October 2024. The surveys found that Regnard Bay and the Cape Preston East area form a wide, shallow embayment bordered to the west by Cape Preston, and to the north by South West and North East Regnard Islands. Due to tidal flow and minor platform reef development, the seabed of the Bay has developed a complex topography, showing evidence of tidal scour, reef accumulation (around South West Regnard Island), and unstable tidal sand banks in the east. BCH studies at the offshore dredge disposal are investigation areas found substrate dominated by bare sand supporting <5% cover of patchy mixed filter feeders.

The detailed broad scale and targeted mapping undertaken as part of this study has, in general, shown that the distribution of BCH is however complex, due to the highly varied substrate that comprises areas of bare sediment, low relief limestone with sand veneer, and outcropping rocky structures and islands. In the Cape Preston East area, as is common elsewhere, bare sediment dominates with patches of sessile organisms occurring where the geomorphic and oceanographic conditions allow. A map of subtidal BCH is presented below in Figure A-8, and the key findings summarised as:

- Regnard Bay and the Cape Preston East area forms a wide, shallow embayment with a complex topography, showing evidence of tidal scour, reef accumulation, and unstable tidal sand banks
- A total of 75,037 ha of seabed BCH was mapped, which included 65,287 ha coarse sand, 1,754 ha subtidal coral reef, 794 mixed filter feeders, 3,730 ha subtidal macroalgae, 976 ha seagrass and 2,496 ha silt classes
- Although these BCHs provide ecological value and are likely to support various marine fauna, they are ubiquitous along the Pilbara coastline
- Targeted hard coral surveys determined that there had been a slight increase of macroalgal cover between the dry season of 2020 and the wet season of 2022, however in general the community composition observed by other surveys in 2012 was still intact
- Targeted seagrass surveys indicated that while overall seagrass coverage is very low, multiple species of seagrass can be found in the area, including *Cymodocea* sp., *Halodule* sp., *Halophia decipiens*, *Halophila ovalis*, *Halophila* sp., *Halophila spinulosa*, and *Syringodium* sp.
- Surveys of the proposed offshore disposal grounds and nearshore anchorages show areas of bare sediment and mixed filter feeder communities which are common in the Pilbara marine environment

Further information detailing subtidal BCH for the ESSP can be found in O2 Marine (2025a).

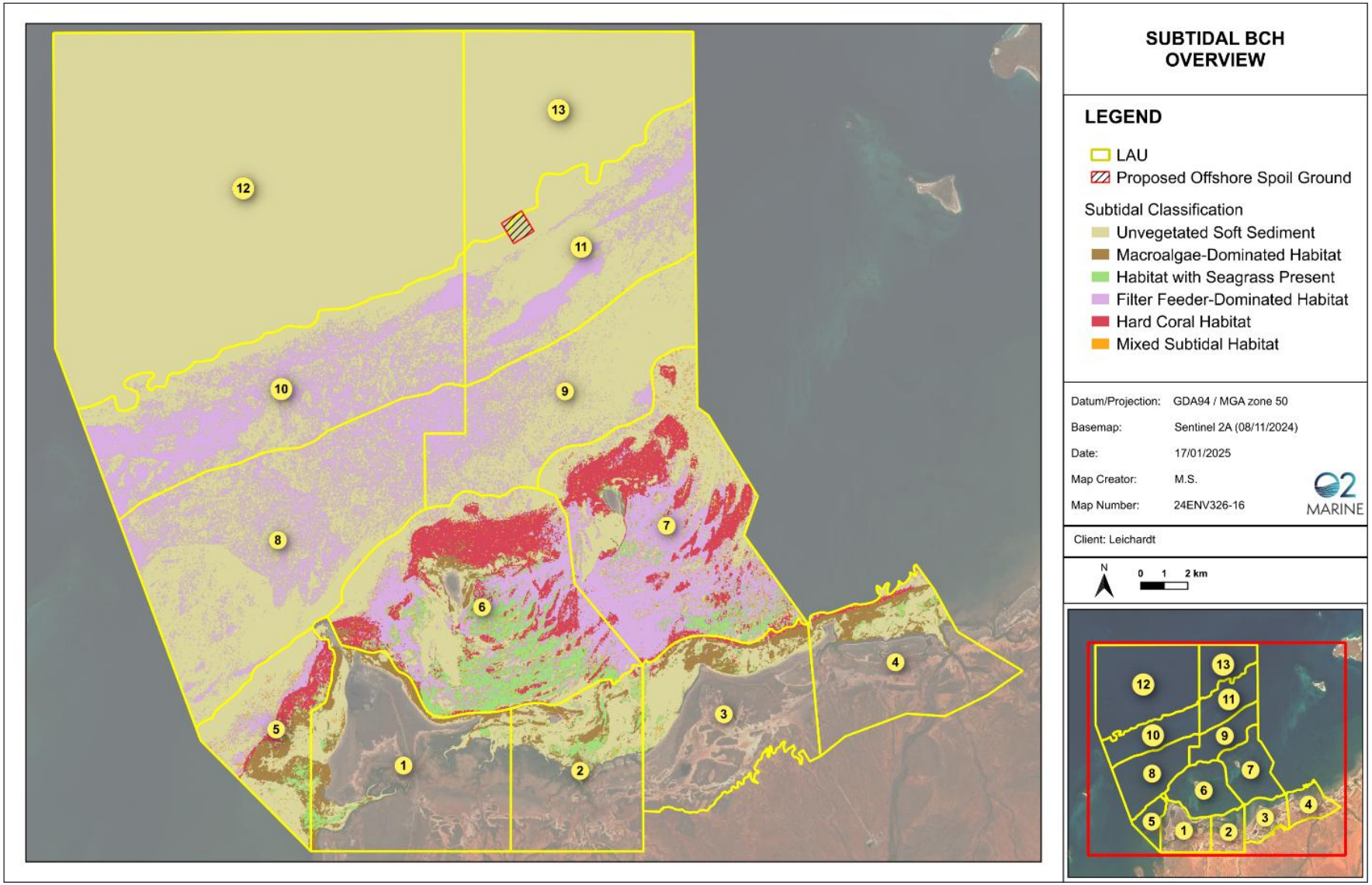

Figure A-8 – Compiled Subtidal BCH map within LAUs.

Intertidal BCH

The Intertidal BCH mapping and assessment for the ESSP covered approximately 40 km of complex coastline, made up of several headlands, shallow embayment's, mangrove stands, tidal creeks, dune complexes and expansive mudflat areas. The following key findings were made:

- A total of 6521.77 ha was mapped over four established LAUs (LAU1, LAU2, LA3 and LAU4). These areas were verified via two field surveys in May 2020 and June 2021. Terrestrial Vegetation dominated the LAU areas (37%), however this in not considered an intertidal BCH, and is discussed further in Phoenix (2025). Figure A-9 outlines the intertidal BCH classifications across LAUs 1 – 4.
- Mudflats (20.7%) were by far the dominant intertidal BCH, then samphire shrubland (8%), mangroves (7.9%), and mudflats (inclusive of algal mats) (7.6%).
- Mangroves (in particular the Closed Canopy (CC) functional group) are deemed the most ecological significant intertidal BCH within the ESSP study area. These CC groups are dominated by *Avicennia marina* and make up 84.4% of the total mangroves mapped. All mangroves surveyed were classified as 'healthy' in accordance with the Duke et al. (2005) mangrove health criteria. No anthropogenic impacts were observed.
- All mangroves with LAU1 and LAU2 (1159.7 ha) lie within the Regionally Significant Mangrove Area #9 (EPA 2001), and are classified by Semeniuk (1997) as internationally, nationally and regionally significant.
- Algal Mat sampling recorded six taxa across the study area, dominated by filamentous cyanobacteria *Lyngbya sp.* then *Coleofasciatus chthonoplastes* and *Schizothrix spp*. These taxa are well documented along the Pilbara coastline.
- Intertidal invertebrate sampling recorded a total of 1095 organisms from 7 taxa within 42 fauna quadrats at 21 individual sites. Fauna counts were significantly higher within LAU4 (n–949) when compared to LAU1 (n–64) and LAU2 (n–82). Overall, these results concluded that the dominant taxa were Mollusc (n-716) followed by Crustaceans (n-363) and Fish (n-16).

Further information detailing intertidal BCH for the ESSP can be found in O2 Marine (2025b).

