

Dredge Management Plan

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This is the approved Dredge Management Plan (DMP) as required under condition 2.7 (U-1003) of EPA Licence 50556



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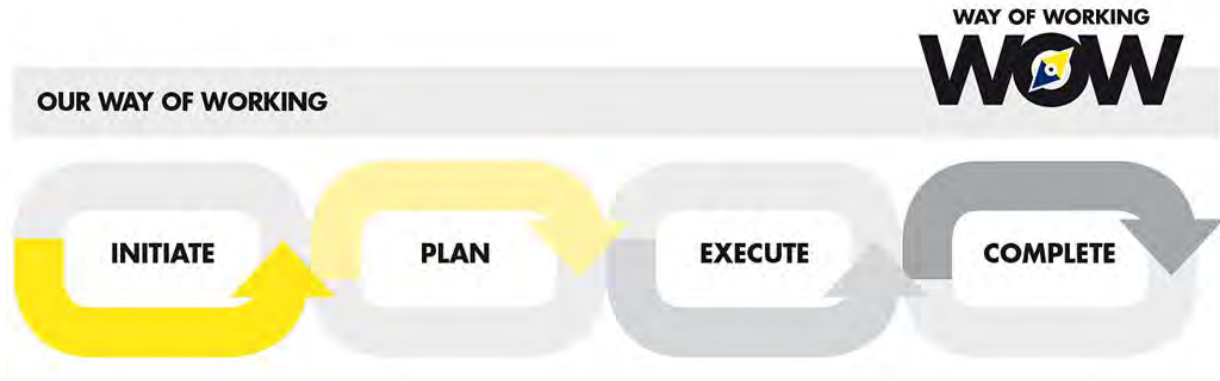
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BOSKALIS WAY OF WORKING

This document forms part of the Boskalis Way of Working, the integrated quality management system applicable to all operations in Boskalis. The Boskalis Way of Working is structured around four Phases as pictured below. This Dredge Management Plan is prepared in the PLAN Phase, where the main implementation is taking place in the EXECUTION Phase.



More detailed information about the Boskalis Way of Working can be found in the Group Manual and the User Guide. A dedicated website with all supporting materials is available at wow.boskalis.com

TABLE OF CONTENTS

BOSKALIS WAY OF WORKING	4
1. INTRODUCTION	8
1.1. General	8
1.2. Purpose	11
1.3. Scope of Document	11
1.4. Contractor's Corporate Statement With Respect To Environment	11
2. SCOPE OF WORK AND DREDGE METHODOLOGY	12
2.1. Project Overview	12
2.2. Work Method	12
2.3. Equipment	13
2.3.1. TSHD Gateway	13
2.3.2. BHD and Dredge Barges	16
2.3.3. Supporting Dredge Equipment	17
3. ENVIRONMENTAL REQUIREMENTS	19
3.1. Introduction	19
3.2. Commonwealth Legislation	19
3.2.1. Environment Protection and Biodiversity Conservation Act 1999	19
3.2.2. Environment Protection (Sea Dumping) Act 1981	19
3.2.3. Maritime Safety and Pollution Legislation	19
3.2.4. Historic Shipwrecks Act 1976	19
3.2.5. Biosecurity Act 2015	19
3.2.6. Australian Ballast Water Management Requirements	20
3.3. State Legislation	21
3.3.1. Protected Areas	21
3.3.2. EPA Code of Practice For Vessel and Facility Management (Marine and Inland Waters)	22
3.3.3. Fisheries Management Act 2007	22
3.4. Development Approval	23
3.5. Dredge Licence	23
4. ECOSYSTEM DESCRIPTION	26
4.1. Introduction	26
4.2. Physical Environment	26
4.2.1. Climate	26
4.2.2. Wave Conditions	26
4.2.3. Wind Conditions	27
4.2.4. Tide	28

4.2.5.	Currents	28
4.2.6.	Geology	30
4.2.7.	Water Quality	30
4.2.8.	Sediment Quality	30
4.2.9.	Ambient Noise	30
4.3.	Biological Environment	31
4.3.1.	Coastal Ecology	31
4.3.2.	Marine Ecology	31
4.4.	Marine pests	32
4.4.1.	Caulerpa taxifolia	33
4.4.2.	Pacific Oyster Mortality Syndrome	33
4.5.	Socio-economic Setting	34
4.6.	Heritage	35
4.7.	Protected Areas	36
5.	ENVIRONMENTAL RISK ASSESSMENT	38
5.1.	Risk and Opportunity Assessment	38
6.	ENVIRONMENTAL MANAGEMENT FRAMEWORK	45
6.1.	Environmental Management Framework Structure	45
6.2.	Sediment Related Impact Management	46
6.2.1.	Adaptive Approach	46
6.2.2.	Proactive Management Practices	48
6.2.3.	Responsive Management Practices	48
6.2.4.	Contingency Management Practice	52
6.2.5.	Validation of TSS-NTU Relationship	53
6.2.6.	Water quality Management framework	53
6.3.	Management of Other Environmental Impacts	54
6.3.1.	Marine Mammals	54
6.3.2.	Invasive Marine Species	57
6.3.3.	Noise quality	59
6.3.4.	Dredge Materials Management Framework	60
6.3.5.	Waste	62
6.3.6.	Hydrocarbon and Chemical Spills	64
7.	REPORTING	66
8.	QUALITY ASSURANCE & QUALITY CONTROL	67
8.1.	Internal Audit	67
8.2.	Audit	67
8.3.	Control & Review of DMP	67

8.4.	Data-handling	67
8.4.1.	Field Logs	67
8.4.2.	Lab Results	67
8.4.3.	Backups of Electronic Data	67
9.	ROLES AND RESPONSIBILITIES	68
9.1.	General	68
9.2.	Project Manager	68
9.3.	Project Safety, Health, Environmental and Quality Manager	68
9.4.	Environmental Manager	68
9.5.	Supervisory Personnel	69
9.6.	Project Personnel	69
9.7.	Environmental Training	69
10.	REFERENCES, ABBREVIATIONS, DEFINITIONS	70
10.1.	References	70
10.2.	Abbreviations	72
10.3.	Definitions	73
11.	ATTACHMENTS	74
11.1.	Specifications TSHD Gateway	74
11.2.	Specifications BHD Magnor	77
11.3.	Specifications Tugs & Dredge Barges	80
11.4.	Risk Matrix	84

1. INTRODUCTION

1.1. General

The Port of Adelaide is the primary port in South Australia, located at Outer Harbor (approximately 14km west of the Adelaide CBD) in South Australia. The port is operated by Flinders Ports Pty Ltd (Flinders Ports) and handles a diverse array of inbound and outbound cargoes, contributing significantly to the State's economic activity. A significant amount of this trade is containerised, and Outer Harbor is the location of the Flinders Adelaide Container Terminal, as well as the Port Adelaide Passenger Terminal. Both of which contribute significantly to South Australia's import and export of goods and visitors.

Flinders Ports has identified the need for an upgrade of the existing infrastructure at Port Adelaide as a priority project for Flinders Ports. A detailed Development Application (DA) Report was submitted in July 2017 in accordance with the **Development Act 1993**, as a Section 49 application given this project is defined as *public infrastructure*. Sponsorship for this application was received from the Minister for Infrastructure prior to lodgment in May 2017. Flinders Ports DA #010/V048/17 received approval on 28th May 2018.

On 12th March 2019 the EPA granted a Dredge Licence (No. 50556) authorising Flinders Ports to undertake at the locations designated Dredging activities in accordance with the conditions set out within the Licence.

This upgrade is being driven by the emergence of Post Panamax class vessels which are wider than the 36m design vessel width of the existing channel and swing basin. Outer Harbor can only currently accommodate vessels up to a maximum width of 42.2m width with operational restrictions. The Port Adelaide Outer Harbor Channel Widening Project will enable the port to accommodate vessels with a maximum width of 49m without operational restrictions.

To meet this growth the existing channel will be widened by 40m to a total width of 170m. The swing basin will be widened from 505m to 560m. The widening footprint of the channel and turning basin are illustrated by the red line in Figure 1.1.

The dredged material will be transported to a designated dredge material placement area (DMPA), located approximately 30km offshore in the Gulf of St Vincent (yellow box in Figure 1.2). This area is 7km by 5km in size and located in deep water (>30m).

Dredging is scheduled to commence in June 2019 and continue for approximately 3 months until completion. Flinders Ports Licence remains valid until February 2023 and includes ongoing monitoring and close-out obligations to be implemented post completion of the actual Dredging.

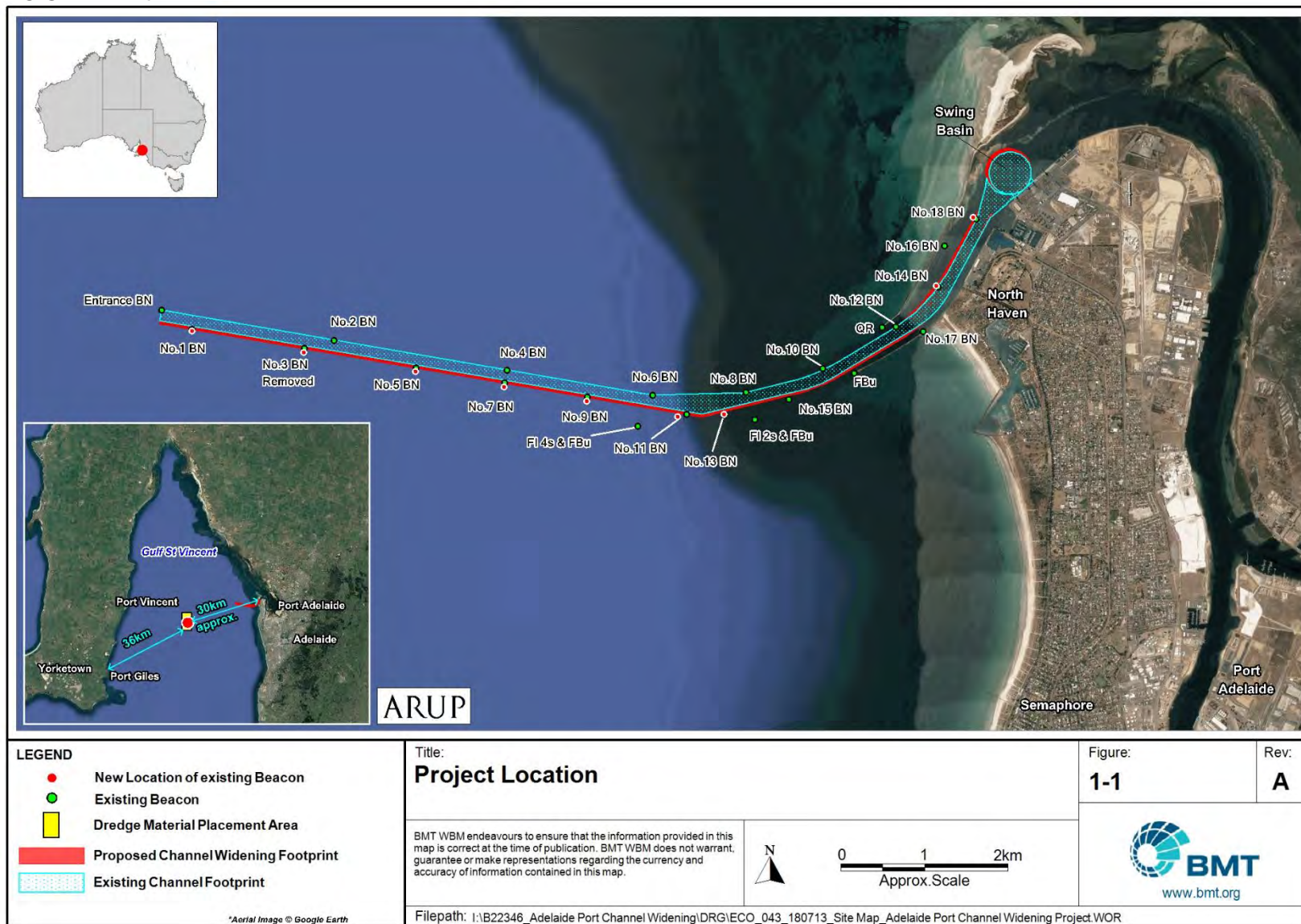


Figure 1.1: Overview Project area with outer shipping channel and turning basin

BOSKALIS WAY OF WORKING

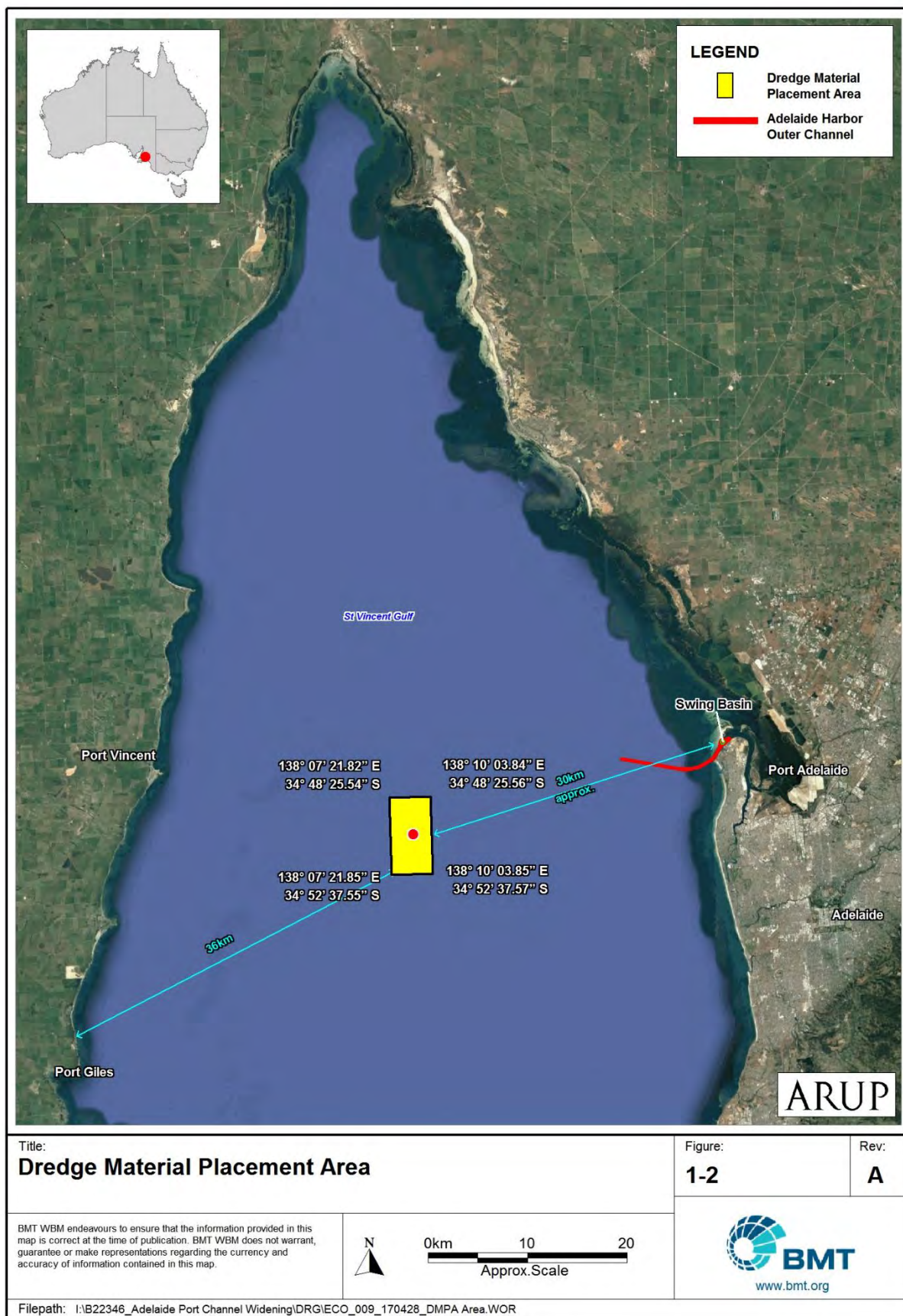


Figure 1.2: Overview location disposal area

1.2. Purpose

The purpose of this document is to identify, as far as is reasonably practicable, all environmental risks associated with the dredging works for the Project and to detail procedures to prevent, minimize and manage such risks.

This Dredge Management Plan (DMP), together with the Environmental Monitoring Program (EMP) [15], specifies how dredging practices and procedures will ensure that any actual or potential adverse effects on the marine receiving environment are avoided or otherwise mitigated to the greatest extent practicable. The DMP is related to management actions during the dredge phase, while the EMP reflects monitoring and survey methods pre-, during and post-dredging works.

The content and scope of the DMP has been guided by Contractor's normal best practise dredge management and the requirements for the DMP as set out in clause 3.2 (U-994) of the dredge licence issued by the Environmental Protection Authority (EPA) [1] and clause 4 of the Development Approval #010/V048/17 [2].

This DMP has been prepared by the Contractor and reviewed by the Client (Flinders Ports), Client's Engineering Consultant (Arup) and Client's Environmental Representative (BMT).

1.3. Scope of Document

This document entails:

- The Scope of Work and work method, including number and type of dredgers used and the dredge methodology (Chapter 2)
- Environmental requirements (Chapter 3)
- Ecosystem description (Chapter 4)
- Environmental risk assessment (Chapter 5)
- Environmental management framework (Chapter 6)
- Reporting (Chapter 7)
- Quality Assurance & Quality Control (Chapter 8)
- Roles and Responsibilities (Chapter 9)

More detail on the environmental monitoring to be performed prior to, during and following dredging is given in the EMP, which includes a description of the methodology for water quality monitoring and zone validation. Furthermore, separate plans are developed for seagrass monitoring [19], Pacific Oyster Mortality Syndrome (POMS) and *Caulerpa taxifolia* management [18], and the Closure Plan [20]. Finally, for the Community Engagement Plan reference is made to [16].

1.4. Contractor's Corporate Statement With Respect To Environment

As the Contractor often operates in environmentally sensitive areas, we adhere to:

- Complying with the applicable statutory environmental provisions and regulations and, wherever possible, going further than required;
- Focusing policy on the prevention or limitation, as far as possible, of pollution of soil, water and air, , creation of waste products and use of dangerous materials;
- Collecting and having waste processed separately, and using water and energy efficiently;
- Translating policy into clear practical guidelines and, furthermore, ensuring that the policy and the guidelines are implemented in practice;
- Permanently ensuring that the environmental awareness and motivation of the employees and others who work on the premises of Boskalis is such that environmental protection - although primarily the management's responsibility - is everybody's concern;
- Optimising our environmental management system according to ISO 14001 standard, to achieve continuous improvement of our environmental performance SHE-Q structure.

2. SCOPE OF WORK AND DREDGE METHODOLOGY

2.1. Project Overview

The Works require the Contractor to widen the existing channel and swing basin to accommodate Post Panamax vessels. The dredging campaign will include:

- Channel widening, from the existing 130m to 170m (-14.2m LAT);
- Turning basin widening, from an existing diameter of 505m to 560m (-14.2m LAT);
- Dredging works in the existing channel to enable declaration of the channel at -14.2m LAT.

An overview of the dredging works is given in Figure 2.1.

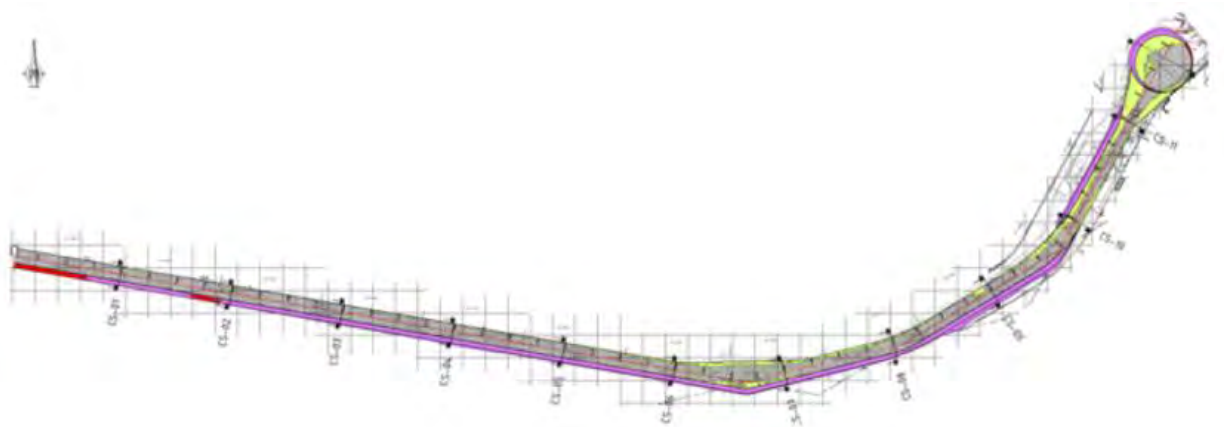


Figure 2.1: Overview channel widening works (pink) and dredging existing channel (yellow)

The total amount of volume to be dredged is estimated at 1.55 million m³ (+/- 20%), taking into account over-depth and tolerances achieved through the differing geological substrates. For environmental risk assessments and predictive modelling, an upper limit bound has been utilised assuming the maximum assumed tolerances apply (1.8 million m³). The final achieved amounts will be confirmed upon completion based upon comparison of pre- and post-dredge bathymetrical surveys.

The dredged material consists of loose sand (St. Kilda formation), clayey sand and sandy clay. In addition, the clayey sand and sandy clay are marked with bands of cementation.

The dredged material will be transported to the Dredge Material Placement Area (DMPA) as shown in Figure 1.2.

Dredging equipment utilised on the project will operate on a 7 day and 24 hour basis, stopping only for maintenance and bunkering requirements. Auxiliary vessels will operate on an as and when required schedule. The expected duration of the dredging works is approximately 11 weeks and are anticipated to commence in June 2019.

2.2. Work Method

Dredging will be conducted by a Trailing Suction Hopper Dredger (TSHD) and a Backhoe Dredge (BHD). The softer material will typically be dredged by the TSHD and the harder material by the BHD. The BHD will load the dredged material into Dredge Barges (DB) which will transport the material to the DMPA where the dredged material will be placed by opening the hopper doors. The estimated split of volume between the TSHD and BHD dredge activities across the channel is shown in Figure 2.2. It can be seen that the largest amount of dredge volume is to be dredged by the THSD and is mostly located in the swing basin and in the channel from KP6 to 11 as also illustrated in Figure 2.3.

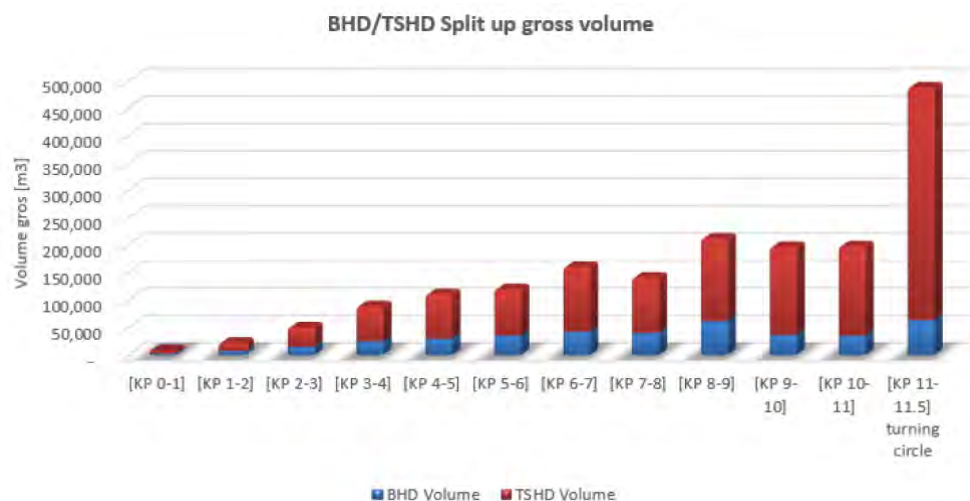


Figure 2.2: Overview estimated gross dredge volumes to be dredged by BHD and TSHD across the channel

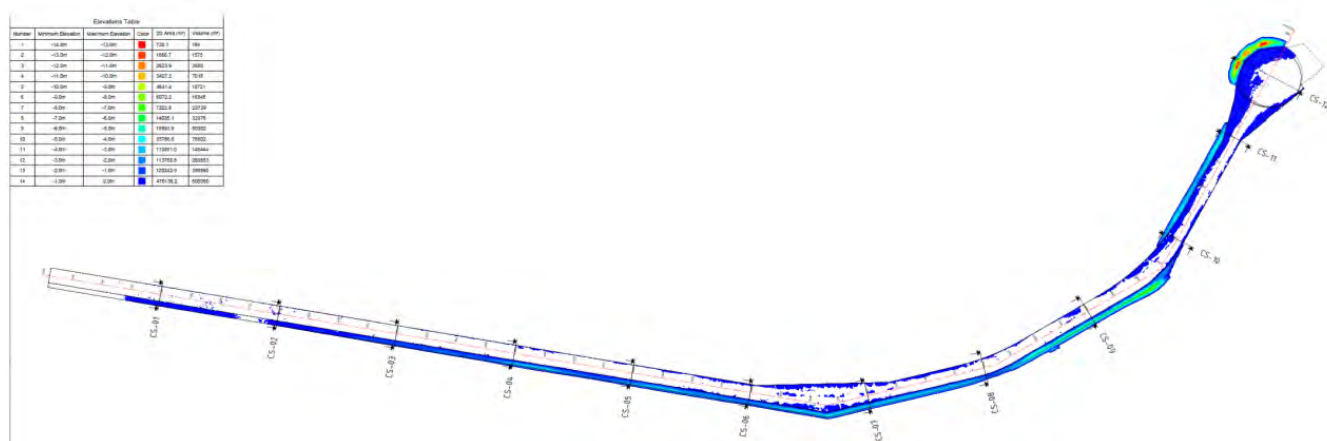


Figure 2.3: Overview of layer thickness to be dredged in the channel where red is largest thickness (maximum 13 to 14m) and dark blue is smallest thickness (0-1m)

2.3. Equipment

2.3.1. TSHD Gateway

The primary dredging equipment selected for the works is the TSHD Gateway shown in Figure 2.4. This is a medium-sized hopper dredge with a capacity of 12,000 m³. Detailed specifications of the TSHD Gateway are given in section 11.1.

