Onslow Seawater Desalination Plant

Operational Marine Environmental Monitoring & Management Plan

January 2021

Fresh Water Thinking | WATER CORPORATION

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Version Register

Version	Status	Author	Reviewer	Change from Previous Version	Authorised for Release (signed and dated)
0	Final	R Stevens J Abbott	C Lane J Phillips	Client comments addressed	

Corporate Endorsement

Water Corporation certifies the Operational Environmental Management Plan has been reviewed and commits to implementing all Management Actions within the document. …… is approved to sign as a designated officer on behalf of the Water Corporation.
Name: **Signed:**
Designation: **Date:**

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Executive Summary

Proposal Name	Onslow Seawater Desalination Plant
Proponent Name	Water Corporation
Short Description	The Proponent intends to construct and operate a seawater desalination plant to supply potable water to the town of Onslow, Western Australia. Seawater intake and brine wastewater release will occur in Beadon Bay approximately 800 m seaward from the shoreline. The desalination processing facility is to be located at Lot 551-553 Beadon Creek Road and will feed the towns existing drinking water storage tanks at Lot 880 Onslow Road
Ministerial Statement	TBA if required
Purpose of the OMEMMP	The purpose of this Operational Marine Environmental Monitoring & Management Plan (OMEMMP; the Plan) is to establish a framework to ensure that the implementation of the project does not compromise the Environmental Values (EVs) and associated Environmental Quality Objectives (EQOs) of the project area.
Key environmental factors/outcomes and objectives	Factor: Marine Environmental Quality. Objective/Outcome: To maintain the quality of water, sediment, and biota so that environmental values are protected. Specifically, the proposal operations (intake and brine water release) shall not compromise the environmental values of the marine environment in Beadon Bay and surrounding areas.
Proposed Construction Date	TBA
OMEMMP require pre-construction?	Yes

Acronyms and Abbreviations

Acronym/ Abbreviation	Description
ANZG	Australian and New Zealand Guidelines
BCH	Benthic Communities and Habitat
DAF	Development Area Footprint
DO	Dissolved Oxygen
EPA	Environmental Protection Authority
EQC	Environmental Quality Criteria
EQI	Environmental Quality Indicator
EQMF	Environmental Quality Management Framework
EQO	Environmental Quality Objective
ESD	Environmental Scoping Document
EV	Environmental Value
HEDP	Hydroxyethylidene Diphosphonic acid
HEPA	High Ecological Protection Area
LEP	Level of Ecological Protection
LEPA	Low Ecological Protection Area
MEQ	Marine Environmental Quality
OMEMMP	Operational Marine Environmental Monitoring & Management Plan
MEQP	Marine Environmental Quality Plan
NWQMS	National Water Quality Management Strategy
MT	Management Target
Mtpa	Million tonnes per annum
ppt	parts per thousand
RO	Reverse Osmosis
SPL	Species Protection Level
SDP	Seawater Desalination Plant
WET	Whole Effluent Toxicity

1 Introduction

1.1 Proposal Description

The Water Corporation propose to construct a seawater desalination plant ('the project') in the town of Onslow, Western Australia. This project will establish a reliable drinking water supply to the town, which is currently supplied from the Cane River borefield. The seawater desalination plant (SDP) will supply fresh water to the town of Onslow and will replace the existing supply from the Cane River borefield as the volume of fresh water has been decreasing. The project will involve the installation of permanent subtidal infrastructure in Beadon Bay (intake head, brine diffusers and transport pipes), a land-based processing plant, and piping to the existing town storage tanks. A short description of the proposal is included in the Executive Summary of this document.

During the seawater desalination process there is no requirement to add biocides or process chemicals, as is common with larger reverse osmosis (RO) plants. An antiscalant (sodium HEDP) will be required to prevent scaling of the RO membranes.

The resulting brine will be released into Beadon Bay via pipeline and diffuser, at rates of up to 2.44 ML/day. The brine will typically be characterised by high salinity (~ 75-77 ppt), increased temperature (~4°C above background) and concentrated naturally occurring compounds.

A summary of the key characteristics is provided in **Table 1-1.**

Table 1-1 Key proposal characteristics

Element	Location	Proposed Extent
Physical Elements		
Seawater intake	Figure 1-1	0.02 ha of intertidal and subtidal BCH, extending approximately 800m offshore into Beadon Bay.
Diffuser outfall	Figure 1-1	Disturbance areas aligned with dilution plume of intertidal and subtidal BCH, extending approximately 800m offshore into Beadon Bay.
Intake/outfall pipeline	Figure 1-1	Lots 551-553 Beadon Creek Rd, Onslow. Land clearing within Lots 551-553 of up to 3.5 ha.
Desalination plant	Figure 1-1	Within existing access track behind coastal dune out to storage tank facility.
Storage supply pipeline	Figure 1-1	
Operational Elements		
Seawater intake	Figure 1-1	Flow rate up to 2.44 ML/day discharged of brine to Beadon Bay*.
Brine release	Figure 1-1	Establishment of a Low Ecological Protection Area (LEPA) surrounding the brine outfall in Beadon Bay.