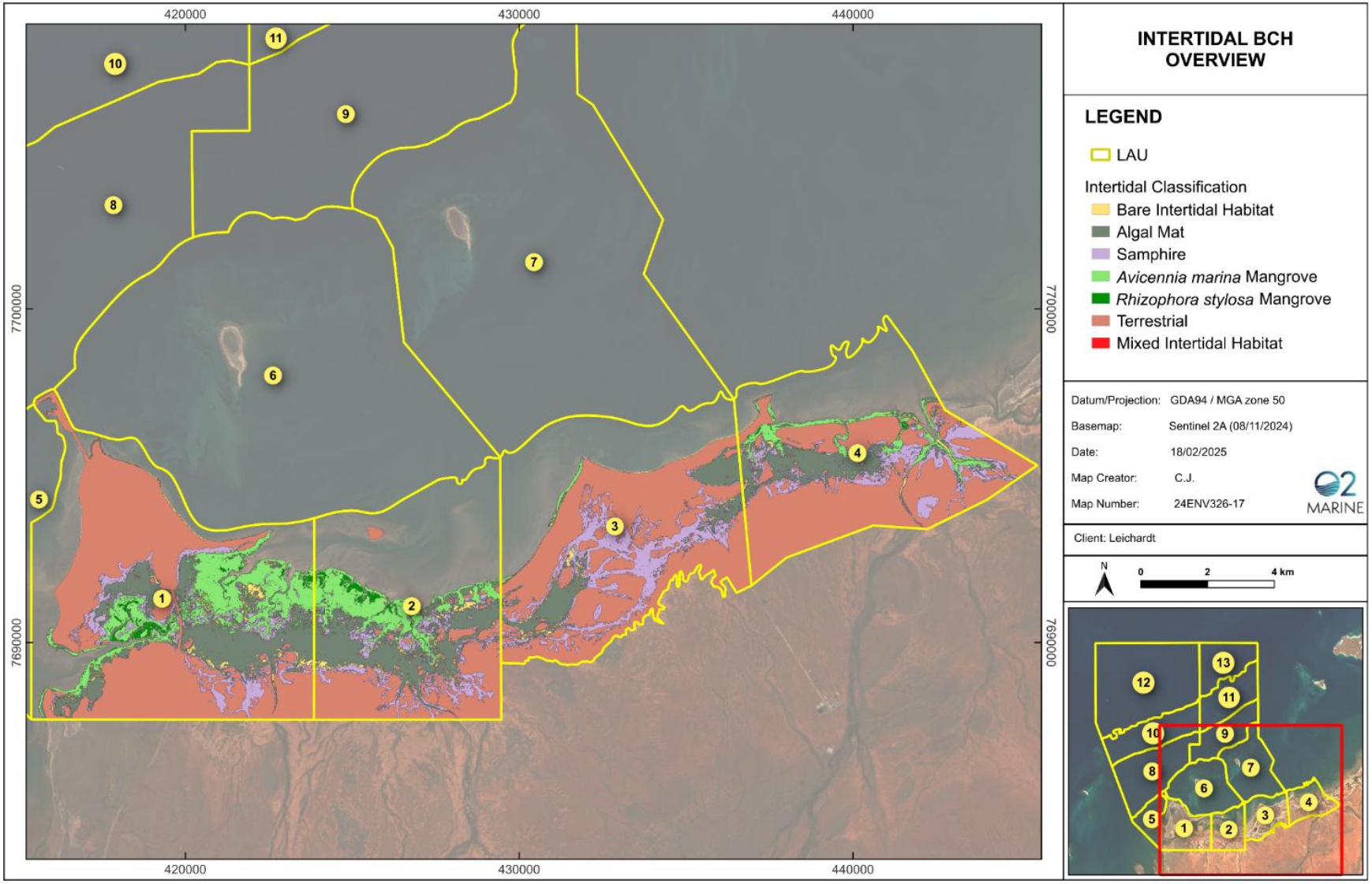

Figure A-9 Compiled Intertidal BCH map within LAUs.

Marine Fauna

O2 Marine undertook a marina fauna desktop study for the ESSP, with the objectives to:

- Identify key species based on their conservation status and their likelihood of occurrence in Proposal-impacted areas
- Summarise key species' ecological characteristics (i.e., population, distribution, habitat use, life history characteristics and ecological windows), and
- Identify EPBC Act related policies pertaining to the management of these species.

Identification of 'key' species as those with the highest conservation, which could be impacted by the Proposal 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 Proposal area. A summary of the key species is below:

Mammals

- Humpback whale (Migratory): high likelihood of occurrence in nearshore and offshore waters. Peak numbers are in July to August, with the northern migration peak during May and August and southern migration peak in August to early September (Jenner et al. 2010)
- Dugong (Migratory): high likelihood of occurrence in nearshore waters, year-round likely foraging where suitable seagrass habitat is present which could include the creeks and surrounding shallow areas.
- Humpback dolphin (Vulnerable, P4 and Migratory): high likelihood of occurrence in nearshore waters, year-round likely using the waters for foraging, socialising, travelling and breeding.
- Indo-Pacific bottlenose dolphin (Migratory): high likelihood of occurrence in nearshore waters, year-round likely using the waters for foraging, socialising, travelling and breeding.

Reptiles

- Green turtle (Vulnerable and Migratory): high likelihood of occurrence in nearshore and offshore waters year-round, including juveniles within the surrounding creeks. High likelihood of juvenile green turtles being present within the Proposals Intake Creek, likely that the creeks and shallow intertidal and nearshore areas provide important foraging habitat for juvenile green turtles. Nesting and inter-nesting occurring from November to March. Peak nesting occurs from December to February.
- Flatback turtle (Vulnerable and Migratory): high likelihood of occurrence in nearshore and offshore waters year-round, with nesting and inter-nesting occurring from October to March. Peak nesting occurs from November to January.
- Hawksbill turtle (Vulnerable and Migratory): high likelihood of occurrence in nearshore and offshore waters year-round, with nesting and inter-nesting occurring from October to March. Peak nesting occurs from November to January.
- Short-nosed sea snake (Critically Endangered): medium likelihood of occurrence, and could be present throughout the year where suitable coral habitat is present
- Leaf-scaled sea snake (Critically Endangered): medium likelihood of occurrence, and could be present throughout the year where suitable coral or seagrass habitat is present

Fish

- Green sawfish (Vulnerable and Migratory): high likelihood of occurrence in inshore and nearshore waters, year-round. Likely that juvenile green sawfish may intermittently use the Proposal Intake Creek for foraging and could provide secondary nursery habitat for juveniles.
- Reef manta (Migratory): high likelihood of occurrence in nearshore and offshore waters, year-round.

Ecological windows for these species have been presented in Table A-2, including for humpback whales and turtles which have a high likelihood of occurrence on a seasonal basis.

There are no conservation significant marine fauna populations or habitats that are restricted to the Proposal development envelope, which is predominantly bare sand with occasional areas of limestone pavement. The habitats surrounding the Proposal are well represented throughout the region.

Table A-2 Key species 'ecological window'. Source (O2 Marine 2025d)

Species presence	J	F	M	A	M	J	J	A	S	O	N	D	Data Source
Dugong*													DBCA (2024); DCCEEW (2024)
Australian humpback dolphin*													Hanf et al. (2022); Raudino et al. (2023)
Indo-Pacific bottlenose													Hanf et al. (2022); Raudino et al. (2023)
Humpback whale													Jenner et al. (2010); Irvine et al. (2018)
-Northward migration													Jenner et al. (2010)
-Southward migration													Jenner et al. (2010)
-Southward peak calves													Jenner et al. (2010); Irvine et al. (2018)
Flatback turtle													DoEE (2017); Peel et al. (2024)
-Foraging													DoEE (2017); Pendoley Environmental (2023; 2024)
-Nesting and inter-nesting													DoEE (2017)
-Hatchlings emerging													DoEE (2017)
Green turtle													DoEE (2017)
-Foraging													DoEE (2017); Pendoley Environmental (2023; 2024)
-Nesting and inter-nesting													DoEE (2017)
-Hatchlings emerging													DoEE (2017); Pendoley Environmental (2023; 2024)
Hawksbill turtle													DoEE (2017)
-Foraging													DoEE (2017); Pendoley Environmental (2023; 2024)
-Nesting and inter-nesting													DoEE (2017)
-Hatchlings emerging													DoEE (2017); Pendoley Environmental (2023; 2024)
Green sawfish													Morgan et al. (2015); Morgan et al. (2017)
-Pupping													Lear et al. (2023)
Reef Manta Ray													Armstrong et al. (2020)
Short-nosed sea snake													Udyawer et al. (2020)
Leaf-scaled sea snake													Udyawer et al. (2020)
*timing of specific life history traits are variable and generally dependent on environmental variables, therefore species could be present year-round and could be displaying a variety of different life history traits (e.g. foraging, travelling, foraging, breeding)													

Dark blue represents full duration of presence, **Light blue** represents timing of specific behaviours, **Diagonal shading** represents peak timing.

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Appendix B. Product Spill Risk Assessment and Management Plan

Product Spill Risk Assessment and Management Plan

1. Introduction

Leichhardt Salt Pty Ltd (Leichhardt) is seeking to develop the Eramurra Solar Salt Project (ESSP), a solar salt project east of Cape Preston, approximately 55 km west-south-west of Karratha in the Pilbara region of WA. The Proposal will utilise seawater and natural solar evaporation processes to produce a concentrated salt product. An average production rate of 5.2 million tonnes per annum (Mtpa) is being targeted with up to 6.8 Mtpa of salt deposited in a low rainfall year.

An integral operational component of the ESSP is the storage and handling of a high saline product. Failure to adequately contain the salt has the potential to impact Marine Environmental Quality (MEQ) via four key operational components:

1. Spillage from the concentration and crystalliser ponds into drainage and creek systems
2. Spillage from trenches/culverts or transfer pipelines into drainage and creek systems
3. Spillage during product loading to transhipment vessels at the end of the trestle jetty *(CPE Port operations - provided for reference)*, and
4. Spillage during product loading from transhipment vessels to ocean going vessels at the offshore mooring areas *(CPE Port operations - provided for reference)*.

There is a risk that the concentrated Product could spill into the marine environment and cause damage. This Product Spill Risk Assessment and Management Plan (the Plan) will present the risk assessment undertaken and proposed management actions if a spill occurs.

1.1. Objectives

The objectives of this Product Spill Risk Assessment and Management Plan are as follows:

- To address the requirement from ESD Requirement 55 of the Environmental Scoping Document
- To understand the risks associated with a product spill within the marine environment
- To describe the management actions to be undertaken in the case of a product spill.

Note that Cape Preston East (CPE) Port operations (product loading and transhipment) are separate to the ESSP and details about the management of these activities are provided in this plan for reference only.

1.1.1. Definitions and relevant references

For this Plan, the Product is defined as the final halite salt product produced from the solar and wind evaporation process.

A Spill is defined as the accidental release of the Product into the environment in a volume that may cause environmental harm. This may be a large amount in one instance, or small amounts over a longer duration, as both have the potential for environmental harm.

The monitoring and management will consider the following:

- Environmental Protection (Unauthorised Discharges) Regulations 2004
- MARPOL (Annex II, III, IV, V, VI)
- *Environmental Protection Act 1986*
- Environmental Protection (Controlled Waste) Regulations 2004
- *Protection of the Seas (Prevention of Pollution from Ships) Act 1983*

1.2. Scope and association with other management plans

This document has been prepared to align with other management plans for the Project and avoid repetition. To that extent, this management plan provides monitoring and management actions for spill impacts, except for the following:

- Dredging and dredge spoil activities, which is covered in the Dredge and Spoil Disposal Monitoring and Management Plan (O2 Marine, 2025a)
- Bitterns disposal, which has been covered in the main document of the Marine Environmental Quality Monitoring and Management Plan (O2 Marine, 2025b)
- Mine closure, covered in the Interim Mine Closure Plan (Preston, 2025)
- Management of leaks or spills of hydrocarbons or chemicals is covered in the Hydrocarbon and Spill Risk Assessment and Management Plan (O2 Marine, 2025c; Appendix C)
- Groundwater impacts which have been covered in the Groundwater Monitoring and Management Plan (Geosyntec, 2025)

2. Rationale and approach

This Plan uses the mitigation hierarchy to ensure that impacts have been avoided or reduced to appropriate levels through the application of risk controls, ranging from avoidance/prevention to mitigation/minimisation (Figure 1). The precautionary principle has been applied where practical, resulting in the highest possible management measures being applied.

