Acid Sulfate Soil Preliminary Assessment for Proposed Mariculture for Abalone farm at Lot 2 Dp1014683 Clark St, Pindimar and adjoining Port Stephens NSW

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For Reliance Holdings Ltd.

Contents

Introduction

This assessment of acid sulphate soils is for an abalone farm proposed to be built on the northern shoreline of Port Stephens immediately west of the village of South Pindimar. This analysis has been written to address issues raised in the Director Generals requirements for the application. In particular:

- Proposed erosion and sediment controls during construction including the management of spoil from the construction of pipelines and management of acid sulphate soils

- Assessment of the need for an acid sulphate soil management plan prepared in accordance with ASSMAC guidelines.

- Nature of sediment to be dredged, including Acid Sulphate Soil

In addition to the impacts of the burial of pipelines the construction of a boardwalk in terms of Acid sulphate soils is considered.

Port Stephens estuary is approximately 150 km north of Sydney, and 60 km north of Newcastle. Like much of Coastal NSW the estuary has been the focus of rapidly increasing residential and commercial, including farming, development.

Acid Sulphate Soils (ASS) is the name given to naturally occurring soil and sediment containing iron sulphides. When these are exposed to air, (i.e. moved above the water table or the water table lowered) oxidation occurs and sulphuric acid is ultimately produced.

In NSW, acid sulphate soils have been found in every coastal estuary. It is estimated that over 400,000 hectares of acid sulphate soils in NSW are being impacted by existing and new activities. The NSW Office of Environment and Heritage mapped landscapes according to the probability of having Acid Sulphate Soils. The most recent map has been used as the base for the initial evaluation of the proposals possible interaction with these soils. (Murphy, 1997)

Site Description

The soil type varies with elevation. Below approximately 3 metres it is a Podsol (Uc2.20, Uc2.33) on deep Pleistocene sand sheets. At higher elevations shallow to moderately deep, well drained brown Podsolic soils (Db2.21) and some yellow Podsolic soils (Dy3.21) on conglomerate.

Based on Port Stephens Acid Sulphate Soil Risk Map edition 2 (Murphy, 1997), the soil is Aeolian sand plain with a low probability of acid sulphate soil material within the soil profile. If present they are likely to be sporadic and below 3 metres from the ground surface. The environmental deposition has generally not been suitable for the formation of acid-sulphate soil materials. Soil tests, undertaken as part of this assessment (see Appendix 1), have found no acid-sulphate soils in terrestial areas of the site. A band of potential acid-sulphate soil (PASS) was detected 1.4 metres below the sediment surface in the intertidal section of the pipe route.

The farm is land based with most of the facilities being located more than 250 meters inshore. Production will occur in tanks inside sheds. We are required to hold the water in ponds before release. These ponds will be located in areas of deep aeolian sand above the 2 metre contour (around 3.5 to 5 meters AHD). These ponds will be lined with geomembrane material and will not be deeper than the water table. There is no plan to change the water table. This is a salt-water farm whose production facilities will be located on areas of previously cleared conglomerate rock substrate.

The pipelines to service the facility will be buried approximately 0.9m deep and be placed around preexisting trees.

Inspection of the ASS maps indicates that the terrestrial land is mapped as Wa4. Investigation of the soil confirms this with no ASS or PASS found down to any depth likely to be affected by the project (i.e. approximately 0.9m). Note that pipes will be shallowly buried and settlement ponds will be on the highest sand plain and have a depth of around 2m. The pipelines must cross an intertidal flat mapped as EiO. This sandbar has been sampled and contains PASS one metre below ground surface. This area is all below water table as it is flooded by the tide two times a day. It is flooded by over one meter of marine water. The trenching and reburial scheme is indicated below.

The Subtidal land is mapped as Em. There will be no disturbance of these sediments as pipes will be laid upon the surface.

The water front of the project is an eroding landscape where the “beach” is approximately 5 meters wide, the higher tides reach the top of the bank and low tide exposes an intertidal sand flat about 190 meters wide.