***In accordance with the Environmental Protection Regulations 1987, Schedule 1, Part 1, Category 54A, this volume is less than the Production Design Capacity of 10 gigalitres per year, and therefore is not considered a Prescribed Premise.*

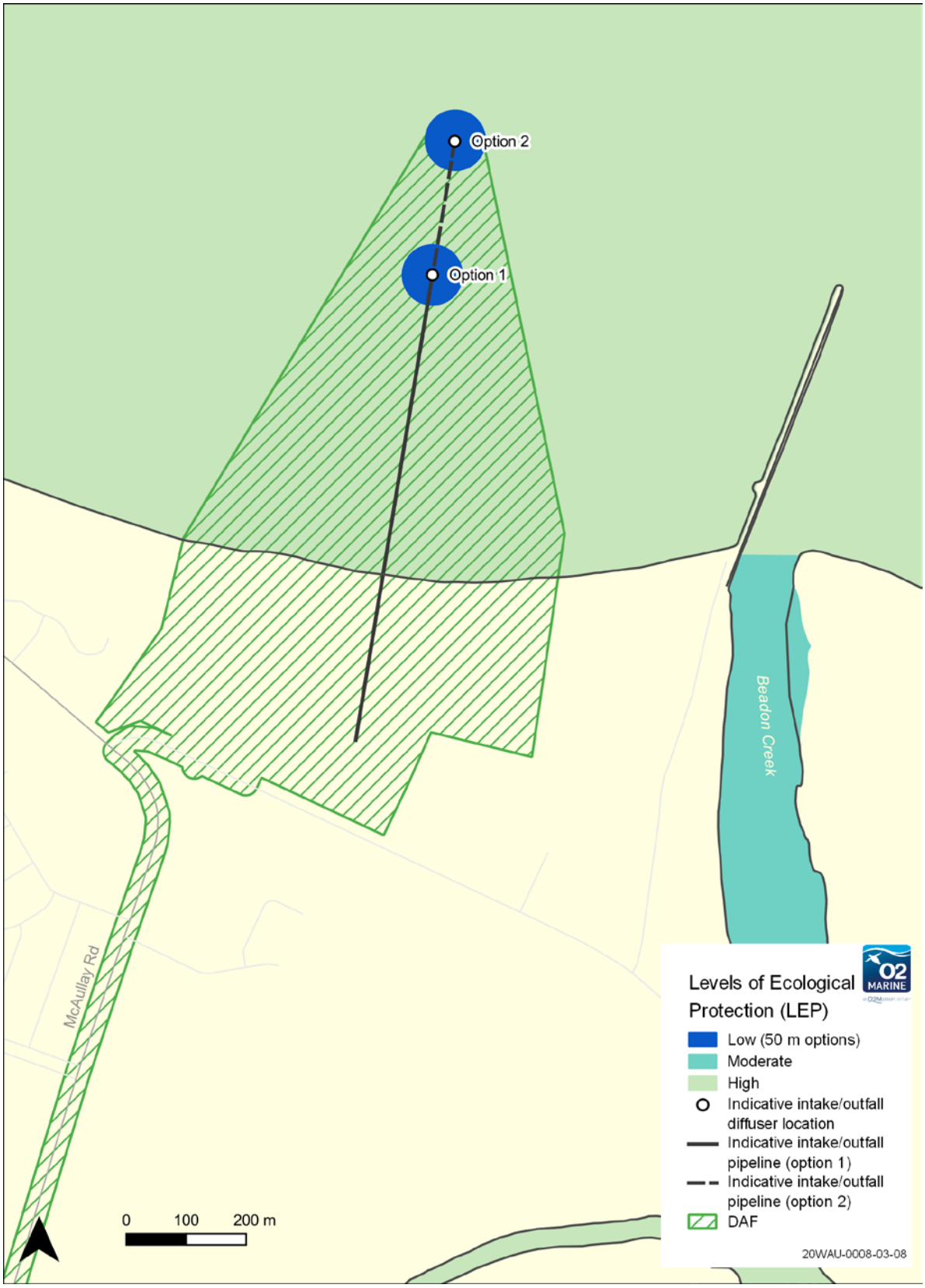

Figure 1-1 Proposed Onslow SDP infrastructure layout and associated development footprint

1.2 Key Environmental Factors

The SDP operations include the release of brine wastewater. This product will contain higher salinity concentrations, higher temperatures and lower dissolved oxygen levels compared to the natural waters of Beadon Bay. The key environmental factors (as defined in EPA 2018) and the associated Environmental Objectives that are relevant to this Project are summarised in **Table 1-2**.

Table 1-2 Key environmental factors and objectives relevant to the Onslow SDP

EPA Theme	EPA Factor	Environmental Objective	Pathway
Sea	Marine environmental quality	Maintenance of ecosystem integrity	The project has the potential to modify water quality during the operational phase through processing of seawater and discharge of the desalination waste stream (brine).
		Maintenance of aesthetic values	Impacts to social surroundings and values may occur due to changes to water quality during the discharge of brine 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 considered to be protected through maintenance of marine environmental quality.

