



**PORT AUTHORITY OF NEW SOUTH WALES**

# **Eden Cruise Wharf Modification 3 to SSI 7734**

## **Operational Water Quality Monitoring Program**

311012-01011 \_ Rev2



23 September 2025

Level 19, 420 George Street  
Sydney NSW 2000  
Australia

T: +61 2 9495 0500  
Worley Consulting Pty Ltd  
ABN 50 098 008 818

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PROJECT 311012- 01011 - Eden MOD3 Operational Water Quality Program							
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23 September 2025  
 Level 19, 420 George Street  
 Sydney NSW 2000  
 Australia  
 T: +61 2 9495 0500  
 Worley Consulting Pty Ltd  
 ABN 50 098 008 818

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## Executive summary

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The Port of Eden (the Port) is located within Twofold Bay, in the Bega Valley local government area (LGA). It is the southern-most declared port in New South Wales (NSW), approximately equidistant between Sydney and Melbourne and approximately 40 kilometres (km) from the NSW and Victorian border. The Eden Cruise Wharf is located at the western end of Weecoon Street, within Snug Cove, which is on the northern side of Twofold Bay. Worley Consulting Pty Ltd (Worley) has been engaged by Port Authority of New South Wales (Port Authority) to prepare an Operational Water Quality Program in accordance with Conditions D10, D11 and D21 of the SSI 7734 MOD 3 Conditions of Approval.

The Operational Water Quality Programs outlined in this report will be implemented in response to the following triggers/events:

- The first planned Oasis and Quantum Vessel (or equivalent) berth events
- The first cruise season with over 60 cruise vessel visits.

For the first Oasis and Quantum Vessel (or equivalent) events, water quality monitoring would be undertaken over three days including the day prior to berthing, day during berthing and day following berthing. There would be 12 monitoring sites included in this program, the location of these sites has been selected to encompass the extent of the predicted vessel generated sediment disturbance modelling domain and the sensitive receptors of aquaculture leases and seagrasses. Physiochemistry parameters (dissolved oxygen (DO), turbidity, temperature, conductivity/salinity and pH) would be measured using a hand held water quality meter throughout the water column, every hour for six hours per day, for the three days. Water samples would be collected at the same 12 sites using a suitable grab sampling method, for measurement of total suspended solids (TSS), twice per day, at two water depths, for the three days. The intent of this program is to compare the actual operational performance against the predicted performance to validate MOD 3 water quality modelling studies and impact assessment on identified sensitive receptors.

For the first cruise season that has over 60 vessel visits, a longer-term continuous monitoring program would be implemented throughout a cruise season. Two water quality loggers would be deployed at the locations of the sensitive receptors of the aquaculture leases and the seagrasses to monitor pH, DO and turbidity. The length of the deployment would be for one month prior to the cruise season to one month following the cruise season (September – May). The intent of this program is to compare the actual operational performance against the predicted performance to validate MOD 3 water quality modelling studies and impact assessment on identified sensitive receptors capturing a longer-term dataset and all conditions, including periods of storms and stronger currents.

## Acronyms and abbreviations

Acronym/abbreviation	Definition
<b>ANZECC (2000)</b>	Australian and New Zealand Environment Conservation Council
<b>ANZG (2018)</b>	Australian and New Zealand Fresh and Marine Water Quality Guidelines
<b>BOM</b>	Bureau of Meteorology
<b>DGV</b>	Default Guideline Value
<b>DO</b>	Dissolved oxygen
<b>EA</b>	Environmental Assessment
<b>EAC</b>	Eastern Australian Current
<b>EPA</b>	Environmental Protection Authority
<b>HAT</b>	Highest Astronomical Tide
<b>LGA</b>	Local government area
<b>LOR</b>	Limit of Reporting
<b>MHL</b>	Manly Hydraulics Laboratory
<b>MOD 3</b>	Eden Cruise Wharf Modification 3 to SSI 7734
<b>NATA</b>	National Association Testing Authority
<b>NSW DPI</b>	New South Wales Department of Primary Industries
<b>NSW DPIRD</b>	New South Wales Department of Primary Industries and Regional Development
<b>NTU</b>	Nephelometric Turbidity Units
<b>PAH</b>	Polyaromatic hydrocarbons
<b>ppt</b>	Part per thousand
<b>SSI</b>	State Significant Infrastructure
<b>TDS</b>	Total dissolved solids
<b>TRH</b>	Total recoverable hydrocarbons
<b>TPH</b>	Total petroleum hydrocarbons
<b>TSS</b>	Total suspended solids
<b>QAQC</b>	Quality Assurance and Quality Control

# 1. Background

## 1.1 Port of Eden

The Port of Eden (the Port) is located within Twofold Bay, in the Bega Valley local government area (LGA). It is the southern-most declared port in New South Wales (NSW), approximately equidistant between Sydney and Melbourne and approximately 40 kilometres (km) from the NSW and Victorian border. The Eden Cruise Wharf is located at the western end of Weecoon Street, within Snug Cove, which is on the northern side of Twofold Bay (Figure 1-1). The Eden Cruise Wharf is located approximately 800 metres (m) from the Eden town centre, with the closest residences being approximately 250 m from the Eden Cruise Wharf in an easterly direction.

Twofold Bay is an open oceanic embayment with a catchment area of approximately 11 km<sup>2</sup> and an average depth of approximately 10.9 m. Twofold Bay is the third deepest natural harbour in the Southern Hemisphere. The area adjacent to the Eden Cruise Wharf (Breakwater Wharf Extension Project) was dredged in 2017 to -10.5 m.



Figure 1-1 Location of the Wharf (Base Map: Nearmap 2024)

## 1.2 Scope of Works

Worley Consulting Pty Ltd (Worley) has been engaged by Port Authority of New South Wales (Port Authority) to prepare an Operational Water Quality Program in accordance with Conditions D10, D11 and D21 of the Eden MOD 3 Conditions of Approval (Table 1-1).

## 1.3 Approval Conditions

The approval conditions that are relevant to the Operational Water Quality Program and how they are addressed in this program is outlined in Table 1-1.

Table 1-1 MOD 3 Relevant Conditions of Approval

Conditions		Approval Conditions	Response
<b>D10</b>	Operational Monitoring Programs	<b>Operational Monitoring Program(s)</b> must be prepared to compare actual operational performance against predicted performance of that identified in <b>Condition A1c(ix) and (x)</b> . The <b>Operational Monitoring Program(s)</b> must be prepared in consultation with identified relevant authorities. Details of information requested by an agency during consultation must be provided to the Planning Secretary as part of any submission of the relevant <b>Operational Monitoring Program</b> , including copies of correspondence from those agencies as required by <b>Condition A7</b> .	Water quality monitoring programs have been prepared to compare the operational performance against predicted performance in the environmental approvals. Refer to Section 4 and Section 5.  Refer to Section 1.4 and <b>Appendix C</b> regarding details of consultation with agencies.
<b>D11</b>	Operational Monitoring Program	a) Details of baseline data.	Refer to Section 3.
		b) The relevant environmental performance criteria or parameter (including reference to where the criteria or parameter are identified in the documents listed in <b>Condition A1(c)(ix) and (x)</b> .	The relevant ANZG guideline values are identified in the respective monitoring programs.  Refer to Section 4.6 and Section 5.7.
		c) Details of monitoring of the project to be undertaken.	Refer to Section 4 and Section 5.
		d) The parameters of the project to be monitored.	Refer to Section 4.6 and Section 5.7.
		e) The frequency and lifespan of monitoring to be undertaken.	Refer to Section 4.4 and Section 5.4.
		f) The location of monitoring.	Refer to Section 4.5 and Section 5.6.
		g) The reporting of monitoring and analysis of results against the relevant	Refer to Section 4.9 and Section 5.10.

Conditions		Approval Conditions	Response
		environmental performance criteria or parameter.	
		h) Details of the methods that will be employed to analyse the monitoring data.	Refer to Section 4.7 and Section 5.8.
		i) Procedures to identify and implement additional mitigation measures where results of monitoring are unsatisfactory.	Refer to Section 4.10 and Section 5.10.
		j) Any consultation to be undertaken in relation to the monitoring programs.	Refer to Section 1.4 and Section 5.6.
<b>D21</b>	Operational Water Quality Monitoring Program	a) Details of the type and frequency of monitoring to be undertaken for single vessel events (the first Quantum class or equivalent and first Oasis class or equivalent) and the first cruise season with more than 60 vessel visits.	Refer to Section 4 and Section 5.
		b) A review of the monitoring results that considers the performance of the SSI relative to the environmental parameters.	Refer to Section 4.9 and Section 5.11.

## 1.4 WQMP Consultation

This monitoring program was provided to NSW Department of Primary Industries and Regional Development (DPIRD) Fisheries for review and consultation in accordance with Condition D19. DPIRD Fisheries endorsed the monitoring program and no changes were requested, a copy of the consultation correspondence is provided in **Appendix C**. It is noted that a high-level proposed Water Quality Monitoring Program design was prepared during the response to the submissions process in consultation with Port Authority and NSW DPIRD Fisheries. Within 60 days post event, a report would be provided to NSW DPIRD Fisheries for review.

Ideally monitoring would be undertaken at the sensitive receptors during the arrival and departure of the cruise vessels, but this is dependent on safety considerations. Consultation with the Harbour Master is recommended regarding the minimum vessel exclusion zones during cruise vessel arrival and departures.

For this program, additional consultation is recommended closer to the execution of the program (i.e., this is not required to finalise this program):

- Consultation with the operators of the aquaculture leases on the possibility for the data sharing of the existing logger, or otherwise consultation on the deployment location of the logger
- Consultation with the Harbour Master on the location of the moorings with respect to navigation
- Updated consultation with NSW DPIRD Fisheries on the final location of the loggers.

## 2. Water Quality Guidelines

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The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) provide high-level guidance on the management context, ecological descriptions, biological indicator selection and other advice for Australia's six marine planning regions.

The following guidelines are applicable to the Operational Water Quality Monitoring Programs:

- NSW Department of Environment and Conservation – Marine Water Quality Objectives for NSW Ocean Waters (2005)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG – 018) - Toxicant Default Guideline Values for 95% species protection  
<http://www.waterquality.gov.au/anz-guidelines>
- IMCRA mesoscale bioregions Default Guideline Values for Physical and Chemical Stressors, Batemans Shelf <http://www.waterquality.gov.au/anz-guidelines>
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC – 000) - Default Guideline Values for Physical and Chemical Stressors, East Coast Australia and Guidelines for Aquaculture and human consumption of aquatic foods
- NSW Food Authority Shellfish Industry Manual (NSWFA 2018).

The following water quality values are current or projected to be relevant to this site:

- Protection of Aquatic Ecosystems (including protected adjacent seagrass communities)
- Protection of Shellfish Aquaculture
- Protection of Cultural and Spiritual values associated with marine waters
- Protection of Visual Amenity.

Protection of water quality values is achieved through the selection of appropriate water quality guideline values. The adopted relevant water quality guideline values are included in the monitoring programs below (Section 4.6 and Section 5.7.2).

### 3. Baseline and Existing Water Quality Data

#### 3.1.1 MOD 3 field survey results (Advisian 2022)

Physicochemical water quality data was collected on 15 September 2022 at nine (9) sites including three reference sites (mussel farm, Cocora Beach and Cattle Bay) and six sites within the cruise ship berth and manoeuvring area, as shown in Figure 3-1. Measurements were taken at the surface (1 m depth), mid-water (half water depth) and bottom (1 m off seabed) using a hand-held water quality meter to measure the following:

- Dissolved oxygen (DO) (% and mg/L)
- Water temperature (°C)
- Conductivity ( $\mu\text{s}/\text{cm}$ )
- Total dissolved solids (TDS) (mg/L)
- Salinity (ppt).



Figure 3-1 Location of water and sediment quality sampling sites, September 2022 (Advisian 2022)

Water quality data is summarised in Table 3-1. All water quality was found to meet available water quality criteria as outlined in Section 1.4. There were slight differences in conductivity / salinity, TDS and DO between the sites within the berth area in comparison to the reference sites.

Table 3-1 Water quality summary statistics September 2022

Parameter	Water Quality Guideline value	Units	Site type	Mean	StDev	Median	Min	Max	N
Conductivity	--	µS/cm	Berth	50,283	104	50,287	50,148	50,468	18
			Reference	49,966	57	49,962	49,907	50,062	8
Dissolved oxygen	90 – 110	%	Berth	101	2	102	99	104	18
			Reference	104	1	104	104	105	8
Dissolved oxygen	≥5	mg/L	Berth	8.1	0.1	8.1	7.9	8.2	18
			Reference	8.3	0.0	8.3	8.3	8.3	8
Salinity	--	ppt	Berth	42.47	0.04	42.47	42.42	42.63	18
			Reference	42.26	0.03	42.26	42.21	42.29	8
Suspended solids	≤10	mg/L	Berth	3.2	1.6	2.5	2.5	7.0	12
Temperature	<19 (spring)	°C	Berth	14.4	0.1	14.4	14.3	14.6	18
			Reference	14.3	0.1	14.3	14.2	14.5	8
Total dissolved solids	--	mg/L	Berth	40,974	40	40,974	40,930	41,113	18
			Reference	40,795	29	40,802	40,750	40,825	8
Turbidity-	0.5 - 10	NTU	Berth	0.8	0.3	0.9	0.4	1.3	12

This study attempted to derive a correlation co-efficient using the total suspended solids (TSS) and turbidity value dataset from this study and previous sampling (Elgin and Associates 2017). A correlation coefficient between turbidity and TSS is useful for operational monitoring given that turbidity can be monitored in the field, but TSS is a lab measure taking longer to receive the results. The relationship between TSS and turbidity is site specific. The water quality guidelines for the protection of aquaculture are based on TSS, not turbidity.