General Parameters of the Proposed Works

While the bulk of the farm construction is proposed to be above 3 meters AHD and for the most part constructed on a rocky (conglomerate) hill the pipelines supplying sea water and returning it to Port Stephens will be buried in sand from the pump station to the high water mark (approximately 115 meters). The soil has been identified as Wa4 (Aeolian sand plain of greater than 4 meters elevation - from the risk maps key) in the acid-sulphate soil risk map. (Murphy, 1997) The pipes then traverse (approximately 5 meters) a sandy beach from high to mid tide level identified as EiO (Estuarine intertidal flat with 0 elevation). The pipelines then continue buried through a further approximately 195 meters of sandy intertidal sediment that is identified as Em (Estuarine Bottom Sediments) in the acid-sulphate soil risk map. At this point (lowest astronomical tide ,approximately 200 meters from the highest astronomical tide point), the pipelines emerge from the sediment and thence to their destinations with no further disturbance of bottom sediments.

Amelioration methods

The acid-sulphate soil risk map (Port Stephens edition 2) produced by the Office of Environment and Heritage (OEH) (Murphy, 1997) indicate a low probability acid-sulphate soil materials, and that they would be at depths greater than 3 metres below ground level in the terrestial areas of the site. The same map indicates a high probability of acid sulphate soil materials in the intertidal area at or near the ground surface in the intertidal area and a high probability of acid sulphate soils subtidally.

In assessing the potential impacts from disturbance of sulfidic material or its use in dam or drains walls, of any change in the watertable during construction or operation of the proposal we find no discernible impact. We will not be using sulfidic material for earthworks, nor is there any intention or likely hood of affecting the water table. The laying of pipelines will be done expeditiously and neutralising materials will be buried with the pipelines during backfilling as required by OEH (Chapman, 1998) (Stone, 1998).

There will be no anticipated disturbance of acid sulphate soils and where there is, neutralising agents will be employed.

Relevant management of the presumed acid sulphate soils of the port's sediments hinges upon prompt refilling of pipeline trenches and liming. Note that the farm will not impact on the water table in the intertidal area and there will be no discernible impact on sediment oxygen levels from before to after pipe installation. Potential Acid Sulphate Soil will not become Actual Acid Sulphate Soil as this requires a lowering of the water table or long term exposure to air. It should also be noted that the water table is likely to change with the tides and that the well oxygenated alkaline seawater has and will continue to have a neutralising effect.

Pipelines Earthwork Methodology

The pipelines will generally be constructed in-situ via the sequential connection of high-density polypropylene pipe ‘spools’ (segments). It is anticipated that a small rubber-tracked excavator will be used to move pipe spools around the site and into position. Pipes are relatively flexible and will be manoeuvred around trees and other obstacles. Spools will be stockpiled in appropriate locations (i.e. cleared areas in close proximity to pipeline route) prior to the construction of each segment.

For required excavations, the top layer (approximately 150 mm) of vegetative groundcover and soil/ sediment will be removed. No trees are anticipated to be removed for pipeline construction. Excavated topsoil/ sediment will be stockpiled adjacent to the pipes for later reinstatement, and any vegetative matter mulched for use within landscaped terrestrial areas. A single trench will be created to accommodate the 4 pipes, approximately 0.9 m deep and approximately 2.6 m wide, in terrestrial areas.

In intertidal areas, the trench will be of a variable depth in order to maintain the consistent grade of the pipe culminating in zero depth at the lowest astronomical tide point where the pipes fully emerge from the sediment. Excavated spoil will be stockpiled for regular backfilling into the trench upon the completion of each segment. Lime will be used to cap sediments below the pipeline trench as recommended by (Chapman, 1998). The sediments will be replaced in the reverse order to extraction, i.e. bottom sediments in first. Any excess fill will be utilised within the site where possible (e.g. filling in erosional sites adjacent to the high water mark) or disposed of at an appropriately licensed landfill. The width of the ‘disturbance corridor’ for buried pipes, including stockpile areas, will be approximately 4.6 m. Disturbed areas will be revegetated with endemic species upon completion of works.

