umwelt
Environmental & Social Consultants

MACKA'S SAND PTY LTD

SOIL AND WATER MANAGEMENT PLAN

For Lot 218 and Lot 220, Salt Ash, NSW

FINAL

November 2021

SOIL AND WATER MANAGEMENT PLAN

For Lot 218 and Lot 220, Salt Ash, NSW

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Mackas Sand Pty Limited

Project Director:	Luke Bettridge
Project Manager:	Dominic Brown
Report No.	R63
Date:	November 2021

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Disclaimer

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	Brendan Rice (Umwelt (Australia) Pty Limited)	July 2016	Peter Jamieson (Umwelt (Australia) Pty Limited)	July 2016
2	Brendan Rice (Umwelt (Australia) Pty Limited)	August 2017	Bret Jenkins (Umwelt (Australia) Pty Limited)	August 2017
3	Rod Williams (Umwelt (Australia) Pty Limited)	April 2018	Bret Jenkins (Umwelt (Australia) Pty Limited)	April 2018
4	Rod Williams (Umwelt (Australia) Pty Limited)	February 2019	Bret Jenkins (Umwelt (Australia) Pty Limited)	February 2019
5	Rod Williams (Umwelt (Australia) Pty Limited)	May 2019	Bret Jenkins (Umwelt (Australia) Pty Limited)	May 2019
6	Dominic Brown (Umwelt (Australia) Pty Limited)	November 2021	Luke Bettridge (Umwelt (Australia) Pty Limited)	November 2021

Table of Contents

Figures

Tables

Appendices

1.0 Introduction

Mackas Sand Pty Ltd (Mackas Sand) operations on Lot 218 and Lot 220 are located approximately 25 kilometres (km) north-east of Newcastle near Salt Ash in the Port Stephens Local Government Area (LGA), New South Wales (refer to **Figure 1.1**). Mackas Sand directors have operated sand extraction operations in the area since 1992. Lot 218 and Lot 220 are owned by the Worimi Local Aboriginal Lands Council.

Mackas Sand was granted Project Approval No. 08_0142 (PA 08_0142) on 20 September 2009 by the Minister for Planning under Part 3A of the *Environmental Planning and Assessment Act 1979* to operate sand extraction operations at Lot 220 and Lot 218. It is estimated that in excess of 21 million tonnes of sand resource will be extracted from Lot 218 and Lot 220, with Lot 218 having an indefinite extraction life due to the ongoing movement of sand from the adjoining mobile dunes. Sand extraction operations commenced at Lot 220 in late 2009.

Modification 1 to PA 08_0142 was approved on 30 September 2013 by the NSW Planning Assessment Commission (PAC) under delegation of the Minister for Planning and Infrastructure (now Minister for Planning and Environment-DP&E). Modification 1 (PA 08_0142 MOD1) approved:

- sand extraction to includes approval to extract within 0.7 metres (m) of the maximum highest predicted groundwater level at Lot 220;
- sand extraction to within 0.7 m of the maximum predicted groundwater level at Lot 218, unless the core sample testing program demonstrates that extraction to within 0.7 m of maximum predicted groundwater can be undertaken without disturbing acid sulphate soils;
- a final landform surface level is at least 1 m above the maximum highest predicted groundwater level at Lot 218 and Lot 220; and
- the approval of an alternate route to access Lot 218. The alternate route connects directly from Lot 218, northward to Nelson Bay Road, as depicted within **Figure 1.1**.
- Sand extraction operations commenced at Lot 218 in late 2013.

A second modification to PA 08_0142 was approved by the PAC on 16 March 2016. The Modification 2 (PA 08_0142 Mod 2) allowed for an increase in maximum hourly truck movements (in and out) of Lot 218 via the approved alternate access road.

1.1 Mackas Sand Operations

Key operational features relevant to this Soil and Water Management Plan (SWMP) are the geomorphology and characteristics of the sand resources subject to extraction and that the depth of sand extraction is limited to 1.0 m above the maximum predicted groundwater level.

The geomorphology of the outer barrier of Stockton Bight has resulted from the programming of the beach following stabilisation of the sea level approximately 6000 years ago. This was followed by three subsequent transgressive dune phases which have resulted in a series of elevated sand dunes that extend landward to Nelson Bay Road.

The Lot 218 operational area is situated within the mobile dune field that is the result of the most recent transgressive phase that occurred 300 to 500 years ago. Lot 220 contains dunes deposited in both the first and second transgressive phases which were formed around 4000 and 1200 years ago respectively.

As the sand resource at Lots 218 and 220 were formed by the deposition of windblown sand they are generally well graded. As such the sand has:

- high infiltration and permeability characteristics
- a typical particle size of 0.2 to 0.3 mm and is a Type C soil as defined in Landcom (2004) and therefore has limited potential to increase surface water turbidity / suspended solid concentration.

Although some acid sulphate soils were formed millions of years ago and occur in ancient marine rocks, those of most concern were formed after the last major sea level rise—within the past 10,000 years (Holocene period). As the sand dunes at Lot 218 and Lot 220 are younger than 10,000 years, the probability of acid sulphate soils being present in this landform is considered to be low. This low probability has also been confirmed via a testing program undertaken by Mackas Sand.

Image Source: Nearmap (Jan 2021)

Legend

- Lot Boundaries
- Approval Areas
- Approved Site Access (not-utilised)
- Approved Site Access (utilised)
- Approved Alternate Site Access (utilised)

FIGURE 1.1

Locality Plan

1.2 Purpose and Scope

To satisfy Condition 18 of Schedule 3 of the Project Approval 08_0142 (PA 08_0142 as modified), a SWMP has been prepared and implemented for the project. The original version of the SWMP was prepared in consultation with the Environment Protection Authority (EPA), Department of Primary Industries (DPI Water) and Hunter Water Corporation (HWC) and submitted to the Department of Planning, Industry & Environment (DPIE) for approval.

The purpose of this SWMP is to define the control mechanisms to be implemented for the management and mitigation of potential water quality impacts generated by extractive operations at Lot 218 in DP 1044608 and Lot 220 DP 1049608 (hereafter referred to as the approval areas) Nelson Bay Road, Salt Ash.

This plan outlines the methodology used to determine compliance of the continued operations and response procedures to be followed in the event of non-compliance or measured exceedances of the relevant criteria.

1.3 Regulatory Requirements

1.3.1 Project Approval

A detailed list of the PA 08_0142 (as modified) conditions and the relevant Statement of Commitments outlined in the Project Approval, and where they are addressed in this document is included in **Table 1.1** and **1.2**.

Table 1.1 Project Approval Conditions

Conditions		Addressed in Section
Schedule 3 – Environmental Performance Conditions **Soil and Water Management**		
18.	The proponent shall prepare and implement a Soil and Water Management Plan for the project to the satisfaction of the Secretary. This plan must: a. be prepared in consultation with EPA, DPI Water and HWC, and be submitted to the Secretary for approval within 3 months of the date of this approval; and	**Whole Document**
	b. include a: ○ Site Water Balance; ○ Erosion and Sediment Control Plan; ○ Surface Water Monitoring Program and ○ Groundwater Monitoring Program. The proponent shall; implement the approved management plan as approved from time to time by the Secretary. *Note: The Department accepts that the initial soil and Water Management Plan may not include a detailed Site Water Balance. However, the detailed Site Water Balance*	**Sections 2.0 to 5.0**

Conditions		Addressed in Section
	must be approved prior to the commencement of any sand washing or groundwater extraction activities for the project.	
19.	The Site Water Balance must: • include details of: ○ Sources and security of water supply; ○ Water use on-site; ○ Water management on site; ○ Any off-site water transfers; and ○ Reporting procedures.	**Section 2.0**
	a. Investigate and describe measures to minimise water use by the project.	**Section 2.5**
20.	The Erosion and Sediment Control Plan must: a. be consistent with the requirements of Managing Urban Stormwater: Soils and Construction Volume 1, 4th Edition, 2004 (Landcom);	**Section 3.1**
	b. identify the activities that could cause soil erosion and generate sediment;	**Section 3.2**
	c. describe measures to minimise soil erosion and the potential for the transport of sediment off site;	**Section 3.2**
	d. describe the location, function and capacity of erosion and sediment control structures; and	**Section 3.2**
	e. describe what measures would be implemented to maintain these structures over time.	**Section 3.2.1**
21.	The Surface Water Monitoring Program must include: a. baseline data on surface water quality, where available;	**Section 4.1**
	b. surface water impact assessment criteria;	**Section 4.2**
	c. a program to monitor surface water quality (particularly in project sediment basins); and	**Section 4.3**
	d. a protocol for the investigation, notification and mitigation of identified exceedances of the surface water impact assessment criteria.	**N/A**
22.	The Ground Water Monitoring Program must include: a. detailed baseline data on groundwater levels and quality, based on statistical analysis (including available HWC data);	**Section 5.1**

Conditions		Addressed in Section
	b. groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts;	**Section 5.2**
	c. a program to monitor groundwater levels and quality, including a groundwater core sample testing program to monitor changes in metallic species above the maximum predicted groundwater level at Lot 218 that;	**Section 5.3 and 5.3.1**
	i. is developed in consultation with the EPA;	**Section 5.3.1**
	ii. samples to a depth at least 2 m below the proposed extraction depth of 0.7 m above the maximum predicted groundwater level, from at least two locations within the area proposed to be extracted within the first 3 years; and	**Section 5.3.1**
	iii. includes testing for acid forming minerals at regular depth and time intervals;	**Section 5.3.1**
	d. a protocol for further groundwater modelling to confirm the limits to excavation depth across the site permitted in accordance with condition 7 of schedule 2; and	**Section 5.4**
	e. a protocol for the investigation, notification and mitigation of identified exceedances of the groundwater impact assessment criteria.	**Section 5.5**

Table 1.2 Statement of Commitments

Conditions		Addressed in Section
Groundwater		
1.8.1	A Groundwater Management Plan will be developed prior to any sand extraction activities to the satisfaction of the Department in consultation with EPA. The Plan will include a groundwater monitoring program that includes quarterly monitoring of groundwater level and quality (electrical conductivity, pH, turbidity, arsenic, manganese and iron) at groundwater monitoring bores SP 1 to SP 6 as shown on Figure 4.7 of the EA. The results of the monitoring are to be commented on and compiled into an annual report.	**Section 5.0 and 6.1**
1.8.2	Any refuelling of equipment used for the proposal will be undertaken by a registered contractor to remove the need for on-site storage of fuels. No maintenance of equipment or storage of chemicals will occur at either site.	**Section 1.4**
1.8.3	Prior to sand washing being undertaken on-site access to a suitable water supply will be obtained and evidence of this will be provided to the Department. Prior to sand washing commencing a detailed Water Management Plan for the sand washing operation will be prepared and provided to the Department.	**Section 2.1**
Surface Water		
1.9.1	Table drains and flow dissipation structures will be installed along on-site access roads as required in accordance with the Erosion and Sediment Control Regional Policy (Port Stephens Council 2002) and the Code of Practice for Managing Urban Stormwater – Soils and Construction (Landcom 2004).	**Section 3.1. and 3.2**
1.9.2	Site Water Management Plans for operations on Lot 218 and Lot 220 will be submitted for approval to the Department in consultation with EPA prior to the commencement of sand extraction activities. The Plan will include details on the storage and handling of chemicals on the sites including refuelling of mobile equipment.	**Whole Document**
1.9.3	Access roads will be constructed so as to not impede flood flows on Tilligerry Creek floodplain. The alternate access road will be sealed between Nelson Bay Road and the southern edge of the Tilligerry Creek crossing to minimise sediment generation and transport adjacent to Tilligery Creek.	**Section 2.1**

1.3.2 Environment Protection Licence

Environment Protection Licence No 13218 Condition L1.1 requires compliance with Section 120 of the *Protection of the Environment Operations Act 1997* (POEO Act), which prohibits the pollution of waters. The management measures described in this plan are designed to address this condition.

1.3.3 Water Licencing

Mackas Sand does not hold any water licences associated with the operations at Lot 218 or 220. As noted in Section 5, Mackas Sand monitors a number of groundwater parameters from a network of groundwater monitoring bores. In accordance with Part 4 Division 4.7 Section 4.41 of the *Environmental Planning and Assessment Act 1979* and as discussed with Department of Industry (DoI) Crown Lands and Water Division (CL&WD) (2017), Mackas Sand are not required to hold a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000*. Furthermore the *Water Management (General) Regulation 2018* Schedule 4 Part 1 Clause 10 also exempts Mackas Sand from the need to hold an access licence.

1.4 Extraction Operations on Lot 218 and Lot 220

Extracted sand is either loaded directly onto trucks using a front-end loader or equivalent or screened on-site before being loaded onto trucks for transport off-site via the alternate haul route (Lot 218) or Oakvale Drive (Lot 220).

As shown in the **Figure 1.2**, approval has been granted for the installation of a wash plant, pond and associated infrastructure. Construction and installation of this infrastructure has not been undertaken to-date. Sand processing undertaken at Lot 218 or Lot 220 consists of mechanical screening to remove oversize materials which poses limited potential to impact on surface or groundwater quality.

A Maximum Extraction Depth Map (2010) has been prepared and submitted to the DPIE, in accordance with Schedule 3 Condition 2 of PA 08_0142 (as modified). Review and revision of the Maximum Extraction Depth Map will be undertaken in accordance with Schedule 3, Condition 3 of PA 08_0142. Furthermore, **Table 5.6** identifies the protocol (Trigger Action Response Plan), for triggering additional review and update (if required) of the Maximum Extraction Depth Map.

Final landform is required to be maintained at a level of at least 1 m above maximum predicted groundwater level (refer to **Figure 1.3**). In accordance with Schedule 2, Condition 7, sand extraction is restricted 0.7 m and 1.0 m above the maximum predicted groundwater level on Lot 220 and Lot 218 respectively. Extraction to 0.7 m above the maximum predicted groundwater level at Lot 218 can be undertaken but is subject to the development of a groundwater core sample testing program in consultation with the EPA.

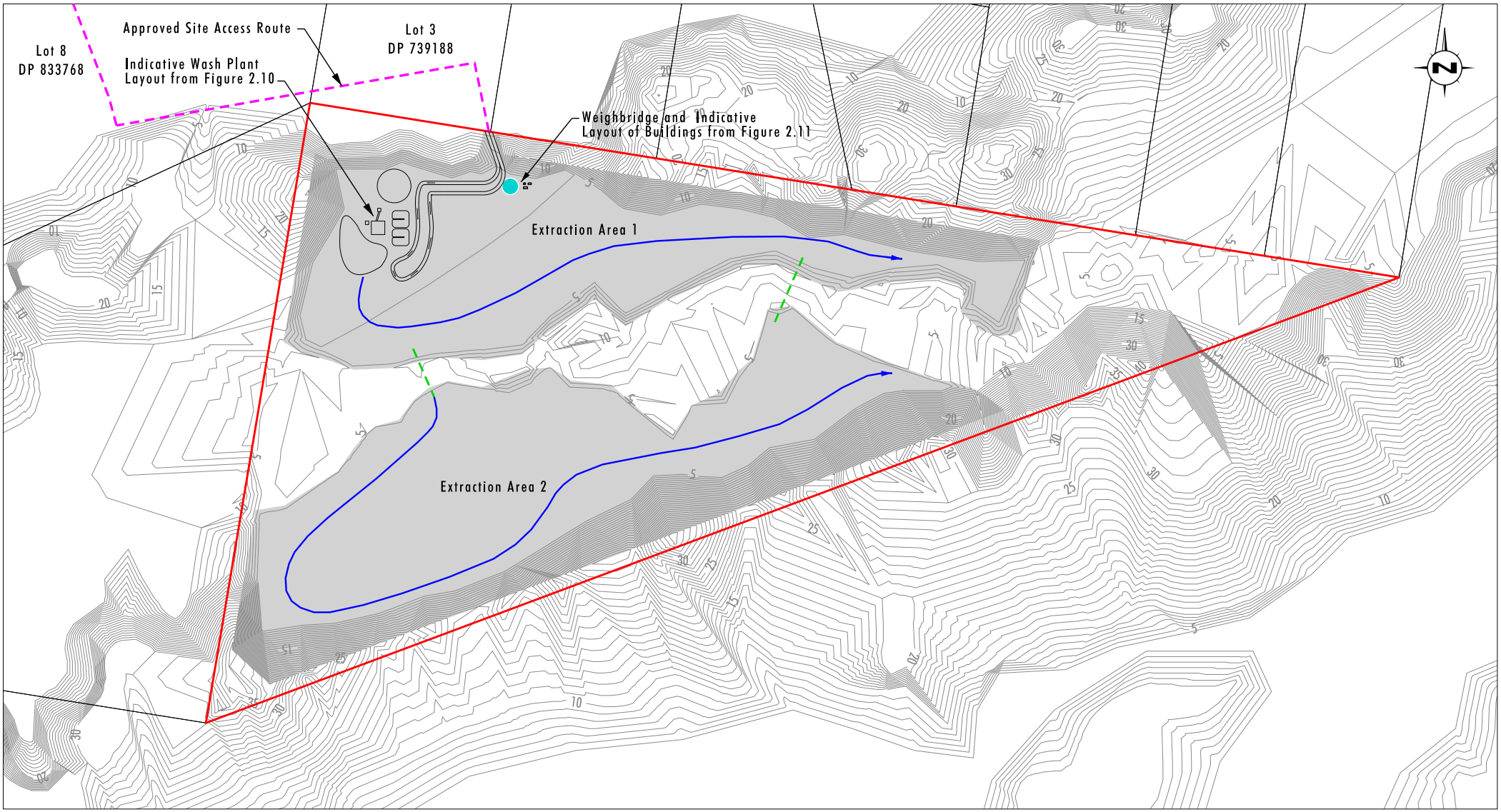
Transects and Cross sections of existing operations for Lot 218 and 220 are provided in **Figures 1.4-1.6**.

Equipment will be refuelled on-site by appropriately qualified personnel in accordance with the Mackas Sand Operational Management Procedure (Umwelt 2014) with no fuel or oil being stored on-site.

The sand at extraction sites on Lot 218 and Lot 220 has high infiltration and permeability and as a result the site exhibits no surface drainage lines. The sand on-site has a typical particle size of 0.2 to 0.3 mm and is a Type C soil as defined in Landcom (2004).