An objective-based approach was used for the management actions outlined in this Plan which seeks to identify significant environmental aspects, establish reporting procedures for environmental performance and implement remedial actions. These management actions aim to control activities and/or conditions that may negatively affect the environment in the event of a Product spill and seek to establish continuous environmental improvement and, if required, rehabilitation.

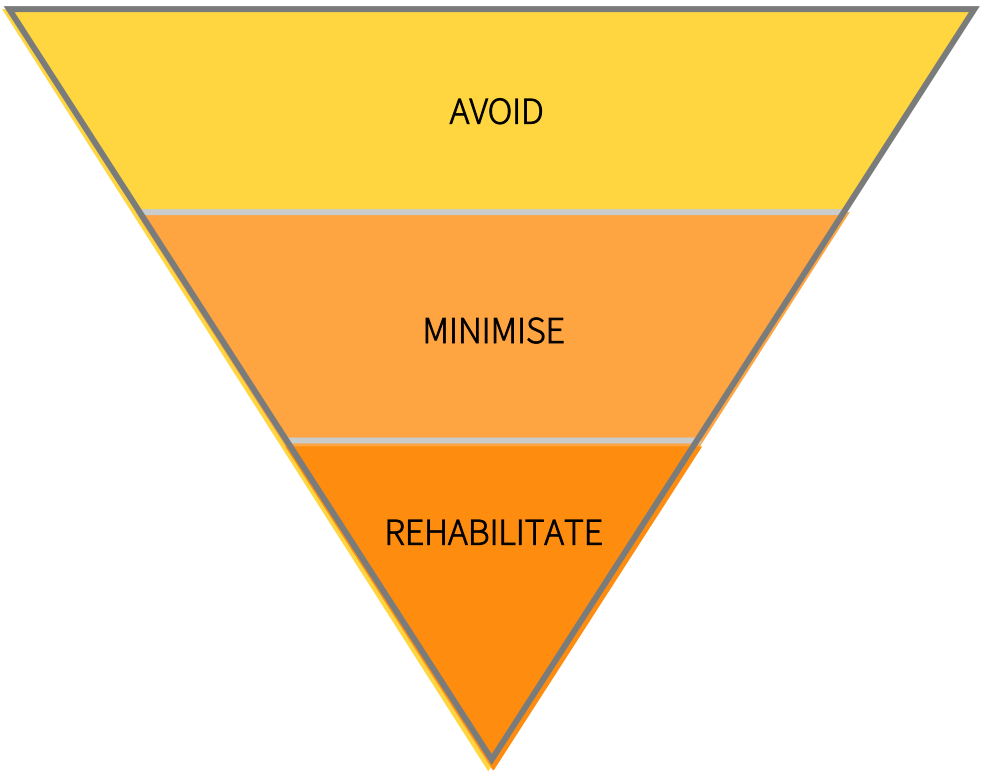

Figure 1: Mitigation hierarchy

2.1. Management Objectives

The monitoring and management objectives of this plan are to:

1. Ensure that all reasonable and practical measures have been undertaken to minimise the generation of product spills
2. Ensure that all reasonable and practicable measures have been undertaken to identify and maximise recovery or treatment of areas exposed
3. Ensure that all reasonable and practicable measures have been undertaken to minimise the environmental impacts associated with the storage and transport of the Product.

2.1.1. Risk-based approach

To ensure that all reasonably foreseeable potential risks and impacts associated with the storage and transport of the product, a risk assessment has been undertaken as part of the development of this plan. A risk-based approach ensures that management targets are identified and prioritised accordingly.

2.1.2. Rationale for choice of provisions

The rationale for the choice of provisions (Indicators and/or Management Actions) described in this Plan is based on implementing the management approach described above to avoid and minimise the potential impacts of the Project on marine environmental quality (MEQ). Monitoring and management actions have been selected to ensure the development and operation of the Proposal align with EPA objectives.

This Plan specifies the proposed objectives, management targets, management actions, monitoring and reporting. Each objective has a management target set to ensure each objective is measurable, and the key actions required to meet the targets. Monitoring requirements have also been specified to check progress and ensure the actions are implemented successfully. This Plan also includes any reporting requirements relating to each objective.

3. Responsibilities

Environmental Manager

- Provide advice on Product storage and management as required
- Conduct ad-hoc or targeted inspections to assess compliance to this Plan
- Provide solutions to manage non-compliance to this Plan
- Undertake any external reporting.

Environmental advisor

- Ensure product spill management is addressed in the site induction and covered in toolboxes when required
- Provide advice and guidance on Product storage and management as required
- Ensure all product spills are reported and investigated in accordance with this Plan
- Ensure that relevant product spills are escalated to the Environmental Manager
- Reporting externally where required
- Conduct regular inspections to assess compliance with this Plan
- Document any non-compliance with this Plan
- Liaise with Environmental Manager as required.

Vessel Contractor and/or operations personnel

- Ensure correct licences and approvals are current for each vessel/plant and provide to the Environmental advisor
- Ensure all product spills are reported and investigated in accordance with this Plan
- Ensure that relevant product spills are escalated to the Environmental Manager.

4. Product Spill Risk Assessment

The potential for the Product to be spilt is dependent on where the Product is and how it is being stored or moved. Therefore, several stages of the product cycle have been identified as needing to be assessed, these include:

ESSP operations:

- Pond storage/movement of dense brine and crystallisation of salt
- Delivery of solid Product to the port salt stockpile area

CPE Port operations:

- Loading the Product onto the outload conveyor system
- Transporting the Product via outload conveyor to the transhipper vessel
- The transfer of the Product from transhipper onto the ocean-going vessel

Containment of Product is a requirement to reduce the environmental impact of the ESSP Project. Failure to adequately contain the salt has the potential to impact the surrounding environment via sthe following pathways:

1. Spillage from the concentration and crystalliser ponds into drainage and creek systems
2. Spillage from trenches/culverts or transfer pipelines into drainage and creek systems
3. Spillage of the Product during transport to the port salt stockpile area

CPE Port operations have the ability to impact marine environments via the following pathways:

1. Spillage of the Product in the conveyor loading zone and/or outside the salt stockpile area boundary
2. Spillage of the Product from the conveyor
3. Spillage during product loading to transhipment vessels at the end of the trestle jetty, and
4. Spillage of the Product during transhipment barge journey to ocean-going vessel
5. Spillage during product loading from transhipment vessels to ocean going vessels at the offshore mooring areas.

A risk matrix, risk likelihood, and acceptance criteria are outlined in Table 1, Table 2 and Table 3. The risk assessment was undertaken using these tables, where each risk, the potential causes, impacts, and pressures were defined (Table 4). Mitigation actions have been stated which aim to reduce or remove the risk. These mitigation actions were incorporated into the risk assessment to provide a residual risk rating for each risk identified.

The implementation of mitigation controls outlined in Table 4 shows the risk likelihood ranging from low to possible. The residual risk for a Product spill during the transport of the Product during operations is medium due to a higher consequence.

Table 1: Risk Matrix

		Consequence Rating				
		C1	**C2**	**C3**	**C4**	**C5**
Likelihood	**Almost Certain**	11	16	20	23	25
	Likely	7	12	17	21	24
	Possible	4	8	13	18	22
	Unlikely	2	5	9	14	19
	Rare	1	3	6	10	15
Consequence Categories	**Health & Safety**	First aid treatment injury or illness	Medical treatment injury or illness (no restrictions and restrictions)	Lost time injury or illness	Serious irreversible disabling or illness	Fatality(ies) or widespread serious irreversible disabling injuries or illness
	Financial	<$1M	$1M - $5M	$5M - $10M	$10M - $25M	>$25M
	Customer	Few, if any customers/port users affected	Confined short term expression of trust and confidence issues by customer/port user	Ongoing trust and confidence issues with customers/port users requiring proactive management	Long-term loss of trust and confidence with customers/port users	Widespread prolonged/unrecoverable loss of trust and confidence wit customers/port users
	Social/Cultural Heritage	Low-level repairable damage to commonplace structures	Limited short-term impacts to cultural values/items. Mostly repairable	Ongoing social issues. Significant damage to structure/items of cultural significance	Long term significant social impacts/damages to structures/items of cultural significance	Breakdown in social order. Irreparable damage to high valued structures/items
	Reputation	Public concern restricted to localised complaints	Limited adverse local public or media attention and complaints	Adverse attention from media or heightened concern by local community	Widespread adverse local or state attention from media, public, government/non-government organisations	Sustained local, state or national condemnation by media, public, government/non-government organisations
	Environment	Minor incident with no effect to environment	Environmental incident that is immediately recoverable	Material environmental impact or harm that is not immediately recoverable	Significant environmental impact or harm requiring long term recovery	Irreversible harm to an environmentally sensitive area
	Legal & Compliance	Procedural non reportable breach	Breach of low-level commitment that is reportable	Breach of regulation incurring fines and penalties	Material breach of regulation. Civil litigation/prosecution	Loss of operating license. Imprisonment of directors/officers

Table 2: Risk likelihood

Likelihood Rating	Likelihood	Description	In Years	Probability
	Almost Certain	Recurring event during the lifetime of an operation/project	At least once per year	>60%
	Likely	The event will probably occur during the lifetime of an operation/project	At least once in 2 - 10 years	40% - 60%
	Possible	The event may occur intermittently or at some time during the lifetime of an operation/project	At least once in 5 – 10 years	15% - 40%
	Unlikely	The event is unlikely to occur during the lifetime of an operation/project	At least once in 10 – 20 years	5% - 15%
	Rare	The event is very unlikely to occur during the lifetime of an operation/project	Less than once in 25 years	<5%

Table 3: Risk acceptance criteria

Risk Acceptance Criteria		
Risk Level	Control Rating Requirement	Reporting Requirement
22 – 25 - Extreme	Effective	Audit & risk Committee/Board
15 – 21 - High	Effective	CEO
6 – 14 - Moderate	Partially effective	Senior Management
1 – 5 - Low	Partially effective	Not required

Note: Adopt the highest Consequence Rating applicable to any individual Consequence Category