The first stage of the construction involves the laying of pipelines that will transport water to and from the facility. The pumpstation is the nearest part of the facility to the shore at 150 meters. The pipelines will be laid from the outlet point back toward the shore. The outlet point will be at approximately 450 metres from the mean high water level. The intake pipes are located 540 metres from the mean high water level. The intake lines will be laid upon the subtidal substrate as per fishery requirements. The intake and release lines will travel together shoreward from the emergence point (Indian Spring Low Tide). The pipelines are approximately six hundred millimeters diameter each and the trench floor will vary in depth in order to maintain grades (though no more than around 0.9m) below the substrate and 2.6 meters wide.

The pipes will be laid at low tide. The pipes are to be laid at approximately thirty to fifty meters per low tide. A trench will be dug, the pipes laid and the sediment backfilled before the return of the tide.

Working from the lowest to the highest point will minimise disturbance. The operation should be completed in around five days. The operation will be planned to occur in a dry weather period. The substrate will be exposed to the air for less than six hours before it is reburied in the anaerobic/saturated conditions from which it came.

The entire sand flat is inundated at least twice a day by water of salinity similar to that of the ocean. The Port Stephens outer harbour has a very high daily water exchange with the ocean.

Construction Methodology for Intake / Outlet pipes

Pipe Location/ Segment	Proposed Pipe Treatment	General Placement Methodology
Within farm precinct	Laid on ground surface	Pipes will be positioned directly on the ground, adjacent to each other, except where they will be partially buried between the Settlement Ponds and the lower access road (see below).
Intersection with internal access roads	Buried under roads, placed within culverts	A trench leading to and beneath the roads will be excavated (generally as outlined above this Table), and a culvert put in position. This includes the area between the Settlement Ponds and the lower access road. Pipe spools will be connected through the culverts.
Lower access road to Pumphouse	Raised above ground on low supports (to avoid impacts on terrestrial fauna mobility)	Pipes will be placed directly on raised concrete supports (at least 200 mm high), positioned at regular intervals. Pipes will be positioned around trees and other obstacles. A shallow trench will be excavated (generally as outlined above this Table) adjacent to the Pumphouse to allow a partially-below ground connection to the Pumphouse.
Pumphouse to Indian Spring Low Tide mark	Buried underground (to avoid visual amenity and access impacts)	Pipes will be positioned directly adjacent to each other within the trench. Excavations within intertidal areas will begin at the low tide mark and progress towards the shoreline. Concrete weights will be attached to the bottom of each pipe spool (for ballast) via 'Band-It' straps and buckles. Pipe spools will be prepared prior to the commencement of trenching in order to minimise trenching time. All works will occur at low tide. As the placement of pipes within the intertidal area is likely to take more than 1 tide cycle, emplaced pipe spools will be sealed and fitted with inlets to allow the pipes to fill with water as the tide rises (to avoid the floatation of the pipes). Highly visible hardwood marker posts would be driven into the sediment to temporarily mark the position of the next excavation. Note that appropriate Acid Sulphate Soil management procedures will be implemented as well as the transplantation of mangrove seedlings and appropriate.
Indian Spring Low Tide mark to pipe terminus (inlet/ outlet)	Raised above seabed on low supports (to avoid seagrass impacts)	All required pipe spools would be joined by butt fusion (on land) before placement. Each end of the pipeline will be capped to create a floating pontoon, allowing the floating of pipes into position with the aid of a work boat. Once in position, low concrete supports will be attached sequentially to each spool via Band-It straps. The pipes would then be strategically flooded and allowed to gently sink to the seabed, maintaining anchorage at both ends. SCUBA divers will be in position to ensure pipe footings are positioned without undue impacts on seagrasses adjacent to the pipeline route. Once pipelines are fixed in position, underwater technicians will fix appropriate inlet structures with screens to the Intake.