In accordance with Section 2.3.8 of the Mackas Sand Project Environmental Assessment, a vegetated bund will be developed and maintained along the landward side of the Lot 218. The proposed final landform at

Lot 220 will also feature reshaped batters to provide additional runoff control should runoff occur during extreme rainfall events.



Source: Department of Lands (2003)
Note: Contour Interval 10m

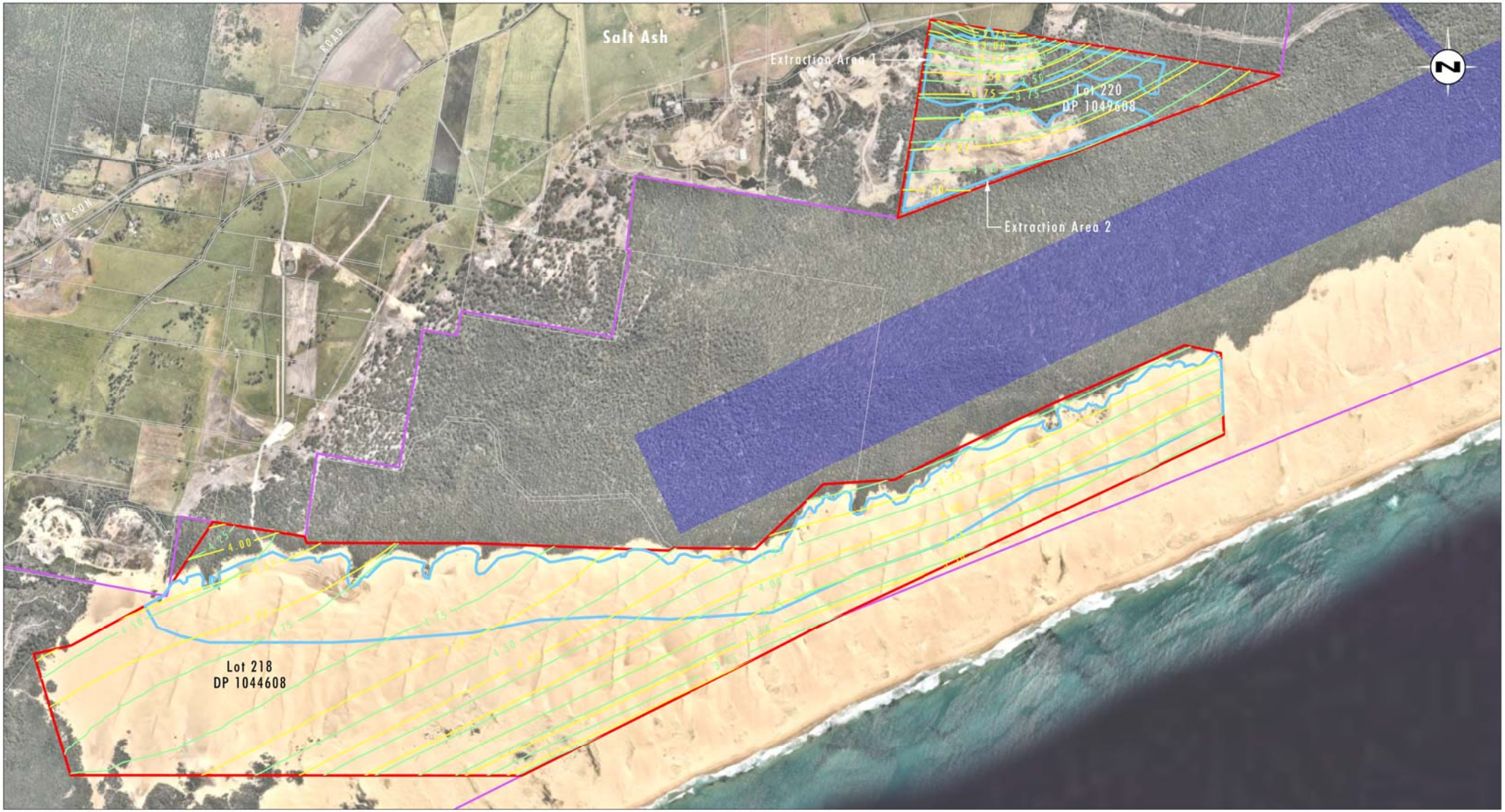
0 100 200 400m
1:8000

Legend
- Lot 220 Boundary
- Internal Access Roads
- Approved Site Access Route
- Direction of Extraction

FIGURE 1.2

Lot 220 Extraction Plan

File Name (A4): R63/1646_502.dgn



Source: Nearmap (2018), Department of Lands (2003)

0 0.5 1 1.25km
1:25 000

Legend

- Lot Boundaries (218 & 220)
- Approved Extraction Area
- North Stockton Catchment Area
- HWC Emergency Borefield Easement
- 2 metres above Average Groundwater Level
- 1 metre above Maximum Predicted Groundwater Level

FIGURE 1.3

Maximum Extraction Depth Map for Lot 218 and Lot 220

File Name (A4): R63_V1/1646_448.dgn

Source: Nearmap (2018)

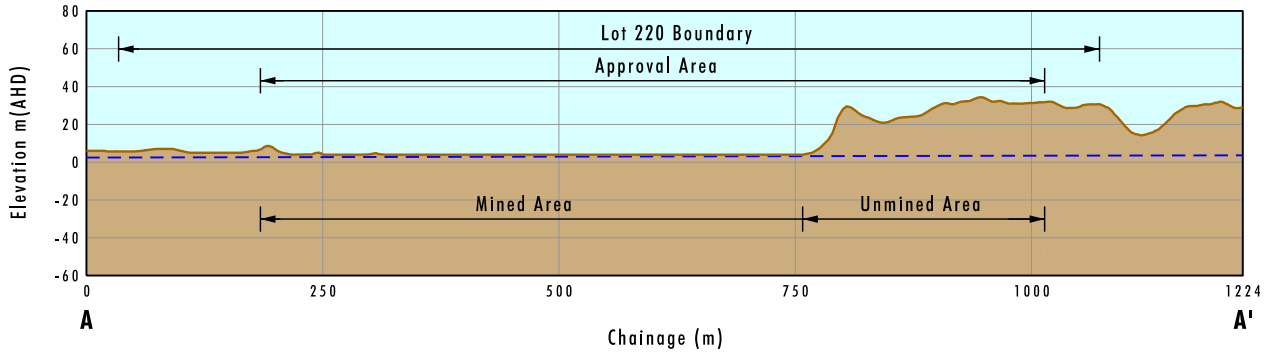
Legend

- Lot Boundaries (218 & 220)
- Approval Area
- Cross Section Location
- EPL Groundwater Monitoring Location

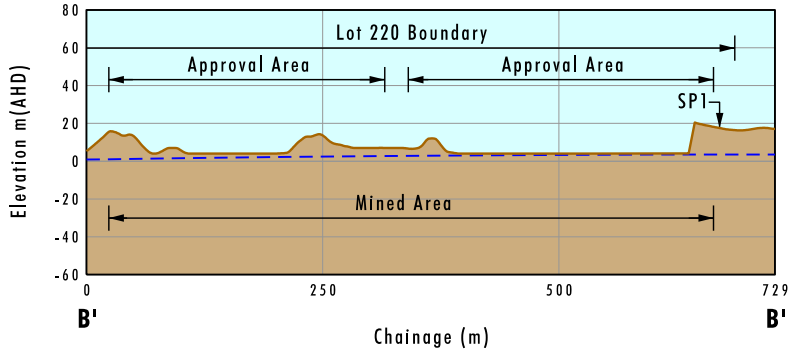
FIGURE 1.4

Cross Section Locations

File Name (A4): R63/1646_505.dgn
20190523 9.15



Section A-A'



Section B-B'

0 50 100 200m
Vertical Scale 1:4000

0 100 200 400m
Horizontal Scale 1:8000

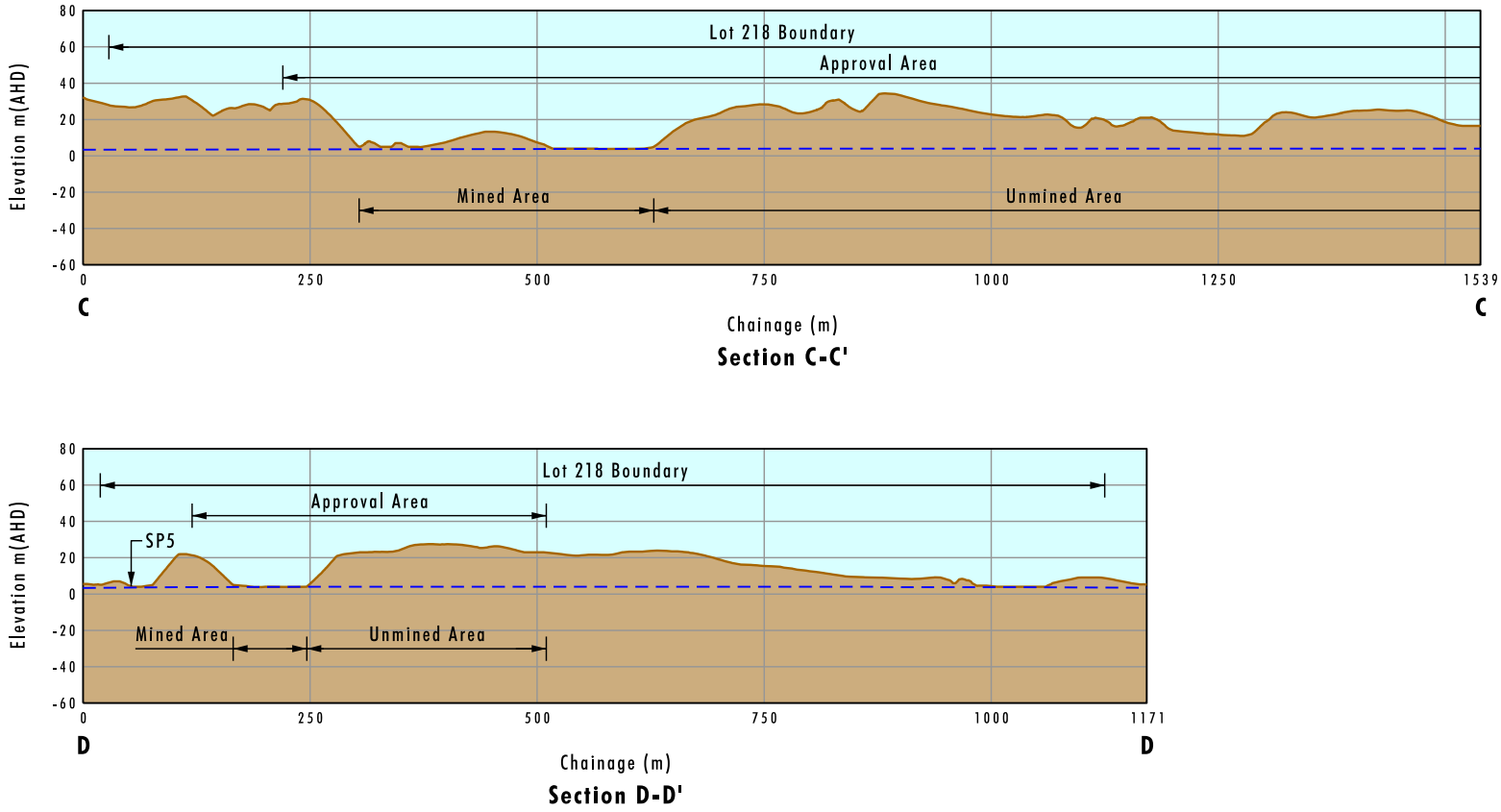
Legend

- Ground Surface
- 0.7m above Maximum Predicted Groundwater Level (Limit of Sand Extraction)
- Sand

Data Source: Centurion Survey (2018), LiDAR (2017/2012)

FIGURE 1.5

Cross Section A-A' and B-B'
Lot 220



0 50 100 200m
Vertical Scale 1:4000

0 100 200 400m
Horizontal Scale 1:8000

Legend

- Ground Surface
- 1m above Maximum Predicted Groundwater Level (Limit of Sand Extraction)
- Sand

Data Source: Centurion Survey (2018), LiDAR (2017)

FIGURE 1.6

Cross Section C-C' and D-D'
Lot 218

File Name (A4): R63/1646_506.dgn
20190523 9.17

2.0 Site Water Balance

2.1 Water Use On-Site

Mackas Sand does not extract groundwater for use at either Lot 218 or Lot 220 sand extraction areas, and therefore does hold any licences for the extraction of groundwater for use at either Lot 218 or Lot 220. Water demand for the current sand extraction operations is nil.

A small crib hut is hut located along Lot 218 alternate access haul road providing potable water. Water is either captured via rainwater or brought to site by a contractor (as needed).

2.2 Water Management On-site

Water management needs on-site are negligible and are limited to surface runoff from the sealed access road. The remainder of the site is comprised of sand which is free draining. There will be no water storages constructed on either site as part of the current approval. There is no surface water runoff at either of the sites that requires diversion or specific management.

2.3 Off-Site Water Transfers

There is no requirement for off-site transfers of water from the sand extraction operations on either Lot 218 or Lot 220.

2.4 Reporting Procedures

Mackas Sand will keep a record of any extraordinary water usage on-site for sand extraction purposes and will compile and present this information as part of the Annual Review.

2.5 Measures to Minimise Water Use

Mackas Sand has effectively reduced its water usage to nil with the sealing of the access road. As such there is no further need to review and investigate opportunities to further minimise water usage. Should this situation change in the future Mackas Sand will investigate opportunities at that time.

3.0 Erosion and Sediment Control Plan

The project has negligible potential to generate runoff or impact on surface waters. This is due to:

- the operation being undertaken on a sand dune environment which has high infiltration and permeability characteristics
- the floor of the extraction operation is typically the lowest point in the landscape. Rain which falls within the footprint of the extraction area typically immediately infiltrates through the sand profile and reports to the groundwater. Occasionally surface water has been observed to pond on site (i.e. perched water due to the infiltration rate being exceeded). This ponded water has not been observed to discharge off site. It is also noted that the nearest drainage line to both operations are located upslope from the extraction areas which further minimises and limits the potential for surface water runoff to discharge offsite. Any surface water runoff generated in the extraction area is expected to be contained with the floor of the extraction area
- the sand has a typical particle size of 0.2 to 0.3 mm and is a Type C soil as defined in Landcom (2004) and as such has limited potential to increase surface water turbidity / suspended solid concentration.

3.1 Managing Urban Stormwater (2004) Requirements

Managing Urban Stormwater: Soils and Construction Volume 1, 4th Edition, 2004 (Landcom) hereafter referred to as Landcom (2004) provides guidelines designed to minimise land degradation and water pollution at urban development sites in NSW. The eight general principles for achieving this during the construction alternate access road at Lot 218 and the sand extraction operations are:

a. Assess the soil and water implications of the development including those related to ESD

b. Investigate the acid sulphate potential on lands near the coast where soil disturbance is likely to have an impact

c. Plan for erosion and sediment control concurrently with engineering design and before earthworks begin, ensuring proper assessment of site constraints and integration of various components

d. Minimise the area of soil disturbed and exposed to erosion

e. Conserve topsoil

f. Control water flow from the top of the development area, through the works and out the bottom of the site

g. Rehabilitate disturbed lands quickly

h. Maintain soil and water management measures appropriately during the construction phase.

This Soil and Water Management Plan has been prepared in accordance with these general requirements.

3.2 Potential Sources of Erosion and Sediment Generation and Their Controls

Mackas Sand will implement the following practical erosion and sediment controls to minimise the generation and transportation of sediment around and offsite:

- temporary silt fences will be constructed immediately downslope of topsoil stockpiles which have the potential to drain off site. Construction details for ESC structures utilised onsite are shown on **Figure 3.1;**
- minimising all disturbed areas and stabilisation by progressive rehabilitation/stabilisation as soon as practicable;
- clearly identifying and delineating areas to be disturbed and ensuring that disturbance is limited to those areas. Clearing as little vegetation as required and minimising machinery disturbance outside of these areas;
- construction of drainage controls such as table drains at roadsides and on hardstand areas;
- interception of runoff from disturbed catchment areas in pit floors or sediment dams;
- regular maintenance of all controls and inspection of all works weekly and following storm events, to ensure erosion and sediment controls are performing adequately; and
- immediate repair or redesign of erosion and sediment controls that are not performing adequately, as identified in field inspections.

3.2.1 Haul Roads

3.2.1.1 Lot 218

The construction of the alternate access road to Lot 218 was completed in 2014. With the surface upgraded with a bitumen seal during 2017. The access road was constructed with grades ranging from 0 - 3% with a two way cross-fall within 100 m of drainage lines. Sediment generation along the sealed section of the haul road is considered negligible.

A small portion of the alternate access haul road located near the entrance to the sand extraction area remains unsealed. This area has some potential for sediment to be tracked by vehicles as they enter and exit site. To address this Mackas Sand will use road side drains and/ or silt fencing and use the natural gradient to maximise the catchment which reports to the quarry floor area.

Internal haul roads located within the Lot 218 operational areas are constructed on a flat surface, are surround by free draining sand and therefore have negligible potential for sediment generation or transport.

3.2.1.2 Lot 220

The remaining unsealed portion of the Lot 220 access roadway was sealed during 2017 and the potential for sediment generation and transport in this area is considered negligible. Internal haul roads located

within the Lot 220 operational areas are constructed on flat surfaces and have negligible potential for sediment generation or transport.

3.2.2 Clearing and Topsoil Stripping

3.2.2.1 Lot 218

Clearing or topsoil stripping activities are not required as part of operations at Lot 218.

3.2.2.2 Lot 220

Operations at Lot 220 require vegetation clearing and topsoil stripping prior to undertaking sand extraction activities, with the extent of the work area demarcated prior to undertaking such work.

3.2.3 Soil and Stockpile Management

3.2.3.1 Lot 218

The sand at Lot 218 is extracted from a series of mobile / windblown dunes. As such, there is no topsoil to be stripped from the surface of the dune and stockpiled for reuse. The sand at Lot 218 is fine grained, free draining. As such, there is minimal potential for sediment to be entrained in surface water runoff from the site.

