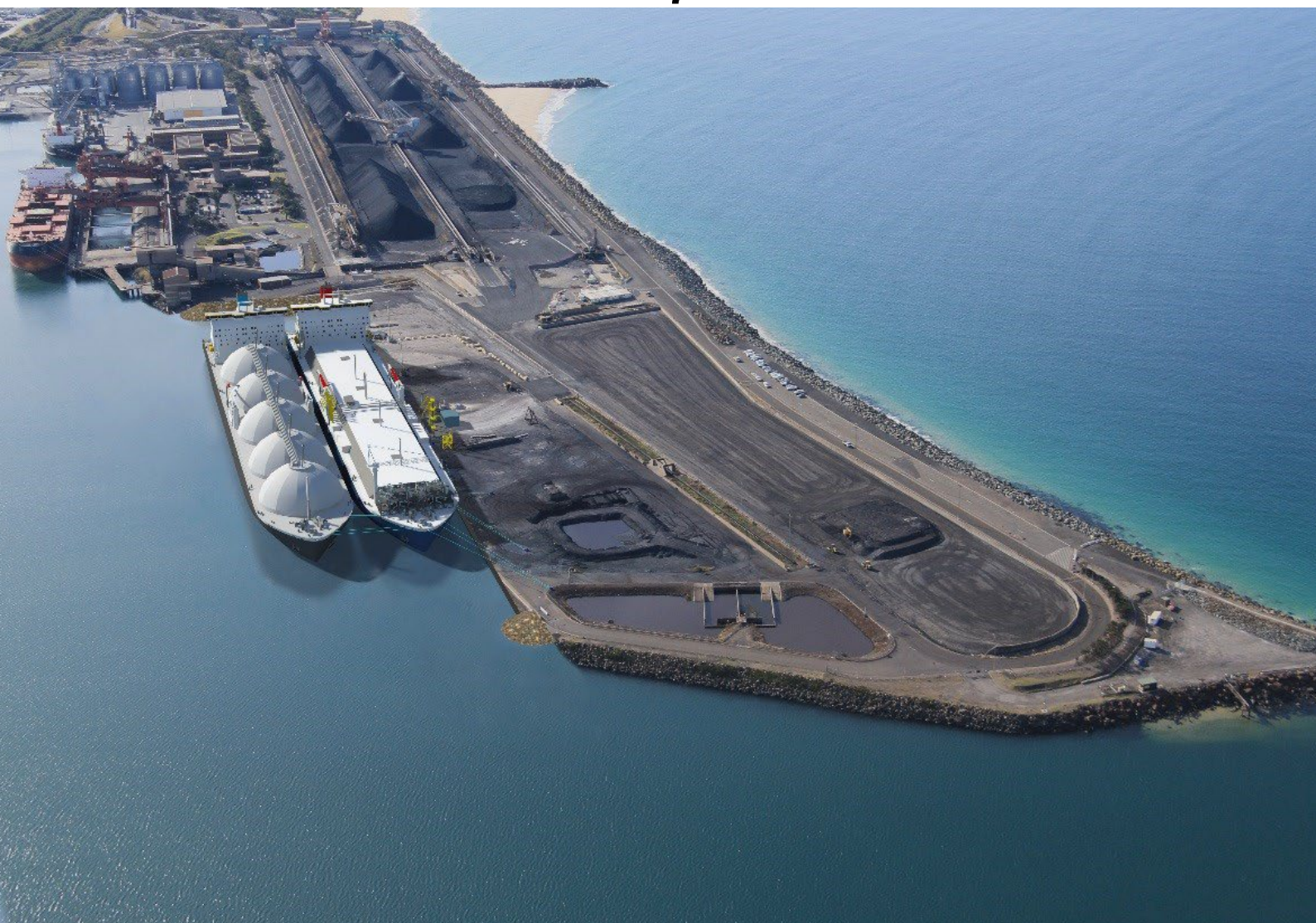
Port Kembla Gas Terminal

Acid Sulfate Soils Management Plan Stage 2B Marine Berth Construction and Dredging – Land and Marine Based

Australian Industrial Energy

10 June 2022

→ **The Power of Commitment**



GHD Pty Ltd | ABN 39 008 488 373
133 Castlereagh Street, Level 15
Sydney, New South Wales 2000, Australia
T +61 2 9239 7100 | **F** +61 2 9239 7199 | **E** sydmail@ghd.com | **ghd.com**

Printed date	17/06/2022 8:27:00 AM
Last saved date	17 June 2022
File name	N:\AU\Sydney\Projects\21\27477\Tech\MP update\Stage 2A\Spoil Management Plan\App A - Acid Sulfate Soils Management Plan\PKGT-AIE-ASSMP-Stage-2A&2B_RevA.docx
Author	Nathan Alexander (Sections 1 to 5) Laurie Fox (Sections 6 to 10)
Project manager	Karl Rosen
Client name	Australian Industrial Energy
Project name	East Coast Gas Project
Document title	Port Kembla Gas Terminal | Acid Sulfate Soils Management Plan
Revision version	Rev D
Project number	2127477
AIE document number	PKGT-AIE-PLN-032

Document status

Rev	Author	Reviewer		Approved for issue		
		Name	Signature	Name	Signature	Date
A	N. Alexander	K. Rosen		K. Rosen		31/03/2022
B	L. Fox / C. Quayle	C. Quayle / K. Rosen		K Rosen		01/04/2022
C	L. Fox / C. Quayle	K. Rosen		K. Rosen		10/05/2022
D	E.K Marsh	K. Rosen		K Rosen		10/06/2022

Contents

Table index

Figure index

Appendices

Abbreviations and definitions

Acronym	Definition
AIE	Australian Industrial Energy
ANC	Acid Neutralising Capacity
AASS	Actual Acid Sulfate Soils
ASS	Acid Sulfate Soils
ASSMAC	Acid Sulfate Soils Management Advisory Committee
ASSMP	Acid Sulfate Soils Management Plan
ASS Waste Guidelines	Waste Classification Guidelines Part 4: Acid Sulfate Soils
Berth 101	MBD Site Compound
$CaCO_3$	Calcium carbonate
CD	Chart Datum
CSSI	Critical State-Significant Infrastructure
DEMP	Dredge and Excavation Management Plan
DP&E	Department of Planning and Environment
DPI - Fisheries	Department of Planning and Industry - Fisheries
ECR	Emplacement Cell Report
EIS	Environmental Impact Statement
EMS	Environmental Management Strategy
EPA	NSW Environment Protection Authority
EP&A Act	Environment Protection and Assessment Act
EPL	Environmental Protection Licence
FEC	Fox Environmental Consulting Pty Ltd
FSRU	Floating Storage and Regasification Unit
GHD	GHD Pty Ltd
H_2O_2	hydrogen peroxide
HM	Harbour Muds
HS	Harbour Silts
HSE	Health, Safety and Environment
KCl	potassium chloride
KPI	Key Performance Indicators
LNG	Liquefied Natural Gas
m^3	Cubic metres
MBD	Marine Berth Construction and Dredging
National ASS Guideline	National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods manual
NGP	National Gas Pipeline
NSW ASS Manual	Acid Sulfate Soil Manual prepared by ASSMAC (1998)
NV	Neutralising Value
OHDSCA	Outer Harbour Dredged Spoil Containment Area
ORF	Onshore Receiving Facilities

Acronym	Definition
PANSW	Port Authority of NSW
PASS	Potential Acid Sulfate Soils
pH_F	Field pH (1:5 soil distilled water ratio):
pH_{FOX}	Field pH following oxidation with hydrogen peroxide (1:5 soil hydrogen peroxide (30%) ratio
pHw	Soil pH measured in water
PKGT	Port Kembla Gas Terminal
PKGT EIS	Port Kembla Gas Terminal Environmental Impact Statement
PKHD	Port Kembla Height Datum
Planning Systems SEPP	State Environmental Planning Policy (Planning Systems) 2021
POEO Act	*Protection of the Environment Operations Act 1997*
PPE	Personal Protective Equipment
QASSTM	Queensland Acid Sulfate Soil Technical Manual
RIS	Reduced Inorganic Sulphur
RL	Reduced level
S	Sulfur
SCR	Chromium Reducible Sulfur
SMEC	SMEC Australia Pty Ltd
SMP	Spoil Management Plan
SPOS	Peroxide oxidisable sulfur
STOS	Total oxidisable sulfur
TAA	Total Actual Acidity
The Project	Port Kembla Gas Terminal Project
TPA	Total Potential Acidity
TSA	Total Sulfidic Acidity
UFP	Unexpected Finds Protocol
WQMP	Water Quality Monitoring Plan

1. Introduction

1.1 Overview

This Acid Sulfate Soil Management Plan (ASSMP) has been developed as a Sub - plan to the Port Kembla Gas Terminal Project (the Project) Spoil Management Plan (SMP). The SMP Sub - plan forms part of the Project's overarching Environmental Management Strategy (EMS). This ASSMP has been prepared by GHD Pty Ltd (GHD) on behalf of Australian Industrial Energy (AIE) to apply to construction activities associated with Stage 2B of the Project. Stage 2B relates specifically to dredging of Berth 101 and placement of materials in the Emplacement Cell. The Stage 2A ASSMP remains applicable to works corresponding to Stage 2A of the Project (refer to Section 2 for a description of these works).

This Stage 2B ASSMP has been prepared by a set of consultants with extensive experience in the identification, treatment, and management of ASS, including team members from GHD and Fox Environmental Consulting Pty Ltd (FEC), to provide the Dredging Principal Contractor management measures and guidance related to the dredging and placement of Acid Sulfate Soils (ASS).

This Plan has been prepared in consultation with the NSW Environment Protection Authority (EPA), Department of Planning and Industry - Fisheries (DPI-Fisheries), NSW Ports, Port Authority of NSW (PANSW) and an EPA accredited contaminated site auditor.

This ASSMP interfaces with the other associated Sub - plans, which together describe the proposed structure for environmental management and monitoring requirements for the Project. This ASSMP addresses the requirements of the Port Kembla Gas Terminal Environmental Impact Statement (PKGT EIS) and associated Infrastructure Approval (SSI 9471) and Environment Protection Licence (EPL) No. 21529.

1.2 Background

AIE is developing the Project which involves the development of a liquefied natural gas (LNG) import terminal at Port Kembla, south of Wollongong, NSW. The Project will be the first of its kind in NSW and will provide a simple and flexible solution to the state's gas supply challenges.

NSW currently imports more than 95 percent of the natural gas it uses from other eastern states. In recent years, gas supplies to the Australian east coast market have tightened, resulting in increased natural gas prices for both industrial and domestic users.

The Project provides an immediate solution to address the predicted shortages and will result in significant economic benefits for both the Illawarra region and NSW. The Project will have a capacity to deliver more than 100 petajoules of natural gas, equivalent to more than 70 percent of NSW gas needs and will provide between 10 to 12 days of natural gas storage in case of interstate supply interruption. LNG will be sourced from worldwide suppliers and transported by LNG carriers to the gas terminal at Port Kembla where it will be re-gasified for input into the NSW gas transmission network.

The Project has been declared Critical State Significant Infrastructure (CSSI) in accordance with Section 5.13 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (NSW) and Schedule 5 of the State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP). The Project received Infrastructure Approval from the Minister for Planning and Public Spaces on 29 April 2019.

The construction of the Project is primarily associated with the establishment of a new berth facility at Port Kembla to enable an LNG carrier to berth alongside the Floating Storage and Re-gasification Unit (FSRU) and new infrastructure to connect the terminal to the existing gas network. Excavation and dredging would be required to establish the new berth facility, with spoil deposited in a cell (referred to as the 'Emplacement Cell') in the Outer Harbour.

The development has progressed to Stage 2A and Stage 2B works located at Berth 101 (referred to as the 'Marine Berth Construction and Dredging (MBD) Site Compound') and the Outer Harbour Dredged Spoil Containment Area (referred to as 'OHDSCA' or the Emplacement Cell). Collectively, these two locations are referred to as "the site".

The Stage 2A works include:

– Completion of excavation works undertaken during Stage 1 (including transport of spoil materials to the Emplacement Cell Construction Site).
– Construction of the quay wall at the MBD Site Compound.
– Construction of Onshore Receiving Facilities (ORF) at the MBD Site Compound (including construction of Wharf Topside Area, Utility Area, and Common Area).
– Installation and commissioning of power, communications, and potable water.
– Installation of gas pipeline within the MBD Site Compound as part of ORF.

The Stage 2B works include:

– Continuation of Stage 2A works (which includes Marine Berth Construction and Dredge 'MBD' site compound).
– Excavation and dredging of the MBD Site Compound in the Inner Harbour and the Emplacement Cell in the Outer Harbour.
– Construction of the Emplacement Cell in the Outer Harbour.
– Marine based construction activities including installation of navigational aids and revetments at the MBD Site Compound.

This ASSMP relates only to Stage 2B works. The Stage 2A ASSMP remains applicable for activities associated with Stage 2A.

1.3 Purpose

This ASSMP has been prepared in accordance with the PKGT EIS and associated Infrastructure Approval (SSI 9471) and EPL No. 21529. It describes how the management measures and commitments in the PKGT EIS, Infrastructure Approval (SSI 9471) and EPL No. 21529 relating to ASS, are to be implemented by the Dredging Principal Contractor during Stage 2B dredging and placement activities.

This ASSMP will address the following, in relation to ASS:

– Occurrence.
– Identification.
– Assessment.
– Disposal.
– Treatment (contingency only).
– Reporting.

AIE and its contractors acknowledge that identification and management of ASS during dredging and placement activities in the vicinity of the Project site is paramount to the successful delivery of the construction phase of the Project. AIE is committed to ensuring this ASSMP is implemented, reviewed, and updated regularly to ensure its objectives are met and that the approval conditions outlined in the Infrastructure Approval (SSI 9471) and EPL No. 21529 are achieved.

This ASSMP is applicable to all staff, employees, subcontractors, and any statutory service authorities undertaking the Stage 2B works described in Section 2 of this ASSMP. The ASSMP implementation and on-going development will be managed by the Project Team (refer to Section 3).