A detailed Construction Management Plan will be prepared before the undertaking of works. This Plan would include details of appropriate construction methodologies, including but not limited to the following:

- Identification and marking of works-corridor and placement of appropriate temporary barricading;
- Identification of appropriate plant access routes and spool stockpile areas;
- Documentation of tidal movements and identification of pipe placement sequences and timeframes;
- Development of safe work procedures;
- Installation of construction signage;
- Emergency retrieval procedures for plant and equipment; and
- Detailed re-vegetation methods for trench locations.

Boardwalk Construction

A proposed boardwalk across Pig Station Creek to the western terminus of Cambage Street is to be positioned over a route that has been previously disturbed.

Earthworks for the construction of the boardwalk is not expected to expose any ASS risk, as there is no potential ASS mapped for the site, excepting a low probability 3 metres below AHD. The auger holes for the boardwalk will be approximately 600mm depth.

The proposal intends to place upright piles of hardwood across the channel of Pig Station Creek and associated wetland areas. During the construction phase it is intended that the hardwood piles be placed in auger holes which are of the same size as the piles. The spoil from these holes will be removed from the site. This form of placement will not generate any appreciable amount of sediment.

Summary

The acid-sulphate soil risk map produced by OEH (Chapman, 1998) indicates a low probability of acid-sulphate soil materials, and that they would be at depths greater than 3 metres below ground level in the terrestrial areas of the site. The same map indicates a high probability of acid sulphate soil materials in the intertidal area at or near the ground surface in the intertidal area and a high probability of acid sulphate soils subtidally.

In assessing the potential impacts from disturbance of sulfidic material or its use in dam or drains walls, of any change in the watertable during construction or operation of the proposal there will be no discernible impact. The process will not be using sulfidic material for pond or terrestrial earthworks, nor is there any intention to affect the water table. No acid sulphate soil (ASS or PASS) has been found within the working depth of the ponds, pipes or other terrestrial facilities. The laying of intertidal pipelines will be done expeditiously and neutralising materials will be buried with the pipelines during backfilling as required by the Department of Agriculture and OEH where acid sulphate soil conditions are encountered.

Note that we will be applying lime during subtidal trenching as PASS was found at the bottom of the intertidal sediment profile below the expected trenching level. A method of management of ASS is to dispose of the potentially acid soil back into an anaerobic environment, usually below the water table. The terrestrial trench for the pipelines will be less than one metre deep and no ASS has been detected along the route. Problems associated with ASS are not expected within these areas (Chapman, 1998)

Appendix 1 Results from Soil and Water Analysis

Soil and Soil water readings were determined in the field and from independent Laboratory analysis. All samples were promptly sealed in two containers with care to exclude air. Samples were kept chilled in the field, frozen within 5 hours and promptly shipped to the lab in appropriate insulated packaging. Field Analysis site distances are from MHWM

