NEWCASTLE SAND

Soil and Water Management Plan

Williamtown Sand Syndicate Pty Ltd

Williamtown Sand

Cabbage Tree Road, Williamtown

7 July 2021

NEWCASTLE SAND

Soil and Water Management Plan

Williamtown Sand
Cabbage Tree Road, Williamtown

File Name: WSS_SWMP_V3_JULY2021.docx

WILLIAMTOWN SAND SYNDICATE PTY LTD

Document Control:

Version	Description	Date	Author	Technical Reviewer
1	Final for Consultation	15 February 2019	J.Berry/ K.O'Connor / T.Overton/ W.Minchin	B.Grant
1.1	Adapted to include comments from consultation.	13 May 2019	J.Berry/ K.O'Connor / T.Overton/ W.Minchin	B.Grant
2	Includes comments from DPIE		J.Berry/ K.O'Connor / T.Overton/ W.Minchin	B.Grant
3	Update following completion of 12 months baseline monitoring and inclusion of DPIE comments from August 2020. Addresses DPIE comments from November 2020. Addresses DPIE comments from April 2021. Includes sections relating to the wash plant approved within Mod 2. Addresses DPIE comments from June 2021.	~~15 October 2020~~ ~~5 January 2021~~ ~~17 May 2021~~ 7 July 2021	J.Berry (Wedgetail Project Consulting)	J.Berry

This document has been prepared by:

WATERSHED HYDROGEO

KLEINFELDER Bright People. Right Solutions.

Kleinfelder Australia Pty Ltd

Versions 3 and above finalised by:

WEDGETAIL PROJECT CONSULTING

Contents

Figures

Tables

Appendices

Appendix 1: Regulatory Consultation
Appendix 2: Relevant statement of commitments Cross Reference
Appendix 3: Summary of Current Groundwater Modelling
Appendix 4: Standard ESC Control Diagrams
Appendix 5: Water Balance Volumes
Appendix 6: Baseline Summary Report

Glossary

Abbreviation	Definition or Meaning
6:2 FTS	6:2 Fluorotelomer sulfonic acid (a PFAS chemical)
°C	Temperature in degrees Celsius
µg/L	Concentration in micrograms per litre (1µg/L = 0.001 µg/L)
µS/cm	MicroSiemens per centimetre – units for electrical conductivity
ADWG (2011)	Australian Drinking Water Guidelines 6
AEMR	Annual Environmental Management Report / Annual Review under Schedule 5, Condition 11
AHD	Australian Height Datum
ANZECC	Typically refers to water quality guidelines prepared by the Australian and New Zealand Environment and Conservation Council
ARI	Average Recurrence Interval
AS	Australian Standard
As	Arsenic
ASS	Acid sulphate soils (not found on this site)
B	Boron
Ba	Barium
BH	Borehole
BTEXN	Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene
Ca	Calcium
Cl	Chloride
Co	Cobalt
Cr	Chromium
Cu	Copper
DPIE – Water	Water Group within DPIE
DPIE	Department of Planning Industry and Environment
EC	Electrical Conductivity used to assist understanding of salinity
Eh	Unit for measurement of ORP / oxidation / reduction state
Fe	Iron
EPA	Environmental Protection Authority

Abbreviation	Definition or Meaning
EPL	Environmental Protection Authority
Fe	Copper
FSANZ	Food Standards Australia New Zealand
H:V	Horizontal : Vertical (a measure of slope)
ha	Hectare (unit of area = to 10,000 m^2)
HDPE	High-density polyethylene
HEPA	Heads of EPAs Australia and New Zealand
Hg	Mercury
HHRA 2017	Human Health Risk Assessment 2017, prepared by AECOM commissioned by Department of Defence
HWC	Hunter Water Corporation
K	Potassium
kL	Kilolitres (1,000 L)
L	Litre
LDPE	Low-density polyethylene
LOR	Limit of reporting – lowest reliable level for detection of analyte in soil or water
m	metre
mBTOC	Metres below top of casing
MED report	Maximum Extraction Depth (MED) report
Mg	Magnesium
mg/L	Concentration in milligrams per litre (1mg/L = 1000 µg/L)
MGA 94	Map Grid of Australia 1994 (coordinate projection grid)
ML	Megalitre (1,000,000 L)
mm	Millimetres (spatial dimension or rainfall depth)
Mn	Manganese
N	Nitrogen
Na	Sodium
NATA	National Association of Testing Authorities
NEMP	PFAS National Environmental Management Plan
Ni	Nickel
NSW	New South Wales
NTU	Nephelometric Turbidity Units
ORP	Oxidative Redox Potential
PFAS	Per and poly-fluorinated alkyl substances
PFDS	Perfluorodecanesulfonic acid
PFHxS	Perfluorohexanesulphonic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
pH	Measure of hydrogen ion concentration to assist understanding of acidity
PVC	Polyvinyl chloride
RAAF	Royal Australian Air Force (Williamtown)

Abbreviation	Definition or Meaning
RL	Reduced Level – in this report, this is same as AHD
RZM	RZM Pty Ltd (Rutile Zircon Mining), a company that dredged a large portion of the quarry area for mineral sands in the late 1970s and early 1980s.
Se	Selenium
SO_4	Sulphate
SSD-6125	Development Consent for the Cabbage Tree Road Sand Quarry
SW	Surface Water
SWMP	Soil and Water Management Plan
TD	Total depth
tpa	tonnes per annum
TRH	Total recoverable hydrocarbon
WSS	Williamtown Sand Syndicate (the owner of Newcastle Sand)
Zn	Zinc

1. INTRODUCTION

1.1 BACKGROUND

Williamtown Sand Syndicate Pty Ltd (WSS), trading as Newcastle Sand have approval to construct and operate a sand quarry on four lots of land located at 398 Cabbage Tree Road, Williamtown, approximately 30 km from the Newcastle central business district. The Project will extract up to 530,000 tonnes per annum of sand products over a period of up to 15 years.

Development Consent (SSD-6125) was granted by the NSW Independent Planning Commission on 9 May 2018 for construction and operation of the quarry, subject to a series of conditions. Condition 15 of Schedule 3 of the Development Consent requires the preparation and implementation of a Soil and Water Management Plan (SWMP).

The SWMP includes the following key components:

- Site Water Balance — refer to **Section 4**.
- Surface Water Management Plan – refer to **Sections 3.5, 5, 7,** and **8**.
- Groundwater Management Plan – prepared by Watershed HydroGeo Pty Ltd – refer to **Sections 3.6, 7,** and **8**.

Quarry activities that have the potential to impact water include vegetation clearing, topsoil stripping, quarry excavations and stockpiling of topsoil and quarry materials. While the activity occurs with permeable sand beds where runoff is limited, surface run-off and sedimentation of surrounding land and water must be avoided. Excavations and quarrying must have regard to the maximum predicted groundwater level, that is currently modelled to vary from approximately 2.75 m AHD in the south to 5.25 m AHD in the north (refer to the Maximum Extraction Depth Report).

This plan has been prepared by Wedgetail Project Consulting Pty Ltd, Kleinfelder and Watershed HydroGeo Pty Ltd in conjunction with Newcastle Sand to satisfy water management Conditions of the Development Consent.

Construction of the quarry commenced in August 2019, the Cabbage Tree Road intersection was completed in May 2020 and the quarry became operational on 18 May 2020. In March 2021, Mod2 was approved enabling the inclusion of a wash plant onsite to improve sand processing.

1.2 PROJECT OVERVIEW

The key details of the Project are shown within **Table 1** below. An overview of the project area is shown in **Figure 1.**

Table 1: Key Aspects of the Cabbage Tree Road Sand Project.

Aspect	Key Aspects of the Project
Key elements	Sand quarry extracting up to 530,000 tonnes per annum over a period of 6 to 15 years including the construction of an intersection with Cabbage Tree Road, sealed and gravel access roads, site office, workshop and weighbridges. Progressive rehabilitation of quarried land returning to native vegetation communities with potential future use of the facilities area.
Location	398 Cabbage Tree Road, Williamtown, within the Port Stephens local government area.
Property Titles	Four titles within the Parish of Stockton, County of Gloucester including: • Lot 1 DP 224587 at 398 Cabbage Tree Road, Williamtown • Lot 121 DP 556403 at 282B Cabbage Tree Road, Williamtown. • Lot 11 DP 629503 at 282A Cabbage Tree Road, Williamtown. • Lot 1012 DP 814078 at 282 Cabbage Tree Road Williamtown.
Land Owner	Port Stephens Shire Council under lease to Williamtown Sand Syndicate Pty Ltd.
Proponent	Williamtown Sand Syndicate Pty Ltd, the owner of the quarry operator Newcastle Sand.
Area	Total Project Area of approximately 42.3 hectares from a Subject Land Area of approximately 176.2 hectares.
Project Life	Up to 15 years. At expected demand the quarry will have an eight (8) year life, or six (6) years at maximum extraction rates.
Extraction Rate	Maximum of 530,000 tonnes per annum, and maximum daily rate of 3,000 tonnes.
Operating Hours	Construction of intersection, access and workshop and office: • 7:00am to 5:00pm Monday to Friday. • 8:00am to 1:00pm Saturday. • No works on Sunday or public holidays. Quarrying Operations: • 7:00am to 5:00pm Monday to Friday. • 7:00am to 4:00pm on Saturday. • No quarrying on Sunday or a Public Holiday. Loading and dispatch of trucks: • 6:00am to 6:00pm Monday to Friday. • 7:00am to 4:00pm Saturday. • No works on Sunday or public holidays.
Transport Rate	• Up to 6 laden trucks per hour (12 trips per hour) during the hours of 6 am to 7 am Monday to Friday. • Up to 10 laden trucks per hour (20 trips per hour) during hours of 7 am to 6 pm Monday to Friday (i.e. all haulage hours excluding the morning peak). • Up to 10 laden trucks per hour (20 trips per hour) during hours of 7 am to 4 pm Saturdays. • Haulage between 5 am and 6 am is subject to agreement from adjacent landowners as per Schedule 3, Condition 1. • Up to 6 vehicles of employees would be expected to arrive from approximately 5:30 am to 7 am and leave between 5 pm and 7 pm.