2. Project overview

2.1 Site description

The site of the Project is situated at Port Kembla within the Illawarra region of NSW, about 80 km south of Sydney. Port Kembla is mainly characterised by an existing import and export terminal and multiple other business, cargo, logistics, bulk goods, and heavy industrial facilities in the vicinity.

Port Kembla is situated about 2 km south of the centre of Wollongong. Other localities surrounding Port Kembla and the Project site include Mangerton, Mount St. Thomas and Figtree to the north-west; Unanderra to the west; Berkeley to the south-west; and Cringila, Lake Heights, Warrawong and the residential region of Port Kembla to the south.

The zoned land use in the region includes special use and industrial use at Port Kembla and a mix of primarily residential and commercial uses at the surrounding localities. Major infrastructure in the region of Port Kembla includes the Princes Highway, which is a major state and regional highway connecting Sydney and Wollongong and regional areas further south. Princes Highway provides access to Port Kembla through turnoffs at Masters Road, Five Islands Road and Northcliffe Drive and is broadly utilised including by heavy vehicles from the port.

The South Coast railway line runs along the periphery of Port Kembla including the stations Port Kembla, Port Kembla North, Cringila and Lysaghts. The rail line services commuters and is also used to transport bulk solid goods like coal, grain, copper and steel from Port Kembla. The environmental features of Port Kembla and the surrounding region are limited given the extensive industrial, commercial and residential development. Waterways in the region include the Gurungaty Waterway, Allans Creek, American Creek and Byarong Creek. Green space includes JJ Kelly Park and Wollongong Golf Club to the north and a larger open area to the south-west.

The Project will be predominantly located within land zoned for dedicated port and industrial uses. Berth and wharf facilities, as well as the FSRU, would be situated at Berth 101 at the Inner Harbour, while the gas pipeline would extend around the periphery of port operations from Berth 101 to a tie-in point at Cringila. The Emplacement Cell will be located in the Outer Harbour. A site overview is provided as Figure 2.1.

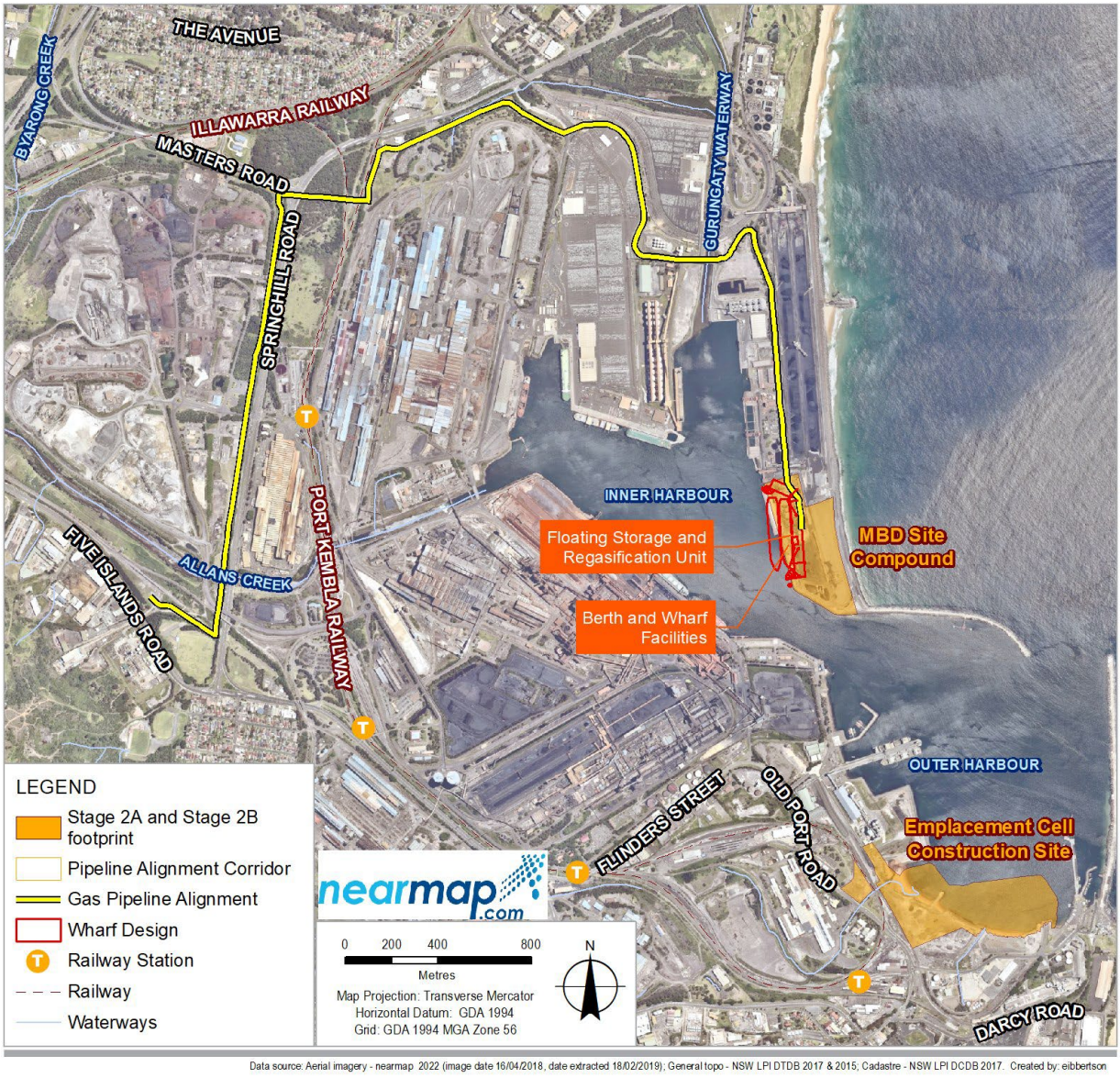


Figure 2.1 Site overview

2.2 Project construction scope of works

The Project construction scope of work has been divided into the three main packages (with associated activities), as outlined in Table .2.1. Construction staging of the Project has been approved in accordance with Condition 3 of Schedule 4 of Infrastructure Approval (SSI 9471) as per correspondence from the Department of Planning and Environment (DP&E) dated 27 October 2021.This ASSMP applies only to the dredging and placement works associated with Stage 2B.

Table .2.1 Construction stages/work packages

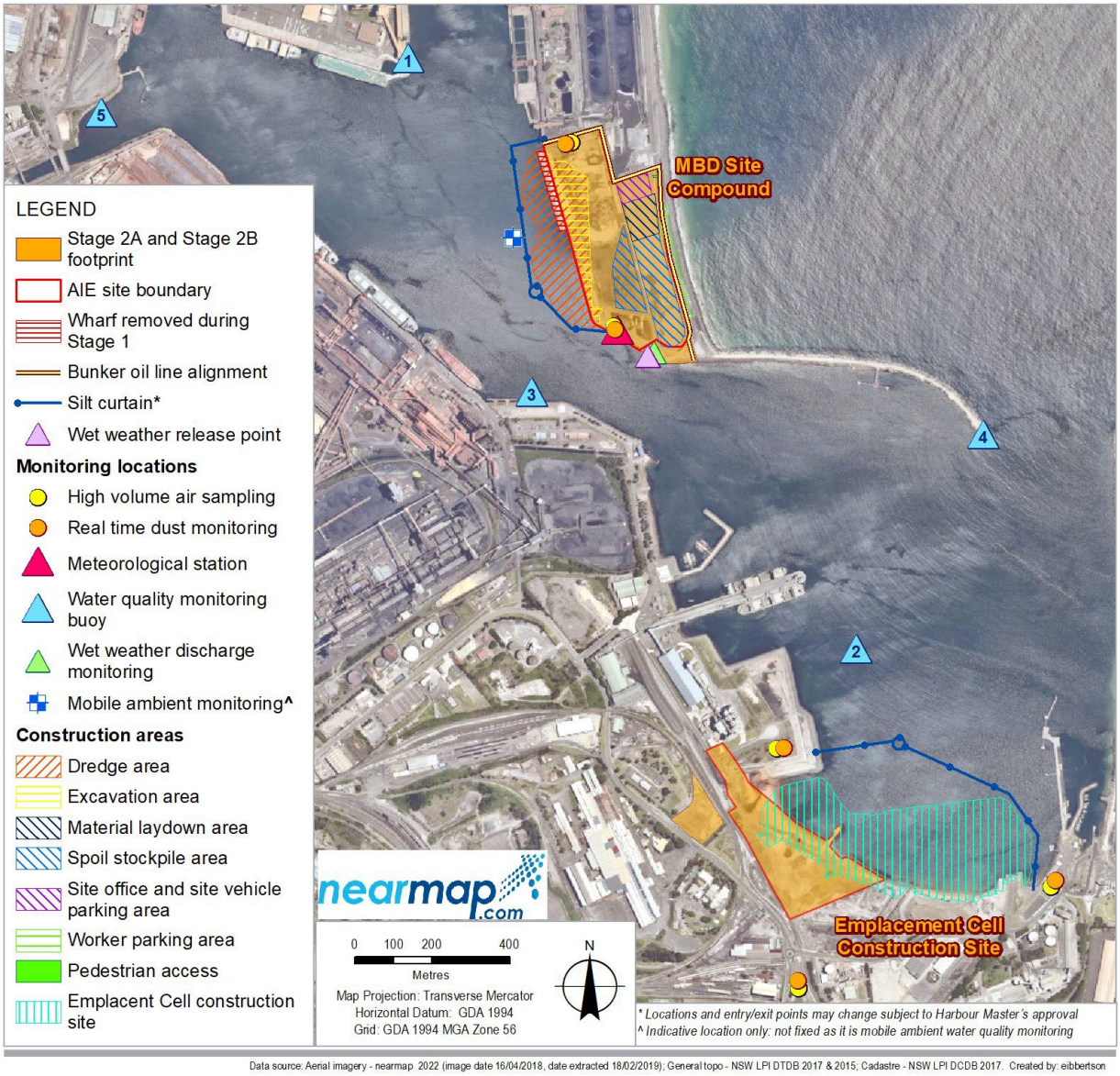
Stage	Package	Proposed commencement	Activities
1	Early Enabling Works	May 2021	Demolition of Berth 101, removal of structures and land based excavation works, and Cone Penetration Testing in the Outer Harbour to inform Emplacement Cell design and relocation of Bunker Oil Pipeline.
2A	Marine Berth Construction – Land Based	January 2022	Completion of excavation works undertaken during Stage 1. Transport of spoil materials to Emplacement Cell Construction Site.
			Quay wall construction.
		February 2022	Installation of communications conduit, potable water line, 11kV power cable, and padmount substation within the MBD Site Compound.
		April 2022	Construction of the ORF, which comprises three areas: Wharf Topside Area; Utility Area; and Common Area.
		June 2022	Pipeline construction and associated ancillary infrastructure within MBD Site Compound.
2B	Marine Berth Construction and Dredging – Land and Marine Based	March 2022	Continuation of Stage 2A with addition of the following activities:
			Excavation/dredging of the MBD Site Compound in the Inner Harbour and construction of the Emplacement Cell in the Outer Harbour
			Marine based construction activities including installation of navigational aids and revetment shore protection.
3	Pipeline Installation including tie-ins (NGP)	June 2022	Construction of an 18” onshore natural gas pipeline approximately 6.3km in length from the Berth 101 site boundary to tie-in facility at Cringila for connection to the Eastern Gas Pipeline. Pipeline construction to occur concurrently with Jemena, subject to separate set of management plans.

*Indicative dates and may be subject to change.

The following will be undertaken as part of the Stage 2B land and marine-based works:

– Continuation of some Stage 2A works.
– Installation of site facilities and preparatory earthworks at Emplacement Cell Construction Site.
– Marine-based construction activities including installation of silt curtains, navigational aids, and revetment shore protection at the MBD Site Compound.
– Construction of the Emplacement Cell in the Outer Harbour.
– Excavation and dredging of the MBD Site Compound in the Inner Harbour.

An outline of the tasks associated with Stage 2B is provided in Section 2.3. The site includes the MBD Site Compound, the Emplacement Cell Construction Site, and the Emplacement Cell located in the Outer Harbour. The location of the Stage 2B works is shown in Figure 2.2. The layout of the MBD compound is provided in Figure 2.3 and Figure 2.4 shows the Emplacement Cell detail.



.