The TSHD will be used to dredge all materials encountered within the dredging envelope and will be aided by the BHD for the harder soil parts.

To start dredging operations, the TSHD will sail to the dredging area. Dredging area for that time will be selected based upon the construction programme, metocean conditions and current turbidity regime in the channel. Once in the dredging area, the suction pipe is lowered to the seabed, the dredge pump(s) are started and dredging commences.

While dredging, the draghead scrapes over the seabed and loosens the sediments. The sediment-water mixture is brought up through the suction pipe and pumped into the hopper well. During loading with its draghead on the seabed, the TSHD sails at a slow speed (generally around 1-3 knots). Figure 2.5 shows the TSHD during the loading process.



Figure 2.4: TSHD Gateway

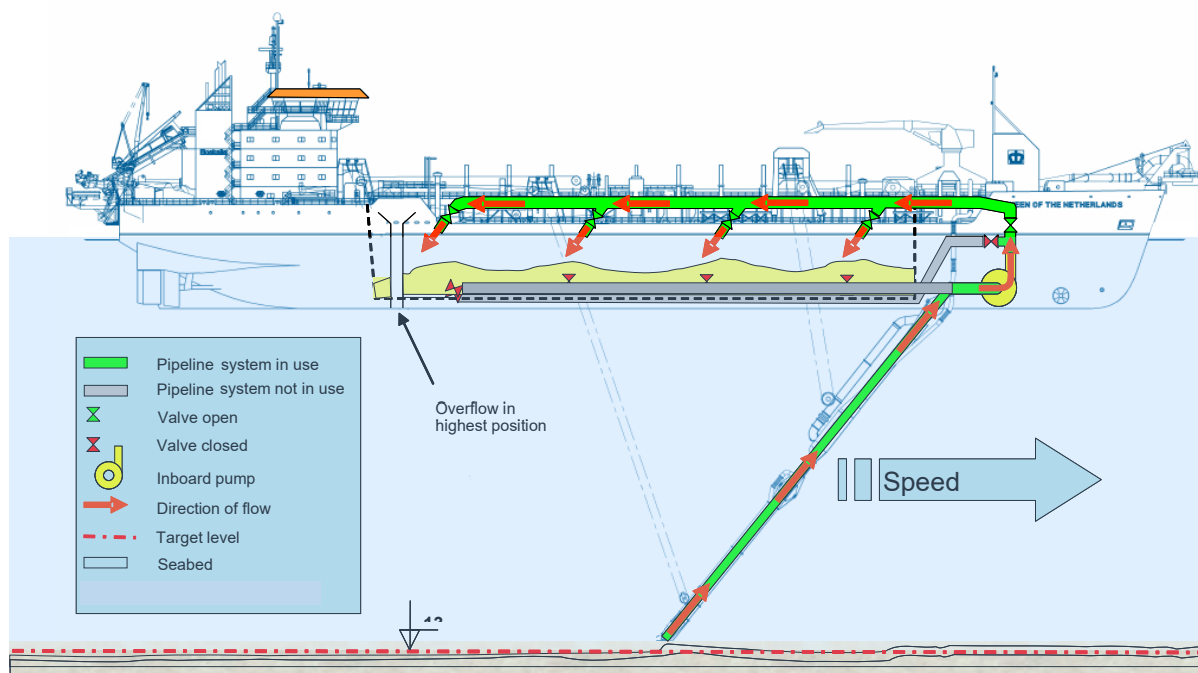


Figure 2.5: TSHD loading process

The dredged material settles out in the hopper and the excess transport water is evacuated through the overflow system. The overflow will be fitted with a 'green valve' as described in further detail below.

When the draught of the vessel reaches the dredging load mark or when circumstances do not allow further loading, dredging will be suspended and the suction pipe will be hoisted on deck. The vessel then sails loaded with dredged material to the approved Dredge Material Placement Area (DMPA).

Dredged materials will be transported in the TSHD from the dredging locations to the DMPA. During the discharge of the hopper the speed of the THSD will be kept to a minimum in order to accurately place the material. The hopper doors will only be opened once above the designated area of the deposition site and closed prior to departing this area. The opening of the bottom doors will generally take around 5 to 10 minutes.

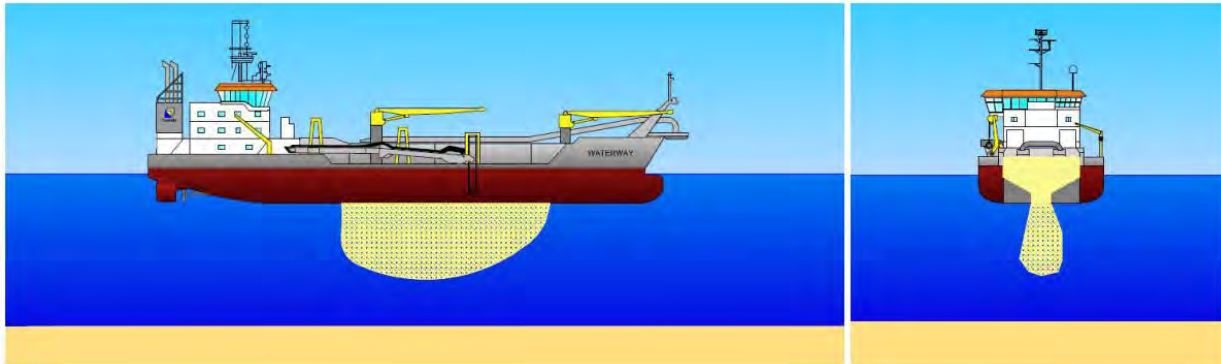


Figure 2.6: TSHD dredge material placement through bottom doors

In line with clause 2.8 (U-996) of the dredge licence [1], the TSHD will be equipped with a ship-borne automated identification system (AIS) and the DGPS system to monitor its location. In addition the following information will be recorded:

- All dates, times, locations (DGPS) and durations for which the hopper doors on the dredge vessel are opened and closed for dredge spoil disposal;
- Vessel movements between the Dredge Area and the DMPA; and
- DGPS position of the vessel(s) at the time of commencement and completion of dredge spoil disposal.

Dredge material placement plans will be based upon a grid of boxes to enable even distribution of the dredge spoil as further described in section 0.

TSHD Overflow with 'Green valve'

The TSHD hopper overflow will be fitted with a 'green valve'. 'Green valves' are devices installed on the overflow that reduce turbidity by preventing entrainment of air into the overflow. When dredging in normal mode, the overflows are fully open and the water mixture including fine sediments, which have not settled in the hopper, makes more or less a free fall down the overflow until it reaches seawater level. During this free fall, air gets entrained (left picture in Figure 2.7). The main part of the fine sediments will settle directly to the seabed due to differences in density. However, a part of the mixture will be pulled towards the water surface by the rising air bubbles creating a visible plume.

When using a green valve, the overflow is partly closed (right picture in Figure 2.7), preventing the free fall of the water sediment mixture. This results in hardly any air being entrained, bringing less fine sediments in suspension in the upper part of the water column. Because a larger part of the fine sediments in the mixture settles to the seabed more rapidly with the use of a green valve, the turbid plumes are smaller, of shorter duration, and mostly confined to the lower parts of the water column where currents have less power for sediment dispersion.

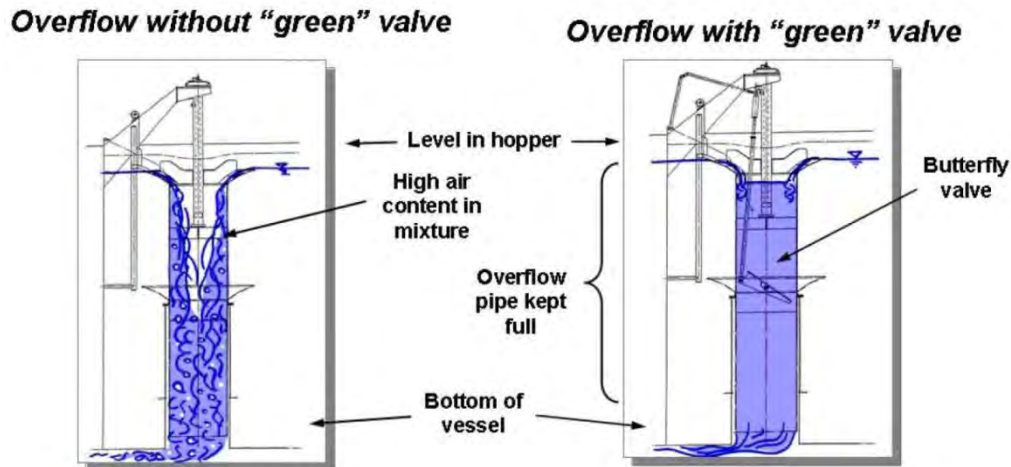


Figure 2.7: the 'Green valve'

2.3.2.BHD and Dredge Barges

The BHD Magnor (see Figure 2.8) will dredge mainly the harder soil or material not accessible by the TSHD Gateway. A BHD is basically a hydraulic excavator installed on a pontoon. Dredging is executed by the excavator which is mounted on a turntable at the front of the pontoon. A general layout of the BHD is given in Figure 2.9, where the main components of a BHD are indicated:

- The pontoon (1);
- The hydraulic excavator, consisting of an excavator body (2), boom (3), stick (4) and bucket (5);
- The spud poles (6) and spud carrier, or tilting spud (7).

To start dredging operations, the BHD is towed to the location where excavation will take place. The BHD positions its spuds on the seabed. Dredging with a BHD is a cycle operated process, the bucket mounted at the end of the stick will excavate the soil from the seabed (shown in Figure 2.8) and will lift the material to the surface. The material in the bucket will then be loaded into a Dredge Barge for further transport to the DMPA. Lifting and lowering of the bucket, boom and stick occurs in a very controlled manner and monitored by Boskalis' in-house developed software package Dredge View 2.0 Crane Monitoring System (DV2-CMS). This provides the dredge operator with a complete overview of the actual conditions, design conditions and the status of the dredging equipment, including the position of the bucket and spuds

Once the BHD has completely loaded the Dredge Barges, the Dredge Barges will sail to the DMPA (pushed by a tug) where the dredged material will be placed. Similar method will be used for positioning and recording of the dredge material placement in the DMPA as for the TSHD described in section 2.3.1. Two Dredge Barges, Terraferre 501 and 502, pushed by the tugs Union Topaz and Onyx, will be available during the Works to allow a continuous dredging process of the BHD. For detailed specifications of the Dredge Barges see Attachment 11.3 .

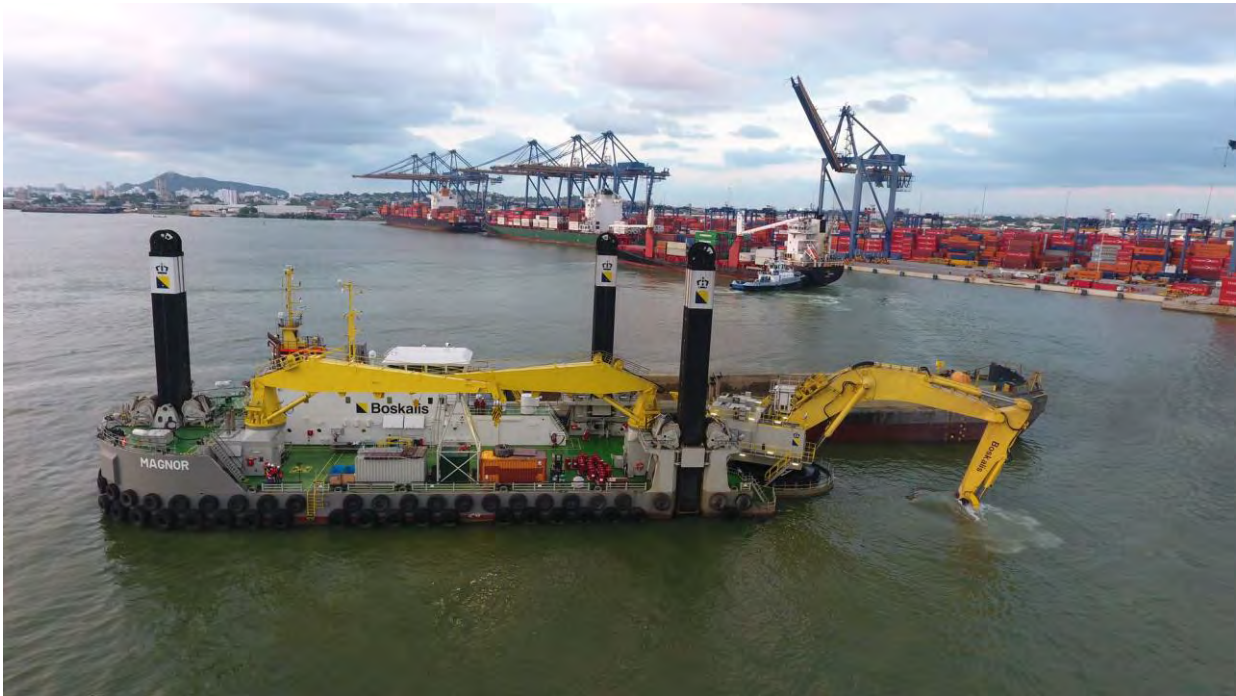


Figure 2.8: BHD Magnor dredging

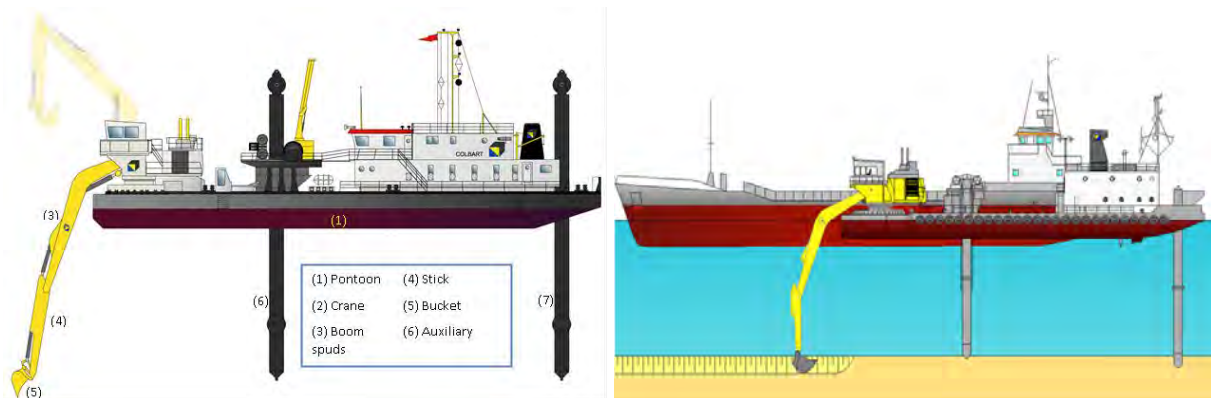


Figure 2.9: General layout BHD (left) and dredging process (right)

2.3.3.Supporting Dredge Equipment

A Sweeping Vessel will be utilised to level any ridges remaining from the TSHD and BHD dredging process to ensure declared channel depth of -14.2m LAT is achieved. It will also be used to assist the TSHD by moving materials from areas that are difficult to access with the TSHD.

The Sweeping Vessel consists of a tug on which an A-frame and bed leveller are installed. By lowering the bed level bar to a certain level (Figure 2.10) and when the tug will start to sail, the material above the cutting edge of the bar will be gathered and will be swept and deposited in lower areas as illustrated in Figure 2.11.

Irregularities in the seabed not achieving -14.2 LAT as a result of TSHD and BHD dredging are identified by a bathymetrical survey and the results of this survey are uploaded into the tug boat's positioning system. In this way, the captain can effectively 'hunt' for the high-spots by looking on his screen. In addition, a track sailing plan including actual position and real time update of the sailed tracks are visualised. These systems allow the Sweeping Vessel's captain to execute bed-levelling works in an efficient way.

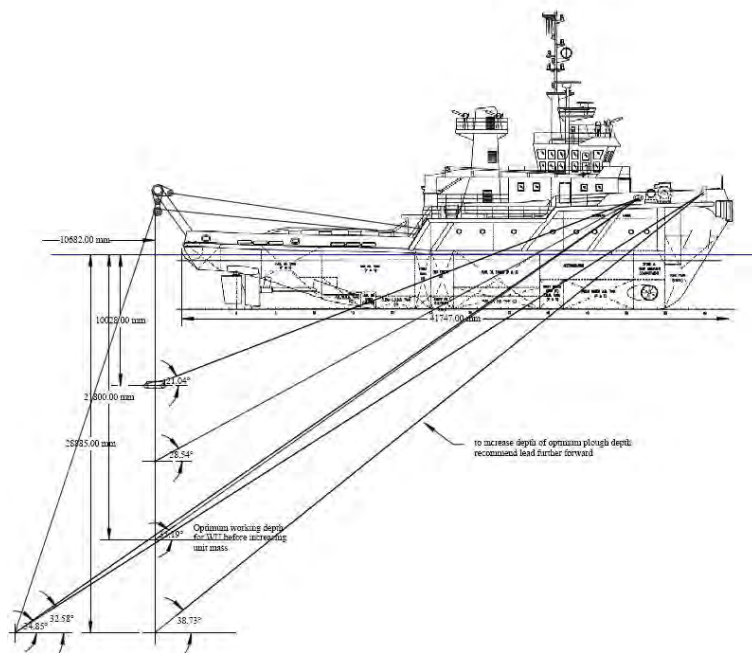


Figure 2.10: Typical Tug and Bed leveller Setup

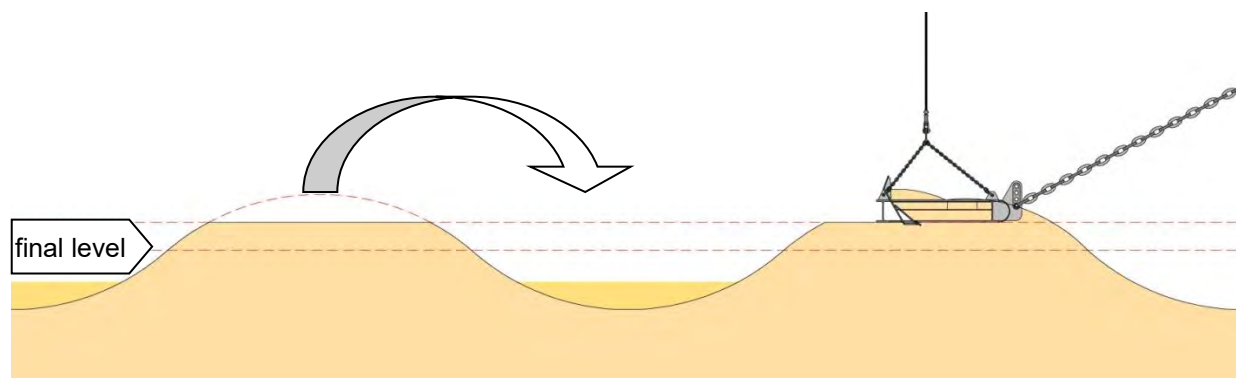


Figure 2.11: Cross section of sweeping process for levelling of ridges

In addition to the Sweeping Vessel, various auxiliary craft will be used to support the dredging operations including a crew transfer vessel and a hydrographic survey vessel. Typical crew- and survey vessels are available locally and will be chartered for the duration of the works.

3. ENVIRONMENTAL REQUIREMENTS

3.1. Introduction

This Chapter presents an overview of the relevant Commonwealth, State legislation and dredge licence requirements for this Project and in particular for this DMP.

3.2. Commonwealth Legislation

3.2.1. Environment Protection and Biodiversity Conservation Act 1999

The Environment Protection and Biodiversity Conservation (EPBC) Act requires developments to be referred where there is the potential for a 'significant impact' on a matter of national environmental significance.

3.2.2. Environment Protection (Sea Dumping) Act 1981

This Act provides the framework for assessing activities that involve placement of material at sea with Commonwealth water. Although this Act is not applicable to the Gulf St Vincent its guideline is used for assessing contamination in marine sediments intended to be placed at sea (the *National Assessment Guidelines for Dredging 2009*).

3.2.3. Maritime Safety and Pollution Legislation

The Commonwealth Government has put in place several instruments in relation to maritime safety and pollution, including: *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*, the *Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations* and various Marine Orders made under the Act and Regulation (e.g. Marine Orders 91, 93, 94, 95, 96, 97). This legislation is reflected in State level instruments (e.g. *Pollution of Marine Waters (Prevention of Pollution from Ships) Act 1987*).

3.2.4. Historic Shipwrecks Act 1976

Under the *Historic Shipwrecks Act 1976* a permit is required for any activities that have the potential to damage or interfere with a historic shipwreck. Approval was granted on 27th of February by the Department for Environment and Water (DEW) for the Project, under the following conditions:

1. The proponent is advised of section 13 of the Historic Shipwrecks Act 1981, which prohibits the damaging, destroying, interfering with, removing or disposing of an historic shipwreck or relic without a permit issued pursuant to section 15 of the Act. If an article believed to be the remains of a ship, part of a ship or an article associated with a ship is encountered during any excavation works, disturbance in the vicinity shall cease and DEW shall be notified, and a qualified maritime archaeologist shall be engaged to assess the material.
2. If the material is confirmed to be material from, or associated with, an historic shipwreck or relic, then a Heritage Management Plan (HMP) must be prepared to identify preservation or mitigation strategies prior to works proceeding. This may involve further field investigation by a qualified maritime archaeologist.
3. A heritage induction must be conducted by a qualified maritime archaeologist to apprise the dredge operators of the potential for undiscovered historic shipwreck material, and the steps to take should potential shipwreck material be discovered during the works.
4. Any changes to the proposal for which planning consent is sought or granted may give rise to historic shipwreck impacts requiring further consultation with DEW, or an additional referral to the Minister for Environment and Water. Such changes would include, for example, an application to vary the planning consent to extend or change the location of the development footprint.

To ensure Contractor personnel is aware of the potential findings of heritage and the procedure upon discovery, training will be provided by Flinders Ports as described in section 9.7.

3.2.5. Biosecurity Act 2015

The Department of Agriculture and Water Resources (DAWR) key biosecurity responsibility is to prevent and manage invasive species that pose a threat to agricultural, fishery and forestry resources. Its key

legislation is the *Biosecurity Act 2015* ('the Biosecurity Act'). The risks of marine pest incursions from international shipping are managed by DAWR. Policy development for this is vested in the Invasive Marine Species Program, which manages the development of the National System and the Australian Biofouling Management Requirements implemented under the Biosecurity Act. Present IMS management is predicated on the National Introduced Marine Pests Coordination Group (NIMPCG) (2009a; 2009b), and its derivative, Australian national lists of agreed marine species of concern that may be brought to Australia by different vectors including commercial shipping, fishing and recreational boating, illegal-entry vessels, aquaculture, the aquarium trade, and other imported products.