Therefore, the principal cause of sediment movement at Lot 218 is windblown sand from the mobile dunes, which is a natural process associated with this landscape.

3.2.3.2 Lot 220

The sand at Lot 220 is extracted from a series of vegetated dunes and as such a topsoil layer is present. Prior to the extraction of the sand resource the topsoil is salvaged and either immediately placed as part of the rehabilitation of the mined area and the perimeter batters or stockpiled in areas for later use in site rehabilitation. Silt fences will be constructed immediately downslope of topsoil stockpiles which have the potential to generate surface water runoff which my drain off site. Stockpiles will be managed in accordance with the relevant controls listed in the Landscape Management Plan.

3.2.4 Site Inspection and Maintenance

The Quarry Manager is responsible for ensuring that inspections of the sediment and erosion control infrastructure is undertaken at least weekly and after rainfall events greater than 40 mm in 24 hours. The Quarry Manager's responsibilities include:

a. ensuring that drains operate properly and that necessary repairs are undertaken

b. maintaining sediment control measures in a functional condition (i.e. >30% capacity) until all earthworks are completed and the site has been successfully rehabilitated to provide a stable non-erosive surface

c. removing spilt sand to ensure that a minimum width of 5 m is maintained between stockpiles and areas of high flow concentration or ecologically sensitive areas

d. removing trapped sediment from behind silt fences and level spreaders, this will generally be undertaken when sediment build up is approximately 30% of the height of the fence

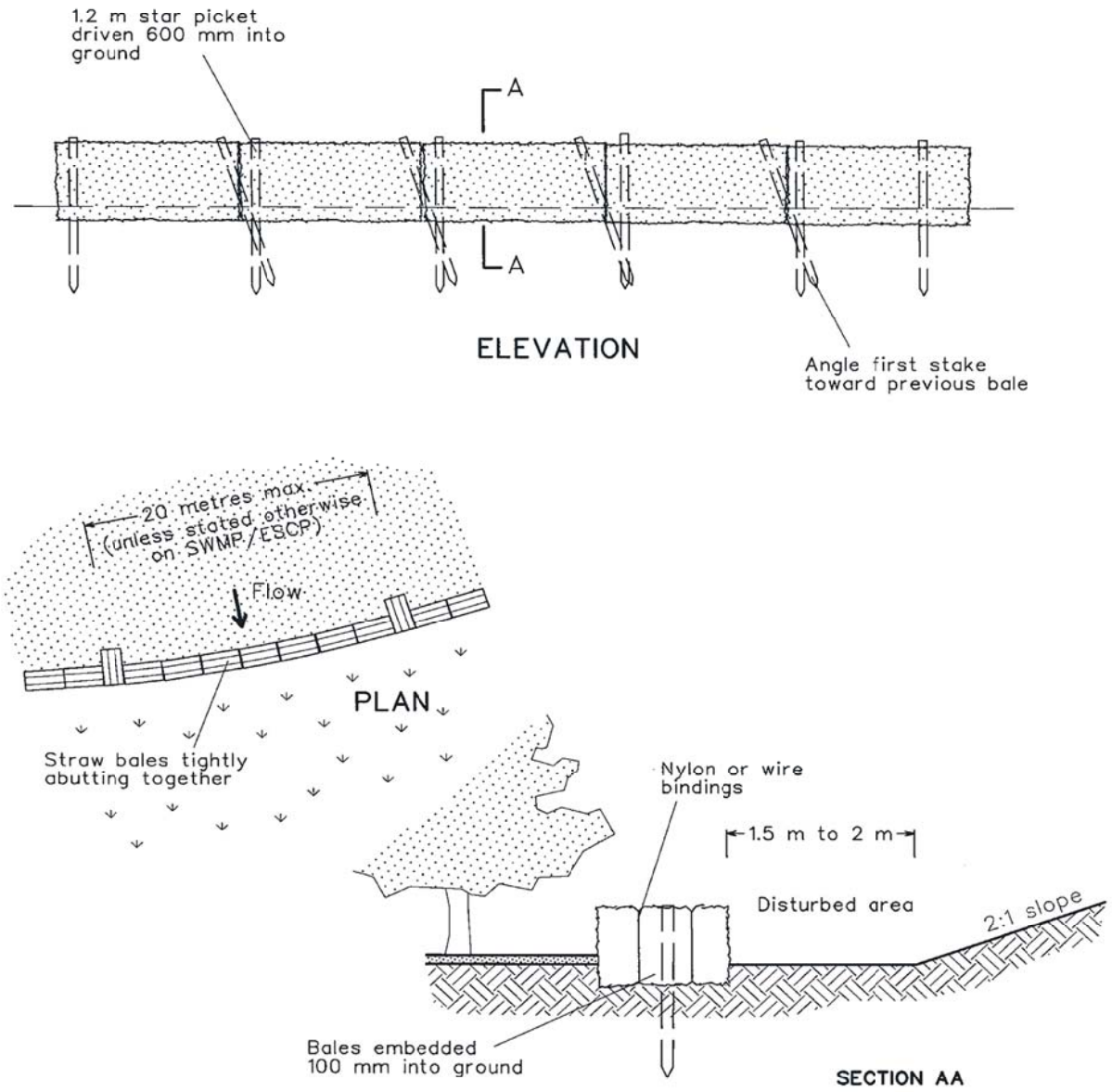
e. inspection of rehabilitated areas and maintenance of any erosion or rills that may occur from time to time

f. constructing additional sediment and erosion control works where required to protect downslope areas if the implemented sediment and erosion controls are inadequate

g. removing temporary sediment and erosion control structures as the last activity in the rehabilitation program

h. keeping a weekly log book that will be kept as hard copy and records:

   - the occurrence of any high rainfall events
   - the condition of any soil and water management works
   - the condition of vegetation and any need to irrigate
   - the need for dust prevention strategies
   - any remedial works to be undertaken.



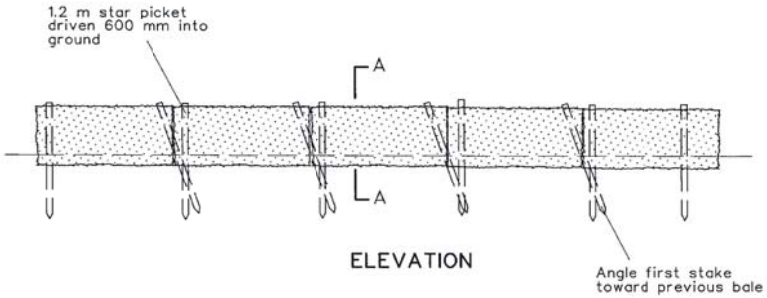
Construction Notes

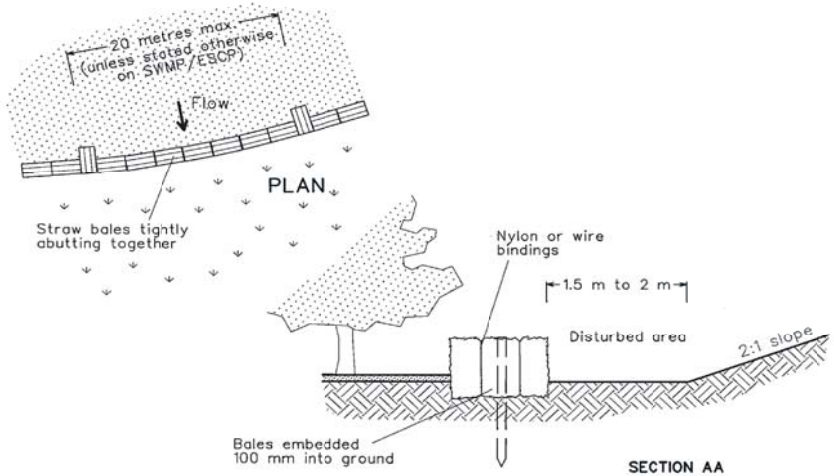
1. Construct the straw bale filter as close as possible to being parallel to the contours of the site.
2. Place bales lengthwise in a row with ends tightly abutting. Use straw to fill any gaps between bales. Straws are to be placed parallel to ground.
3. Ensure that the maximum height of the filter is one bale.
4. Embed each bale in the ground 75 mm to 100 mm and anchor with two 1.2 metre star pickets or stakes. Angle the first star picket or stake in each bale towards the previously laid bale. Drive them 600 mm into the ground and, if possible, flush with the top of the bales. Where star pickets are used and they protrude above the bales, ensure they are fitted with safety caps.
5. Where a straw bale filter is constructed downslope from a disturbed batter, ensure the bales are placed 1 to 2 metres downslope from the toe.
6. Establish a maintenance program that ensures the integrity of the bales is retained - they could require replacement each two to four months.

FIGURE 3.1

Sediment and Erosion Control Structures
Straw Bale Filter

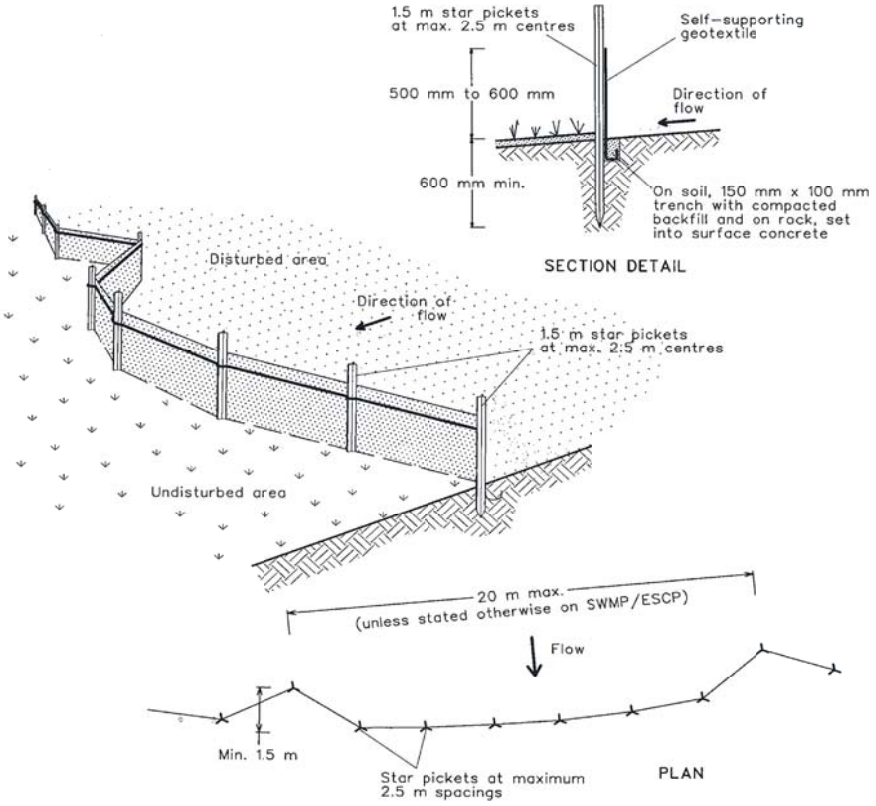
Source: ?





Construction Notes

1. Construct the straw bale filter as close as possible to being parallel to the contours of the site.
2. Place bales lengthwise in a row with ends tightly abutting. Use straw to fill any gaps between bales. Straws are to be placed parallel to ground.
3. Ensure that the maximum height of the filter is one bale.
4. Embed each bale in the ground 75 mm to 100 mm and anchor with two 1.2 metre star pickets or stakes. Angle the first star picket or stake in each bale towards the previously laid bale. Drive them 600 mm into the ground and, if possible, flush with the top of the bales. Where star pickets are used and they protrude above the bales, ensure they are fitted with safety caps.
5. Where a straw bale filter is constructed downslope from a disturbed batter, ensure the bales are placed 1 to 2 metres downslope from the toe.
6. Establish a maintenance program that ensures the integrity of the bales is retained - they could require replacement each two to four months.



Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

FIGURE 3.2

Sediment and Erosion Control Structures
Silt Fence

Source: ?

4.0 Surface Water Monitoring Program

4.1 Baseline Surface Water Quality

There are no surface flow or drainage lines on either Lot 218 or Lot 220 due to the high permeability of the sand other than the man made shallow drainage channel that drains groundwater in an east to west direction along the northern boundary of Lot 220 and to the north and north-west of Lot 218. Groundwater is monitored as discussed in **Section 5.0**.

As a result there is no surface water that can be monitored to establish baseline conditions other than in low-lying areas where surface water may intermittently pond following an intense rainfall event (i.e. perched water due to the infiltration rate being exceeded). As this water is present for a short time on an intermittent basis, and reports to the local groundwater, groundwater sampling and testing is undertaken as detailed in **Section 5.0**.

4.2 Surface Water Impact Assessment

There is negligible potential for surface water runoff from areas other than the access road and as a result no specific water quality criteria are required other than those determined for groundwater as discussed in **Section 5.2**.

4.3 Surface Water Quality Monitoring

The development has negligible potential to generate runoff or impact on surface waters. The base of the extraction area will be highly permeable and will be above the highest predicted groundwater level.

Surface water monitoring will comprise regular weekly visual inspection of silt fences to ensure that these don't become clogged with sediment and generate off-site runoff.

5.0 Groundwater Monitoring Program

5.1 Monitoring Bores

A series of monitoring bores were installed across Lot 218 and 220 during September 2008 to assist in preparation of the Mackas Sand Project Environmental Assessment (2009). The locations of these bores and the adjoining Hunter Water Corporation (HWC) bore field are provided in **Figure 5.1**.

Monitoring bores SP1-5 continue to be utilised as part of the Mackas Sand Groundwater Monitoring Program Network, with the corresponding bore construction information and cross sections for Lot 218 and Lot 220 provided in **Appendix 3**. SP6 was operational until windblown sand from the mobile dunes covered the bore in 2011. Since this time, BL158 (as part of the HWC bore field) has been utilised as a proxy bore to BL6.

5.2 Existing Environmental Baselines

5.2.1 Groundwater Quality and Levels

The baseline groundwater monitoring results for the Mackas Sand Project has been categorised as follows:

- September and October 2008: these results were used to inform and are presented in the Environmental Assessment (2009)
- November 2010 and January 2011: Given the limited groundwater dataset, Mackas Sand commenced the approved groundwater monitoring program in November 2010. A 2011 investigation determined that the turbidity and metal results were invalid due to the sampling methodology used (i.e. a bailer causing elevated / false turbidity results)
- March 2011 to September 2013: Following the 2011 investigation, the sampling methodology was amended. A dataset of 12 monitoring rounds from March 2011 to September 2013 has been used to inform groundwater investigation trigger levels.

Table 5.1 presents the groundwater results for the above time periods. As the water level results are not influenced by turbidity they do not follow the three time period categories.

Table 5.1 Groundwater Baseline Data

	Scale	Date Commencement / Range	Count	Min	Ave	Max
pH	pH Unit	September – October 2008	2	4.8	5.3	5.9
		November 2010 and January 2011	2	4.78	5.48	5.83
		March 2011 – September 2013	12	4.67	5.63	6.94
Conductivity	µS/cm	September – October 2008	2	104	239	570
		November 2010 and January 2011	2	118	222	409
		March 2011 – September 2013	12	84	201	541
Turbidity	NTU	Monitoring for parameter not undertaken during development of EA				
		November 2010 and January 2011	2	25.2	149.5	496
		March 2011 – September 2013	12	<0.1	4.6	32.2
Arsenic	mg/L	September – October 2008	2	<0.001	0.003	0.006
		November 2010 and January 2011	2	<0.001	0.005	0.016
		March 2011 – September 2013	12	<0.001	0.0012	0.004
Manganese	mg/L	Monitoring for parameter not undertaken during development of EA				
		November 2010 and January 2011	2	0.014	0.033	0.084
		March 2011 – September 2013	12	<0.001	0.0176	0.048
Iron	mg/L	September – October 2008	2	0.22	2.4	8.7
		November 2010 and January 2011	2	1.14	4.58	13.1
		March 2011 – September 2013	12	0.06	1.14	5.70
Level	mAHD	July-October 2008	3	0.6	2.15	3.55
		March 2010 – February 2012	22	0.30	2.01	3.45

Table 5.2 Hunter Water Corporation Groundwater Levels – mAHD

Date Range	Count	Min	Ave	Max
04/02/2010-12/08/2011	33	1.12	2.44	3.56

As summarised in **Table 5.1**, baseline groundwater monitoring indicates the local area ranges from acid (pH 4.67) to neutral (pH 6.94), has low conductivity (EC 84 to 541 µS/cm), turbidity levels are low (<0.1 to 32.2 NTU), low to moderate iron levels (0.06 to 5.7 mg/L) manganese ranged from <0.001 to 0.048 mg/L, and low arsenic concentrations (<0.001 to 0.004 mg/L).

Groundwater level monitoring in the vicinity of Lot 218 and Lot 220 is also undertaken by Hunter Water Corporation (HWC) at bores BL135, BL152, BL153, BL156, BL158, and BL159, which are considered nearby to operations (see **Figure 5.1**). HWC recorded groundwater levels are set out in **Table 5.2**

Recorded groundwater levels within or adjacent to Lot 220 (Monitoring Points SP1 to SP4) ranged from 0.30 mAHD (in the vicinity of the manmade drain adjacent to SP4) to 2.64 mAHD while groundwater levels adjacent to the northern boundary of Lot 218 (Monitoring Points SP5 and SP6/BL 158) ranged from 2.04 mAHD at BL158 to 3.45 mAHD at SP5.

Analysis indicates that the groundwater profile at Lot 220 typically dips from south to the north (i.e. SP1 to SP4) towards Tilligerry Creek to the north of the site. Assessment against the maximum groundwater level predicted within Umwelt (2011) is presented in **Table 5.3**.

During 2015 groundwater levels at SP2 and SP3 were recorded above the predicted maximum. Typically these recorded levels are within what is considered a reasonable margin of error (<0.25 m) for the groundwater model. The exception being the groundwater levels recorded on 13 May 2015 (3.43 mAHD), 31 August 2015 (3.15 mAHD) and 18 November 2015 (3.10 mAHD) at SP2.

Initial investigations into the potential causes of these elevated levels indicate that they do not appear to be related to rainfall events in isolation but may also be influenced by:

- temporary localised changes in vegetation, topography and / or
- influenced by operational practices associated with the adjacent sand mining operation to the west which is within meters of SP2.