Figure 2.2 Stage 2A and Stage 2B works and location of MBD Site Compound, Emplacement Cell and Emplacement Cell Construction Site

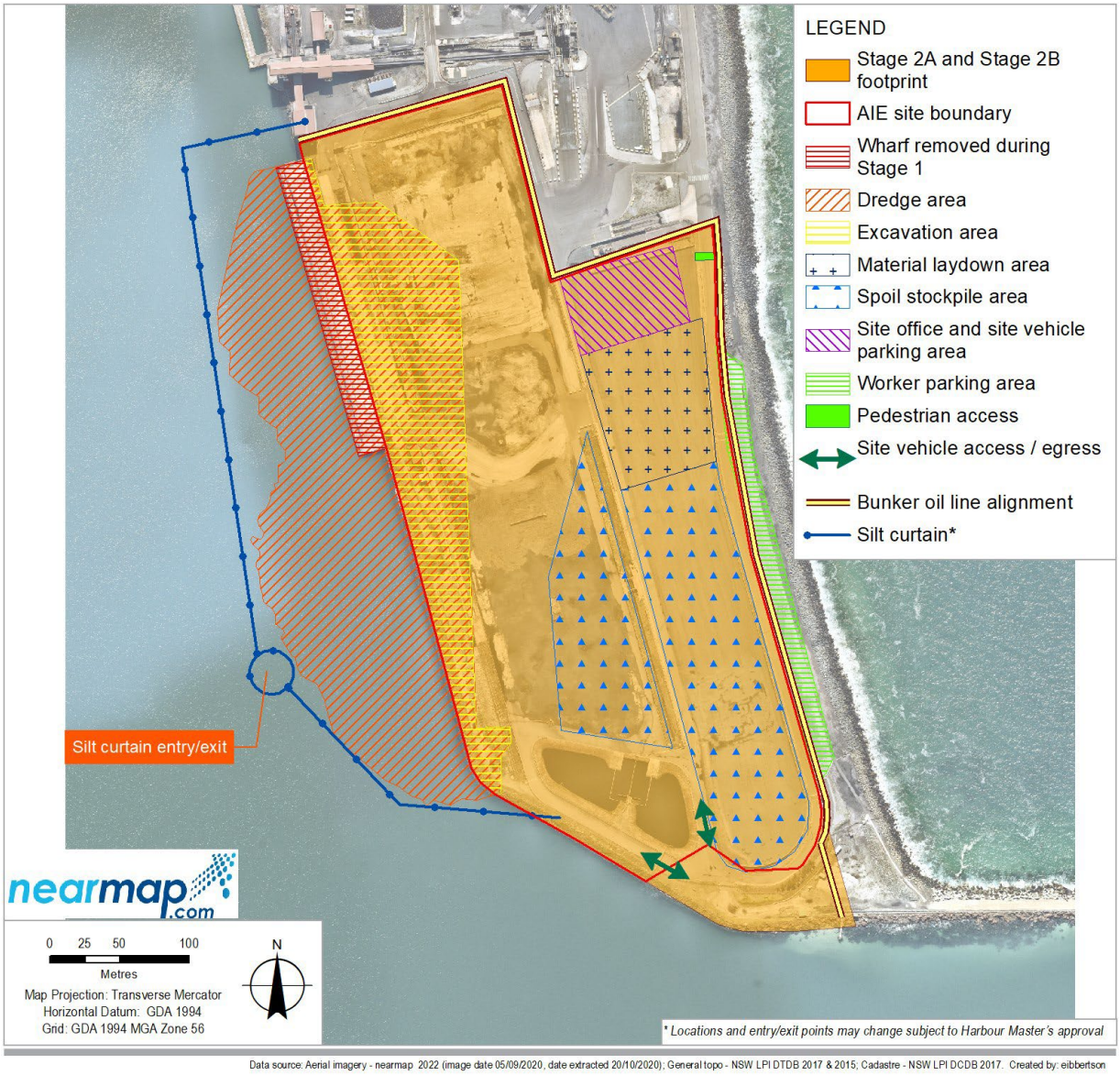


Figure 2.3 Layout of MBD Site Compound

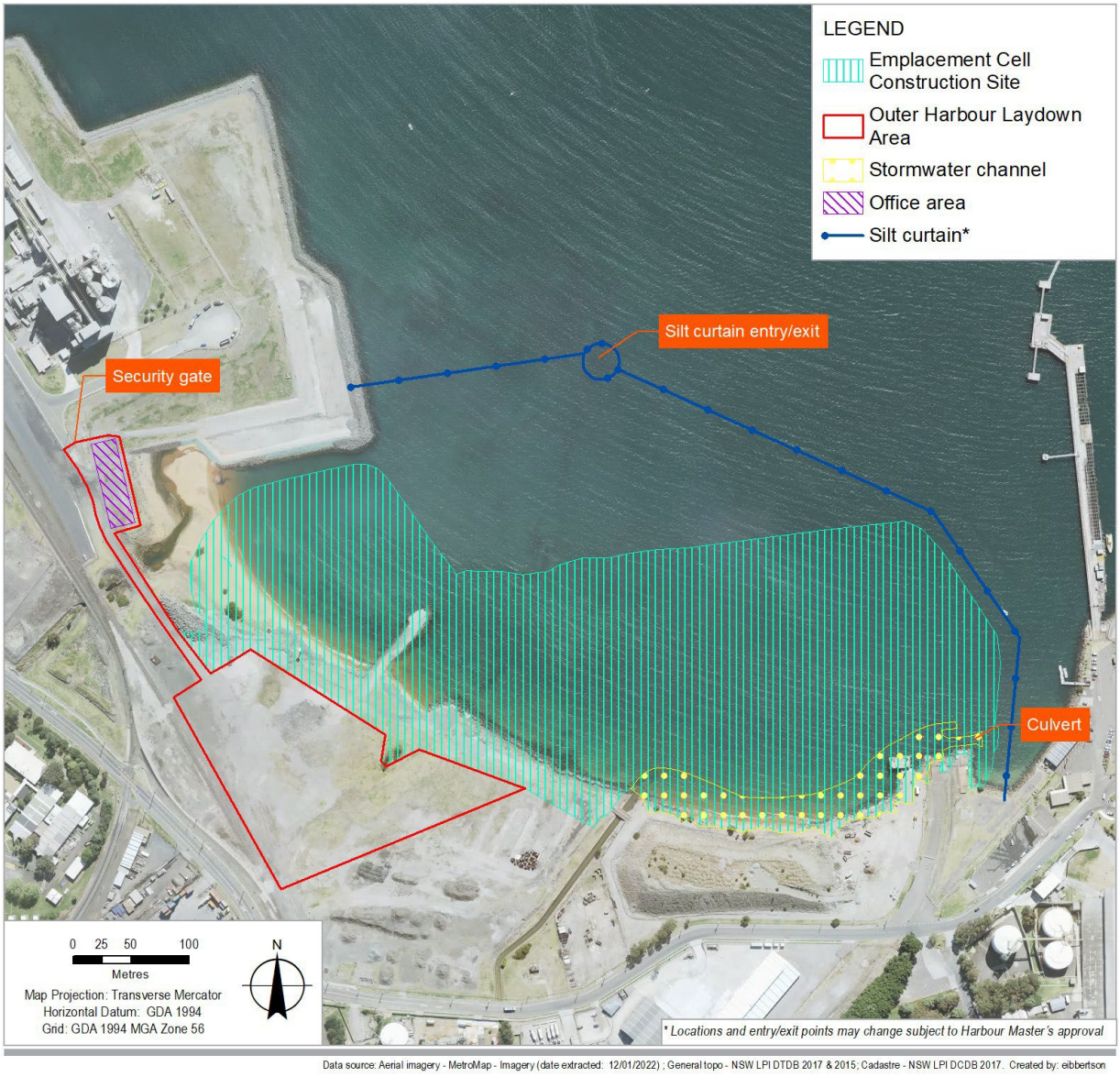


Figure 2.4 Layout of Emplacement Cell Construction

2.2.1 Program

The Stage 2A works commenced in January 2022. Stage 2B, which includes the continuation of land-based construction and marine-based works, are then anticipated to commence in March 2022 (refer to Table .2.1 for construction staging). As noted in Section 2.2, these dates are only indicative and may be subject to change.

2.3 Stage 2B: Excavation and dredging

An Emplacement Cell Report (ECR) has been developed by SMEC Australia Pty Ltd (SMEC) titled 'Port Kembla Gas Terminal Development – Emplacement Cell Report (2022)' in accordance with Infrastructure Approval (SSI 9471) Schedule 3, Condition 8 and 9. The ECR (SMEC, 2022) outlines the design and construction methodology of the Emplacement Cell.

Approximately 450,000m^3 of materials will be excavated/dredged from the MBD Site Compound and placed within the boundaries of the Emplacement Cell. Further details, including detailed design drawings, can be found in the ECR (SMEC, 2022). A summary of the excavation and dredging works is provided in Section 2.3.2 and Section 2.3.3.

2.3.1 Silt curtains

Prior to the commencement of dredging activities, silt curtains will be installed within the Inner Harbour (MBD Site Compound) and Outer Harbour (Emplacement Cell). A fixed gate or bubble curtain gate will be installed to allow for the entrance and exit of barges whilst also controlling the dispersion of silt.

Silt curtains will be suitable for tidal and working harbour conditions.

Navigation and special markers will be installed to the satisfaction of the Harbour Master to alert marine vessels operating in the port harbours of the presence of silt curtains and any other risks to navigation.

Further information regarding the use of silt curtains is provided in the Dredge and Excavation Management Plan (DEMP) for Stage 2A and Stage 2B.

2.3.2 Excavation and dredge staging

Construction activities undertaken during Stage 1 involved the excavation of fill materials at the MBD Site Compound. Excavation has continued through Stage 2A and will continue as part of Stage 2B. On completion of existing fill materials being excavated, dredging operations will commence at the MBD Site Compound as part of the Stage 2B works.

Dredging activities at the MBD Site Compound and Emplacement Cell will be staged to accommodate other construction works occurring at the MBD Site Compound.

Construction staging for excavation and dredging activities to be undertaken are summarised in the ECR (SMEC, 2022). Excavation and dredging at the MBD Site Compound is shown in Figure 2.5. An overview of the Emplacement Cell is shown in Figure 2.6.

2.3.3 Marine-based construction activities at MBD Site Compound

Marine based construction works required at the MBD Site Compound during Stage 2B are summarised in Table 2.2.

Table 2.2 Marine based construction works during Stage 2B

Component	Works required
Navigational aids	– Construction of new navigation aid pile through the new southern revetment. – Installation of navigation platform, tower, and lights, including all access requirements such as ladders, platforms, and handrails. – Lights will be battery powered and charged via solar panels. – Existing navigation aid to be removed after the commission of the new navigation aid.
Revetment shore protection	– Revetments will be constructed at the north and south embankments of the new MBD Site Compound wharf (refer to Figure 2.5) following completion of dredging works. – Works will comprise: • Laydown of Texcel 1200R geotextile. • Placement of thick quarry run to a depth of 190mm. • Placement of underlay rock to a depth of 400mm. • Placement of armour rock to a depth of 900mm.
Revetted Trench	– Dredging of an approximate 10x10m trench to -14.5 reduced level (RL) Port Kembla Height Datum (PKHD) for accommodating the under-keel requirements of the FSRU strainers. An approach channel may also be required. – The trench should have sufficient scour protection.
Berthing box	– Dredging will be undertaken to facilitate berthing boxes to be constructed.

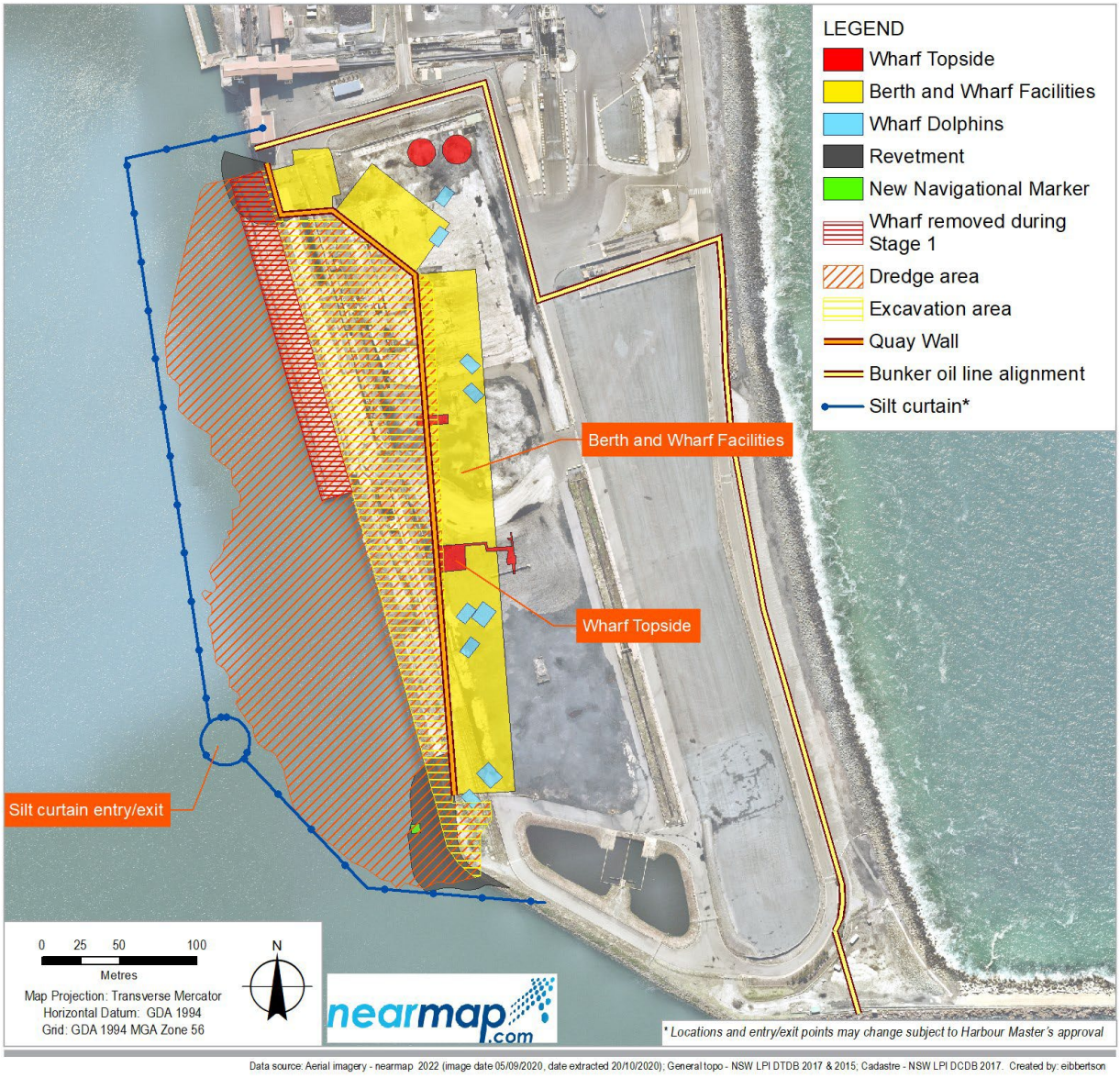


Figure 2.5 Dredging and excavation works for MBD Site Compound (Stage 2B)