Table 4: Product spill risk assessment

Risk	Potential Cause(s)	Potential Impact (s)	Description (influencing factors)	Mitigation Measures	Residual Risk		
					Likelihood	Consequence	Rating
ESSP operations							
Storage of Product during operation	• Product spill from the crystalliser ponds • Product spill from land based pipelines • Salt dust blown from crystalliser ponds or salt stockpile	• Increased groundwater salinity • Increased sediment salinity • Salt covering of areas of algal mats and samphire adjacent to the crystalliser embankments • Localised salt crust on terrestrial surface	• Supratidal vegetation could become salt stressed because of increased groundwater or sediment salinity • Seasonal spring tides, storm surges or rainfall events could transport the spilt salts • Proximity to mangroves	• Project location chosen predominantly on salt flats devoid of marine and intertidal biota • Install engineering and containment control to prevent the Product from spilling over, leaking, or overflowing from storage facilities. • Ensure the use of industry-standard storage facilities	Possible	C1	4 - Low

Risk	Potential Cause(s)	Potential Impact (s)	Description (influencing factors)	Mitigation Measures	Residual Risk		
					Likelihood	Consequence	Rating
CPE Port Operations (for reference only)							
Transport of Product (halite salt)	• Spillage during product loading to transhipment vessels • Spillage of the Product during transhipment from loading zone to ocean-going vessel • Spillage during product loading from transhipment vessels to ocean-going vessels at the offshore mooring areas	• Increase in groundwater salinity and density • Increase in nearshore salinity surrounding the end of the trestle jetty • Increase in salinity along transhipment route • Increase salinity within the offshore mooring area • Salinity-induced stress or acute toxicity on pelagic and benthic communities and marine fauna	• Length of outload conveyor • Extreme weather events (i.e., fire, flood, or cyclone) • Vessel condition • Sensitive BCH habitats (i.e., coral reefs) • Wharf conveyor proximity to BCH	• Ensure the use of industry-standard equipment/vessels for salt Product transport and loading. • Conduct regular maintenance on vessels, conveyor belts and load zone containment devices (i.e., skirtboards and conveyor belt scrapers) • Ensure easy access to mechanical containment devices for maintenance purposes • Route jetty washdown drainage to the bitterns disposal system. • Utilise engineering controls to ensure the loading system on the transhipper jetty cannot discharge the Product unless the transhipping vessels are moored alongside the jetty. • Transhipping vessels to have a semi-enclosed storage hold to minimise loss of Product due to wind conditions. • Ensure all vessels have Emergency Product Spill Response and Management Procedures.	Unlikely	C2	5 - Medium

5. Product Storage and Handling Monitoring and Management

5.1. Rationale

An integral operational component of the Project is the transportation, storage, and handling of salt. Regular monitoring and management will be undertaken to ensure the salt product is appropriately contained both on land and within the marine environment.

An overview of the Product Storage and Handling Monitoring and Management program is outlined in Table 5

Table 5: Overview of the Product Storage and Handling Monitoring and Management Program

	Management Actions	Environmental		Performance
Management Targets	Actions	Monitoring	Reporting/ Evidence	Timing
Achieve zero spills of salt product into the environment from the crystalliser ponds and pipelines	• Obtain and comply with approvals under Part V of the EP Act • Ensure the quantity of Product does not exceed the capacity of the facility and equipment being used. • Inspect Product storage facilities regularly for damage and leaks • Develop and implement a Groundwater Monitoring and Management Plan (GMMP) as outlined in the Environmental Review Document. • Implement adaptive management practices including an annual review of management outcomes and actions of the GMMP. • Develop and implement a Surface Water Management Plan.	Operational monitoring: • Scheduled inspection of storage facilities and infrastructures • Scheduled inspections and routine maintenance of brine infrastructure (including pond embankments). • Inspections of embankments following an extreme weather event such as a cyclone or flood event. Environmental monitoring: • Internal Audit Program. • Groundwater monitoring as outlined in the GMMP.	Operational monitoring: • Inspection checklist Environmental monitoring: • In accordance with Approval conditions.	Operational phase: Internal: • Incident reporting (as required). • Operations reporting (monthly). External: Routine regulatory reporting as required by approvals under the *Mining Act 1978* and Part IV and Part V of the EP Act (DEMIRS & DWER, Annual).

Management Targets	Management Actions Actions	Environmental Monitoring	Reporting/ Evidence	Performance Timing
		• Surface water quality monitoring outlined in the SWMP. • In accordance with Approval conditions.		
CPE Port operations – for reference only. Achieve zero spills of salt product from the conveyors and conveyor loading zone.	• Obtain and comply with approvals under Part V of the EP Act • Inspect the conveyor belt for spilt Product that could impact the efficiency of the conveyor belt. • Ensure the quantity of product loaded onto the conveyor does not exceed the conveyor belt's capacity. • Inspect the containment devices at the conveyor loading zone regularly. • Clean up product spillage around the loading zone. • Load the material in the centre of the conveyor.	Operational monitoring: • Inspect the loading zone containment infrastructure regularly. • Inspect the conveyor belt regularly. Environmental monitoring: • In accordance with Approval conditions. •	Inspection checklist	Operational phase: Internal: • Incident reporting (as required). • Operations reporting (monthly). External: • In accordance with Approval conditions.
CPE Port operations – for reference only. Achieve zero spills of salt product into the marine environment from product loading system to transhipping vessels.	• Implement diligent operation procedures to ensure that loading is immediately ceased if spillage occurs. • Obtain and comply with approvals under Part V of the EP Act	Operational monitoring: • Daily inspection of loading zone equipment. • Scheduled inspections and routine maintenance	Operations monitoring: • Daily inspection checklist. • Post extreme weather event inspection checklist.	Operational phase: Internal: • Incident reporting (as required).

Management Targets	Management Actions Actions	Environmental Monitoring	Reporting/ Evidence	Performance Timing
	• Implement adaptive management practices to evaluate operational procedures in the event a Product spill occurs. • Product spillages on the jetty should be cleaned up by hosing the product to the wharf drainage system or returned dry to the onshore stockpile. • Develop, implement, and maintain risk identification procedures and operational controls through an EMS aligned to the ISO 14001:2015 Standard. • Develop and implement a site environmental monitoring and measurement programme as part of an EMS aligned to the ISO 14001:2015 Standard. • Implement terrestrial and marine sediment sampling in accordance with the MEQMMP and BCHMMP. • Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.	of product transportation and loading systems . • Inspections of storage and transport facilities following an extreme weather event such as a cyclone, flood, or fire. Environmental monitoring: • Internal Audit Programme. • Sediment sampling to test for toxicants, with results compared against EQC in the MEQMMP and BCHMMP.	Environmental monitoring: • In accordance with Approval conditions.	• Operations reporting (monthly). • Annual MEQ report summarising all water and sediment quality results. External: Routine regulatory reporting as required by approvals under *Mining Act 1978* and Part IV and Part V of the EP Act (DEMIRS & DWER, Annual).
CPE Port operations – for reference only.	• Ensure transhipment only takes place when weather conditions allow safe	Operational monitoring:	Operations monitoring:	Operational phase: Internal:

	Management Actions	Environmental		Performance
Management Targets	Actions	Monitoring	Reporting/ Evidence	Timing

Achieve zero spills of salt product into the marine environment along transhipment route.	journey along transhipment route to the ocean-going vessel.
	• Ensure transhipping vessels have a semi-enclosed storage hold to minimise loss of Product due to wind conditions.
	• Implement diligent operation procedures to ensure that transhipment of Product is undertaken without loss of product or sinking of vessel including:
	  • weather checks
	  • transhipment vessel maintenance procedures
	  • suitably trained crew
	  • develop, implement, and maintain Emergency Product Spill Response and Management Procedures for transhipment barges.
		• Inspection and maintenance of transhipment material handling systems.
		• Scheduled inspections and routine maintenance of transhipment vessels.
		• Inspections of transhipment vessels following an extreme weather event such as a cyclone, flood, or fire.
		Environmental monitoring:
		• Daily weather checks
		• Monitoring within Emergency Product Spill Response and Management Procedures.
			• Daily inspection checklist
			• Post extreme weather event inspection checklist.
			Environmental monitoring:
			In accordance with Emergency Product Spill Response and Management Procedures.
				• Incident reporting (as required).
				• Operations reporting (monthly).
				• Annual MEQ report summarising all water and sediment quality results.
				External:
				As required by State and Commonwealth requirements for maritime environmental emergencies i.e. Department of Transport; Australian Maritime Safety Authority

CPE Port operations – for reference only. Achieve zero spills of salt product into the marine environment from product loading systems from transhipping vessels to ocean-going vessels.	• Ensure product loading only takes place when weather conditions allow safe mooring of the transhipping vessel alongside the ocean-going vessel to ensure controlled product discharging can occur. • Develop, implement, and maintain risk identification procedures and operational	**Operational monitoring:** • Scheduled inspections and routine maintenance of product loading systems and vessels. **Environmental monitoring:** • Internal Audit Programme.	**Operational monitoring:** **Operational monitoring:** In accordance with manufacturers' recommendations. **Environmental monitoring:**	**Operational phase:** **Internal:** • Incident reporting (as required). • Operations reporting (monthly).

Management Targets	Management Actions Actions	Environmental Monitoring	Reporting/ Evidence	Performance Timing
	controls through an EMS aligned to the ISO 14001:2015 Standard. • Develop and implement a site environmental monitoring and measurement programme as part of an EMS aligned to the ISO 14001:2015 Standard. • Implement sediment and water sampling as outlined in the MEQMMP. • Develop and implement environmental auditing and inspection; incident reporting; and implementation of corrective/preventative actions as part of an EMS aligned to the ISO 14001:2015 Standard.	• Monitoring within Emergency Product Spill Response and Management Procedures.	In accordance with Approval conditions.	• Annual MEQ report summarising all water and sediment quality results. External: Routine regulatory reporting as required by approvals under Part IV and Part V of the EP Act (DWER, Annual). As required by State and Commonwealth requirements for maritime environmental emergencies i.e. Department of Transport; Australian Maritime Safety Authority

5.2. Monitoring

5.2.1. Routine Inspections

During Project operations, regular inspections will be undertaken for all facility infrastructure involved in salt storage, handling, and transport. Inspections will include, but not be limited to:

- Bund walls
- Piping
- Pump stations
- Drainage infrastructure
- Product loading zones
- Conveyor belts.

All inspections will be conducted with the aid of inspection checklists. Photographs will be used for collecting supporting evidence to accompany checklists.

The routine inspections aim to identify the early occurrence of any displaced salt outside of the storage or transport systems. A visual inspection should look for signs of salt crystals, degraded surface soil structure, surface crusting, or highly rusted metal.