Given the localised extent of the elevated groundwater readings and that the readings have subsequently return to below the predicted maximum, no further assessment of the maximum groundwater level and corresponding extraction level is proposed at this stage.

Table 5.3 Recorded and Predicted Maximum Groundwater Levels (2010-2018)

Monitoring Point	Recorded Maximum (mAHD)	Approximate Predicted Maximum (mAHD)	Difference (m)
SP1	2.51	3.6	-1.09
SP2	3.43	2.8	0.63
SP3	2.7	2.6	0.10
SP4	1.14	1.25	-0.11
SP5	3.49	3.6	-0.11
BL158	3.13	3.7	-0.57

5.2.2 Acid Sulphate Soils

The Williamtown 1:25,000 Acid Sulfate Sulphate Soils Risk Map (NSW Department of Natural Resources 2006) classifies almost all of the approved mining area as Wd4 and Wa4, which are described as landforms resulting from aeolian processes forming either dunes or sandplains at an elevation of above 4 mAHD.

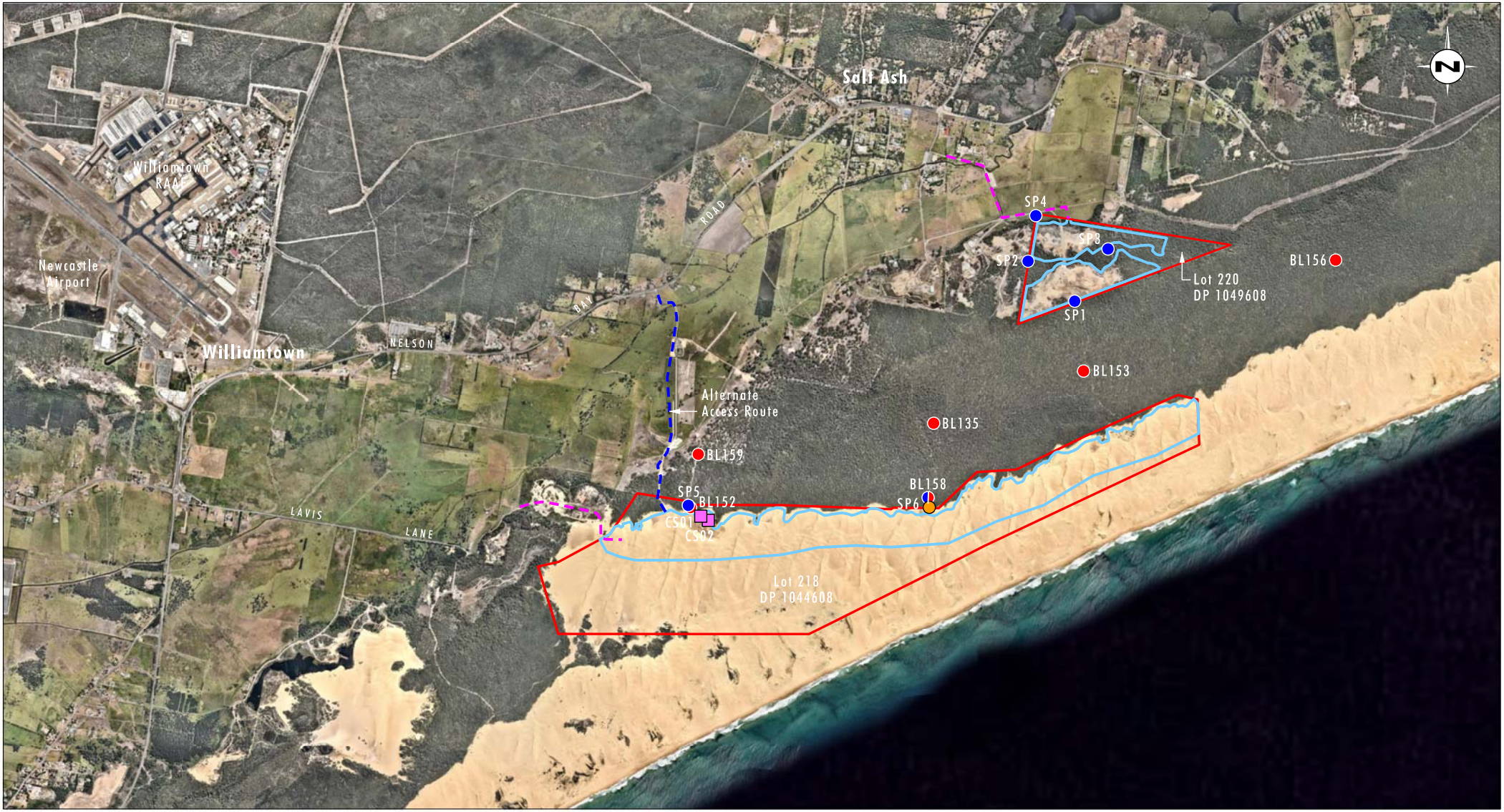
The probability of acid sulphate soils being present in this landform is considered to be low with any acid sulphate materials present likely to be sporadically distributed and at least 3 m below the ground surface and possibly much deeper if buried by windblown sand.

Very small sections of the north-eastern corners of the Lot 218 operational area and Lot 220 are classified Wa2 and Ap2 soils respectively. These soils are also considered to have a low probability of containing acid sulphate soils, although may contain acid sulphate material between 1 and 3 m below the ground surface. The section of Lot 220 that contains Ap2 soils will form part of the vegetation buffer that will surround the site and will not be disturbed.

It is considered that sand extraction operations pose minimal risk of exposing acid sulphate soils, as sand extraction will not occur below the groundwater table. The probability of acid sulphate soils occurring within the project area is very low as all of the material to be extracted would have been exposed to the air in the past.

RCA Australia Pty Ltd were commissioned to undertake soil tests at Lot 218 and 220 in 2017. Soil testing consisted of the development of 16 test pits at varying depths across extraction areas. Samples were collected at depths varying from 1.5, 2.5 and 3.5 m below the existing pit floor. A total of 12 samples were collected for Acid Sulfate Soils testing and 39 samples collected for metals, including arsenic, iron and manganese.

Acid Sulphate Soil Testing was conducted in accordance with ASC NEPM (2013) guidelines (EPA approved guideline) and best practice methods in accordance with NSW SEPP 55 – Remediation of Land. Results from Acid Sulphate Soil testing showed that no samples exceeded criteria from the NSW Acid Sulfate Soil Management Advisory Committee's Acid Sulfate Soil Manual (1998) (EPA Approved Manual) and confirmed that acid sulphate soils are not present in the areas tested. Sampling for iron and manganese provided results consistent with the overall sand environment, whilst arsenic results were below detectable limits.



Source: Nearmap (2018)

Legend

- Lot Boundaries (218 & 220)
- Approval Area
- Approved Site Access
- Alternate Access Route
- EPL Groundwater Monitoring Location
- Hunter Water Groundwater Monitoring Location
- Core Sampling Location
- Historical Monitoring Bore - not utilised

FIGURE 5.1

Mackas Sand Water Monitoring Locations

File Name (A4): R63_V1/1646_452.dgn

5.3 Groundwater Impact Investigation Trigger Levels

The sand extraction operations on Lot 218 and Lot 220 are located within the North Stockton Catchment Area (see **Figure 1.2**) which have the potential to be used as an emergency drinking water supply in the future. Water quality within the North Stockton Catchment Area does not currently comply with the Australian Drinking Water Guidelines (ADWG) 2011, as presented in **Table 5.4**.

Groundwater in the North Stockton Catchment Area is capable of being used for drinking water supply following treatment. Treatment of the groundwater from the North Stockton Catchment Area typically involves pH adjustment and reduction of heavy metals such as iron, manganese and arsenic. As noted in**Table 5.4**, ADWG provide health and aesthetic guideline values. Recommended values are based on aesthetic or health considerations.

Analysis indicates that the groundwater monitored in the study area does not comply with AWDG (2011) standards for various parameters depending on whether the health or aesthetic guideline values are applied and would require treatment before use.

Section 3.3.2.3 of the ANZECC (2000) guidelines recommend that impact assessment criteria (trigger values) be used as a yardstick against which to compare the results of water quality monitoring and suggest that when monitoring results fall outside the trigger values there is a possible risk to environmental value and further action should be taken to investigate or address the cause. The trigger values are not exceedance criteria but are used to initiate investigations into the groundwater quality. Setting appropriate trigger values is a key issue in identifying and managing changes in groundwater quality.

Table 5.4 Australian Drinking Water Guidelines 2011

Parameter	Recommended Limit/Range
pH	6.5 – 8.5 (Aesthetic only*)
Turbidity (NTU)	5 (Aesthetic only*)
Fe (mg/L)	0.3 (Aesthetic only*)
As (mg/L)	0.01 (Health only)
Mn (mg/L)	0.1 (Aesthetic) & 0.5 (Health)
Cobalt (mg/L)	NA**
Chromium (III) (mg/L)	NA**
Zinc (mg/L)	3 (Aesthetic only*)

* Insufficient data to set a guideline value based on health considerations

** No endorsed ADWG value

Potential impacts to groundwater quality due to operations include:

- risks from acid sulphate soils (ASS), which can be identified through lowered pH and elevated arsenic levels
- fuel spills, identified through regular observation and would be identified by the presence of a hydrocarbon film.

Section 3.4.3.2 of the ANZECC Guidelines recommend that site specific monitoring results and measurements should be used, where available, to develop appropriate guidelines to inform and identify when further investigation is required.

Given that baseline groundwater levels are highly variable and largely outside of the ADWG 2011, trigger values have been developed based on values provided within the ADQG (2011), ANZECC guidelines (2000) and long term groundwater monitoring results from a previous operation in the local area. Where site specific monitoring results are not yet available (i.e. Cobalt, Chromium (III) and Zinc temporary trigger values will informed by the ADWG (2011) or ANZECC Guidelines (2000).

Temporary trigger values will be used until a suitable collation of data is available to inform site specific trigger values. Taking into consideration the existing groundwater quality at the site, potential impacts due to operations, and the ADWG (2011), trigger values for further investigation are presented in **Table 5.5**.

Table 5.5 Groundwater Investigation Trigger Values

Parameter	Unit of Measure	Min	Max
pH	pH Unit	4.5**	8.5*
Conductivity	µS/cm	NA	600**
Turbidity	NTU	NA	50**
Arsenic	mg/L	NA	0.01*
Manganese	mg/L	NA	0.1*
Iron	mg/L	NA	5.70**
Cobalt	mg/L	NA	0.15***
Chromium (III)	(mg/L)	NA	0.0906***
Zinc	(mg/L)	NA	3*
Total Petroleum Hydrocarbons	Visual	No oily film observed	Oily film observed

*these values based on ADWG (2011)

** these values based long term groundwater monitoring from a previous operation in the local area

*** values based on ANZECC (2000) guidelines

5.4 Groundwater Monitoring

In accordance with the requirements of condition M2 of EPL 13218, groundwater levels and groundwater quality will be monitored quarterly at the six monitoring bore locations (SP1 to SP5 and BL158) (refer to **Figure 5.1**). The collection of groundwater samples for analysis, and the subsequent review and interpretation will be undertaken by a suitably qualified and experienced person(s).

Groundwater depth and quality will be monitored quarterly at SP1, SP2, SP3, SP4, SP5 and BL158 for the life of the operation for the following groundwater quality parameters:

- pH (Lab)
- conductivity (µS/cm)
- arsenic
- iron
- manganese
- turbidity
- cobalt
- chromium (III)
- zinc
- Total Petroleum Hydrocarbons (visual).

5.5 Groundwater Core Sample Testing Program

To assess the potential for ASS impacts to occur due to the lowering of the extraction height at Lot 218 to 0.7 m above the predicted maximum groundwater level approved under PA 08_0142, Mackas Sand has developed a groundwater core sample testing program.

The program was developed in consultation with the EPA. A separate document has been prepared that details the requirements of the Groundwater Core Sample Testing Program (refer to **Appendix 2**). The sampling locations are provided in **Figure 5.1**.

5.6 Groundwater Reporting and Contingency Measures

Quarterly results will be compiled and analysed by a suitably qualified and experienced person(s) to check for unforeseen impacts or trends in groundwater level or quality with reference to the trigger values in **Table 5.5** and the predictions made in Umwelt (2011). A short report will be prepared quarterly and provided to the Quarry Manager who will implement any necessary changes or controls that may be required.

Groundwater data will be reported annually within the Annual Review. If any unexpected trends in groundwater quality are observed, the Trigger Action Response Plan (TARP) as outlined in **Table 5.6** shall be implemented.

Table 5.6 Impacts on Groundwater TARP

TARP	Impacts on groundwater
Trigger	Groundwater monitoring indicates a continuous decreasing or increasing trend in groundwater level / quality over three consecutive quarterly sampling periods outside minimum or maximum trigger values as shown in **Table 5.3** or **Table 5.5**.

Action	• Notify Mackas Sand Quarry Manager and Director
	• Investigate the potential cause of the change in groundwater level / quality
	• Any groundwater level investigation will include consideration of the following:
	  ○ The 24 hour rainfall event volumes that occurred in the lead up to the reading
	  ○ Comparison of the rainfall event volumes with the June 2007 storm which established the maximum predicted groundwater level
	  ○ Comparison of the measured levels against the predicted maximum at all other monitoring locations (i.e. localised or wider observation)
	  ○ Observations of the event across the wider region
	  ○ Local topographic changes which may be influencing surface water flows and groundwater recharge zones
	  ○ Operations and activities which adjoin and are further afield from the sand extraction operations at Lot 218 and Lot 220
	  ○ The validity of the input parameters used in groundwater model (i.e. should they be altered in light of observations in the field and/or new information now available).
	  ○ The groundwater model will be rerun if:
	  ▪ the input parameters are inconsistent with the field observations and / or
	  ▪ the measured levels at more than 50% of the groundwater monitoring bores at Lot 218 and Lot 220 are higher than the predicted maximum giving consideration of the accuracy of the model (i.e. 0.25m) and / or
	  ▪ new information becomes available which may raise the height of the approved predicted maximum groundwater level map.
	• Determine if the incident has caused or is threatening material harm to the environment.
	• Notify DPIE of the incident with 24 hours following the identification of three consecutive monitoring results exceeding the minimum or maximum trigger values as shown in **Table 5.5**
	• Initiate PIRMP (see Section 6.3.1) should an incident or activity result or has the potential to result in material harm to the environment

Response	• Develop corrective/preventative actions based on the outcomes of the investigation and/or additional monitoring. • Notify regulatory agencies as specified in Section 6.3 and DPIE of the investigation outcome and actions taken and/ or to be implemented, within 7 days of the date on which the incident occurred.

	• Revise the extraction depth map should a revision of the groundwater model predict a rise in the height of the approved predicted maximum groundwater level. • Communicate the revised extraction depth map with operational staff and adjust all future extraction activities accordingly.
Plan	• Prioritise actions based on the risk to the environment and likelihood of a repeat incident • Monitor the completion of actions to ensure they have been effective • Review and if necessary this plan in accordance with Schedule 5 Condition 4A of PA 08_0142 (as modified)

6.0 Reporting and Review

6.1 Reporting

Mackas Sand will engage a suitably qualified and experienced person to regularly review and interpret the groundwater level and quality results. Mackas Sands will keep a log of any incidents that have the potential to adversely impact on the groundwater level and quality of surrounding privately owned land. The Quarry Manager will investigate any exceedances of the water quality impact assessment criteria.

An Annual Review will be prepared and submitted to the Secretary and relevant agencies in accordance with the requirements of Condition 4 of Schedule 5 of PA 08_0142 (as modified). The Annual Review will include an assessment of observations and incidents recorded in the Quarry Manager's log book and the results of groundwater level and quality monitoring. This will include any investigations that have been undertaken to address unforeseen impacts and contingency/mitigation measures that have been implemented to address these unforeseen impacts.

The Annual Review and groundwater monitoring results will be made publicly available on the Mackas Sand website (www.mackassand.com.au) in accordance with Condition 9 of Schedule 5 of the Project Approval.

6.2 Complaints Handling

In accordance development consent and EPL requirements, Mackas Sand has established a 24 hour complaints line. The number is **0408 490 911** and is listed on the Mackas Sand website (www.mackassand.com.au).

Complaints received on the number will be directed to the Quarry Manager who will respond to the complainant within 24 hours if the complainant is contactable. A record of all complaints will be kept on-site and published on the Mackas Sand Pty Ltd.'s website.

All complaints and information in regard to responses will be provided to the CCC. One of the functions of the CCC is to review complaints or disputes between Mackas Sand and members of the community.

6.3 Incident Reporting Protocol

Condition 2 of Schedule 5 of PA 08_0142 (as modified) requires any exceedances of limits/performance criteria within the approval to be reported to DPIE within 24 hours of the exceedances being recorded. This includes any incidents that cause (or may cause) material harm to the environment.

Following the reporting of an exceedance or incident to the DPIE, HWC and DPI Water and other relevant agencies, Condition 3 of Schedule 5 of PA 08_0142 (as modified), requires the proponent to prepare a written report of the exceedance within six days of the exceedance being reported. The written report must contain:

- a description of the date, time and nature of the exceedance;
- identification of the cause (or likely cause) of the exceedance;

- a description of actions taken to date; and
- a description of the proposed measures to address the exceedance.

In the event of any exceedances or incidents which cause or may cause material harm to the environment, Mackas Sand will report in accordance with the requirements of Conditions 2 and 3 of Schedule 5. The Quarry Manager will be responsible for ensuring these reporting requirements are complied with.

6.3.1 Material Harm Incidents

Mackas Sand is committed to minimising any potential for material harm to the environment and surrounding community. A PIRMP has been developed for Mackas Sand operations which outlines the response and notification procedures in the event of a potential material harm incident. In addition to reporting required by Condition 2 of Schedule 5 of PA 08_0142 (as modified) incidents resulting or having the potential to result in material harm to the environment, (as defined by Section 147 of *the Protection of the Environment Operations Act 1997*) shall be reported to the following authorities (as relevant) immediately after the Quarry Manager becomes aware of the incident:

- the EPA – Environment Line (if not the ARA);
- the Ministry of Health;
- WorkCover;
- the Local Authority (Council) if not the ARA; and
- Fire and Rescue NSW.