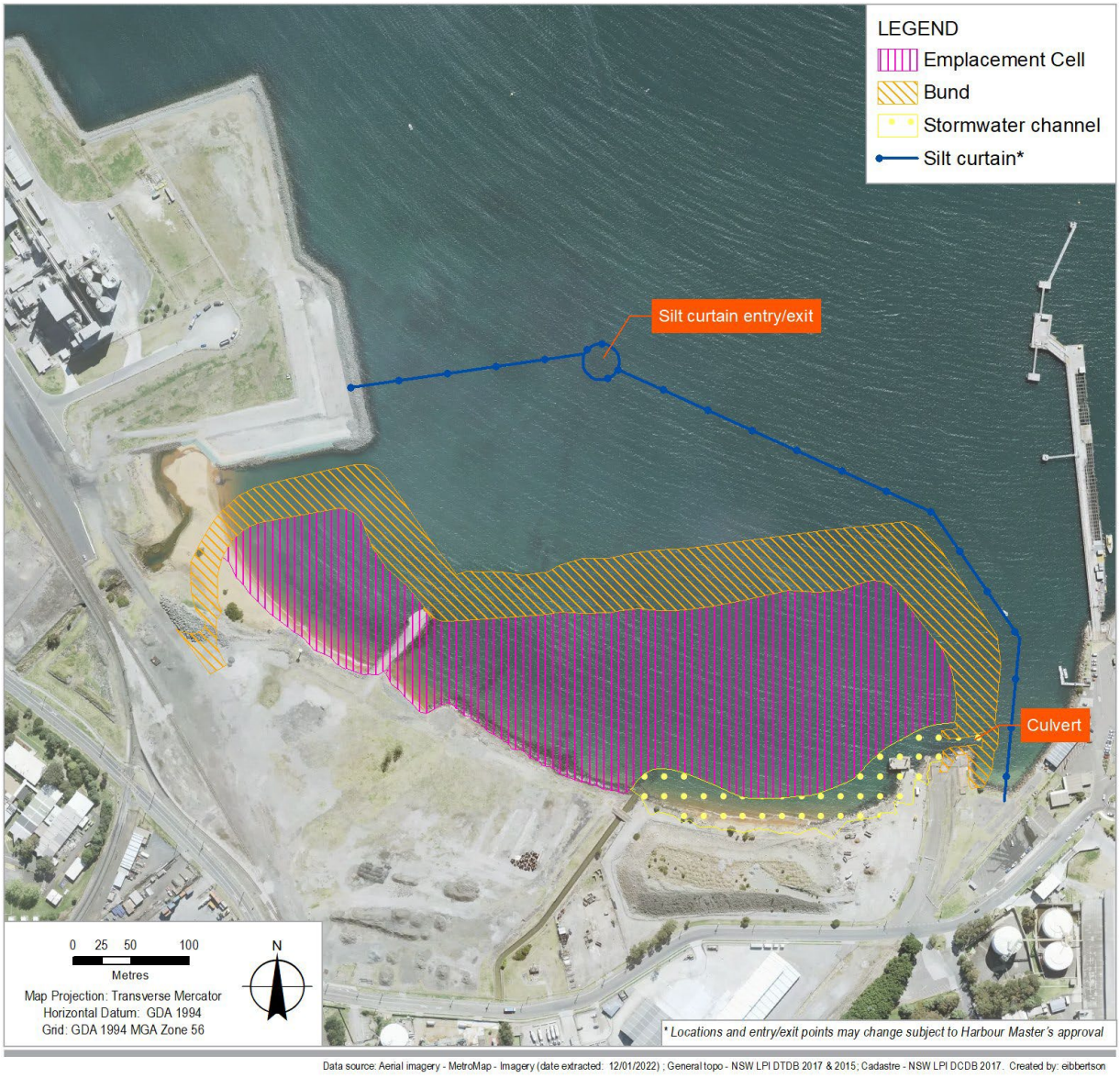


Figure 2.6 Emplacement Cell overview (Stage 2B)

2.4 Stage 2B: Construction of the Emplacement Cell

The Emplacement Cell will be located within the Outer Harbour, comprising of an approximate 800 m perimeter bund. The Emplacement Cell has been designed and constructed to receive approximately 450,000 m³ of dredged materials from the MBD Site Compound. All contaminated materials including Harbour Muds (HM)/Harbour Silts (HS) will be placed below -1 m PKHD and in no instances above the Lowest Astronomical Tide (LAT) ~-0.02m PKHD and Potential Acid Sulfate Soils (PASS) will be placed below +0.9m PKHD within the Emplacement Cell.

The construction work components and key features of the Emplacement Cell are summarised in Table 2.3. An overview of the Emplacement Cell is shown in Figure 2.6. Further details are provided in the ECR (SMEC, 2022).

Table 2.3 Emplacement Cell key features – Stage 2B

Component	Description
Emplacement Cell	– All contaminated soils, including HM/HS will be placed within the Emplacement Cell generally below lower than -1.0m PKHD and in no instances above the LAT (~-0.02m PKHD). – PASS will be placed below +0.9m PKHD within the Emplacement Cell. – The final Emplacement Cell levels will be graded towards the proposed stormwater channel. – Design life of 15 years.
Perimeter bund	– The design bund crest level was derived based on tide, storm surge, sea level rise and wave overtopping and assumed to be +3.55m PKHD. The adopted crest level also includes allowance for assessed post-construction settlement of up to 250mm. – Minimum crest width of 6m and 11m at passing bays. – Maximum permanent batter slopes of 1V:3H for seaward slopes and 1V:2H for landward/internal slopes. – The bund is to accommodate a 110t long reach excavator, fully loaded semi-trailer and temporary material stockpiles.
Rock revetment	– Rock revetment structure will extend to the toe of the main bund to provide protection to the bund structure against coastal processes.
Stormwater channel	– Stormwater channel to extend from the existing Darcy Road drain outlet to the eastern side of the Emplacement Cell. – Stormwater channel outlet is to comprise a box culvert structure on the eastern end of the Emplacement Cell, providing vehicular access onto the bund at the Jetty 3 abutment and within the NSW Ports property boundary.

3. Roles and responsibilities

The Project Team is responsible for all activities associated with Stage 2B, including the implementation and maintenance of the various mitigation/management measures outlined in this ASSMP. Relevant roles and responsibilities of the Project Team are outlined in Table 3.1.

Table 3.1 Roles and responsibilities for ASS Management

Project Role	Responsibility
AIE Project Director	– Responsible for the overall funding and direction of works associated with Stage 2B. – Ensuring provision of adequate resources to achieve the environmental objectives for the Project including ensuring sufficient resourcing for the Environmental Team, Engineering and Construction Teams.
AIE Construction Manager	– Proactively stewards the effective implementation of Stage 2B in accordance with requirements of the Infrastructure Approval (SSI 9471), this ASSMP, Environmental Strategy, and all related Sub - plans. – Demonstrate proactive support for ASS and environmental requirements.
AIE HSE Manager	– Develop and update all Health, Safety and Environmental (HSE) Management Strategies and Sub - plans. – Ongoing liaison and engagement with government agencies and point of escalation for any environmental incidents. – Identifying environmental issues as they arise and proposing solutions. – Coordinate and facilitate periodic environmental inspections with the key contractors. – Environmental Reporting.
AIE Environmental Representative	– Develop strong working relationships with the Principal Contractor Team and sub-contractors. – Ensure ASS and environmental risks are appropriately identified, communicated, and effectively managed. – Instruct and advise management team on compliance issues. – Provide specialist ASS advice and input as required. – Conduct audit review as required and co-ordinate internal audits of this ASSMP. – Reports on the performance of this ASSMP and recommends changes or improvements to Project Manager. – Orders STOP WORK for any ASS breaches and immediately reports incidents to the AIE Construction Manager. – Conducts investigation and response to soil and water quality complaints arising from the implementation of the ASSMP and inquiries, where required. – Liaise and seek input from appropriately experienced ASS consultant(s) when uncertainty arises
Emplacement Cell Auditor	– Audit the construction of the Emplacement Cell and verify that works have been completed in accordance with the design intent (Emplacement Cell), The auditor role is to satisfy Condition 10 Schedule 3 of the Infrastructure Approval and any other relevant conditions therein.
Stage 2B Principal Contractor Project Manager	– On-site Project management and control. – Decision-making authority relating to environmental performance of the construction program. – Authority over Project construction and site activities in accordance with the EMS and ASSMP. – Ensure relevant training is provided to all Project staff prior to commencing individual activities. – Reports to AIE Construction Manager on ASS and environmental matters. – Ensures appropriate Contractor resources are allocated to implement the ASS and environmental requirements.

Project Role	Responsibility
	– Responsible for planning and scheduling of construction, and to ensure operations are conducted in accordance with statutory requirements, the ASSMP and the EMS. – Monitors performance against environmental Key Performance Indicators (KPI's). – Ensures that all ASS and environmental objectives associated with the Project are achieved. – Day-to-day decision-making authority relating to ASS and environmental performance of construction activities and direct site activities and construction. – To provide resources to ensure environmental compliance and continuous improvement. – Ensure all personnel are aware of any changes to EMS, this ASSMP and improved procedures. – Ensure this ASSMP is implemented for the duration of Stage 2B.
Stage 2B Principal Contractor Construction Foreman	– Implement requirements contained in the EMS and Sub - plans, work procedures and standard drawings. – Maintaining open and transparent communication with other Project discipline managers and other areas of the Project. – Reporting of hazards and incidents and implementing any rectification measures. – Ensures appropriate contractor resources are allocated. – Orders STOP WORK for any environmental breaches and reports incidents to the Project Manager. – Ensure this ASSMP is implemented for the duration of Stage 2B.
Stage 2B Principal Contractor Environmental Representative	– Delivers ASS and environmentally focussed toolbox talks and provides applicable site inductions and training. – Provides ASS and environmental advice, assistance, and direction to Project Manager to ensure construction activities are conducted in accordance with regulatory legislation and this ASSMP. – Participate and cooperate with AIE HSE Manager with regards to undertaking of joint ASS and environmental site inspections. – Coordinate / undertake wet-weather inspections as per EPL No. 21529 and report accordingly to the AIE HSE Manager. – Develop strong working relationships with the AIE team and ASS Consultants (if engaged). – Ensure ASS and environmental risks are appropriately identified, communicated, and effectively managed. – Ensure communication of relevant ASS and environmental information to Project personnel. – Provide specialist advice and input as required. – Ensure construction manager, superintendents and field supervisors fully understand the environmental constraints and how construction practices must ensure any such constraints are considered and mitigated against during construction. – Orders STOP WORK for any environmental breaches and immediately reports incidents to Principal Contractor Project Manager and AIE HSE Manager.
Independent ASS Consultants	– Required on an as needed basis or as specialist advisors to AIE during dredging and placement
Subcontractors and construction personnel	– Undertake an environmental induction and training in the identification of ASS prior to accessing to site. – Comply with legislative requirements. – Participate in inspections and audits. – Follow ASS and environmental procedures. – Report all ASS and environmental incidents and hazards. – Introduce ASS and environmental topics to prestart meetings. – Ensure that all relevant permits and clearances are in place prior to commencing work.

4. Legislative requirements

AIE and the Principal Contractor are committed to compliance with legislative requirements and industry standards throughout all their activities for Stage 2B. Management and monitoring of ASS materials will be carried out in accordance with the relevant NSW legislation and regulations. Applicable NSW guidelines supplemented by other relevant State and National ASS guidance will also be followed which include, but are not limited to, those listed in Table 4.1.

Table 4.1 Legislation and relevant guidelines applicable to this ASSMP

Legislation and Regulation	Description	Applicability
State		
Protection of the Environment Operations Act 1997 (POEO Act)	The objectives of the POEO Act are to protect and enhance the environment of NSW with regard to the need for ecologically sustainable development. The Act provides the statutory framework for managing pollution in NSW, including the procedures for issuing licences for environmental protection on aspects such as waste, air, water, and noise pollution control. Companies and property owners are legally bound to control emissions (including particulates and deposited dust) from construction sites under the POEO Act.	Exposure of PASS to oxygen has the potential to result in acid leachate which may constitute a pollution event in not managed appropriately.
Guidelines		
National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods and Dredging of ASS sediments and Spoil Management Guidance manual (Sullivan, Ward, Toppler, & Lancaster, 2018a)(National ASS Guideline)	The National ASS Guideline provides technical and practical advice regarding the identification and sampling of ASS in both the field and prior to investigations being undertaken. Requirements of ASS investigation stages are detailed in Section 8, including sampling procedures and indicators.	The good practice management guidance provided in the National ASS Guideline has been implemented into this ASSMP.
Acid Sulfate Soil Manual (ASSMAC, 1998)(NSW ASS Manual)	The NSW ASS Manual was developed by the Acid Sulfate Soils Management Advisory Committee (ASSMAC) and forms the overarching approach to the management of ASS in NSW. The Manual provides management guidelines, assessment guidelines and management plan guidelines.	As per the Infrastructure Approval (SSI 9471) Schedule 3, Condition 6, the management of ASS during construction of the Project must be undertaken in accordance with the NSW ASS Manual. This ASSMP has been prepared in accordance with the assessment guidelines outlined in the NSW ASS Manual (ASSMAC, 1998).
Queensland Acid Sulfate Soil Technical Manual (QASSTM, 2014): Soil Management Guidelines. (Dear, et al., 2014)	The QASSTM provide best practice management procedures for a variety of ASS scenarios.	Where the NSW ASSMAC guidelines do not provide guidance and/or management procedures have been superseded, use has been made of the 2014 QASSTM.
*Waste Classification Guidelines Part 4: Acid Sulfate Soil*s (NSW EPA, 2014)(ASS Waste Guidelines)	The ASS Waste Guidelines are developed by the NSW EPA and provide 'best practice' guidance for planning, assessing and managing activities in areas prone to developing ASS. The guidelines apply to ASS which are unable to be managed on-site and provides guidance for off-site disposal requirements.	Disposal of ASS materials will be undertaken in accordance with the ASS Waste Guidelines (NSW EPA, 2014).

5. Planning requirements

5.1 Conditions of approval

The planning requirements and the corresponding ASS management measures applicable to Stage 2B are listed in Table 5.1. Management measures are detailed in Section 8.