The Eden MOD 3 Water and Sediment Quality Assessment (Advisian 2023) concluded that there was insufficient data to derive a correlation co-efficient as most values were below the laboratory limit of reporting (LOR). This approach will be reassessed with the targeted collection of additional TSS and turbidity data in this Operational Water Quality Program.

### 3.1.2 Eden Breakwater Wharf Extension Project – Sediment Plume Impact Modelling Study (Jacobs 2017)

Operational impacts of cruise ship movements on bottom sediments and ensuing turbidity/sediment plumes within the Port of Eden were originally assessed by modelling undertaken by Jacobs (2017) as part of the documentation prepared for the original SSI 7734 application. The modelling showed that cruise vessel operations may generate a suspended sediment plume and increased turbidity along the vessel arrival and departure route. However, the spatial extent of the plume was found to be limited to the cruise vessel routes. The modelling also confirmed that most of the elevated TSS would occur along the seabed and through the water column with relatively minor TSS visible at the surface (Figure 3-2). Increased levels of TSS at the location of identified sensitive receptors (i.e., seagrass habitats

and mussel aquaculture), which are located a few hundred metres away from the arrival and departure routes, were generally short-lived (usually less than one hour) (Figure 3-3).

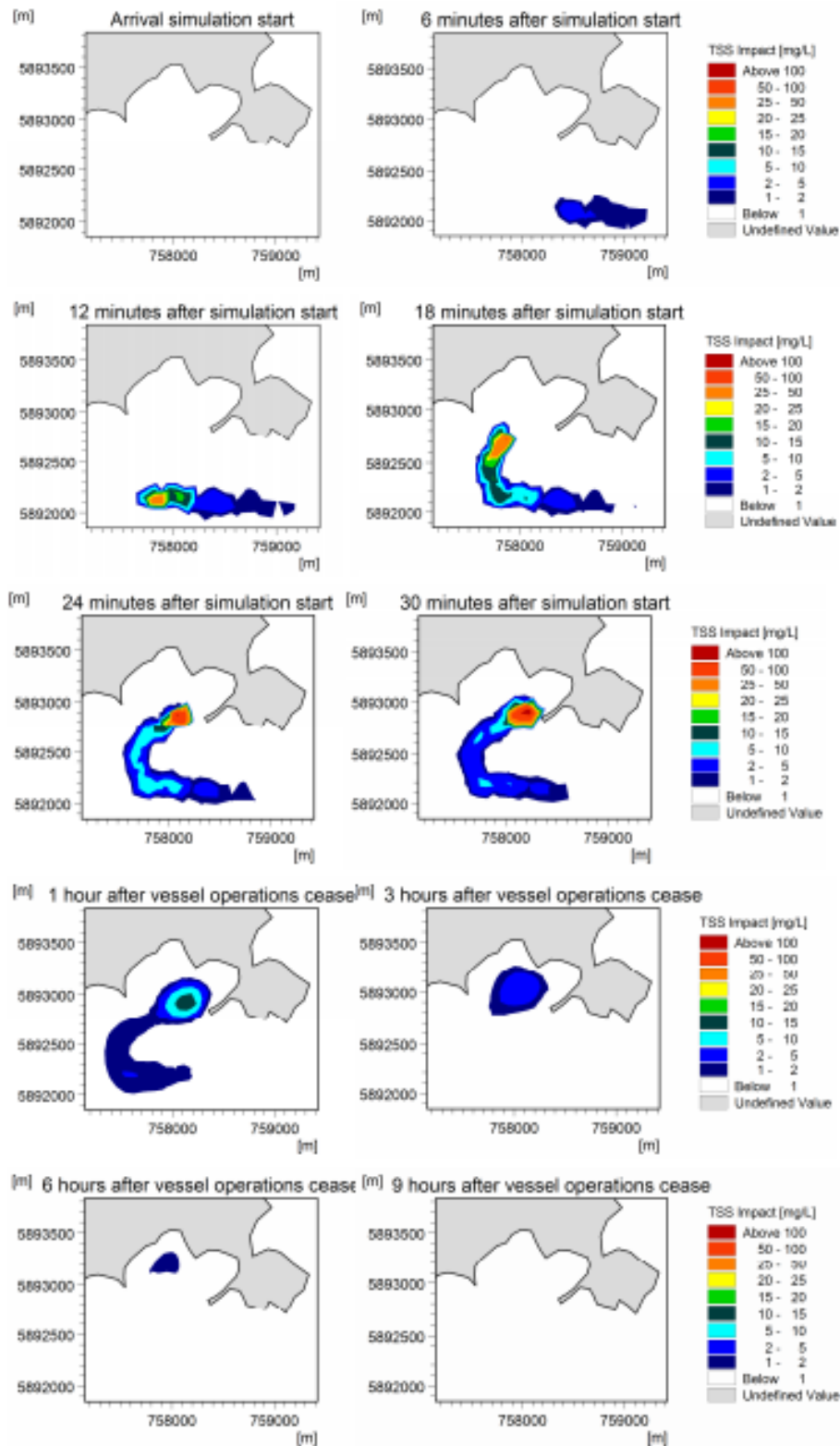


Figure 3-2 Modelled maximum TSS plumes based on extreme propeller power scenario of Costa Diadema (Source: Jacobs 2017)

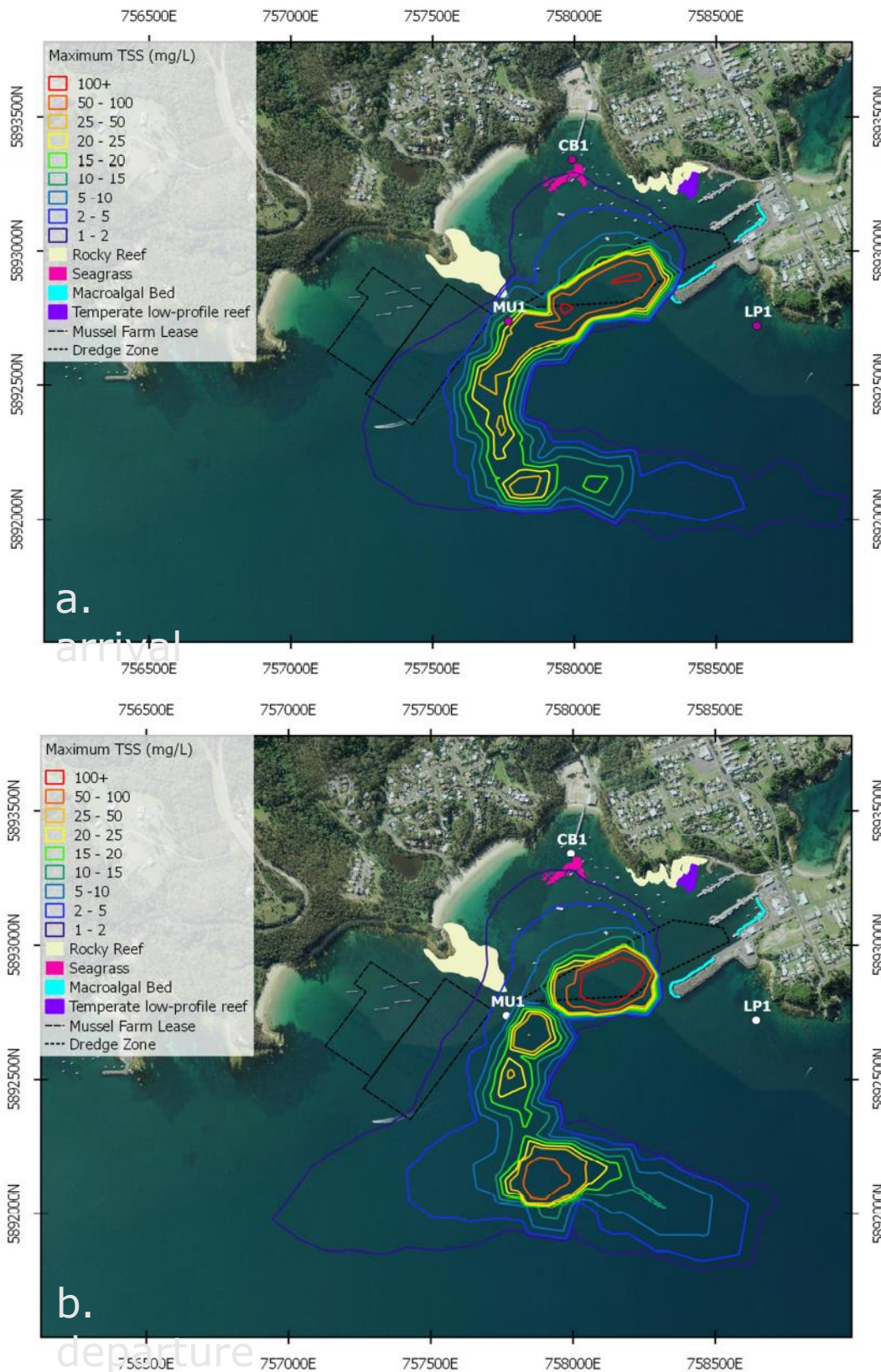


Figure 3-3 Stimulated scenarios (a. typical arrival and b. typical departure of *Costa Diadema*) based on typical wind, showing proximity of water quality monitoring locations and benthic habitats to the maximum TSS above ambient through the water column (Source: Jacobs, 2017)

### 3.1.3 Eden MOD3 Updated Sediment Plume Assessment (Jacobs 2023)

In 2023 Jacobs were engaged by Port Authority to undertake updated quantitative modelling for Eden MOD3 of sediment plume and sediment deposition based on updated vessel type and frequency of visitations. A summary of the modelling results in regard to key environmental receptors during worst case scenarios is provided below (Jacobs 2023).

#### 3.1.3.1 Vessel characteristics

For the operational plume assessment, Oasis Class (or equivalent) cruise vessels such as Oasis of the Seas and Symphony of the Seas were considered by Jacobs. This is the largest vessel size considered within the MOD3 approval. Table 3-2 summarises the vessel particulars for the Oasis Class (or equivalent).

Table 3-2 Summary of typical Oasis Class (or equivalent) cruise vessel particulars (Source: Jacobs 2023)

Particulars	Oasis Class
LOA	Up to approximately 370 m
Draught Max	9.3 m
Breadth Moulded	47 m
Number of propellers	3
Propeller diameter	6.2 m
Propeller max shaft power	3 x 20000 kW
Number of bow thrusters	4
Number of stern thrusters	3
Nominal bow thruster power	4 x 5500 kW
Nominal stern thruster power	3 x 10000 kW (Azipods)

#### 3.1.3.2 Assessment of operational impacts on sedimentation

##### Sediment generation

Jacobs (2023) developed relationships for operational sediment generation for the design vessel, Oasis of the Seas, to apply in their modelling. These relationships are a function of water depth and applied main engine power, as shown in Figure 3-4. The relationships were used by Jacobs to develop the sediment loads for the operational sediment plume modelling of the Oasis of the Seas vessel. According to Jacobs (2023), these relationships were based on the calculated bed current velocities in conjunction with empirical equations to determine the evolution of scour induced propeller wash. These modeling methods were used to estimate the bed material mobilised and suspended during key cruise ship operations.

The empirical equations are based on the methods outlined in the PIANC publication "Guidelines for Protecting Berthing Structures from Scour caused by Ships", PIANC Report No. 180 Maritime Navigation Commission, Brussels (2015). The technical publication provides guidelines and detailed background information about vessel propulsion and power estimates and methodologies to estimate the flow velocities caused by propellers at the seabed. Further

details of calculations adopted from the guidelines for the modelling are described in Appendix C9.

The number of applied propellers within different zones was updated based on recent navigational simulations for vessels with Azipod propulsion systems, noting that this slightly deviates from the assumptions applied in Jacobs (2017) modelling which considered smaller vessels without azipod propulsion units.