Aspect	Key Aspects of the Project
Resource and products	Approximately 3.25 Mt of sand, comprising the following products to be extracted from site by truck onto Cabbage Tree Road for transport to markets: • Raw fill sand. • Screened sand. • Sandy loam. • Concrete sand. • Glass sand (estimated at about 16% of total resource). The Project covers approximately 42.3 hectares (including access roads) with extraction to a depth of not more than 0.7m above the highest predicted groundwater level.
Extraction	• Maximum extraction rate of 530,000 tonnes per annum. • Excavator and/or bulldozer to clear vegetation and strip topsoil. • Bulldozer or grader to windrow sand. • Front-end loader to feed conveyors to convey sand to the processing plant. • Front-end loader and haul truck to convey sand when conveyor unsuitable.
Processing Methods	• Raw sand product extracted directly from face with no processing. • Sand fed into electrically powered screen. • Screened sand sold as product or fed to electrically powered, air separator, or, wash plant. • Products stockpiled for loading directly into truck or fill bulk bags for removal from the site by truck.
Support facilities and utilities	• Site office, workshop, stores, car parking. • Power supply from local network • Water supply from local network.

1.3 PURPOSE AND SCOPE

This SWMP outlines the key management controls to be implemented during quarry construction and operations to minimise impacts to soil and water within and surrounding the Project Area.

This document satisfies Development Consent Conditions 15 (SWMP) and 16 to 21 (Tomago Sand Beds) of Schedule 3, and the Statement of Commitments in Appendix 2 of the Consent. A checklist of where each condition has been addressed in this document is provided in **Table 2**.

This SWMP will be implemented in conjunction with the other management plans required under the Development Consent for the duration of quarry construction and operations.

1.4 PLAN PREPARATION AND CONSULTATION

The plan is required to be prepared in consultation with the NSW Environmental Protection Authority (EPA), the Water Group within the Department of Planning, Industry and Environment (DPIE - Water) and the Hunter Water Corporation (HWC), prior to approval by the Department of Planning, Industry and Environment (DPIE). Copies of correspondence is included in **Appendix 1**.

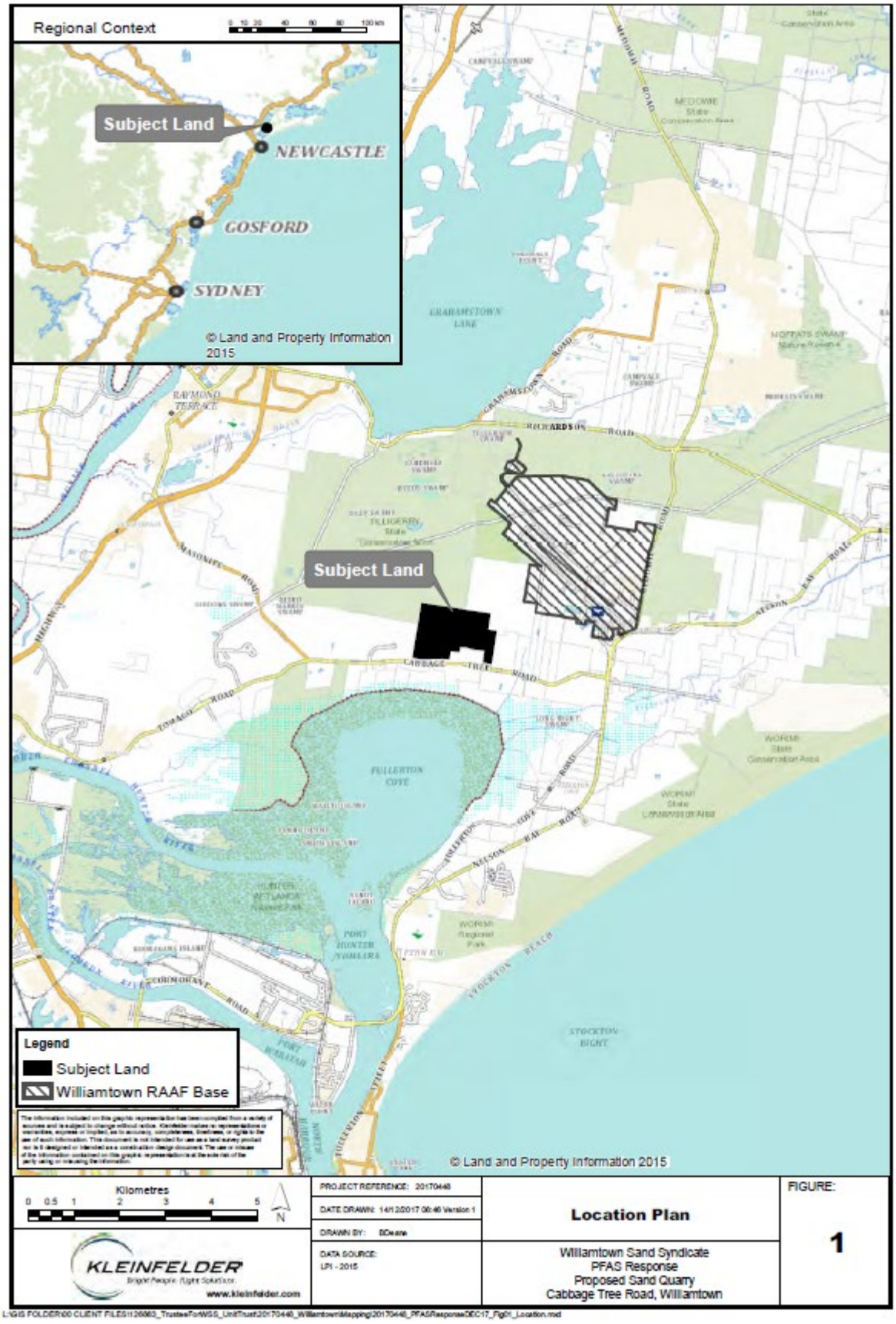

Figure 1: Location of Williamtown Sand quarry on Cabbage Tree Road, Williamtown

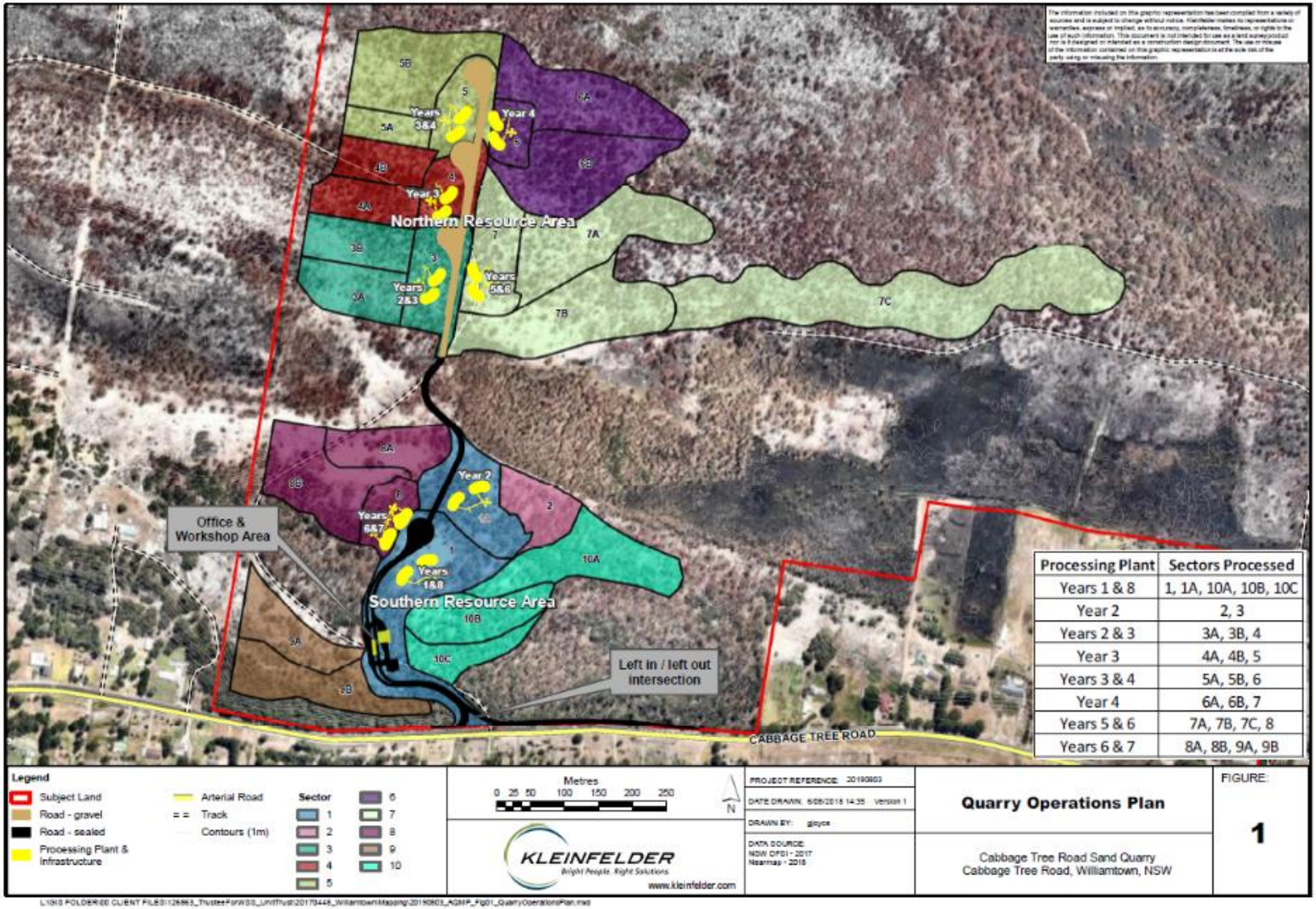

Figure 2: Resource and sequence plan as per approved plans

2. STATUTORY REQUIREMENTS

2.1 LEGISLATION AND GUIDELINES

Legislation relevant to soil and water management includes:

- *Environmental Planning and Assessment Act 1979.*
- *Water Management Act 2000.*
- *Hunter Water Regulation 2015 Part.2 Special Areas: Tomago Sandbeds Catchment.*

Guidelines that are specific to soil and water management within the Project Area include:

- Managing Urban Stormwater: Soils and Construction Volume 1 4th Edition, March 2004, Landcom, New South Wales Government, (Landcom 2004).
- Managing Urban Stormwater: Soils and Construction, Volume 2E Mines and quarries, 2008, Department of Environment and Climate Change NSW in association with the Sydney Metropolitan Catchment Management Authority, New South Wales Government, (DECC 2008).