The planning requirements include the conditions set out in the Infrastructure Approval (SSI 9471) dated 13 October 2021 and the mitigation/management measures outlined in the PKGT EIS (GHD, 2018b).

Table 5.1 Planning requirements

Requirement	Reference	Responsibility	Evidence	Applicability to this ASSMP
Infrastructure Approval Requirements (SSI 9471)				
Acid Sulfate Soils The Proponent must ensure that any construction activities in identified areas of ASS risk are undertaken in accordance with Acid Sulfate Soil Manual (ASSMAC, 1998).	Schedule 3, Condition 6	– AIE HSE Manager – Stage 2B Principal Contractor Project Manager	This plan	Applicable
Prior to the commencement of construction, the proponent must prepare a SMP to the satisfaction of the Planning Secretary and in consultation with the EPA, DPI - Fisheries, NSW Ports, PANSW and an EPA accredited contaminated site auditor. The plan must be consistent with the ECR and include: (b) A DEMP that: – includes an investigation of all reasonable and feasible measures to reduce the road haulage of spoil – describes all activities to be undertaken during dredging, excavation and disposal works – describes in detail the location and depth of disposal areas during all stages of construction, including the final form of the emplaced material – includes procedures for handling, transporting, storing and disposing of dredge and excavated material, including: • potentially acid forming material • contaminated material • asbestos containing materials; and – includes a description of measures that would be implemented to: • minimise the generation and dispersion of sediments during dredging and disposal • minimise soil erosion and discharge of sediment and other pollutants to lands and/or Port Kembla harbour • monitor and manage odours and air emissions during handling of sediments or from stored material prior to emplacement within the disposal area; and – includes contingency measures in the event of a failure of the silt curtain.	Schedule 3, Condition 11(b)	AIE HSE Manager	Refer to DEMP Section 6.4 Section 7 Section 8.5	Applicable
PKGT EIS Management Measures				
Preparation of an ASSMP by a consultant experienced in the identification and management of ASS. This will also include appropriate management and/or treatment of ASS. The ASSMP will be developed in line with the requirements of the Acid Sulphate Soils Management Advisory Committee Guidelines (ASSMAC, August 1998 and as updated). The ASSMP will be prepared to identify, manage and treat the ASS encountered during excavation and dredging to minimise the production of acid leachate.	EIS Measure C04	– AIE HSE Manager – Environmental Consultant	This plan	Applicable

6. ASS occurrence and risk

6.1 Acid sulfate soils

ASS naturally occur in soil and sediment that contain, predominantly, iron sulfides. When these sulfides are disturbed and exposed to air, oxidation can occur, producing sulfuric acid. Unoxidised sulfidic soils are commonly referred to as PASS. These are typical of marine sediments formed below water, such as in Port Kembla.

The 1:25,000 Port Kembla ASS Risk Map (DLWC, 1997) indicates that Berth 101 (in red outline) is situated in an area mapped as disturbed terrain at an elevation greater than 4 m (shown in grey shading) (refer to Figure 6.1).

Estuarine sediments exist within the Port Kembla Harbour and are mapped as high probability of ASS. The MBD Site Compound was constructed using fill comprising of sediments originally dredged from the Inner Harbour, which were subsequently placed over existing marine sediments containing ASS.

Figure 6.1 ASS risk map

6.2 Stratigraphic units

Based on previous investigations by GHD and Worley Parsons in 2018 and 2021, six stratigraphic units were defined within Berth 101 and one unit termed HM and HS was identified within Port Kembla. Sandstone/siltstone bedrock is described in the ECR (SMEC, 2022) and have been encountered at 16 m below PKHD with no bottom depth recovered. Materials encountered during the GHD and Worley Parsons investigations and in the ECR (SMEC, 2022) are summarised in Table 6.1 below. Visual examples for Unit 1A, Unit 1B and Unit 2 are shown in Photo 1 to Photo 4 below.

Table 6.1 Site specific subsurface conditions

Unit	Generalised description
Fill	Gravelly sand, sand, silt, black, dark brown, grey, some to trace, silts and cobbles. Foreign materials, coalwash, coal, slag, steel, wood, concrete.
Unit 1A	SAND, brown, pale brown, yellow, orange, fine to coarse grained, trace amounts of shell fragments, fine to coarse gravel, silt bands and layers, clayey sand layers, trace iron stained sand, fine black sand layers (probable heavy mineral sands), rounded to sub-rounded gravel, clay lenses and layers. Foreign materials: charcoal, wood and coal.
Unit 1B	SAND pale grey to pale brown, fine- to medium-grained occasional coarse-grained SAND. Clayey SAND, black, dark grey, grey, fine to coarse grained sand, medium to high plasticity clay, trace silt, shell fragments, gravel.
Unit 2	Sandy CLAY and CLAY, brown, grey, high plasticity, trace of fine coarse grained, trace of gravel, rounded cobbles. Silty SAND, dark brown, grey, black, fine to coarse sand, trace of fine gravel, shell fragments
Unit 3	Sandy CLAY with lesser amounts of Silty CLAY, Silty/Clayey SAND and CLAY SILTSTONE with lesser amounts of Sandy
Unit 4	SILTSTONE, Silty SANDSTONE and SANDSTONE
Harbour Muds (HM) and Harbour Sediments (HS)	Upper unit black-brown clayey silt mud (HM) with coarse sand and gravel sized coal and lower unit of grey silty clay (HS).

GHD carried out ASS sampling and analysis of the stratigraphic units within the MBD Site Compound and its surrounds (GHD, 2018a) (GHD, 2022a). The report found dark grey clayey sands and gravelly clays occurring as discrete layers within Units 1A and 1B called “Unit 1C”. Following consultation with the design team and the Dredging Principal Contractor, it was considered impractical because of the discrete nature, to segregate the Unit 1C material from Unit 1A and Unit 1B. As there will be no segregation, the use of the term ‘Unit 1C’ has been discontinued.

Photo 1: Example of Unit 1A

Photo 2: Example of Unit 1B

Photo 3: Example of Unit 1B occurring as a thin layer in Unit 1A

Photo 4: Example of Unit 2 – estuarine

6.3 Laboratory results

ASS assessments of the dredged materials included GHD investigations in 2018 and 2021. A total of 169 samples were collected from 49 borehole locations that were generally positioned on a grid approximately 20 m to 40 m apart. Based on laboratory results and geospatial distribution of RIS concentrations in the units assessed, GHD considered that the 169 samples sufficiently represented the vertical and spatial distribution of ASS at the site and were in line with the National ASS Guidelines (Sullivan, Ward, Toppler, & Lancaster, 2018a).

A summary of the laboratory results per stratigraphic units is provided in Table 6.2 below. The full results and laboratory reports are presented in GHD ASS Factual Report (GHD, 2022a).

Table 6.2 Summary of Laboratory Results for Dredged Sediments

Unit	Generalised description	No of Samples	pH $_{KCL}$	TAA (%S)	Scr (% S)	Net Acidity (% S)	ANC % (%$SCaCO_3$)	Estimated Volume (m^3)[1]	ASS Risk category
Fill	Gravelly sand, sand, silt, black, dark brown, grey, some to trace, silts and cobbles. Foreign materials, coalwash, coal, slag, steel, wood, concrete.	13	Range: 9.0 to 9.8 Average: 9.6 Median: 9.6	<0.02	Range: 0.005 to 0.020 Average: 0.008 Median: 0.007	Range 0.02 to 0.02 Average 0.02 Median: 0.02	Range: 0.44 to 2.50 Average: 1.41 Median: 1.40	20,667	Non ASS
Unit 1A	SAND, brown, pale brown, yellow, orange, fine to coarse grained, trace amounts of shell fragments, fine to coarse gravel, silt bands and layers, clayey sand layers, trace iron stained sand, fine black sand layers (probable heavy mineral sands), rounded to sub-rounded gravel, clay lenses and layers. Foreign materials: charcoal, wood and coal.	57	Range: 8.4 to 10 Average: 9.6 Median: 9.7	<0.02	Range: 0.005 to 0.330 Average: 0.022 Median: 0.012	Range 0.02 to 0.02 Average 0.02 Median: 0.02	Range: 0.14 to 4.42 Average: 2.33 Median: 2.39	98,506	Low Risk
Unit 1B	SAND pale grey to pale brown, fine to medium-grained occasional coarse-grained SAND. Clayey SAND, black, dark grey, grey, fine to coarse grained sand, medium to high plasticity clay, trace silt, shell fragments, gravel (former Unit 1C material)	42	Range: 6.6 to 9.7 Average: 8.2 Median: 8.1	<0.02	Range: 0.005 to 0.201 Average: 0.036 Median: 0.025	Range:0.02 to 0.03 Average 0.02 Median 0.02	Range: 0.03 to 2.42 Average: 0.20 Median: 0.09	123,239	Low Risk

Unit	Generalised description	No of Samples	pH $_{KCL}$	TAA (%S)	Scr (% S)	Net Acidity (% S)	ANC (%$SCaCO_3$)	Estimated Volume (m^3)[1]	ASS Risk category
Unit 2	Sandy CLAY and CLAY, brown, grey, high plasticity, trace of fine coarse grained, trace of gravel, rounded cobbles. Silty SAND, dark brown, grey, black, fine to coarse sand, trace of fine gravel, shell fragments.	24	Range: 5.5 to 8.3 Average: 6.3 Median: 6.2	<0.02	Range: 0.005 to 1.250 Average: 0.474 Median: 0.510	Range 0.02 to 1.26 Average:0.44 Median 0.047	Range: 0.10 to 0.78 Average: 0.29 Median: 0.18	110,020	High Risk
Unit 3	Sandy CLAY with lesser amounts of Silty CLAY, Silty/Clayey SAND and CLAY SILTSTONE with lesser amounts of Sandy SILTSTONE, Silty SANDSTONE and SANDSTONE (Unit 4)	31	Range: 5.5 to 8.2 Average: 6.6 Median: 6.4	<0.02	Range: 0.007 to 0.454 Average: 0.060 Median: 0.016	0.02 to 0.45 Average: 0.06 Median: 0.02	Range: 0.05 to 0.41 Average: 0.20 Median: 0.20	10,992	Non coastal ASS (sulfidic residual soil and pyrite in weathered rock)
HM and HS	Upper unit black-brown clayey silt mud (HM) with coarse sand and gravel sized coal and lower unit of grey silty clay	14	Range: 8.2 to 9.0 Average: 8.50 Median: 8.50	<0.02	Range 0.103 to 6.29 Average: 0.92 Median: 0.22	Range <0.02 to 4.85 Average: 2.49 Median: 2.49	Range 2.7 to 38.8 Average: 8.05 Median: 5.11	52,599	High Risk
Action Criteria				0.03	0.03	0.03			

Notes:
[1] Estimated volumes from ECR (SMEC, 2022)Table 5.2 and do not include a bulking factor
TAA Total Actual Acidity
ANC Acid Neutralising Capacity
Scr Chromium reducible sulphur
Net Acidity includes ANC

6.4 ASS / PASS materials to be managed during Stage 2B

6.4.1 General

The soil to be dredged consists of sand, clayey sand, clay, silt and some weathered rock. Details regarding the dredging operations to be performed during Stage 2B works are outlined in the Stage 2A and Stage 2B DEMP and ECR (SMEC, 2022).

Dredge volume estimates for the various materials are summarised in Table 6.3 (based on Table 5.3 from the ECR (SMEC, 2022).)

Table 6.3 Estimated volumes by material type

Unit	Disposal	Bank volume including over dredge
Fill	Suitable for bund construction	20,667
Unit 1A (Sand)		98,506
Unit 1B (Sand/clayey sand)		123,239
Unit 2 + 500mm buffer zone.	ASS – Contained below Mean Sea Level (MSL)	12,396
2 (Clay)	ASS – Contained below MSL	97,624
Unit 3 (Clay and weather rock)	Non-coastal ASS. Managed in accordance with Unit 2.	10,992
Surface Level Sediments	Contaminated and ASS – Contained below MSL	39
HM (Harbour Mud/Silt)	Contaminated and ASS – Contained below MLW	27,126
HS (Silty/Clayey sand)		25,434
Rock	No restriction	2,129
Total Volume		**418,152m^3**

During dredging operations, the dredge operators will work in controlled cuts, limit the amount of spillage from the buckets and have in place sediment controls devices i.e., a fixed silt curtain around the active dredge area.

The information provided in Table 6.4 shows the various depths of each material Unit and will provide input into the *SeaTools* system on the dredge. The ECR (SMEC, 2022)and Figure 11.5 in the Stage 2A and Stage 2B DEMP (Heron Construction and GHD, 2022, p. 30) have defined the elevation ranges for each material Unit, a summary of which is provided in Table 6.6.4 below. Operators will be alerted by the *SeaTools* system if they are dredging beyond the defined layers that are intended to be dredged. Dredge operators and the Stage 2B Principal Contractor Environmental Representative will also report visually on the types of material they are dredging, in particular if material changes significantly. It is understood due to safety issues, direct access to the material may not be possible in every instance of the dredging process. Digital aids such as drones, or similar, will be used to assist visual checks of material. Each barge load of material will be tracked from the dredge to final placement.

GHD identified differences between elevation and lithology-based interpretation of each material Unit. For the majority of the differences, there is no material effect as the material will remain in situ (for areas outside the dredge footprint) or will end up either in the bund or within the Emplacement Cell itself for reasons independent of this interpretation, and the unit definition will not change the fate of the material.

There are a small number of differences identified in the northern portion of the excavation/dredge area where the lithology indicates the material is Unit 2, however the elevation defined this material as Unit 1B (GHD, 2022b). The excavation/dredging contractor will be made aware of shallower Unit 2 soils in the northern part of the site and will update the designated unit elevations accordingly. Control measures including supervision and monitoring during excavation/dredging activities in the northern portion of site is included in Table 8.1.