Under the Biosecurity Act, the Australian Government has principal responsibility for the management of ship ballast water, while the States focus upon the biofouling vector. Nevertheless, the legislation provides latitude for the Commonwealth to manage biofouling-related risks, including the ability to intervene where there is a biosecurity risk that needs to be managed.

To support DAWR's intention regarding biofouling management, vessel class specific requirements and a range of national best practice biofouling management guidelines have been developed to assist vessels to reduce the likelihood of accumulating and translocating quarantinable marine pests. The Guidelines applicable to Contractor's vessels are the:

- National Biofouling Management Guidance for Non-Trading Vessels; and
- National Biofouling Management Guidance for Commercial Vessels.

3.2.6. Australian Ballast Water Management Requirements

The Australian Government is a Party to the *International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004* (BWM Convention). The requirements of this Convention have now been enshrined in Australian law. The implementation of the BWM Convention is in a transitional phase until such time as its full force is attained in 2024. During this transitional period the ballast water management requirements vary between vessels, based upon factors such as age and size. Suffice to state, however, that any ballast water onboard which has been sourced from outside Australia needs to be managed by approved methods if intended to be discharged in Australian waters, with the primary means being by ballast water exchange (as a transitional measure) or via processing in an approved ballast water treatment system. The DAWR also regulates the movement and discharge of domestically sourced ballast water within Australian waters. These requirements differ from those pertaining to international ballast water.

In particular the Australian Ballast Water Management Requirements identifies areas where ballast water may be managed and where not (including 'Same Risk Areas'). Figure 3.1 gives an indication for the areas relevant to the Project.

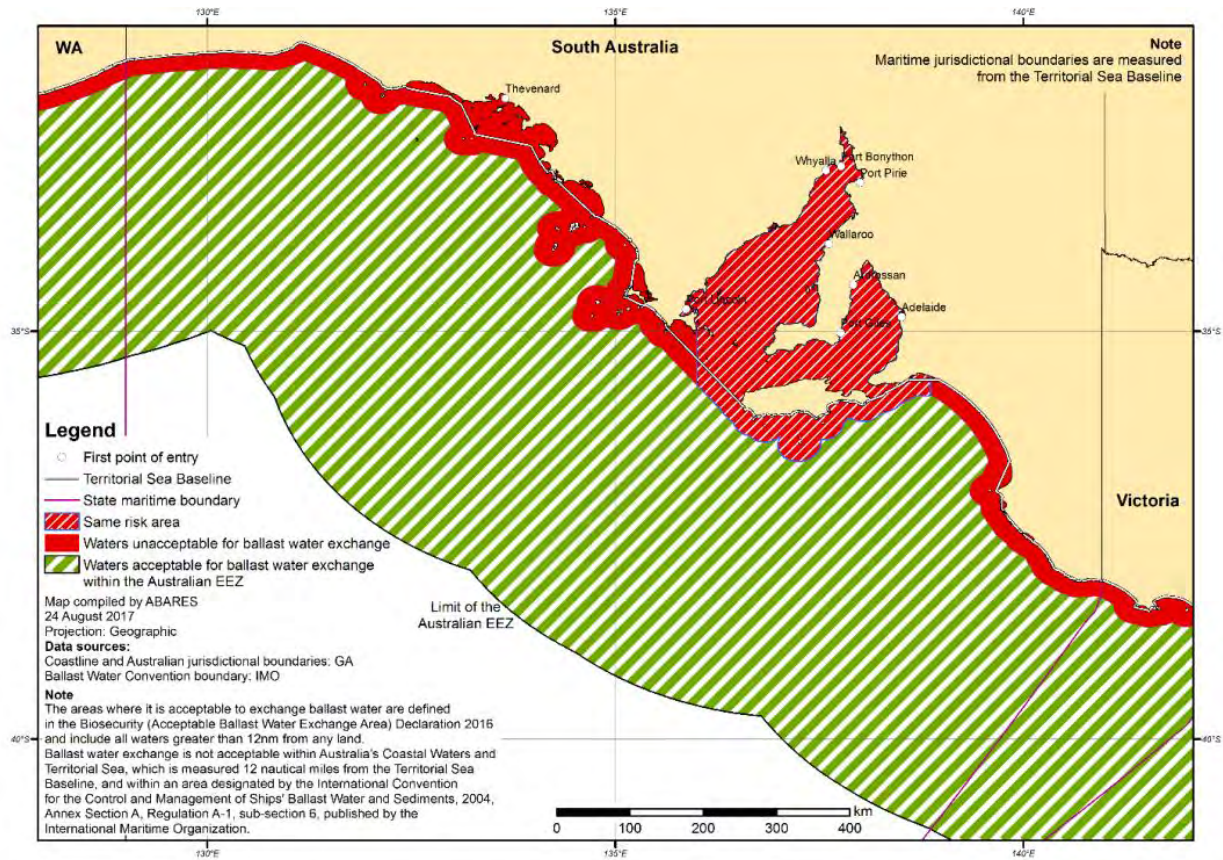


Figure 3.1: Ballast Water Same Risk Area

3.3. State Legislation

3.3.1. Protected Areas

Marine parks are declared under the *Marine Parks Act 2007* and aquatic reserves are declared under the *Fisheries Management Act 2007* under which the Barker Inlet – St Kilda Aquatic Reserve falls. In addition, the Project area is within the Adelaide Dolphin Sanctuary (ADS), which is protected under the ADS Act 2005 (see also map in Figure 4.14). Speed restrictions apply within the ADS as shown in Figure 3.2



Figure 3.2 Speed restrictions within the Adelaide Dolphin Sanctuary [4]

3.3.2.EPA Code of Practice For Vessel and Facility Management (Marine and Inland Waters)

This code of practice of the SA EPA is established for the prevention of pollution from the construction, use, and maintenance of vessels and related facilities. It provides guidance for all types of vessels and vessel owners.

3.3.3.Fisheries Management Act 2007

In South Australia, primary responsibility for the control of noxious and pest marine species is vested in Primary Industries and Regions South Australia (PIRSA). In this regard, PIRSA's authority is vested in the South Australia *Fisheries Management Act 2007*. PIRSA has developed a range of controls and guidance measures intended to limit the risk of the introduction, or translocation, of marine pest species in SA waters. This includes recognition of a number of pest species of particular concern, as detailed in the brochure *Aquatic Pests: A Threat to South Australia* (PIRSA undated). Specific requirements to the Project are furthermore given in Attachment D of the Dredge Licence [1] and detailed in Client's POMS Management Plan [18].

3.4. Development Approval

A detailed Development Application Report was submitted in July 2017 by Flinders Ports [2] in accordance with the *Development Act 1993* as a Section 49 application, given this project is defined as *public infrastructure*. Sponsorship for this application was received from the Minister for Transport and Infrastructure prior to lodgment in May 2017. Flinders Ports DA 010/V048/17 received approval on 28th May 2018.

Condition 4 of the Development Approval states that a Dredge Management Plan (DMP) must be prepared. This condition reads:

‘Prior to the commencement of dredging works, a Dredge Management Plan (DMP) must be prepared and submitted to the reasonable satisfaction of the EPA which is designed to provide real time adaptive management of dredge plumes (incorporating ‘alarm’ and ‘hold’ triggers and management actions if triggers are exceeded) and incorporates, as a minimum, details about the following:

- a. The use of continuous (10 minute interval or similar) turbidity and light logging (using calibrated remote and telemetered instruments with self-cleaning capability).*
- b. Water sampling (at an appropriate spatial and temporal frequency) to monitor total suspended solids (TSS) and chlorophyll to enable comprehensive seasonal calibration of relationships between other parameters.*
- c. The use of probes or similar to monitor dissolved oxygen, pH, salinity, temperature (at an appropriate spatial and temporal frequency).*
- d. Real time access to telemetered stations so that raw data can be obtained in an appropriate electronic format.*
- e. Monitors to confirm dumping activities are occurring within the designated area in real time.*
- f. Implementation of additional mitigation measures for any dredging works undertaken between December to February.*
- g. Appropriate management of *Caulerpa taxifolia* within the Outer Harbor shipping channel to ensure that dredging near the Outer Harbor breakwater and swing basin (where *Caulerpa taxifolia* infestations are known to occur) would not spread fragments of *Caulerpa taxifolia* throughout the nearshore marine environment.*
- h. Measures to minimise the risk factors associated with the spread of Pacific Oyster Mortality Syndrome (POMS) outside the Port River Estuary. This component of the Plan shall be developed to the reasonable satisfaction of PIRSA Biosecurity SA and SARDI Aquatic Sciences.’*

3.5. Dredge Licence

Under the *Environment Protection Act 1993* a dredge licence was granted on 12th of March 2019. Clause 3.2 (U-994) of the dredge licence outlines the requirements for the Dredge Management Plan as given below.

‘The licensee must ensure the Dredge Management Plan (DMP) identifies, as far as is reasonably practicable, all environmental risks associated with the dredging and details procedures:

3.2.1 to prevent or minimise risks including, but not limited to methodology, contingency plans and responses to:

- a monitoring of parameters in Schedule 1, including when turbidity data is identified as exceeding ALARM or HOLD criteria (Schedule 2);
- b the detection of *Caulerpa taxifolia* within the Premises;
- c plant and equipment failure or break down;
- d a fuel or chemical spill to the environment; and
- e detection of contaminants or debris in dredge spoil.

3.2.2 to prevent or minimise risks associated with dredge spoil disposal including the use of Automatic Identification System (AIS) units to monitor vessel location and to record:

- a all dates, times, locations (DGPS) and durations for which hopper doors on dredge vessels are opened and closed for dredge spoil disposal;
- b vessel movements between the Dredge Area (Attachment E) and the Dredge Material Placement Area (DMPA) (Attachment A); and
- c DGPS position of dredge vessel(s) at the time of commencement and completion of dredge spoil disposal

3.2.3 to prevent or minimise risks of collision to marine mammals including:

- a monitoring by Marine Mammal Observers (MMO) within the caution zone;
- b provision of advice by MMOs to personnel on board dredge vessels;
- c procedures to delay or pause dredging when marine mammals are observed within 50m of the Back Hoe Dredge (BHD); and
- d reporting and recording sightings of marine mammals.

3.2.4 to prevent or minimise risks associated with biofouling including the transfer and spread of non-native aquatic species through dredge vessel transit and operation including:

- a a plan for inspecting and cleaning vessel hulls (including sea chests and piping) and equipment (including mooring lines, anchors, chains and warps and unpainted hull appendages such as anodes, velocity probes and echo sounders) to ensure vessels are free from bivalve mollusc species and marine pests;
- b a procedure for recording inspections and cleaning including dates, methods and locations at which such activities took place, application of antifouling coating including date, location and type of coating applied; and
- c providing to the EPA the records specified in paragraph 4.b of this condition to demonstrate completion of biofouling management of each dredging vessel prior to entry into South Australian waters.

3.2.5 to prevent or minimise, as far as is reasonably practicable, dust, noise and odour resulting from dredging.

NOTES

Further information regarding biofouling can be found in the EPA Code of Practice for Vessel and Facility Management (marine and inland waters)

In addition, the following licence conditions are also applicable to the DMP:

- Clause 1.1 on overflow management (U-1001);
- Clause 1.2 on turbidity management (U-1000);
- Clause 1.3 on turbidity response (U-1002);
- Clause 2.1 on approved dredge methods (U-989);
- Clause 2.2 on approved dredge timing (U-993);
- Clause 2.3 on bunding (S-5);
- Clause 2.7 on dredge management plan (U-1003);
- Clause 2.8 on dredge vessel tracking (U-996);
- Clause 3.1 on dredge area and dredge material placement area (DMPA) assessment (U-992);

- Clause 4.6 on dredging register (A-7); and
- Clause 4.9 on variation of conditions of licence (U-997).

4. ECOSYSTEM DESCRIPTION

4.1. Introduction

To understand the impacts of the Project on the environment, it is important to understand the complete system. A clear understanding of the system in which the Project is planned is based on three components:

- The marine environmental system (physical and biological);
- The socio-economic system and;
- The governance context.

The first component describes both the a-biotic and biotic system. This includes the prevailing physical and chemical conditions, e.g. currents and water quality, and the ecosystem, i.e. the flora and fauna, as well as the interaction between the two. The second component is the socio-economic aspect. This component describes the economic setting and relevant stakeholders that are integral in the project area and for the envisaged development. The third component is the governance setting. This describes the legal framework, the local and international laws, as well as maritime laws, and regulations related to the environment in which the project is to be executed as described in Chapter 3. Information in this Chapter builds upon the Development Application Report [5].

4.2. Physical Environment

4.2.1. Climate

Adelaide experiences a mild climate with a yearly average temperature of 16.4 °C and average rainfall of 536 mm. Winter periods are mild and wet, while summer periods are warm and dry. Adelaide is the driest capital city of Australia. Average monthly temperature and precipitation rates are shown in Figure 4.1.

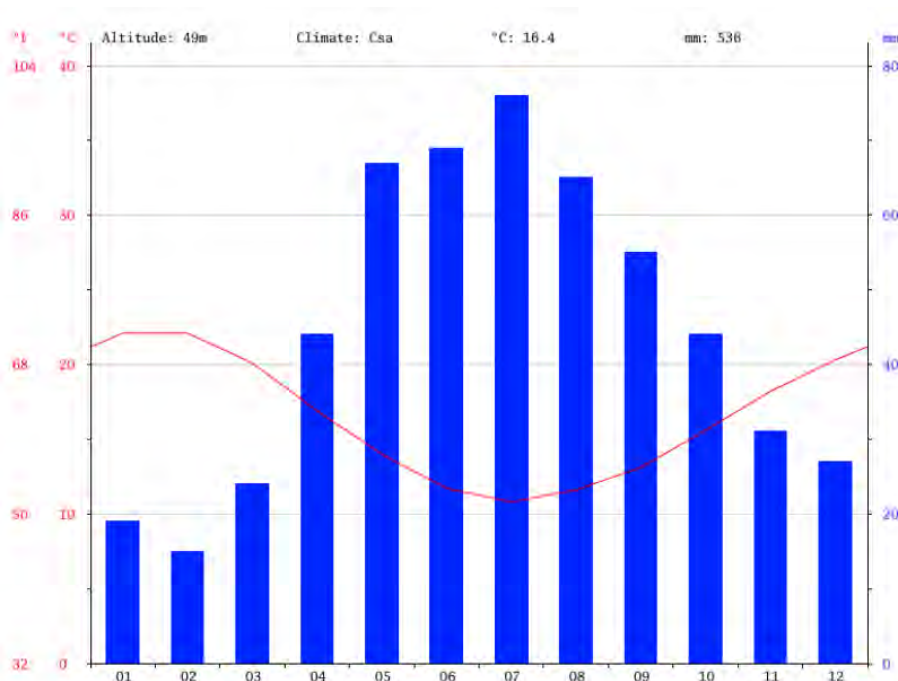


Figure 4.1: Temperature and precipitation at Adelaide [26]

4.2.2. Wave Conditions

Waves are fairly consistent over the year, with a dominant wave direction from the southwest. Wave heights are mostly below <1 m with a maximum of 2 m. Higher wave heights are generally observed in wintertime compared to summertime (Figure 4.2).

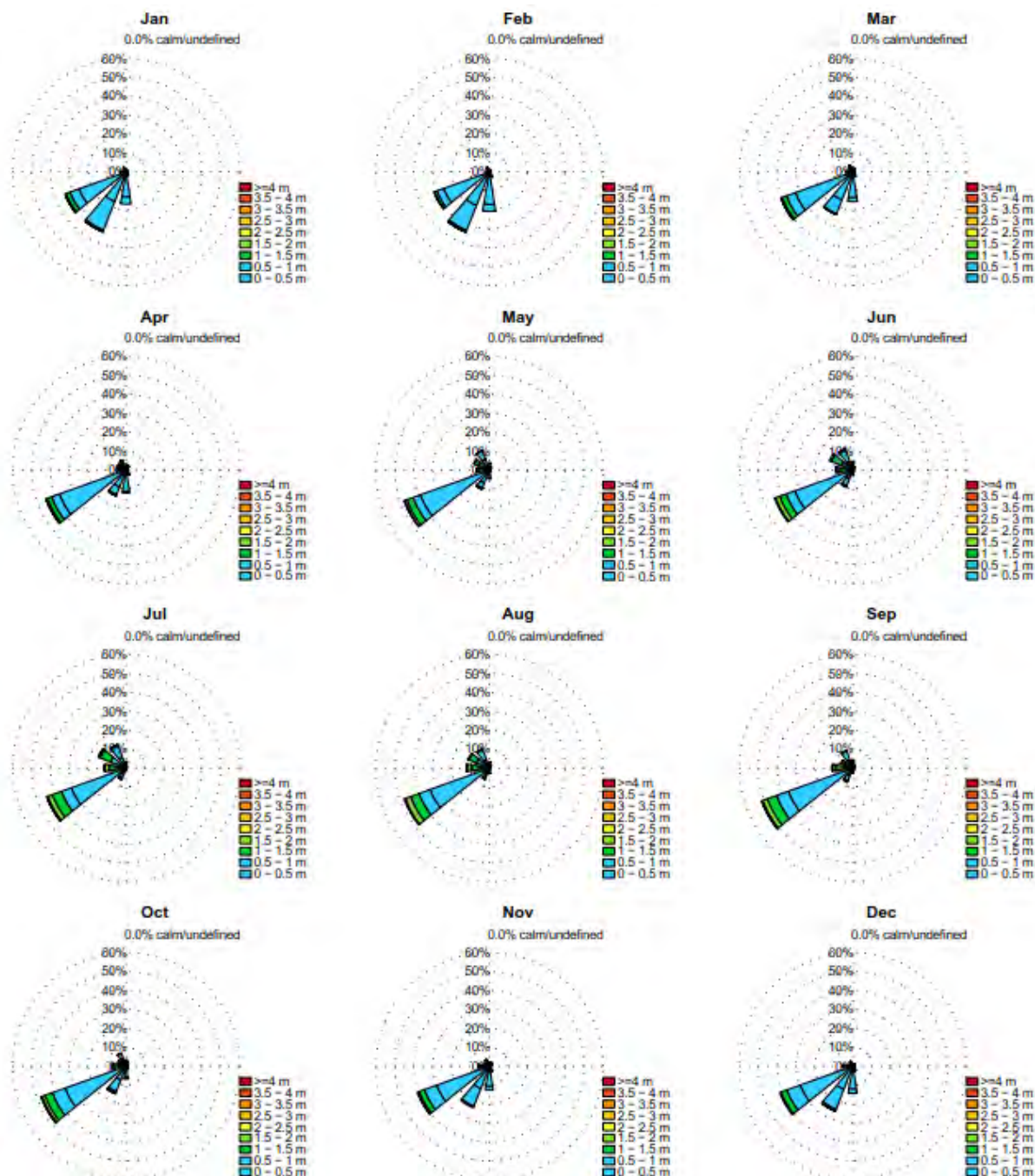


Figure 4.2: Wave conditions at Port entrance [27]

4.2.3. Wind Conditions

Wind measurements at Adelaide airport are shown in Figure 4.3. During the summer period, wind is mostly directed from south to southwest. During the winter period, wind directions are more variable and most frequently from the north to north east direction. High wind speeds (>10 m/s) occur more frequently during summer compared to winter.

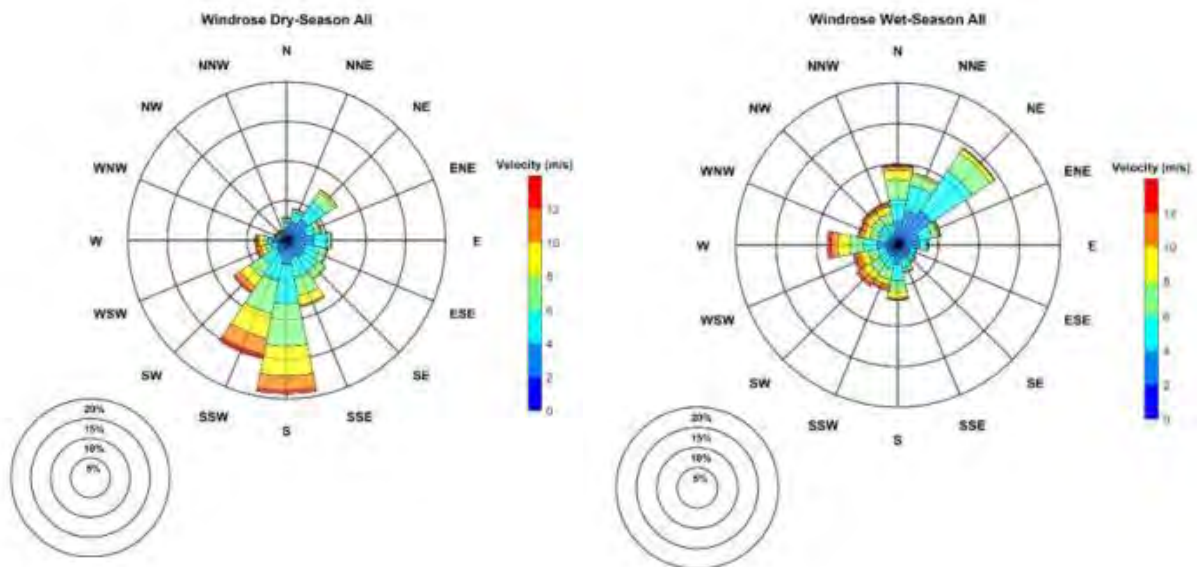


Figure 4.3: Windroses from measurements at Adelaide airport for summer season (left) and winter season (right) [8]

4.2.4. Tide

Tidal levels at Adelaide Outer Harbor are provided in Table 4.1. Adelaide experiences a semidiurnal tide with two high and two low tides a day. The tide has a diurnal inequality, caused by the influence of the sun. When, for example, the sun is north of the equator, it tends, at a point in the southern hemisphere, to cause the evening tide to be higher than the morning tide, but when the declination of the sun is south the effect is reversed. In addition, a special phenomenon occurs, the so called 'dodge tide'. This is a local South Australian term for a neap tide with minimal rise and fall over the course of a day or two as marked with the circle in Figure 4.4.

Table 4.1: Tidal levels compared to Chart Datum (Admiralty Chart AUS130-0137-0138-0780-0781)

HAT	MHWS	MHWN	MSL	MLWN	MLWS	LAT
2.80	2.30	1.30	1.30	1.30	0.30	0.00

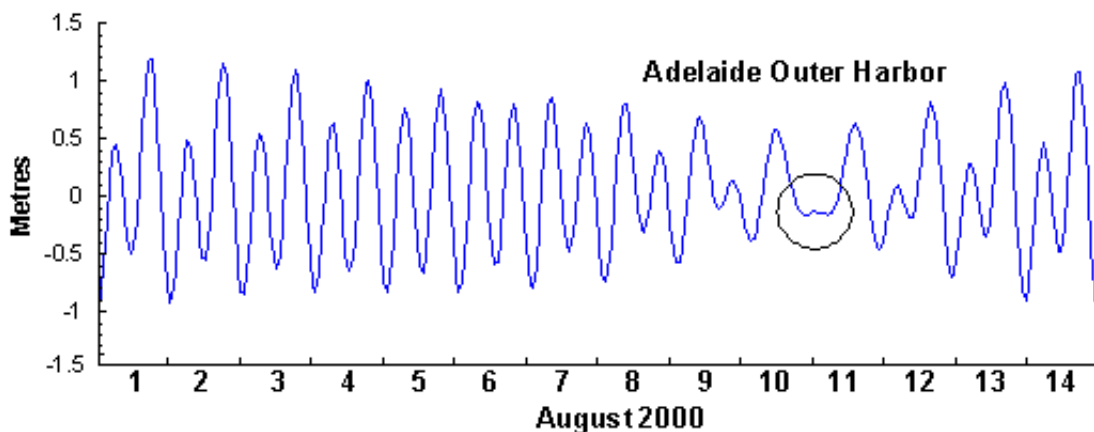


Figure 4.4: Adelaide tide at Outer Harbor [28]

4.2.5. Currents

Currents in Gulf St Vincent move in a clockwise direction. During summer months, residual currents together with predominantly southerly/south-easterly winds cause waters to move in a northerly direction

along the east and west side of the Gulf and return at the head of the Gulf in southward direction through the centre of the gulf. In winter, this convergence is mostly reversed.