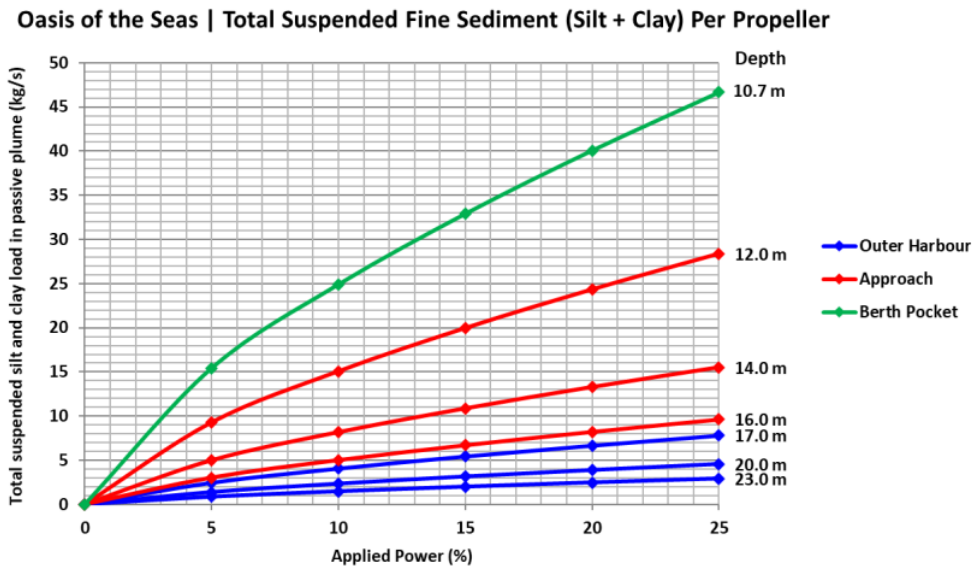


Figure 3-4 Oasis of the Seas: Suspended silt/clay load in passive plume per propeller vs applied propeller power (Source: Jacobs 2023)

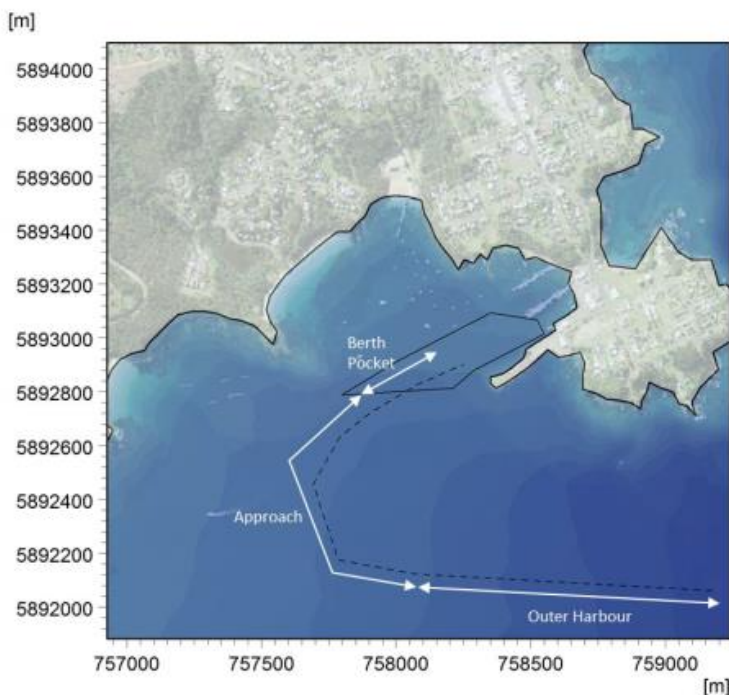


Figure 3-5 Classification of zones along typical arrival and departure routes (Source: Jacobs 2023)

The suspended sediment loads assumed for the design vessels were developed by Jacobs for each modelling scenario based on the dimensional analysis above, and Table 3-3 below, which shows the applied power and assumed sediment generation rate for the critical scenario that was shown to have the greatest potential impact on the sensitive receivers. Jacobs (2023) considered a higher silt/clay content in the eastern berth pocket (7% silt and 9% clay), whereas the western/central berth pocket has lower content (approximately 4% silt and 4% clay). It is worth noting that silt/clay levels on the western berth pocket align with the assumptions adopted in Jacobs (2017a) study.

Table 3-3 Estimated fine sediment loads due to Azipods propulsion system of Oasis class (or equivalent) cruise vessels (Source: Jacobs 2023).

Operational scenario	Zone	Total rate of silt entering passive plume (kg/s)	Total rate of clay entering passive plume (kg/s)
<b>Oasis of the Seas arrival – Typical power</b>	Outer	2.63	2.63
	Approach	10.70	10.70
	Berth	7.71	7.71
<b>Oasis of the Seas departure – Typical power</b>	Outer	4.66	4.66
	Approach	10.70	10.70
	Berth	17.50	17.50

The modelling accounted for the estimated fine sediment load entering into the plume associated with the Oasis vessel (or equivalent) bow thrusters (Table 3-3 and Table 3-4). As indicated, the estimates were based on the proportion of fine sediments from the eastern berth pocket as identified in sediment sampling undertaken in September 2022 by Advisian (i.e. 7% silt and 9% clay).

Table 3-4 Estimated fine sediment load per bow thruster of Oasis vessels (or equivalent) (Source: Jacobs 2023)

Vessel	Zone	Percentage power applied per thruster	Rate of silt entering passive plume per thruster (kg/s)	Rate of clay entering passive plume per thruster (kg/s)
<b>Oasis of the Seas</b>	Berth	50%	1.08	1.39

Table 3-5 Total estimated fine sediment load of Oasis vessels (or equivalent) (Source: Jacobs 2023)

Vessel	Zone	Percentage power applied per thruster	No of Thrusters	Rate of silt entering passive plume per thruster (kg/s)	Rate of clay entering passive plume per thruster (kg/s)
<b>Oasis of the Seas</b>	Berth	50%	4	4.32	5.55

## Impact on sensitive receivers

The Jacobs (2023) updated sediment plume modelling considered the higher nearbed velocities induced by the propeller wash from the Oasis class (or equivalent) vessels when compared with the Costa Diadema. Single vessel transits were simulated to assess the potential sediment plume resulting from the typical arrival and departure operations of an Oasis cruise vessel (or equivalent) at Eden. In addition, repeated vessel movements were modelled using one week of back-to-back vessel transits during the cruise season and during the off season to assess the potential for cumulative impacts. Future worst case ship visitation during both cruise and non-cruise seasons were considered in the model.

The sediment plume modelling considered four environmental (weather) scenarios, including hindcast, no wind, south-westerly (SW) circulation and north-easterly (NE) circulation. The hindcast scenario was considered to be the most appropriate scenario to assess durations that are longer than a single cruise visit, as there were no records of a storm from a single direction lasting the length that was modelled in the SW and NE scenarios. The NE winds have generally the greatest potential to blow the sediment plume toward the sensitive receivers of the mussel farms and seagrass beds as indicated by the Jacobs modelling. The NE wind scenario also affects the approach path and thruster power needed for the ship to approach the berth as indicated by Smartship navigation simulations. The SW wind case shows the plume extending around Lookout Point. Wind waves would have limited impact on the resuspension of sediment, as their orbital velocities near the seabed would be very low.

Sediment plume modelling undertaken by Jacobs in 2023 is shown in Figure 3-6 and Figure 3-7 for the hindcast and NE wind back to back vessel visit scenarios during Cruise season, respectively. The modelling outcomes, including spatial and timeseries plots of TSS for Oasis class (or equivalent) vessel arrival and departure simulations (single vessel runs), closely align with those from the Jacobs (2017) study. It can be seen that:

- During all scenarios, the predicted peak TSS increase at the key environmental receptors (i.e., aquaculture areas, rocky reefs and seagrasses) is between <math><1-5\text{ mg/L}</math> in these areas. A very small part of north west corner of the aquaculture lease is most affected during NE winds, but with peak increases still modelled as remaining below 10 mg/L.
- Back-to-back simulations do not indicate any cumulative impacts on TSS concentration above the ambient levels during typical hindcast wind conditions (Jacobs 2023). Increases in TSS at key environmental receptors tend to be of short duration. The long-term deposition of fine sediments at key environmental receptors is unlikely to occur given the predicted re-suspension during typical wave conditions (Jacobs 2023).

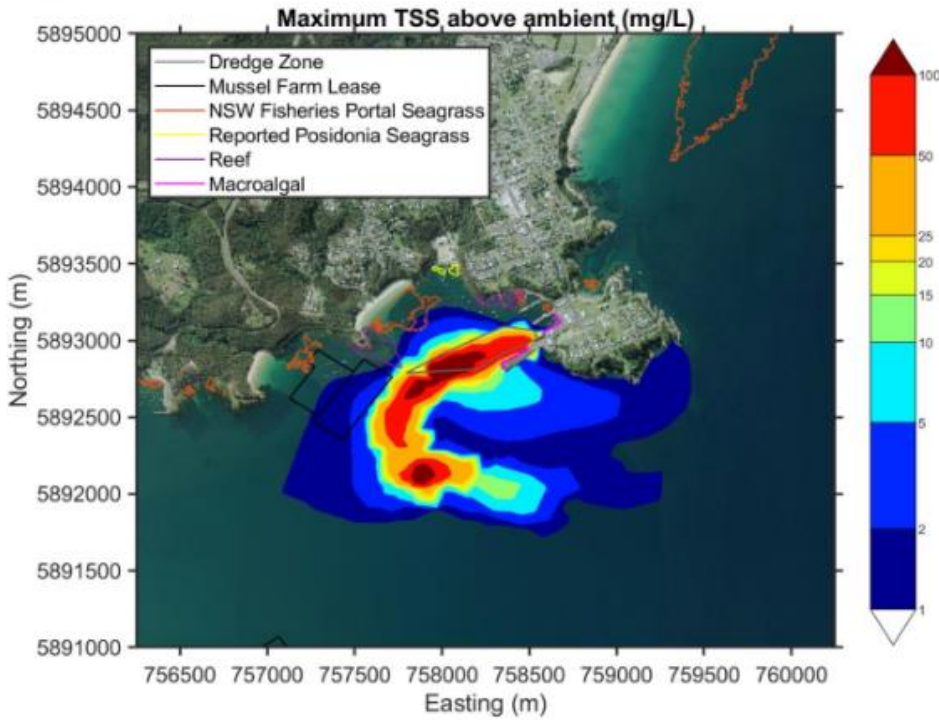


Figure 3-6 Estimated maximum TSS (mg/L) in relation to key environmental receptors based on modelling results of Oasis of the Seas with back-to-back transits during cruise season for a hindcast wind scenario (Source: Jacobs 2023).

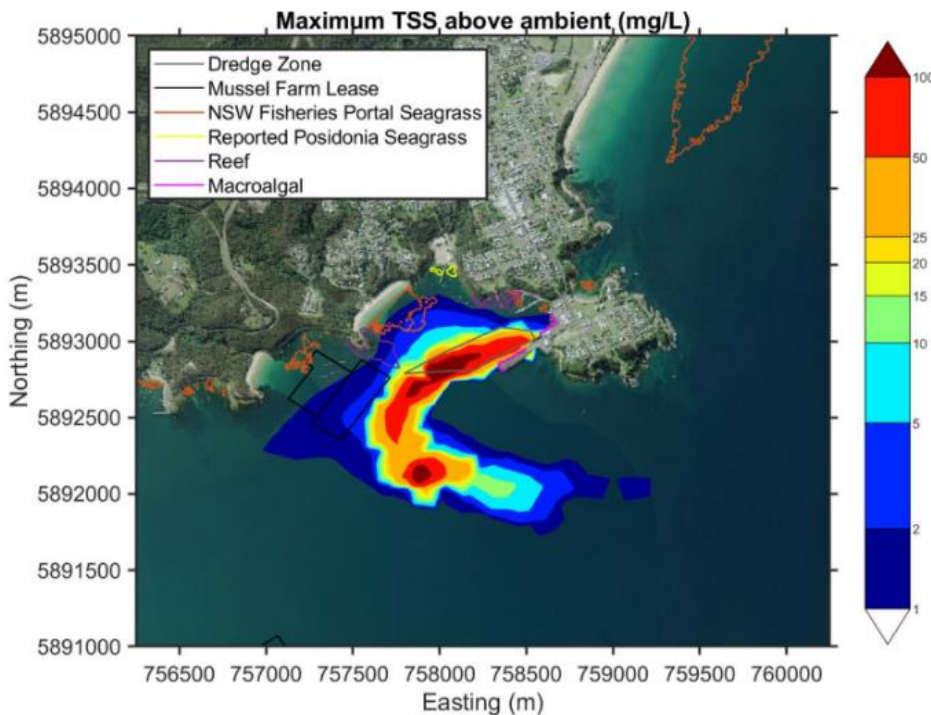


Figure 3-7 Estimated maximum TSS (mg/L) in relation to key environmental receptors based on modelling results of Oasis of the Seas with back-to-back transits during cruise season for a NE wind scenario (Source: Jacobs 2023).

### 3.1.3.3 Impact on sedimentation due to smaller non-cruise vessels

Jacobs (2023) considered the impacts on sedimentation from smaller non-cruise vessels, such as tugs and fishing vessels. The manoeuvring characteristics are based on existing operations in the Port of Eden. The main non-cruise vessels operating in the Port of Eden during the 2020 – 2021 and 2021 – 2022 seasons were the tugs Cooma and Wistari, as well as the fishing vessel Saint Antonio & Giuseppe (Table 3-6). Accounting for the size, propellers number and type, it was concluded by Jacobs (2023) that the impacts on sediment plume dynamics associated with existing vessels can be considered to be negligible.