Table 6.6.4 Unit elevation ranges (Units are m PKHD)

Material Unit	Top of unit	Bottom of unit
Fill	0	2.4
1A	2.5	-2.9
1B	-3	-8.9
2	-9	-15.5
3	-15.6	-23
4	-23.1	-30

6.4.2 Emplacement Cell

The design of the Emplacement Cell has been detailed within the ECR prepared by SMEC (2022). Figure 6.2 below shows the intended burial sequencing of the ASS sediments at the OHDSCA.

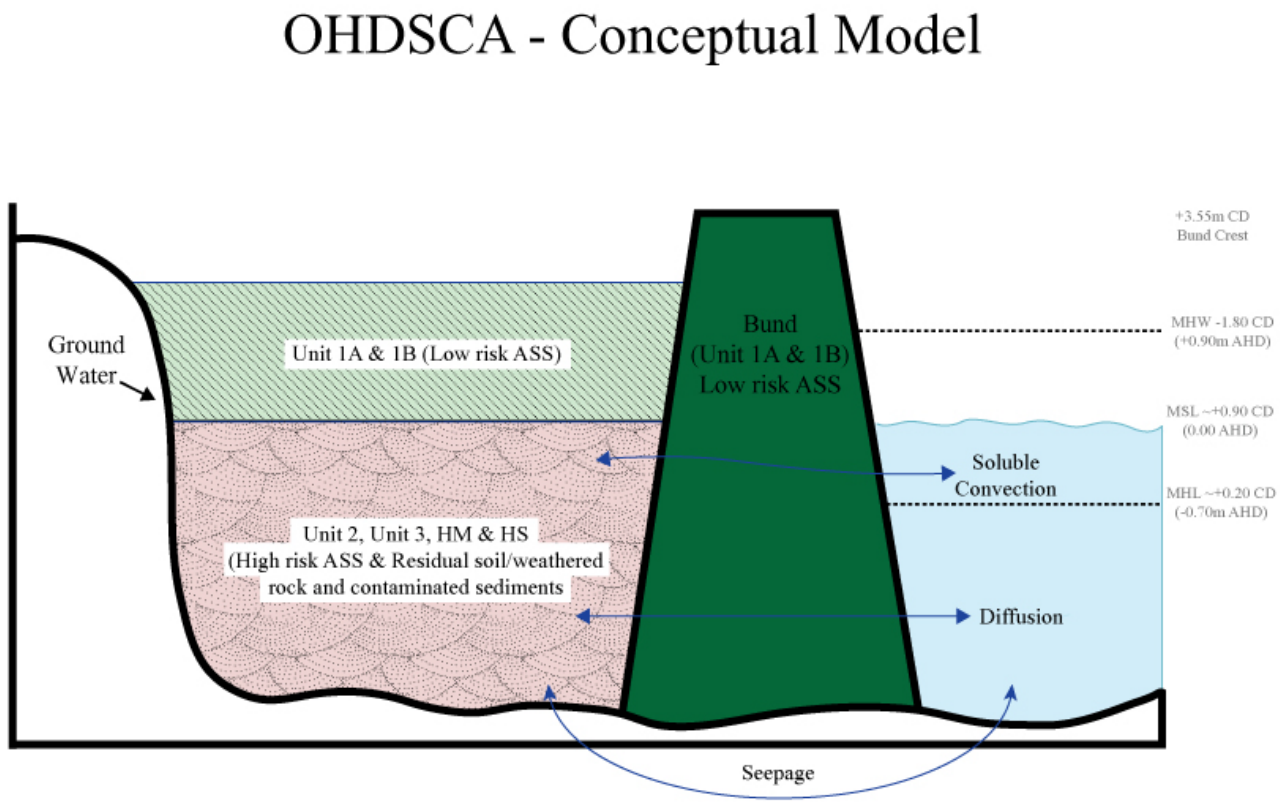


Figure 6.2 Conceptual Model for OHDSCA Port Kembla NSW (Chart Datum (CD) is equivalent to PKHD)

7. Assessment criteria

The preferred method for managing high risk ASS material is outlined in Section 8 and includes direct placement within an anoxic environment to prevent oxidation.

The field screening and laboratory testing criteria adopted for the project are therefore applicable in circumstances where temporary stockpiling of material occurs prior to placement in its final designated location within the emplacement cell.

This may include stockpiling in the following circumstances:

– Existing stockpiling of Unit 1A material proposed for use in Emplacement Cell bund above +0.9 m PKHD
– As a contingency for unexpected stockpiling of other ASS material due to equipment failure / inclement weather / extreme weather.

The screening results will be used as a basis for the selection of samples for further laboratory analysis of any stockpiled material. Sampling of stockpiles will be at rate of 1 sample per 5,000m3 to confirm self-neutralisation capacity and provide additional data to determine liming requirements for any PASS requiring treatment.

7.1 Validation testing for material requiring treatment will be at a minimum of four test samples per batch or one sample per 1000 m³.Field screening

Field screening would be undertaken by an environmental consultant experienced in ASS. Field screening can be a safety concern as strongly acidic and boiling solutions with sulphurous gases can be generated by the field screening process. Therefore, appropriate Personal Protective Equipment (PPE) and safety controls would be adopted when carrying field screening tests. Assessing the potential presence of ASS using a field screening method requires correct recording of pH using a calibrated water quality meter and other characteristics such as the type of reaction, temperature, colour, odours, etc observed during the test. The water quality meter would be fitted with an industrial level probe suitable for solutions of pH 1. The pH value recorded during the test cannot be relied upon in isolation, as the presence of organic acids, iron and manganese, etc, can generate similar reactions to sulfidic based reactions.

The following screening criteria is used to assess the potential presence of ASS:

– Field pH_F (1:5 soil distilled water ratio):
  - A pH_F less than or equal to 4.5 is likely to indicate the presence of Actual Acid Sulfate Soils (AASS).
– Field pH (pH_{FOX}) following oxidation with hydrogen peroxide (1:5 soil hydrogen peroxide (30%) ratio):
  - A final pH_{FOX} of less than 3.5 can be indicative of Potential Acid Sulfate Soils (PASS).
  - Field screening uses the following fizz rating (reaction rating) to classify the rate the samples reacted to the peroxide (Sullivan, Ward, Toppler, & Lancaster, 2018a, p. 48):
    – L = Low reaction
    – M = Medium reaction
    – H = High reaction
    – X = Extreme reaction
    – V = Volcanic reaction
  - Other observations to record include temperature, odour (e.g. hydrogen sulphide), colour and type of reaction. For example:
    – A sample with a low concentration of reduced inorganic sulphur (RIS) may have a slight reaction such as a few small bubbles, unlikely to change colour, small change in pH and not a significant change in temperature.

- A sample with a high concentration of RIS can cause an extreme or volcanic reaction, significant decrease in pH_{FOX} and significant increase in temperature. A yellow colour may indicate the presence of pyrite. An example of a strong reaction is provided in Figure 7.1 below.
- A sample with a high proportion of buffering material (e.g. shells calcium carbonate ($CaCO_3$)) can keep the pH_{FOX} elevated above 3.5 even though there is RIS in the sample.
- A sample with iron and or manganese or organic acids can trigger strong to extreme reactions with a slower production of froth and generate less heat than a sulfidic reaction.

- Calculate the change in pH using the following equation: $\Delta pH = pH_f - pH_{fox}$

Field screening would be undertaken by an environmental consultant experienced in ASS in accordance with Appendix A of the National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual (Sullivan, Ward, Toppler, & Lancaster, 2018a, p. 44). Interpretation of the field screening results would be carried out by an environmental consultant experienced in ASS with reference to Tables A2 and A3 in the National ASS Guidelines (Sullivan, Ward, Toppler, & Lancaster, 2018a, pp. 49-50).

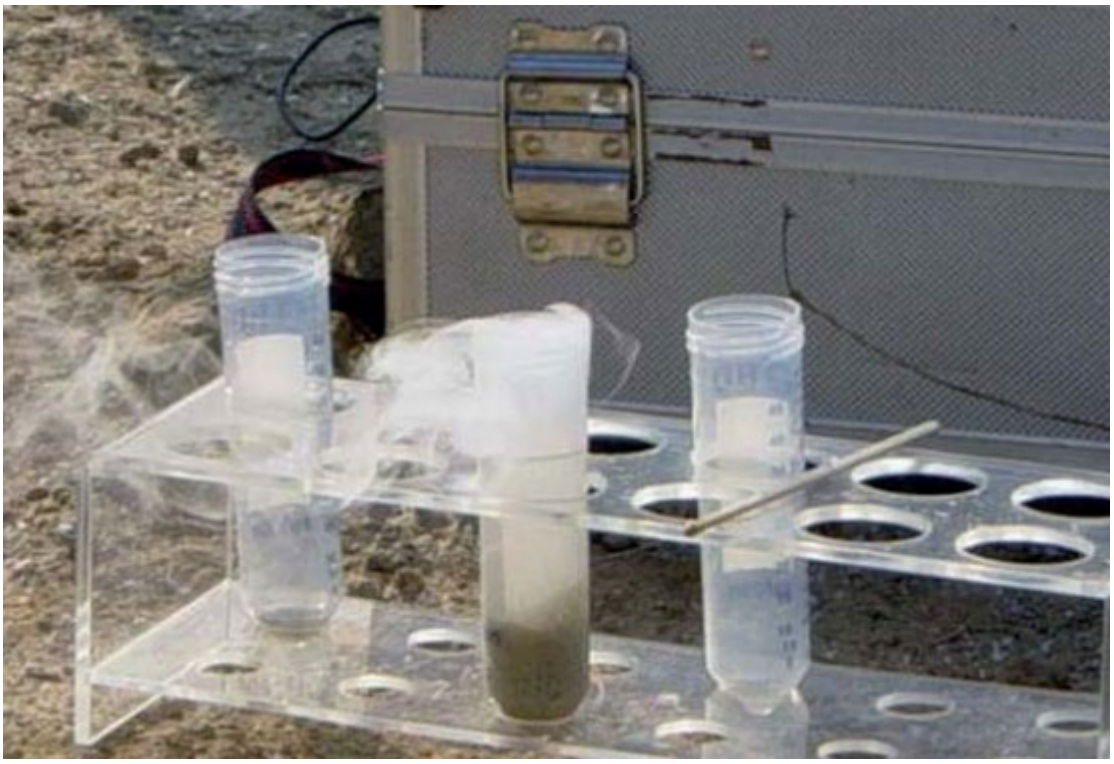


Figure 7.1 View of a strong reaction (reaction rating 3)

7.2 Laboratory testing criteria

The assessment and management of coastal ASS has been based on the following:

- Acid Sulfate Soil Manual (1998) prepared by the Acid Sulfate Soil Management Advisory Committee (ASSMAC, 1998).
- Sullivan, L, Ward, N, Toppler, N and Lancaster, G 2018, National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual, Department of Agriculture and Water Resources, Canberra ACT (Sullivan, Ward, Toppler, & Lancaster, 2018a).
- Simpson, SL, Mosley, L, Batley, GE and Shand, P 2018, National Acid sulfate soils guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management (Simpson, Mosley, Batley, & Shand, National Acid sulfate soils guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge, 2018a)
- Dear, S-E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McElnea, A. E., Moore, N. G. & Watling, K. M., 2014. Queensland Acid Sulfate Soil Technical Manual (QASSTM): Soil Management Guidelines. Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government (Dear, et al., 2014).

The ASSMAC Guidelines (1998), whilst still recognised as a reference document in NSW, have been superseded in terms of up-to-date scientific research and management practices. Where the ASSMAC Guidelines are silent, the Queensland and National guidance has been relied upon when dealing with management of Coastal ASS on the east coast of Australia.

ASS action criteria adopted for this assessment are listed in Table 7.1. The volume of ASS to be disturbed will be >1000 tonnes.Table 7.1 Acid sulfate soil action criteria

Soil Texture Category	Approximate Clay Content (%)	Action Criteria (>1000 tonnes)	
		Sulphur Trail Net Acidity (ex. ANC)	Acid Trail Net Acidity (ex. ANC)
		(SPOS or SCR) (%)	TAA, TPA or TSA (mol H^+/tonne)
Coarse	<5%	0.03	18
Medium	5% to 40%	0.03	18
Fine	>40%	0.03	18

Notes:
Net Acidity calculated using acid base accounting
SPOS Peroxide oxidisable sulphur
SCR Chromium reducible sulphur
TAA Total Actual Acidity
TPA Total Potential Acidity
TSA Total Sulphidic Acidity

8. Management mitigation and control

8.1 Principles for mitigating impacts

The following is an outline of the general principles for mitigating impacts associated with identified ASS as per the *National ASS Dredging Guidelines* (Simpson, Mosley, Batley, & Shand, National Acid sulfate soils guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge, 2018a):

– The disturbance of ASS should be avoided wherever possible.
– Where disturbances of ASS are unavoidable, preferred management strategies are:
  - minimisation of disturbance.
  - Neutralisation of acidity (treatment).
  - Hydraulic separation of sulfides either on its own or in conjunction with dredging.
  - Strategic reburial (reinternment, with treatment of any excess acidity).

These general principles have been adopted where practicable in the management strategy for ASS that will be encountered at the site and are discussed in the following sections.

8.2 Preferred ASS management option for Stage 2B

Construction of the berth pocket will mean that avoiding ASS will not be possible. The general principle for managing the high risk ASS will therefore consist of prevention of oxidation during dredging operations with strategic re-burial below permanent water table. Contingencies for the high risk ASS will include Sea dumping at an approved off shore site.

High risk ASS (Unit 2) sediments, (HM/HS) and Unit 3 material will be placed within an anoxic environment within a time period of between 12 and 48 hours following excavation and/or dredging. This will be achieved by placing the excavated saturated sediments on SHBs to be transported to the emplacement area where they will be immediately placed below water in a tidal environment (below +0.9 m PKHD) (refer to Figure 6.2). It is noted that HM/HS will be placed below -1 m PKHD and in no instances above the Lowest Astronomical Tide (LAT) ~-0.02m PKHD.

Low risk ASS (Units 1A and 1B) will also be excavated and placed on SHBs then transported to the emplacement area where they will be used for the construction of the bund wall used for encapsulation of the high risk ASS and contaminated sediments (refer to Figure 6.2).