Typical flood and ebb tidal current patterns in the Project area are shown in respectively Figure 4.5 and Figure 4.6. It can be seen that tidal currents in the outer channel are in perpendicular direction to the channel and directed northward during flood period and southward during ebb period, except close to the port entrance where currents are directed north during ebb also. Current velocities during flood are higher compared to ebb.

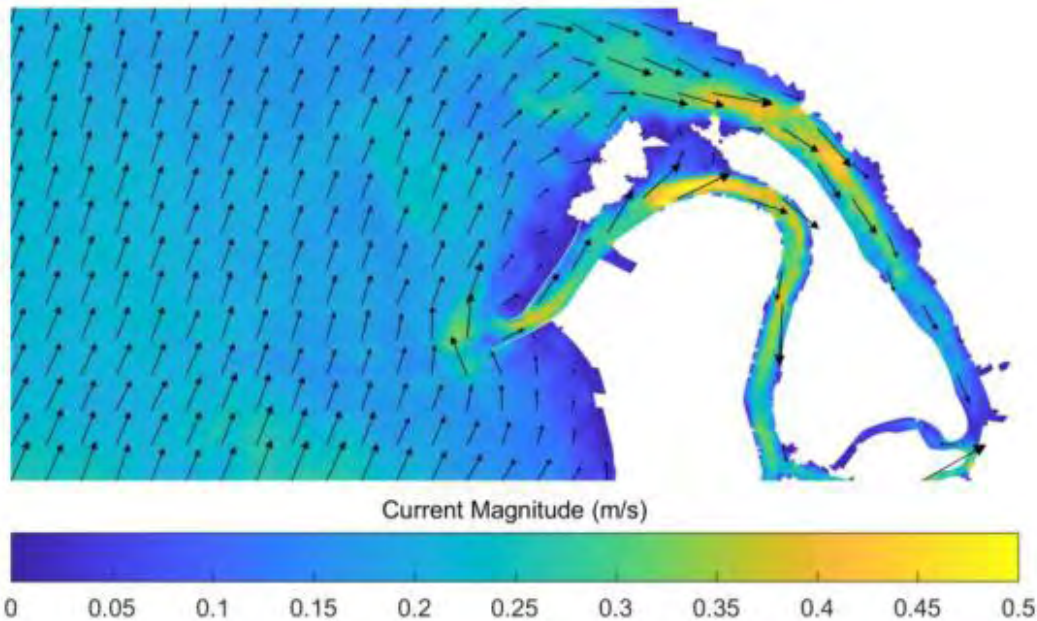


Figure 4.5: Typical flood tidal current [8]

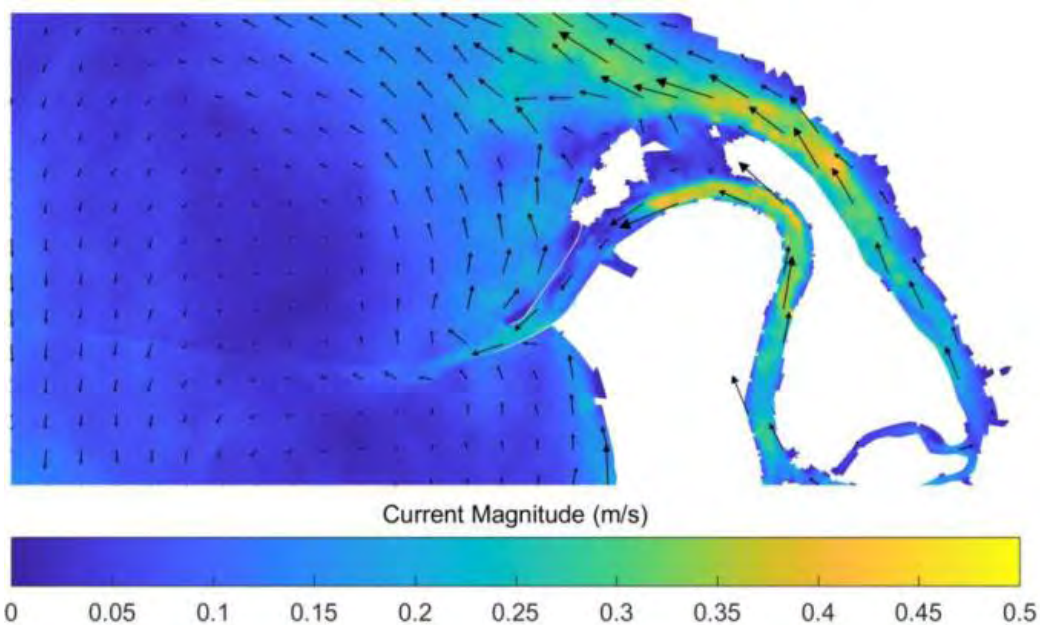


Figure 4.6: Typical ebb tidal current [8]

4.2.6. Geology

The geology of Outer Harbor comprises of the St Kilda formation which is characterized by shelly sand and silt on the top part, sandy clay, clayey sand and cemented parts made of calcareous sandstone, fossiliferous limestone, sand marls and stiff clays.

4.2.7. Water Quality

Turbidity levels in the Gulf St Vincent are typically low, with an average background turbidity at the Port River of less than 5 NTU [5]. Due to the seasonal current convergence described in section 4.2.5, turbidity levels are typically higher in summer across the Gulf compared to winter due to denser, more saline water moving southwards in summer. This is confirmed by historical measurements conducted by EPA and current water quality monitoring conducted for the Project. In general, the water in the Gulf is highly saline due to relatively high evaporation rates. Furthermore, short-lived peaks in turbidity are observed due to propeller wash from berthing and departing vessels. The Development Application Report states furthermore that algae blooms may occur due to the high level of nutrients in the Gulf especially during neap tides [5].

4.2.8. Sediment Quality

Sediment quality measurements have been conducted most recently by Golder Associates in 2016 ([5], [13]) and compared to the National Assessment Guidelines for Dredging 2009 (NAGD) and the ANZECC water quality criteria. Overall, sediments were found to be clean and below the screening levels. There was a single exceedance of the NAGD screening level for Antimony and elevated readings for Ammonia at a number of sites.. Effects of sea disposal of sediments with increased ammonia have been investigated and indicated that water quality effects are localised, short lived and within the range of natural variability [13]. Therefore it is concluded that material to be dredged is appropriate for disposal at the DMPA.

4.2.9. Ambient Noise

Recent background noise measurements are not available. However historical noise measurements from 2004 and 2001 show levels below 40 dB(A) during quiet periods of the day.

As described in the Development Application Report [5], the most sensitive area to noise impact from dredging works is the residential area located south of the Port entrance. This area falls under the 'quiet locality' provision under the *Environment Protection (Noise) Policy 2007*, where the following noise limits apply:

- During the day (7 am to 10 pm) LA_{eq} noise level not exceeding 52 dB(A)
- During the night (10 pm to 7 am) LA_{eq} noise level not exceeding 45 dB(A) and a LA_{max} noise level not exceeding 60 dB(A).

A worst case assessment was made by the Client to assess the potential noise impacts from the dredging works on the residential area located just south of the port entrance as shown in Figure 4.7. This figure presents the noise contours where impact may occur when dredging occurs exactly adjacent to the residential area and during several wind conditions (upwind, neutral, downwind seen from the residential area point of view). The assessment shows that there might be a potential noise impact when dredging occurs close to the residential area, in combination with west to northwesterly directed winds, extending to the green contour line in Figure 4.7. It is expected that this impact is limited since dredging will only occur in this area for a small period of time and west to northwesterly wind conditions do not occur very frequently (Figure 4.3). Besides, the design was optimised to widen the channel on the opposite side of the residential area, west side instead of east, which is expected to reduce noise impacts. In the noise impact assessment however the worst case location was taken into account as a conservative approach (red line in Figure 4.7).

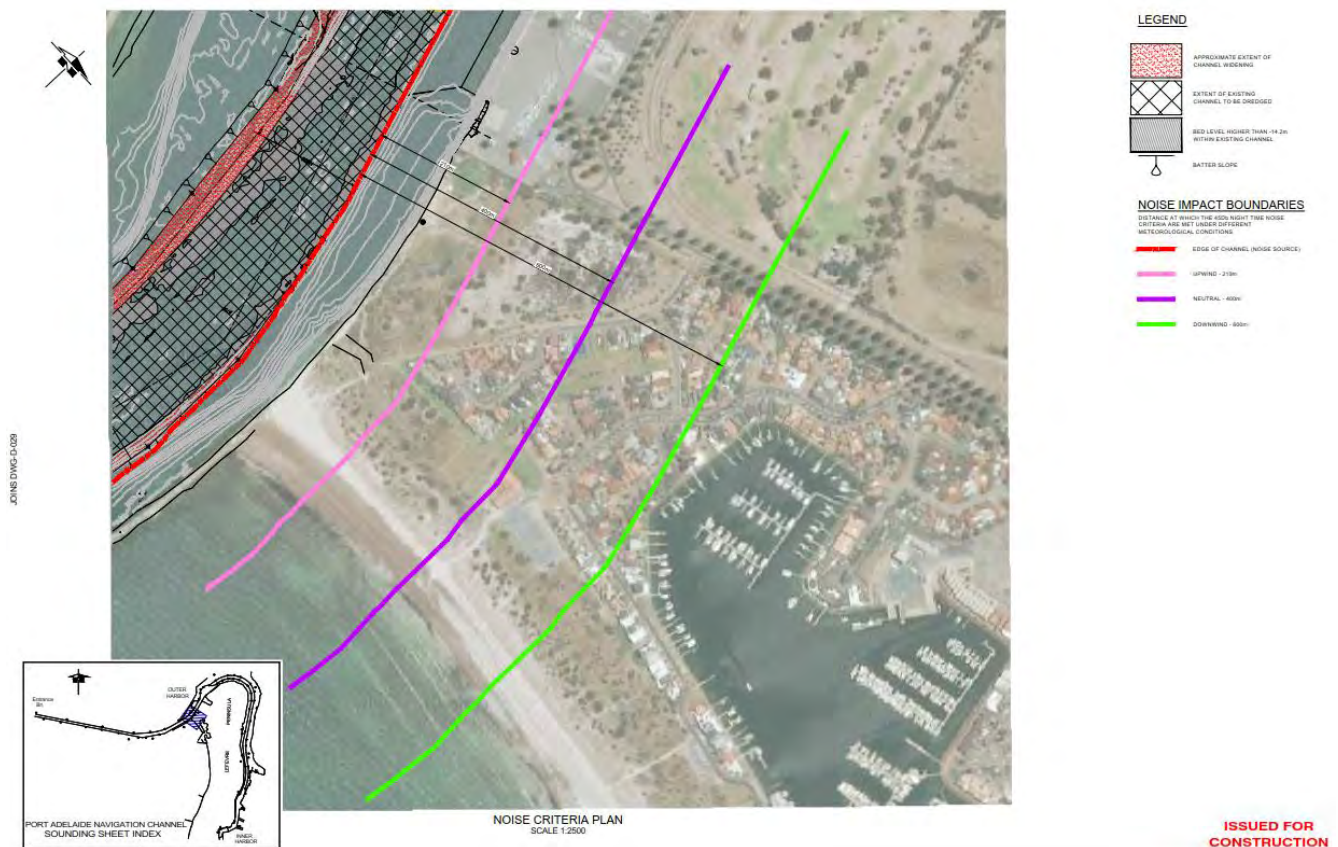


Figure 4.7: Zones of impact at which the 45 dB LA_{eq} night time noise criteria for 'quiet locality' residential area is exceeded for different wind conditions (neutral, upwind, downwind from the residential area point of view)

4.3. Biological Environment

4.3.1. Coastal Ecology

Shore birds

The shoreline of Gulf St Vincent supports several populations of shorebirds. In particular Bird Island, located within the Port River as shown in Figure 4.14, which provides habitat for a large number of shorebirds.

4.3.2. Marine Ecology

Seagrass

Seagrass meadows occur within Gulf St Vincent and Barker Inlet, including areas within or adjoining the Outer Harbor and access channel. Several seagrass species occur in the Gulf St Vincent, where the following three categories are found in the vicinity of the dredging works (see also Figure 4.8):

- moderate to dense coverage of *Heterozostera tasmanica* in the Barker Inlet;
- moderate to dense mixed meadows of *Posidonia sinuosa* and *Amphibolis Antarctica* adjacent to the channel; and
- sparse *Halophila australis* or *Posidonia*.

In addition, the nearshore area is dominated by macroalgae with consolidated rock, razorfish and sparse seagrass (*Halophila australis* and/or *Posidonia*). From the seagrass species located adjacent to the Project area, *Heterozostera tasmanica*, is known to be the most sensitive to reduced light [5].

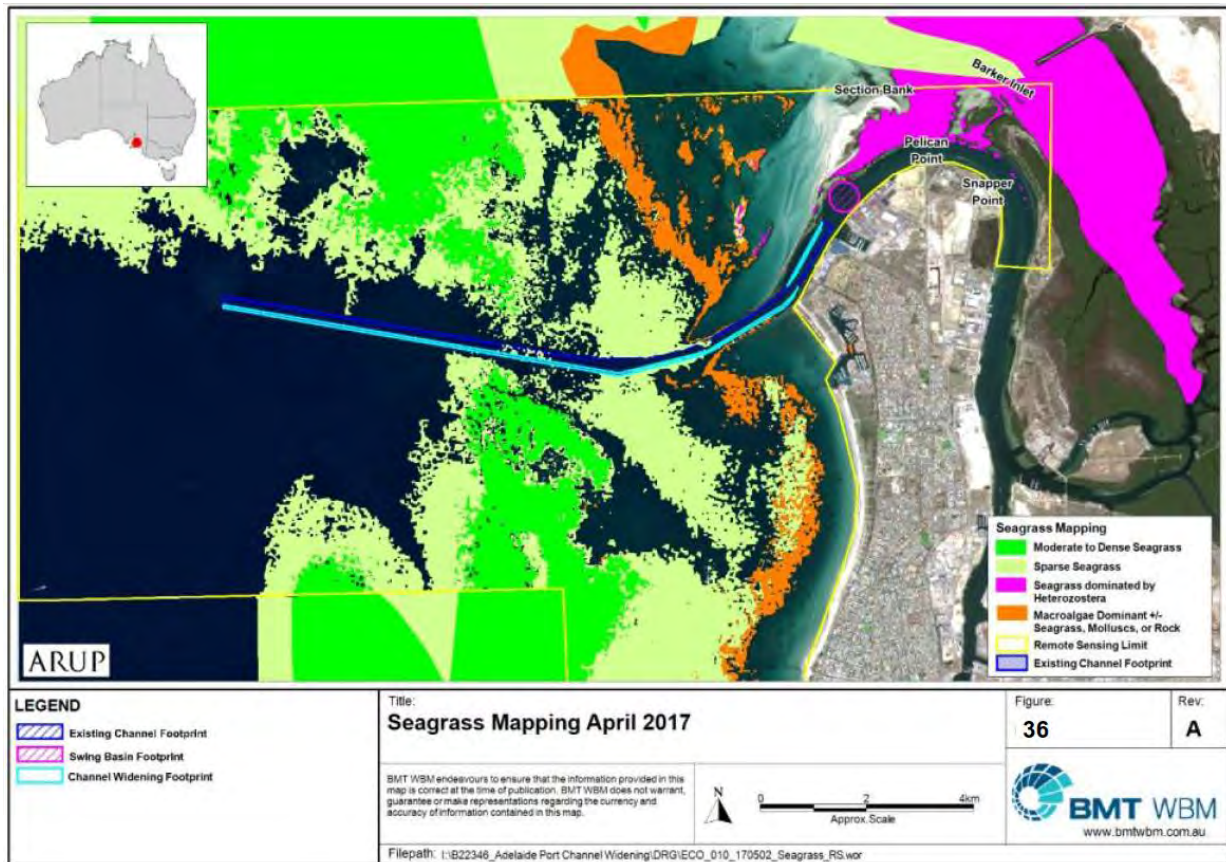


Figure 4.8: Seagrass Mapping by BMT in April 2017 [5]

Marine Megafauna

Dolphins are commonly observed within the Port River and the Gulf of St Vincent and the Project area is partly located in a dolphin sanctuary (see section 4.7). The most common dolphin species within Barker Inlet is the Indo-Pacific bottlenose dolphin.

Other Marine Megafauna species, such as whales (including humpback whales and southern right whale), sharks (including the great white shark), turtles, sea lions and fur seals, also occur within the Gulf, however their occurrence is not common. Only nine confirmed sightings of southern right whales, six humpback whales and seven unidentified whales were made between 2013 and 2017 and between May and September as recorded by the SA Whale Centre (SAWC, 2017).

Fisheries

The Gulf St Vincent is an important nursery ground for a large number of fish and invertebrate species, and sustains some of South Australia's largest marine commercial fisheries, including:

- Prawn
- Scalefish
- Abalone
- Rock lobster

4.4. Marine pests

The main marine pests which may be present in the area and impose a risk by spreading through Project activities are: the macroalgae *Caulerpa taxifolia* and the Pacific Oyster Mortality Syndrome (POMS) as will be explained in the following sections.

4.4.1. *Caulerpa taxifolia*

Caulerpa taxifolia is a type of seaweed and was found since 2002 in the Port River Barker Inlet system. Recent survey in the dredge footprint conducted by Flinders Ports/BMT in 2018 confirmed the presence of *C. taxifolia* at two sites within the Swing Basin (Figure 4.9), where it was found in between other algae species. No *C. taxifolia* was found within the seagrass meadows located adjacent to the channel, indicating that *C. taxifolia* has not spread over the years.

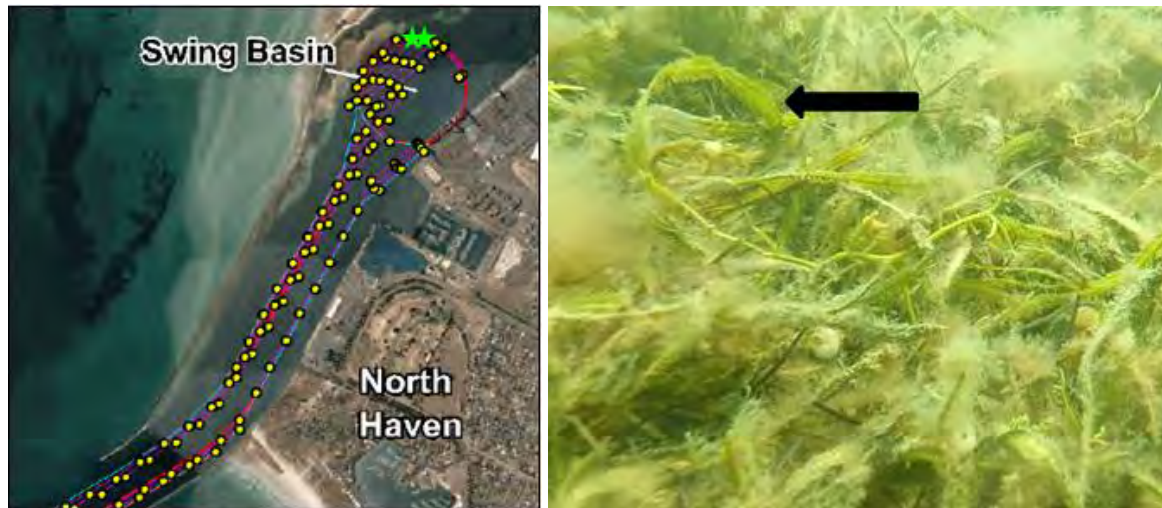


Figure 4.9: Survey extent and location of *C. taxifolia* (green stars) in the swing basin [14]

4.4.2. Pacific Oyster Mortality Syndrome

POMS is a disease that only affects Pacific oysters (*Crassostrea gigas*) and was confirmed in the Port Adelaide River estuary in February 2018 [12]. The POMS virus has been reported to non-lethally affect mussels (*Mytilus spp.*) and may spread through the movement of contaminated bivalves (O'Reilly *et al.* 2017). To identify bivalves in the Project area, Flinders Ports/BMT conducted a field survey in September 2018. This showed a density coverage in the dredge channel of approximately 180,000 m², with high density coverage areas of only 2% (Figure 4.10). The dominant bivalve species observed was the razorfish *Pinna bicolor* (Figure 4.11) and several individual Pectinidae scallops were found.

Although multiple surveys and sampling of the razorfish have indicated negative results on POMS, a decision was made by PIRSA to minimise the potential spread of POMS within the Gulf by requiring removal or destruction of the bivalves in the dredging footprint prior to commencement of the Works.

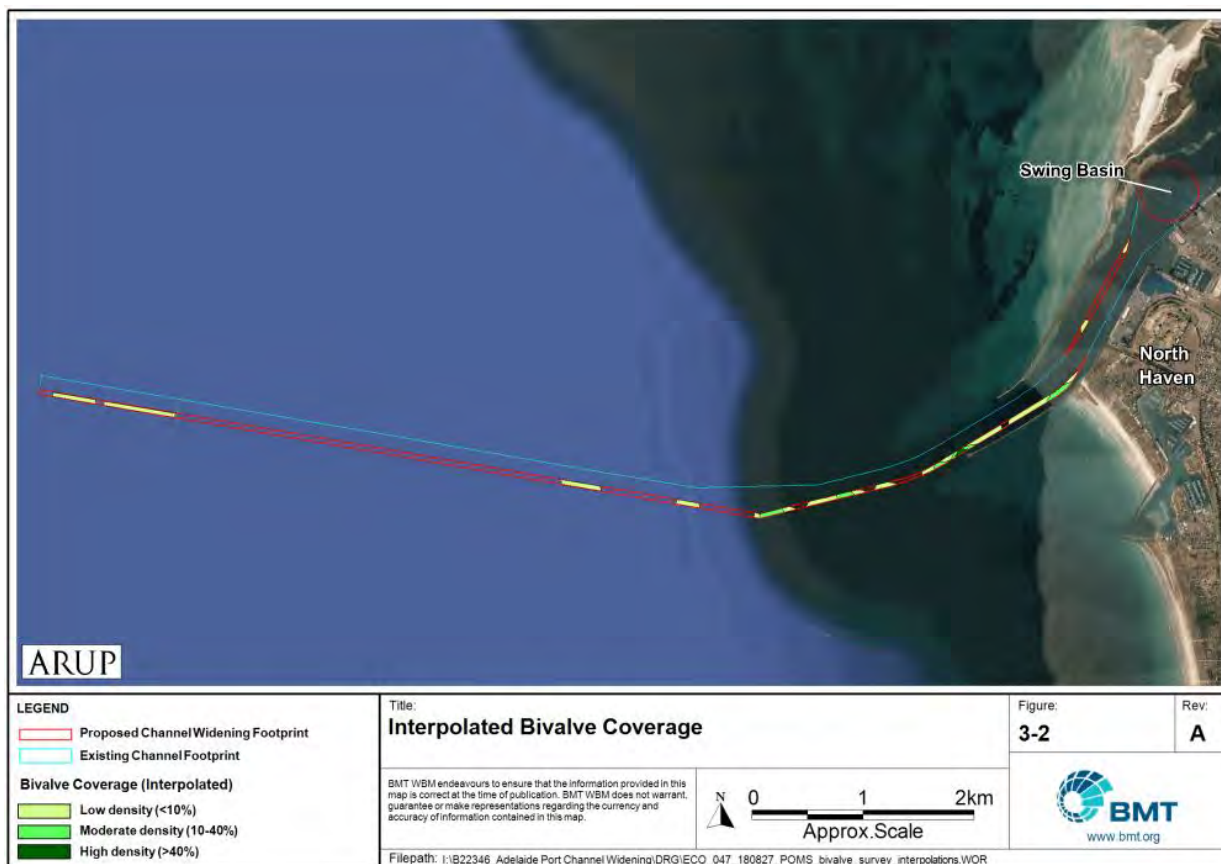


Figure 4.10: Distribution of bivalves along the Channel [12]



Figure 4.11: Razorfish present on the seabed [12]

4.5. Socio-economic Setting

The Project will contribute to state-wide strategic policies and plans for the development of a strong and sustainable South Australian economy by increasing export and remaining competitive with other ports across Australia [5].