Type	location	Lat / Long	Site	Depth	Height AHD	ph	H_2O_2pH	Comment
Soil	-180 m seaward	-32.688217/152.084798	C 1	0.75 m	-2 m	8.7	7.3	NVR
soil	-180 m seaward	-32.688217/152.084798	C 1	1.5 m	-2 m	8.7	8.1	NVR
Soil	-130 m out	-32.687814/150.084585	D 1	0.5 m	-1.7 m	8.0	7.7	NVR
Soil	-130 m out	-32.687814/150.084585	D 1	1.0 m	-1.7 m	8.3	7.8	NVR
Soil	-130 m out	-32.687814/150.084585	D 1	1.5 m	-1.7 m	8.2	7.8	NVR
Soil	-80 m out	-32.687392/152.084372	D 2	0.5 m	-1.5 m	7.8	5.6	NVR
Soil	-80 m out	-32.687392/152.084372	D 2	1.0 m	-1.5 m	7.2	3.1	Slight Reaction few bubbles
Soil	-80 m out	-32.687392/152.084372	D 2	1.5 m	-1.5m	7.1	3.7	Slight Reaction few bubbles
Soil	-25 m seaward	-32.686972/152.084056	C 2	0.75 m	- 1m	7.3	7.0	NVR
Soil	-25 m seaward	-32.686972/152.084056	C 2	1.4 m	-1 m	6.7	6.6	NVR v strong organic staining
Soil	-14 m seaward	-32.686886/152.083999	C 3	1 m	-1 m	7.6	6.9	NVR
Soil	-14 m seaward	-32.686886/152.083999	C 3	1.3 m	-1 m	7.1	7.2	NVR strong organic staining
Soil	-6 m seaward	-32.686988/152.084117	C 4	1.0 m	-0.5 m	7.4	7.4	NVR
soil	-6 m seaward	-32.686988/152.084117	C 4	1.4 m	-0.5 m	7.7	7.2	NVR
soil	30 m inland	-32.685952/152.084275	A 1	.45 m	1.1 m	6.6	6.4	NVR
soil	30 m inland	-32.685952/152.084275	A 1	0.65 m	1.1 m	6.1	6.3	NVR
soil	30 m inland	-32.685952/152.084275	A 1	0.85 m	1.1 m	5.8	6.1	Lab -> not ASS or PASS
Soil water	30 m inland	-32.685952/152.084275	A 1	0.9 m	1.1 m	5.0		Turbidity 999 NTU
Soil	130 m in	-32.685083/	D	0.5 m	1.34 m	5.2	5.7	NVR

Type	location	Lat / Long	Site	Depth	Height AHD	ph	H_2O_2pH	Comment
		152.084003	3					
Soil	130 m in	-32.685083/ 152.084003	D 3	1.0m	1.34 m	4.8	6.4	NVR
Soil	230 m in site road	-32.684737/ 152.083731	A 2	0.8 m	2.06 m	4.6	5.0	Lab -> Not ASS or PASS
Soil water	230 m in site road	-32.684737/ 152.083731	A 2	1.25 m	2.06 m	5.2		
soil	230 m in site road	-32.684737/ 152.083731	A 2	1.3 m	2.06 m	4.6	5.0	NVR
Soil water	230 m in site road	-32.684737/ 152.083731	B 2	1.6 m	2.06 m	4.75		Dark stained water
Soil water	230 m in site road	-32.684737/ 152.083731	B 1	2 m	2.06 m	4.4		Dark stained water
Soil	250 m in	-32.684039 / 152.083635	D 4	0.5 m	3.69 m	4.6	6.1	NVR
Soil	250 m in	-32.684039 / 152.083635	D 4	1.5 m	3.69 m	5.7	6.2	NVR
Soil	250 m in	-32.684039 / 152.083635	D 4	2.0 m	3.69 m	5.1	5.9	NVR

Appendix 2 Procedure for installing pipeline across intertidal and subtidal areas.