Guidelines that are specific to water quality within the Project Area include:

- Australian and New Zealand Guidelines for fresh and marine water quality: National Water Quality Management Strategy, 2000, Australian and New Zealand Environmental Conservation Council: Agriculture and Resources Management Council of Australia and New Zealand (ANZECC 2000).
- National Health and Medical Research Council Australian Drinking Water Guidelines 2018.
- Per and poly-fluorinated alkyl substances (PFAS) contamination of groundwater by operations at RAAF Base Williamtown, located 800-1000 m to the northeast of the Site has meant that approximately two-thirds of the Site being within NSW EPA's 'Broader Management Zone' for PFAS at Williamtown0F1. With respect to PFAS, the most relevant guideline is the Heads of EPAs Australia and New Zealand (HEPA) 2020. PFAS National Environmental Management Plan (NEMP) 2.0.

Guidelines that are specific to groundwater management within the Project Area include:

- *Tomago-Tomaree-Stockton Groundwater Management Plan 1996.*
- *Water Sharing Plan for the Tomago-Tomaree-Stockton Groundwater Sources 2003.*
- *Aquifer Interference Policy.*

2.1.1 Adopted Australian Guidelines for PFAS

In 2016, Food Standards Australia New Zealand (FSANZ) were commissioned to develop health based guidance values for a selection of PFAS. FSANZ (2017) published levels for use in site investigations which were updated and incorporated into the HEPA NEMP (2018) and

[1] https://www.epa.nsw.gov.au/working-together/community-engagement/community-news/raaf-williamtown-contamination/background-and-ongoing-management

consequently the HEPA NEMP V2 (2020). The HEPA NEMP V2 (2020) is the recognised national guidance for the investigation and management of PFAS in Australia and form the key guidance for PFAS for this SWMP.

2.2 DEVELOPMENT CONSENT

Development Consent was granted for the Project under the *Environmental Planning and Assessment Act 1979* by the NSW Independent Planning Commission. The requirement for a Soil and Water Management Plan arises from Condition 15(d) within Schedule 3 of the Development Consent. Other management requirements are outlined in Condition 16 to 20 of Schedule 3 and in Appendix 2 – Statement of Commitments.

Table 2 provides a summary of where each requirement of the consent relating to soil and water are addressed in this document.

Table 2: Development Consent Conditions

Condition	Description	Addressed in Section
Schedule 3 – Specific Environmental Conditions		
12	**Water Supply** The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of operations under the consent to match its available water supply, to the satisfaction of the Secretary	Section 4.1
15	**Soil and Water Management Plan** The Applicant must prepare a Soil and Water Management Plan for the development to the satisfaction of the Secretary. This plan must: a) be prepared by suitably qualified and experienced person/s approved by the Secretary; b) be prepared in consultation with the EPA, Hunter Water and DPIE-Water; c) be submitted to the Secretary for approval prior to commencing ground disturbing activities on the site, unless otherwise agreed by the Secretary; and d) include a: (i) Site Water Balance that includes: • details of: ○ sources and security of water supply; ○ water use and management on site, including wash plant process water use and management; ○ any off-site water transfers; and ○ reporting procedures; and • measures to be implemented to minimise clean water use on site; (ii) Surface Water Management Plan, that includes: • a program for obtaining baseline data on surface water flows and quality in water bodies that could potentially be affected by the development; • a detailed description of the surface water management system on site including the: ○ clean water diversion system; ○ erosion and sediment controls; ○ dirty and process water management systems, including details of the type and dosing rate(s) of flocculants and coagulants; and	Refer to **Appendix 1** Section 4 Section 3 Section 5 Section 7 Section 8

Condition	Description	Addressed in Section
	○ water storages; and ○ contingency measures for PFAS-containing or contaminated water and sediments; and • a program to monitor and report on: ○ any surface water discharges; ○ the effectiveness of the water and sediment management system, including the effectiveness of water recovery during processing; ○ the quantity and type of flocculants and or coagulants used in the sand washing process; ○ potential PFAS detections in wash water and settlement products; ○ the quality of water discharged from the site to the environment; ○ surface water flows and quality in water bodies that could potentially be affected by the development; (iii) Groundwater Management Plan that includes: • A monitoring program to manage potential impacts, if any, on groundwater and any associated surface water source near the proposed extraction area that includes: ○ Identification of methodologies for determining threshold water quality criteria; ○ Regular testing of groundwater bores for the presence of PFAS; ○ Contingency measures in the event of a breach of thresholds; and ○ A program to regularly report on monitoring; and • A Construction Environmental Management Plan to manage any intersection with groundwater encountered during provision of services to the site (such as water supply pipelines) and construction of quarrying-related facilities (such as weighbridges, offices and workshop buildings). This Plan must include sampling of any groundwater encountered during such activities and testing for presence of PFAS and include contingency protocols should any groundwater be found to contain PFAS.	Section 3 Section 7 Section 8
	The Applicant must implement the Soil and Water Management Plan as approved from time to time by the Secretary. The Applicant must provide an updated Soil and Water Management Plan, inclusive of the wash plant and water and sediment management system, to the Secretary for approval. Construction of the water and sediment management system described in the MR (Mod 2) must not commence prior to the updated Soil and Water Management Plan being approved by the Secretary.	Noted
16	**Tomago Sandbeds Special Area** The Applicant must operate the development so that it has a neutral or beneficial effect on the water quality of the Tomago Sandbeds Special Area	Section 7
17	The Applicant must not construct quarry infrastructure within the Tomago Sandbeds Special Area.	Project Design Section 7
18	The Applicant must establish and use an on-site sewage pump-out system, incorporating a holding tank, located outside of the Tomago Sandbeds Special Area.	Section 5.1.2, Section 7
19	The Applicant must not store liquids other than water within the Tomago Sandbeds Special Area. Any liquids (other than water) kept on the site must be	Section 7

Condition	Description	Addressed in Section
	stored within a bunded and roofed area constructed in accordance with the relevant Australian Standards.	
20	The Applicant must construct and use a fully bunded and undercover re-fuelling facility located outside of the Tomago Sandbeds Special Area for all mobile equipment re-fuelling operations, with the exception of tracked equipment. Re-fuelling of any tracked equipment within the Tomago Sandbeds Special Area must be conducted within a fully bunded and lined hardstand that is capable of holding both the tracked equipment and the fuel truck.	Section 5.1.2 Section 7
21	The Applicant must ensure that, outside of the operating hours during which quarrying operations are permitted, all fuel-powered equipment is removed from the Tomago Sandbeds Special Area to a secure storage, except for equipment being used in vegetation clearing operations, which may be stored within a fully-bunded and lined hardstand area outside of operating hours. Note: Operating hours for quarrying operations are shown in **Table 1.**	Section 5.1.2 Section 7
Schedule 5 – Environmental Management, Reporting and Auditing		
3	**Management Plan Requirements** The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include: a) detailed baseline data; b) a description of: • the relevant statutory requirements (including any relevant approval, licence or lease conditions); • any relevant limits or performance measures/criteria; and • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures; c) a description of the measures that to be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria; d) a program to monitor and report on the: • impacts and environmental performance of the development; and • effectiveness of any management measures (see (c) above); e) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible; f) a program to investigate and implement ways to improve the environmental performance of the development over time; g) a protocol for managing and reporting any: • incidents; • complaints; • non-compliances with statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; and • a protocol for periodic review of the plan	This plan
Appendix 2 – Statement of Commitments		
The Statement of Commitments have been integrated within the Management Controls of Section 7, a cross referenced table of relevant conditions is included in **Appendix 2**.		

NEWCASTLE SAND

3. EXISTING ENVIRONMENT

3.1 SITE DESCRIPTION

The Site is situated approximately 9 kilometres (km) north of Newcastle. The Williamtown RAAF base is located 2.5 km to the north east, with Fullerton Cove approximately 600 m to the south and the Hunter River estuary beyond (**Figure 1**).

Residential dwellings are located to the east (closest dwelling is 244 m), south (closest dwelling is 61 m) and west (closest dwelling is 83 m) of the Site. Most are small properties utilised as hobby farms (e.g. keeping horses and chickens), some are larger and graze livestock as well. Potable water for dwellings is likely to comprise primarily reticulated water from Hunter Water network and rain water. Many properties appear to have spear point wells installed for stock and domestic use. No dwellings are located within 4 km north of the Site.

The site and adjoining properties to the south and east are within the NSW EPA's Broader Management Zone (the lowest area of concern within the declared Williamtown Management Area) for per and poly fluoryl akyl substances (PFAS). Monitoring on behalf of the Australian Defence Force identified an isolated low level detection (0.02 µg/L) of PFAS in a sample opposite the southern boundary of the site. Sampling by WSS has not detected any PFAS within the sand onsite, however, PFAS has been detected sporadically at low levels in surface water in the drainage channel on the eastern extent of the property (outside the extraction area) and in groundwater on the southern boundary (outside the extraction area) of the site (consistent with existing detections) and in the north east of the site (outside the extraction area). All PFAS detections have been at low levels and have occurred sporadically (i.e. typically not detected in consecutive samples).

A large portion of the extraction area was previously dredged by RZM for mineral sands. The site is predominantly vegetated, with exception to a gravel road, two former silica sand extraction areas and the verge of Cabbage Tree Road. Vegetation varies in condition relative to past mining areas and the associated rehabilitation.

Access to the site is via a left in/ left out intersection on Cabbage Tree Road extending into the site on a bitumen sealed road through the Office and Workshop area, and will progressively extend north to the southern boundary of the Northern Resource Area. The road is constructed as quarrying progresses to enable road registered trucks to access process and stockpile areas. Within the Northern Resource Area, the road will be a gravel surface, unless additional sealing is required to reduce water consumption. The office and workshop area (including the weighbridges, fuel storage and vehicle storage) will be located in the southern part of the Site located outside the Tomago Sandbeds Special Area. The processing plant will be placed at strategic locations throughout the Site appropriate to the area of extraction at that time. The processing and stockpile area includes a constructed gravel hardstand to maintain plant stability and enable safe loading of product sand. Refer to **Figure 2**.

3.2 CLIMATE

Key climate related statistics from the nearby Williamtown Airport weather station are provided within **Table 3** below. The following key observations can be inferred from the climate information:

- Avoid planting within November, December, January and February to minimise the extent of additional watering.
- Water required for dust suppression is likely to be highest through summer months with higher temperatures, evaporation and lower rainfall than through winter.
- The number of days of rainfall per month remains relatively consistent throughout the year.
- Observations onsite suggest the months of August and September have a high occurrence of north-westerly winds, which given the location of receptors, requires greater diligence with dust suppression and is likely to increase water usage.