Land use adjacent to the Project is a mix of industrial and residential land usage (Figure 4.12). The closest residential area is present 300m of the Port, at North Haven. Commercial fishing activity occurs within

Gulf St Vincent in proximity of the disposal ground, contributing to the local and state economy. In addition, recreational fishing and boating occurs throughout the Gulf of St Vincent, with two yacht clubs located near the Project area: the Royal South Australian Yacht Squadron (in Outer Harbor) and the Cruising Yacht Club of SA and Gulf Point Marine (south of the Project).

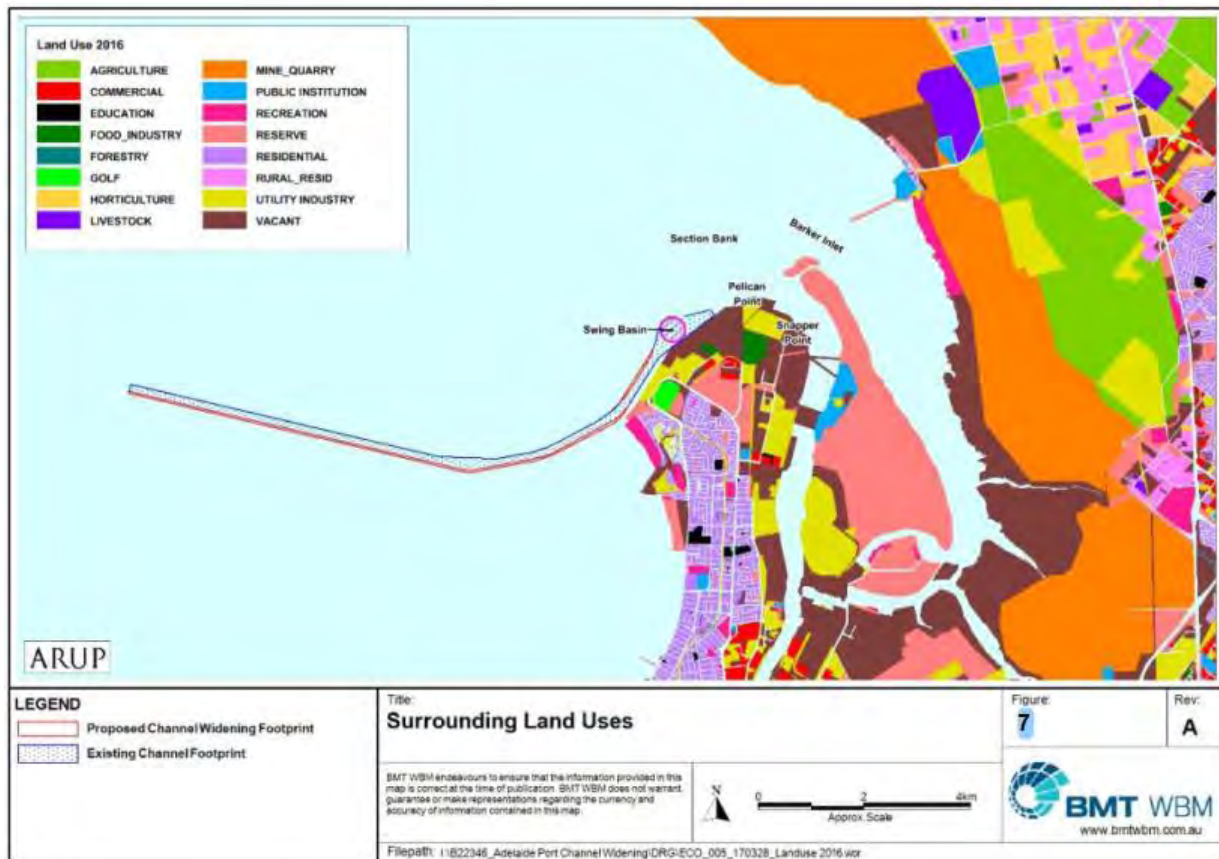


Figure 4.12: Land use surrounding the Project [5]

4.6. Heritage

A number of shipwrecks may be located around or in the Project area as shown in Figure 4.13. Impact to shipwrecks is mentioned to be limited in the Development Application Report [5] due to previous dredging campaign at the same locations. Furthermore, a detailed desktop study conducted by Maritime Heritage [29] estimates no risk of presence of shipwrecks located in the dredge channel only low risk of debris field from the *Grecian* located south of the entrance of the access channel (Figure 4.13). Training will be provided by a Heritage Consultant on the procedure upon discovery of heritage as outlined in section 9.7.



Figure 4.13: Potential and actual wrecksites in area of interest, from National Australian Shipwreck Database [29]

4.7. Protected Areas

Part of the Project is located within the Adelaide Dolphin Sanctuary (ADS), which is protected through the *Adelaide Dolphin Sanctuary Act 2005* (Figure 4.14). The sanctuary hosts around 30 resident bottlenose dolphins and around 400 transient dolphins that visit at various times. The sanctuary spans multiple habitats, ranging from mangrove forest to seagrass, saltmarsh and tidal flats and creeks which provide habitat and food for the dolphins. The Adelaide International Bird Sanctuary is located inside the ADS, north of the project area (Figure 3.2) to which speed restrictions apply as described in section 3.3.1



Figure 4.14: Adelaide dolphin sanctuary [4]

5. ENVIRONMENTAL RISK ASSESSMENT

Based on the proposed work method (Chapter 2), the project environmental requirements (Chapter 3) and the system understanding (Chapter 4), a certain environmental impact can be expected which has to be mitigated. The expected impact level and associated risk reduction measures are assessed by means of the Contractor's environmental risk and opportunity assessment further presented in this Chapter. For other Project related risks, reference is made to the Project risk register.

5.1. Risk and Opportunity Assessment

The risk assessment follows BKA's standard risk assessment procedure. This includes initial risks without taking any mitigation measures, residual risks including existing controls and final risks including proposed improved existing controls or new controls as presented in Table 5.1. Risks are ranked according to the Risk Matrix in Attachment 11.4.

The main environmental risks foreseen are:

- Impact to seagrass and water quality due to the generation of turbid plumes;
- Biosecurity risk of introduction of invasive marine species and spread of POMS
- Vessel interaction with Marine Megafauna.

Table 5.1: Environmental Risk Assessment

#	Activity/ Area	Hazard	Cause	Unwante d Event / Effect	Inherent Risk				Existing Controls	Residual Risk				Recommended Action (Improve existing controls / implement new controls)	Person To Act	Final Risk			
					Consequence	Likelihood	Level	Rank		Consequence	Likelihood	Level	Rank			Consequence	Likelihood	Level	Rank
General Risks																			
1	Social Interfaces	Heritage interference	Dredging activities	Damage to heritage site	5-Minor	3-Seldom	Medium	7	- Initial investigation of dredging areas. - Local knowledge (ie location of Heritage items)	5-Minor	4-Unlikely	Medium	8	- Provide induction on heritage - Known Heritage areas identified as Exclusion zone on electronic charts.	Client Represent ative; HSE Manager; Vessel Master; Project Manager	5-Minor	5-Remote	Low	9
Environment																			
2	Dredging and vessel movements related risks	Spread of <i>Caulerpa taxifolia</i>	<i>Caulerpa taxifolia</i> present in the area	Take over other species	5 – Minor	3 – Seldom	Medium	7	Recent survey conducted by BMT found <i>Caulerpa taxifolia</i> only at two locations in the swing basin, none found in the seagrass meadows indicating spread of <i>C.t.</i> is minor	5-Minor	5 – Remote	Low	9	Survey prior to dredging; Removal of any <i>Caulerpa taxifolia</i> according to [14]	Environme ntal Represent ative; Project Manager; Environme ntal Manager; Dredge Master	5 – Minor	6 – Rare	Low	10

#	Activity/ Area	Hazard	Cause	Unwanted Event / Effect	Inherent Risk				Existing Controls	Residual Risk				Recommended Action (Improve existing controls / implement new controls)	Person To Act	Final Risk			
					Consequence	Likelihood	Level	Rank		Consequence	Likelihood	Level	Rank			Consequence	Likelihood	Level	Rank
3	Dredging Vessel Mobilization related risks	Introduction of invasive Species	Marine growth on hull, transportation of species onboard vessels and via Ballast Water	Introduction of invasive species to port of entry, regulatory breach.	3-Major	3-Seldom	High	5	<ul style="list-style-type: none"> - Conduct vessel quarantine Risk Assessment and invasive species inspection prior to mobilisation; - Conduct quarantine inspection - Ballast water management as per DAWR and IMO requirements - Comply with National Biofouling Guidelines for Non-Trading vessels 	3-Major	4-Unlikely	High	6	<ul style="list-style-type: none"> - Docking of vessel prior to entry to Australian waters and conduct hull cleaning and antifouling renewal as appropriate - Biofouling inspection and report following docking by third party 	Technical Department Project Manager Vessel Master 3rd Party Consultant on Biosecurity	3-Major	6-Rare	Medium	8
4	Dredging Contaminants	Impact on personnel and fauna, odour, impact to residents and port users	Ingestion, Absorption, Inhalation	Health impact, fish death	4-Moderate	5-Remote	Medium	7	Flinders Ports have conducted investigation which shows no contaminants in dredged material.	4-Moderate	6-Rare	Low	9	NA	NA	4-Moderate	6-Rare	Low	9

#	Activity/ Area	Hazard	Cause	Unwanted Event / Effect	Inherent Risk				Existing Controls	Residual Risk				Recommended Action (Improve existing controls / implement new controls)	Person To Act	Final Risk			
					Consequence	Likelihood	Level	Rank		Consequence	Likelihood	Level	Rank			Consequence	Likelihood	Level	Rank
5	General Dredging and Marine activities	Impact on local Marine Megafauna; i.e. dolphins	Increased marine activity in their habitat	Collision, Avoidance	3-Major	4-Unlikely	High	6	<ul style="list-style-type: none"> - MMO training to crew members on board the dredge; - Speed restrictions in Adelaide Dolphin Sanctuary 	3-Major	5-Remote	Medium	7	<ul style="list-style-type: none"> - Implementation of MMO vessel interaction guidelines; - Marine Mammal observation and records - Ensure adherence to vessel speed limits. 	Vessel Master; Trained dredge crew; Environmental Manager.	3-Major	6-Rare	Medium	8

#	Activity/ Area	Hazard	Cause	Unwanted Event / Effect	Inherent Risk				Existing Controls	Residual Risk				Recommended Action (Improve existing controls / implement new controls)	Person To Act	Final Risk			
					Consequence	Likelihood	Level	Rank		Consequence	Likelihood	Level	Rank			Consequence	Likelihood	Level	Rank
6	Turbidity generation by dredge vessels	Exceedance of turbidity limits causing impact on seagrass and water quality	Dredging fine material, hopper overflow, propeller wash from shipping movement	Impact to seagrass through reduced light penetration	3-Major	2-Occasional	Severe	4	<ul style="list-style-type: none"> - Comply with Trigger levels which are based on background levels - Undertake plume modelling to determine zone of impact - Selection of equipment. Mechanical dredging i.e. Backhoe Dredging preferable to a Cutter Suction dredge. - Monitoring of seagrass health prior and post dredging 	3-Major	3-Seldom	High	5	<ul style="list-style-type: none"> - Continuous water quality monitoring during works - Implement Adaptive Management Actions (e.g. reduce overflow, alternate dredge areas) - Use of a Green Valve 	Vessel master; Project Manager Environmental Manager	3-Major	3-Remote	Medium	7
7	Placement of dredge material	Placement outside of dedicated placement area	Insufficient survey, incorrect positioning, navigation issues	Breach of dredge permit; potential impact on sensitive areas	4-Moderate	4-Unlikely	Medium	7	<ul style="list-style-type: none"> - Work in accordance with survey data; - Updated survey information on all vessels; - AIS ; - Trained personnel 	4-Moderate	5-Remote	Medium	8	<ul style="list-style-type: none"> - Disposal planning to be updated frequently; - Dedicated vessel route; - Periodic review of tracking data; - Monitor weather. 	Superintendent Vessel Master Surveyor Project Manager	4-Moderate	6-Rare	Low	9

BOSKALIS WAY OF WORKING

#	Activity/ Area	Hazard	Cause	Unwanted Event / Effect	Inherent Risk				Existing Controls	Residual Risk				Recommended Action (Improve existing controls / implement new controls)	Person To Act	Final Risk			
					Consequence	Likelihood	Level	Rank		Consequence	Likelihood	Level	Rank			Consequence	Likelihood	Level	Rank
8	Dredging	Noise	Main engines, Auxiliary generators etc.	Impact to local residents	5-Minor	3-Seldom	Medium	7	- Conduct noise impact assessment - Flinders Ports Complaints response plan in place	5-Minor	4-Unlikely	Medium	8	- Avoid to work at night close to residential area with strong north/north-west wind - Review noise attenuation if necessary	Project Manager Superintendent Vessel Masters; Flinders Ports	5-Minor	5-Remote	Low	9
9	Dredging	Oil spills	Leakage, equipment failure	Contamination, Pollution	4-Moderate	4-Unlikely	Medium	7	-Hydraulic hoses, check valves and fittings are regularly inspected and maintained; -All vessels are equipped with spill kits - Vessel planned Maintenance system in place	4-Moderate	5-Remote	Medium	8	-Emergency Response Plan; -Management framework as per DMP - Bunkering procedure and permit in place	Project Manager; Superintendent Vessel Masters; HSE Manager Flinders Ports	4-Moderate	6-Rare	Low	9

BOSKALIS WAY OF WORKING

#	Activity/ Area	Hazard	Cause	Unwanted Event / Effect	Inherent Risk				Existing Controls	Residual Risk				Recommended Action (Improve existing controls / implement new controls)	Person To Act	Final Risk			
					Consequence	Likelihood	Level	Rank		Consequence	Likelihood	Level	Rank			Consequence	Likelihood	Level	Rank
10	Dredging	Waste generation	Ineffective waste management / spills	Pollution	5-Minor	4-Unlikely	Medium	8	<ul style="list-style-type: none"> - Waste segregation -Sufficient bins with lids provided -Approved Waste Contractor for disposal of listed waste and untreated sewage 	5-Minor	5-Remote	Low	6	<ul style="list-style-type: none"> -Work, Health Safety Management Plan -Waste Management training - No sewage discharged from vessels within Harbor limits 	Project Manager Vessel Masters; HSE Manager	5-Minor	6-Rare	Low	10

6. ENVIRONMENTAL MANAGEMENT FRAMEWORK

This Chapter describes the Environmental Management strategies that have been developed for the key environmental risks associated with the dredging works as identified in Chapter 5. Contractor's environmental management frameworks are described and measures related to dredging activities in line with the dredge licence conditions for the DMP. This includes measures related to minimising turbidity, monitoring of Marine Mammals, biofouling, dredging control methods and management of waste and spills. For details on the methodology for water quality monitoring reference is made to the EMP [15] For details on community complaints reference is made to the Community Engagement Plan [16].

6.1. Environmental Management Framework Structure

The environmental management frameworks (EMFs) have been grouped into:

- Management of sediment-related impacts resulting from dredging and dredge material placement activities (section 6.2)
- Management of other environmental impacts (section 6.3):
 - Marine Mammals
 - Invasive Marine Species
 - Noise
 - Dredge Control
 - Waste
 - Hydrocarbon and Chemical Spills

Each EMF states the objectives and performance criteria that are relevant and contain specific, measurable performance criteria to achieve these objectives. In turn, these targets necessitate the application of certain management actions. In order to continuously improve the effectiveness of the Project's environmental management system, performance criteria and monitoring activities are employed to measure success in meeting the requirements and identify the need for corrective actions. Reporting complete the EMFs. The template used for constructing each EMF is presented in Table 6.1.

Table 6.1 Environmental Management Framework Template

Item	Content
Objective	A description of the environmental values associated with the element to be protected, enhanced and/or managed, and associated management commitment.
Performance criteria	Outlines measurable criteria/outcomes for each element that, when achieved, represent compliance with the objective for the element. These criteria are defined in regulatory requirements, permit requirements and Client documents.
Management Actions	Outlines the strategies, tasks or action program that would be implemented to achieve the performance criteria. For each management action, there is details on responsibility and timing
Monitoring	Describes the monitoring requirements to measure achievement of the performance criteria based on implementation of management actions. This includes auditing actions intended to check compliance with requirements of the element.
Reporting	Defines the format, timing and responsibility of reporting requirements associated with the element.
Corrective Action(s)	Lists actions to be implemented where monitoring or auditing indicates performance criteria are not being met to minimise environmental harm and/or achieve performance criteria.

6.2. Sediment Related Impact Management

6.2.1. Adaptive Approach

Adaptive management seeks to develop adaptive strategies to assess the system, predict the impact, and cater for uncertainties (Figure 6.1). In general, levels of uncertainty about the dredging related impacts decrease over the course of the project as more accurate information is collected. For instance, turbidity values are best measured during actual dredging operations, as compared to being fully dependent upon numerical modelling predictions which tend to be conservative towards worst-case, thus turbidity levels measured are often lower.

By monitoring throughout the dredging activities opportunities can be identified and seized to amend the dredging productivity. For example, if the measured turbidity is well below the environmental thresholds it would be possible to increase production or make the operational timeframes more flexible.

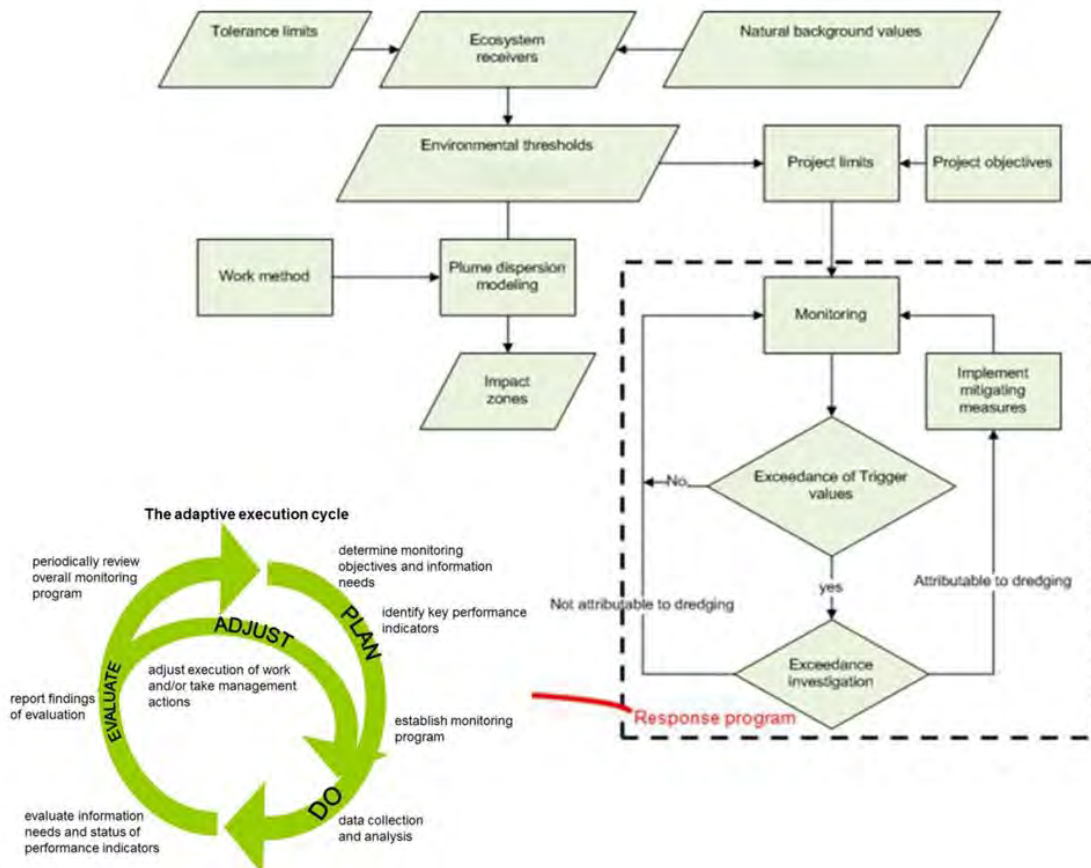


Figure 6.1: The adaptive management cycle

Adaptive management ensures that the dredging activities remain within required turbidity thresholds; however, adaptive management strategies go beyond merely staying within an environmental boundary condition. Limits set must be adhered to, but they should not become the goal in itself. The main goal is to limit, if not prevent, any negative impacts to the marine ecosystem while meeting the objectives of the planned dredging activities, such as timely delivery and optimizing productivity. The means to achieve this goal for this Project is by adapting the operational plan based upon the continuous monitoring of water quality.

Three types of management strategies are distinguished to limit control and manage potential impacts of dredging and disposal operations on sensitive receptors.

1. Proactive management

Adaptive management is incorporated in the design of the dredging and disposal works and comprises of proactive and responsive measures. Proactive management measures aim to optimise the design of the work method in terms of limiting potential environmental impacts of the dredging, both on the short-term (same temporal scale as the dredging execution period) and longer term.

2. Responsive management

Responsive management involves the continuous incorporation of new information and lessons learned (e.g. monitoring data, project experiences) in the management program to effectively respond to a situation. Responsive measures are implemented when low level management trigger levels are exceeded in order to prevent environmental impact.

3. Contingency Management

Contingency management is adopted when predictions and monitoring data indicate that environmental limits are or will be exceeded. Contingency management provides a last resort when adaptive management measures prove insufficient, or when environmental limits prove incorrect from what was predicted.

6.2.2. Proactive Management Practices

Work Method Selection

Dredging operations will release fines into surrounding waters. Fines lost from the TSHD through overflow and/or during dredge material placement are partly deposited straight to the sea bed and partly released to the water column. These fines may be transported away, by hydrodynamic forces, resulting in negative impacts on the seagrass meadows located adjacent to the Project area as described in section 4.3.2. The impact is either smothering due to sedimentation or reduced light levels due to increased suspended sediment levels.

To reduce the release of sediments to the water column, Contractor's work method includes the use of a BHD loading Dredge Barges to remove the harder material, instead of a Cutter Suction Dredger (CSD) as proposed in the application Development Approval [5]. This results in a lower release of fines in the water column since:

- the BHD dredges up the material mechanically such that seabed sediments are dredged in lumps causing limited release of fine material into the marine environment, while a CSD dredges up the material hydraulically resulting in significant spill at the cutterhead.
- The dredged material is loaded in the Dredge Barges with limited water, resulting in no or limited overflow of the Dredge Barges, while for CSD dredging in a barge significant overflow would have to be applied to allow for efficient dredging.

In addition, the TSHD will be fitted with a green valve, which will reduce the dispersion of the sediment plume into the far-field as described in section 2.3.1.

Predictive Modelling

Before the project started and as part of the development approval application, a dredge plume dispersion model has been set up by BMT to predict turbidity generation caused by the dredge operations and assess the areas of impact. Based on this plume dispersion model zones of impact are defined and the locations at which turbidity is measured (for more detail, see [11]). Also, based on this model study the likelihood of exceeding the turbidity triggers with Contractor's proposed work method and without implementing mitigation measures could be calculated and is expected to be limited. However, vital assumptions made for the plume model study have to be verified at start of works as described in section 6.2.5.

6.2.3. Responsive Management Practices

In order to respond adequately to the dispersion of suspended sediments as a result of Contractor's Scope of Work, a responsive turbidity monitoring program will be deployed. Turbidity thresholds have been set based on baseline monitoring conducted for the Project as described in the EMP and follow a tiered system. During dredging continuous monitoring will be conducted at two stations located adjacent to the dredge channel (D1, D2 in Figure 6.2) and one background station away from the area of influence to monitor ambient turbidity values (B1 in Figure 6.2).



Figure 6.2: Continuous water quality monitoring stations [1]

As per Schedule 2 of the dredge licence [1] the ALARM criteria is:

- 2.8 NTU based on a 15 day rolling median; or
- 5.8 NTU based on a 6 day rolling median.

In case the turbidity monitoring results show exceedances of the ALARM criteria, the following measures will be adopted:

- Examine monitoring equipment for any faults/defects/biofouling that have influenced data collection
- Review and analyse results against:
 - Background turbidity levels, to determine if ambient turbidity is elevated and is accounting for increased turbidity at D1 or D2. If the background data at B1 is also elevated, and the difference between B1 and D1 or D2 is within 20% or B1 is above D1 or D2, dredging may proceed with caution and close monitoring of the continuous turbidity monitoring data and meteorological forecasts.
 - Meteorological and current, wave, tidal conditions, which may be the cause of increased turbidity for example during storm events.
 - Manual soundings of turbidity to verify instrument readings in case continuous turbidity monitoring data seems erroneous and/or to investigate cause of exceedance if this cannot sufficiently be determined from continuous turbidity readings and meteorological data, weather permitting.
- If elevated turbidity is determined to be as a result of dredging activities and not background variability or weather conditions, modifications to the dredge operation will be implemented. This may include:
 - Changing the dredge location until turbidity at station D1 or D2 is reduced below the trigger level i.e. dredging at the outer part of the channel or in the turning basin
 - Alter overflow regime to reduce fines being spilled at a location
 - Modify dredge phasing with respect to tidal conditions, as explained in more detail below.