Table 3-6 Comparison of vessels (Source: Jacobs 2023)

Particulars / Vessel	Oasis Class	Cooma	Wistari	Saints Antonio & Giuseppe
Length	362 m	33.9 m	34 m	39.9 m
Beam	47 m	10.8 m	10.8 m	9 m
Draught	9.3 m	4.6 m	4.2 m	3.5 m
Propeller diameter	6.2 m	2.2 m	2.2 m	-
Number of propellers	3	2	2	-
Propulsion power	3 x 10000 kW (Azipods)	2 x 1417 kW	2 x 1342.8 kW	-

### 3.1.3.4 Summary

The following conclusions can be drawn from the sediment plume model (Jacobs 2023) and sediment plume assessment:

- Peak suspended sediment concentrations of less than 5 mg/L within the sensitive reef and seagrass areas are similar to that previously modelled with the same scenario with the previous design vessel, the Costa Diadema (Jacobs 2017). Similarly, the majority of the mussel farm lease area showed peak TSS less than 5 mg/L, with slightly higher peak TSS (less than 10 mg/L) generated at the northwest corner of the lease.
- The worst-case scenario of one week of back-to-back vessel transits estimated that there would be very low (below 0.1 mm) fine sediment deposition at key environmental receptors, including the Snug Cove seagrass community and Posidonia within Weecon Cove. The long-term deposition of fine sediments and cumulative impacts at key environmental receptors is unlikely to occur based on sediment plume modelling and any deposited sediment is predicted to be resuspended by typical wave conditions.
- Localised and short-term reductions in DO levels in water within the zones of increased turbidity/TSS are possible and have potential to impact on marine flora and fauna within the extent of the plume. However, this is not expected to significantly increase as a result of the MOD 3 proposal nor impact on key environmental receptors.

### 3.1.4 Eden Breakwater Wharf Extension Project – Baseline Water Quality Data Collection (Elgin Associates 2017)

A baseline water quality monitoring program was undertaken at six sites in Snug Cove, Cattle Bay and Twofold Bay by Elgin Associates (2017) for the Eden Breakwater Wharf Extension Project (Figure 3-8). Eight rounds of water quality sampling and one round of post extreme

weather event sampling were undertaken, with samples collected and analysed between September 2016 and January 2017. The program provided a baseline dataset of ambient water quality within Twofold Bay for a range of water quality parameters.



Figure 3-8 Baseline water quality monitoring sites (Source: Elgin Associates 2017)

The following baseline water quality data (provided as ranges) were reported by Elgin Associates (2017):

- Chlorophyll-a ranged from 1-6 µg/L
- Turbidity ranged from 0.3-0.9 NTU during baseline conditions, with elevated levels (up to 7.4 NTU) observed at all sites following a storm event
- TSS ranged from 0.5-0.8 mg/L during baseline conditions, with elevated levels of 2 – 3 mg/L following a storm event
- There were occasional exceedances of the ANZECC (2000) DGVs for 95% protection levels of the dissolved metals, copper (<1-4 mg/L), lead (<0.5-1.4 mg/L) and zinc (<5-12 mg/L). All samples recorded concentrations below the laboratory LOR for cadmium and mercury
- Organic hydrocarbons including Polycyclic Aromatic Hydrocarbons (PAH), Total Recoverable Hydrocarbons (TRH) and Total Petroleum Hydrocarbons (TPH) (various fractions) were detected on one occasion at sites W1 (located immediately adjacent to the Eden Cruise Wharf) and W2 (a few hundred metres south-east of the Eden Cruise Wharf)
- Total nitrogen ranged from 0.13-0.145 mg/L and consistently exceeded the ANZECC (2000) DGV of 0.12 mg/L across all sites.

Median water quality results for a range of physicochemical parameters from Elgin Associates (2017) are provided in Table 3-7. Median results from all sites were very similar over the course of the investigation.

Table 3-7 Median Water Quality from Baseline Study (Source: Elgin Associates 2017)

	Field analytes					Lab analytes			
	Dissolved Oxygen (%)	Turbidity (NTU)	pH	Salinity (ppt)	Temperature (°C)	Suspended solids (mg/L)	Turbidity (NTU)	Ammonia (mg/L N)	Ammonium (mg/L N)
<b>LOR</b>	0.1	0.1	0	0.01	0.01	1	0.1	0.02	0.02
<b>ANZECC 2000<sup>1</sup></b>	90-110	0.5-10	8-8.4	--	--	<5	0.5-10	0.91	0.02
<b>W1</b>	101.7	0.5	8.1	35.4	15.8	0.5	0.6	0.025	0.025
<b>W2</b>	103.1	0.5	8.1	35.4	15.7	0.8	0.8	0.025	0.025
<b>CB1</b>	103.9	0.8	8.1	35.4	15.9	0.5	0.7	0.025	0.025
<b>MU1</b>	102.3	0.5	8.1	35.4	15.7	0.5	0.5	0.035	0.035
<b>BAY1</b>	102.6	0.8	8.1	35.4	15.7	0.5	0.8	0.025	0.025
<b>BAY2</b>	102.3	0.3	8.0	35.4	15.2	0.5	0.4	0.025	0.025

### 3.1.5 Twofold Bay routine mussel lease monitoring (Eden Sea Farms 2010-2015)

There are commercial aquaculture leases located within Twofold Bay. This includes farms approximately 700 m west of the Eden Cruise Wharf, off Cocora Point (lease numbers AL07/098 and AL08/098), and alternate farms established within an existing aquaculture lease area at Boydtown (lease numbers AL06/001 and AL06/002). It is noted that a small lease to the north of AL07/098 is no longer current. Mussel farming is the main activity on these leases, but oyster, algae and scallop production may also be undertaken. A map of existing aquaculture leases and water sampling sites in Twofold Bay is included in Figure 3-9.

Eden Sea Farms undertake routine water quality monitoring of temperature, salinity, faecal coliforms and phytoplankton, including within Snug Cove, to monitor water quality in the vicinity of these aquaculture facilities. Results of the data collected at Snug Cove between February 2010 and January 2015 were summarised by Ocean Environmental (2015) as part of a Water Quality Management Plan prepared for the proposed Cattle Bay Marina and is presented in Table 3-8.

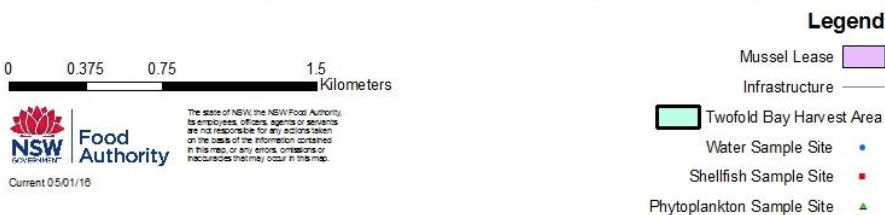
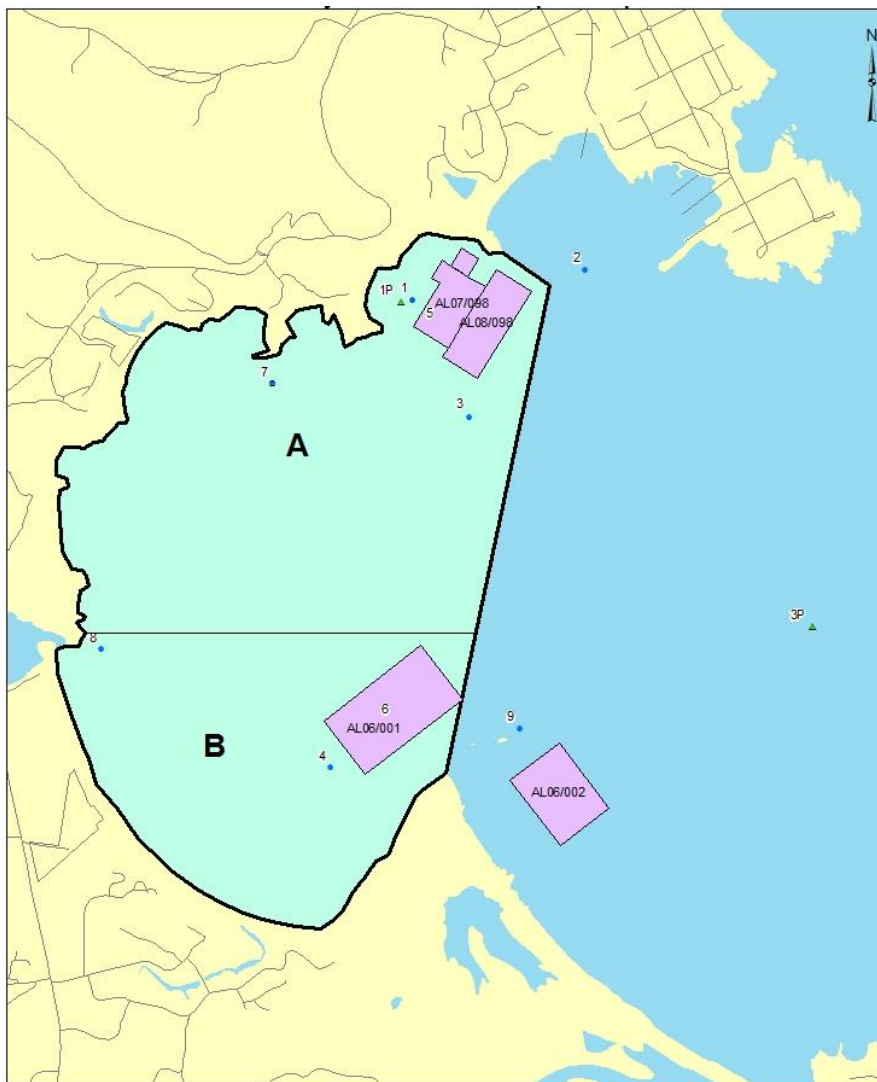


Figure 3-9 Mussel lease areas (pink rectangles) and location of water quality sampling (blue dots) and phytoplankton sites (green triangles) (Source: DPI 2016)

Table 3-8 Summary of water quality data 2010-2015 in the vicinity of the aquaculture facilities (Source: Eden Sea Farms 2010-2015; Ocean Environmental 2015)

Parameters	Range	Average
<b>Water Temperature (°C)</b>	13 – 20	18
<b>Salinity (ppt)</b>	34.8	33.5 – 39.3
<b>Faecal coliforms (cfu/100mL)</b>	83% of values <10 70% of value <2	12.4

### 3.1.6 Water Quality Assessment of Australian Ports (Jahan and Strezov 2017)

A water quality assessment of six Ports within NSW, including Port of Eden, was undertaken by Jahan and Strezov (2017). Seawater samples from five sites within Snug Cove and Twofold Bay were collected from 2016-2017 and analysed for a range of heavy metals, physiochemical and biological variables to determine indices of water quality health (including Water Quality, Heavy Metal, Contamination and Environmental Water Quality Indices). A map of sampling locations is included in Figure 3-10.



Figure 3-10 Location of sampling sites within the Port of Eden (Source: Jahan and Strezov 2017)

The following results were obtained in relation to the Port of Eden:

- Out of the six ports in the assessment, the Port of Eden and Port Botany had the poorest water quality. During low tide, the Water Quality Index was Moderate to Good, with the moderate rating related to low dissolved oxygen, elevated turbidity and elevated faecal coliforms. Water quality during high tide was assessed as Good
- There are higher turbidity values in the Port of Eden in comparison to background sites, which indicates the impact of Port activities on the water environment
- The Port of Eden experiences flushing during high tide with improved results for the water quality parameters dissolved oxygen, turbidity, phosphates and biological oxygen demand (BOD).

The Port of Eden had high concentrations of copper, manganese, cadmium, cobalt, iron and zinc resulting in a Heavy Metal Assessment Index of Medium to High. There were exceedances

of the ANZECC (2000) water quality guidelines for copper, cadmium, cobalt and zinc. The Trace Element Toxicity Index was high in the middle of the Port area in Snug Cove, in comparison to the southern background site outside of the Port of Eden (Figure 3-10).

A summary of results is provided in Table 3-9 and Table 3-10.