Table 3: Summary of key climate statistics from Williamtown Airport Bureau of Meteorology Weather Station

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)	28.2	27.7	26.3	23.7	20.4	17.7	17.2	18.7	21.5	23.8	25.6	27.4	**23.2**
Mean number of days ≥ 35 °C	3	1.6	0.5	0	0	0	0	0	0.1	0.4	1.6	2.4	**9.6**
Mean minimum temperature (°C)	18.1	18.1	16.4	13.2	10.1	8	6.4	6.9	9.1	12	14.4	16.6	**12.4**
Mean rainfall (mm)	99.9	118.2	120.5	111.6	109.6	124.7	70.9	72.9	60.4	73.9	82.3	78.6	**1123.8**
Mean number of days of rain	11.9	11.9	12.9	11.7	12.4	12.7	10.2	10	9.7	11.5	11.7	11.1	**137.7**
Mean number of days of rain ≥ 1 mm	7.2	7.3	8.1	7.5	7.6	8.4	6.3	6.1	5.6	7.3	7.3	7.1	**85.8**
Mean daily evaporation (mm)	6.9	6.2	5	3.8	2.7	2.5	2.6	3.6	4.7	5.6	6.3	7.2	**4.8**

3.3 GEOLOGY

Review of the Newcastle 1:250,000 series geological map (Sheet S1 56-2, 1966) indicates that the site is underlain by Quaternary aged marine and freshwater deposits comprising gravel, sand, silt, clay and “Waterloo Rock”.

The majority of the Site is located above the Tomago Sandbeds. The Tomago Sandbeds were formed during the Pleistocene era with the original sand deposits occurring up to 250,000 years ago. Rising sea levels created a large bay extending from Newcastle to Port Stephens. The Hunter and Karuah Rivers both flowed into the bay and deposited large volumes of sand. A combination of wave and wind action spread the sand along the coastline and formed the

series of shallow dunes that make up the Tomago Sandbeds (Hunter water website 15/08/2018).

The sand dunes consist of a layer of highly permeable fine-grained sands underlain by impervious clay and rock. The thickness of the sand layer reaches a maximum of 50 metres, but on average is 20 metres deep (Hunter water website 15/08/2018).

The North Stockton Sandbeds, which form the current coastline between Newcastle and Port Stephens, were deposited much more recently than the Tomago Sands. They overlie the eastern extremity of the Tomago Sands and were deposited in the Holocene era (10,000 years ago) (Hunter water website 15/08/2018).

3.4 TOPOGRAPHY AND LANDFORM

The Site is located on the southern margin of an inner coastal dune barrier system. Topographically, the site and surrounding area comprises sand sheets and low undulating sand dunes on a coastal plain. The area from which sand extraction is proposed generally comprised of low undulating sand dunes.

Existing ground surface elevations across the areas from which sand extraction is proposed are variable (refer to **Figure 2** for location of Sectors):

- Sectors 1 and 2 – up to 8-9m AHD
- Sectors 3, 4 and 5 – up to 15m AHD
- Sectors 6 and 7 – up to 23.5m AHD

Adjoining flatter low-lying sand flats typically range in elevation from 2.2 m to 4 m AHD. Cabbage Tree Road forms the southern extent of the Site and is approximately 3.2 m AHD. Refer to **Figure 3** for the topography of the site in relation to the local area.

3.5 EXISTING SURFACE WATER

The high permeability of the Tomago Sandbeds result in little or no defined surface runoff, no defined natural drainage lines are on the site. Drainage is therefore predominantly via vertical infiltration into the sand, with any ephemeral surface drainage generally expected to be in the direction of the existing surface slopes.

In the area around the Site, the Tomago Sandbeds are located on the edge of low lying (about 2-3 m AHD) Holocene aged freshwater and alluvial and estuarine swamp deposits. These low-lying areas adjoining the Site are frequently waterlogged during high rainfall, due to increasing and shallow groundwater levels and a shallow groundwater gradient that slows the percolation of surface water. It is likely that the majority of accessible surface water onsite is an expression of groundwater, typically created through past man-made excavations.

The western portion of the southern and northern resources area theoretically drain to the west, while the dominant surface drainage direction for most of the Site is to the east (i.e. Catchments 2 and 3 above). Here the landform drops from the edge of the resource area around 5 m AHD to the swamp or flats over a relatively short distance with the gradient reaching up to 16%. The swamp areas have a gradient of approximately 0.1% with the elevation falling 1.5 m over the 1100 m to the eastern boundary of the Subject Land with water conveyed by an open constructed channel (in middle of Catchment 3).

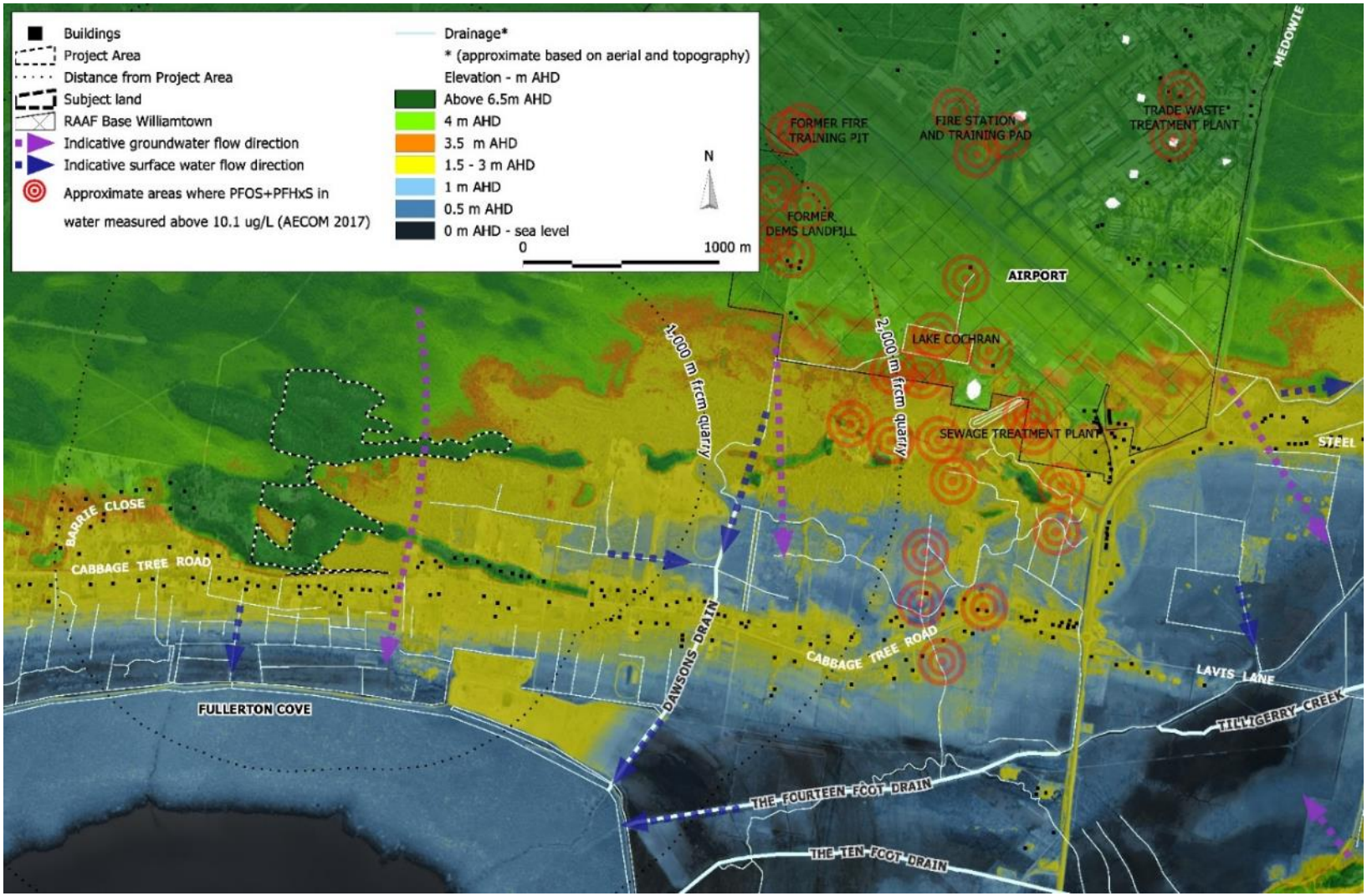

Figure 3: Elevation and drainage of the project area and subject land in relation to surrounding lands