5.2.2. Groundwater Monitoring

A Groundwater Monitoring and Management Plan (GMMP) has been developed (Geosyntec 2025). The GMMP will outline the bore network that will be used to monitor the salinity levels of the groundwater at both the water table and at depth. Bores will be located between the embankment walls and the mangroves. Sampling will commence from installation during the construction phase allowing for baseline levels to be established before operations begin. Baseline data will be collected from installation up until the time of the filling of the nearest evaporation pond.

The GMMP outlines trigger threshold levels, response actions, monitoring, frequency of monitoring, and reporting for the following:

- Electrical conductivity (EC)/ Total Dissolved Solids (TDS)
- Groundwater levels

If a trigger is exceeded, then management actions will be undertaken according to the GMMP.

5.3. Emergency Product Spill Response

An ‘Emergency Product Spill Response Procedure’ will be developed that outlines the reactive procedure in response to a Product spill incident within any operational stage that includes the storage, handling, and transportation of the Product, which may include but is not limited to:

- purpose of plan
- contaminant inventory (Safety Data Sheets)
- site layout diagram - specific to the spill location
- description of potential emergencies
- risk assessments

- employee safety
- allocate responsibility
- communications
- backup resources
- regularly test emergency procedures
- notify authorities and neighbours
- site evacuation
- remediation and cleanup options
- incident investigation.

An Emergency Product Spill Response Procedure will be developed to ensure preparedness for any Product spill across any operational stage of the Project, which includes the storage, handling, and transport of the Product. The purpose of the Spill Response Procedure is to lessen environmental risks and impacts, aid in the clean-up, and reduce occupational health and safety impacts. A Product spill may occur at any stage of production, which may include but is not limited to:

- A wall breach, equipment damage or sinking of vessels
- Monitoring data that suggests a significant change in the level of salinity above the baseline
- Confirmed reports of significant BCH impacts
- After cyclones, if warranted.

The spill response procedure will apply the prevention, preparedness, response, and recovery (PPRR) model which ensures a quick and effective response to any incident. The procedure will include, but not limited to the following:

- Contaminant inventory (SDSs)
- Site layout diagrams (including the identification of high-risk spill locations)
- Risk assessments
- Spill response procedures
- Employee safety
- Allocation of responsibilities
- Communications and reporting methods and timeframes
- Site evacuation plan
- remediation and cleanup options
- Incident investigation procedures
- Reporting procedures.

6. Adaptive management and review of the Plan

Regular audits (at a frequency to be stipulated by approval conditions) will be implemented to ensure daily inspections are occurring, inductions and training have been provided to the appropriate personnel, and any corrective actions have been actioned in acceptable timeframes. Audits will also ensure all processes and system documentation are up-to-date and available to all operational personnel.

The Product Storage and Handling Monitoring and Management Plan is a living document and will be regularly reviewed in accordance with Table 6. Leichhardt are committed to continual improvement and will conduct a regular review of the content and implementation of this plan.

Table 6: Product Spill risk assessment and management plan review timeframes

Timing	Rationale
Upon receipt of Approval Conditions	Ministerial Statement and/or Licence conditions obtained may necessitate a comprehensive review of the Plan to ensure all relevant aspects are covered to ensure compliance.
Prior to the commencement of action	Ensure that the contractors and approval holder implement all commitments accordingly and that no operational details are non-compliant.
Any time operational activities significantly change	Operational changes to the project may change the risk profile. Therefore, this document will require a review to ensure that it remains applicable and relevant to changed operational conditions.
Following any significant incident 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-compliance.

7. Reporting

Monthly operations reports will include a report on the vessel and equipment inspections. This report will include any issues flagged that require corrective action. Any corrective actions should be actioned in acceptable timeframes.

7.1. Incident Reporting

All incidents are to be reported to the Leichhardt Environmental Manager in accordance with the Leichhardt Emergency Product Spill Response Procedure. For a major spill the Environmental Advisor must be notified as soon as possible and may assist in the clean-up and investigation.

Incidents will be reported based on the requirements outlined in the *Environmental Protection Act 1986*, Environmental Protection (Unauthorised Discharges) Regulations 2004, and *Contaminated Sites Act 2003*.

Oral or written notification of a Product spill will be made to Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) as soon as practical, and within 2 hours of the incident. Followed by a written report submitted to DEMIRS within 3 days after the incident.

Incidents will be reported to Department of Water and Environmental Regulation (DWER) in accordance with section 72 of the *Environmental Protection Act 1986.*

Product spills in marine environment due to transhipping incident or sinking of transhipment vessels to be reported as per State or Commonwealth maritime environmental emergency requirements i.e. Department of Transport; Australian Maritime Safety Authority.

8. References

Geosyntec Consultants (2025). Groundwater Monitoring and Management Plan. – Eramurra Solar Salt Project. Prepared for Leichhardt Salt Pty Ltd.

O2 Marine (2025a). Dredging and Spoil Disposal Monitoring and Management Plan. Report No.210397. Prepared for Leichhardt Salt Pty Ltd.

O2 Marine. (2025b). Marine Environmental Quality Monitoring and Management Plan. Report No. R210456. Prepared for Leichhardt Salt Pty Ltd.

O2 Marine (2025c). Appendix C - Hydrocarbon and Chemical Spill Risk Assessment and Management Plan. Prepared for Leichhardt Salt Pty Ltd.

Preston (2025). Interim Mine Closure Plan. Prepared for Leichhardt Salty Pty Ltd.

Appendix C. Hydrocarbons Spill Risk Assessment and Management Plan

Hydrocarbon and Chemical Spill Risk Assessment and Management Plan

1. Introduction

Leichhardt Salt Pty Ltd (Leichhardt) is seeking to develop the Eramurra Solar Salt Project (ESSP), a solar salt project east of Cape Preston, approximately 55 km west-south-west of Karratha in the Pilbara region of WA. The Proposal will utilise seawater and natural solar evaporation processes to produce a concentrated salt product. An average production rate of 5.2 million tonnes per annum (Mtpa) is being targeted with up to 6.8 Mt of salt deposited in a low rainfall year. The Proposal includes the development of a series of concentration ponds, crystallisers and processing plant. Supporting infrastructure includes bitterns outfall, drainage channels, product dewatering facilities, desalination plant, 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 both offshore and onshore disposal of dredge spoil material.

The ESSP will have a number of chemical and hydrocarbon storage facilities (permanent and temporary) positioned at different locations throughout the project footprint. These facilities may include the following:

- Diesel generators (booster pumps, lights and general project mobile power supply)
- Intake / Outlet pumps
- Refuelling station(s)
- Washdown areas
- Chemical storage area for plant maintenance and servicing.

This Hydrocarbon and Chemical Spill Risk Assessment and Management Plan (HCSRAMP) will present the risk assessment undertaken, measures to prevent spillage and proposed management actions if a spill occurs.

1.1. Objectives

The objectives of this HCSRAMP are as follows:

- To address the requirement of ESD Requirement 55 of the Environmental Scoping Document.
- To summarise the risks associated with a hydrocarbon and/or chemical spill within the marine environment.
- To describe the management actions to be undertaken in the case of a hydrocarbon and/or chemical spill.

Note that Cape Preston East (CPE) Port operations (product loading and transhipment) are separate to the ESSP and details about the management of these activities are provided in this plan for reference only.

1.1.1. Definitions and relevant references

For the purpose of this HCSRAMP, hydrocarbons are defined as organic compounds consisting of only hydrogen and carbon (e.g. diesel, oil and grease). Chemicals may be defined as any other hazardous or toxic chemical associated with construction and operations of the Project.

A spill is defined as the accidental release of hydrocarbons and/or chemicals into the environment in a volume that may cause environmental harm. This may be a large amount in one instance, or small amounts over a longer duration, as both have the potential for environmental harm.

A vessel is defined as a fuel-powered ocean-going boat used throughout the life of the Project. Examples of ESSP vessels include, a piling barge, and crew support vessels, and support vessels. For the purpose of this risk assessment, the hydrocarbon management for dredging vessels will be covered within the Dredging and Spoil Disposal Monitoring and Management Plan (DSDMMP). The dredge vessel emergency spill response procedure/plan will be developed in consultation with this HCSRAMP, and will incorporate management and protocols specific to the selected vessel. CPE Port operation vessel (included in this plan for reference only) include transhipper barges and bulk cargo vessels, This specific procedure/plan will be provided and approved prior to the commencement of dredge works.

Monitoring and management will consider the following:

- *MARPOL (Annex I), Pollution of Waters by Oil and Noxious substances Act 1987*
- *Protection of the Seas (Prevention of Pollution from Ships) Act 1983.*
- *Marine Order 21 (safety of emergency arrangements) 2016*
- *Marine Order 30 (prevention of collisions) 2016*
- *Marine Order 91 (marine pollution prevention – oil) 2014*
- *Environmental Protection Act 1986*
- *Contaminated Sites Act 2003*
- *Dangerous Goods Safety Act 2004*
- *Pollution of Water by Oil and Noxious Substances Act 1987*
- *Environmental Protection (Unauthorised Discharges) Regulations 2004*
- *Environmental Protection Act 1986*
- *Environmental Protection and Biodiversity Conservation Act 1986 (Cth)*
- *Environmental Protection Regulations 1987*

1.2. Scope and association with other management plans

This document has been prepared to align with other Project management plans for the ESSP and avoid repetition. To that extent, this management plan provides monitoring and management actions for hydrocarbon and chemical spill impacts, except for the following:

- Dredging and spoil disposal activities, which is covered in the Dredging and Spoil Disposal Monitoring and Management Plan (O2 Marine, 2025a)
- Bitterns disposal, which has been covered in the main document of the Marine Environmental Quality Monitoring and Management Plan (2025b)
- Management of leaks or spills of salt product is be covered in Appendix B - Product Spill Management Plan (O2 Marine 2025c)
- Cape Preston East (CPE) Port operations (transhipment and loading of salt product) are not required to be covered in this plan, but have been left in for reference only.

2. Rationale and approach

This Plan uses the mitigation hierarchy to ensure that impacts have been avoided or reduced to appropriate levels through the application of risk controls, ranging from avoidance/prevention to mitigation/minimisation (Figure 1). The precautionary principle has been applied where practical, resulting in the highest possible management measures being applied.

An objective-based approach was used for the management actions outlined in this Plan. This plan seeks to identify significant environmental aspects, establish reporting procedures for environmental performance and implement remedial actions. These management actions aim to control activities and/or conditions that may negatively affect the environment in the event of a hydrocarbon spill and seek to establish continuous environmental improvement and, if required, rehabilitation.