Table 3-9 Water Quality Parameters and Index for Port of Eden in 2016-2017 (Source: Jahan and Stezov 2017)

Parameter	High Tide	Low Tide	Background
pH	7.72 ± 0.36	7.4 ± 0.36	7.6 ± 0.36
Dissolved Oxygen (%)	87.8 ± 4.32	57.67 ± 22.9	88.5 ± 0.42
Total dissolved solids (mg/L)	67125 ± 8822	53100 ± 10323	50400 ± 10323
Turbidity (NTU)	0.1925 ± 0.06	3.68 ± 3.70	0.7 ± 0.29
Temperature (°C)	19.8	20.2	20.1
Phosphate (mg/L)	0.014 ± 0.008	1.55 ± 2.52	0.278 ± 0.226
Nitrate (mg/L)	0.043 ± 0.038	0.013 ± 0.008	0.058 ± 0.0215
Biological Oxygen Demand (mg/L)	0.9 ± 0	89 ± 129	6.5 ± 5.031
Faecal Coliforms (col/100mL)	899.875 ± 205.5	570.125 ± 418.13	366.25 ± 503.85
Conductivity (m/S)	54.525 ± 0.33	54.85 ± 0.822	54.7 ± 0.71
Water Quality Index	75.76 ± 0.86	51.98 ± 16.47	74.52 ± 1.38
Water Quality Assessment	Good	Moderate to Good	Good

Table 3-10 Water Quality Metal Parameters (mg/L) for Port of Eden in 2016-2017 (Source: Jahan and Stezov, 2017)

Analytes	Min	Max	Mean	Background
Silver (Ag)	<LOR	0.001	<LOR	<LOR
Aluminium (Al)	0.013	0.016	0.015	<LOR
Arsenic (As)	0.002	0.006	0.0032	0.0035
Cadmium (Cd)	0.001	0.007	0.001	<LOR
Chromium (Cr)	<LOR	0.001	<LOR	<LOR
Copper (Cu)	<LOR	<LOR	<LOR	<LOR
Iron (Fe)	<LOR	0.094	0.082	0.015
Manganese (Mn)	0.001	0.051	0.01	0.0045
Nickel (Ni)	<LOR	0.009	0.0016	0.001
Lead (Pb)	<LOR	0.001	<LOR	<LOR
Selenium (Se)	<LOR	<LOR	<LOR	<LOR
Zinc (Zn)	0.001	0.029	0.0075	0.002
Mercury (Hg)	<LOR	<LOR	<LOR	<LOR
Beryllium (Be)	<LOR	0.001	<LOR	<LOR
Vanadium (V)	0.004	0.005	0.004	0.004
Boron (B)	3.99	4.57	4.36	4.29

Analytes	Min	Max	Mean	Background
<b>Cobalt (Co)</b>	<LOR	0.002	<LOR	<LOR
<b>Molybdenum (Mo)</b>	0.008	0.01	0.0084	0.008
<b>Antimony (SB)</b>	<LOR	<LOR	<LOR	<LOR
<b>Barium (Ba)</b>	0.005	0.029	0.0093	0.007
<b>Bismuth (Bi)</b>	<LOR	<LOR	<LOR	<LOR
<b>Tin (Sn)</b>	0.001	0.001	0.001	0.001

### 3.1.7 Other relevant information

#### 3.1.7.1 Coastal Management Program (Bega Valley Shire Council)

Bega Valley Shire Council are currently working with UNSW Water Research Laboratory (WRL), NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) and Elgin Associates on a Coastal Management Program to identify coastal hazards and future management actions. Seven hazards have been identified as influencing the Bega Valley coastline including beach and foreshore erosion, shoreline recession, coastal lake and watercourse instability, coastal inundation, tidal inundation, coastal cliff and slope instability (Bega Valley Shire Council 2021). Coastal hazards are linked to coastal water quality, and it is expected that associated coastal water quality impacts and risks will increase in relation to climate change and sea level rise.

#### 3.1.7.2 Bega Valley Shire Council 2020 Bushfire Response, Water Quality Monitoring

In 2020, the Bega Valley Shire was heavily impacted by fires with approximately 4,000 km<sup>2</sup> of land including large areas of foreshore and steep terrains left bare (Bega Valley Shire Council 2021). Potential impacts to water quality were identified because of increased runoff of sediment and ash and erosion leading to increased turbidity, altered pH values and reduced DO. It was identified that significant future rainfall events could cause detrimental impacts to seagrass communities via sedimentation, a higher risk of fish kills due to reduced DO and a higher risk of algae blooms resulting from increased nutrient run off.

Bega Valley Shire Council are currently implementing a program to identify and manage impacts of bushfires on coastal water quality as part of the NSW Government bushfire response grants. This includes the management responses of installing sediment and erosion controls, restoration of estuarine foreshores and habitat. Coastal water quality monitoring will also be conducted to assess impacts of bushfires.

Twofold Bay receives runoff from numerous catchments including Shadrachs, Nullica, Brandy Creek, Towamba and Lake Curalo catchments. Planned works for these catchments include:

- Shadrachs, Nullica and Brandy Creek – sediment and erosion controls
- Towamba – sediment and erosion controls, engagement with landowners
- Lake Curalo – weed control and revegetation of cleared areas.

## 4. Operational Monitoring Program – Quantum and Oasis Vessel (or equivalent) Events

### 4.1 Objectives

The objective of this program is to undertake water quality monitoring during the first Oasis and Quantum Class (or equivalent) size cruise ship visitation events. The intent of this program is to compare the actual operational performance against the predicted performance to validate the MOD 3 water quality modelling studies and impact assessment on identified sensitive receptors (Advisian 2023; Jacobs 2017; Jacobs 2023, Section 3.1.2).

### 4.2 Overview

An overview of the proposed water quality modelling validation study for the first visit of a Quantum and an Oasis Vessel (or equivalent) is outlined in Table 4-1.

Table 4-1 Proposed water quality modelling validation study – Quantum and Oasis (or equivalent) Events

Monitoring Program Element	Description
<b>Aims</b>	Undertake water quality monitoring during the first Oasis and Quantum Class (or equivalent) size cruise ship visitation events, to validate water quality modelling studies undertaken for the Environment Assessment (EA) Report, including to assess impacts on identified sensitive receptors.
<b>Trigger</b>	First Oasis and first Quantum Class (or equivalent) size cruise ship berthing events
<b>Temporal Replication</b>	Monitoring undertaken over 3 days during each event: <ol style="list-style-type: none"> <li>1. Day before berthing</li> <li>2. Day during berthing (including during arrival, if possible)</li> <li>3. Day following berthing (including during departure, if possible).</li> </ol> Ideally monitoring would be undertaken at the sensitive receptors during the arrival and departure of the cruise vessels, but this is dependent on consultation regarding safety considerations and minimum vessel exclusion zones.
<b>Water Quality Guidelines</b>	Australian and New Zealand Water and Sediment Quality Guidelines (ANZG 2018).
<b>Water Quality Sampling Locations</b>	12 monitoring sites that encompass the extent of the vessel generated sediment disturbance modelling domain, including sites near sensitive receptors (i.e., seagrasses and aquaculture leases).
<b>Field Methods</b>	Physicochemistry profiling (measurements throughout the water column) using a hand-held probe at the 12 sites with measurements collected every 1 hour over 6 hours for each day.

Monitoring Program Element	Description
	Collection of marine water samples using a grab sampler for TSS analysis in the surface and mid-water depths at the 12 sites, twice each day.
<b>Field conditions</b>	Field conditions would be recorded on each day of sampling including: <ul style="list-style-type: none"> <li>• Date, site, time and depth of sampling</li> <li>• Wind speed and direction</li> <li>• Current speed and direction</li> <li>• Tidal state (ebb or flow)</li> <li>• Swell height</li> <li>• Rainfall (mm) in days prior, or on day of sampling</li> <li>• Other observations, such as visible plumes, oil slicks on water surface etc.</li> </ul>
<b>In-situ field Parameters</b>	Dissolved oxygen (DO) (%) Temperature (°C) Turbidity (NTU) Conductivity (µS/cm) /salinity (ppt) pH
<b>Laboratory Parameter</b>	Low level TSS (mg/L)
<b>QA/QC</b>	Appropriate field and laboratory protocols would be followed.
<b>Reporting</b>	Post event reports that include the analysis of event data with comparison to predicted modelling results.  The additional TSS and turbidity data would be used to refine the TSS/turbidity correlation (it was noted in Section 3.3.1 of the Water and Sediment Quality Assessment (Advisian 2023) that additional data is needed).

### 4.3 Monitoring Triggers

The monitoring trigger for this program is the first visit of an Oasis (or equivalent) and the first visit of a Quantum Class (or equivalent) size cruise ship. Each of these events would separately trigger monitoring and reporting:

- A single monitoring event and associated reporting would be undertaken for the first Quantum Class (or equivalent) vessel visit to Eden, which is anticipated to occur during December 2024
- A single monitoring event and reporting would also be undertaken for the first Oasis Class (or equivalent) vessel visit to Eden, when/if triggered. There are currently no scheduled Oasis Class (or equivalent) vessel visits.

#### **4.4 Monitoring Frequency and Lifespan**

During these one-off sampling events, the water quality monitoring program would be undertaken over 3 days including:

1. Day before berthing
2. Day during berthing (including during arrival if possible)
3. Day following berthing (including during departure if possible).

#### **4.5 Monitoring Sites**

Twelve (12) water quality monitoring sites are included in the program and data would be collected at each of the 12 locations. The monitoring sites are located within the vessel generated sediment disturbance modelling domain (Jacobs 2023) and the previously identified sensitive receptors (i.e., seagrasses and aquaculture leases).

Water quality monitoring sites are shown in Figure 4-1.

# Eden MOD3 Operational Water Quality Program

Oasis or Quantum Vessel (or Equivalent) Event Water Quality Sites

## Legend

### Water Quality Sites

○ Sensitive Receptors

● Vessel Path

--- Modelled Assumed Vessel Pathway (Jacobs 2017)

▭ NSW Aquaculture Leases (NSW DPI 2024)

### Estuarine Macrophyte Mapping (NSW DPI 2023)

■ Halophila

■ Posidonia

■ Posidonia - Sparse

■ Zostera

■ Zostera - Sparse

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0 250 500

Meters

Scale at A3 - 1:10,000

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere

## 4.6 Monitoring Parameters

### 4.6.1 Field Conditions

The following field conditions would be recorded each day of sampling (and at each site as applicable):

- Timing of the cruise ship movements
- Timing of other vessel movements during the monitoring program
- Date
- Time of sampling
- Site
- Depths of sampling
- Tide times (low and high) and tide states (ebb or flood)
- Wind speed and direction
- Current speed and direction
- Any natural regional events that occur such as upwellings, major storms or algae blooms etc.
- Swell height and direction
- Rainfall (mm) on day of sampling and days preceding sampling
- Visual observations of water quality (e.g., presence of surface slicks, rubbish, debris, discoloured water or odour).

A template for field notes is attached in **Appendix A**.

### 4.6.2 Water Quality Parameters

During each day:

- In-situ water quality monitoring at 12 sites would be undertaken with physicochemistry measurements collected every 1 hour over 6 hours per day.
- Water quality samples at 12 sites would be collected twice per day for subsequent NATA laboratory analysis of TSS.

A summary of the targeted monitoring parameters, LORs and adopted water quality guidelines for the monitoring program is provided in Table 4-2.

Table 4-2 Water quality monitoring parameters and water quality guidelines

Parameter	Method	Unit	LOR	Water Quality Guideline
Turbidity	Field	NTU	-	< 10 mg/L <sup>1</sup>
Temperature	Field	°C	-	16.8 – 19.6 °C <sup>3</sup>
Conductivity	Field	µS/cm	-	--
Salinity	Field	PSU	-	33,000 - 37,000 <sup>3</sup>
pH	Field	-	-	8 - 8.4 <sup>1</sup>
Dissolved oxygen	Field	%Sat	-	> 93.4 <sup>3,4</sup>
Total suspended solids	Lab	mg/L	1 mg/L (low level)	< 10 mg/L <sup>2</sup>

1 Default water quality guidelines for stressors in marine waters of south-east Australia (ANZECC 2000)

2 Default water quality guidelines for aquaculture and human consumption of aquatic foods (ANZECC 2000)

3 Site specific guideline for marine Twofold Shelf IMCRA bioregion during season of spring (ANZG 2018)

4 The ANZG 2018 site specific guideline for dissolved oxygen in summer in the marine Twofold Shelf IMCRA bioregion was converted from mL/L to %Sat assuming the average temperature (19.5°C) and average salinity (34.4 PSU).

## 4.7 Collection Methods

The physicochemical parameters (turbidity, temperature, conductivity/salinity, pH and dissolved oxygen) would be measured in-situ using a hand-held probe to do continuous profiling through the water column (surface water to seabed) at each site. Water samples for TSS would be collected using a water grab sampler with subsequent transportation to, and analysis at, a NATA accredited laboratory. Images of the proposed water quality equipment are in Figure 4-2.

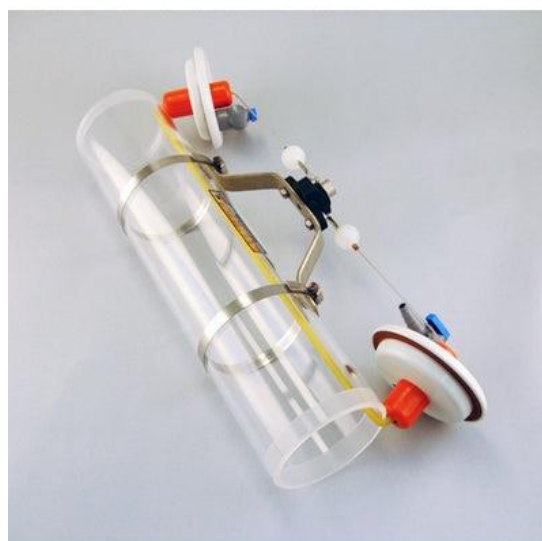


Figure 4-2 YSI multi parameter probe ([www.ysi.com](http://www.ysi.com)) and beta water grab sampler ([www.wildco.com](http://www.wildco.com)).

## 4.8 QA/QC

### 4.8.1 In-field

The following in-field quality assurance and quality control (QA/QC) protocols will be followed:

- Population of field data sheets (refer to example in **Appendix A**)
- At least one field member is an experienced (senior level or above) water quality scientist with offshore seawater sampling experience. All field survey staff are to be appropriately trained in the water sampling techniques in terms of how to use the equipment
- Water samples for TSS would be collected using clean disposable nitrile gloves. Water samples are to be placed immediately into sterile sampling containers provided by the lab and into eskies on ice
- Standard identification labels to be adhered to each individual container and labelled according to date, sampling personnel and company
- Water grab sampler should be held at the sampling sites for one minute to allow site waters to flow through and rinse prior to collection. Sampler is decontaminated prior to use and at end of sampling by triple rinsing with either chlorinated tap water or distilled water
- All samples to be forwarded to a NATA accredited laboratory under recognised chain of custody (COC) with clear identification including date, location, sampler and sample ID.