Careful selection of dredge phasing in relation to tidal dynamics aims to decrease the risk to sensitive receptors. Typical dredge plume dispersion patterns for falling and rising tides are illustrated in Figure 6.3 and Figure 6.4 respectively. This shows that during falling tide, the dredge plume is directed southward towards station D2, and during rising tide, northward towards station D1. Influence of dredge operations to the monitoring stations should thus be seen with respect to the tidal phase and hence dredge operations can be modified according to the tide. For example, if station D1 exceeds the ALARM level, dredging close to D1 can be carried out during falling tide as it will not contribute to increased turbidity at this station, but should be avoided during rising tide. The exact opposite of this described pattern would be valid in relation to dredging near station D2. These responsive actions aim to decrease the risk to sensitive receptors.

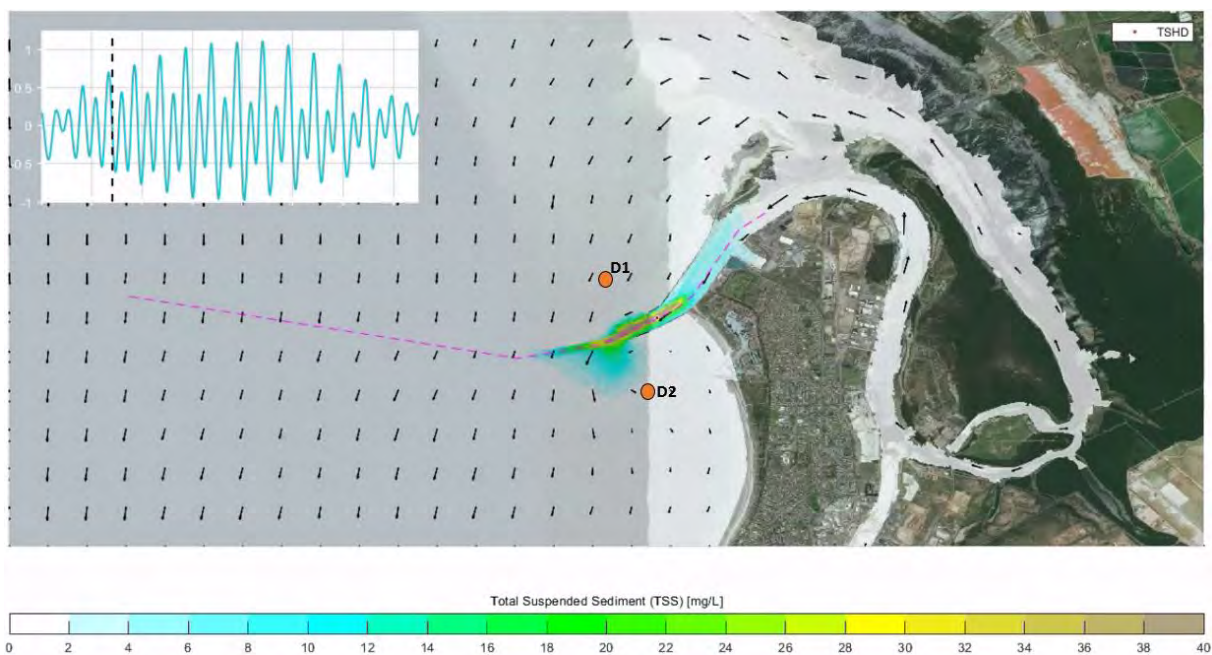


Figure 6.3: Example of a simulated dredge plume during a falling tide

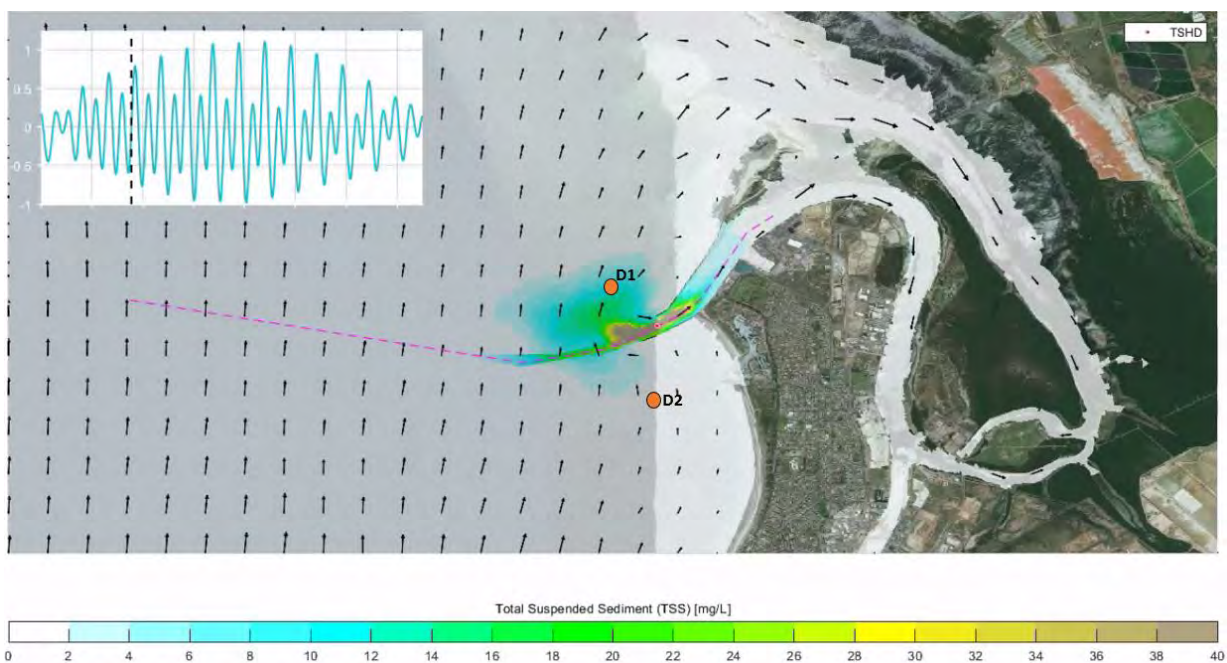


Figure 6.4: Example of a simulated dredge plume during a rising tide

Furthermore, it should be noted that the BHD is expected to result in limited release of sediments into the water column and therefore may not contribute to elevated turbidity levels at one of the stations. In comparison to the TSHD dredging the amount of fines released from the BHD dredging in the dredge plume is approximately 80% smaller (see also [9] and [10]). To verify the dispersion of the BHD plume, handheld measures will be conducted at the start of the dredge campaign. This will provide information on the extent and turbidity levels caused by the BHD and the potential of the BHD plume to cause increased turbidity levels at the monitoring stations. Measurements will be taken at several distances from the BHD (approximately 100, 500, 1000m) and in several directions (Figure 6.5), to assess the extent, direction of travel of the plume and turbidity levels.

If an ALARM level is exceeded and these handheld measurements have shown that levels at 1,000 m from the BHD, the shortest possible distance between the BHD and the closest monitoring station, and in the direction of the station, are below 5.8 NTU (the lowest HOLD level as given in section 6.2.4), BHD dredging can continue since it will not result in increased levels above the HOLD levels. In case of a HOLD level exceedance the actions are described in section 6.2.4.

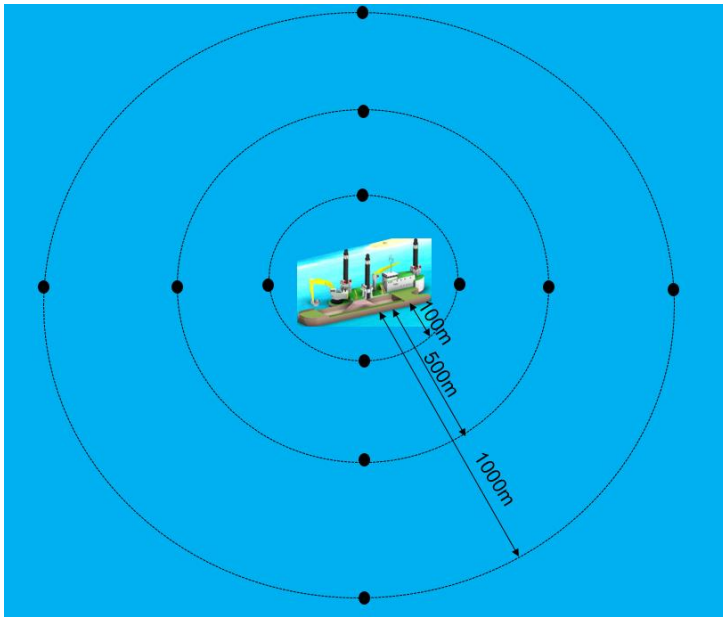


Figure 6.5: Indicative sketch of handheld monitoring locations around the BHD

6.2.4. Contingency Management Practice

As per Schedule 2 of the dredge licence [1] the HOLD criteria for the Project is defined as:

- 5.8 NTU based on a 15 day rolling median; or
- 15.8 NTU based on a 6 day rolling median.

When the HOLD criteria has been exceeded and if the exceedance is attributable to Contractor's operations the following actions should be taken in line with dredge licence clause 1.3.2 (U-1002) [1]:

- cease dredging as soon as reasonably practicable, but no later than within 3 hours of turbidity exceeding HOLD criteria;
- not recommence dredging until turbidity no longer exceeds HOLD criteria or unless otherwise approved in writing by the EPA;
- notify the EPA as soon as is reasonably practicable, but no later than 3 hours of turbidity exceeding HOLD criteria; and
- provide a written report to the EPA within 7 days of turbidity exceeding the HOLD criteria, which includes the date, time and duration of turbidity exceeding the HOLD criteria, the associated turbidity (expressed as NTU), the cause(s) for the exceedance, actions taken to rectify the matter and corrective actions identified and taken (or to be taken) to prevent future events of the same or similar kind.

In addition, in case of a HOLD criteria exceedance the following will apply to the continued operation of the BHD:

- If there is no downward trend in the raw turbidity data after three hours (one quarter tidal cycle) then the BHD must cease dredging unless hand-held turbidity measurements confirm raw turbidity is below 5.8 NTU at 100 m from the BHD in each compass direction (N, S, E, W).

- Hand-held measurements will be taken every three hours to confirm turbidity is below 5.8 NTU at 100 m while HOLD trigger is exceeded, if the BHD continues dredging.
- If hand-held turbidity measurements indicate that turbidity is higher than 5.8 NTU within 100 m of the BHD, then additional measurements will be taken at 500 m and 1,000 m from the BHD in each compass direction (N, S, E, W) to delineate the extent of the plume. If this monitoring indicates that the BHD is not contributing to the HOLD exceedance, then BHD dredging may continue pending approval from the EPA.

An overview of the responsive and contingency management process is given in Figure 6.6.

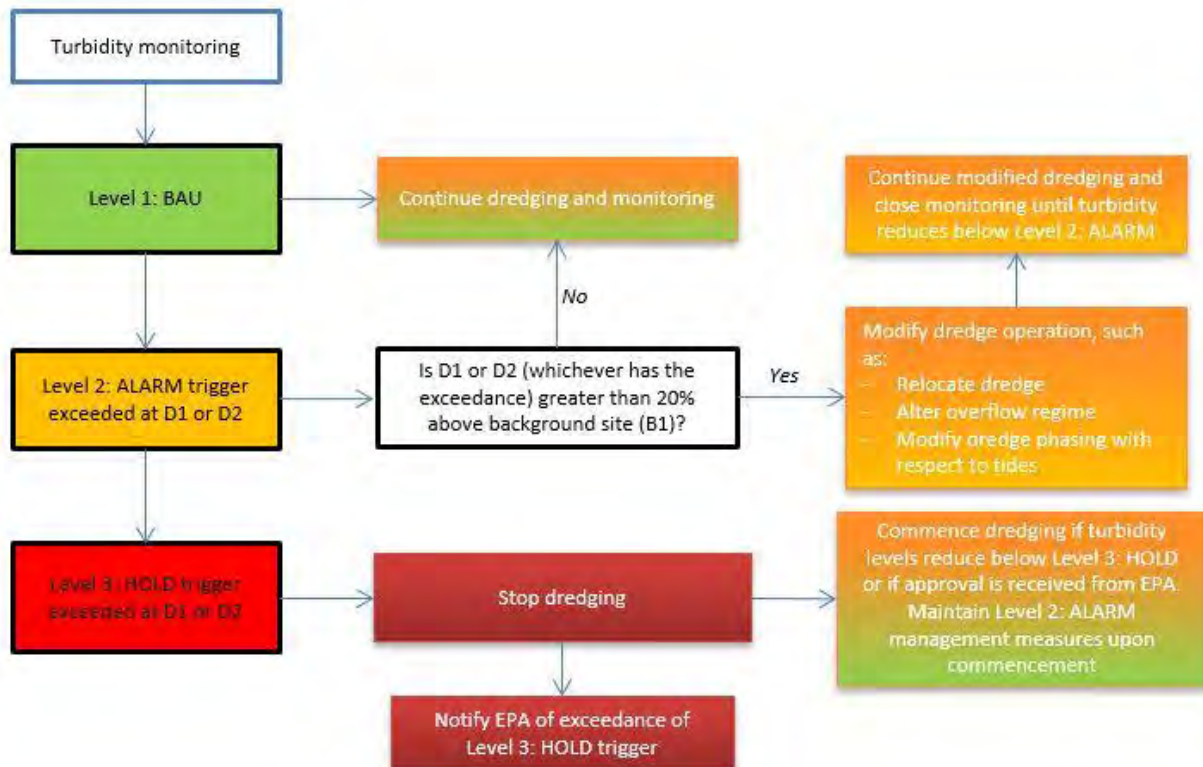


Figure 6.6: Responsive and contingency management process flow chart

6.2.5. Validation of TSS-NTU Relationship

Model outcomes from the plume dispersion model made by BMT prior to start of works ([8], [6] and [9]) are given in Total Suspended Solid (TSS) concentrations in mg/l. In order to relate this to the measured turbidity values in Nephelometric Turbidity Units (NTU), a relationship has been adopted of 1 NTU = 3 mg/l based on 16 samples conducted during a trial dredge campaign in 1996 as described in [8]. Based on this relationship, the zones of impact are calculated and the location of the monitoring buoys are defined. To validate this relationship, measurements will have to be taken in the actual dredge plumes at the start of works. The method to validate this relationship is described in section 4.1.5.5 of the EMP [15].

Should the results of the TSS-NTU correlation be significantly different to the relationship already in use, the discrepancy will be communicated to the EPA as soon as available. It is not intended that this will change the existing water quality limits, but will inform dredging methods [15].

6.2.6. Water quality Management framework

For the management of potential dredging impacts on the seagrass meadows located nearby, a risk-based Water Quality Management Framework has been developed and is provided in Table 6.2.

Table 6.2 Water Quality Management Framework

Item	Content
Objective	To minimise impacts to water quality and marine ecological sensitive receptors, including seagrass and benthic habitats of the Port River and Gulf St Vincent.
Performance criteria	No exceedance of HOLD criteria as defined in dredge licence [1]
Management Actions	Proactive and responsive measures conducted by Contractor as described in section 6.2.2 and 6.2.3 Baseline measurements conducted by FP as described in the EMP [15]
Monitoring	Continuous turbidity monitoring will be undertaken throughout the duration of the works. Alarms will be provided immediately to the Dredge Contractor when either the ALARM or HOLD criteria is exceeded.
Reporting	<ul style="list-style-type: none"> ▪ Monthly compliance reports will be prepared and submitted by the 7th day of each month according to licence clause 3.4.2 f (U-991) [1]. This report will include: <ul style="list-style-type: none"> - Summary of monitoring program - Raw monitoring data (QA checked) - QA/QC procedures - Summary of data - Details of HOLD value exceedances (if any) and corrective actions taken <p>Water quality data will be provided by the Environmental Representative, while the trigger value exceedances and corrective actions will be Contractor's responsibility.</p> <ul style="list-style-type: none"> ▪ In addition, when turbidity HOLD criteria has been exceeded a written report will be submitted to EPA within 7 days of exceeding the limit.
Corrective Action(s)	See contingency measures as described in section 6.2.4

6.3. Management of Other Environmental Impacts

This section provides a concise overview of management of environmental impacts other than related to sediment.

6.3.1. Marine Mammals

Contractor has experience working in areas where marine mammals are present and implementing marine mammal interaction protocols on its vessel(s). Crew on board the dredge vessels will be trained for Marine Mammal Observation (MMO), especially for the dolphins present in the area and to ensure awareness of the Adelaide Dolphin Sanctuary as described in section 4.3.2 and 4.7.

Marine Mammal Observation training will be given by Contractor's Environmental Manager prior to start of dredging to the bridge crew and captains of the TSHD, Dredge Barges and BHD. In addition, all project personnel will be briefed and reminded during Contractor's initial safety induction and tool-box meetings of the presence of marine mammals and the associated obligations.

The MMO training will typically include:

- Types of marine mammals likely to be present in the area and how to identify them
- Search and scanning protocol and methods to be used
- Marine mammal behaviours
- Requirements of the relevant licence conditions
- Measures to be taken if marine mammals are sighted
- Reporting requirements
- Health and safety requirements specific to undertaking the observations

The trained crew members will visually monitor, using binoculars, during daylight hours around the site of the activities prior to the start of dredging activities and during sailing activities. Should marine mammals move into those areas during the dredging activities, it is considered that they will have acclimatized themselves to the works and therefore cessation of dredging will not be implemented. Should a marine mammal move very close to ongoing dredging activities, measures will be implemented to reduce the risk of collision, taking into consideration vessel safety.

During all phases of the Project, the general principle guiding vessel operations will be to avoid, as far as practicable, any interaction with marine mammals. Therefore, vessels in the vicinity of a cetacean or cetaceans will (with the exception of emergency situations) adhere to the following guidelines. These guidelines are based on guidelines from JNCC for oil & gas industry and piling and blasting activities, Referral decision (EPBC 2017/8033) condition 1 for piling vessels in transit [3] and speed restriction requirements within the Dolphin Sanctuary [4]. These guidelines do not specify dredging activities, however Contractor has adopted these to be adhered to by dredging vessels. Furthermore, dredge licence clause 3.2.3 will be adopted. This has resulted in the mitigation scenarios described in the following paragraphs for the Project.

In all cases, the following guidelines should be followed:

- Adhere to speed limits in the Dolphin Sanctuary (Figure 3.2) set at 7 knots and becomes 4 knots within 200m of a moored vessel;
- Monitoring by a MMO within the caution zone (150m of any dredging vessel);
- Delay or pause dredging when marine mammals are observed within 50m of the Backhoe Dredge;
- Record any sightings on the Marine Mammal Observation Log Sheet;
- Report any sightings of large cetaceans to Flinders Ports Marine Operations Centre immediately, including location where the animal was sighted and direction it was traveling in;
- Do not intentionally approach within 300 m of whales (Figure 6.7);
- Do not approach cetaceans from an angle of less than 60° into or away from the direction of travel of the cetacean(s) as shown in Figure 6.7;
- Should any cetacean(s) commence bow riding in front of a vessel, the vessel master will not change course or speed suddenly;
- If possible and safe for the vessel, vessels are to slow down to no-wake speeds when within 300 m of a whale and 150 m of a dolphin.

It should be noted, that in confined waters, such as areas within breakwaters, there may be occasions where it may not be possible for vessels to maintain the approach angles or distances without compromising the safety of the vessel and its crew. If such situations should arise, all efforts will be made to minimise vessel interactions with, or disturbance to, marine mammals taking into consideration the health and safety of the crew and vessel at all times.

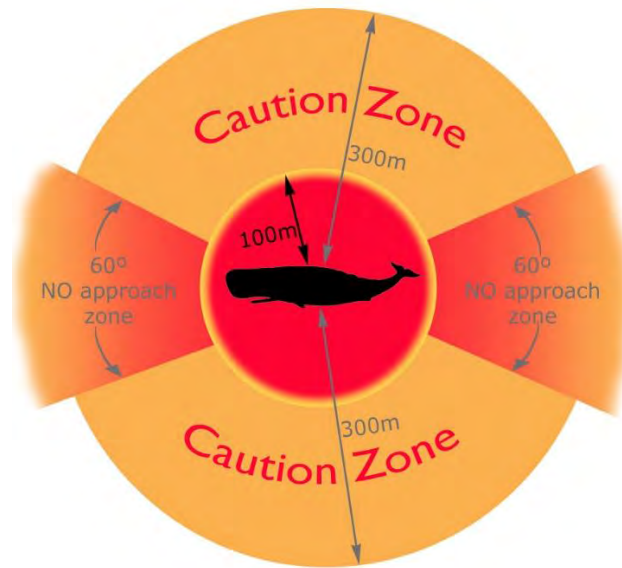


Figure 6.7 : Vessel approach distances for whales

Each dredge vessel has a trained MMO on board and a Marine Mammal Observation log sheet. When a marine mammal is sighted this will be reported on the log sheet. Logging will typically include:

- Date and time;
- Location of the vessel at the time of the sighting;
- Heading and distance from the vessel;
- Direction in which the animal is travelling;
- Number of animals;
- Type of animal (dolphin, whale), species if known;
- Observer name and position.

The following sections describe in detail the marine mammal procedures for the different dredging activities occurring in the Project.

Trailing Suction Hopper Dredge and Dredge Barge sailing to and from the DMPA

During this activity, the TSHD sails at a speed of 12 to 16 knots and the Dredge Barge at 8 to 9 knots, depending on whether the TSHD/Dredge Barge is loaded or not. Because of the sailing speed, the following interaction guidelines apply:

- When a whale is seen within 1000m from the dredge, determine whether evasive manoeuvring or slowdown may be required to keep 300m distance, based on the animal's travelling speed and direction.
- When a whale is seen within 300m from the dredge, take evasive action or slow down, depending on the animal's traveling speed and direction.
- When a dolphin is seen within 150m from the dredge, keep boat speed constant and/or slow down, depending on the animal's traveling speed and direction.

Trailing Suction Hopper Dredge dredging

During dredging, the TSHD moves at speeds of 1- 2.5 knots. The TSHD has one suction pipe down in the water and drag head on the seabed. These two factors make manoeuvring difficult, but the risk of colliding with a cetacean at these speeds is low. The following guidelines apply:

- When a whale is seen within 300m from the dredge, stay on course until the cetacean has moved away.
- When the whale is still within 300m when the dredging process has finished, determine whether it is safe to lift the drag head(s) and suction pipe(s) out of the water. Then determine the best direction

to safely and slowly move away from the cetacean. Do not increase speed until the cetacean is at least 300m away.

- Similar precautions have to be taken for dolphins within a 150 m caution zone.

Backhoe Dredge dredging

A BHD is stationary when dredging. It lifts the bucket from the seabed and loads the dredged material into the Dredge Barges, located next to the BHD. The following guidelines apply:

- When a large cetacean approaches within 300m of the BHD, inform all auxiliary vessels nearby not to approach the BHD until the animal has moved away. Vessels already present within a 300m radius from the dredge should remain stationary (when safe to do so) or move away very slowly, ensuring the animal does not get caught between two or more vessels.
- If a marine mammal is observed within 50m of a BHD, assess whether the lifting or lowering of the bucket may pose a risk to the marine mammal and pause or delay dredging until the animal has moved away.

Table 6.3 provides a summary of the Marine Mammal Management framework as explained in detail above.