A Low Ecological Protection Area (LEPA) has been designated around the proposed outfall and no impacts to marine environmental quality (MEQ) arising from the brine wastewater discharge are permitted beyond the LEPA.

1.3 Purpose of this OMEMMP

The purpose of this Operational Marine Environmental Monitoring & Management Plan (OMEMMP; the Plan) is to establish a framework to ensure that the implementation of the project does not compromise the Environmental Values (EVs) and Environmental Quality Objectives (EQOs) of the project area.

The OMEMMP establishes a process for monitoring and reporting residual impacts against acceptable limits of ecological change during the lifecycle of the project. Where results outside the limits of acceptable change are reported specific management actions are triggered to ensure the EVs and associated EQOs are not compromised.

1.4 Policies and Guidelines

This OMEMMP has been drafted in consideration of the following guidance:

- *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (EPA 2020)
- *Technical Guidance – Protecting the Quality of Western Australia's Marine Environment* (EPA 2016).

2 Rationale & Approach

2.1 Environmental Quality Management Framework

The EPA has prepared an Environmental Quality Management Framework (EQMF) for Western Australia's coastal waters (EPA 2016). This EQMF is based on:

- identifying Environmental Values (EVs)
- establishing Environmental Quality Objectives (EQOs) and spatially defining Levels of Ecological Protection (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 Environmental Quality Criteria (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.

The key elements of the EQMF as it applies to the Onslow SDP are outlined below.

2.1.1 Environmental Values & Environmental Quality Objectives

The EVs and associated EQOs for the Pilbara marine environment are already well established in Pilbara Coastal Waters Consultation Outcome (DoE 2006). Five EVs and eight corresponding EQOs apply to the SDP Project area. These EVs and corresponding EQOs are presented in **Table 2-1**.

Note that while the five EVs and 8 EQOs are relevant to the Project, only EQOs 1, 4 and 6 require development of EQIs under this plan. The remainder are not considered at risk from implementation of the project if EQO1 is met.

Table 2-1 Environmental Values and Environmental Quality Objectives applicable to the Project area

Environmental Values	Environmental Quality Objectives	Relevant for Establishment of EQIs
Ecosystem Health	EQO1: Maintenance of ecosystem integrity. EQO1 is split into four sub-objectives, being: Maximum, High, Moderate and Low Levels of Ecological Protection (LEPs) (Refer Section 2.3 below).	Yes
Fishing and Aquaculture	EQO2: Seafood (caught) is of a quality safe for human consumption.	Protection of Ecosystem Health will protect this EQO
Recreation & Aesthetics	EQO4: Water quality is safe for primary contact recreation (e.g. swimming and diving).	Protection of Ecosystem Health will protect this EQO
	EQO5: Water quality is safe for secondary contact recreation (e.g. fishing and boating).	Protection of primary contact recreation EQO 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.	Protection of Ecosystem Health will protect this EQO
Industrial Water Supply	EQO8: Water quality is suitable for industrial supply purposes.	Protection of Ecosystem Health will protect this EQO

2.1.2 Levels of Ecological Protection

In accordance with EPA (2016), the objective for 'Ecosystem Health' is spatially allocated into four Levels of Ecological Protection (LEPs): Maximum, High, Moderate and Low. Each LEP area is assigned an acceptable limit of change as described within EPA (2016). LEP boundaries have been previously described for the SDP project area in the *Pilbara Coastal Water Quality Consultation Outcomes* (DoE 2006). These existing LEP boundaries were reviewed and updated in the context of the proposed SDP brine outfall to spatially define proposed LEPs around the project infrastructure and are presented in **Figure 1-1**.

2.1.3 Environmental Quality Criteria

In this OMEMMP, EQG are adopted as trigger levels and EQS as thresholds. If monitored values are below the EQG then the EQO are considered to have been met and the EPA Factors protected. If an EQG is exceeded, there is an increased risk that the associated EQO may not be achieved and assessment against the EQS is triggered. 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.

2.2 Key Environmental Impacts

The key threat to marine environmental quality is the discharge of high-salinity brine (i.e. salinity >75 ppt in Dry Season and >77ppt in Wet Season) into the marine environment through a diffuser located at one of two options offshore from Onslow Beach in Beadon Bay

(**Figure 1-1**). Key elements of the preliminary diffuser design and configuration are provided in **Table 2-2**.