### 4.8.2 Laboratory

QA/QC procedures to be employed by the laboratory include:

- Analysis should be undertaken by a NATA certified laboratory
- The lab is to record samples as whether they meet respective holding times and have a sample tracking system
- During the project, the laboratory is to report that all the samples arrived intact and were analysed within holding times for the respective analytes. Samples to be kept below 4°C at all times from the point of collection to the analysis
- The laboratory is to have established sampling analysis methods that are based on internationally recognised procedures such as those published by the United States Environment Protection Agency (USEPA), American Public Health Association (APHA), Australian Standard (AS) and National Environment Protection Measures (NEPM)
- The laboratory is to have established QA/QC standards and internal testing.

### 4.8.3 Quality Control Samples

For TSS analysis, quality control samples will be collected and processed as per Table 4-3.

Table 4-3 Quality control sample requirements and descriptions.

QA/QC sample	Description
<b>Field duplicate</b>	<p>Collected at 5% of locations. One sample is split in two samples, and the additional sample is labelled as a duplicate to test laboratory method.</p> <p>TSS total sample replication (2 events/day x 3 days x 12 sites x 2 depths = 144 samples). TSS duplicate replication (144 samples x 5%). An additional three duplicate samples would be collected per day (9 in total).</p>
<b>Trip blank</b>	<p>A trip blank (deionised) water will be included and treated as a sample. It will be used to identify errors or contamination in sample collection or analysis.</p>

## 4.9 Reporting

Reports would be prepared for the First Quantum Class (or equivalent) vessel and the First Oasis Class (or equivalent) vessel events to include:

- Executive Summary
- Introduction
- Methodology, including sampling and analysis procedures, figures demonstrating sampling locations, water quality guidelines, sample numbers and including detail of QA/QC samples and any deviations to the methods contained within this Program
- Results, including:
  - Description of the field observations and any field or data anomalies encountered
  - Water quality results across the sites, depths and sampling days with reference to the appropriate water quality guidelines
  - Annotated figures with the actual water quality results against the previously modelled TSS and turbidity plume mapping.
- Quality assurance procedures and results
- Discussion including:
  - A review of the monitoring results that considers the performance of the SSI relative to the environmental parameters

- Comparison to predicted modelling results of the TSS concentrations within the vessel pathway and at the sensitive receptors
  - Comparison to water quality impact assessment from the MOD 3 Water and Sediment Quality Assessment and Operational Sediment Plume Assessment
  - Discussion of environmental factors that may have influenced water quality on the days of sampling, including (but not limited to) regional influences such as upwelling events, currents, recent rainfall and sampling conditions.
- Appendices:
    - Chain of Custody records
    - Official laboratory reports (including QA/QC samples and results).

## **4.10 Corrective Procedures**

The approval conditions relating to the operational water quality monitoring program outline the steps should a water quality exceedance occur.

If an exceedance of the environmental parameters identified in this program occurs at the location of the sensitive receptors, then the Proponent must notify the Planning Secretary and NSW DPIRD Fisheries as soon as possible and within 24 hours of the identification of the exceedances.

The notification must include details of the circumstances of the event, including:

- (a) the nature of the event
- (b) the parameters that were exceeded
- (c) the timing and duration of the event
- (d) the measures employed to minimise the exceedance.

The Planning Secretary may direct the Proponent to prepare a Report on Environmental Parameter Exceedance and submit it to the Planning Secretary within the time frame specified by the Planning Secretary. The Report must detail the cause and major contributor of the exceedance, the effectiveness of any action(s) taken in response the exceedance and the options available to prevent recurrence.

If a non-compliance and/or non-adherence to this plan is identified, corrective actions will be identified and implemented by the Proponent based on the Water Quality components of the OEMP prepared for the project, the results of any investigations and the best possible outcome for operational activities, the environment and the local community.

## 5. Operational Monitoring Program – over 60 Vessel Cruise Season

### 5.1 Objectives

The objective of this program is to undertake continuous water quality monitoring during the first cruise season that exceeds 60 vessels per season. The intent of this program is to compare the actual operational performance against the predicted performance to validate MOD 3 water quality modelling studies and impact assessment on identified sensitive receptors (Advisian 2023; Jacobs 2017, Jacobs 2023; Section 3.1.2). This study would collect continuous water quality data during all conditions, including post rainfall/storms and strong currents.

### 5.2 Overview

An overview of the proposed modelling validation water quality study is outlined in Table 5-1.

Table 5-1 Proposed water quality modelling validation study – cruise season with over 60 vessels

Monitoring Program Element	Description
<b>Aims</b>	Undertake continuous water quality monitoring during one cruise ship season of significant size, to validate water quality modelling studies undertaken for the EA Report including to assess impacts on identified sensitive receptors.  This study would aim to collect data during all conditions, including storm events, within one cruise season, at the location of sensitive receptors.
<b>Trigger/s</b>	The first cruise season scheduled to have over 60 vessel visits.
<b>Temporal Replication</b>	Continuous water quality monitoring undertaken for the duration of one cruise season (October to April), one month prior (September) and for one month following (May).
<b>Water Quality Guidelines</b>	Australian and New Zealand Water and Sediment Quality Guidelines (ANZG 2018).
<b>Water Quality Sampling Locations</b>	Two fixed logger locations would be used. Loggers would be located at sensitive receptors: <ol style="list-style-type: none"> <li>1. Aquaculture leases</li> <li>2. Seagrasses</li> </ol>
<b>Field Methods</b>	Continuous physicochemistry monitoring using water quality loggers deployed at the aquaculture leases and the seagrasses.
<b>In-situ field Parameters</b>	Dissolved oxygen (%)  pH

Monitoring Program Element	Description
	Turbidity (NTU) Wave and current data to be sourced from existing buoys (if possible).
<b>Reporting</b>	Sampling and analysis plan (prepared prior to sampling). One post cruise season report including analysis of season trends with comparison to predicted modelling results.

### 5.3 Monitoring Triggers

The monitoring trigger for this program is the first cruise season that has over 60 vessels scheduled to visit.

### 5.4 Monitoring Frequency and Lifespan

Continuous water quality monitoring would be undertaken for the full duration of one cruise season (October to April) and include one month prior (September) and one month following (May). The full timeline for the deployment of loggers is proposed for the start of September to the end of May.

Current Port Authority forecasting suggests that a cruise season of over 60 vessels is approximately 10 years away. This information is known well in advance (months) so there would be sufficient planning and notification time ahead of the season to mobilise equipment.

### 5.5 Existing Aquaculture Logger

There is currently a water quality logger deployed at the Twofold Bay aquaculture leases. If available, then this may be investigated as an option to source data via a data sharing agreement. Otherwise, a new logger would be installed at this location.

Given the likely time interval between the development and implementation of this program, the most practical option will need to be investigated when the cruise season of over 60 vessels is triggered.

This methodology has been designed to be consistent with that of the existing logger to ensure that the same instruments are used, and consistent water quality parameters are measured. Noting that there may be changes in technology between now and implementation of the program.

### 5.6 Monitoring Sites

Two continuous water quality monitoring loggers would be deployed at two locations in the vicinity of sensitive receptors including 1) aquaculture lease and 2) seagrasses with sub-options for the location of each logger.

There are several considerations in the selection of the monitoring sites for the deployment of loggers:

- The loggers will be moored well outside of the cruise vessel and recreational vessel pathways. Given that these are fixed long term moorings within a busy harbour, consultation regarding the location of the proposed sites with the Harbour Master and the existing aquaculture leases is recommended.
- The loggers will be moored in areas of sandy seabed and not on mapped seagrasses or subtidal reef/macrophytes (where they could damage the known vegetation communities). Careful consideration will be given to the deployment sites to avoid dragging of the mooring anchor chain over marine vegetation, while also being deployed in appropriate areas for monitoring.
- In locations which are not easily accessible to help prevent human tampering and theft.
- The logger locations will be representative of the location of the sensitive receptors.
- Based on DPIRD advice following the results of the Quantum water quality monitoring program in February 2025, a monitoring location should be relocated in the vicinity of WQ1 in the Quantum monitoring program (**Appendix C**). The results of the Quantum monitoring program showed higher than modelled turbidity and TSS results in the vicinity of WQ1 (shown in Section 4.5) (Worley 2025). As such, two options (Option 1C and Option 1D) have been included and one of these should be selected in preference to Option 1A and Option 1B.

Options for the location of the loggers is reviewed in Table 5-2 with the final locations to be determined upon the event being triggered and after consultation with DPIRD Fisheries, at least three months before monitoring begins. Options for the locations of water quality loggers are shown in Figure 5-1.

Table 5-2 Logger location options for the long-term deployment during cruise season

Logger 1	Location	Depth of logger deployment	Considerations
<b>Seagrass</b>	Option 1A – attached to western end of wave attenuator	Mid water	Likely protected from theft and tampering. Eliminates risk to navigation. Diver based installation. Wave attenuator structure may interfere with turbidity results. Located nearly 200 m from Zostera so not be representative of water quality changes in the immediate vicinity. ~200 m away from large patch of Zostera
	Option 1B – directly east and adjacent Zostera	Mid water	Would require deployment and needs to avoid impacts on seagrasses and macroalgae. Environmentally friendly





			<p>moorings (EMFs) should be used if possible.</p> <p>Vessel based installation (crane and heavy anchor lifting) by specialised contractor.</p> <p>Potential risk to navigation.</p> <p>Targets the largest area of seagrasses.</p>
	Option 1C – attached to eastern end of wave attenuator	Mid water	<p>Likely protected from theft and tampering.</p> <p>Eliminates risk to navigation.</p> <p>Diver based installation.</p> <p>Located 150 m away from mapped Posidonia and in the vicinity of WQ1, observed to have higher than modelled TSS and turbidity during the Quantum visit in February 2025 (Worley 2025).</p> <p>Option 1C or 1D are preferred due to vicinity to WQ1.</p>
	Option 1D – directly adjacent to the Posidonia beds	Mid water	<p>Would require deployment and needs to avoid impacts on seagrasses and macroalgae. Environmentally friendly moorings (EMFs) should be used if possible or the logger could be attached to the rocky seawall.</p> <p>Targets the mapped Posidonia beds and in the vicinity of WQ1, observed to have higher than modelled TSS and turbidity during the Quantum visit in February 2025 (Worley 2025).</p> <p>Option 1C or 1D are preferred due to vicinity to WQ1.</p>
<b>Logger 2</b>			
<b>Aquaculture</b>	Option 2A – northeast of aquaculture lease	Surface (-20 cm)	<p>Would require deployment and needs to avoid impacts on aquaculture leases, seagrasses and macroalgae. EMF should be used if possible.</p>
	Option 2B – east of aquaculture lease		<p>Vessel based installation (crane and heavy anchor lifting) by specialised contractor.</p> <p>Potential risk to navigation.</p>
	Option 2C – existing logger (if available)	Near surface	<p>Ideal if data sharing can be reached.</p> <p>Existing water quality parameters are suitable.</p> <p>Exact location is not known.</p>

# Eden MOD3 Operational Water Quality Program






> 60 vessels  
Water Quality Logger Sites

## Legend

### Water Quality Logger Site Options

-  Sensitive Receptors
-  Vessel Path
-  Modelled Assumed Vessel Pathway (Jacobs 2017)
-  NSW Aquaculture Leases (NSW DPI 2024)

### Estuarine Macrophyte Mapping (NSW DPI 2023)

-  Halophila
-  Posidonia
-  Posidonia - Sparse
-  Zostera
-  Zostera - Sparse

While every care is taken to ensure the accuracy of this data, Worley Consulting makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which might be incurred as a result of the data being inaccurate or incomplete in any way and for any reason.



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## 5.7 Monitoring Parameters

### 5.7.1 Field Conditions

The following field conditions would be recorded during the season:

- Cruise ship movement data including the type of vessel, timing of movements and length of stay
- Rainfall during the cruise season (available from the nearest BOM station 069015 at Eden Marine Rescue)
- Timing of deployment
- Any natural regional events that occur such as upwellings, major storms or algae blooms etc.
- Wave and current data would be useful in terms of identifying events during the season. Wave and current data would be obtained from existing buoys if possible. Wave data can also be obtained from the following sources:
  - Manly Hydraulics Laboratory (MHL) collects continuous offshore wave data from 7 monitoring locations in NSW including at Eden <https://mhl.nsw.gov.au/Station-EDENOW>
  - The NSW Nearshore Wave Tool provides transformed wave data based on offshore wave conditions from the NSW Waverider buoy network and BOM Auswave forecast <https://mhl.nsw.gov.au/Data-Wave>.

### 5.7.2 Water Quality Parameters

Continuous monitoring of the water quality parameters would be undertaken including:

- Dissolved oxygen (DO) (%)
- Turbidity (NTU)
- pH (NTU)
- TSS (mg/L) (extrapolated using turbidity/TSS correlation if possible).