Table 6.3: Marine Mammal Management Framework

Item	Content
Objective	To reduce the risk of disturbance or injury to Marine Mammals resulting from dredging and disposal activities
Performance criteria	No incidents of vessel-related disturbance or mortality to Marine Mammals
Management Actions	See detailed description in section 6.3.1
Monitoring	Monitoring based on visual observations by a MMO on board the dredge vessels during transit and operation
Reporting	<p>Daily log of all sightings to be recorded on the dredge vessels, indicating the sighting of each individual animal and actions taken. This will include:</p> <ul style="list-style-type: none"> ▪ Date and time; ▪ Location of the vessel at the time of the sighting; ▪ Heading and distance from the vessel; ▪ Direction in which the animal is travelling; ▪ Number of animals; ▪ Observer name and position. <p>Report of any incident to Flinders Ports Marine Operations Centre (84470902), EPA (EPAFlindersPorts.OHD@sa.gov.au) and DEW (Jon Emmet, 0428 106 412) as soon as reasonably practical.</p>
Corrective Action(s)	<p>Corrective actions could include: increase level of observation, training, procedure review, vessel speed limit in certain areas</p> <p>A complete action plan will be made on a case-by-case basis</p>

6.3.2. Invasive Marine Species

Australia is sensitive to the risks posed by invasive marine species (IMS), as they pose major ecological, economic and social risks. Marine pest species are known to be introduced or translocated by a variety of vectors, including ballast water, biofouling, aquaculture operations, aquarium imports, marine debris and ocean current movements.

In order to prevent the introduction of marine species Contractor will ensure the control and management of ballast water and biofouling as detailed in the management framework (Table 6.4).

Mitigation measures to prevent the spread of POMS and *Caulerpa taxifolia* related to the movement of Project vessels are also described, however for detailed information on the management of this risk reference is made to the POMS Management Plan [18] and EMP [15].

Table 6.4: Invasive Marine Species Framework

Item	Content
Objective	To ensure risk of translocation of organisms in ballast water or on the hull of a dredge vessel is minimised
Performance criteria	Compliance with: <ul style="list-style-type: none"> ▪ Biosecurity Act 2015 (Commonwealth) ▪ International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention) ▪ Australian Ballast Water Management Requirements Version 7 (DAWR 2017) ▪ National Biofouling Management Guidance for Non-Trading Vessels ▪ National Biofouling Management Guidance for Commercial Vessels ▪ Fisheries Management Act 2007 (PIRSA, South Australia) ▪ Attachment 4 Dredge Licence [1]
Management Actions	<u>Biofouling:</u> <ul style="list-style-type: none"> ▪ Conduct an IMS 'desktop' risk-assessment consistent with the Department of Agriculture and Water Resources (DAWR) Australian Biofouling Management Guidance to determine if a vessel and its intended movements represent a 'low' or 'high' risk situation ▪ As warranted by the initial vessel appraisal and vessel movement risks (e.g. intention to travel to Australia) and/or inspection, implement further management measures (e.g. hull cleaning, drydocking, treatment of internal seawater systems) as may be indicated ▪ Overseas vessels will be cleaned in dry-dock prior to arrival in Australia ▪ Renewal of antifouling coating to the hull and cavities before the coating's lifespan expires ▪ Vessel should leave its last overseas port of call as soon as practicable, and within no more than 14 days of the last anti-fouling coating application or invasive marine species inspection (WA guideline) <u>Ballast water:</u> <p>In accordance with the IMO Ballast Water Management Convention 2004 and the Australian Ballast Water Management Requirements 2017</p> <ul style="list-style-type: none"> ▪ Treating ballast water or exchanging ballast water from another country in mid-ocean (at least 200 nm from land) and in waters more than 200 m deep; if this is not possible as far from the nearest land as possible, and in all cases at least 12 nm from the Australian Baseline and outside the Same Risk Area (Figure 3.1) and in water at least 50 meters in depth.

Item	Content
	<ul style="list-style-type: none"> Ballast-water exchange can be done either by flow-through or by emptying and refilling the tanks to replace at least 95% of the water in them (International Maritime Organization guidelines consider that pumping through three times the volume of the ballast-water tanks will meet the standard) <p><u>POMS & <i>C. Taxifolia</i>:</u></p> <ul style="list-style-type: none"> Adhere to exclusion zones of 10km around commercial oysters growing areas In line with recommendations made in [14] conduct a survey of <i>C. Taxifolia</i> prior to commencement of dredging, should this be found it will be dredged by a BHD or TSHD without overflow and disposed in the DMPA. If minor presence only it may be killed with salt.
Monitoring	Inspection of dry-dock cleaning of vessel by specialised Consultant
Reporting	<p>Inspection report after cleaning of the overseas vessels in dry-dock by a specialised Consultant and provide records to the EPA</p> <p>Evidence of vessel loads, exchanges or discharges of ballast water to be recorded in the ballast water record book</p>
Corrective Action(s)	<p>In the event that known or suspected risk biota is detected after arrival in Australia:</p> <ul style="list-style-type: none"> Collect and retain samples for DAWR and/or PIRSA Cooperate to identify remedial action/s and develop tailored action plan in consultation with DAWR and/or PIRSA Re-inspect vessel, and instigate appropriate remedial actions as may be warranted on the basis of that inspection

6.3.3.Noise quality

As described in section 4.2.9 a residential area is located just south of the port entrance (near the Passenger Terminal). During unfavorable wind conditions nuisance from noise might occur. Table 6.5 describes the noise management framework to manage this risk.

Table 6.5: Noise Management Framework

Item	Content
Objective	<p>To protect the acoustic amenity and minimise nuisance noise on surrounding sensitive receivers.</p> <p>To respond effectively to any noise quality issues that arises during construction.</p>
Performance criteria	There are no complaints lodged from the public or port users about noise associated with dredge operations.
Management Actions	<p>Dredging to be avoided during non-favourable wind conditions (strong westerly / north westerly wind) at Outer Harbor port entrance / passenger terminal during night time.</p> <p>Ensure that engines and equipment on board the dredge are properly maintained in good working order.</p> <p>Maintenance activities with high noise levels to be avoided during night time while</p>

Item	Content
	dredging near sensitive areas.
Monitoring	<p>Upon receipt of a noise complaint an assessment will be made including the need for further investigation through for example handheld noise measurements to validate noise levels.</p> <p>Noise complaints will be registered in the complaints register from Flinders Ports according to the Community Engagement Plan [16].</p>
Reporting	The result of any noise investigations and corrective actions are to be provided to Flinders Ports within 2 days following receipt of a complaint.
Corrective Action(s)	In the event that a noise complaint is received, an investigation is to be undertaken and corrective measures applied where feasible including fixing faulty machinery that may be causing nuisance, repositioning noise-producing plant and avoiding dredging in unfavourable wind conditions.

6.3.4.Dredge Materials Management Framework

Dredging Control TSHD

The dredging process is controlled by means of the TSHD's Dredge View 2.0 – Hopper Monitoring System (DV2-HMS), a Boskalis' in-house development. The computer system monitors and displays all the dredging processes such as the position and level of the draghead, pump settings, power control and bottom doors.

The position of the vessel and draghead(s) are visualised on screen against a background of bathymetric data, obstacles, buoys and special features such as the presence of existing cable(s) or pipeline(s). DV2-HMS allows the operator maximum control over the dredge area, both in the horizontal and vertical planes.

For placement via the bottom doors, it is possible to pre-define so called 'disposal-boxes' in the DV2-HMS module. These boxes enable the helmsman to accurately position the TSHD above a specific target, in order to discharge the dredged material in that particular box. This is illustrated in Figure 6.8. The location of the boxes can be defined during preparation of the works by the surveyor, superintendent and TSHD's Captain.

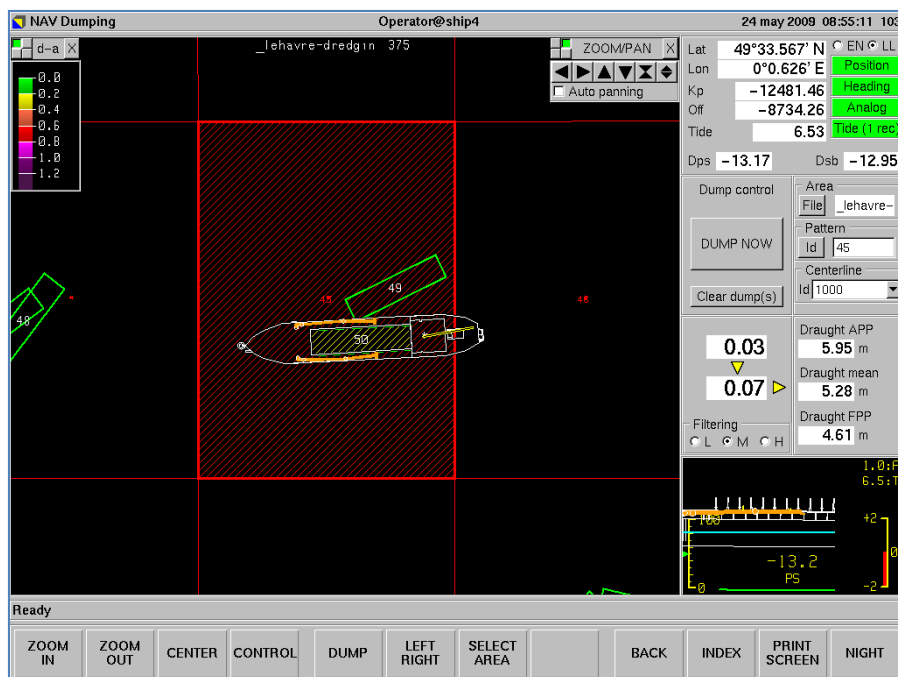


Figure 6.8: DV2-HMS TSHD control display of disposal boxes

Survey

Dredged material will be placed in the DMPA by means of opening of the hopper doors as described in section 2.3.1.

The DMPA will be subdivided by Contractor into various disposal boxes as described in previous section. To ensure the dredged material is at all times discharged within the boundaries of the DMPA, each box will be subdivided into smaller disposal boxes. The size of each individual disposal box will be adjusted for the discharge footprint of the vessels, therefore ensuring that the TSHD and dredge barges have disposal boxes suitable for their specific dimensions. The additional subdivision of the main boxes will allow for control of distribution and gradual build-up of the material within the disposal area. A 100m buffer zone that will not be used will be maintained along the edge of the DMPA as a safeguard.

The disposal location of each load will be logged and recorded. Regular progress surveys will be undertaken to ensure all vessels are provided with accurate bathymetrical data. The vessel will dispose its load evenly across the dedicated disposal boxes. In practice this means that the vessel will be disposing at slow speed to ensure the load is spread and no unwanted high spots are created. Based on the information obtained from the progress surveys the disposal process might be further optimized with regards to speed of the vessel whilst depositing the load as depending on the soil characteristics of the dredged material and its dispersion over the seabed might vary.

The EMF for dredge material management, detailed in Table 6.6, ensures that all dredged material will be removed from within the defined dredging footprint, transported safely and released within the boundaries of the DMPA.

Table 6.6: Dredge Material Management Framework

Item	Content
Objective	<ul style="list-style-type: none"> Manage the spoil disposal activities and spoil grounds to ensure potential environmental impacts are minimised

Item	Content
	<ul style="list-style-type: none"> ▪ Avoid disturbance of navigation and shipping activities at the Project and at the spoil disposal area
Performance criteria	<ul style="list-style-type: none"> ▪ No dredging to take place outside the footprint of the dredged area ▪ All dredge material to be disposed of within the boundaries of the DMPA ▪ The dredged material shall be deposited in a uniform matter which avoids mounding
Management Actions	<ul style="list-style-type: none"> ▪ Establish the position is within dredging site prior to dredging using Differential Global Positioning System (DGPS). ▪ Establish the position is within DMPA prior to disposal using DGPS ▪ Dredged material will be disposed evenly over the area within the DMPA as far as practically possible ▪ Establish clear communication with the Client concerning: <ul style="list-style-type: none"> - Safety exclusion zones around the dredgers and/or the dredge areas - Dredging operations, locations, schedule and any associated amendments - Shipping traffic schedules - Communication with other marine traffic ("Notices to Mariners", radio contact, etc.) ▪ Include exclusion zone on board the dredgers survey screens.
Monitoring	Hydrographic survey of dredge area and DMPA prior to the start of the works, during the works and at the completion of all dredging-related activities
Reporting	<ul style="list-style-type: none"> ▪ Quarterly dredge register recording all days that dredging is undertaken and the location of those works in line with dredge licence clause 4.6 (A-7) [1]; ▪ In line with dredge licence clause 3.1 (U-992) and 2.4.1 (U-995) [1]: <ul style="list-style-type: none"> - Undertake a bathymetric survey to establish the current seabed level of the dredge area and DMPA prior to the proposed commencement of dredging and develop and submit a report of this survey to the EPA - Conduct a bathymetric survey of the DMPA and Dredge Area within one month upon completion of dredging, if weather allows, to the EPA.
Corrective Action(s)	<ul style="list-style-type: none"> ▪ High spots above design levels within the disposal site will be flattened or removed ▪ Not all corrective actions can be listed. Therefore it is prudent to consider additional corrective actions on a case-by-case basis

6.3.5. Waste

Contractor is committed to the objective to minimise the generation of waste during execution of the Project through the application of the practices outlined in the waste management hierarchy below:

1. Source reduction;

2. Reuse and recycling to recovery;
3. Treatment and responsible disposal.

The Waste Management Framework (Table 6.7) contains a summary of the management measures and strategy to reduce the environmental impacts from the generation of hazardous and non-hazardous waste and sewage. Criteria for disposing, managing, monitoring, minimising or avoiding the generation of different types of waste are applied in line with applicable Acts, Regulations and International conventions.

Table 6.7: Waste Management Framework

Item	Content
Objective	To ensure that general refuse produced on-board the dredge vessel is collected, retained and transferred to an appropriate facility without unintentional material loss.
Performance Criteria	<ul style="list-style-type: none"> ▪ All solid and hydrocarbon wastes to be disposed onshore at approved facilities. ▪ No environmental incidents (including “near misses”) from waste. ▪ All project personnel to complete a Project induction, including information on waste management practices.
Management actions	<ul style="list-style-type: none"> ▪ Adoption of waste minimisation initiatives wherever possible and practical, in particular with regards to procurement and (sub)contracting processes. ▪ Segregate chemicals and hazardous waste from other solid waste and treat them according to regulatory requirements with regard to storage, transport and disposal. ▪ General “good housekeeping” practices. ▪ Provide sufficient number of waste receptacles and ensure these have lids and are able to be sea fastened where applicable. ▪ Employ approved and licensed waste contractors for pick up and disposal of vessel waste (including food scraps), untreated sewage and listed wastes. ▪ Sea-going vessels will manage waste in accordance with MARPOL 73/78 Annex IV, vessel garbage logs and waste receipts (including sewage receipts) to be kept on board. ▪ Controls onboard dredging and auxiliary support vessels are based primarily around the segregation and collection of waste in dedicated waste containers. ▪ Designated waste receptacles shall be assigned and clearly identified onboard all vessels, worksites and office facilities. ▪ Spill kits will be placed in the direct vicinity of areas where liquid wastes are stored.
Monitoring	<ul style="list-style-type: none"> ▪ Housekeeping inspections with regard to waste to ensure there is no accumulation of waste materials in work areas and that wastes are appropriately stored. ▪ Auditing and vessel inspections.
Reporting	<ul style="list-style-type: none"> ▪ Recording of the quantities and types of waste received and disposed of, as well as of the disposal method. ▪ Contractor shall report listed wastes to Client as required. ▪ Reporting of any significant loss of waste material to Flinders Ports as soon as practicable.

Item	Content
Corrective Action(s)	In the event that waste is lost overboard all reasonable and practicable measures must be employed to retrieve the waste.

6.3.6. Hydrocarbon and Chemical Spills

This management framework is established to effectively minimise the risk of hydrocarbon and chemical substances entering the environment during the dredging activities and operation of auxiliary vessels engaged in the Project. Within the framework the necessary tools to effectively manage the use, transport and storage of hydrocarbons and chemicals, including fuel supply to Project vessels, are provided (Table 6.8). The framework also presents information related to inspection and maintenance of plant and equipment.

Table 6.8: Hydrocarbon and Chemical Management Framework

Item	Content
Objective	Minimise the possible environmental impact from the use, transport and storage of hydrocarbons and chemicals.
Performance Criteria	<ul style="list-style-type: none"> Comply with all local regulations applicable to hydrocarbon and chemical management and MARPOL 73/78. No incidents during the delivery, transport or storage of hydrocarbons and chemicals. All Project personnel to complete a Project Induction, including information on spill management practices
Management Actions	<ul style="list-style-type: none"> Ensure bunkering is undertaken in accordance with the Bunkering procedure and Permitting process. Adequate training of all relevant staff and crew on procedures related to bunkering. Maintain communication between bunkering vessels and the fuel supply when bunkering activities are being undertaken. Install and use dry-break, breakaway couplings or similar technology where practicable during bunkering operations. Use of licensed supplier for fuel transfer and transport. Follow vessel's planned maintenance system and regularly inspect hydraulic oil systems, hoses and couplings to minimise the potential for spills. Contractor shall ensure that any plant and equipment used will be fit for purpose, well maintained, and operated by an appropriately trained person. Ensure vessels are equipped with sufficient low-pressure alarms and shutdown systems to minimise hydrocarbon loss to the marine environment in the event of a hydraulic hose failure. Appropriate storage and handling of oils, grease and chemicals as per Australian Standard 1940-2004. Chemicals shall be approved in accordance with Flinders Ports Chemical Selection, Assessment and Approval requirements. Include consideration of the potential for ecotoxicity in the selection process for hydrocarbons and chemicals.

Item	Content
	<ul style="list-style-type: none"> ▪ Have up to date Safety Data Sheets (SDS) available for all oil and chemical products. ▪ Inspect storage of all hazardous materials and hydrocarbons regularly. ▪ Ensure save bunds are monitored and emptied in a timely manner after heavy rainfall.
Monitoring	<ul style="list-style-type: none"> ▪ Routine and pre-bunker hose and coupling monitoring/inspection. ▪ Records of liquids received, stored and dispensed will be maintained and reconciled. ▪ Undertake visual monitoring of hoses, couplings and the sea surface pre bunkering and during bunkering operations.
Reporting	Audits and incident reporting.
Corrective Action(s)	<ul style="list-style-type: none"> ▪ Implement spill contingency management. ▪ If necessary, change hydrocarbon procedures and inform crew (via toolboxes etc.).

7. REPORTING

Environmental reporting is one of the important parts in the implementation of the DMP ensuring that the required information is properly communicated to the EPA. Table 7.1 summarizes the items to be reported and the reporting frequencies. For seagrass monitoring reference is made to the EMP [15] and for POMS and *Caulerpa taxifolia* reference is made to the POMS Management Plan [18] and the EMP [15].

Table 7.1 Environmental items to be reported at specified frequencies

ASPECT	REPORTING FREQUENCY
Dredge register	Quarterly: <ul style="list-style-type: none"> for the months of January, February and March, the register must be submitted by the end of April in that year; for the months of April, May and June, the register must be submitted by the end of July in that year; for the months of July, August and September, the register must be submitted by the end of October in that year; for the months of October, November and December, the register must be submitted by the end of January in the following year.
Water quality monitoring (see also EMP)	Monthly by the 7 th day of each month, reporting on the previous month
HOLD turbidity limit exceedance	Within 7 days of turbidity exceeding the limit
TSS – NTU correlation report	Once, at start of dredging
Marine Mammal recording	Daily logs, reported monthly
Bathymetric survey of dredge and disposal area	Once, no more than three months prior to the proposed dredging commencement date
Biofouling inspection report	Once, after vessel cleaning and prior to arrival in Australia
Audit	Monthly
Environmental incident	If occurring, as soon as reasonable practical to the EPA (EPAFlindersPorts.OHD@sa.gov.au) and in addition for marine mammal incidents: Flinders Ports Marine Operations Centre 84470902) and Mr. Jon Emmet from DEW (+61 428 106 412)

8. QUALITY ASSURANCE & QUALITY CONTROL

This Chapter describes the quality control system for the environmental monitoring program, i.e.: internal audits, inspections, compliance (external) audits, data-handling.

8.1. Internal Audit

The aim of internal audits is to identify problems that may exist, so that Contractor/Sub-Contractor improves the standards of HSE performance. The audits are to judge how HSE issues are managed and to verify the respect of law and regulations, the responsibilities, risk evaluation and management, respect of environment, safeguarding of health, Sub-Contractor and Suppliers control, competence and training of workforce, implementation of the HSE training plan, emergency preparedness, accident/incident investigation, HSE improvement plan.

8.2. Audit

Compliance audits will be carried out on a frequency to be defined during construction phase by an approved Environmental Consultant, BMT.

8.3. Control & Review of DMP

An up to date controlled copy of the DMP will be maintained on site at all times and it will be available for all parties and available for auditing purposes. The copy of the DMP will be available to the Operator, Project Consultants and all sub-contracting companies.

All revisions made to the DMP will be communicated to all parties and the superseded version of the DMP will be replaced on the online document control system, if any, which is used by employees to access specific documents. Any revisions to the DMP must be approved in writing by the EPA.

The Environment Manager is responsible for ensuring that relevant site personnel are informed and aware of any environmental requirements and changes to the DMP. They will liaise with the Project Management team concerning environmental issues including technical advice. Information will be provided to all applicable site personnel, including subcontractors, in the form of initial inductions and toolbox talks.

The SHE-Q Manager shall report to the Project Management any non-conformances, incidents and other environmental issues that arise from internal and external inspection and concerns from the Subcontractors, Workers or Site Foreman. Project Management shall administer corrective and preventive measures on the raised environmental non-conformances, referring to the relevant legislation and technical guidelines.

8.4. Data-handling

8.4.1.Field Logs

Field logs are filed at the end of each monitoring day, and relevant information is included in the monthly water quality report.

8.4.2.Lab Results

Lab results will be included in the TSS – NTU relationship establishment report.

8.4.3.Backups of Electronic Data

Backups of electronic data will be made at least once a week.

9. ROLES AND RESPONSIBILITIES

9.1. General

The responsibility for environment is founded in Contractor's management structure. This accountability is put forward to project sites and vessels via subsequent management levels. Responsibilities per below mentioned function will be supplemented with tasks following from the risk assessment.

The project management / staff will implement the DMP by:

- Setting an example for their colleagues by their own behaviour regarding environmental matters;
- Asking corporate SHE-Q department for advice if necessary;
- Making sure that the project activities comply with environmental regulations and requirements;
- Ensuring that all project employees understand the environmental regulations;
- Applying the same instructions to suppliers / sub-contractors; and
- Proposing measures to prevent risks for the environment.

The below description of key personnel involved in the environmental management of the Project may be adjusted upon award based on defined roles between Contractor and Company and possible Subcontractors.

9.2. Project Manager

Although he/she is allowed to delegate some of his tasks, the Project Manager is ultimately responsible for all environmental aspects of the Project. This includes amongst others:

- Perform an environmental risk assessment prior to commencement of the works;
- Examine whether the environmental plan meets contractual and legal requirements;
- Ensure the employment of sufficient qualified and trained personnel;
- Make employees aware of the environmental plan and their environmental responsibilities;
- Make sure that the response to environmental incidents is accurate;
- Arrange periodic environmental inspections and meetings;
- Report environmental incidents according the incident reporting procedure (RBW-510);
- Report the environmental actions such as inspections, audits and toolbox meetings; and
- Set environmental targets for project.

Tasks which will be carried out by the Project Manager or Works Manager are:

- Monthly SHE-Q inspection;
- Participation in the investigation and analyses in the event of a serious environmental incident; and
- Chairing the environmental meetings with supervisory personnel when required.

9.3. Project Safety, Health, Environmental and Quality Manager

The Project Safety, Health, Environment and Quality Manager is responsible for the environmental management related to the construction site, temporary facilities and the vessels. This includes waste management, oil spill prevention and response, resource consumption, and air emission and noise control measures. The Project SHE-Q Manager has the following responsibilities:

- Advise and support management and supervisory personnel on environmental issues;
- Induct and instruct new project personnel, subcontractors and third parties;
- Perform random project spot-checks to verify compliance with the environmental plan;
- Investigate environmental incidents and non-conformities;
- Administrate and review regularly the environmental plan and attached procedures; and
- Record and review the environmental performances achieved on the Project.

9.4. Environmental Manager

The Environmental Manager is responsible for the development, implementation and reporting of the DMP, together with the Project Manager and the Project SHE-Q Manager. The Environmental Manager has a coordinating role. His/her tasks include:

- Contact person for Client for issues related to ecology;
- Liaison and first contact for Engineering Consultant and Environmental Consultant for issues related to ecology and water quality;
- Advising project manager on implementing possible mitigation measures in case exceedance of turbidity levels;
- Providing training on turbidity related aspects to relevant project personnel;
- Provide marine mammal training to crew members on board the dredge vessels;
- First contact in case of incidents with marine mammals;
- Investigate environmental, ecology related incidents and non-conformities;
- Reviewing (with the Project Manager) and updating the DMP; and
- Responsible for reporting.