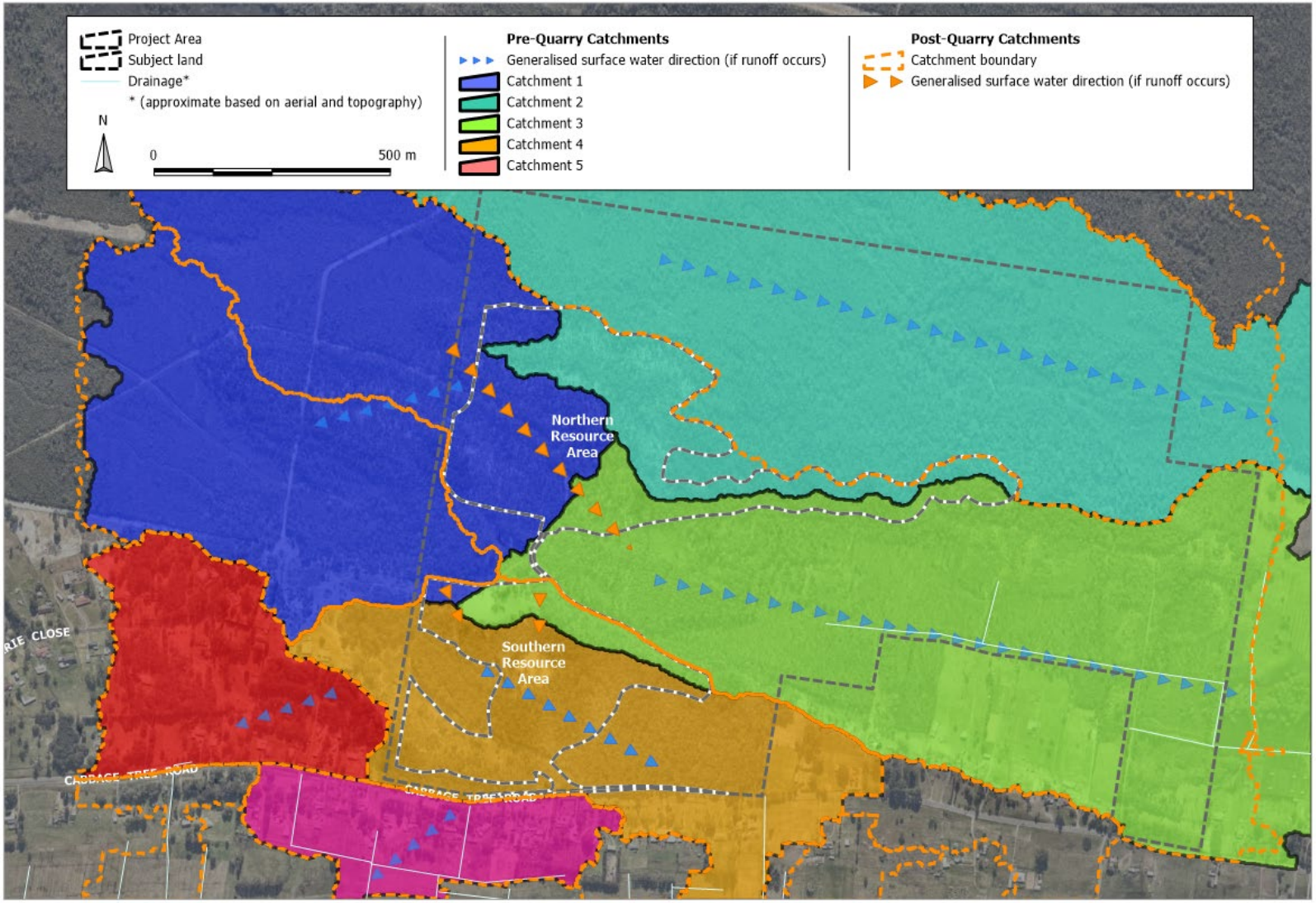

Figure 4: **Indicative pre-quarrying and post quarrying catchment boundaries and overall catchment direction (if runoff occurred and assuming low areas were filled to overtop).**

From the eastern boundary of the Site, drainage is directed via constructed channels through to Dawsons Drain and the northern extent of Fullerton Cove where the elevation drops 1 m over 1900 m (with an average gradient of 0.05%).

For the south eastern portion of the Project area, a portion of the resource area has the potential to drain south east across the Subject Land to a culvert beneath Cabbage Tree Road (Catchment 4). In this area the landform drops at about 14% to the swamp or flats that then appears to have a very slight gradient to the south eastern corner of the site (i.e. less than 0.5 m over at least 140 m). From this point the area drains via series of constructed channels through to the Ring Drain, a large constructed channel around the northern extent of Fullerton Cove over a distance of 590 m with an average gradient of less than 0.4%. Inspection of the site, shows this culvert is only likely to flow during periods of extended rainfall and a high water table.

Cabbage Tree Road has been built up during its construction, with shallow table drains constructed partially along the northern side of the road and deeper drains constructed partially along the southern side. The nearest culvert is located at the eastern extent of the subject land, approximately 80 m beyond the proposed road construction area.

Following quarrying at the site the catchments will progressively change with Catchment 3 increasing in size with water from within the quarry footprint (currently draining west) directed south east into Catchment 3 (i.e. Catchment 1 will drain to Catchment 3). However, given the high permeabilities it is highly unlikely that any changes in flow would be realised across the site.

3.5.1 Surface Water Quality

Prior to commencing monitoring in 2019, limited data was currently available for surface water on the Subject Land, the following data is based on studies within the catchment for Dawsons Drain associated with the Department of Defence (AECOM 2016) investigations and is expected to be characteristic of water conditions onsite (see **Table 4** below).

The pH levels are slightly lower than the range for ANZECC lowland rivers, though consistent with the likely high groundwater input (pH 4.8-5.63). The EC levels are typically within range, while dissolved oxygen is typically lower, consistent with expectations for shallow, man-made (e.g. drainage channels), low gradient and largely stagnant surface water bodies in swamp areas.

Table 4: Characteristic surface water for the Dawson Drain catchment (from AECOM 2016)

Range	pH	Conductivity	DO	TDS	Temp
Unit	pH unit	µS/cm	%	mg/L	C
Min	6.15	72	5%	46	21.4
Max	7.76	804	94%	522	30.3
Median	6.38	383	50%	248	23.5
Within drain on subject land (near SW4)	6.66	383	77%	248	21.9
ANZECC - Lowland Rivers	6.5-8.0	125-2200	85-110		

Additional baseline water quality data collection commenced in 2019 (where available given low rainfall and limited surface water) and continues to be collected in accordance with this management plan. A copy of this data is available at www.newcastlesand.com.au.

3.6 EXISTING GROUNDWATER

The site is located on highly permeable Pleistocene Tomago Sandbeds (sand dunes). The source of the water within the Tomago Sandbeds is rainfall that lands directly on the sand surface. While a proportion of the rainfall is lost to plants and evaporation, sufficient water is stored in the sand to provide a viable and significant source of water for ongoing extraction. Over time rainfall landing on the sandbeds has washed out any remnants of sea salt leaving the deep sand system full of fresh water (Hunter water website 15/08/2018).

A previous groundwater investigation was undertaken by RCA Australia (RCA Australia, 2015), groundwater was encountered on the Subject Land ranging from 0.67 m below ground level (mbgl) to 15.65 mbgl. Groundwater when at its highest is visible at or near the surface for land below 3 m AHD. Groundwater at the Site has a low hydraulic gradient and was interpreted to flow in a general southerly to south-easterly direction, towards Fullerton Cove (RCA Australia, 2015) from Grahamstown Dam in the north toward Fullerton Cove in the south, the groundwater gradient within the local area is less than 0.2%.

The northern portion of the Subject Land is located within the Hunter Water Special Area, owing to the presence of the Tomago Sandbeds and their use for a portion of the lower Hunter's drinking water supplies.

The Project area and extent of extraction has been designed such that sand extraction remains a minimum of 0.7 m above the highest predicted groundwater level, with the final landform to be established at no less than 1 m above the highest predicted groundwater level (about 2 m above the average level).

3.6.1 Groundwater modelling

Numerical modelling using MODFLOW software was carried out by Umwelt (2015 and 2016). A summary of the modelling is included in **Appendix 3**.

Conditions of Approval require that this be updated within two years following commencement of operations. One of the objectives of the monitoring outlined in this document is to provide additional data to refine the conceptual and numerical models. This process is also relevant to the separate Maximum Extraction Depth (MED) report and is designed to allow the quarry to adapt to changing or unexpected conditions and improved understanding of groundwater hydrology over time.

3.6.2 Hunter Water Tomago Sand Beds Special Area

The Tomago Sandbeds catchment provides an important source of water for the Lower Hunter, supplying up to 20% of annual consumption, and is used to supplement the Hunter dams during times of drought or water quality issues. A significant proportion of this area is protected land, the majority comprising formally gazetted reserves managed by the NSW National Parks

and Wildlife Service. The Tomago Sandbeds are formally gazetted as the Tomago Sandbeds Catchment Area. Other land uses within the Tomago Sand Bed's catchment include Defence facilities, industrial areas, agriculture and urban areas.

3.6.3 Groundwater Level and Quality

WSS installed a network of 12 monitoring bores on-Site (**Figure 6).** A pair of nested bores were also installed on-Site by AECOM/Defence as part of Defence's PFAS investigations. These bores are not currently used by Defence and will be included as part of the monitoring network.

A short record of water levels is available from these, and monitoring has re-commenced.

Groundwater samples were collected from 12 existing groundwater monitoring bores installed onsite by RCA Australia (RCA Australia, 2015). The location of the groundwater bores is shown in **Figure 7** and results of laboratory testing are summarised in **Table 5**. These results provide initial water monitoring data for the quarry on which additional baseline data will be collected (refer to **Section 8.3**).

Table 5: Initial groundwater data (RCA 2015)

Analysis	Ground Surface RL	Water Level * (Feb 2015)	pH	Conductivity EC	Chloride (Cl)	Nitrate (as N)	Sulphate (as S)	Sodium (Na)	Arsenic (As) (filtered)
Units	(m AHD)	(m AHD)	pH unit	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L
BH1	8.21	2.87	5.63	127.9	21	<0.1	<2	11	<0.001
BH2	7.40	2.3	5.10	130.7	20	2.3	<2	13	<0.001
BH3	7.03	1.85	5.50	112.5	15	1.4	<2	8.8	<0.001
BH4	2.81	1.54	5.51	150.3	24	0.57	<2	17	<0.001
BH5	6.76	1.71	5.20	240.5	52	<0.1	4.7	26	<0.001
BH6	3.01	2.09	5.36	266.2	48	<0.1	5.6	25	<0.001
BH7	2.60	1.54	5.58	145.2	22	<0.01	<2	16	<0.001
BH8	3.28	1.62	5.22	252.2	57	<0.1	2.0	28	0.005
BH9	17.07	1.59	4.85	103.0	18	0.54	3.7	9.8	<0.001
BH10	6.09	3.01	4.81	236.2	60	<0.05	<2	28	<0.001
BH11	6.02	3.64	4.89	131.0	27	<0.01	<2	15	<0.001
BH12	8.06	2.09	5.17	166.4	34	<0.01	<2	19	<0.001
MW239S	3.09		4.9	410					

* for the purpose of comparison, the quarry final land form (i.e. 1m above maximum groundwater) will range from approximately 3.75 m AHD in the south to 5.25 m AHD in the north. Around the area of the intersection, Cabbage Tree Road is approximately 3.1 m AHD and houses south of Cabbage Tree Road are built on a level of approximately 2.6 m AHD.

3.7 EXISTING PFAS DATA

Analysis of soil, surface water and groundwater from across the subject land have been sampled and analysed for the presence of PFAS.