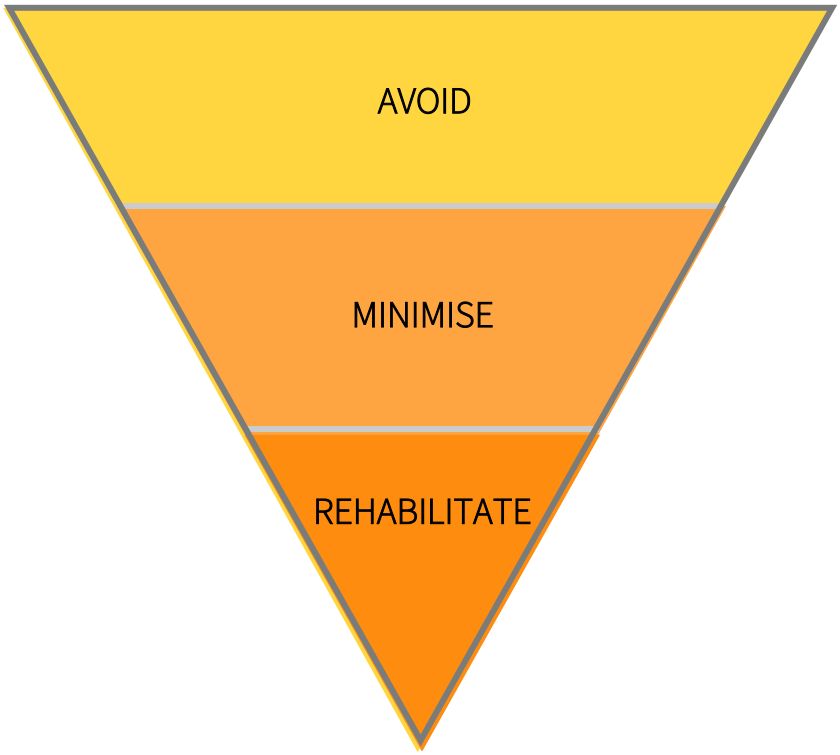

Figure 1: Mitigation hierarchy

2.1. Management Objectives

The monitoring and management objectives of this plan are to:

1. Ensure that all reasonable and practical measures have been undertaken to minimise the generation of hydrocarbon and chemical spills
2. Ensure that all reasonable and practicable measures have been undertaken to identify and maximise recovery or treatment of areas exposed

3. Ensure that all reasonable and practicable measures have been undertaken to minimise the environmental impacts associated with the storage and transport of hydrocarbons and chemicals.

2.1.1. Risk-based approach

To ensure that all reasonably foreseeable potential risks and impacts associated with the storage and transport of the product, a risk assessment has been undertaken as part of the development of this plan. A risk-based approach ensures that management targets are identified and prioritised accordingly.

2.1.2. Rationale for choice of provisions

The rationale for the choice of provisions (Indicators and/or Management Actions) described in this Plan is based on implementing the management approach described above to avoid and minimise the potential impacts of the Project on marine environmental quality (MEQ). Monitoring and management actions have been selected to ensure the development and operation of the Project aligns with EPA objectives.

This Plan specifies the proposed objectives, management targets, management actions, monitoring and reporting of hydrocarbon spills. Each objective has a management target set to ensure each objective is measurable, and the key actions required to meet the targets. Monitoring requirements have also been specified to check progress and ensure the actions are implemented successfully. This Plan also includes any reporting requirements relating to each objective.

3. Responsibilities

Environmental Manager

- Provide advice on hydrocarbon and chemical storage and management as required
- Conduct ad-hoc inspections to assess compliance to this Plan
- Provide solutions to manage non-compliance to this Plan
- Undertake any external reporting.

Environmental advisor

- Ensure spill management is addressed in the site induction and covered in toolboxes when required
- Provide advice and guidance on hydrocarbon and chemical storage and management as required
- Ensure all spills are reported and investigated in accordance with this Plan
- Ensure that relevant spills are escalated to the Environmental Manager
- Reporting externally where required
- Conduct regular inspections to assess compliance with this Plan
- Document any non-compliance with this Plan
- Liaise with Environmental Manager as required.

Vessel Contractor

- Ensure correct licences and approvals are current for each vessel and provide to the Environmental advisor
- Ensure all spills are reported and investigated in accordance with this Plan
- Ensure that relevant spills are escalated to the Environmental Manager.

4. Hydrocarbon and Chemical Risk assessment

The potential for Hydrocarbon and/or chemical spills is dependent on the stage of the Project, the function taking place, and the location on-site. Hydrocarbons will be used throughout the construction, operational and decommissioning phases of the Project. Hydrocarbons in the form of fuels are required for the operation of vessels and equipment. It is a requirement to prevent the pollution of hydrocarbons and chemicals into the marine environment under the International Convention for the Prevention of Pollution from Ships (MARPOL). Failure to manage the use and storage of hydrocarbons and chemicals on-site could impact the marine environment, marine fauna, and benthic habitat, through the following ways:

- Hydrocarbon spills from fuel storage onboard any vessel
- Hydrocarbon or chemical spills from vessel collisions or groundings
- Hydrocarbon or chemical runoff from terrestrial sources
- Hydrocarbon or chemical spills from faulty equipment
- Natural gas leaks
- Uncontrolled accidental fuel combustion

A risk matrix, risk likelihood, and acceptance criteria are outlined in Table 1, Table 2 and Table 3. The risk assessment was undertaken using these tables, where each risk, the potential causes, impacts, and pressures were defined (Table 4). Mitigation actions have been stated which aim to reduce or remove the risk. These mitigation actions were incorporated into the risk assessment to provide a residual risk rating for each risk identified.

The implementation of mitigation controls outlined in Table 4 result in all risks being either unlikely or very unlikely (rare) to occur in the duration of the Project. The residual risk for a hydrocarbon spill and/or combustion from a leak or failed containment is categorised as Medium due to the severity of the consequences.

Table 1: Risk Matrix

		Consequence Rating				
		C1	**C2**	**C3**	**C4**	**C5**
Likelihood	**Almost Certain**	11	16	20	23	25
	Likely	7	12	17	21	24
	Possible	4	8	13	18	22
	Unlikely	2	5	9	14	19
	Rare	1	3	6	10	15
Consequence Categories	**Health & Safety**	First aid treatment injury or illness	Medical treatment, injury, or illness (no restrictions and restrictions)	Lost time injury or illness	Serious irreversible disabling or illness	Fatality(ies) or widespread serious irreversible disabling injuries or illness
	Financial	<$1M	$1M - $5M	$5M - $10M	$10M - $25M	>$25M
	Customer	Few, if any customers/port users affected	Confined short term expression of trust and confidence issues by customer/port user	Ongoing trust and confidence issues with customers/port users requiring proactive management	Long-term loss of trust and confidence with customers/port users	Widespread prolonged/unrecoverable loss of trust and confidence with customers/port users
	Social/Cultural Heritage	Low-level repairable damage to commonplace structures	Limited short-term impacts to cultural values/items. Mostly repairable	Ongoing social issues. Significant damage to structure/items of cultural significance	Long term significant social impacts/damages to structures/items of cultural significance	Breakdown in social order. Irreparable damage to high valued structures/items
	Reputation	Public concern restricted to localised complaints	Limited adverse local public or media attention and complaints	Adverse attention from media or heightened concern by local community	Widespread adverse local or state attention from media, public, government/non-government organisations	Sustained local, state, or national condemnation by media, public, government/non-government organisations
	Environment	Minor incident with no effect to environment	Environmental incident that is immediately recoverable	Material environmental impact or harm that is not immediately recoverable	Significant environmental impact or harm requiring long term recovery	Irreversible harm to an environmentally sensitive area
	Legal & Compliance	Procedural non reportable breach	Breach of low-level commitment that is reportable	Breach of regulation incurring fines and penalties	Material breach of regulation. Civil litigation/prosecution	Loss of operating license. Imprisonment of directors/officers

Table 2: Risk likelihood

Likelihood				
Likelihood	Description	In Years	Probability
Almost Certain	Recurring events during the lifetime of an operation/project	At least once per year	>60%
Likely	The event will probably occur during the lifetime of an operation/project	At least once in 2 - 10 years	40% - 60%
Possible	The event may occur intermittently or at some time during the lifetime of an operation/project	At least once in 5 – 10 years	15% - 40%
Unlikely	The event is unlikely to occur during the lifetime of an operation/project	At least once in 10 – 20 years	5% - 15%
Rare	The event is very unlikely to occur during the lifetime of an operation/project	Less than once in 25 years	<5%

Table 3: Risk acceptance criteria

Risk Acceptance Criteria		
Risk Level	Control Rating Requirement	Reporting Requirement
22 – 25 Extreme	Effective	Audit & risk Committee/Board
15 – 21 High	Effective	CEO
6 – 14 Moderate	Partially effective	Senior Management
1 – 5 Low	Partially effective	Not required

Note: Adopt the highest Consequence Rating applicable to any individual Consequence Category

Table 4: Hydrocarbon risk assessment

Risk	Potential Cause(s)	Potential Impact (s)	Description (influencing factors)	Mitigation Measures	Residual Risk		
					Likelihood	Consequence	Rating
ESSP operations							
Fuel combustion	• Ignition of hydrocarbon or natural gas leak or spill resulting in combustion	• Alteration of aquatic sediments • Property damage • Loss of cargo • Impacts to Project production • Impacts to marine fauna • Impacts to vessel personnel	• Localised alterations to physio-chemical parameters • Movement of hydrocarbon pollutants in the marine environment • Reduction of air quality • Vessel damage	• Follow standard industry procedures for refuelling marine vessels.	rare	C4	10- Medium
Release of Hydrocarbons other chemicals	• Fuel leak from piling barge or crew support vessels during the construction phase. • Damage to the piling barge or crew support vessels onboard fuel storage. • Failure to contain an onshore spill • Failure of stormwater control and/or treatment systems • Faulty or damaged equipment • Insufficient equipment for task	• Oil spill/Oily water discharge • Degraded marine water quality • Degraded marine sediment quality • Impacts to marine fauna • Impacts to marine benthic habitat • Alteration of aquatic sediments • Property damage • Impacts to Project production	• Movement of hydrocarbon pollutants in the marine environment • Coating or smothering of benthic habitat and/or sediment • Impact to light penetration in the water column • Oiling of fauna (particularly seabirds) leading to injury or mortality • Loss or disturbance to critical habitat to marine fauna • Toxic effects to marine fauna	• Project vessels will have self-containing hydraulic oil drip tray management systems • Engineering controls such as diversion, containment, and treatment of first flush stormwater, bunding of berth edge and spill plates • No additional chemicals will be added to the Product during production • Spill kits positioned in high-risk locations on the jetty and on vessels. • All equipment on board vessels is to be maintained in accordance with the manufacturer's recommendations or dredging contractor's vessel management systems. • Ensure onshore engineering controls are designed to contain terrestrial hydrocarbon spills • Ensure stormwater treatment systems are designed to filter out hydrocarbons and chemicals • Spill kits are designed for the location that they will be most likely used in • All hydrocarbons and chemicals are listed in on-site MSDSs • Ensure all Project vessels have a Shipboard Oil Pollution Emergency Plan (SOPEP) • Ensure compliance to Annex I 'Regulations for the prevention of pollution by oil' within the MARPOL. • Ensure compliance to the Protection of the Sea (Prevention of Pollution from Ships) Act 1983. • Ensure compliance to Marine Order 91 (marine pollution prevention - oil) 2014.	rare	C3	6- Medium