The information about a pollution incident that must be notified includes:

- the time, date, nature, duration and location of the incident;
- the location of the place where pollution is occurring or is likely to occur;
- the nature, the estimated quantity or volume and the concentration of any pollutants involved, if known;
- the circumstances in which the incident occurred, including the cause of the incident, if known; and
- the action taken or proposed to be taken to deal with the incident and any resulting pollution or threatened pollution, if known.

6.4 Records

In accordance with EPL condition M1.2, monitoring records will be maintained on site for at least four years.

In addition, the following records must be kept in respect to any samples required to be collected as per EPL condition M1.3:

- date(s) on which the sample was taken;

- time(s) at which the sample was collected;
- the point at which the sample was taken; and
- the name of the person who collected the sample.

6.5 Review

The SWMP is to be reviewed in accordance with Condition 4A and Condition 7 of Schedule 5 of PA 08_0142, or as directed by the Secretary of DPIE.

The review process is to reflect changes in environmental requirements, technology and operational procedures.

7.0 References

ANZECC (2000), Australian and New Zealand Guidelines for Fresh and Marine Water Quality, October 2000.

DNR (2004), Water Sharing Plan for the Tomago-Tomaree-Stockton Groundwater Sources. Department of Natural Resources (2004).

Landcom (2004), Managing Urban Stormwater: Soils and Construction Volume 1, 4th Edition, 2004 (Landcom).

Minister for Planning – Project Approval 08_0142 dated 20th September 2009.

NEPC, National Environment Protection (Assessment of Site Contamination) Measure, 1999 as amended 2013.

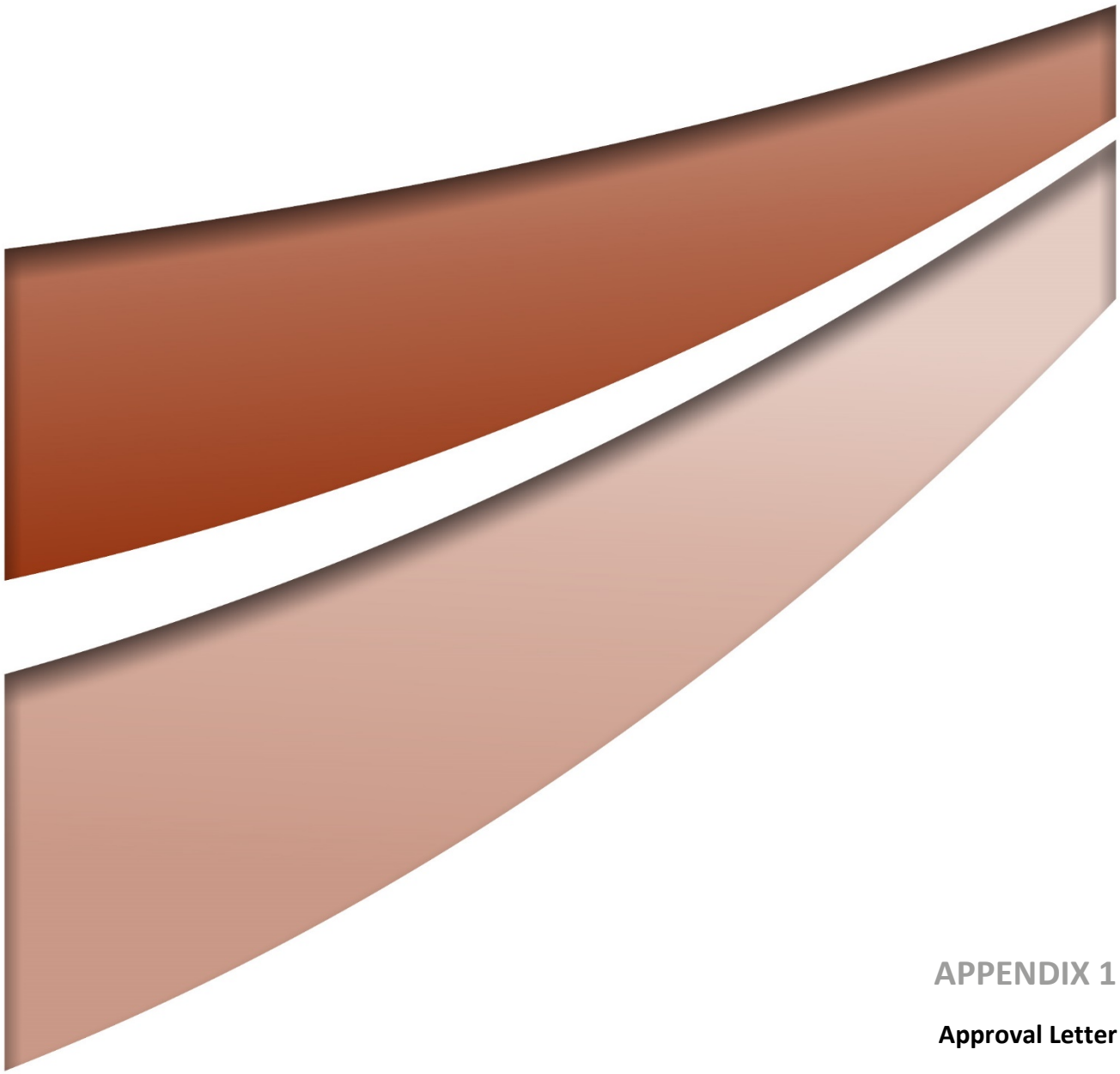
NHMRC & ARMCANZ (1996), Australian Drinking Water Guidelines – Summary. National Health and Medical Research Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT.

NSW Acid Sulfate Soil Management Advisory Committee, Acid Sulfate Soil Manual, August 1998.

Umwelt (Australia) Pty Limited (2009). Environmental Assessment of Sand Extraction Operations from Lot 218 DP 1044608 and Lot 220 DP 1049608, Salt Ash.

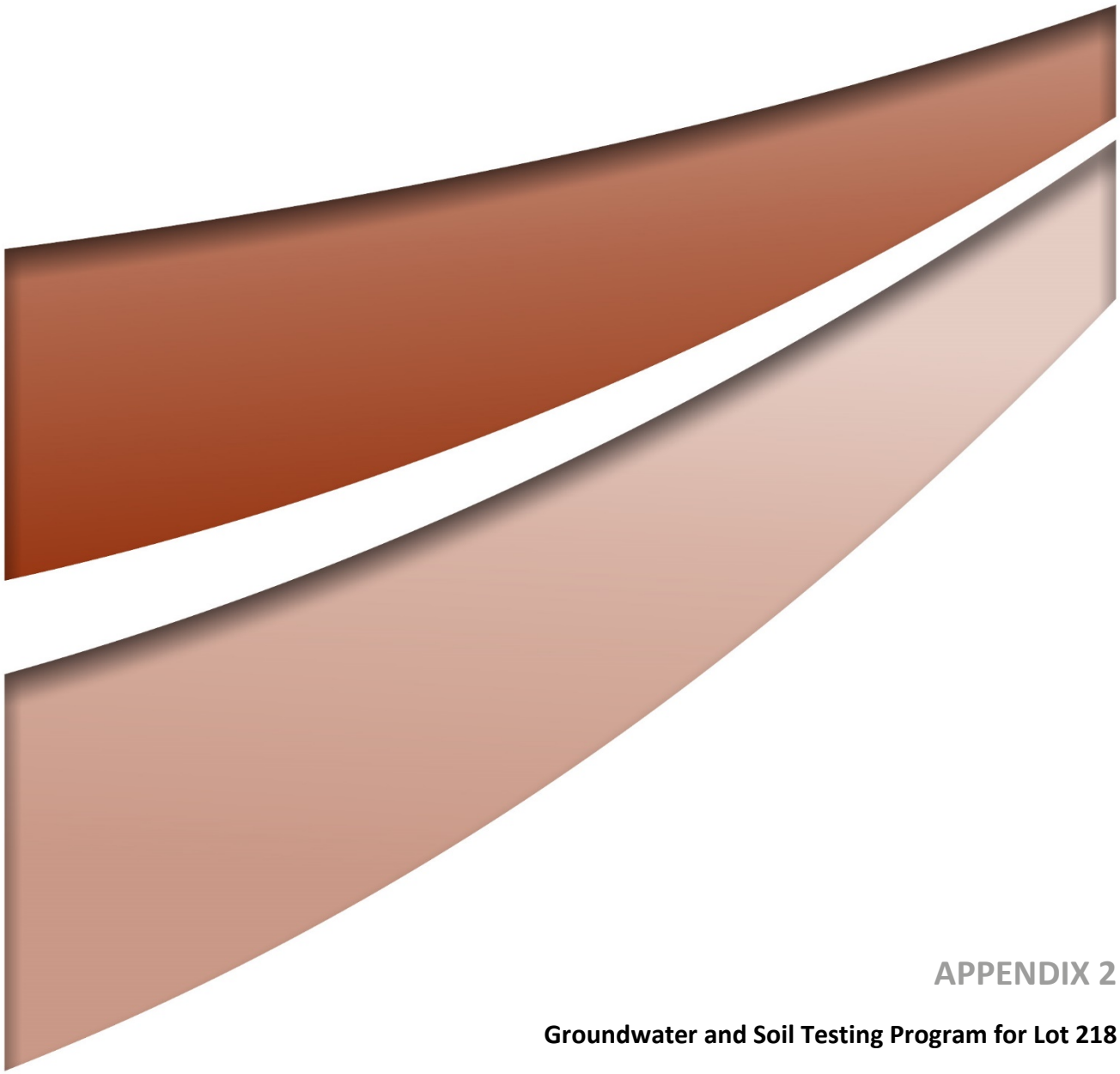
Umwelt (Australia) Pty Limited (2011). Determination of Maximum Predicted Groundwater Level and Maximum Extraction Level at Lot 218 and 220, Salt Ash.

Umwelt (Australia) Pty Limited (2014). Mackas Sand Operational Management Procedure, Lot 218 and 220, Salt Ash.



APPENDIX 1

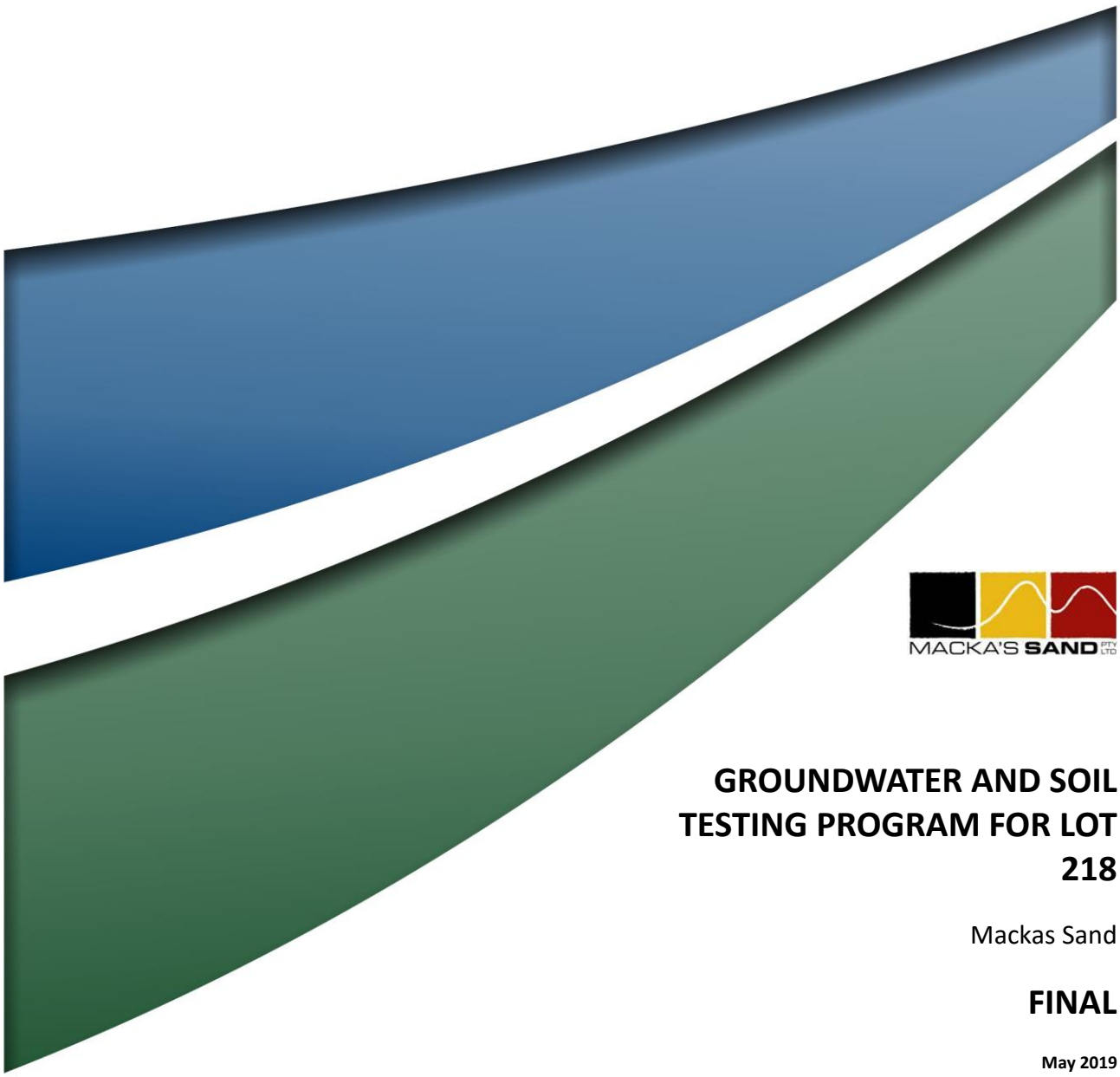
Approval Letter



APPENDIX 2

Groundwater and Soil Testing Program for Lot 218

umwelt
Environmental & Social Consultants



MACKA'S SAND PTY LTD

GROUNDWATER AND SOIL TESTING PROGRAM FOR LOT 218

Mackas Sand

FINAL

May 2019

GROUNDWATER AND SOIL TESTING PROGRAM FOR LOT 218

Mackas Sand

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Mackas Sand

Project Director:	Bret Jenkins
Project Manager:	Rod Williams
Report No.	1646/R68/V2
Date:	May 2019

Newcastle

75 York Street
Teralba NSW 2284

T| 1300 793 267
E| info@umwelt.com.au

www.umwelt.com.au

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Disclaimer

This document has been prepared for the sole use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that for which it was supplied by Umwelt (Australia) Pty Ltd (Umwelt). No other party should rely on this document without the prior written consent of Umwelt.

Umwelt undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. Umwelt assumes no liability to a third party for any inaccuracies in or omissions to that information. Where this document indicates that information has been provided by third parties, Umwelt has made no independent verification of this information except as expressly stated.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	Brandan Rice	June 2016	Peter Jamieson	June 2016
2	Rod Williams	May 2019	Bret Jenkins	May 2019

Table of Contents

Figures

Tables

1.0 Introduction

Mackas Sand Pty Ltd (Mackas Sand) undertakes sand extraction operations on Lot 218 // DP 1044608 and Lot 220// DP 1049608 located approximately 25 kilometres north east of Newcastle near Salt Ash in the Port Stephens Local Government Area (LGA), New South Wales (refer to **Figure 1.1**). Mackas Sand's directors have operated sand extraction operations in the area since 1992. Lot 218 and Lot 220 are owned by the Worimi Local Aboriginal Lands Council.

Mackas Sand was granted Project Approval No. 08_0142 (PA 08_0142) on 20 September 2009 by the Minister for Planning under Part 3A of the *Environmental Planning and Assessment Act 1979* to operate sand extraction operations at Lot 220 and Lot 218. It is estimated that in excess of 21 million tonnes of sand resource will be extracted from Lot 218 and Lot 220, with Lot 218 having an indefinite extraction life due to the ongoing movement of sand from the adjoining mobile dunes.

A modification to PA 08_0142 was approved on 30 September 2013 by the NSW Planning Assessment Commission (PAC) under delegation of the Minister for Planning and Infrastructure (now Minister for Planning and Environment-DP&E). The modification (PA 08_0142 MOD1) approved:

- sand extraction to within 0.7 metres of the maximum predicted groundwater level at Lot 220
- sand extraction to within 0.7 metres of the maximum predicted groundwater level at Lot 218, unless the core sample testing program demonstrates that extraction to within 0.7 metres of maximum predicted groundwater can be undertaken without disturbing acid sulphate soils
- a final landform surface level at least 1 metre above the maximum predicted groundwater level at Lot 218 and Lot 220 and
- the approval of an alternate route to access Lot 218. The alternate route connects directly from Lot 218, northward to Nelson Bay Road, as depicted within **Figure 1.1**.