The majority of the Unit 1A and 1B sediments will be placed below water in a tidal environment and will only present a risk of oxidation once the bund has risen above 0.9 m PKHD. The dredging technique for placement of the material above 0.9 m PKHD, may not be sufficient to ensure proper mixing of the material to take advantage of its self-neutralising capacity. To mitigate this risk, use will be made of an existing stockpile of low risk Unit 1A material currently stored adjacent to the Emplacement Cell footprint which will be placed in the bund above 0.9 m PKHD. This material will be tested prior to use, to verify its self-neutralising capacity (Refer to Table 8.1).

Stockpiling of high risk ASS is not planned. In the unlikely event that severe weather conditions force the closure of Port Kembla, dredging would also cease. The likely small volumes of high risk ASS that may be impacted by port closure would be managed under contingency measures (refer Section 10).

Stockpiling of low risk ASS may occur due to bund construction issues and weather events. Based on previous results, it is recommended that, should stockpiling occur, visual inspections occur on a weekly basis and daily pH monitoring (as per ASSMAC 1998 Appendix 1) is carried out (contingency measure – refer to Section 8.4.2 below).

8.3 Training and responsibilities

The Principal Contractors' Environmental Representatives should either be appropriately trained, or appoint an appropriately trained person, who will be responsible for managing the ASS issues during Stage 2B works. This person must be an environmental scientist or equivalent, with at least five years' experience with sound practical knowledge of assessment and identification of ASS.

This person shall be familiar with and have experience in:

– Relevant statutory requirements for dredging and managing ASS.
– Effective communication skills in outlining ASS risks and mitigation measures to a range of stakeholders including Principal Contractor and sub-contractor employees, site auditor and other interested parties.
– Recognition of dredged ASS sediments that are likely to be encountered (Units 1A, 1B, 2, 3, HM, HS).
– ASS screening and laboratory tests including interpretation of results.
– Typical on-site management procedures for dredged ASS materials, including implementing management procedures and contingencies when required.
– Treatment of ASS using liming and validation sampling (if required as a contingency).

8.4 Visual assessment and field screening

Visual assessment of potential ASS will be used for appropriate management of potentially acid generating material and are further discussed in the sections below. The results of visual assessment and field screening are used to inform a set of decisions as to how the excavated material is to be managed.

8.4.1 Visual classification

The preliminary visual checking of potential ASS will be based on material type, colour and consistency. The following classification apply to the excavated and dredged sediments:

– Unit 1A: SAND, brown, pale brown, yellow, orange, fine to coarse grained, trace amounts of shell fragments, fine to coarse gravel, silt bands and layers, clayey sand layers, trace iron stained sand, fine black sand layers (probable heavy mineral sands), rounded to sub-rounded gravel, clay lenses and layers.
– Unit 1B: Clayey SAND, black, dark grey, grey, fine to coarse grained sand, medium to high plasticity clay, trace silt, shell fragments, gravel. Gravelly CLAY, black, dark grey, grey, low to medium plasticity, fine to coarse grained angular to sub-angular gravel, trace of fine to coarse grained sand.
– Unit 2: CLAY, grey, dark grey, high plasticity, trace of fine coarse grained, trace of gravel, rounded cobbles Silty SAND, dark brown, grey, brown, fine to coarse sand, trace of fine gravel, shell fragments
– Residual soils (Unit 3) and weathered rock (Unit 4) Residual soils and weathered rock are typically stiff to very stiff clays, dark brown mottled dark green-grey, pale brown and brown-orange. Unit 3 materials are not Coastal ASS but have reduced inorganic sulphur from past depositional history and will be disposed along with Unit 2 material.

Examples of Unit 1A, Unit 1B and Unit 2 are shown in Photo 1 to Photo 4 in Section 6.2.

8.4.2 Field test classification and pH monitoring (contingency only)

The field screening, pH_F and pH_{FOX} , will be performed as a contingency only (refer to Section 7.1). The test will be used to assess the potential presence of ASS where stockpiling of material occurs prior to placement in its final location. The screening results will be used as a basis for the selection of samples for further laboratory analysis as indicated in Section 7.1. Field screening results will be recorded manually on a proforma similar to the ASS field screen recording sheet included in Appendix A. An example of a completed field screening record sheet is also included in Appendix A.

8.5 Management of ASS during excavation, dredging, transport and placement

8.5.1 Mitigation and monitoring Stage 2B

The monitoring and management of ASS will be the responsibility of the Principal Contractor's Environmental Representative. The following general management procedures are considered applicable during excavation, dredging, stockpiling and placement of sediments during Stage 2B:

- Appointment of an appropriately qualified person (refer Section 8.3) to manage the ASS issues during the dredging activities.
- Make daily observations of excavated and dredged sediments to make sure that the Units excavated are as per the expected model. Unit 2 (high risk ASS) and Unit 3 (residual soil) is to remain saturated during transport and placement and will not be allowed to dry out. It is understood due to safety issues, direct access to the material may not be possible in every instance of the dredging process. Digital aids such as drones, or similar, will be used to assist visual checks of material.
- AIE and the Stage 2B Dredging Principal Contractor have advised that the dredging operation is GPS tracked and the material from each barge that is placed in the emplacement cell is recorded. The Principal Contractor's Environmental Representative is to review the material placement records of the dredging contractor on a daily basis.
- Make daily observations of the emplaced bund sediments (Unit 1A and 1B) as they emerge from the water (above about +0.9 m PKHD).
- Carry out regular monitoring of the surface water within the Inner Harbour in line with the site specific EPL No 21529.
- Continuous water quality monitoring via water quality monitoring buoys.
- Instigate contingency measures (refer to Section 10) where unforeseen stockpiling or delays to dredging mean that ASS are likely to exceed expected timelines for emplacement below water and /or stockpiling.
- Neutralisation, using agricultural lime (as a contingency only), of stockpiled sediments depending on monitoring and laboratory results.

Verification testing of the material will not be practicable during the dredging process as direct access to the dredge material will not be possible for safety and operational reasons.

Table 8.1 outlines the mitigation strategies to be adopted to control the potential environmental impacts during excavation and dredging, stockpiling, transport and placement of the sediments. The sampling rates given are based on experience on similar projects and are in line with industry standards for similar sized projects (refer 2018 National ASS Guidelines Case Study 2) (Simpson, Mosley, Batley, & Shand, National Acid sulfate soils guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge, 2018a).

The Unexpected Finds Protocol (UFP) contained within the Stage 2A and Stage 2B Contaminated Spoil Protocol is to be followed for any unexpected finds of ASS/PASS material.

Table 8.1 Summary of Potential Issues and Mitigation Strategies Stage 2B

Activity	Potential Issues	Environmental Impact	Mitigation Strategies	Procedures
Excavation and dredging of Units 1A and 1B to about -10 m PKHD	Aeration and oxidation of pockets of high risk ASS within Units 1A and 1B during excavation and dredging operations.	Low to negligible impacts to harbour waters during dredging	– Visual assessment of dredged sediments to ensure units excavated are consistent with the expected model, and observation of surface water. Visual assessment may be aided with drones or similar photographic devices.	– DEMP – UFP
	Oxidation during and following placement within bund below +0.9 PKHD.	Very low to negligible risk of oxidation occurring during placement below 0.9 m PKHD	– Visual assessment of dredged sediments to ensure units excavated are consistent with the expected model, and observation of surface water. Visual assessment may be aided with drones or similar photographic devices. – Daily review of dredging records.	– Site specific procedures for monitoring to be prepared by the Principal Contractor – UFP
Excavation and dredging of Units 1A and 1B to about -10 m PKHD – northern portion of the site	Previous investigation identified shallow occurrence of Unit 2 in the northern portion of the site (GHD, 2022b). Based on RLs in the ECR (SMEC, 2022) inadvertent excavation of Unit 2 may occur and be placed in the bund with Unit 1A and Unit 1B materials. Oxidation during and following placement within bund above +0.9 PKHD. Potential for acidic run-off to affect surrounding infrastructure and impact marine environment.	Low to medium risk of oxidation depending on volume of high risk ASS and the capacity for low risk ASS to self neutralise	– Excavation/dredging contractor is made aware of shallower Unit 2 soils in the northern part of the site, and updates the designated unit elevations accordingly – Visual assessment of dredged sediments to ensure units excavated are consistent with the expected model, and observation of surface water. Visual assessment may be aided with drones or similar photographic devices. – Daily review of dredging records.	– Site specific procedures for monitoring to be prepared by the Principal Contractor – UFP
Dredging and transport of Unit 2 and Unit 3, HM and HS	Aeration and oxidation of ASS during dredging operations, placement in dredge hopper and disposal in Emplacement Cell.	Low to negligible impacts to harbour waters Potential acidification with the SHB if delays occur	– Visual assessment to confirm high risk ASS. – Visual assessment may be aided with drones or similar photographic devices. – Observation of surface water during dredging and transport to emplacement cell and sampling as per EPL and ASSMP. – Sediments to remain saturated and exposed for less than 48 hours during transport by split barge hopper. – Daily review of dredging records. – Should delays occur material will be kept moist or below water level..	– DEMP – UFP – Site specific procedures for monitoring during dredging and transport to be prepared by Principal Contractor

Activity	Potential Issues	Environmental Impact	Mitigation Strategies	Procedures
Placement of high risk ASS below +0.9 PKHD (i.e. below the water)	Separation of fine grained sediments concentration of ASS and oxidation during settlement	Low impact. Low risk of oxidation due to buffering capacity of the harbour water and saturated state of the suspended sediment	– Monitoring of water quality as per the WQMP and ASSMP. – Visual assessment and survey to ensure sediments do not exceed +0.9m PKHD. – If visual indicators show that oxidation has occurred prior to placement, contingency measures shall be applied as per Section 10,	– Site specific procedures for monitoring of placed dredged sediments below water to be prepared by Principal contractor. – UFP
Disposal of low risk ASS within the bund of the Emplacement cell above +0.9m PKHD	Incomplete mixing of Unit 1A and 1B material leading to high risk ASS being exposed once the bund emerges from below water. Potential for acidic run-off to affect surrounding infrastructure and impact marine environment.	Low impact to harbour waters within the bund during placement. Low risk of oxidation due to buffering capacity of Unit 1A and Unit 1B and natural buffering of the harbour water and saturated state of the suspended sediment	– Use of stockpiled Unit 1A material in Emplacement Cell bund above +0.9 m PKHD. – Sampling and field screening of stockpiled Unit 1A material at rate of 1 sample per 5,000m^3 prior to placement to confirm self neutralisation capacity. – Monitoring of pH of outflow water (leachate), from stockpiled material as required. – No Unit 2 or Unit 3 material to be placed above +0.9m PKHD or within the bund to be confirmed visually and via review of dredging records.	– Site specific procedures for monitoring of placed dredged sediments below water to be prepared by Principal contractor. – UFP

9. Monitoring testing and reporting during dredging and placement

Monitoring, testing and reporting of soil and water would be carried out accordance with current national and state ASS guidance, environmental guidelines (e.g. Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018) (ANZG, 2018), National Acid Sulfate Soils Guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management (Simpson, Mosley, Batley, & Shand, 2018b), National Acid Sulfate Soils guidance: National Acid Sulfate Soils Sampling and Identification Methods Manual (Sullivan, Ward, Toppler, & Lancaster, 2018a)) and best practice industry standards. Complete records of all testing, treatment and monitoring would be kept by the Principal Contractor. Table 9.1 gives the required monitoring and reporting frequency.

Full time automated water quality monitoring is outlined in the Water Quality Monitoring Plan (WQMP) (GHD, 2022d) and includes pH and dissolved oxygen monitoring at two locations outside the Emplacement Cell. The WQMP also outlines a tiered trigger level response to limits. Weekly grab samples for contaminants are also included in the WQMP (GHD, 2022d). The monitoring and reporting in Table 9.1 are specific to ASS and will be in addition to the WQMP (GHD, 2022d).

The Principal Contractor's Environmental Representative will undertake a series of targeted internal audits of environmental controls used during construction to review compliance with the requirements of the ASSMP in accordance with the EMS.

Table 9.1 Required monitoring and reporting frequency

Activity	Excavation and Dredge site (as per WQMP locations)	Emplacement Cell (as per WQMP locations)	Inner and Outer Harbour (as per WQMP location)
Monitoring of water quality	Establish baseline water quality prior to dredging. Sampling and testing requirements: – Once per week and analysed for: • pH • Turbidity (water clarity) • Dissolved oxygen • Acidity • alkalinity – Once per month and analysed for: • Heavy metals (As, Cu, Cd, Cr, Pb, Zn, Al, Fe) • Sulfate • Chloride • Nutrients	Establish baseline water quality prior to placement. Sampling and testing requirements: – Once per week and analysed for: • pH • Turbidity (water clarity) • Dissolved oxygen • Acidity • alkalinity – Once per month and analysed for: • Heavy metals (As, Cu, Cd, Cr, Pb, Zn, Al, Fe) • Sulfate • Chloride • Nutrients	Establish baseline water quality prior to dredging (Inner Harbour) and placement (Outer Harbour). Sampling and testing requirements: – Once per week and analysed for: • pH • Turbidity (water clarity) • Dissolved oxygen • Acidity • alkalinity – Once per month and analysed for: • Heavy metals (As, Cu, Cd, Cr, Pb, Zn, Al, Fe) • Sulfate • Chloride • Nutrients
Monitoring of stockpiles	N/A	Sampling of existing stockpile (40,000 m^3) of Unit 1A material prior to placement in bund (1 sample per 5,000m^3) Verification testing of any stockpiled material requiring	N/A

Activity	Excavation and Dredge site (as per WQMP locations)	Emplacement Cell (as per WQMP locations)	Inner and Outer Harbour (as per WQMP location)
		treatment at a minimum of four test samples per batch or one sample per 1000 m Monitoring of pH of outflow water (leachate), from stockpiled material as required	
Monitoring of limed material and validation requirements (contingency only)	Maintaining lime register with amount of lime applied and volumes (refer to Section 10.2) Validation Plan required based on Dear et al 2014 with modifications as shown in Section 10.2.2.	Maintaining lime register with amount of lime applied and volumes (refer to Section 10.2). Validation Plan required based on Dear et al (2014) if liming is carried out at this location	N/A
Reporting	Weekly email to Project Team and auditor Monthly summary report	Weekly email to Project Team and auditor Monthly Summary report	Weekly email to Project Team and auditor Monthly Summary report

10. Contingencies

10.1 Off-site disposal

The Emplacement Cell has been designed to receive material resulting from dredging and excavation of the berth pocket. The design of the emplacement cell has incorporated a volume assessment that included application of a range of bulking and compaction factors to each of the dredge units to consider the likely range of dredge volumes. The volume of material dredged for construction of the key trench under the emplacement cell bund alignment has also been considered and is included in the overall dredge volumes.