Risk	Potential Cause(s)	Potential Impact (s)	Description (influencing factors)	Mitigation Measures	Residual Risk		
					Likelihood	Consequence	Rating

Vessel collision or grounding	• Poor visibility during navigation
	• Equipment malfunction i.e., vessel navigation equipment
	• Navigation error
		• Property damage
		• Damage to on-vessel fuel storage
		• Oil spill/Oily water discharge
		• Impacts to Project production
		• Impacts to vessel personnel
			• Vessel damage
			• Movement of hydrocarbon pollutants in the marine environment
			• Potential oiling of fauna (particularly seabirds) leading to injury or mortality
			• Interaction with other marine vessel users along the transhipment route
				• Ensure all Project vessels have a SOPEP, including in the event of vessel sinking
				• All vessels will be equipped with appropriate equipment for navigation and safety in compliance with Marine Order 30
				• Vessel crew comply to Marine Order 30, including:
				  • Adherence to steering and sailing rules including maintaining lookouts (e.g., visual, hearing, radar, etc.), proceeding at safe speeds, assessing the risk of collision and taking action to avoid collision (monitoring radar).
				  • Adherence to navigation light display requirements, including visibility, and light position/shape appropriate to activity.
				  • Adherence to navigation noise signals as required.
				• Implementation of Marine Order 21 (safety of emergency arrangements) 2016, including
				  • Adherence to minimum safe manning levels
				  • Navigational systems and equipment required are those specified in Regulation 19 of Chapter V of Safety of Life at Sea
				• Automatic Identification System (AIS) that provides other users with information about the vessel's identity, type, position, course, speed, navigational status and other safety-related data
					unlikely	C1	2 - low

CPE Port operations							
Fuel combustion	• Transhipper collision resulting in an ignition source being generated	• Alteration of aquatic sediments • Property damage • Loss of cargo • Impacts to Project production • Impacts to marine fauna • Impacts to vessel personnel	• Localised alterations to physio-chemical parameters • Movement of hydrocarbon pollutants in the marine environment • Reduction of air quality • Vessel damage	• Follow standard industry procedures for refuelling marine vessels.	rare	C4	10- Medium
Release of Hydrocarbons other chemicals	• Fuel leak from vessels during operations due to equipment failure. • Fuel leak from vessels during operations due to user error. • Failure to contain an onboard spill • Insufficient equipment for task	• Oil spill/Oily water discharge • Degraded marine water quality • Degraded marine sediment quality • Impacts to marine fauna • Impacts to marine benthic habitat • Alteration of aquatic sediments • Property damage	• Movement of hydrocarbon pollutants in the marine environment • Coating or smothering of benthic habitat and/or sediment • Impact to light penetration in the water column • Oiling of fauna (particularly seabirds) leading to injury or mortality	• Project vessels will have self-containing hydraulic oil drip tray management systems • Engineering controls such as bunding and shutoff valve • Spill kits positioned in high-risk locations on the on vessels. • All equipment on board vessels is to be maintained in accordance with the manufacturer's	rare	C3	6- Medium

Risk	Potential Cause(s)	Potential Impact (s)	Description (influencing factors)	Mitigation Measures	Residual Risk		
					Likelihood	Consequence	Rating
		• Impacts to Project production	• Loss or disturbance to critical habitat to marine fauna • Toxic effects to marine fauna	recommendations or contractor's vessel management systems. • All hydrocarbons and chemicals are listed in on-vessels MSDSs • Ensure all Project vessels have a Shipboard Oil Pollution Emergency Plan (SOPEP) • Ensure compliance to Annex I 'Regulations for the prevention of pollution by oil' within the MARPOL. • Ensure compliance to the Protection of the Sea (Prevention of Pollution from Ships) Act 1983. • Ensure compliance to Marine Order 91 (marine pollution prevention - oil) 2014.			

Vessel collision or grounding	• Poor visibility during navigation
	• Equipment malfunction i.e., vessel navigation equipment
	• Navigation error
		• Property damage
		• Damage to on-vessel fuel storage
		• Oil spill/Oily water discharge
		• Impacts to Project production
		• Impacts to vessel personnel
			• Vessel damage
			• Movement of hydrocarbon pollutants in the marine environment
			• Potential oiling of fauna (particularly seabirds) leading to injury or mortality
			• Interaction with other marine vessel users along the transhipment route
				• Ensure all Project vessels have a SOPEP, including in the event of vessel sinking
				• All vessels will be equipped with appropriate equipment for navigation and safety in compliance with Marine Order 30
				• Vessel crew comply to Marine Order 30, including:
				  • Adherence to steering and sailing rules including maintaining lookouts (e.g., visual, hearing, radar, etc.), proceeding at safe speeds, assessing the risk of collision and taking action to avoid collision (monitoring radar).
				  • Adherence to navigation light display requirements, including visibility, and light position/shape appropriate to activity.
				  • Adherence to navigation noise signals as required.
				• Implementation of Marine Order 21 (safety of emergency arrangements) 2016, including
				  • Adherence to minimum safe manning levels
				  • Navigational systems and equipment required are those specified in Regulation 19 of Chapter V of Safety of Life at Sea
				• Automatic Identification System (AIS) that provides other users with information about the vessel's identity, type, position, course, speed, navigational status and other safety-related data
					unlikely	C1	2 - low

5. Hydrocarbon and Chemical Spill Monitoring and Management Program

5.1. Rationale and approach

Following on from the risk assessment, management actions have been defined to reduce the impact of the risks identified as they align with the management objectives outlined in Section 2.1. The implementation of the management actions aims to identify hazards early and minimise the impact. An overview of the hydrocarbon and chemical management targets and actions are outlined in Table 5.

The likelihood of all hydrocarbon spills resulting in significant impacts is considered rare after mitigation measures are applied. Therefore, it is unlikely that there would be a loss to benthic habitat or marine fauna resulting from hydrocarbon spills.

Table 5: Overview of the hydrocarbon and chemical management targets and actions

Management Targets	Management Actions			Performance
	Actions	Monitoring	Reporting/ Evidence	Timing
ESSP operations				
Achieve zero hydrocarbon spills into the marine environment from fuel storage onboard construction vessels.	• Construction vessels shall have and implement a SOPEP, including having spill control equipment/materials available on board. • All vessel-based personnel will receive adequate training to understand and implement the SOPEP, appropriate to their job role and responsibilities. • Inspections of all equipment on board vessels to ensure compliance with the manufacture's recommendations and/or dredging contractor's vessel management systems. • Ensure compliance to the *Pollution of Waters by Oil and Noxious Substances Act 1987.*	• Engineering controls are inspected for faults weekly • Operational equipment to be routinely inspected	• Weekly inspection checklist • Report incidents (see section 7.1)	Construction and Operational phase: Internal: • Incident reporting (as required). • Operations reporting (monthly). External: Routine regulatory reporting as required by approvals under *Port Authorities Act 1999*, and Part IV and Part V of the EP Act (PPA & DWER, Annual).
Achieve no hydrocarbon or chemical spills from vessel collisions or groundings.	• All construction vessels will be fitted with Automatic Identification Systems (AIS)	• Conduct vessel inspections weekly (see section 5.2.2)	• Weekly inspection checklist	Construction and Operational phase: Internal: • Incident reporting (as required).

Management Targets	Management Actions			Performance
	Actions	Monitoring	Reporting/ Evidence	Timing
	• All vessels will be restricted to a maximum speed of 9 knots in the dredged channel. • Regularly inspect all safety equipment. • Minimised vessel movements.		• Report incidents (see section 7.1) • In accordance with SOPEP	• Operations reporting (monthly). External: Routine regulatory reporting as required by approvals under *Port Authorities Act 1999*and Part IV and Part V of the EP Act (PPA & DWER, Annual). As required by State and Commonwealth requirements for maritime environmental emergencies i.e. Department of Transport; Australian Maritime Safety Authority
Achieve no hydrocarbon and/or chemical runoff from terrestrial sources.	• Spill kits are accessible in high-risk locations. • All on-site personnel complete site inductions that include the location of spill kits. • All on-site personnel are sufficiently trained to use the spill kits available. • Ensure on-site personnel are aware of all hydrocarbons and chemicals stored onsite through updated MSDSs. • Chemicals and Hydrocarbons will be stored in accordance with AS1940,	• Conduct regular inspections of onshore stormwater control, treatment, and containment systems • Update MSDSs regularly	• Weekly inspection checklist • Report incidents (see section 7.1)	Operational phase: Internal: • Incident reporting (as required). • Operations reporting (monthly). External: Routine regulatory reporting as required by approvals under *Mining Act 1978, Port Authorities Act 1999* and Part IV and Part V of the EP Act (DEMIRS, PPA & DWER, Annual).

Management Targets	Management Actions			Performance
	Actions	Monitoring	Reporting/ Evidence	Timing
	AS 3833 or AS 3780 to minimise the potential for environmental harm. • Storage will only be in designated areas and within the limits specified in applicable Licence conditions under the EP Act.			