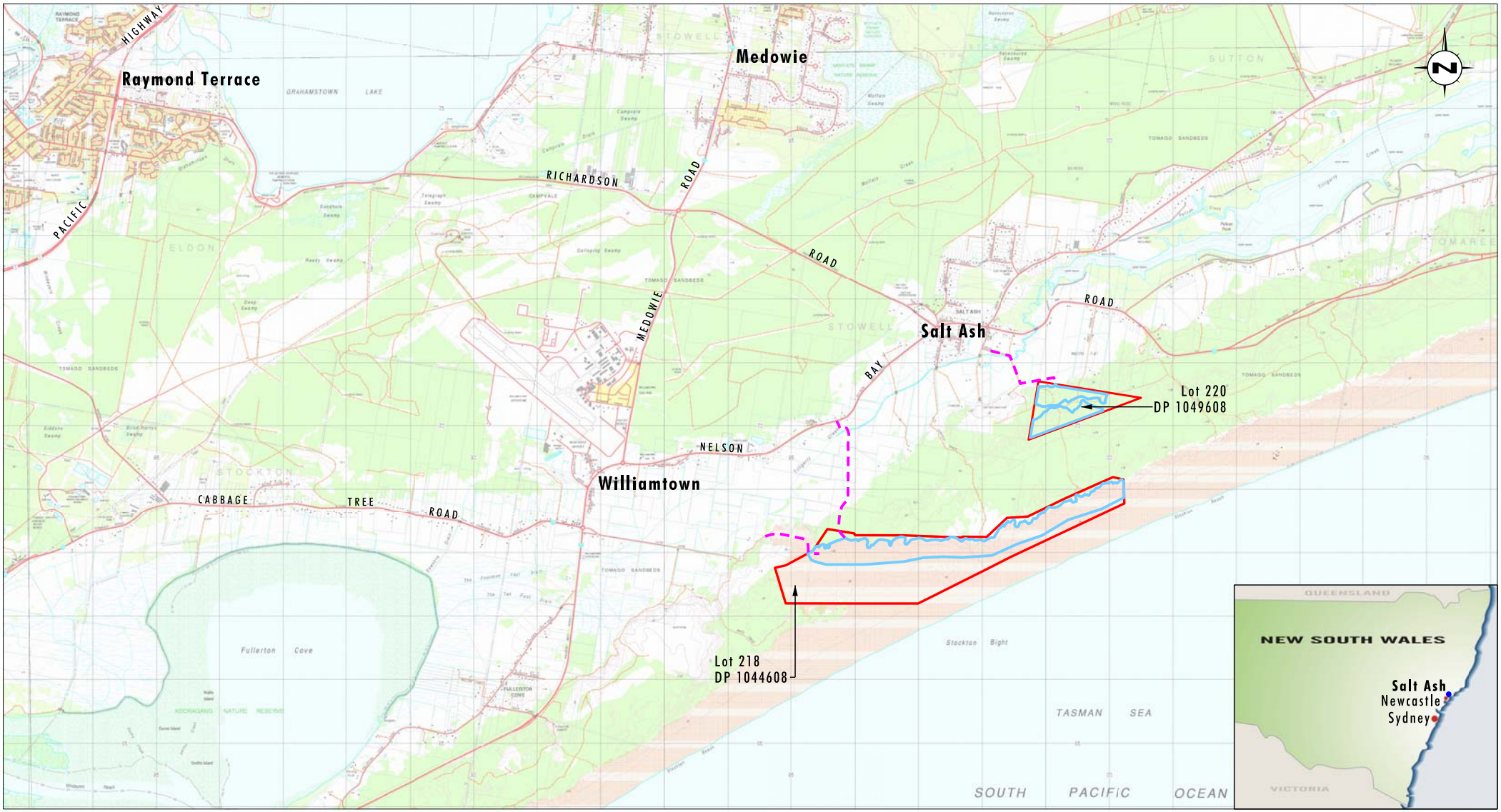
A second modification to PA 08_0142, (MOD2), was approved by the PAC on 16 March 2016. The modification allows for an increase in maximum hourly truck movements (in and out) of Lot 218 via the approved alternate access road.

1.1 Purpose and Scope

To satisfy Schedule 3, Condition 22(c) of the Project Approval 08_0142 (as modified) and Environment Protection Licence (EPL 13218), a program to monitor groundwater levels and quality, including a groundwater core sampling testing program to monitor changes in metallic species above the maximum predicted groundwater level at Lot 218 is required to be developed (referred to hereafter as the Groundwater and Soil Testing Program).

The Groundwater and Soil Testing Program is to be prepared in consultation with the Environment Protection Authority (EPA) and submitted to the Secretary of the Department of Planning and Environment (DP&E) for approval.

The purpose of this Groundwater and Soil Testing Program is to develop a program to monitor groundwater levels and quality and changes in metallic species above the maximum predicted groundwater level at Lot 218 in DP 1044608 Nelson Bay Road, Salt Ash.



Source: Department of Lands (2006)

Legend

- Lot Boundaries
- Approval Areas
- Approved Site Access

FIGURE 1.1

Locality Plan

1.2 Regulatory Requirements

1.2.1 Project Approval and EPL

A detailed list of the relevant PA 08_0142 (MOD2) and EPL conditions and where they are addressed in this document is included in **Table 1.1**.

Table 1.1 Project Approval and EPL Conditions

Conditions		Addressed in Section
Project Approval **Schedule 3 – Environmental Performance Conditions** **Soil and Water Management**		
22.	The Ground Water Monitoring Program must include: (c) a program to monitor groundwater levels and quality, including a groundwater core sample testing program to monitor changes in metallic species above the maximum predicted groundwater level at Lot 218, that; (i) is developed in consultation with EPA; (ii) samples to a depth at least 2 m below the proposed extraction depth of 0.7 m above the maximum predicted groundwater level, from at least two locations within the area proposed to be extracted within the first 3 years; and (iii) includes testing for acid forming minerals at regular depth and time intervals;	**Section 2.0**
Environment Protection Licence **Section 8 – Pollution Studies and Reduction Programs** **U1 Pollution Reduction Study (PRS) 2 – Groundwater and Soil Monitoring Program for Lot 218**		
U1.1	The licensee must develop a program to monitor groundwater levels and quality and a soil core testing program to monitor changes in metallic species above the maximum predicted groundwater level at Lot 218. The groundwater monitoring program must include details of monitoring bores (and justification for their inclusion); parameters to be monitored (and justification) and frequency of monitoring (and justification). The soil testing program must include core samples to a depth at least 2 metres below the proposed extraction depth of 0.7 metres above the maximum predicted groundwater level. The soil sampling must include cores from at least two locations within the area proposed to be extracted in the period 2015 to 2017. The testing of the cores must include testing for acid forming minerals at regular depth and time intervals. The program must be written into a report which must be supplied to the EPA (addressed the Manager Hunter - hunter.region@epa.nsw.gov.au) by 30 June 2016.	**Section 2.0**

2.0 Monitoring Program

2.1 Groundwater Monitoring Program

In accordance with the requirements of condition M2 of EPL 13218 groundwater levels and quality will be monitored quarterly at the two monitoring bore locations associated with Lot 218, SP5 and BL158 (refer to **Figure 2.1**). Monitoring commenced at BL158 in 2011 as a proxy bore for SP6 as SP6 has been engulfed by a mobile dune. These bores are located between sand extraction operations on Lot 218 and Hunter Water Corporation's Emergency Borefield Easement to the north and will be used to monitor for any potential migration of metallic species in groundwater from sand extraction operations should this occur.

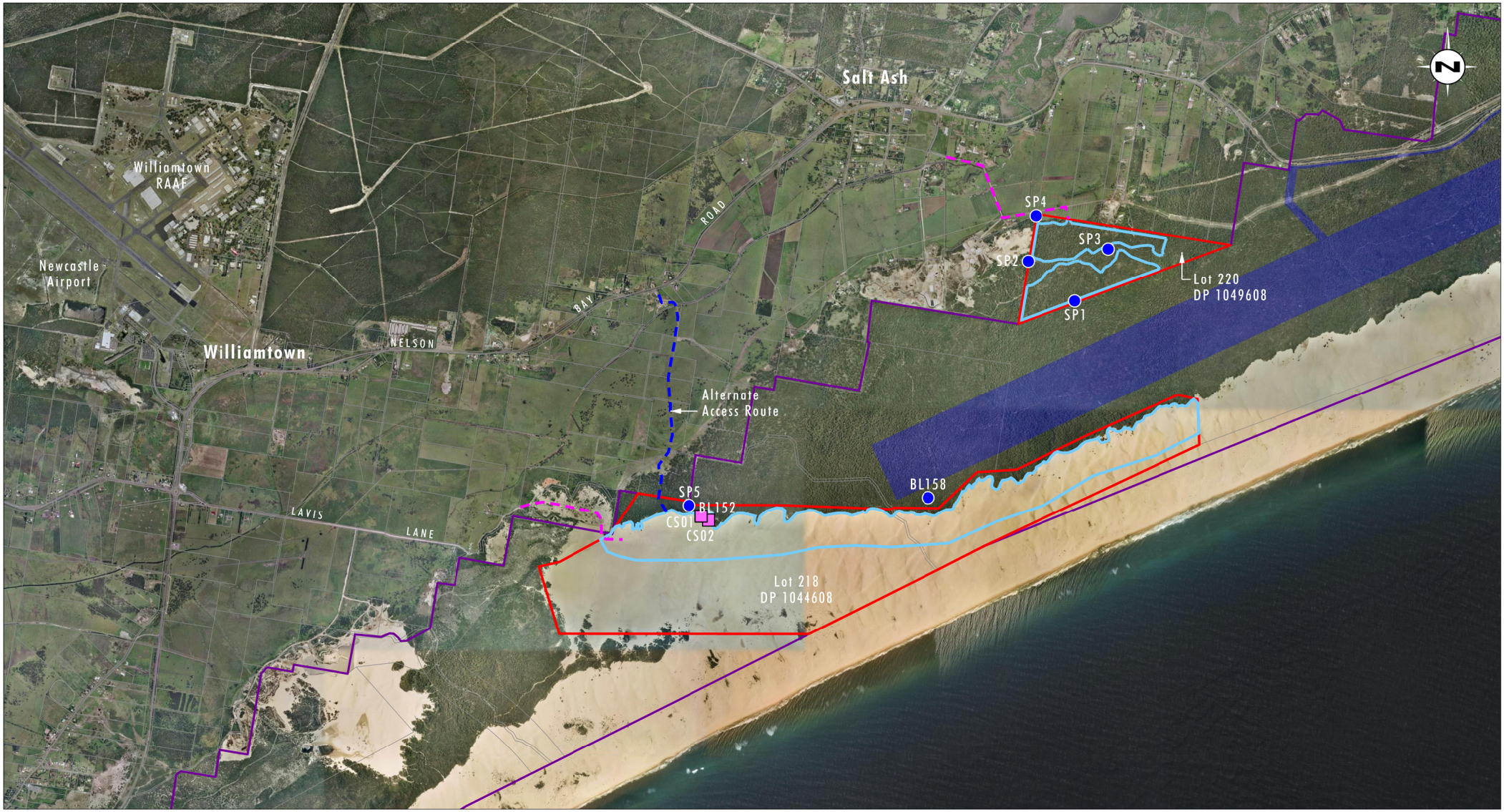
Groundwater depth and quality will be monitored quarterly at SP5 and BL158 for the life of the operation for the following parameters, as detailed in Section 5.4 of the Soil and Water Management Plan (SWMP), being:

- Level (mAHD)
- pH (Lab)
- conductivity (µS/cm)
- arsenic
- iron
- manganese
- turbidity
- cobalt
- chromium (III)
- zinc
- Total Petroleum Hydrocarbons (visual only).

The list of tested analytes has been in place since 2008, except for cobalt, chromium and zinc which have been included as part of the 2019 revision.

This list has been reviewed as a part of a Pollution Reduction Study for EPL 13218 (2016). Based on available documentation regarding potential metallic species impacts from Acid Sulphate Soils (ASS), this review confirmed that the list of analytes tested is appropriate to further monitor any potential impacts in raising the metallic species in the groundwater and soil profile. Additional parameters were included as part of a review to the Mackas Sand SWMP (2019).

If soil testing as discussed in **Section 2.2** demonstrates that there is potential for mobilisation of metallic species as a result of sand quarrying operations, additional groundwater monitoring bores will be installed within the Lot 218 extraction area.



Source: Department of Lands (2003)

0 0.5 1 2km
1:45 000

Legend

- Lot Boundaries (218 & 220)
- Approval Area
- Approved Site Access
- Alternate Access Route
- Mackas Sand Groundwater Monitoring Location
- Indicative Core Sampling Location
- North Stockton Catchment Area
- HWC Emergency Borefield Easement

FIGURE 2.1

Mackas Sand Monitoring Locations

File Name (A4): R68_V1/1646_463.dgn

2.2 Soil Core Testing Program

In order to test for the presence of actual or potential acid sulphate materials below the maximum predicted groundwater level and the subsequent potential for the changes is groundwater quality (i.e. mobilisation of metallic species), Mackas Sand has developed a soil core testing program for Lot 218. The requirements for the testing program were initially developed in consultation with the EPA through the Environmental Assessment process.

Samples will be obtained from two locations proposed to be extracted within the next two years (refer to **Figure 2.1**).

Condition 22(c) of the Project Approval and U1.1 of the EPL requires samples to be taken from two locations to a depth of at least 2 m below the proposed extraction depth of 0.7 m above the maximum predicted groundwater level.

It is proposed to collect samples at 0.5 m intervals down to a depth of 2 m below the proposed extraction depth of 0.7 m above the maximum predicted groundwater level at each of these locations.

The analysis of the samples collected will be undertaken in accordance with Australia Standard (AS) 4969 *Analysis of acid sulfate soil – Dried samples – Method of test.*

Collection of soil core samples will generally include:

- sampling at 0.5 m intervals or less to a depth of 2 m below the proposed extraction depth of 0.7 m above the maximum predicted groundwater level, with sample sizes of at least 250 grams
- samples will be in placed in plastic film and tied plastic sample bags
- a soil profile log will be kept, this in order to determine if soil colour changes with depth can be correlated with changes to Potential Acid Sulphate Soils (PASS) or Net Acid Generation Potential
- groundwater 'grab' samples will be collected if groundwater is intercepted
- samples will be taken to a NATA accredited laboratory for testing.

Once results are obtained a short report will be prepared and submitted to the EPA, DPE and relevant agencies. Should results indicate the potential for the mobilisation of metallic species; an additional investigation will be undertaken in consultation with the EPA to assess depth and extent of the potential for mobilisation.

3.0 Reporting

3.1 Groundwater and Soil Review, Reporting and Contingency Measures

Groundwater level and quality monitoring results will be compiled and analysed to check for unforeseen impacts or trends in association with testing results from the soil testing program.

If laboratory results identify the potential for Net Acid Generation and PASS then groundwater results will be reviewed for trends in metallic species to indicate potential impact and additional groundwater monitoring bores will be established within the approved extraction to monitor the potential mobilisation of metallic species.

The reason for the unexpected trends or exceedances will be explored, potential contingency measures will be developed and a report will be prepared and submitted to DPE, EPA and relevant agencies. This may include additional groundwater and / or soil testing to confirm any particular changes in metallic species above the maximum predicted groundwater level.

Results of this testing will then be utilised to inform changes to any operational extraction management measures utilised.

4.0 Review

The Groundwater and Soil Monitoring Program is to be reviewed in accordance with Condition 4A and Condition 7 of Schedule 5 of PA 08_0142, or as directed by the Secretary of DPE.

The review process is to reflect changes in environmental requirements, technology and operational procedures.

5.0 References

Environmental Planning and Assessment Act 1979

National Health and Medical Research Council (2011). Australian Drinking Water Guidelines Vol. 6. v3.5 (2018).

Umwelt (Australia) Pty Limited (2011). Determination of Maximum Predicted Groundwater Level and Maximum Extraction Level at Lot 218 and 220, Salt Ash.

Umwelt (Australia) Pty Limited (2014). Mackas Sand Soil and Water management Plan at Lot 218 and 220, Salt Ash.

Umwelt (Australia) Pty Limited (2019). Mackas Sand Soil and Water Management Plan at Lot 218 and 220, Salt Ash.

umwelt
Environmental & Social Consultants

Newcastle
75 York Street
Teralba NSW 2284

Perth
First Floor
12 Prowse Street
West Perth WA 6005
PO Box 783
West Perth WA 6872

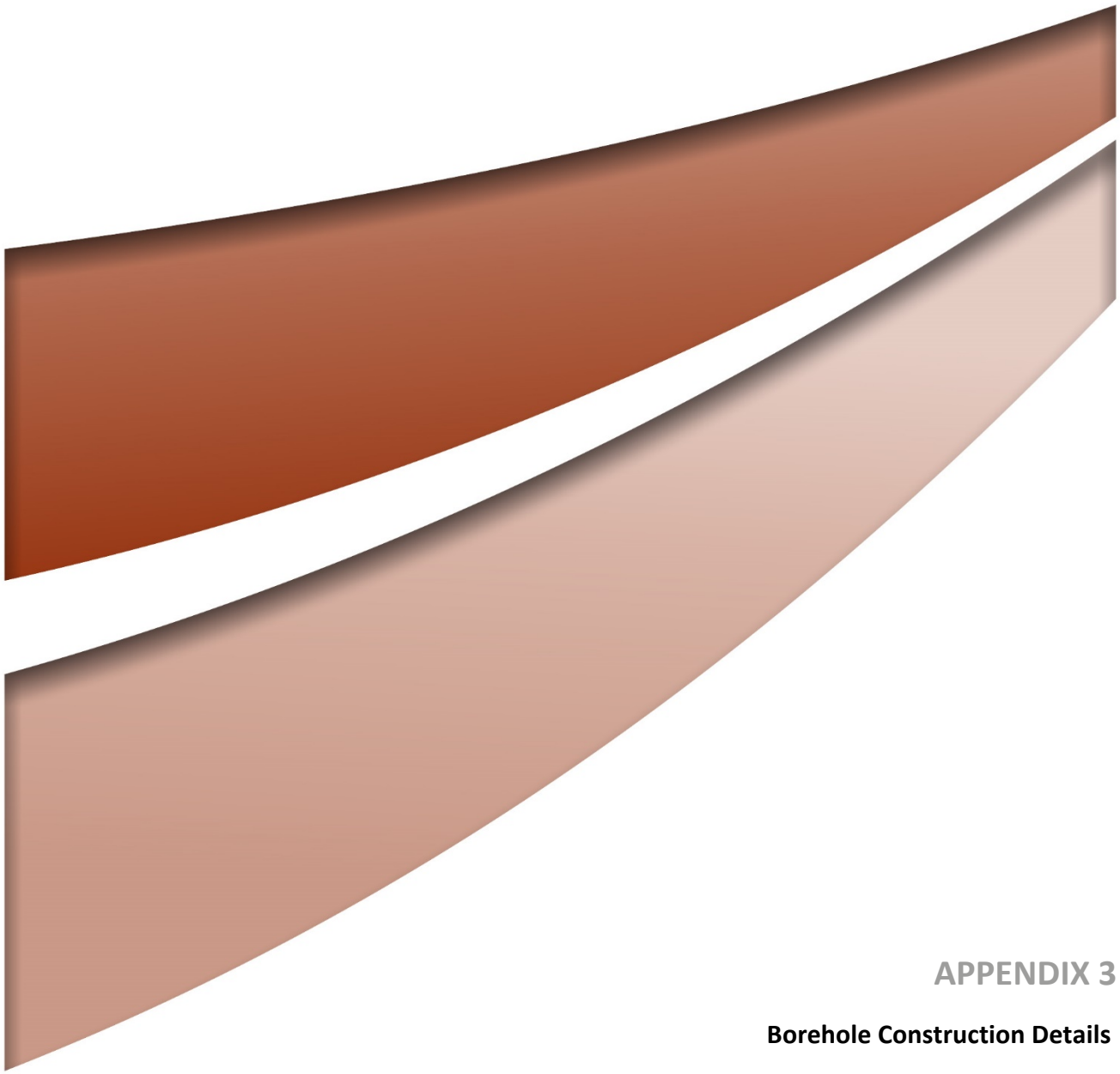
Canberra
2/99 Northbourne Avenue
Turner ACT 2612
PO Box 6135
O'Connor ACT 2602