Table 2-2 Preliminary diffuser design and configuration

Design Parameters	Details
Location:	Outfall is located on the seafloor 450 m (option 1) or 800 m (Option 2) offshore in Beadon Bay, Onslow.
Coordinates (MGA50):	Option 1: E 306082, N 7606075 Option 2: E 306115, N 7606292
Water Depth:	-2.6 m CD to -2.9 m CD (depending on outfall location)
No. of Ports:	Single port
Port Spacing:	1 m above seabed
Port Diameter:	0.2 m
Port Angle:	Single port per riser. Port angle in horizontal plane: 90º to dominant current direction. Port angle in vertical plane: 45º
Discharge Regime:	Constant Discharge
Discharge Velocity:	0.9 m/s
Discharge Flow Rate:	0.028 m^3/s
Discharge Volume:	2.44 ML/day
Discharge Temperature:	+4°C above receiving water
Raw Brine Salinity:	75 ppt Dry Season, 77 ppt Wet Season
Whole Effluent Toxicity (WET) Results	99% SPL requires 23 dilutions – target brine concentration 4.4%
	80% SPL requires 8 dilutions – target brine concentration 13.0%

Source: Baird (2020)

Desalination plants produce brine effluent that may also contain constituents that can alter marine environmental quality, including high salt concentrations, chemicals, and metals (in-particular iron, used for flocculation and removal of particulates prior to reverse osmosis (RO) treatment). The proposal will not include discharge of biocides or process chemicals other than the antiscalant.

A conceptual model for the Onslow SDP project (**Figure 2-1**) has been developed which presents the key threats and their associated pressures. These are then contextualised into the pressure/response pathways through identification of the environmental indicators though which the pressures and threats act to reduce MEQ if not appropriately managed. The operational activities and associated potential impact pathways are further described in **Table 2-3**.

Table 2-3 Operational activities and potential impact pathways

Facilities	Operational Activities	Potential Environmental Impact Pathway	EQO at Risk
Brine Discharge Operations	Discharge of brine (i.e. 2.44 ML/day) to the marine environment.	Localised impact to water/sediment quality due to changed water quality conditions down-current from and adjacent to the brine outfall. Risks to water quality outside LEPA are primarily associated with diffuser not operating as expected or modelling predictions being incorrect.	EQO1 – EQO8

Potential operational impacts considered relevant to operation of the Onslow SDP that require active monitoring include:

- changes to marine salinity (osmotic stress)
- elevated water temperature (thermal stress).

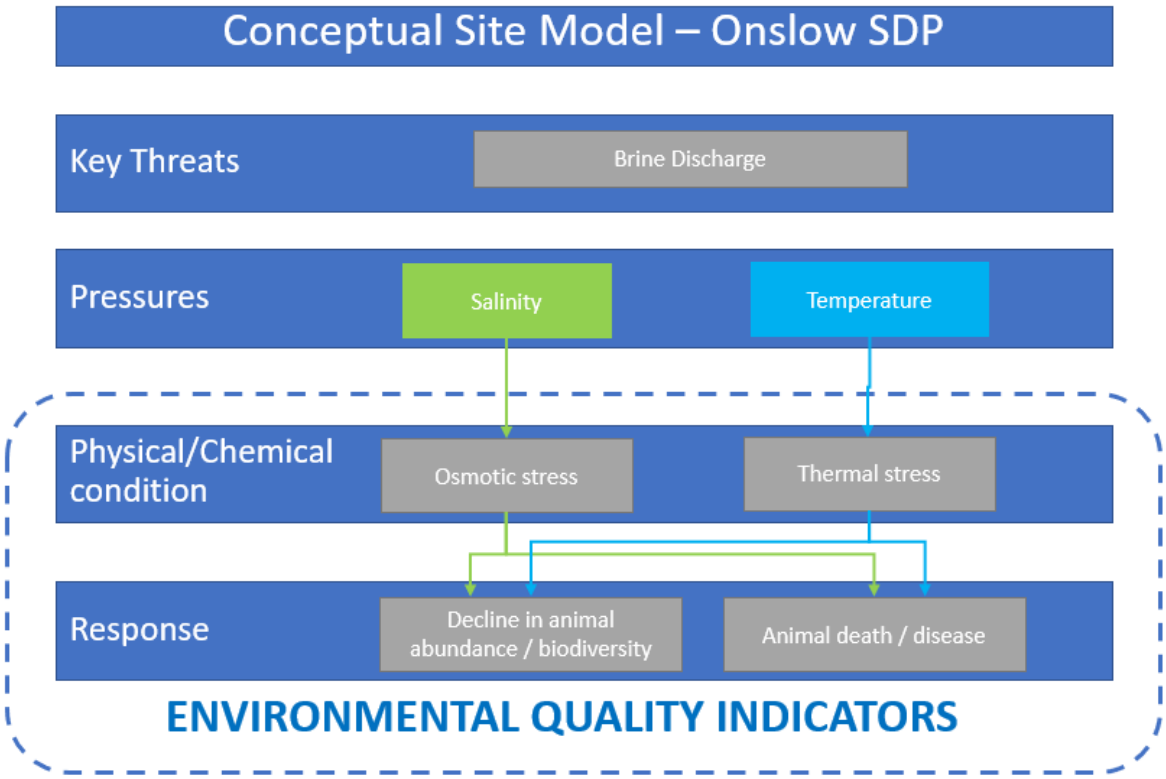

Figure 2-1 Conceptual model for the Onslow SDP project

2.3 Scope of OMEMMP

The scope of the OMEMMP applies to the discharge of brine that has the potential to impact on the environmental quality of the marine environment of the project area. The OMEMMP has been designed to monitor, report, and manage potential impacts on marine environmental quality related to the operational phase of the SDP project. The key phases of the operations covered in this plan include:

- SDP commissioning
- SDP operations.