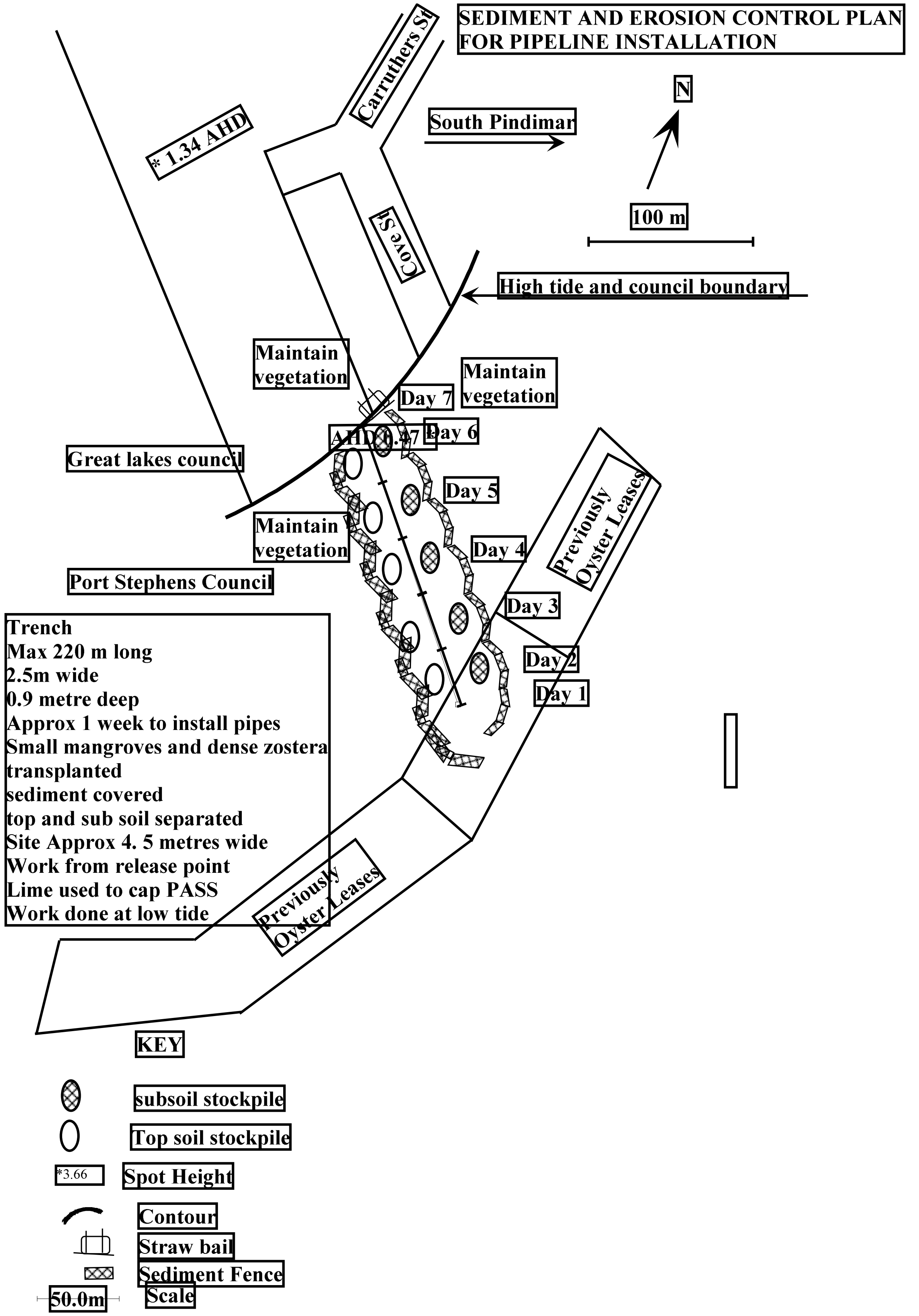
Pipe spools will be stockpiled for installation.
Excavation would start at the low tide point and progress toward the high tide point (shoreline) As Indicated in Appendix 3
The top layer would be removed with a mud bucket fitted to a rubber-tracked excavator and deposited to one side of the trenching line (approx. 150 mm deep top layer)
The trenching would be carried out to a depth of 900 mm and spoils deposited on the opposite side to the top soil cutting in stockpiles. All stockpiles of saturated sediment will be deposited on a ground sheet and will be covered to ensure moisture retention.
The trench width would be to accommodate four pipes, @ 630 mm diameter with spacing around the pipes, giving an overall requirement of approximately 2600mm wide, with an allowance of 1000mm each side for deposition of top cut and trenching spoils, giving an estimated 4600mm wide path for pipe installation.