Sydney
50 York Street
Sydney NSW 2000

Brisbane
Level 13
500 Queen Street
Brisbane QLD 4000

Orange
Office 1
3 Hampden Street
Orange NSW 2800

T| 1300 793 267 E| info@umwelt.com.au www.umwelt.com.au



APPENDIX 3

Borehole Construction Details

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

1

Driller's Licence No: 1772
Class of Licence: 2
Driller's Name: PETER STEWART
Assistant Driller's Name IDRUS BULSEY
Contractor:
New bore ☐ Replacement Bore ☐
Deepened ☐ Enlarged ☐
Reconditioned ☐ Other (specify) Monitoring Well
Final Depth 4.5 m

2

Work Licence No 5 BL
Name of Licensee: MACKAY SAND
Intended Use: Ground water Monitoring well
Completion Date:

3 DRILLING DETAILS

From (m)	To (m)	Hole Diameter (mm)	Drilling Method Code
0	4.5	180	1

4 WATER BEARING ZONES

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method Code	D D L at end of test (m)	Duration Hrs	Duration min	Salinity (Conductivity or TDS) Cond. (µS/cm)	Salinity (Conductivity or TDS) TDS (mg/L)
1.2	4.5	3.3	1.2								

5 CASING / LINER DETAILS

Material Code	O D (mm)	Wall Thickness (mm)	From (m)	To (m)	Method of Fixing Code
5	60.45	4.85	1.2	4.5	5
Casing Protector					

Casing Support Method Code 2
Type of casing bottom Code 2
Centralisers installed: No ☑ Yes ☐ (Indicate on Sketch)
Sump installed No ☑ Yes ☐ From m To m
Pressure cemented No ☑ Yes ☐ From m To m
Casing Protector cemented in place No ☑ Yes ☐

6 WATER ENTRY DESIGN

General Material Code	General OD (mm)	General Wall thickness (mm)	General From (m)	General To (m)	General Opening type Code	General Fixing Code	Screen Aperture (mm)	Slot Details Length (mm)	Slot Details Width (mm)	Slot Details Alignment Code
6	60.45	4.85	1.2	4.5	5	5				

7 GRAVEL PACK

Type	Grade	Grain size (mm) From	Grain size (mm) To	Depth (m) From	Depth (m) To	Quantity Litres	Quantity or m³
Rounded ☑	Graded ☐	2	5	1.2	4.5	33	
Crushed ☐	Ungraded ☐						
Bentonite/Grout seal No ☐ Yes ☑							
Method of placement of Gravel Pack Code 1							

8 BORE DEVELOPMENT

Chemical used for breaking down drilling mud No ☐ Yes ☐ Name:

Method	Bailing/ Surging ☐	Jetting ☐	Airlifting ☐	Backwashing ☐	Pumping ☐	Other:
Duration	hrs	hrs	hrs	hrs	hrs	hrs

9 DISINFECTION ON COMPLETION

Chemical/s used	Quantity applied (litres)	Method of application
Decon 90	1 LH	Sprayed on

10 PUMPING TESTS ON COMPLETION

Test type		Date	Pump intake depth (m)	Initial Water Level (S W L) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery Water level (m)	Recovery Time taken (hrs)	Recovery Time taken (min)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
Single stage (constant rate)										

Height of measuring point above ground level: m Test Method Code See Code Table 4

For DIPNR use only:	G	W							

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

Work Licence No: 5 BL

WORK PARTLY BACKFILLED OR ABANDONED [11]

Original depth of work : ..... metres . Is work partly backfilled: No ☐ Yes ☐

Is work abandoned : No ☐ Yes ☐ Method of abandonment: Backfilled ☐ Plugged ☐ Capped ☐

Has any casing been left in the work No ☐ Yes ☐ From ..... (m) To ..... (m)

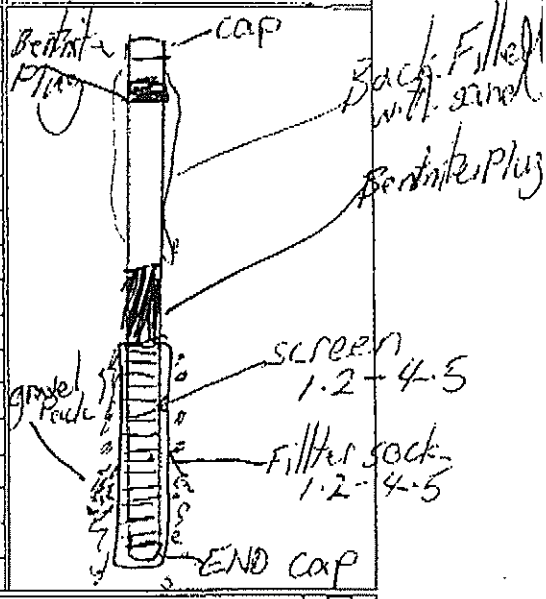
Sealing / fill type Code	From depth (m)	To depth (m)	Sealing / fill type Code	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist ☐ Geologist ☐ Driller ☐ Diviner ☐ Client ☐ other ☐ ..... [12]

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY) [13]

Depth From (m)	Depth To (m)	Description
0	2	White Sand Medium Grain
2	4.5	Amber Sand Medium to Coarse

WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG [14]

Method of Excavation : Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Bailing ☐ Other :

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimensions of liner (m)	From Depth (m)	To Depth (m)

PLEASE ATTACH COPIES OF THE FOLLOWING IF AVAILABLE [15]

Geologist log	No ☐ Yes ☐	Laboratory analysis of water Sample	No ☐ Yes ☐	Pumping test(s)	No ☐ Yes ☐
Geophysical log	No ☐ Yes ☐	Sieve analysis of aquifer material	No ☐ Yes ☐	Installed Pump details	No ☐ Yes ☐

LOCATION OF BORE [16]

Lot No DP No

Work Location Coordinates Easting 375915.77 Northing 6368256.54 Zone

GPS : No ☐ Yes ☐ >> AMG/AGD ☐ or MGA/GDA ☐ (See explanation)

Please mark the work site with "X" on the DIPNR CLID map or supply a sketch map of the location Attach the map to this Form A package.

SIGNATURES [17]

Driller Signature: Date:

Licensee Signature: Date:

NOTE: If not enough space is provided use a separate piece of paper. Provide details of works location, Drillers License Number and Work License Number.

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

1

Driller's Licence No: 1772
Class of Licence: 2
Driller's Name: PETER STEWART
Assistant Driller's Name: TOMAS BULSEY
Contractor:
New bore ☐ Replacement Bore ☐
Deepened ☐ Enlarged ☐
Reconditioned ☐ Other (specify) Monitoring Well
Final Depth m

2

Work Licence No 4 BL
Name of Licensee: MACKAS SAND
Intended Use: Ground water Monitoring Well
Completion Date:

3 DRILLING DETAILS

From (m)	To (m)	Hole Diameter (mm)	Drilling Method Code
0	4.3	180	1

4 WATER BEARING ZONES

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method Code	D D L at end of test (m)	Duration Hrs	Duration min	Salinity (Conductivity or TDS) Cond. (µS/cm)	Salinity (Conductivity or TDS) TDS (mg/L)
.5	4.3	3.8	.5								

5 CASING / LINER DETAILS

Material Code	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method of Fixing Code
5	60.45	4.75	0	4.3	5
Casing Protector					

Casing Support Method Code: 2
Type of casing bottom Code: 2
Centralisers installed: No ☑ Yes ☐ (Indicate on Sketch)
Sump installed No ☑ Yes ☐ From m To m
Pressure cemented No ☑ Yes ☐ From m To m
Casing Protector cemented in place No ☑ Yes ☐

6 WATER ENTRY DESIGN

General Material Code	General OD (mm)	General Wall thickness (mm)	General From (m)	General To (m)	General Opening type Code	General Fixing Code	Screen Aperture (mm)	Slot Details Length (mm)	Slot Details Width (mm)	Slot Details Alignment Code
5	60.45	4.75	.5	4.3	5	5				

7 GRAVEL PACK

Type	Grade	Grain size (mm) From	Grain size (mm) To	Depth (m) From	Depth (m) To	Quantity Litres or m³
Rounded ☑	Graded ☑	.2	.5	.5	4.3	25
Crushed ☐	Ungraded ☐					
Bentonite/Grout seal No ☐ Yes ☑						
Method of placement of Gravel Pack Code 1						

8 BORE DEVELOPMENT

Chemical used for breaking down drilling mud No ☐ Yes ☐ Name:

Method	Bailing/ Surging ☐	Jetting ☐	Airlifting ☐	Backwashing ☐	Pumping ☐	Other:
Duration	hrs	hrs	hrs	hrs	hrs	hrs

9 DISINFECTION ON COMPLETION

Chemical/s used	Quantity applied (litres)	Method of application
Decon 90	1 LTR	Sprayed on

10 PUMPING TESTS ON COMPLETION

Test type		Date	Pump intake depth (m)	Initial Water Level (S W L) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery Water level (m)	Recovery Time taken (hrs)	Recovery Time taken (min)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
Single stage (constant rate)										

Height of measuring point above ground level: m Test Method Code: See Code Table 4

For DIPNR use only: G W

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

Work Licence No: 4 BL

WORK PARTLY BACKFILLED OR ABANDONED [11]

Original depth of work : ..... metres . Is work partly backfilled : No ☐ Yes ☐

Is work abandoned : No ☐ Yes ☐ Method of abandonment: Backfilled ☐ Plugged ☐ Capped ☐

Has any casing been left in the work No ☐ Yes ☐ From ..... (m) To ..... (m)

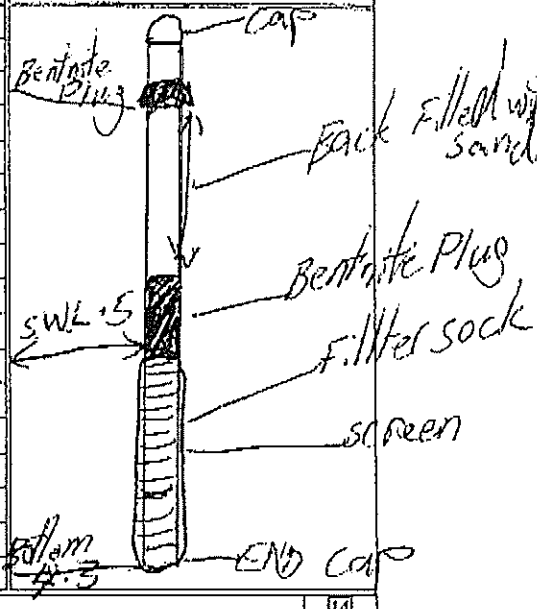
Sealing / fill type Code	From depth (m)	To depth (m)	Sealing / fill type Code	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist ☐ Geologist ☐ Driller ☐ Diviner ☐ Client ☐ other ☐ ..... [12]

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY) [13]

Depth From (m)	Depth To (m)	Description
0	.5	Black Loamy Sand
.5	1.4	Grey Clay
1.4	4.3	White Sand Medium-Coarse

WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG [14]

Method of Excavation : Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Bailing ☐ Other :

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimensions of liner (m)	From Depth (m)	To Depth (m)

PLEASE ATTACH COPIES OF THE FOLLOWING IF AVAILABLE [15]

Geologist log	No ☐ Yes ☐	Laboratory analysis of water Sample	No ☐ Yes ☐	Pumping test(s)	No ☐ Yes ☐
Geophysical log	No ☐ Yes ☐	Sieve analysis of aquifer material	No ☐ Yes ☐	Installed Pump details	No ☐ Yes ☐

LOCATION OF BORE [16]

Lot No DP No

Work Location Coordinates Easting 398836.417 Northing 6670666.604 Zone

GPS : No ☐ Yes ☑ >> AMG/AGD ☐ or MGA/GDA ☐ (See explanation)

Please mark the work site with "X" on the DIPNR CLID map or supply a sketch map of the location Attach the map to this Form A package.

SIGNATURES [17]

Driller Signature: Date:

Licensee Signature: Date:

NOTE: If not enough space is provided use a separate piece of paper. Provide details of works location, Drillers License Number and Work License Number.

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

1

Driller's Licence No: 1772
Class of Licence: 2
Driller's Name: PETER STEWART
Assistant Driller's Name: LOUIS BULSEY
Contractor:
New bore ☐ Replacement Bore ☐
Deepened ☐ Enlarged ☐
Reconditioned ☐ Other (specify) Monitoring Well
Final Depth 7 m

2

Work Licence No 3 BL
Name of Licensee: MACKAYS SAND
Intended Use: Ground water Monitoring well
Completion Date:

DRILLING DETAILS 3

From (m)	To (m)	Hole Diameter (mm)	Drilling Method Code
0	7	180	1

WATER BEARING ZONES 4

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method Code	D D L at end of test (m)	Duration Hrs	Duration min	Salinity (Conductivity or TDS) Cond. (µS/cm)	Salinity (Conductivity or TDS) TDS (mg/L)
3.5	7	3.5	3.5								

CASING / LINER DETAILS 5

Material Code	O D (mm)	Wall Thickness (mm)	From (m)	To (m)	Method of Fixing Code
8	60.45	4.95	0	7	5
Casing Protector					

Casing Support Method Code: 2
Type of casing bottom Code: 2
Centralisers installed: No ☐ Yes ☐ (Indicate on Sketch)
Sump installed No ☑ Yes ☐ From m To m
Pressure cemented No ☑ Yes ☐ From m To m
Casing Protector cemented in place No ☑ Yes ☐

WATER ENTRY DESIGN 6

General Material Code	General OD (mm)	General Wall thickness (mm)	General From (m)	General To (m)	General Opening type Code	General Fixing Code	Screen Aperture (mm)	Slot Details Length (mm)	Slot Details Width (mm)	Slot Details Alignment Code
5	60.45	4.95	3.5	7	5	5				

GRAVEL PACK 7

Type	Grade	Grain size (mm) From	Grain size (mm) To	Depth (m) From	Depth (m) To	Quantity Litres	Quantity or m³
Rounded ☑	Graded ☑	2	5	3.5	7	25	
Crushed ☐	Ungraded ☐						

Bentonite/Grout seal No ☐ Yes ☑
Method of placement of Gravel Pack Code 1

BORE DEVELOPMENT 8

Chemical used for breaking down drilling mud No ☐ Yes ☐ Name:

Method	Bailing/ Surging ☐	Jetting ☐	Airlifting ☐	Backwashing ☐	Pumping ☐	Other:
Duration	hrs	hrs	hrs	hrs	hrs	hrs

DISINFECTION ON COMPLETION 9

Chemical/s used	Quantity applied (litres)	Method of application
Decon 90	1 Ltrs	sprayed on Augers

PUMPING TESTS ON COMPLETION 10

Test type		Date	Pump intake depth (m)	Initial Water Level (S W L) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery Water level (m)	Recovery Time taken (hrs)	Recovery Time taken (min)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
Single stage (constant rate)										

Height of measuring point above ground level: m Test Method Code See Code Table 4

For DIPNR use only: G W

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

Work Licence No: 3 BL

WORK PARTLY BACKFILLED OR ABANDONED [11]

Original depth of work : ..... metres . Is work partly backfilled : No ☐ Yes ☐

Is work abandoned : No ☐ Yes ☐ Method of abandonment: Backfilled ☐ Plugged ☐ Capped ☐

Has any casing been left in the work No ☐ Yes ☐ From ..... (m) To ..... (m)

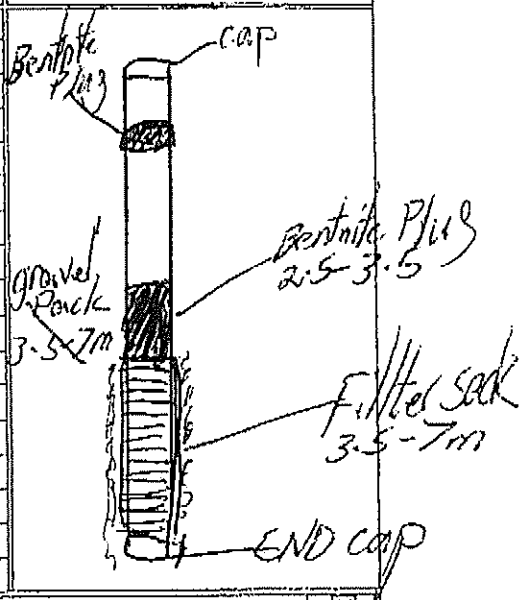
Sealing / fill type Code	From depth (m)	To depth (m)	Sealing / fill type Code	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist ☐ Geologist ☐ Driller ☐ Diviner ☐ Client ☐ other ☐ ..... [12]

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY) [13]

Depth From (m)	Depth To (m)	Description
0	3	Grey sand Fine to Medium
3	7	Light Brown sand Medium

WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG [14]

Method of Excavation : Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Bailing ☐ Other :

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimensions of liner (m)	From Depth (m)	To Depth (m)

PLEASE ATTACH COPIES OF THE FOLLOWING IF AVAILABLE [15]

Geologist log	No ☐ Yes ☐	Laboratory analysis of water Sample	No ☐ Yes ☐	Pumping test(s)	No ☐ Yes ☐
Geophysical log	No ☐ Yes ☐	Sieve analysis of aquifer material	No ☐ Yes ☐	Installed Pump details	No ☐ Yes ☐

LOCATION OF BORE [16]

Lot No DP No

Work Location Coordinates Easting 399479.258 Northing 6370391.17 Zone

GPS : No ☐ Yes ☑ >> AMG/AGD ☐ or MGA/GDA ☐ (See explanation)

Please mark the work site with "X" on the DIPNR CLID map or supply a sketch map of the location Attach the map to this Form A package.