During the EIS assessment process, PFAS was not detected. A summary of the results of PFAS testing within the Project Area and Subject Lands is provided in *December 2017 PFAS Response Paper* (Kleinfelder 2017), available on the NSW Planning's Major Projects Website. Sampling and analysis has included the following:

- *Groundwater Assessment, Cabbage Tree Road, Williamtown* (RCA, June 2016). This study included the collection of groundwater samples from three bores on the north-eastern side of the subject land for analysis of PFAS. PFAS were not detected in the samples.
- *Per- and Poly-fluorinated Alkyl Substances Assessment* (Kleinfelder, February 2017). This study involved the laboratory analysis of 16 soil samples for PFAS from nine locations across the Project Area. Samples analysed were collected from multiple depths and from both the overlying topsoil, if present, and underlying dune sands to be quarried. PFAS were not detected in any of the soil samples submitted for analysis.
- *Groundwater sampling for Per- and Poly-fluorinated Alkyl Substances* (Kleinfelder, June 2017). This study included the collection and analysis of one surface water and four groundwater samples from the southern portion of the study area for PFAS analysis. PFAS were not detected in the samples.

Within a 1 km buffer of the quarry AECOM have presented results for 33 locations (in addition to the 17 locations collected on the Subject Land by WSS). Within this area PFOA was not detected in any of the samples analysed. Concentrations of the sum of PFOS and perfluorohexane sulfonate (PFHxS) within the 1 km buffer zone of the proposed quarry are shown within **Table 6** and **Figure 5**. The areas of highest recorded PFAS contamination are located down gradient and approximately 1,600 m east of the Project Area with concentrations above 50 µg/L. Publications relating to the Defence PFAS are presented at https://www.defence.gov.au/Environment/PFAS/Williamtown/publications.asp. The NSW Government information relating to PFAS at Williamtown can be found at https://www.epa.nsw.gov.au/working-together/community-engagement/community-news/raaf-williamtown-contamination.

Table 6: Sample results by AECOM 2017 within 1 km of the quarry as part of the Defence PFAS investigations.

Type	Not Detected Below Limit of Reporting (LOR) (<0.001 µg/L)	Detected (>LOR to 0.07 ug/L)	Detected (0.07 ug/L to 10 ug/L)
Groundwater (11 locations)	10 locations	1 shallow groundwater 0.03 µg/L Deeper groundwater in the same location less than LOR.	Nil
Residential Water (bores and tanks) (21 locations)	21 locations	4 locations	1 location
Surface Water	1 location	Nil	Nil

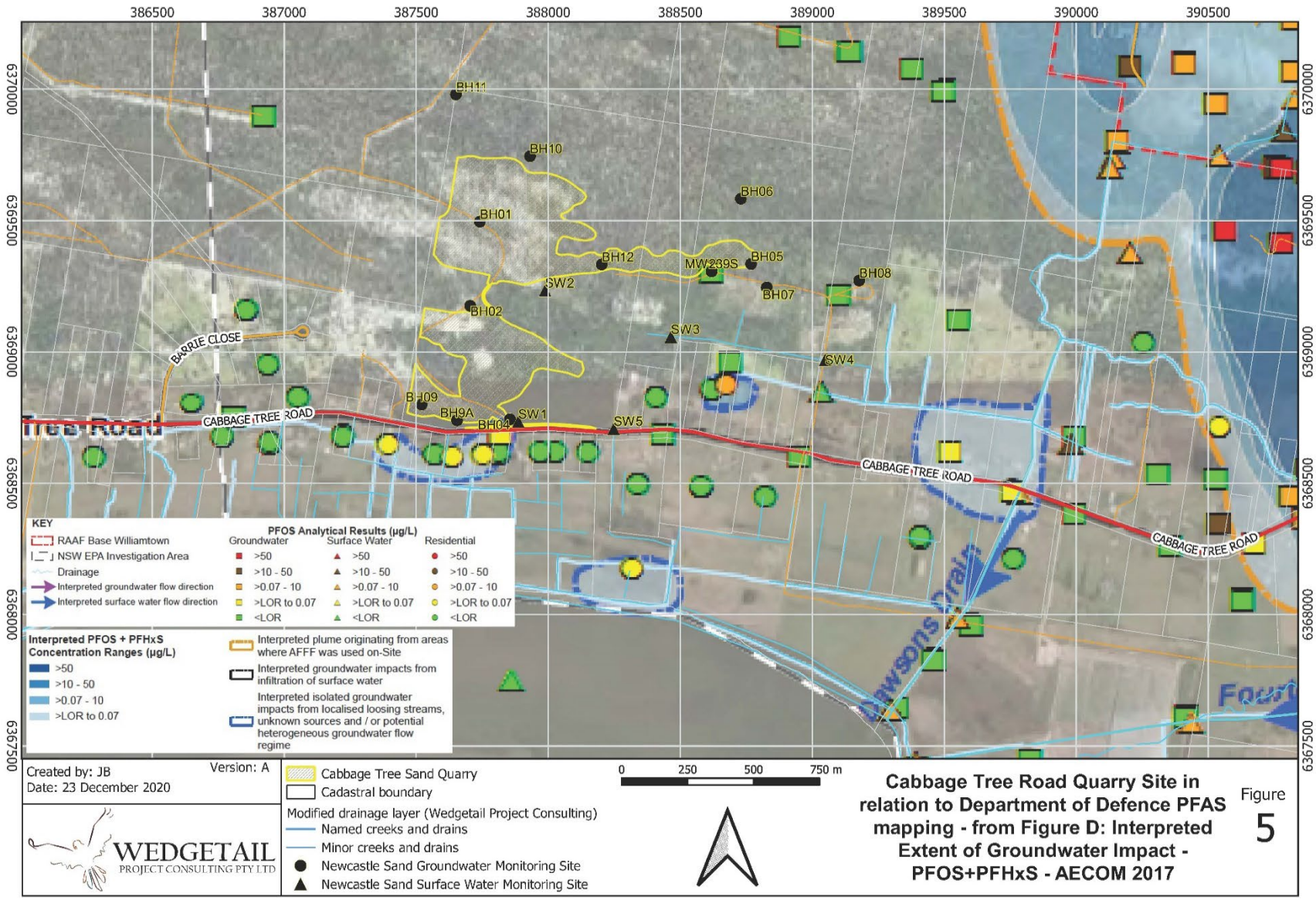

Figure 5: **PFOS + PFHxS (from Figure D RAAF Base Williamtown PFAS Management Area Plan, 27 May 2019)**

During 2019/ 2020, PFAS was detected sporadically (i.e. are not routinely present in consecutive samples) at low levels in surface water in the drainage channel on the eastern extent of the property and in groundwater on the southern boundary of the site (consistent with existing detections) and also in the north east of the site, nearest in proximity to the RAAF base. All PFAS detections have been at low levels and are sporadic in nature, but appear consistent with that observed in the RAAF PFAS Investigation zone for this area. These results are summarised in **Table 7** below.

Table 7: Summary of PFAS results from baseline monitoring for the quarry conducted by Kleinfelder 2020 using the SWMP surface and groundwater monitoring network

Analyte	Units	LOR	HEPA NEMP 2020 99% level of protection in freshwater	HEPA NEMP 2020 Drinking Water	Detected Concentration Range (Groundwater)	Detected Concentration Range (Surface Water)	Locations
PFOS	µg/L	0.01	0.00023 (below LOR)	0.07	<0.01	<0.01-0.05	Concentrations reported above LOR at SW4 (16 Sep & 25 Sep 2019).
PFOA	µg/L	0.02	19	0.56	<0.02	<0.02	Not detected.
PFDS	µg/L	0.02	-	-	<0.02-0.02	<0.02	Concentrations reported above LOR at BH4 (16 Sep 2019)
Sum of PFHxS and PFOS	µg/L	0.01	-	0.07	<0.01	<0.01-0.07	Concentration reported above LOR at SW4 (16 Sep & 25 Sep 2019)
Sum of PFAS	µg/L	0.01	-	-	<0.01-0.19	<0.01-0.07	Concentrations reported above LOR at BH4 (16 Sep 2019), BH6 (6:2 FTS 0.19 µg/L on 17 Dec 2019) and SW4 (16 Sep & 25 Sep 2019)

3.7.1 Health Advice Relating to PFAS

The Site is partially within the "Broader Management Zone" of EPA's declared "Williamtown Management Area" relating to PFAS identified in some surface waters, groundwaters and biota around the nearby RAAF Williamtown and Newcastle Airport.

The NSW EPA's current advice (as of April 2021) for the Broader Management Zone is as follows:

- Do not use groundwater, bore water or surface water for cooking or drinking.
- Avoid swallowing water when bathing, showering or swimming and paddling in the water (including creeks and drains).
- Do not use groundwater or surface water for swimming or paddling pools.
- Avoid eating home grown foods.

Advice applicable to all management areas, and of potential relevance to the quarry (with respect to excavation activities associated with the road construction) is that *"Drain clearing works do not pose a significant risk and any potential exposure to PFAS can be appropriately*

managed by following proper OH&S practices which restrict the potential for incidental ingestion of drain water."

Studies commissioned by the Department of Defence (HHRA 2017) defined four Risk Zones (Zone A to Zone D) associated with the contamination. Advice was developed for each zone based on the observed data in these areas and exposure risks were calculated to determine what to ensure people were not exposed to PFAS above the tolerable daily intake (TDI). The quarry is located within Risk Zone C. Potential exposure to residents within Risk Zone C was determined to be low and acceptable for the following scenarios:

- Drinking groundwater, providing the average PFOS+PFHxS concentration does not exceed the FSANZ 2017 drinking water guideline of **0.07 µg/L** [consistent with the PFAS NEMP 2.0].
- Inhalation of dust from soil irrigated with impacted groundwater or flooded by PFAS impacted groundwater.
- Dermal contact with groundwater and/or soil.
- Incidental ingestion of groundwater and/or soil.
- Dermal contact with surface water in drains and/or creeks.
- Incidental ingestion and dermal contact with sediment from drains and or creeks as a result of outdoor activities.
- Consumption of low to moderate quantities of locally sourced seafood.
- Consumption of locally grown fruit.

The following precautions are prescribed in the HHRA 2017 are based on avoiding typical and upper level exposure levels in Risk Zone C, these are as follows:

- Drink groundwater only if the average concentration does not exceed the drinking water guidelines.
  - Note. The proposed quarry will utilise reticulated town water supplies.
- Do not consume eggs from poultry that have been exposed to a water source with detectable PFAS concentrations or soil or plants flooded or irrigated with water with detectable PFAS concentrations.
  - Not relevant to the quarry.
- Minimise consumption of milk from cows that have been exposed to a water source with detectable PFAS concentrations or soil or plants flooded or irrigated with water with detectable PFAS concentrations.
  - Not relevant to the quarry.
- Minimise consumption of home slaughtered beef from cattle exposed to a water source with detectable PFAS concentrations or soil or plants flooded or irrigated with water with detectable PFAS concentrations.
  - Not relevant to the quarry.
- Minimise consumption of high quantities of locally caught fish.
  - Not relevant to the quarry.
- Minimise the ingestion of surface water during swimming and recreational activities within creeks and drains.
  - Not relevant to the quarry.