Project activities associated with offshore and onshore construction are managed through their respective, specialised environmental management plans.

3 Monitoring & Management

3.1 Overview

To ensure that defined EVs and associated EQOs to *maintain the quality of water, sediment, and biota so that environmental values are protected* through commissioning and routine operation of the Onslow SDP facility, a comprehensive monitoring and management program is proposed for each phase. The elements of the monitoring and management program are separated into 'commissioning' and 'operations' phases as they relate to potential MEQ impacts from the Project.

3.2 Commissioning Phase

Monitoring and management actions proposed to mitigate potential impacts of the Onslow SDP on MEQ during the commissioning phase are described in **Table 3-1**.

It is noted that, monitoring and management during the commissioning phase is intended to inform operational adjustments that may be required to ensure that the designated LEPs can be achieved throughout ongoing routine operations. Therefore, during commissioning, failure to achieve the performance targets at the HEPA/LEPA boundary is not considered to be a non-compliance and no reactive monitoring, investigations and/or compliance reporting is required.

3.3 Operations Phase

Monitoring and management actions proposed to mitigate potential impacts of the Onslow SDP on MEQ during the operations phase are described in **Table 3-2**.

Table 3-1 Performance monitoring and management proposed to be undertaken during commissioning of the Onslow SDP

Monitoring Program			Performance Target (s)	Management Response	Reporting
Rationale	**Approach**	**Timing / Frequency**			
Brine Toxicity Evaluation					
Whole of effluent toxicity (WET) of final brine product is required to confirm the number of dilutions of brine required to achieve 99% SPL at HEPA/LEPA boundary.	Undertake WET testing to confirm toxicity of final brine waste from the Onslow SDP.	Following SDP completion, as soon as brine sample is available. AND Whenever composition of brine has been permanently changed.	Minimum level of dilution as defined by WET testing to achieve a 99% SPL at the LEPA/HEPA boundary.	If the performance target is not achieved, then the management response may include, but should necessarily be limited to: > Investigate the potential sources of higher than predicted toxicity (i.e. chemicals). > If possible review and adjust desalination process to reduce brine toxicity. > Increase the dilution ratio of brine water prior to discharge. > Adjust discharge regime (e.g. timing, flow rate, volume) where possible.	A WET report will be completed within two months following receipt of laboratory results.
Brine dispersion modelling and diffuser performance requires validation during the commissioning phase of the Onslow SDP to determine the optimum outfall discharge operations required to achieve the specified number of dilutions at HEPA/LEPA boundary.	Measurement of water temperature and salinity of brine prior to release (i.e. within the SDP). AND In-situ measurement of salinity and temperature near the seabed at the LEPA/HEPA boundary.	Program should be implemented during commissioning and will include: > Measurements prior to release should be at least daily for six weeks. > In-situ measurements should be taken at least once every hour for six weeks.	<u>Prior to Release</u> > Salinity ≤75 ppt (dry season) & ≤77 ppt (wet season) > Temperature +4^{o}C <u>HEPA/LEPA Boundary</u> > Salinity <80th percentile of seasonal baseline salinity > Temperature <80th percentile of seasonal baseline temperature	If the performance target(s) are not achieved, then the management response may include, but should necessarily be limited to: > Investigate the cause of exceedance. > Undertake equipment inspection, maintenance and calibration as required. > Adjust dilution ratio of brine water prior to discharge. > Adjust discharge regime (e.g. timing, flow rate, volume) where possible.	A diffuser performance and model validation report will be completed within two months following completion of commissioning.

Table 3-2 Monitoring and management proposed to mitigate impacts on marine environmental quality from operational brine discharge

Pressure (Indicator)	Monitoring Program		Trigger (EQG)	Trigger Exceedance Response	Threshold (EQS)	Threshold Exceedance Response	Reporting
	Approach	Timing / Frequency					
Salinity	Routine Measurement of outfall brine salinity prior to release (i.e. within the SDP). Reactive Measurement of salinity at the locations identified within Figure 3-1.	Routine At least daily throughout operations Reactive Initiated within 5 days following a confirmed EQG exceedance.	Brine salinity should not exceed 80 ppt for more than 7 consecutive days.	In the event of EQG exceedance, management response may include, but should necessarily be limited to: > Investigate the cause of exceedance. > Undertake asset performance monitoring, maintenance and calibration as required. > Adjust dilution ratio of brine water prior to discharge. > Adjust discharge regime (e.g. timing, flow rate, volume) where possible. > Temporary storage of brine on site during periods of low mixing > Initiate reactive investigation to determine if EQS has been exceeded.	Salinity measured near the seabed on the LEPA/HEPA boundary should not exceed the 80th percentile of seasonal baseline salinity for more than 2 consecutive days.[1]	In the event of EQS exceedance, management responses may include, but not be limited to: > Investigate the cause of exceedance. > Undertake asset performance monitoring, maintenance and calibration as required. > Adjust dilution ratio of brine water prior to discharge. > Adjust discharge regime (e.g. timing, flow rate, volume) where possible. > Temporary storage of brine on site during periods of low mixing > Initiate reactive investigation to determine if EQS has been exceeded.	Routine > Monitoring results to be included in routine operational reports. > Operational reports to be included with annual compliance report. > Reactive > An EQG investigation report will be prepared within 30 days of an EQS exceedance. > DWER CEO will be notified within 24 hours of an EQS exceedance. An EQS investigation report will be prepared and issued to the DWER CEO within 3 months of an EQS exceedance.
Temperature	Routine Measurement of water temperature prior to release (i.e. within the SDP). Reactive Measurement of water temperature at the locations identified within Figure 3-1.	Routine At least daily throughout operations. Reactive Initiated within 5 days following a confirmed EQG exceedance.	Brine water temperature should not increase by more than 4˚C above ambient water temperature for more than 7 consecutive days.		Water temperature measured near the seabed on the LEPA/HEPA boundary should not exceed the 80th percentile of seasonal baseline temperature[1].		