The pipes would be welded and have weights fixed to the bottom of the pipes, the ballast would be concrete sections attached by 316 SS bandit strap and buckles running along the full length of the pipe spools.
All spools would be prepared prior to the commencement of trenching and be ready for installation as time will be of the essence with attention to minimum disturbance to the working corridor.
The spools would be positioned behind the excavator during excavation and be ready for lifting into position.
Backfilling would be carried out using the trenching spoils with lime used as a capping to the exposed trench floor.
The top soil layer would be used to top the trench and reinstate the disturbed area.
As it is unlikely that the full intertidal crossing could be laid in on low tide event, the pipe spools would be blanked off and have fitted an inlet at the seaward end to allow the pipes to fill with water as the tide rises and eliminate the possibility of the pipes becoming pontoons and floating out of the trench.
Hardwood marker posts would be driven in to mark the ends of the pipes and indicate the position for excavation for the next set of pipes.
The procedure would be repeated for the installation of the next set of flanged spools until reaching the high tide point.

The land side end cap would be removed at the commencement of excavation and reinstalled at the land side ends of the next set of pipe spools at the same time as the pipes are positioned in the trench and welded to the previously installed set of pipe spools.
The movement of the tide will determine the chainage distance achievable and this will dictate the spool lengths.
It is assumed the installation at the low tide point (starting point) could be reduced due to ingress of tide and the pipe spools therefore may have to be reduced.
Observation and determination of spool lengths would be concluded prior to work commencing.

Pre requisites
Marking out the corridor of works and barricading.
Documenting tidal movement and time frame.
Removal of excess spoils and dumping point.
Emergency retrieval of excavator procedure.
Installation of signage
Site specific induction for all personnel on site
Development of safe work procedures.
Development of job safety and environmental assessment procedures.
Establishment of first aid and emergency facilities and personnel.
Testing the impact of the excavator on the low tide area.
Marking positions for inlet and outlet points
Weather reports.