Management Targets	Management Actions			Performance
	Actions	Monitoring	Reporting/ Evidence	Timing
Achieve no hydrocarbon spills from faulty fuel-consuming equipment.	• All on-site personnel complete site inductions that include the location of spill kits. • Ensure on-site personnel are aware of all hydrocarbons and chemicals stored onsite through updated MSDSs. • Spill kits are positioned in high-risk locations. • Equipment used is appropriate for the task. • The quantity and capacity of the equipment is appropriate for the task. • Report abnormal fuel consumption rates that may indicate a fuel leak. • Ensure good ventilation in locations where personnel work.	• Conduct weekly inspections of fuel-consuming equipment • Monitor air quality within confirmed spaces.	• Weekly inspection checklist • Report incidents (see section 7.1) • Report abnormal fuel consumption rates.	Construction and Operational phase: Internal: • Incident reporting (as required). • Operations reporting (monthly). External: Routine regulatory reporting as required by approvals under *Mining Act 1978, Port Authorities Act 1999* and Part IV and Part V of the EP Act (DEMIRS, PPA & DWER, Annual). Internal: • Incident reporting (as required). • Operations reporting (monthly). External: Routine regulatory reporting as required by approvals under *Mining Act 1978* and Part IV and Part V of the EP Act (DEMIRS & DWER, Annual).

Management Targets	Management Actions			Performance
	Actions	Monitoring	Reporting/ Evidence	Timing
Achieve no uncontrolled accidental fuel combustion.	• Ensure refuelling is in well-ventilated areas.	• Conduct weekly vessel inspections (see section 5.2.2	• Weekly inspection checklist	Internal: • Incident reporting (as required).
Achieve no impact on marine fauna and benthic habitat from hydrocarbon and/or chemical spills.	• Inspect all fuel-consuming equipment and vessels for fuel leaks regularly. • Inspect all engineering containment controls for damage regularly. • Report any leaks or faulty containment equipment. • Maintain all engineering containment controls to manufacturer's standards. • Refueling of machinery only within designated areas.	• Conduct weekly vessel inspections (see section 5.2.2)	• Weekly inspection checklist	Construction and Operational phase: Internal: • Incident reporting (as required). • Operations reporting (monthly). External: Routine regulatory reporting as required by approvals under *Mining Act 1978, Port Authorities Act 1999* and Part IV and Part V of the EP Act (DEMIRS, PPA & DWER, Annual). As required by State and Commonwealth requirements for maritime environmental emergencies i.e. Department of Transport; Australian Maritime Safety Authority.

Management Targets	Management Actions			Performance
	Actions	Monitoring	Reporting/ Evidence	Timing
CPE Port operations				
Achieve zero hydrocarbon spills into the marine environment from fuel storage onboard operational and transhipment vessels.	• Vessels shall have and implement a SOPEP, including having spill control equipment/materials available on board. • All vessel-based personnel will receive adequate training to understand and implement the SOPEP, appropriate to their job role and responsibilities. • Inspections of all equipment on board vessels to ensure compliance with the manufacture's recommendations and/or dredging contractor's vessel management systems. • Ensure compliance to the *Pollution of Waters by Oil and Noxious Substances Act 1987.*	• Engineering controls are inspected for faults weekly • Operational equipment to be routinely inspected	• Weekly inspection checklist • Report incidents (see section 7.1)	Construction and Operational phase: Internal: • Incident reporting (as required). • Operations reporting (monthly). External: Routine regulatory reporting as required by approvals under *Port Authorities Act 1999*, and Part IV and Part V of the EP Act (PPA & DWER, Annual).
Achieve no hydrocarbon or chemical spills from vessel collisions or groundings.	• Project transhipper vessel will be fitted with Automatic Identification Systems (AIS) • During product loading, an exclusion zone of at least 300m around the loading vessel will apply for all other vessels.	• Conduct vessel inspections weekly (see section 5.2.2)	• Weekly inspection checklist • Report incidents (see section 7.1)	Construction and Operational phase: Internal: • Incident reporting (as required). • Operations reporting (monthly).

Management Targets	Management Actions			Performance
	Actions	Monitoring	Reporting/ Evidence	Timing
	• All vessels will be restricted to a maximum speed of 9 knots in the dredged channel. • Regularly inspect all safety equipment. • Minimised vessel movements.		• In accordance with SOPEP	External: Routine regulatory reporting as required by approvals under *Port Authorities Act 1999*and Part IV and Part V of the EP Act (PPA & DWER, Annual). As required by State and Commonwealth requirements for maritime environmental emergencies i.e. Department of Transport; Australian Maritime Safety Authority
Achieve no uncontrolled accidental fuel combustion.	• Ensure no live flames or ignition points are in proximity to the jetty and transhipper.	• Conduct weekly vessel inspections (see section 5.2.2	• Weekly inspection checklist	Internal: Incident reporting (as required).
Achieve no uncontrolled accidental fuel combustion.	• Ensure refuelling is in well-ventilated areas.	• Conduct weekly vessel inspections (see section 5.2.2	• Weekly inspection checklist	Internal: Incident reporting (as required).
Achieve no impact on marine fauna and benthic habitat from hydrocarbon and/or chemical spills.	• Inspect all fuel-consuming equipment and vessels for fuel leaks regularly. • Inspect all engineering containment controls for damage regularly. • Report any leaks or faulty containment equipment.	• Conduct weekly vessel inspections (see section 5.2.2)	• Weekly inspection checklist	Construction and Operational phase: Internal: • Incident reporting (as required). • Operations reporting (monthly). External:

Management Targets	Management Actions			Performance
	Actions	Monitoring	Reporting/ Evidence	Timing
	• Maintain all engineering containment controls to manufacturer's standards.			Routine regulatory reporting as required by approvals under *Mining Act 1978, Port Authorities Act 1999* and Part IV and Part V of the EP Act (DEMIRS, PPA & DWER, Annual). As required by State and Commonwealth requirements for maritime environmental emergencies i.e. Department of Transport; Australian Maritime Safety Authority.

5.2. Monitoring

5.2.1. Inductions

Site-based personnel will undergo inductions to familiarise themselves with the site, jetty and/or each vessel. The SOPEP and material safety data sheets (MSDS) will be made available to all site-based personnel. Site-based personnel will receive spill response training.

5.2.2. Inspections

Inspections will be conducted to ensure equipment is maintained according to the manufacturer's recommendations. Inspections will be conducted, but not limited to the following:

- Vessel equipment (including navigation and safety equipment)
- Vessel fuel stores (including checking for leaks)
- Hydrocarbon engineering containment controls onboard all vessels
- Terrestrial hydrocarbon engineering containment controls (i.e., stormwater and runoff containment controls, bunding of berth edge, spill plates, and self-containing hydraulic oil drip tray management systems)
- All fuel-consuming equipment on-site
- Presence and preparedness of spill kits

All inspections will be conducted with the aid of inspection checklists. Photographs will be used for collecting supporting evidence to accompany checklists.

5.3. Audits

Regular audits (at a frequency to be stipulated by approval conditions) will be implemented to ensure regular inspections are occurring, and that any corrective actions have been actioned in acceptable timeframes. Audits will also ensure all processes and system documentation are up to date and available to all operational personnel (i.e. the Induction register, MSDS and the SOPEP).

5.4. Incident Monitoring

In the event of a hydrocarbon or chemical spill, the spill will be cleaned immediately by on-site personnel with the aid of the spill kits. Following an incident, the following information needs to be recorded for spills where possible/relevant:

- Date and time of incident
- Position (latitude and longitude or true bearing and distance)
- Radio stations and frequencies being monitored
- Time of next report
- Brief description of actual pollution (type of hydrocarbon, estimate quantity discharged, whether discharge is continuing, cause of discharge, and if possible, estimate the movement of the slick)

- Weather and sea conditions
- Actions being taken regarding the spill (including what equipment and method is being used)
- Potential impacts of the spill (including known sensitivities and protection priorities)

If a spill originates from a project vessel, the additional information needs to be recorded with the above information:

- Vessel name, call sign, and flag of vessel
- True course, speed, route information
- Type, and quantities of cargo on board
- Condition of the vessel (including ability to transfer cargo, ballast, or fuel)
- Name, address, telephone and facsimile for the vessel owner and representative
- Type of vessel, length, breadth, tonnage

6. Adaptive Management

The Hydrocarbon and Chemical Spill Monitoring and Management Program contained in this document is a living document and will be regularly reviewed in accordance with Table 6. Leichhardt are committed to continual improvement and will conduct regular review of the content and implementation of this plan.

Table 6: Hydrocarbon and Chemical Spill Risk Assessment and Management Plan review timetables

Timing	Rationale
Upon receipt of Approval Conditions	Ministerial Statement and/or Licence conditions obtained may necessitate a comprehensive review of the Plan to ensure all relevant aspects are covered to ensure compliance.
Prior to commencement of action	To ensure that the contractor and approval holder implement all commitments accordingly and that operational details are fully compliant.
Any time operational activities significantly change	Operational changes to the project may change the risk profile. Therefore, this document will require a review to ensure that it remains applicable and relevant to changed operational conditions.
Following any significant incident 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-compliance.

7. Reporting

Monthly operations reports will include a report on the weekly vessel and equipment inspections. This report will include any issues flagged that require corrective action. Any corrective actions should be actioned in acceptable timeframes.

7.1. Incident Reporting

The Leichhardt Environmental Manager and Environmental Advisor will be notified immediately following any hydrocarbon or chemical spills in the marine environment (irrespective of quantity or volume). The following external stakeholders will also be notified:

- A Marine Pollution Report (POLREP) report will be submitted to the Department of Transport (DoT) immediately (no later than 12 hours after the incident).
- A "Marine Incident Report" form will be submitted to DoT in the event of a vessel collision within 7 days of the incident or as required by State and Commonwealth requirements for maritime environmental emergencies i.e. Department of Transport; Australian Maritime Safety Authority.
- A documented report provided to the Leichhardt Environment Manager in accordance with the Leichhardt Hazard and Incident Reporting procedures.
- In the event people, property or the environment are significantly harmed as a result of the spill Leichhardt may report the incident to (depending on location and impact):
    - DEMIRS using their Dangerous Goods Incident Report Form, submitted within 3 days of the accident
    - Pilbara Ports (if within *Port Authorities Act 1999* land or waters)
    - Department of Water and Environmental Regulation (DWER) in accordance with Section 72 of the *Environmental Protection Act 1986.*

8. References

O2 Marine (2025a). Dredging and Spoil Disposal Monitoring and Management Plan. Report No.210397. Prepared for Leichhardt Salt Pty Ltd.

O2 Marine. (2025b). Marine Environmental Quality Monitoring and Management Plan. Report No. R210456. Prepared for Leichhardt Salt Pty Ltd.

O2 Marine (2025c). Appendix C - Hydrocarbon and Chemical Spill Risk Assessment and Management Plan. Prepared for Leichhardt Salt Pty Ltd.