[1] Refer seasonal baseline percentile values presented in Appendix B.

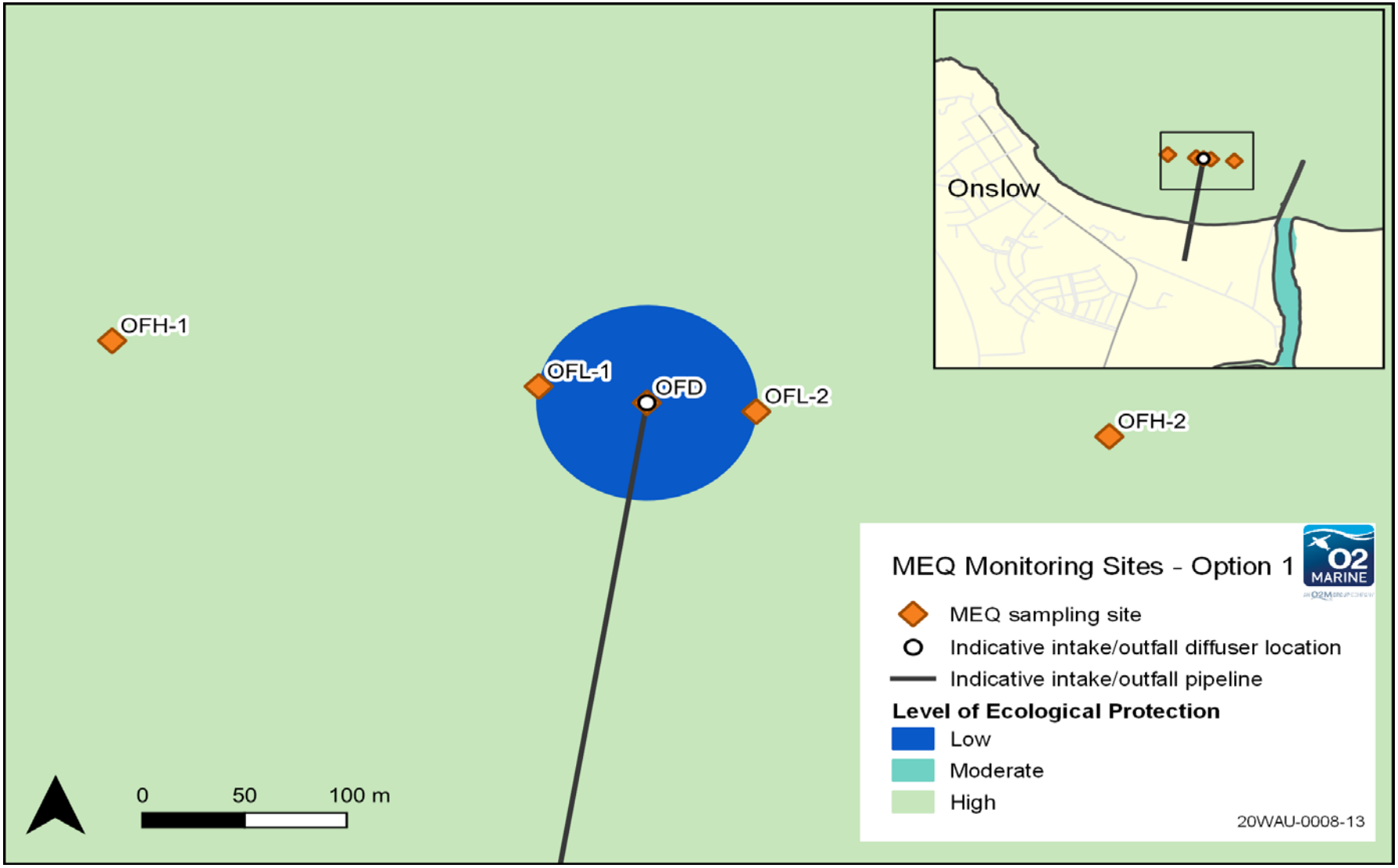

Figure 3-1 Indicative marine water quality monitoring sites

4 Stakeholder Consultation

The Proponent has consulted with stakeholders during the development of the Referral Supporting Document (O2 Marine 2021) for the Onslow SDP proposal. Consultation has included relevant regulatory, local government, industry, and community stakeholders. Stakeholder consultation will continue an as-needed basis through the approvals, design, construction, and operational phases of the Project. For further details of the stakeholder consultation process refer to Section 3 of the Referral Supporting Document (O2 Marine 2021).