Additional TSS and turbidity data will be collected during the Quantum Vessel Event (Section 4) and can be used to derive a TSS/turbidity correlation. If appropriate, this correlation can be used to extrapolate the turbidity data to obtain a TSS dataset.

A summary of the targeted monitoring parameters, LORs and adopted water quality guidelines for the monitoring program is provided in Table 5-3.

Table 5-3 Water quality monitoring parameters and water quality guidelines

Parameter	Method	Unit	Water Quality Guideline
Turbidity	Continuous logger	NTU	10 mg/L <sup>1</sup>
pH	Field	-	8-8.4 <sup>1</sup>
Dissolved oxygen	Field	% or mg/L	5 mg/L <sup>2</sup>

<sup>1</sup> Default water quality guidelines for stressors in marine waters of south-east Australia (ANZECC 2000), <sup>2</sup> Default water quality guidelines for aquaculture and human consumption of aquatic foods (ANZECC 2000).

## 5.8 Methods

### 5.8.1 Deployment

Water quality loggers would be deployed in-situ to continuously monitor turbidity, pH and DO. The depth of the deployment would be based on the sensitive receptors. The logger near the aquaculture leases would ideally be just below the surface. The logger near the seagrass beds would be deployed in the mid water column.

The deployment method will depend on the location:

- Fixed deployments – using a heavy (around 200 kg) mooring, polyvinyl chloride jacket steel cable wire, yellow surface data buoy with navigation hazard light. This would need to be performed by a suitable commercial vessel with a winch and staff experienced in mooring deployments. The mooring may be lowered to the seabed using a chain or leaded ground line up to 1.5 times the datum depth. Environmentally friendly moorings (EMFs) should be used if possible.
- Attached to existing structures – the logger would be deployed in the mid water column depth. If possible, using existing structures (such as the wave attenuator) would reduce the instrument tampering risks and eliminate the navigational and reduce risks associated with mooring scour on the seafloor harming seagrass or macroalgae.

A suitable multiparameter sonde/logger would be used for the deployment such as Exo2 or a Seabird 16plusV2 (either option would be suitable) (Figure 5-2). However, the specific type of water quality logger will need to be selected closer to the implementation of this program, based on the best available technology and options.

If the water quality logger is still located at the aquaculture lease, and a data sharing agreement is reached, then it is recommended that the same logger is used at the seagrass site. An Exo2 is currently deployed at the aquaculture leases.

For submerged loggers, biofouling is the largest factor that can impact on their operation and maintenance. The proposed loggers below have options for built in wipers and biofouling resistance for fixed long-term deployments.

Product information sheets are attached for general information purposes based on current technology in **Appendix B**.



Figure 5-2 YSI Exo multi parameter probe ([www.ysi.com](http://www.ysi.com)) and Seabird 16plusV2 ([www.seabird.com](http://www.seabird.com))

## 5.8.2 Telemetry

Connecting the loggers to a real time data buoy would allow for the real time viewing of water quality data via a website. This would assist in early identification of data or logging issues and allow for the viewing of data in real time.

## 5.9 QA/QC

### 5.9.1 Data logger servicing and data retrieval

After each maintenance trip, the downloaded data would undergo QA/QC checks. Once the trip's data has been uploaded, the data for all parameters at each site will be plotted as a time series and visually inspected for anomalies or evidence of logger failure. Anomalies may include:

- Erratic peaks or troughs
- Sudden elevations or drops
- Systematic fluctuations occurring on the same period as the logger wipers
- Sensor 'drift' issues appearing as gradual increases followed by a sudden drop when the logger has undergone maintenance or recalibration.

### 5.9.2 Redundancy

Redundancy (having an additional spare instrument) is recommended for instrument swap out during maintenance and in case of an emergency. Replacement loggers can also be hired on as needed basis, but this is dependent on availability.

### 5.9.3 Data Management and Analysis

A Data Custodian will be responsible for managing, QA/QC and analysing the dataset. After downloading the data in-field, the raw data should be backed up as soon as practicable.

The quality-controlled dataset will be added to a master database, providing a continuous time series of data collected to date. Details of data points removed during the cleaning process will be saved in a data cleaning log.

## 5.10 Corrective Procedures

The approval conditions relating to the operational water quality monitoring program outline the steps should a water quality exceedance occur.

If an exceedance of the environmental parameters identified in this program occurs at the location of the sensitive receptors, then the Proponent must notify the Planning Secretary and NSW DPIRD Fisheries as soon as possible and within 24 hours of the identification of the exceedances.

The notification must include details of the circumstances of the event, including:

- (a) the nature of the event
- (b) the parameters that were exceeded
- (c) the timing and duration of the event
- (d) the measures employed to minimise the exceedance.

The Planning Secretary may direct the Proponent to prepare a Report on Environmental Parameter Exceedance and submit it to the Planning Secretary within the time frame specified by the Planning Secretary. The Report must detail the cause and major contributor of the exceedance, the effectiveness of any action(s) taken in response the exceedance and the options available to prevent recurrence.

If a non-compliance and/or non-adherence to this plan is identified, corrective actions will be identified and implemented based on the Water Quality components of the OEMP prepared for the project, the results of any investigations and the best possible outcome for operational activities, the environment and the local community.

## 5.11 Reporting

Within 60 days post event reports would be prepared for the First Cruise Season with over 60 vessels and would include:

- Executive Summary
- Introduction
- Methodology, including sampling and analysis procedures, figures demonstrating sampling locations, water quality guidelines, deployment and logger methodologies and any deviations to the methods contained within this program
- Results, including:
  - The quality-controlled dataset will be presented in each Field Report, with both raw and quality-controlled data provided in Excel

- Description of the field observations and any field or data anomalies encountered
  - Summary of water quality statistics including the min, max, median, standard deviation and 95%ile
  - Time series plots of the cruise visits
  - Time series plots of the water quality data
  - Time series plots of the rainfall and wave data
  - Multivariate and univariate statistical analysis of the water quality results in relation to the cruise visits.
- Quality assurance procedures and results
  - Discussion including:
    - A review of the monitoring results that considers the performance of the operation of the cruise terminal relative to the environmental parameters
    - Comparison to predicted modelling results of the turbidity and TSS concentrations within the vessel pathway and at the sensitive receptors
    - Comparison to the water quality impact assessment from the MOD 3 Water and Sediment Quality Assessment and Operational Sediment Plume Assessment
    - Discussion of environmental factors that may have influenced water quality throughout the season including (but not limited to) significant regional events such as storms, flooding, bushfires or upwelling.

## **6. Health and Safety Requirements**

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### **6.1.1 Hazard Identification**

A hazard identification assessment will be undertaken prior to mobilising for fieldwork. The purpose will be to identify key hazards and controls to reduce the hazards to as low as reasonably possible, prior to commencing fieldwork.

### **6.1.2 Safe Work Method Statement**

All sampling activities are to be conducted under a Safe Work Method Statement (SWMS) or similar which is to be developed by the contractor and reviewed and approved prior to the commencement of any fieldwork. The SWMS is to include identified hazards, risks and controls relating to (but not limited to) travel, boating activities and water quality sampling including manual handling.

### **6.1.3 Personal Protective Equipment**

Field personnel involved in sampling and handling water samples shall always wear appropriate personal protective equipment (PPE) including personal floatation devices (PFDs) when working over water, closed shoes / safety boots, long sleeved shirts, glasses, hats and nitrile gloves.

## 7. References

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Worley (2025) Eden Cruise Wharf Modification 3 to SSI 7734 – Operational Water Quality Monitoring Report Quantum Class Visit. A report prepared for PANSW in May 2025. Project number: 311012-00687.

## **Appendix A. Field Notes Template**

**Field Records Sheet**
**Instructions:**

1. Fill out field conditions sheet for each sampling event (six sampling hourly sampling events per day, over 3 days)
2. For each sampling event, collect physicochemistry data using water column profiling at each site.
3. For two sampling events per day, collect surface and mid water column samples for laboratory analysis of TSS, at each site.

**Day/date:**
**Sample Event:** \_\_\_ of 6

**Cruise Ship timing and movements:**
**Other Vessel timing and movements:**

Site	1	2	3	4	5	6	7	8	9	10	11	12
<b>Time</b>												
<b>Site Depth</b>												
<b>Water Sample Depth (TSS)</b>												
<b>Tide tides (low and high)</b>												
<b>Tide states (ebb or flood)</b>												
<b>Wind Speed and Direction</b>												
<b>Current Speed and Direction</b>												
<b>Rainfall on day</b>												
<b>Rainfall in 3 days preceding</b>												
<b>Other field observations (discoloured waters, odours, surface slick, debris); Water &amp; Air Temperature</b>												

## **Appendix B. Water Quality Logger Specifications**

## **Appendix C. Consultation Correspondence**

Priestley, Megan (Newcastle)

---

From: Megan.Priestley@worley.com  
Subject: FW: Eden Mod 3 Operational Water Quality Monitoring Report[External Sender]

---

From: Carla Ganassin [REDACTED]  
Sent: Monday, 4 August 2025 11:50 AM  
To: Francisca Alvarez [REDACTED]  
Cc: Christa Sams [REDACTED]; Sam Isaacs [REDACTED]; Kate de Roover [REDACTED]; Emma Wilkie [REDACTED]  
Subject: RE: Eden Mod 3 Operational Water Quality Monitoring Report

Hi Francisca,

Yes, you have interpreted our advice correctly.

Your approach below sounds good. Can you please notify DPIRD Fisheries of the advice received from your consultants Worley, and keep us informed of any changes to the seagrass water quality monitoring location.

Regards,

Carla Ganassin

Senior Fisheries Manager, Aquatic Ecosystems Assessments  
Aquatic Assessments, Regulation & Engagement Unit, Fisheries and Forestry Division  
P 0447 644 357 E [REDACTED]  
[dpiird.nsw.gov.au](http://dpiird.nsw.gov.au)



Department of Primary Industries  
and Regional Development

---

From: Francisca Alvarez [REDACTED]  
Sent: Friday, 1 August 2025 11:32 AM  
To: Carla Ganassin [REDACTED]  
Cc: Christa Sams [REDACTED]; Sam Isaacs <[REDACTED]>; Kate de Roover [REDACTED]; Emma Wilkie <[REDACTED]>  
Subject: Re: Eden Mod 3 Operational Water Quality Monitoring Report

Hi Carla,

Please see the **attached** figure from the Operational Water Quality Monitoring Program. I forgot to include this in my previous email (below). This figure makes it clearer where the proposed 2 continuous monitoring location options are - one for the aquaculture leases, and one for seagrass.



Kind regards,

Francisca

**Francisca Alvarez** | Environmental Planning Officer

My work days are Monday to Friday

**Port Authority of New South Wales**

Level 4, 20 Windmill Street | Walsh Bay NSW 2000 Australia  
PO Box 25 | Millers Point NSW 2000 Australia

E: [REDACTED]

T: +61 476 682 910 |

[www.portauthoritynsw.com.au](http://www.portauthoritynsw.com.au)



We acknowledge and pay our respect to the traditional custodians of the lands and waters of NSW and all Aboriginal Elders, past, present and emerging.

---

From: Francisca Alvarez

Sent: Thursday, July 31, 2025 10:51:57 AM

To: Carla Ganassin [REDACTED]

Cc: Christa Sams [REDACTED]; Sam Isaacs [REDACTED]; Kate de Roover [REDACTED]; Emma Wilkie [REDACTED]

Subject: RE: Eden Mod 3 Operational Water Quality Monitoring Report

Hi Carla,

Thank you for your comments on the *Operational Water Quality Monitoring Report- Quantum Class Visit for the Eden Cruise What Modification 3 to SSI 7734* (Worley Consulting, 311015-00687\_RevO, 9 May 2025).

Condition **D21** states that '*The Operational Water Quality Monitoring Program must include:*

- a. *details of the type and frequency of monitoring to be undertaken for single vessel events (the first Quantum class or equivalent and first Oasis class or equivalent) and the first cruise season with more than 60 vessel visits;*
- b. *a review of the monitoring results that considers the performance of the SSI relative to the environmental parameters.'*

Section 5.6 of the Water Quality Monitoring Program specifies that 'Two continuous water quality monitoring loggers would be deployed at two locations in the vicinity of sensitive receptors including 1) aquaculture lease and 2) seagrasses.'

In response to your feedback, **Port Authority proposes to:**

- seek advice from our consultants Worley to determine whether:
  - a location at/near WQ1 for a continuous water quality monitoring station is appropriate, noting the Water Quality Monitoring Program included an assessment of different monitoring sites as part of the process of selecting final locations (see section 5.6 of the WQ Monitoring Program).
  - a continuous water quality monitoring station at/near WQ1 could replace one of the selected location options, i.e. there would be two continuous water quality monitoring loggers deployed at two locations, with WQ1 being selected to measure water quality parameters at seagrass sensitive receptors.
- (following confirmation by Worley) edit the *Operational Water Quality Monitoring Program* (prepared under condition **D21**) to add a requirement that once the 'first cruise season with more than 60 vessel visits' event has been triggered, Port Authority would continuously monitor water quality at location WQ1 as one of the locations.
- add the above additional mitigation measure / edit to the WQ Monitoring Program, to the Water Quality Monitoring Sub Plan – as per condition **D24**. Condition D24 requires that the recommendations identified in the Operational Monitoring Report '... must be implemented as part of the SSI in the timeframes outlined in the Operational Monitoring Report. Additional mitigation measures must be included in the relevant OEMP Sub-plan.'