It is noted that none of these management measures are relevant to the proposed construction and quarrying activities for the site.

4. SITE WATER BALANCE

4.1 WATER SOURCES

There will be two sources of water on site:

- Rainwater will be captured from the workshop and office roofed area and reused for dust suppression and/or ablutions. Based on an approximate roof area of 380m^2, with average rainfall, this would be expected to generate 335 kL per annum (accounting for 80% capture).
- Reticulated potable water supplied by Hunter Water Corporation (HWC) will be connected to the main line located adjacent to Cabbage Tree Road and supply all remaining water. Water sourced from the HWC network will be fitted with a carbon filter (or similar) to reduce the presence of chemicals within the potable water used onsite.

No groundwater is to be extracted for use in quarry operations. Incidental groundwater encountered during construction of the intersection and installation of services, including surface water runoff may be used for dust suppression onsite, only where it is characterised and clear of PFAS contamination.

4.2 WATER USAGE

Water usage onsite will consist of the following key aspects:

- Site facilities (drinking, cleaning, ablutions).
- Processing of sand within the wash plant.
- Dust suppression (gravel roads, stock piles, un-stabilised batters).
- Revegetation (occasional tube stock watering following planting, pending rainfall).

4.2.1 Site Facilities

Site Facilities require potable water to supply the onsite office and ablution facilities. This is expected to be less than **1.5 kL/day**, (based on 150 L per person for 10 people) and will be drawn from rainwater collection (for ablutions only), supplemented by HWC's reticulated water supply for the potable component. The use of water will be kept to a minimum utilising water saving strategies wherever possible such as (but not necessarily limited to):

- Leaking taps will be fixed quickly after identification.
- Where feasible, pipework will be insulated, or the hot water boilers located close to taps to avoid wasting water while waiting for hot water to flow through.
- Water efficient toilets will be installed and maintained these to minimise leaks.
- Use collected rainwater for toilet flushing, cleaning or dust suppression.

This will also aid reducing the volume of offsite water transfer (i.e. pumped septic).

4.2.2 The Wash Plant

The wash plant uses water to separate the fine silts and organic particles from the sand creating a product more suitable for concrete applications. Aside from evaporation, the wash plant system is effectively a closed system with the exception of two primary water losses described below:

- Increases in moisture content of product sand (estimated to be a nett 2-3%), that incidentally reduces the need for dust suppression on the stockpile. Water in excess of the field capacity of the sand will drain to a sump for recovery.
- Silts and fines are typically removed from the system as a slurry due to handling requirements, if placed directly on batters this reduces dust suppression water use, if placed on stockpile pad, excess was drains to a sump for recovery.

Current estimates suggest water usage in the Wash Plant will amount to 81 m^3 per day of water use (i.e. 81 kL/day for 1500 tonnes). Annually, if processing 60% of the product (i.e. 318,000 tonnes), this equates to 17.2 ML per annum, or about 60% of the estimated peak water usage and 7 ML above the 10.2 ML estimated for batter and stockpile dust suppression.

Water is then topped up as needed to account for water lost. Fresh and process water will be stored within a series of water tanks piped to the wash plant.

Strategies in addition to the above bleed recovery, include:

- Refining the wash process to minimise the volume or extent of washing undertaken based on the need to meet the required product specifications. This has the potential to reduce water lost in both product and fines removal.
- Enclosing the water tanks where feasible will reduce evaporation of the fresh and process water storages.
- Inclusion of suitable coagulant and flocculant to improve fines removal and associated water recovery.
- Regular visual leak monitoring and inspection of tank and pipeline condition.

4.2.3 Dust Suppression

Management of dust onsite and consequential reduction in required dust suppression will include the following key controls:

- Adoption of a bitumen sealed access and haulage road from Cabbage Tree Road to the southern boundary of the northern resource area.
- Conveyors employed to transfer sand from the quarry face to the processing plant, will result in a reduction in wheel traffic and required dust suppression.
- Dust suppression by water cart (or static sprays) of the gravel road section and any other un-vegetated areas as required to reduce visible windblown dust. The rate of application is expected to be a maximum of 12 mm per day (maximum daily evaporation of 10 mm multiplied by 120% to account for wind generated by truck movements, Umwelt 2015c). Noting the rate and frequency are relative to the material type and frequency of haulage, and application rates and frequencies of less than half of that figure have achieved control efficiencies above 95% in the Hunter Valley. Over the maximum extent of gravel road (approximately 6,600 m^2 during Year 4/5) this equates to about **80 kL per day** (over 10 hours), on days where rainfall is not sufficient

to supress dust. During Years 1, 2, 7 and 8 negligible water will be required for dust suppression on the main haulage road.

- Static sprays will be installed on the stockpiles and on batters. It is estimated that in order to maintain stockpile surface moisture levels at peak production up to **45 kL per day** of water may be required.
- Daily water consumption for dust suppression is therefore estimated to be up to **125 kL per day**.

4.2.3.1 Reducing water use for dust suppression

Opportunities to minimise usage of potable water will be investigated during the quarrying. The primary likely source of dust (and required dust suppression) for the project is wheel generated dust from unsealed roads, followed by stockpile dust suppression.

Newcastle Sand will review annual water consumption and opportunities to minimise water use for dust suppression and provide a brief justification for or against their application in the following period. Methods of further reduction may include:

- Polymer dust suppressants. Indicatively these can reduce water consumption by 75%, this reduces peak water usage from 125 kL/day to 31.25 kL/day. Evaluation of suitable dust suppressants will be subject to agreement by HWC to ensure usage within the Tomago Sand Beds without adverse impact.
- Bitumen sealing of the spine road through to the southern boundary of the northern resource area boundary will be completed when the processing area moves to the Northern Resource Area, prior to customer haulage trucks (i.e. road registered trucks) needing to travel to the Northern Resource Area.
- Additional bitumen seal of gravelled road surfaces in the northern portion will be undertaken where water usage due to the inclusion of the wash plant exceeds 27 ML/year (approximately 90% of original water use estimates).

As of December 2020, the following aspects have been investigated for minimising water use:

- More frequent sweeping of bitumen sealed surfaces is minimising the extent of dust suppression required, however, this is also resulting in increased friction for truck tyres and degradation of the sealed surface.
- Polymers for stockpile and roadway suppression were investigated with the following conclusion:
  - Two dust suppressants were investigated, one designed to effectively coat particles to minimise lift off, the second a skin intended for static stockpile protection.
  - Cost is prohibitively high relative to water use, or planting, economies may be warranted where the use of the polymers is minimising equipment hire in conjunction with water costs.
  - The frequency of application, and therefore the amount of polymer required is likely to be higher than typical applications due to the mobile and shifting nature of the sand.

Polymers are recommended for further investigation (in conjunction with HWC) as an additive to the gravel road, this would be expected during extraction within Sectors resource sectors 4 to 7. These polymers may be used in place of bitumen sealing, where water demand needs to be further reduced relative to the EIS estimates.

4.2.4 Revegetation

Water required to support revegetation onsite will vary significantly by year, seed stock germination rates and prevailing weather conditions around the time of planting. Planting will be undertaken to avoid extreme hot weather periods to maximise success and minimise watering requirements. For the purpose of estimating maximum water use, assuming 1/3 of all revegetation required establishment watering (say five events each of 10 L of water per plant), this would equate to an average of less than **3kL** per day. However, tubestock planting is likely to occur in 2-3 campaigns per year, each of less than **300 kL**, and is likely to be planned where rainfall minimises the extent of watering required.

4.2.5 Water Usage Summary

Water usage assumptions are detailed in the sections above. This section provides a summary of the predicted water usage.

During the worst-case years of production (longest extent of gravel road – e.g. part yr 4, yr 5 and part yr 6), the following water usage is estimated:

- Site facilities: 1.5 kL/day, 312 days per year – 0.47 ML/year.
- Wash plant: 81 kL/day / 1500 tonnes (approx. 212 days per year), a portion of this water satisfies the requirement for dust suppression – 17.2ML/year.
- Dust suppression: 125 kL/day, 226 days per year (accounting for rainfall) – 28.25 ML (less water already applied associated with the wash plant).
- Revegetation: 300 kL in three separate campaigns – 0.9 ML.
- **Total of 29.65 ML/yr, of which 29.2 ML would be drawn from the HWC network.**.

During a typical year, where the length of gravel road is reduced (e.g. yrs 1, 2, 3, part yr 4, part yr 6, 7, 8), the following usage is expected:

- Site facilities: 1.5 kL/day, 312 days per year – 0.47 ML per year.
- Wash plant: 81 kL/day / 1500 tonnes (approx. 212 days per year), a portion of this water satisfies the requirement for dust suppression – 17.2ML/year.
- Dust suppression: 42 kL/day, 226 days per year (accounting for rainfall) – 9.4 ML (less water already applied associated with the wash plant)
- Revegetation: 300 kL in only one campaign – 0.3 ML per year.
- **Total of 17.9 ML/yr, of which 17.4 ML would be drawn from the HWC network.**.

4.3 OFFSITE WATER TRANSFER

The transfer of water offsite will be kept to a minimum by using water saving devices in the ablution facilities and site office.

Water will be transferred offsite as follows, at an estimated 50 kL per annum:

- All grey and black water generated in the site office, workshop and ablution facilities will be collected in a suitably sized tank (approximately 10 kL) and removed by tanker approximately every 7-10 working days (based on the usage identified in **Section 4.2**). Initial operations show less than 4,000L are disposed offsite each month, as such annual offsite transfer of septic waste is estimated at 48 kL.

- Incidental rainwater from bunded areas (e.g. fuel storage areas) will be stored in sumps and removed by tanker. An estimate of 2 kL is provided, however, largely due to the covered location of fill point, it should be noted that no water was removed during 2020.

Where product sand increases in moisture content relative to the insitu moisture content, additional water will be transferred offsite within the product sand. This volume of water is highly variable due to various factors (e.g. rainfall, evaporation, product type, stockpiling duration etc). For the purpose of the water balance, this is estimated at 3% of the washed product sand tonnage. At maximum production, based on 60% being washed, this would be estimated at 9.5ML being transferred offsite in Product Sand.

Other water is lost from the site through the following more variable factors:

- Infiltration through sand.
- Soak drains from paved areas.
- Evaporation.