SIGNATURES [17]

Driller Signature: Licensee Signature:

Date: Date:

NOTE: If not enough space is provided use a separate piece of paper. Provide details of works location, Drillers License Number and Work License Number.

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

1

Driller's Licence No: 1772
Class of Licence: 2
Driller's Name: PETER STEWART
Assistant Driller's Name IDRIS BULLSEY
Contractor:
New bore ☐ Replacement Bore ☐
Deepened ☐ Enlarged ☐
Reconditioned ☐ Other (specify) Monitoring Well
Final Depth 8.5 m

2

Work Licence No 2. BL
Name of Licensee: MACKA'S SAND
Intended Use: Ground Water Monitoring Well
Completion Date:

DRILLING DETAILS 3

From (m)	To (m)	Hole Diameter (mm)	Drilling Method Code
0	8.5	180	1

WATER BEARING ZONES 4

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method Code	D D L at end of test (m)	Duration Hrs	Duration min	Salinity (Conductivity or TDS) Cond. (µS/cm)	Salinity (Conductivity or TDS) TDS (mg/L)
4.5	8.5	4	4.5								

CASING / LINER DETAILS 5

Material Code	O D (mm)	Wall Thickness (mm)	From (m)	To (m)	Method of Fixing Code
8	60.45	4.93	0	8.5	5
Casing Protector					

Casing Support Method Code 3
Type of casing bottom Code 3
Centralisers installed: No ☑ Yes ☐ (Indicate on Sketch)
Sump installed No ☑ Yes ☐ From m To m
Pressure cemented No ☑ Yes ☐ From m To m
Casing Protector cemented in place No ☐ Yes ☐

WATER ENTRY DESIGN 6

General Material Code	General OD (mm)	General Wall thickness (mm)	General From (m)	General To (m)	General Opening type Code	General Fixing Code	Screen Aperture (mm)	Slot Details Length (mm)	Slot Details Width (mm)	Slot Details Alignment Code
5	60.45	4.93	4.5	8.5	5	5				

GRAVEL PACK 7

Type		Grade		Grain size (mm) From	Grain size (mm) To	Depth (m) From	Depth (m) To	Quantity Litres	Quantity or m³
Rounded	☑	Graded	☑	2	5	4.5	8.5	35	
Crushed	☐	Ungraded	☐						
Bentonite/Grout seal	No ☐	Yes ☑							
Method of placement of Gravel Pack		Code	1						

BORE DEVELOPMENT 8

Chemical used for breaking down drilling mud No ☐ Yes ☐ Name:

Method	Bailing/Surging ☐	Jetting ☐	Airlifting ☐	Backwashing ☐	Pumping ☐	Other:
Duration	hrs	hrs	hrs	hrs	hrs	hrs

DISINFECTION ON COMPLETION 9

Chemical/s used	Quantity applied (litres)	Method of application
Decon 90	1 Ltrs	Sprayed on Augers Before & After

PUMPING TESTS ON COMPLETION 10

Test type		Date	Pump intake depth (m)	Initial Water Level (S W L) (m)	Pumping rate (L/s)	Water Level at end of pumping (D D L) (m)	Duration of Test (hrs)	Recovery Water level (m)	Recovery Time taken (hrs)	Recovery Time taken (min)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
Single stage (constant rate)										

Height of measuring point above ground level: m Test Method Code See Code Table 4

For DIPNR use only:	G	W							

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

Work Licence No: 2 BL

WORK PARTLY BACKFILLED OR ABANDONED 11

Original depth of work : ..... metres . Is work partly backfilled : No ☐ Yes ☐

Is work abandoned : No ☐ Yes ☐ Method of abandonment: Backfilled ☐ Plugged ☐ Capped ☐

Has any casing been left in the work No ☐ Yes ☐ From ..... (m) To ..... (m)

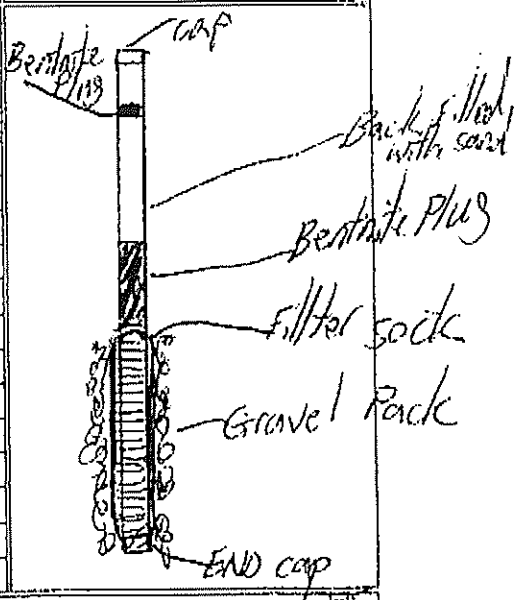
Sealing / fill type Code	From depth (m)	To depth (m)	Sealing / fill type Code	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist ☐ Geologist ☐ Driller ☐ Diviner ☐ Client ☐ other ☐ 12

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY) 13

Depth From (m)	Depth To (m)	Description
0	1.5	Light Grey sand
1.5	3.2	Dark Brown Sand
3.2	8.5	White sand Medium grain

WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG 14

Method of Excavation : Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Bailing ☐ Other :

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimensions of liner (m)	From Depth (m)	To Depth (m)

PLEASE ATTACH COPIES OF THE FOLLOWING IF AVAILABLE 15

Geologist log	No ☐	Yes ☐	Laboratory analysis of water Sample	No ☐	Yes ☐	Pumping test(s)	No ☐ Yes ☐
Geophysical log	No ☐	Yes ☐	Sieve analysis of aquifer material	No ☐	Yes ☐	Installed Pump details	No ☐ Yes ☐

LOCATION OF BORE 16

Lot No DP No

Work Location Coordinates Easting 378820.655 Northing 6370293.529 Zone

GPS : No ☐ Yes ☑ >> AMG/AGD ☐ or MGA/GDA ☐ (See explanation)

Please mark the work site with "X" on the DIPNR CLID map or supply a sketch map of the location Attach the map to this Form A package.

SIGNATURES 17

Driller Signature: Date:

Licensee Signature: Date:

NOTE: If not enough space is provided use a separate piece of paper. Provide details of works location, Drillers License Number and Work License Number.

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

1

Driller's Licence No: 1772
Class of Licence: 2
Driller's Name: PETER STEWART
Assistant Driller's Name ZORAS BULSEY
Contractor:
New bore ☐ Replacement Bore ☐
Deepened ☐ Enlarged ☐
Reconditioned ☐ Other (specify) Monitoring well
Final Depth 5.9 m

2

Work Licence No 6 BL
Name of Licensee: MACKA'S SAND
Intended Use: Ground water Monitoring Well
Completion Date:

DRILLING DETAILS 3

From (m)	To (m)	Hole Diameter (mm)	Drilling Method Code
0	5.9	180	1

WATER BEARING ZONES 4

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method Code	D D L at end of test (m)	Duration Hrs	Duration min	Salinity (Conductivity or TDS) Cond. (µS/cm)	Salinity (Conductivity or TDS) TDS (mg/L)
2.7	5.9	3.2	2.7								

CASING / LINER DETAILS 5

Material Code	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method of Fixing Code
5	60.45	4.95	2.7	5.9	5
Casing Protector					

Casing Support Method Code 2
Type of casing bottom Code 2
Centralisers installed: No ☑ Yes ☐ (Indicate on Sketch)
Sump installed No ☑ Yes ☐ From m To m
Pressure cemented No ☑ Yes ☐ From m To m
Casing Protector cemented in place No ☑ Yes ☐

WATER ENTRY DESIGN 6

General Material Code	General OD (mm)	General Wall thickness (mm)	General From (m)	General To (m)	General Opening type Code	General Fixing Code	Screen Aperture (mm)	Slot Details Length (mm)	Slot Details Width (mm)	Slot Details Alignment Code
5	60.45	4.95	2.7	5.9	5	5				

GRAVEL PACK 7

Type	Grade	Grain size (mm) From	Grain size (mm) To	Depth (m) From	Depth (m) To	Quantity Litres or m³
Rounded ☑	Graded ☑	2	5	2.7	5.9	26
Crushed ☐	Ungraded ☐					

Bentonite/Grout seal No ☐ Yes ☑
Method of placement of Gravel Pack Code 1

BORE DEVELOPMENT 8

Chemical used for breaking down drilling mud No ☐ Yes ☐ Name:

Method	Bailing/Surging ☐	Jetting ☐	Airlifting ☐	Backwashing ☐	Pumping ☐	Other:
Duration	hrs	hrs	hrs	hrs	hrs	hrs

DISINFECTION ON COMPLETION 9

Chemical/s used	Quantity applied (litres)	Method of application
Decon 90	1 litre	sprayed on

PUMPING TESTS ON COMPLETION 10

Test type		Date	Pump intake depth (m)	Initial Water Level (S W L) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery Water level (m)	Recovery Time taken (hrs)	Recovery Time taken (min)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
Single stage (constant rate)										

Height of measuring point above ground level: m Test Method Code See Code Table 4

For DIPNR use only:	G	W							

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

Work Licence No: 6 BL

WORK PARTLY BACKFILLED OR ABANDONED [11]

Original depth of work : ..... metres . Is work partly backfilled : No ☐ Yes ☐

Is work abandoned : No ☐ Yes ☐ Method of abandonment: Backfilled ☐ Plugged ☐ Capped ☐

Has any casing been left in the work No ☐ Yes ☐ From ..... (m) To ..... (m)

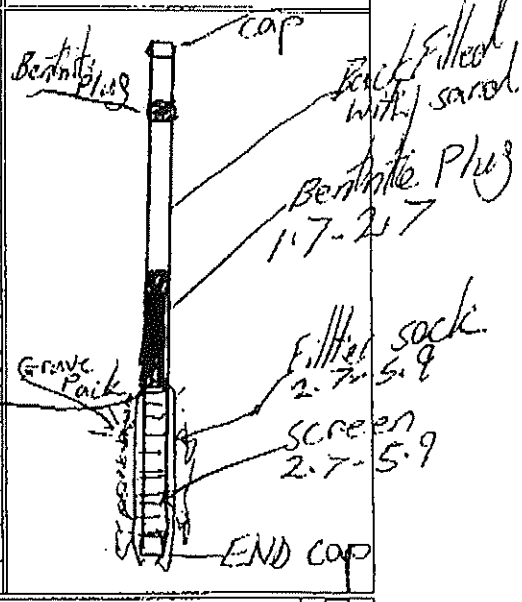
Sealing / fill type Code	From depth (m)	To depth (m)	Sealing / fill type Code	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist ☐ Geologist ☐ Driller ☐ Diviner ☐ Client ☐ other ☐ ..... [12]

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY) [13]

Depth From (m)	Depth To (m)	Description
0	.5	Black Loamy Sand
.5	1.5	Gray sandy Fine
1.5	5.9	Amber Sand Medium Grain

WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG [14]

Method of Excavation : Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Bailing ☐ Other :

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimensions of liner (m)	From Depth (m)	To Depth (m)

PLEASE ATTACH COPIES OF THE FOLLOWING IF AVAILABLE [15]

Geologist log	No ☐ Yes ☐	Laboratory analysis of water Sample	No ☐ Yes ☐	Pumping test(s)	No ☐ Yes ☐
Geophysical log	No ☐ Yes ☐	Sieve analysis of aquifer material	No ☐ Yes ☐	Installed Pump details	No ☐ Yes ☐

LOCATION OF BORE [16]

Lot No DP No

Work Location Coordinates Easting 397992.741 Northing 6368222.846 Zone

GPS : No ☐ Yes ☐ >> AMG/AGD ☐ or MGA/GDA ☐ (See explanation)

Please mark the work site with "X" on the DIPNR CUD map or supply a sketch map of the location Attach the map to this Form A package.

SIGNATURES [17]

Driller Signature: Licensee Signature:

Date: Date:

NOTE: If not enough space is provided use a separate piece of paper. Provide details of works location, Drillers License Number and Work License Number.

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

[1]

Driller's Licence No: 1772
Class of Licence: 2
Driller's Name: PETER STEWART
Assistant Driller's Name IDRUS BULSEY
Contractor:
New bore ☐ Replacement Bore ☐
Deepened ☐ Enlarged ☐
Reconditioned ☐ Other (specify) Monitoring Well
Final Depth 19 m

[2]

Work Licence No 1 BL
Name of Licensee: MACKAS SAND
Intended Use: Ground Water Monitoring Well
Completion Date:

DRILLING DETAILS [3]

From (m)	To (m)	Hole Diameter (mm)	Drilling Method Code
0	19	180	1

WATER BEARING ZONES [4]

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Cumulative	Test method Code	D D L at end of test (m)	Duration Hrs	min	Salinity (Conductivity or TDS) Cond. (µS/cm)	TDS (mg/L)
15	19	4	15m								

CASING / LINER DETAILS [5]

Material Code	OD (mm)	Wall thickness (mm)	From (m)	To (m)	Method of Fixing Code
8	63.45	4.95	0	19	5
Casing Protector					

Casing Support Method Code 2
Type of casing bottom Code 2
Centralisers installed: No ☑ Yes ☐ (Indicate on Sketch)
Sump installed No ☑ Yes ☐ From m To m
Pressure cemented No ☑ Yes ☐ From m To m
Casing Protector cemented in place No ☑ Yes ☐

WATER ENTRY DESIGN [6]

General Material Code	OD (mm)	Wall thickness (mm)	From (m)	To (m)	Opening type Code	Fixing Code	Screen Aperture (mm)	Slot Details Length (mm)	Width (mm)	Alignment Code
5	60	4.95	16	19	5	5				

GRAVEL PACK [7]

Type		Grade		Grain size (mm) From	To	Depth (m) From	To	Quantity Litres or m³
Rounded	☑	Graded	☑	.2	.5	16	19	25
Crushed	☐	Ungraded	☐					

Bentonite/Grout seal No ☐ Yes ☑
Method of placement of Gravel Pack Code 1

BORE DEVELOPMENT [8]

Chemical used for breaking down drilling mud No ☐ Yes ☐ Name:

Method	Bailing/Surging ☐	Jetting ☐	Airlifting ☐	Backwashing ☐	Pumping ☐	Other:
Duration	hrs	hrs	hrs	hrs	hrs	hrs

DISINFECTION ON COMPLETION [9]

Chemical/s used	Quantity applied (litres)	Method of application
Decon 90	1Ltrs	Sprayed on Augers before & after

PUMPING TESTS ON COMPLETION [10]

Test type		Date	Pump intake depth (m)	Initial Water Level (S W L) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery Water level (m)	Time taken (hrs)	(min)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
Single stage (constant rate)										

Height of measuring point above ground level: m Test Method Code See Code Table 4

For DIPNR use only: G W

NSW Department of Infrastructure, Planning and Natural Resources

FORM A PARTICULARS OF COMPLETED BORE

VERSION 2004

Work Licence No: / BL

WORK PARTLY BACKFILLED OR ABANDONED [11]

Original depth of work : ..... metres . Is work partly backfilled : No ☐ Yes ☐

Is work abandoned : No ☐ Yes ☐ Method of abandonment: Backfilled ☐ Plugged ☐ Capped ☐

Has any casing been left in the work No ☐ Yes ☑ From ..... (m) To ..... (m)

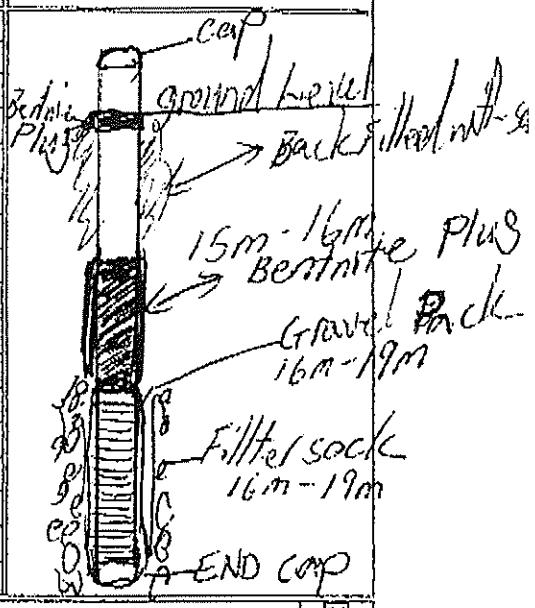
Sealing / fill type Code	From depth (m)	To depth (m)	Sealing / fill type Code	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist ☐ Geologist ☐ Driller ☐ Diviner ☐ Client ☐ other ☐ ..... [12]

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY) [13]

Depth From (m)	Depth To (m)	Description
0	1.2	Gravel sand Fine
1.2	12.3	Amber Sand Course
12.3	19	Amber-Brown sand

WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG [14]

Method of Excavation : Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Bailing ☐ Other :

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimensions of liner (m)	From Depth (m)	To Depth (m)

PLEASE ATTACH COPIES OF THE FOLLOWING IF AVAILABLE [15]

Geologist log	No ☐ Yes ☐	Laboratory analysis of water Sample	No ☐ Yes ☐	Pumping test(s)	No ☐ Yes ☐
Geophysical log	No ☐ Yes ☐	Sieve analysis of aquifer material	No ☐ Yes ☐	Installed Pump details	No ☐ Yes ☐

LOCATION OF BORE [16]

Lot No DP No

Work Location Coordinates Easting 399201.465 Northing 6369258.767 Zone

GPS : No ☐ Yes ☑ >> AMG/AGD ☐ or MGA/GDA ☐ (See explanation)

Please mark the work site with "X" on the DIPNR CLID map or supply a sketch map of the location Attach the map to this Form A package.

SIGNATURES [17]

Driller Signature: Date:

Licensee Signature: Date:

NOTE: If not enough space is provided use a separate piece of paper. Provide details of works location, Drillers License Number and Work License Number.

umwelt
Environmental & Social Consultants

Umwelt (Australia) Pty Limited

T| 1300 793 267 E| info@umwelt.com.au www.umwelt.com.au