These tasks may be handed over to the SHE-Q Manager once routines have been established.

9.5. Supervisory Personnel

Supervisory project personnel (Superintendent, Captain/ Dredge Master and Foreman) in charge of particular works and project employees, have the responsibility to supervise the environmental aspects accompanying those works. This includes amongst others:

- The Captain or Vessel Master on the dredge vessel assigns a crewmember on each shift to log marine mammal observations on the appropriate log sheets;
- Report dangerous environmental incidents;
- Correct behaviour that might result in environmental pollution;
- Make sure that during the works, the environment is protected;
- Make sure that emergency preparedness and response tools for environmental incidents will be effective;
- Conduct a weekly environmental inspection of the work and the activities when required; and
- Organize and carry out toolbox meetings.

9.6. Project Personnel

All project personnel are responsible to comply with the environmental policy, Safety Instructions (RBW - 502) and project specific environmental instructions.

They shall:

- Behave and work according the ruling environmental measures and instructions;
- Use equipment, machines, vehicles and tools in environmental friendly manners;
- Use and maintain environmental protection equipment in appropriate manners;
- Report instantly any noticed (possible) danger to supervisory project personnel; and
- Attend and participate in toolbox and environmental meetings.

Prior to employment of project personnel, the Project Management has to verify whether the employees are sufficiently trained for their tasks and duties on the Project. If project circumstances require so, the Project Management shall, in consultation with the SHE-Q and Personnel & Organization departments, arrange specific training.

9.7. Environmental Training

To ensure all (relevant) project personnel is aware of the environmental commitments of the Project, the following training will be provided during the project:

- General induction will be given to all project personnel including environmental awareness specific to the Project reflecting EPA Licence condition and awareness on the Adelaide Dolphin Sanctuary.
- Operational staff will be trained in the contents and operation of the DMP, particularly the use of the online monitoring website and trigger level system.
- Training to crew members on board the dredge vessel dedicated as marine mammal observers, described in detail in section 6.3.1
- In addition, a Heritage Consultant engaged by Client will provide training to relevant Contractor personnel on the Heritage act and the procedure upon discovery of any archaeological findings.

10. REFERENCES, ABBREVIATIONS, DEFINITIONS

10.1. References

Controlled Legislation		
No.	Document No.	Document Title
[1]		Licence No. 50556 Flinders Ports Pty Limited issued 12 March 2019
[2]	010/V048/17	Development Approval Outer Harbor Channel and Swing Basin Widening
[3]		Referral Decision not controlled action if undertaken in a particular manner, Department of the Environment and Energy
[4]		Adelaide Dolphin Sanctuary map, Government of South Australia & National Parks South Australia

Client Documents		
No.	Document No.	Document Title
[5]		Outer Harbor Channel Widening Project Development Application Report, July 2017
[6]		Outer Harbor Channel Widening Project Development Application Report – Addendum #1, September 2017
[7]	253257-DMP-D-001	Port Adelaide Outer Harbor Channel Widening Project – Dredge Management Plan, July 2018
[8]	R.B22346.006.01.PlumeModelling	Port Adelaide Outer Harbor Channel Widening – Dredge Plume Modelling Report, BMT June 2017
[9]	M.B22346.013.Selected Dredge Scenario	Selected Dredging Scenario and Water Quality Limits – Adelaide Outer Harbor Channel Widening Project, BMT December 2018
[10]	M.B22346.014.01 Selected Dredge Scenario	Selected Dredging Scenario and Water Quality Limits – Adelaide Outer Harbor Channel Widening Project, BMT February 2019
[11]	253257-00	Outer Harbor Channel Widening Project Dredge Methodology Summary, Arup January 2019
[12]	R.B22346.011.POMS_Bivalve_Survey_Final	Port Adelaide POMS Risk Assessment – Bivalve Survey, BMT October 2018
[13]		Adelaide Port Outer Harbour Channel Widening Project: Sediment Characterisation - Summary of Results, BMT 2018
[14]		Memorandum: <i>Caulerpa taxifolia</i> Presence and Dredge Management, BMT 2018
[15]	R.B22346.010.00_EMP	Environmental Monitoring Plan
[16]		Community Engagement Plan
[17]	253257-SPC-D-001	Dredging - Technical Specifications, Flinders Ports

Client Documents

No.	Document No.	Document Title
		December 2018
[18]		POMS Management Plan
[19]		Seagrass Monitoring Program
[20]		Closure Plan

Contractor Documents

No.	Document No.	Document Title
[21]	036-10315-02-001	Work, Health and Safety Management Plan
[22]	036-10315-02-002	Emergency Response Plan
[23]	036-10315-02-004	Quality Management Plan
[24]	036-10315-02-006	Inspection Test Plan
[25]	036-10315-14-003	Survey Method Statement

Other Documents

No.	Document No.	Document Title
[26]		https://nl.climate-data.org/oceanie/australie/south-australia/adelaide-5696/ visited on 13-02-2019
[27]		WorldWaves offshore database, February 2015
[28]		http://www.bom.gov.au/oceanography/projects/ntc/dodge/dodge.shtml visited on 14-02-2019
[29]		Maritime Heritage Surveys, December 2018. Outer Harbor Channel Widening Desktop Underwater Cultural Heritage Assessment.
[30]		Due Diligence Investigation of Historic Shipwrecks for Flinders Ports' Outer Harbor Channel Widening Project, Heritage South Australia 27 February 2019

10.2. Abbreviations

Abbreviation	Full meaning
ADS	Adelaide Dolphin Sanctuary
AIS	Automatic Identification System
BHD	Backhoe Dredge
BAK	Boskalis Australia Pty Ltd (Contractor)
CD	Chart Datum
CSD	Cutter Suction Dredger
DAWR	Department of Agriculture and Water Resources
DB	Dredge Barge
DEW	Department for Environment and Water
DGPS	Differential Global Positioning System
DMP	Dredge Management Plan
DMPA	Dredge Material Placement Area
DV2-CMS	Dredge View 2.0 Crane Monitoring System
DV2-HMS	Dredge View 2.0 Hopper Monitoring System
EMF	Environmental Management Framework
EMP	Environmental Monitoring Plan
EPBC	Environment Protection and Biodiversity
FP	Flinders Ports Pty Ltd (Client)
HSES	Health, Safety & Environment
IMO	International Maritime Organisation
IMS	Invasive Marine Species
km	Kilometre
KP	Kilometre Point
LAT	Lowest Astronomical Tide
m	Metres
NIMPCG	National Introduced Marine Pests Coordination Group
NTU	Nephelometric Turbidity Units
PIRSA	Primary Industries and Regions South Australia
POMS	Pacific Oyster Mortality Syndrome
rev	Revision
SA	South Australia
SDS	Safety Data Sheets
SHE-Q	Safety, Health, Environment and Quality
TSHD	Trailing Suction Hopper Dredge
WoW	Way of Working
WQMP	Water Quality Monitoring Plan

10.3. Definitions

Definition	Full meaning
Client	Flinders Ports Pty Ltd
Client's Engineering Consultant	Arup
Client's Environmental Representative	BMT
Contractor	Boskalis Australia Pty. Ltd.
Project	Port Adelaide Outer Harbor Channel Widening
Project number	036-10315
Subcontractor	Companies contracted by Contractor to perform a specific portion of the work.
Supplier	A company that is requested to supply (temporary) materials or services on behalf of Contractor

11. ATTACHMENTS

11.1. Specifications TSHD Gateway

EQUIPMENT SHEET

GATEWAY
TRAILING SUCTION HOPPER DREDGER



CONSTRUCTION/CLASSIFICATION

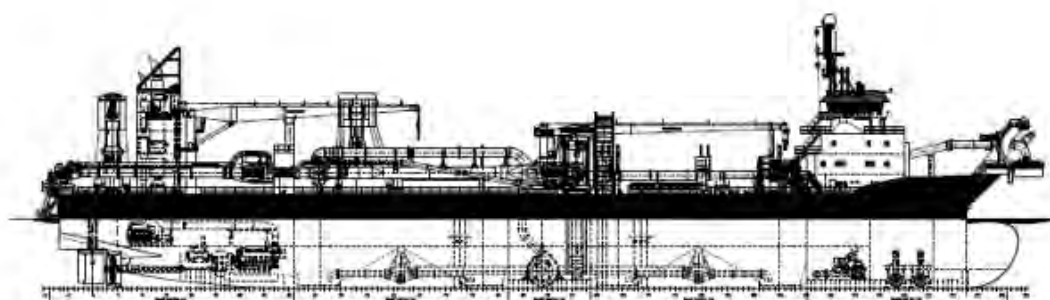
Built by	Merwede Shipyard B.V.
Year of construction	2010
Classification	1 * Hull * Mach. Hopperdredger. Unrestricted Navigation. Dredging within 15 miles from shore or within 20 miles from port; or dredging over 15 miles from shore with a significant wave height restriction to 3.0 m. * AUT-UMS

FEATURES

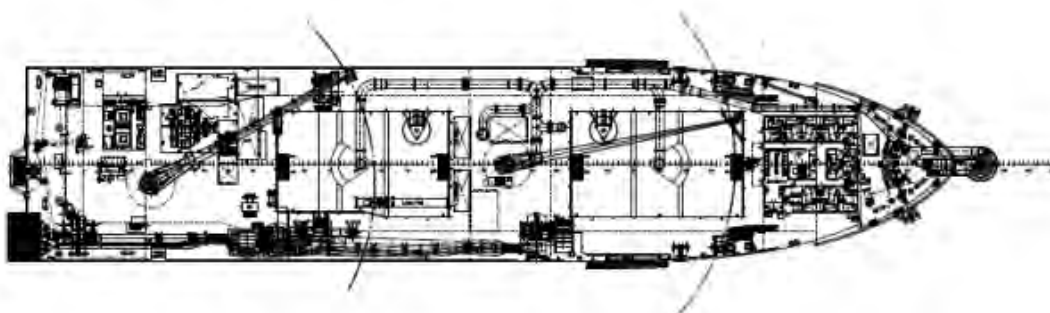
2 Separate hoppers with pump room in between.
Accommodation on fore ship.
1 Suction pipe with submersible dredge pump at starboard side.
2 Fixed deckcranes.
Relative small draught.

MAIN DATA

Length overall	143.53 m
Breadth	28.00 m
Moulded depth	13.50 m
Max. draught Int. load line	8.00 m
Max. draught dredging load line	10.00 m
Carrying capacity (D.W.)	about 22,000 t
Hopper capacity	12,000 m ³
Suction pipe diameter	1 x 1,200 mm
Max. dredging depth	approx. 62.00 m
Discharge systems	Dumping through bottom doors (4), shore discharge and rainbow.
Sailing speed loaded	15.4 kn
Total installed power	13,870 kW
Sand pump output	Inboard dredge pump: 7,500 kW Submersible dredge pump: 3,500 kW
Jet pump output	2 x 1,250 kW
Pump ashore output	7,500 kW
Propulsion power sailing	2 x 6,000 kW
Bow thruster	2 x 700 kW



SIDE VIEW



TOP VIEW DECK LEVEL

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11.2. Specifications BHD Magnor

EQUIPMENT SHEET

MAGNOR
BACKHOE

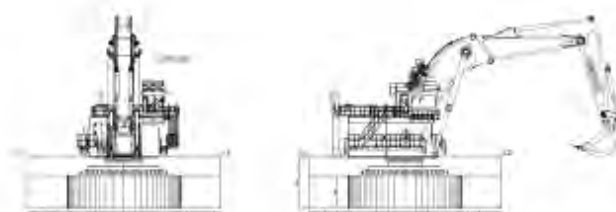
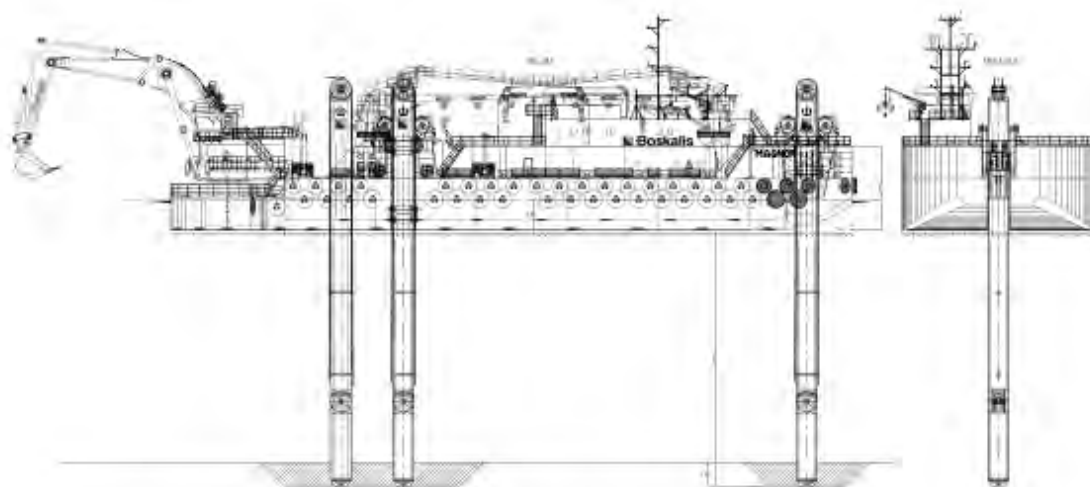


CONSTRUCTION / CLASSIFICATION

Vessel built by	Ravestein B.V.
Year of conversion	2015
Classification	Bureau Veritas unrestricted navigation, Green Passport

MAIN DATA

Gross tonnage	2,312 GT
Length overall	72 m
Moulded breadth	20.4 m
Moulded depth	5.5 m
Normal draught	3.39 m
Spud length	40 m
Spud system	3 spuds /tilting spud
Type of excavator	BK 12700 DD Greenline
Bucket capacity	up to 40 m ³
Maximum dredging depth	18 / 32 m
Total installed power	4,100 kW
Excavator engine power	3,356 kW



SIDE VIEWS

11.3. Specifications Tugs & Dredge Barges

EQUIPMENT SHEET

TERRAFERRE 501/502
HOPPER AND TRANSPORTATION BARGES



CONSTRUCTION/CLASSIFICATION

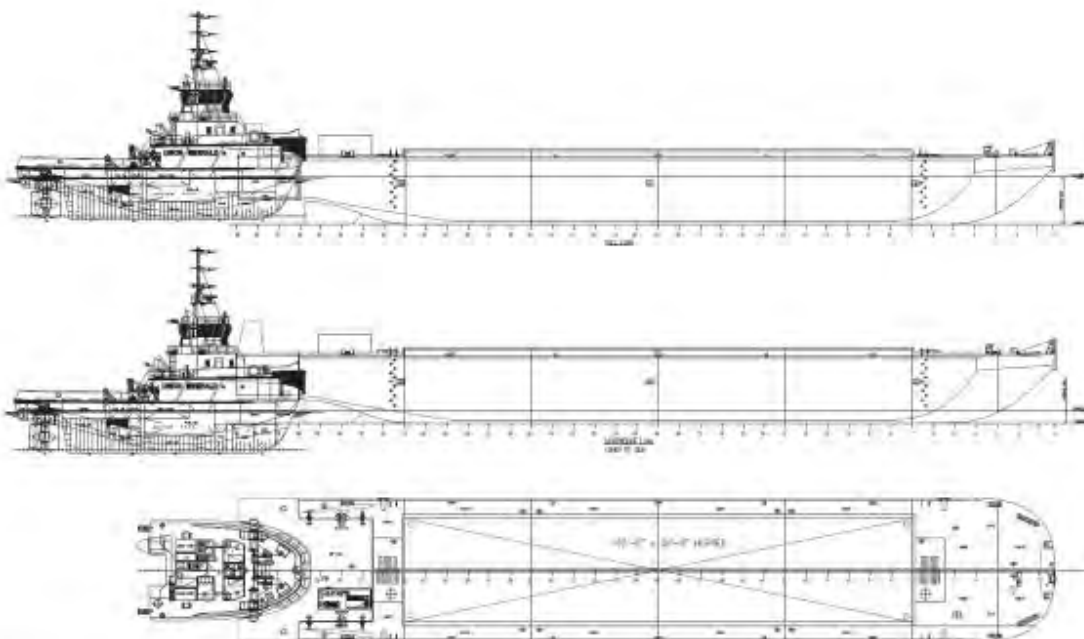
Built by	Gunderson Marine, Inc
Year of construction	1995 converted with ATB system in 2012
Classification	Bureau Veritas (BV) * A1, Barge

MAIN DATA

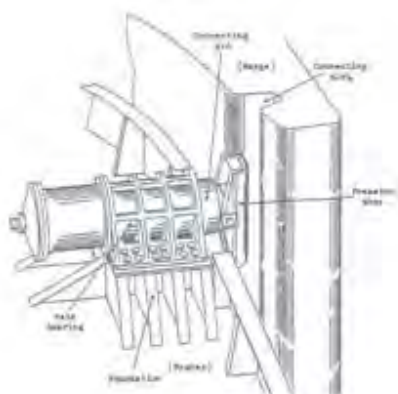
Type	Non-propelled split hopper barge
Length overall	94.3 m
Width	16.55 m
Depth	7.16 m
Max. draught	5.529 m
Hopper capacity	3,823 m ³
GRT/NRT	2,955/917
Accommodation	None
Power sets	Hydraulic set Cat 3208 186.4kW Auxiliary set Isuzu 8.2kW
Discharge system	Split hopper

ARTICOUPLING SYSTEM

For more details on the available pusher tugs, please refer to a separate equipment sheet for Union Topaz/Union Onyx.



PUSHER TUG WITH BARGE MOORING ARRANGEMENT



ARTICOUPE FD-SERIES MOORING ARRANGEMENT

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EQUIPMENT SHEET

UNION TOPAZ - UNION ONYX
TUG



CONSTRUCTION/CLASSIFICATION

Year of construction	2008
Classification	Lloyd's Register * 100 A1 TUG * UMC, UMS, unrestricted service
IMO number	Union Topaz 9406427 Union Onyx 9406415

FEATURES

Air-conditioned accommodation for 9 persons
Bunker capacity: potable water 30 m ³ , fuel oil 185 m ³
Crane 4T SWL @ 2 m. outreach

DECK EQUIPMENT

Fore winch	Hydraulic Double drum - 130 T. brake load Line pull 44 T. @ 10 m/min. on 1 st layer
Aft winch	Hydraulic Split drum - 130 T. brake load Line pull 44 T. @ 10 m/min. on 1 st layer

ARTICOUPLE SYSTEM

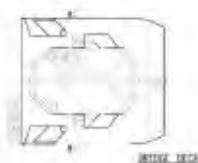
Equipped with Articouple system to push barges Terraferre 501/502. Please refer to the Terraferre 501/502 equipment sheet for additional specifications.

MAIN DATA

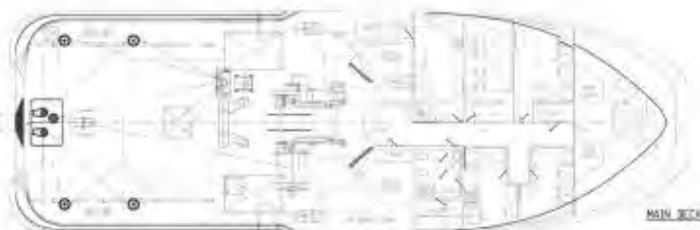
Gross tonnage	493
Length overall	33.00 m
Beam overall	11.00 m
Min. draught	4.40 m
Main engines	2 x ABC 8MDZC 4
Total power	3,700 kW
Propulsion	2 x fixed pitch ASD propeller
Bollard pull (ahead)	65 t
Bollard pull (astern)	62 t
Speed ahead (max.)	13 kn
Speed ahead (economic)	10 kn

NAVIGATION AND COMMUNICATION EQUIPMENT

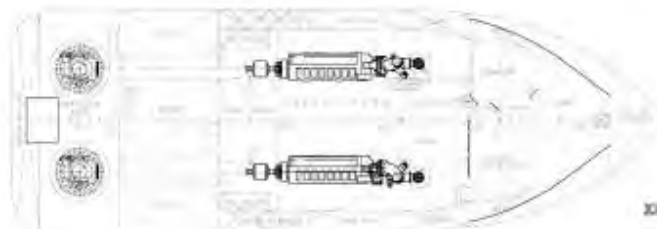
Magnetic compass	Cassens & Plath Observator
Echo sounder	Skipper GDS-101
VHF	Sailor RT-5022
Radar	Furuno Far-28x7
GPS	Furuno GP-32



SIDE VIEW



MAIN DECK



DOUBLE BOTTOM

TOP VIEW DECK LEVEL

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11.4. Risk Matrix

<p>Acceptable: Risk is acceptable, provided Standard control and mitigation measures are maintained, periodically reviewed and improved where possible.</p>					<p>Unacceptable: Risk cannot be performed without additional measures. In short, apply multiple control and mitigation measures when risk is unacceptable.</p>					
<p>Caution: additional control and mitigation measures are required to comply with As Low As Reasonably Predictable (ALARP)</p>					<p>Historical</p>					
<p>Stop: risk level is not acceptable. Apply multiple control and mitigation measures and re-assess risk level.</p>					<p>Frequency</p>					
					<p>Probability</p>					
					<p>Unheard of in the industry*</p>					
					<p>Has occurred once or twice in the industry*</p>					
					<p>Has occurred many times in the industry, but not in the Company*</p>					
					<p>Has occurred once or twice in the Company*</p>					
					<p>Has occurred frequently in the Company*</p>					
					<p>Has occurred frequently at the location*</p>					
					<p>Frequency</p>					
					<p>Probability</p>					
					<p>1 in 100,000 - 1,000,000*</p>					
					<p>1 in 10,000 - 100,000</p>					
					<p>1 in 1,000 - 10,000</p>					
					<p>1 in 100 - 1,000</p>					
					<p>1 in 10-100</p>					
					<p>> 1 in 10</p>					

CONSEQUENCES					IMPACT	LIKELIHOOD					
People (OHS)	Environment	Cost	Community Reputation	Legal Compliance		Rare (6)	Remote (5)	Unlikely (4)	Seldom (3)	Occasional (2)	Likely (1)
Slight Injury /Illness, First Aid	Localized (immediate area) Temporary impact (days)	<A\$100k	Local mention only. Quickly forgotten. Freedom to operate unaffected.	Minimal legal issues. Little or no scrutiny by regulatory authorities. No risk of litigation or fines.	Incidental (6)	Low (11)	Low (10)	Low (9)	Medium (8)	Medium (7)	High (6)
Medical Treatment Case.	Localized (<1 km ²) Short term (weeks) impact	A\$100k - A\$1M	Short term local concern. Some impact on asset level nonproduction activities.	Minor legal issues. Report provided to regulatory authorities. Low risk of litigation and fines.	Minor (5)	Low (10)	Low (9)	Medium (8)	Medium (7)	High (6)	High (5)
Major Injury/illness, Permanent Partial Disability or Lost Time Case	Medium scale (1-10 km ²) Short term (months) impact	A\$1M - A\$10M	National bad mention. Short term regional concern. Close scrutiny of Asset level operations/future proposals.	Serious breach of regulation. Investigation by regulatory authorities. Possible litigation and fines.	Moderate (4)	Low (9)	Medium (8)	Medium (7)	High (6)	High (5)	Severe (4)
1-3 Fatalities (or Permanent Total Disabilities)	Medium scale (1-10 km ²) Short term (months) impact	A\$10M - A\$100M	Medium term national concern. Minor venture or minor asset operations restricted or curtailed.	Major breach of regulation. Major litigation and fines.	Major (3)	Medium (8)	Medium (7)	High (6)	High (5)	Severe (4)	Severe (3)
4-20 Fatalities (or Permanent Total Disabilities)	Large scale (10- 100 km ²) Long term (de) impact	A\$100M - A\$1000M	Persistent national concern. Long term 'brand' impact. Major venture/asset operations severely restricted.	Civil prosecution. Serious litigation, including class actions. Heavy fines.	Severe (2)	Medium (7)	High (6)	High (5)	Severe (4)	Severe (3)	Severe (2)
>20 Fatalities (or Permanent Total Disabilities)	Regional Scale (>100 km ²) Long term/permanent impact	>A\$1000M	International concern. Major ventures terminated. Company at stake	Criminal prosecution. Possible jail sentences for directors and senior officers. Heavy fines for the company.	Catastrophic (1)	High (6)	High (5)	Severe (4)	Severe (3)	Severe (2)	Severe (1)