5 Implementation

5.1 Roles & Responsibilities

Water Corporation (the Proponent) is responsible for:

- Implementation of this OMEMMP
- Maintaining compliance with the provisions of this OMEMMP
- Reporting on compliance and performance of the operational asset, as applicable
- Reporting any non-compliance incidents.

5.2 Review

This OMEMMP is a living document and will be regularly reviewed in accordance with **Table 5-1** to ensure it remains relevant to the Project and aligns with industry best practice.

Table 5-1 OMEMMP review timeframes for the project lifecycle

Timing	Rationale
Scheduled Review	
Upon receipt of Approval Conditions	Approval conditions obtained will necessitate a comprehensive review of this OMEMMP to ensure all relevant aspects are covered within this Plan to ensure compliance.
Upon completion of Baseline Data Assessment	This review is required to derive the site specific EQCs for the ongoing assessment of Project 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 brine wastewater.
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 OMEMMP 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 OMEMMP 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 OMEMMP will require a review to ensure that it remains fit-for-purpose for altered operational conditions.
Any time brine discharge quality or regime alters	Process or design alterations changes to the brine discharge may result in an altered risk profile. Therefore, the OMEMMP will require a review to ensure that it remains fit-for-purpose for altered operational conditions.

During review of the OMEMMP consideration should be given to (but not limited to):

- overall effectiveness of the Plan
- appropriateness of EVs, EQO and LEPs
- to refine EQC with compiled baseline data set
- new threats to MEQ that may be identified
- lessons learned during sampling or analysis
- changes in industry best practice
- changes in environmental risk
- any changes in methodology or equipment used.

5.3 Amendments

Throughout the life of the Project, any amendments to this OMEMMP will be detailed in **Table 5-2** and the revision status updated accordingly. A tracked change version of the revised OMEMMP will be provided where possible for all minor, non-structural changes to the document. All changes post-assessment must be provided separate to compliance reports and submitted to registrar@dwer.wa.gov.au.

Table 5-2 Summary of OMEMMP update

Item no.	OMEMMP section no.	OMEMMP page no.	Complexity of change	Summary of change	Reason for change

6 References

ANZG (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

ANZECC/ARMCANZ (2000). Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy No 4, Australian and New Zealand Environment and Conservation Council and Agricultural and Resource Management Council of Australia and New Zealand, Canberra, ACT.

Baird (2020). Onslow SDP Hydrodynamic Modelling Report. 15 June 2020. Prepared for Water Corporation by Baird Australia. Report Number: 13166.301.R1.RevA

DoE (2006). Pilbara Coastal Water Quality Consultation Outcomes – Environmental Values and Environmental Quality Objectives. Department of the Environment, Government of Western Australia, Marine Series Report No. 1. pp. 67

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O2 Marine (2020) Onslow SDP Project. Desalination Brine Toxicity Assessment. Prepared for Water Corporation by O2 Marine, Busselton, Western Australia. Report R200092. Rev 0

O2 Marine (2021) Onslow Seawater Reverse Osmosis Proposal: Section 38 Referral Supporting Document. Prepared for Water Corporation by O2 Marine, Busselton, Western Australia. Report R200092.

7 Appendix A Monitoring and Reporting

A.1 Plant Commissioning

A.1.1 Sampling Methods

A.1.1.1 WET Testing

WET testing will be conducted during the commissioning phase when SDP processes and the brine are considered representative of routine operations. The proposed WET testing sampling program will involve two processes namely:

1. Range finding test for toxicity to determine if the effluent is toxic and if so, determine the appropriate concentration range for subsequent tests
2. Definitive toxicity testing to determine the 50% Effect Concentration (EC50), 50% Inhibitory Concentration (IC50), 50% Lethal Concentration (LC50) and No Observed Effect Concentration (NOEC) values of effluent for selected species.

WET testing is proposed to be undertaken on a minimum of five (5) locally relevant species from four (4) taxonomic groups. Testing will be in accordance with laboratory NATA accredited methodologies and in accordance with ANZG (2018) toxicity sampling and testing protocols.

A.1.1.2 Brine Physico-chemical Monitoring

Daily measurements of temperature and salinity will be collected over the six-week commissioning period. Measurements will be obtained from the brine prior to release using a pre-calibrated water quality meter or appropriate inline sensor.

A.1.1.3 In-situ Physico-chemical Monitoring

Measurements of temperature and salinity will be collected on at least an hourly basis over a designated six-week period during commissioning. In-situ loggers attached to seabed frames designed to stand upright on the seabed, while maintaining the instruments at approximately 0.3 m above the seafloor, will be used to collect the in-situ measurements. Data collection will be undertaken at sites OFL1 and OFL2 (**Figure 3-1**).