Appendix 3 Sediment and Erosion Control Plan for Pipeline Installation



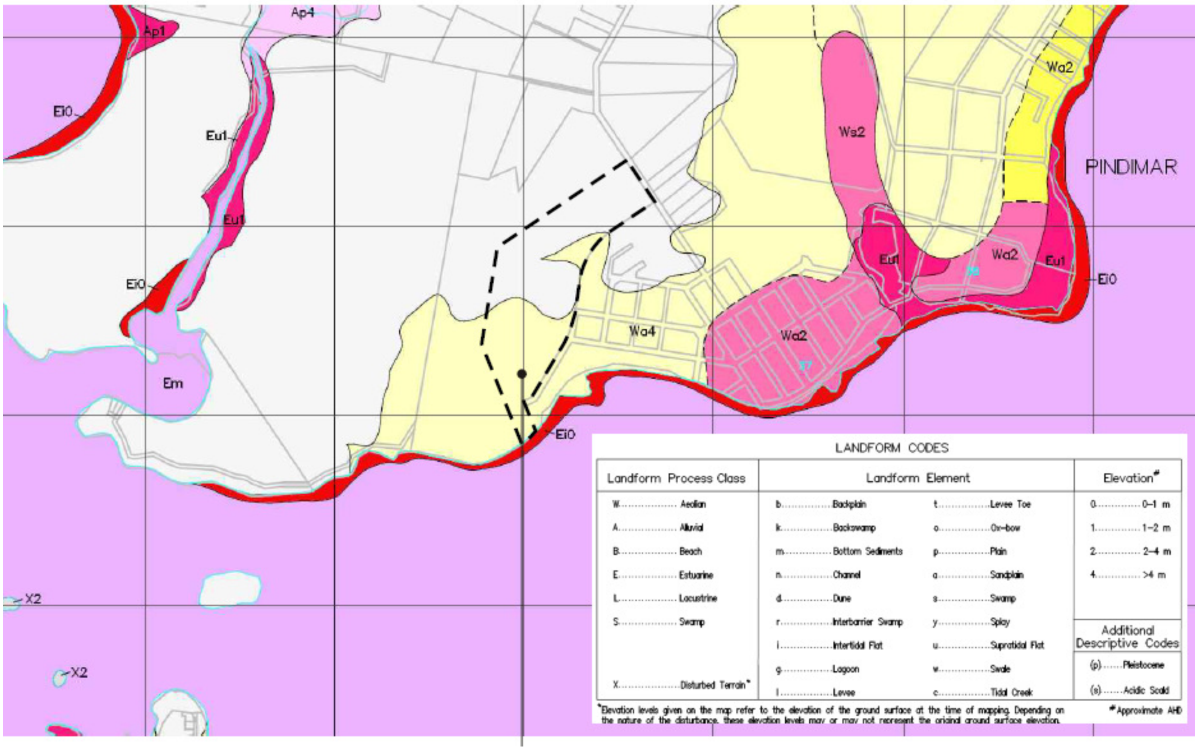
Appendix 4 Acid Sulphate Soil Risk Map

Extract from: Acid Sulphate Soil Risk Map Port Stephens Edition 2.

KEY

Map Class Description	Depth to Acid Sulfate Soil Materials		Environmental Risk	Typical Landform Types
HIGH PROBABILITY High probability of occurrence of acid sulfate soil materials within the soil profile. The environment of deposition has been suitable for the formation of acid sulfate soil materials. Acid sulfate soil materials are widespread or sporadic and may be buried by alluvium or windblown sediments.	Below water level	Bottom sediments.	Severe environmental risk if bottom sediments are disturbed by activities such as dredging.	Bottom sediments of lakes, lagoons, tidal creeks, rivers and estuaries.
		At or near the ground surface.	Severe environmental risk if acid sulfate soil materials are disturbed by activities such as shallow drainage, excavation or clearing.	Estuarine swamps, intertidal flats and supratidal flats.
		Within 1 metre of the ground surface.	Severe environmental risk if acid sulfate soil materials are disturbed by activities such as shallow drainage, excavation or clearing.	Low alluvial plains, estuarine sandplains, estuarine swamps, backswamps and supratidal flats.
		Between 1 and 3 metres below the ground surface.	Environmental risk if acid sulfate soil materials are disturbed by activities such as deep excavation for pipelines, dams or deep drains.	Alluvial plains, alluvial swamps, alluvial levees and sandplains.
		Greater than 3 metres below the ground surface.*	Environmental risk if acid sulfate soil materials are disturbed by activities such as deep excavations, -e.g. large structure foundations or deep dams.	Elevated levees and sandplains, alluvial plains and alluvial swamps in estuarine reaches of catchments.
LOW PROBABILITY Low probability of occurrence of acid sulfate soil materials within the soil profile. The environment of deposition has generally not been suitable for the formation of acid sulfate soil materials. Soil materials are often Pleistocene in age. Acid sulfate soil materials, if present, are sporadic and may be buried by alluvium or windblown sediments.	Below water level	Bottom sediments.	The majority of these landforms are not expected to contain acid sulfate soil materials. Therefore, land management is generally not affected by acid sulfate soils. However, highly localised occurrences may be found, especially near boundaries with environments with a high probability of occurrence. Disturbance of these soil materials will result in an environmental risk that will vary with elevation and depth of disturbance.	Elevated alluvial plains and levees dominated by fluvial sediments. Plains and dunes dominated by aeolian soils. Pleistocene plains. Lacustrine and alluvial bottom sediments.
		At or near the ground surface.		
		Within 1 metre of the ground surface.		
		Between 1 and 3 metres below the ground surface.		
		Greater than 3 metres below the ground surface.*		
NO KNOWN OCCURRENCE Acid sulfate soils are not known or expected to occur in these environments		No known occurrences of acid sulfate soil materials.	Land management activities not likely to be affected by acid sulfate soil materials.	Bedrock slopes, elevated Pleistocene and Holocene dunes, and elevated alluvial plains.
DISTURBED TERRAIN		Disturbed terrain may include filled areas, which often occur during reclamation of low lying swamps for urban development. Other disturbed terrain includes areas which have been mined or dredged, or have undergone heavy ground disturbance through general urban development or construction of dams or levees. Soil investigations are required to assess these areas for acid sulfate potential.		

*Deep occurrences of acid sulfate soil materials not able to be confirmed by field inspection and sampling.



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