The result of the volumetric assessment is that the Emplacement Cell can accommodate the dredge materials from Berth 101 which forms the basis of the assessment in the ASS management plan. A key consideration of the volumetric assessment is the extent that the Berth 101 “bank” volumes are “bulked” during the dredging process and sensitivity analysis for bulking factors was undertaken. Potential contingency plans to accommodate any excess ASS based upon worse case bulking factors are being investigated which may include either off-shore disposal via a Commonwealth Sea Dumping Permit or disposal at other off-site facilities licenced to receive ASS.

10.2 On-site treatment

10.2.1 Overview

Treatment of ASS using lime is not expected to occur and is included here as a contingency only, as a result of the following:

– Stockpiling due to equipment failure / inclement weather / extreme weather.
– Identification of visual indicators to suggest oxidation of materials prior to placement within the Emplacement Cell.

The following sections outline the general procedures should it become necessary to treat with lime.

The type and amount of lime to be applied should be such that a neutralising value (NV) of at least 95 can be achieved. The NV should be identified prior to mixing. NV relates to the purity of the lime and an NV of 100 is preferred to ensure that the lime is effective in neutralising the potential acid.

Fine powdered agricultural lime ($CaCO_3$, <0.5 mm particle size) generally has an NV of 90% to 100%, whilst other manufactured forms of lime can have an NV as low as 80%. Where NV is below 100, the factor of safety, hence the amount of lime, will have to be adjusted accordingly.

Calculation of the quantity of lime required for treatment will be calculated based on rates recommendations made by the laboratory with which the analysis was undertaken, however it should be noted that the following formula from the NSW ASS Manual (ASSMAC, 1998) may also be used for guidance:

$$\text{Lime required (kg } CaCO_3\text{/tonne material)} \cong \text{kg } H_2SO_4\text{/tonne of material x safety factor}$$
$$\cong \text{(oxidisable S \% x 30.59) x 1.5}$$

The design of the treatment pad would be in general accordance with Figure 10.1, noting concrete hardstand can be used in place of compacted clay.

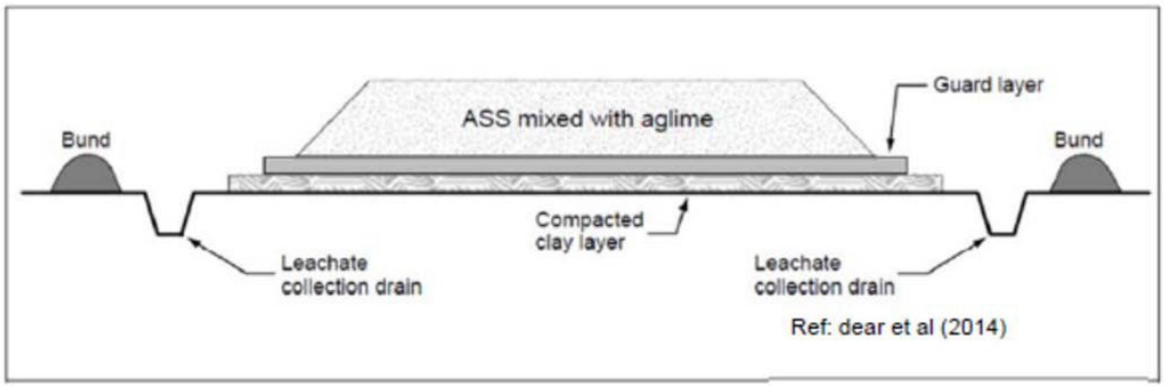


Figure 10.1 ASS treatment pad (example)

The following procedures (or other equivalent) would be undertaken for the treatment pad and liming. It is aligned with the PKGT EIS recommendations, National ASS Guideline (Sullivan, Ward, Toppler, & Lancaster, 2018b) and the NSW ASS Manual (ASSMAC, 1998):

- The area will be bunded (50 mm high bund) and provision made to collect run-off water and be sufficiently robust to avoid impacts to the harbour during storm events.
- Spreading of the soil in thin (<300 mm) layers on impervious pads within the boundary of the site works.
- A guard layer of neutralising agents should be provided at the base of the pad prior to the addition of ASS as per page 48 of the *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines* (DSITIA, 2014), which states: *The minimum guard layer rate beneath any treated-in-place ASS will be 5 kilograms fine aglime per m² per vertical metre of fill.*
- Where the highest detected sum of existing and potential acidity is more than 1.0% S equivalent, the rate will be at minimum 10 kilograms fine aglime per m² per vertical metre of fill.
- Addition of lime followed by mixing.
- The amount of lime to be added will be determined based on the results of laboratory analysis taking into consideration existing acidity, potential acidity, retained acidity.
- A factor of safety should also be applied to the lime rate calculation of between 1.5 and 2 and will depend on the likely area of reuse or disposal option for this material and environmental sensitivity.
- Leachate is to be monitored in accordance with the NSW ASS Manual (ASSMAC, 1998).

10.2.2 Performance criteria and verification testing

In order to demonstrate that appropriate quantities of lime have been used, a lime register shall be maintained by the Principal Contractors. The register shall list the amount of lime delivered to the site, verified by delivery dockets, and where/when the lime has been used. The lime usage shall quantify areas limed and soil volumes treated, liming rates and quantities of lime used.

Validation of ASS treatment will occur within one week of treatment and is based on:

- Minimum four test samples per batch or one sample per 1000 m³.
- Samples to be tested using the SCR with full acid base accounting including retained acidity.
- The performance criteria as outlined below
  - No single sample shall exceed a net acidity of 18 mol H+/tonne (0.03% S).
  - If any single sample is between 0 and 18 mol H+/tonne (0.00 to 0.03% S), then the average of any four spatially adjacent samples (including the exceeding sample) shall have an average net acidity of zero or less.
- Field screening at a greater density (i.e. one sample per 500 m^3) should also be undertaken to confirm pH_F post treatment is > 6.5 (but no higher than 8.5)

If performance criteria are not met further mixing and application of lime will be required as above and further verification testing undertaken prior to placement.

11. References

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

ASSMAC. (1998). *Acid Sulfate Soil Manual.* Acid Sulfate Soil Management Advisory Committee.

Dear, S. E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McElnea, A. E., Moore, N. G., & Watling, K. M. (2014). *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines.* Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government.

DLWC. (1997). *Acid Sulfate Soil Risk Map - Wollongong 1: 25,000, 2nd Ed.* Department of Land and Water Conservation.

DPIE. (2021). *Infrastructure Approval - SSI 9471, dated 13 October 2021.* Department of Planning, Infrastructure and Environment.

EP&A Act. (1979). *Environment Planning and Assessment Act.*

EPL. (2021). *Environmental Protection Licence No. 21529, dated 3 December 2021.* NSW EPA.

FEC. (2022). *Port Kembla Gas Terminal Dredge Emplacement Area - Expert Advice and Literature Review Acid Sulfate Soils (Ref.: FEC200106AA-L02 Final, dated 24/1/2022).* Fox Environmental Consulting Pty Ltd.

GHD. (2018a). *Contamination Assessment Report for Berth 101, Proposed Port Kembla Gas Terminal (Report ref: 2127477-75508, October 2018).* GHD Pty Ltd.

GHD. (2018b). *Port Kembla Gas Terminal - Environmental Impact Statement.* GHD Pty Ltd.

GHD. (2019). *Port Kembla Gas Terminal - Environmental Impact Statement Modication Environmental Assessment.* GHD Pty Ltd.

GHD. (2022a). *Port Kembla Gas Terminal - Acid Sulfate Soil - Factual Report (Ref: 2127477-94608-1073. 2/2/2022).* Wollongong: GHD Pty Ltd.

GHD. (2022b). *Supplementary Acid Sulfate Soil Advice – Shallow Unit 2 soils in northern excavation/dredge area Port Kembla Gas Terminal, Port Kembla, NSW (Ref: 2127477-70293-1079, dated 5/2/2022).* Wollongong: GHD Pty Ltd.

GHD. (2022c). *Spoil Management Plan - Stage 2A and Stage 2B Marine Berth Cosntruction and Dredging - Land and Marine Based (Ref: PKGT-AIE-SMP-Stage-2A&2B_RevB, dated 18/2/2022).* GHD Pty Ltd.

GHD. (2022d). *Water Quality Mangement Plan - Stage 2A and Stage 2B Marine Berth Construction and Dredging - Land and Marine Based (Ref: PKGT-AIE-WQMP-Stage-2A2B_RevB, dated 18/2/2022).* GHD Pty Ltd.

Heron Construction and GHD. (2022). *Dredge and Excavation Mangement Plan (Ref: HC-AIE-PKGT_DOC -QA-001_DEMP, Rev. B, dated 28 February 2022).* Heron Construction Company Ltd.

NSW EPA. (2014). *Waste Classification Guidelines – Part 4: Acid Sulfate Soils.*

NSW Government. (2011). *State Environmental Planning Policy (State and Regional Development) 2011.* NSW Government.

Simpson, S. L., Mosley, L., Batley, G. E., & Shand, P. (2018a). *National Acid sulfate soils guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge.* Canberra, ACT: Department of Agriculture and Water Resources.

Simpson, S. L., Mosley, L., Batley, G. E., & Shand, P. (2018b). *National Acid Sulfate Soils Guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management.* Canberra, ACT: Department of Agriculture and Water Resources.

SMEC. (2022). *Port Kembla Gas Terminal Development - Emplacement Cell Report (Ref: 30013105, Rev. 7, 14 March 2022).* Wollongong: SMEC Australia Pty Ltd.

Sullivan, L., Ward, N., Toppler, N., & Lancaster, G. (2018a). *National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual.* Canberra ACT: Department of Agriculture and Water Resources.

Sullivan, L., Ward, N., Toppler, N., & Lancaster, G. (2018b). *National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual.* Canberra ACT: Department of Agriculture and Water Resources. Retrieved from waterquality.gov.au

Worley Parsons. (2012). *Berth 101 Upgrade Project Marine Assessment Dredge Spoil Contamination Assessment - Stage 2 Detailed Site Investigation (Report Ref: 301015-02809-00-CS-REP-0003, dated 15 October 2012).* Worely Parsons Pty Ltd.

Appendices

Appendix A

Example ASS field screen recording sheet

Field Screening Results - pH_F and pH_{FOX} Recording Sheet

Client:		Project number:	
Project:		Location:	
Sample preservation:		Page (X of X):	
pH / temperature meter ID:		Calibration date (attach calibration record):	
pH of 30% hydrogen peroxide solution:		Calibration result (pass / fail):	
Field screening performed by:		Checked by:	

Sample ID	Depth interval (m)	Date of sampling	Sample Description						Field Screening Results									
			Soil type (SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, density/consistency)	Jarosite staining	Shell Fragments	Iron staining	SO_4 odour	Organics present	Date	Time	pH_F (pH units)	pH_{FOX} (pH units)	Δ pH (pH units)	Temp (°C)	Reaction rating	Describe reaction	Colour change	Odour
				☐	☐	☐	☐	☐							Choose an item.			
				☐	☐	☐	☐	☐							Choose an item.			
				☐	☐	☐	☐	☐							Choose an item.			
				☐	☐	☐	☐	☐							Choose an item.			
				☐	☐	☐	☐	☐							Choose an item.			
				☐	☐	☐	☐	☐							Choose an item.			
				☐	☐	☐	☐	☐							Choose an item.			

Field Screening Results - pH_F and pH_{FOX} Recording Sheet

Client:	AIE	Project number:	2127477
Project:	Port Kembla Gas Terminal	Location:	Foreshore Road, Port Kembla, NSW
Sample preservation:	Frozen	Page (X of X):	1 of 1
pH / temperature meter ID:	SR12345	Calibration date (attach calibration record):	5/5/2022
pH of 30% hydrogen peroxide solution:	5.1	Calibration result (pass / fail):	Pass
Field screening performed by:	Colee Quayle	Checked by:	Laurie Fox

Sample ID	Depth interval (m)	Date of sampling	Sample Description						Field Screening Results									
			Soil type (SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, density/consistency)	Jarosite staining	Shell Fragments	Iron staining	SO_4 odour	Organics present	Date	Time	pH_F (pH units)	pH_{FOX} (pH units)	Δ pH (pH units)	Temp (°C)	Reaction rating	Describe reaction	Colour change	Odour
BH01	0.5-0.6	5/5/2022	Silty Clay, medium plasticity, dark grey, with fine grained sand, soft.	☒	☒	☐	☐	☐	5/5/2022	13:35	6.5	2.5	-4.0	60	X	Rapid bubbling, steam	Orange, iron stain	SO_4
BH02	0.0-0.1	5/5/2022	Sandy silt, black, fine to medium grained sand, loose.	☐	☐	☐	☐	☒	5/5/2022	13:45	5.0	4.0	-1.0	25	L	Minor bubbling	No	None
				☐	☐	☐	☐	☐							Choose an item.			
				☐	☐	☐	☐	☐							Choose an item.			
				☐	☐	☐	☐	☐							Choose an item.			
				☐	☐	☐	☐	☐							Choose an item.			
				☐	☐	☐	☐	☐							Choose an item.			

ghd.com

→ The Power of Commitment