Water quality instrument maintenance and calibration will be performed prior to the deployment in accordance with manufacturer specifications and appropriate QA/QC protocols. Any maintenance visits will involve retrieval of the instrument frame, maintenance and then re-deployment, typically within a 24-hr period.

A.1.2 Data Assessment and Reporting

A.1.2.1 WET Testing

Upon receival WET testing laboratory results will be validated and a WET testing summary report and compiled within two months of receipt of results which will include, but not be limited to:

- summary of the collection methods applied, tests undertaken and modelling program details
- table and charts, as appropriate, summarising results

- an interpretation of the raw data from the software program used (i.e. BurrilOZ)
- presentation of modelling results with respect to dilution contours to confirm the spatial allocation of LEPs with the LEPA/HEPA boundary required to meet the 99% SPL
- any actions or recommendations required to ensure the EQS has been achieved.

A.1.2.2 Diffuser Performance & Model Validation

Upon completion of the six-week commissioning monitoring, results obtained from daily brine monitoring and continuous in-situ monitoring for temperature and salinity will be compiled into a summary report. Th summary report will be compiled within two months of completion of commissioning and include, but not be limited to:

- summary of the sampling methods applied
- tables and charts, as appropriate, summarising daily brine readings
- tables and charts, as appropriate, summarising in-situ water quality results
- an assessment of all data collected against the performance targets in **Table 3-1**
- a review of remedial actions implemented to improve performance
- an assessment to determine that designated performance targets were consistently being achieved at the completion of the commissioning phase.

A.2 Ongoing Plant Operations

A.2.1 Sampling Methods

A.2.1.1 Routine – Brine Water Quality Sampling

Daily measurements of temperature and salinity will be collected over the six-week commissioning period. Measurements will be obtained from the brine prior to release using a pre-calibrated water quality meter or appropriate inline sensor.

A.2.1.2 Reactive – HEPA/LEPA Monitoring

Measurements of temperature and salinity will be collected on at least a daily basis following the exceedance and will continue until the exceedance has been effectively mitigated. Measurements of salinity and temperature should be made at sites OFL1 and OFL2 (**Figure 3-1**) and can either be made by deployment of in-situ loggers as per Section A1.3.1 or using a pre-calibrated water quality sonde.

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

A.2.2 Data Assessment and Reporting

A.2.2.1 Routine – Brine Water Quality Sampling

Routine daily brine water quality results are to be presented with an assessment against the EQGs identified in **Table 3-2** in the monthly operational reports.

A summary of results recorded annually including assessment against the EQGs identified in **Table 3-2** and will be included within the Annual Compliance Report.

An EQG investigation report will be prepared within 5 days of any EQG in accordance with Water Corporation's Environmental Management System. The investigation report will include, but not be limited to;

- a summary of the exceedance
- a summary of the investigation findings and outcomes
- a summary of preventative and/or corrective actions implemented, including identification that reactive monitoring has or will be undertaken to confirm potential for impacts to occur.

A.2.2.2 Reactive – HEPA/LEPA Monitoring

In the event of an EQS exceedance, the CEO of DWER will be notified and a report provided to the CEO within 3 months describing any subsequent investigations, management actions put into place and success of the actions in returning marine environmental quality to within requirements. The investigation report will include, but not limited to;

- a summary of the exceedance
- a summary of the investigation findings and outcomes
- a summary of preventative and/or corrective actions implemented, including identification that any further environmental investigations (BCH assessment, WET testing etc.) has or will be undertaken to confirm whether ecological impacts, including distribution and severity, have occurred that are not commensurate with the High level of ecological protection.

8 Appendix B Baseline Water Quality Data

Seasonal baseline data within Beadon Bay for water salinity and temperature are summarised in **Table 8-1**. The baseline data period is between June 2019 and March 2021. Updated data and a baseline report will be included following completion of the Baseline Monitoring Program.

Table 8-1 Seasonal water quality data in Beadon Bay (Jun-2019 – Mar 2021)

Season	Month	Salinity (ppt)			Temperature (°C)		
		Median	20th Percentile	80th Percentile	Median	20th Percentile	80th Percentile
Dry Season	May	37.25	36.47	37.67	24.18	21.43	25.53
	June	37.69	35.43	37.50	21.98	21.33	21.85
	July	37.54	37.43	37.50	20.82	20.22	21.40
	August	37.42	37.29	37.55	20.25	19.48	20.96
	September	37.59	37.47	37.69	23.40	22.68	24.33
	October	37.47	37.35	37.58	24.18	23.41	25.06
Wet Season	November	37.54	37.40	37.76	26.47	25.74	27.00
	December	37.50	36.77	37.62	28.35	27.53	29.30
	January	37.59	37.53	37.62	28.76	27.89	29.59
	February	37.61	37.59	37.62	27.39	26.79	28.19
	March	38.45	38.03	38.71	29.19	28.75	29.75
	April	38.09	37.82	38.31	28.39	27.30	29.14