DPI Fisheries consultation

It is noted that section 5.12 of the Water Quality Monitoring Program specifies additional consultation closer to the execution of the program, including updated consultation with NSW DPIRD Fisheries on the final location of the loggers.

As per condition **D3**, the Water Quality Management Sub Plan would be subject to DPI Fisheries review, and any edits to this Sub-Plan would be made in consultation with DPI Fisheries. Condition D19 states that the Operational Water Quality Monitoring Program must be prepared in consultation with DPI Fisheries. Therefore any future edits to this program would also be made in consultation with DPI Fisheries.

Can you please clarify if I have understood your request correctly? Are you agreeable to our proposal above?

Thank you

Kind regards,

**Francisca Alvarez** | Environmental Planning Officer

My work days are Monday to Friday

**Port Authority of New South Wales**

Level 4, 20 Windmill Street | Walsh Bay NSW 2000 Australia  
PO Box 25 | Millers Point NSW 2000 Australia

E: [REDACTED]

T: +61 476 682 910 |

[www.portauthoritynsw.com.au](http://www.portauthoritynsw.com.au)



We acknowledge and pay our respect to the traditional custodians of the lands and waters of NSW and all Aboriginal Elders, past, present and emerging.

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From: Carla Ganassin [REDACTED]  
Sent: Wednesday, 2 July 2025 9:41 AM  
To: Francisca Alvarez [REDACTED]  
Cc: Christa Sams [REDACTED]; Sam Isaacs [REDACTED]; Kate de Roover [REDACTED]; Emma Wilkie [REDACTED]  
Subject: FW: Eden Mod 3 Operational Water Quality Monitoring Report

Hi Francisca,

Thank you for referring these reports in accordance Condition of Approval D24 for the Eden Wharf Mod3 state significant project.

DPIRD Fisheries acknowledges receipt of the Operational Water Quality Monitoring Report- Quantum Class Visit for the Eden Cruise What Modification 3 to SSI 7734 (Worley Consulting, 311015-00687\_RevO, 9 May 2025) and has reviewed this report.

DPIRD Fisheries commends the comprehensive water quality monitoring undertaken in this report, and provides the following comments:

Key Fish Habitat/Sensitive Seagrass Receivers

DPIRD Fisheries expresses some concern for the turbidity levels reported near sparse Posidonia seagrass at site WQ1. At this location 14 – 16mg/L TSS was recorded associated with the quantum vessel transit. These levels are above Aquatic Food Water Quality guideline of 10mg/L, and also above the Jacobs modelling which (contrary to the 0-5mg/L TSS stated in this water quality report) did not report any TSS values at the WQ1 site (i.e. <1mg/L).

The inclusion of the following operational measure as part of the Harbour Master's Berthing Requirements is commended and supported by DPIRD Fisheries and will assist in managing turbidity impacts where practicable to do so:

'Where practicable minimise the power and duration thrusters are used, especially in the berth box, to reduce sediment disturbance and the resultant impacts on water quality and sensitive ecological communities and habitats in Port of Eden'.

However, while the turbidity from Quantum and OASIS vessels would be infrequent pulse events, DPIRD Fisheries is concerned about the resilience of the seagrass at site WQ1 against additional potential turbidity from other cruise vessels at the wharf. Noting that the Eden Wharf Mod 3 application included approval for an unlimited number of cruise vessel visits to the port, the modelling undertaken for this Mod 3 application was inaccurate regarding turbidity impacts to site WQ1 from Quantum/OASIS size class vessels, and there is potential for turbidity in this area from smaller sized cruise vessels.

To better consider potential impacts on the seagrass at site WQ1 from all cruise vessel activities at the wharf, DPIRD Fisheries recommends that the peak season water quality monitoring required under Condition of Approval 21 for this Mod 3 approval includes specific monitoring of turbidity at this site.

#### Aquaculture Lease Sensitive Receiver

The reported TSS and other water quality levels are not expected to be significantly impacting any food safety or aquaculture concerns in the area.

The Aquaculture Unit within DPIRD Fisheries supports the above request for additional/increased monitoring during peak seasons.

If you wish to discuss the above response, please make contact.

Regards,

Carla Ganassin

Senior Fisheries Manager, Aquatic Ecosystems Assessments  
Aquatic Assessments, Regulation & Engagement Unit, Fisheries and  
Forestry Division  
P 0447 644 357 E [REDACTED]  
[dpiird.nsw.gov.au](http://dpiird.nsw.gov.au)



Department of Primary Industries  
and Regional Development

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From: Kate de [REDACTED]  
Sent: Thursday, 5 June 2025 11:52 AM  
To: Carla Ganassin [REDACTED]  
Cc: Emma Wilkie [REDACTED]  
Subject: Fw: Eden Mod 3 Operational Water Quality Monitoring Report

Morning Carla,

We have just received the Water Quality Monitoring Program results from the recent 24 May 2024 modification to the Eden Breakwater Wharf Extension (SSI-7734).  
<https://www.planningportal.nsw.gov.au/major-projects/projects/eden-breakwater-wharf-extension>  
This was required under D25 of their consolidated conditions.  
I just wanted to make sure someone from your team had also seen this.

Thank you, and have a lovely rest of your week.

Kate de Roover (*she/her*)  
Policy Officer Aquaculture  
Aquaculture Management | Primary Industries  
Department of Primary Industries  
and Regional Development

M 0456 495 806 E [REDACTED]

[dpirod.nsw.gov.au](http://dpirod.nsw.gov.au)

Port Stephens Fisheries Institute TAYLORS BEACH

Working Hours: Mon -Fri: 7:30am-3pm



We stand on Country that always was and always will be Aboriginal land. We acknowledge the Traditional Custodians of the land and waters, and we show our respect for Elders past, present and emerging. We are committed to providing places in which Aboriginal people are included socially, culturally and economically through thoughtful and collaborative approaches to our work.

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From: Francisca Alvarez [REDACTED]  
Sent: Wednesday, 4 June 2025 1:02 PM  
To: Emma Wilkie [REDACTED]  
Cc: DPIRD Fisheries Info [REDACTED]; Christa Sams [REDACTED]; Sam Isaacs [REDACTED]  
Subject: Eden Mod 3 Operational Water Quality Monitoring Report

Hi Emma,

Please see **attached** the Eden (MOD 3 to SSI 7734) Operational Water Quality Monitoring Report – Quantum Class Visit. Note that Appendix E has been **attached** separately (not in the pdf report) due to the length of the file.

The Port Authority of New South Wales (Port Authority) is providing DPIRD with this report as per condition [D24 of the Eden Mod 3 conditions of approval](#).

Please also see **attached** the updated Harbour Master Instructions (HMI) for your information. The following additional measure has been incorporated into page 3 of the HMI for all future cruise vessel visits to the berth.

*Where practicable minimise the power and duration thrusters are used, especially in the berth box, to reduce sediment disturbance and the resultant impacts on water quality and sensitive ecological communities and habitats in Port of Eden.*

Kind regards,

**Francisca Alvarez** | Environmental Planning Officer

My work days are Monday to Friday

**Port Authority of New South Wales**

Level 4, 20 Windmill Street | Walsh Bay NSW 2000 Australia  
PO Box 25 | Millers Point NSW 2000 Australia

E: [REDACTED]  
T: +61 476 682 910 |  
[www.portauthoritiesnsw.com.au](http://www.portauthoritiesnsw.com.au)





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**From:** Carla Ganassin [REDACTED]  
**Sent:** Tuesday, 2 July 2024 2:40 PM  
**To:** 'Sam Isaacs'  
**Cc:** Christa Sams  
**Subject:** RE: Eden MOD3 Water Quality Monitoring Programme - consultation request

Dear Sam,

DPIRD Fisheries has reviewed the Eden Cruise Wharf Modification 3 to SSI 7734: Operational Water Quality Monitoring Program (311012-01011\_Rev0) (Worley Consulting, dated 24 June 2024) in light of the pending Conditions of Approval outlined in your email below.

DPI Fisheries is supportive of this plan as drafted.

We have noted that s.3.1.3.2, 1<sup>st</sup> paragraph, last sentence – needs a readability edit.

Note: As of July 1 DPI Fisheries is now known as DPIRD Fisheries.

Regards,

**Carla Ganassin**

Senior Fisheries Manager, Coastal Systems  
Marine Estate Management Branch, Fisheries and Forestry Division

[REDACTED]  
[dpird.nsw.gov.au](http://dpird.nsw.gov.au)



**Department of Primary Industries  
and Regional Development**

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**From:** Sam Isaacs [REDACTED]  
**Sent:** Tuesday, 25 June 2024 10:08 AM  
**To:** Carla Ganassin [REDACTED]  
**Cc:** Christa Sams [REDACTED]  
**Subject:** Eden MOD3 Water Quality Monitoring Programme - consultation request

Dear Carla,

Thank-you for your time on the phone on Friday. Since we last spoke during the Submissions Report preparation in late 2023 Port Authority has progressed the SSI 7734 MOD 3 approval which is now has confirmed conditions of approval and is pending finalisation. In readiness for the upcoming cruise season we have progressed developing the operational plans and monitoring regimes in accordance with these confirmed conditions of approval.

Worley Consulting (formerly Advisian) has prepared the attached Water Quality Monitoring Program (WQMP) in accordance with the conditions of approval and based on the DPI Fisheries feedback received during the exhibition stage and in response to the Submissions Report. Please note the WQMP document was previously referred to as the Sampling and Analysis Plan in the Submissions Report.

Please can DPI Fisheries review the draft version of the WQMP and provide any feedback or confirm that it is consistent with your original intent for the monitoring. To assist us with planning for the next cruise season it

would be greatly appreciated if you could provide your feedback within 2 weeks if possible. If you have any queries on the document I am happy to arrange a meeting with the Port Authority and Worley Consulting to discuss potential updates to the plan.

A copy of the final agreed conditions of approval relating to the WQMP are included below for your reference.

### **Operational Monitoring Programs (Modification 3)**

D9 Conditions D10 to D25 apply to operations associated with Conditions D17 and D20.

D10 Operational Monitoring Program(s) must be prepared to compare actual operational performance against predicted performance of that identified in Condition A1(c)(ix) and (x). The Operational Monitoring Program(s) must be prepared in consultation with the identified relevant authorities. Details of information requested by an agency during consultation must be provided to the Planning Secretary as part of any submission of the relevant Operational Monitoring Program, including copies of correspondence from those agencies as required by Condition A7.

D11 Each Operational Monitoring Program must include:

- (a) details of baseline data;
- (b) the relevant environmental performance criteria or parameter (including reference to where the criteria or parameter are identified in the documents listed in Condition A1(c)(ix) and (x))
- (c) details of monitoring of the project to be undertaken;
- (d) the parameters of the project to be monitored;
- (e) the frequency and lifespan of monitoring to be undertaken;
- (f) the location of monitoring;
- (g) the reporting of monitoring and analysis of results against the relevant environmental performance criteria or parameter;
- (h) details of the methods that will be employed to analyse the monitoring data;
- (i) procedures to identify and implement additional mitigation measures where results of monitoring are unsatisfactory; and
- (j) any consultation to be undertaken in relation to the monitoring programs.

### **Operational Water Quality Monitoring (Modification 3)**

D19 An Operational Water Quality Monitoring Program must be prepared in consultation with DPI Fisheries.

D20 The Operational Water Quality Monitoring Program must enable the monitoring of the first:

- (a) cruise season with more than 60 vessel visits; and
- (b) visit of a Quantum class (or equivalent); and
- (c) visit of an Oasis class (or equivalent).

D21 The Operational Water Quality Monitoring Program must include:

- (a) details of the type and frequency of monitoring to be undertaken for single vessel events (the first Quantum class or equivalent and first Oasis class or equivalent) and the first cruise season with more than 60 vessel visits;
- (b) a review of the monitoring results that considers the performance of the SSI relative to the environmental parameters.

D22 If an exceedance of the environmental parameters identified in the Operational Water Quality Monitoring Program occurs, the Proponent must notify the Planning Secretary and DPI Fisheries as soon as possible and within 24 hours of the identification of the exceedance. This notification must provide details of the circumstances of the event, including:

- (a) the nature of the event;
- (b) the parameters that were exceeded;
- (c) the timing and duration of the event; and
- (d) the measures employed to minimise the exceedance.

D23 Following a notification of an exceedance of environmental parameters (as required by Condition D22) the Planning Secretary may direct the Proponent to prepare a Report on Environmental Parameter Exceedance and submit it to the Planning Secretary within the time frame specified by the Planning Secretary. The Report must detail the cause and major contributor of the exceedance, the effectiveness of any action(s) taken in response the exceedance and the options available to prevent recurrence.

I am happy to discuss the above at any time.

Kind regards,

Sam

**Sam Isaacs** | Senior Project Manager

**Port Authority of New South Wales**  
Level 4, 20 Windmill Street | Walsh Bay NSW 2000 Australia  
PO Box 25 | Millers Point NSW 2000 Australia