Stormwater collected in the resource areas will be allowed to freely infiltrate through the sands into the groundwater. The bitumen roadway will be shaped such that water sheds to broad table drains that will allow stormwater to infiltrate into the ground.

4.4 WATER BALANCE REPORTING

The following reporting will be completed and included within the Annual Environmental Management Report (AEMR) relating to the site water balance:

- Total volume of water drawn from the HWC network.
- Volume of water from the HWC network added to the Wash Plant.
- Volume of water transferred from site (e.g. septic / bunded water capture).
- Comparison with estimated water use (Section 4.2), with following actions:
  - Where water use, with the inclusion of the wash plant, exceeds 27 ML/annum, additional bitumen sealing of gravel roads will be undertaken to reduce dust suppression water usage.
  - Where more than 20% above estimated maximum, review water usage areas and investigate methods to minimise usage where feasible.
- Annual water usage should be recorded within **Appendix 5**.

5. SURFACE WATER MANAGEMENT

5.1 SURFACE WATER MANAGEMENT SYSTEM

5.1.1 Clean water diversion system

For the purposes of this plan, “clean water” is defined as surface water falling outside the disturbance area of the quarry. Rain collected by the roofs of the workshop and office building is also clean water and is captured and stored in a rainwater tank for re-use.

As the quarry extent typically extends to the topographic high of the landscape, and runoff volumes into the quarry site are expected to be negligible on account of permeable sands, no clean water diversions will be required or installed around the perimeter of the site.

Where access roads extend through largely undisturbed areas of the quarry, the access road will incorporate drainage swales to avoid potential for clean water crossing road surfaces.

5.1.2 Dirty water management system

For the purposes of this plan, “dirty water” is defined as surface water falling within the disturbance area of the quarry. The dirty water management system comprises two core management streams grouped based on the risk and type of likely contaminants:

1. **Quarry disturbance areas and roads comprising:**
    a. Dirty water generated from runoff from exposed quarrying areas. Potential contaminants largely restricted to an increase in sediments (e.g. fine sand, silts and organic matter carried by surface water). Very low potential for isolated spills due to equipment failure. Key controls for this aspect are:
        i. Erosion prevention.
        ii. Infiltration and sedimentation controls.
        iii. Spill kits maintained and staff trained on use are accessible on plant and equipment.
    b. Dirty water generated from runoff from access roads (bitumen and gravel). Potential contaminants are similar to the above, with slightly increased potential for hydrocarbon contaminants (on account of vehicle frequency), weeds, and increased volume of water due to the reduced infiltration, consistent with contaminants from other private and public roads in the catchment. Key controls for this aspect are:
        i. Spill kits maintained and staff trained on use are accessible on plant and equipment. This control is likely to be considerably higher than controls used for general vehicle and equipment use across the sand beds.
        ii. Infiltration and sedimentation controls.
        iii. Focused weed management along access roads.
2. **Wash Plant System**
    a. The Wash Plant uses water to separate the naturally occurring fine silts, sands and organics from the product sand. As a result the process water becomes progressively more concentrated with fine silts, sands organics requiring treatment to reduce

suspended fines in the process water. The management of the dirty water will be via one or a combination of the following:

i. Automated injection of drinking-water-grade coagulant and flocculant at the following estimated dosage rate (adjusted as needed based on field results):
   - Positively-charged polymer coagulant (such as polyDADMAC) at 2 parts per million (ppm).
   - Negatively-charged flocculant at a rate of approximately 6 parts per thousand (6ppt).

ii. Using a sufficient number of holding tanks that would provide enough settling time to allow natural settlement of fines and recovery of water for processing.

iii. Spray application of semi concentrated fines on batters and rehabilitation areas.

iv. Transfer of thickened material blend with landscape sand on the landscape sand stockpile area.

b. Product Stockpile Pad, will be similar to that already used with improved directional drainage to a shallow sump for recovery of the water and feed back into the system.

c. Landscape sand stockpile pad will be similar to proposed product stockpile pad with improved directional drainage to a shallow sump for recovery of the water and feed back into the system. The fines would be pumped as a slurry to a bed of landscape sand that will filter the fines and enable blending of the fines with the sand.

3. Storage and core operational areas:

a. Dirty water generated from the office area and adjoining site compound. This area consists offices, ablutions management, vehicle and equipment parking. While this area includes clean water associated with runoff from roof areas, contaminants from this are likely to include increased potential for nutrients, hydrocarbons, infiltration, metals and sediment controls. Key controls for this area are:

i. Positioning the office area outside the Hunter Water Special Area.

ii. Capture of roofed area runoff in water tanks for re-use within onsite ablutions and dust suppression.

iii. Infiltration and sedimentation controls.

iv. Septic pump out system for the capture and storage of ablutions with periodic removal by a licensed contractor.

v. Hydrocarbon controls.

b. Dirty water generated from areas used for fuel storage, fuel filling and the workshop area. Contaminants from this are likely to include increased potential for hydrocarbons and metals. Key controls for this aspect are:

i. Positioning the workshop area outside the Hunter Water Special Area.

ii. Implementing hydrocarbon control procedures.

iii. Covering of fuel storage areas to minimise water volumes.

iv. Impervious bunding of work areas to retain spills and prevent water ingress.

v. Impervious Lined sumps to retain spills for pump out to licenced offsite disposal area by a licenced contractor.

5.1.2.1 Hydrocarbon Controls

Hydrocarbons are an essential input to the Quarry for the operation of trucks, machinery and equipment. To minimise the contaminant risks the following hydrocarbon use controls will be implemented for all areas:

- Spill kits will be kept at plant areas and site machinery.
- Training of site personnel on use of spill kits.

- Inductions for operators and visitors including awareness of need to manage and report spills to the Quarry Manager.

The above controls are applicable for the whole site. The use of the above controls are likely to provide a higher level of protection for minimising hydrocarbon contamination risks than the majority of activities occurring across the broader Tomago Sand Beds (e.g. commercial and residential properties, gravel and bitumen local roads and high volume public roads).

As part of the general operating of the site the following locations will be utilised for the storage of hydrocarbons:

- The main Diesel fuel tank to be located in the Workshop area – will be used as the primary fuel store for the site operations. This is located outside the Hunter Water Special Area.
- The Workshop – will hold minor quantities of chemicals used for the maintenance of site plant.
- Mobile diesel fuel tanker / trailer – will be used to take fuel to the tracked plant for fuelling in the current extraction area, where refuelling is undertaken over relocatable bunds.

It is also possible that fuel associated with emergency generators may be stored onsite. All flammable and combustible liquids used on site must comply with the requirements of AS1940: 2017.

The processing area will move around the site depending on the extraction area currently being used. The processing area will include:

- A bunded parking area for the overnight parking of the bull dozer / tracked machinery (where at a distance from workshop).
- If power via electrical mains supply is unavailable, diesel generators will be required. The diesel generators will:
  - Be located within a fenced bunded area.
  - Include a double skinned self-bunded diesel storage tank.
  - Be refuelled as required within suitable impervious bunding.

Other plant utilised on site will be removed outside of the Tomago Sandbeds Special Area for overnight storage and re-fuelling. This plant will be returned to the Office and Workshop Compound area on conclusion of operations each day and will be stored within fenced area with CCTV and back to base security at the Office and Worksop area located outside the Special Area. This plant includes:

- Pneumatic tyred loaders (2x full time).
- Dump Trucks (campaign usage as required for extraction area 7C).
- Sales truck (Daily).
- Trailer mounted diesel generator (where used for emergency power supply).

The following tracked plant will be utilised on site and will be stored and refuelled on a bunded and lined hard stand area where located within the Hunter Water Special Area:

- Dozer.
- Excavator.

5.1.3 Water storages

The primary water source is from the HWC mains water supply.

To supply water to the wash plant, incoming water from the HWC network will be fitted with a carbon filter (or similar) to reduce the presence of chemicals within the water used onsite. The filtered water will be fed from the mains network to a series of water storage tanks onsite, up to 50kL per tank in capacity containing approximately 300,000 L in total).

Beyond the wash plant water storage system the following are located onsite::

- Rainwater tank to cater for rainfall collected from office and workshop roofs.
- Septic tank for collection and retention of effluent from office facilities and ablutions.
- 20 kL header tank for HWC network water storage (provides non-mains dependent water source and improves refill times of water carts when required onsite).

Given the site is located on sandy soils, with restrictions on access or proximity to groundwater no designated water storages are proposed or required for the operation of the quarry.

5.2 EROSION AND SEDIMENT CONTROLS

5.2.1 Objective of erosion and sediment control

The objective of erosion and sediment control and soil management is to:

- Minimise the land disturbance activities by phasing the works combined with rehabilitation.
- Minimise topsoil movement to allow soils to stabilise with vegetation during rehabilitation.
- Avoid sedimentation from Project Area into adjoining vegetation and the biodiversity offset areas.
- Minimise offsite transport of suspended sediment.
- Limit edge effects from changes in water quality and sedimentation runoff from the Project Area.
- Provide for the classification and management of any potentially contaminated sands (e.g. discoloured or odorous).

5.2.2 Assessment of erosion hazard

Chapter 4.4 of the *Managing Urban Stormwater, Soils and Construction Volume 1* (4th Edition, March 2004) Landcom (NSW Government) historically referred to as the *Blue Book* (Landcom 2004), provides details on the special considerations for SWPMs when considering the management of soil erosion.

Table 13 of Appendix C (Landcom 2004) presents specific soil data for Newcastle soils. The soil characteristics relevant to the Site are presented in **Table 8**.

Table 8: Soil Characteristic Constraints to Development

Parameter	Description
Soil Name	**Stockton Beach (sk)**
Description	**Shallow non-cohesive soils**; wind and wave erosion hazards; localised steep slopes, mass movement; some local high water-tables and waterlogging; general risks to foundations.
Soil Hydraulic group	**Group A** – very low runoff potential. Water moves into and through these soil materials relatively quickly, when thoroughly wetted. Usually, they consist of deep (>1.0 metres), well-drained sandy loams, sands or gravels. They shed runoff only in extreme storm events.
Acid Sulphate Soils (ASS) Risk	**Widespread** – Potential ASS indications in 60-80% of samples tested across the broader soil landscape, however onsite testing did not identify any ASS risk areas within the proposed extraction area.
Universal Soil Classification Scheme	**Sp**
K-factor in the Universal Soil Loss Equation	**0.009** **0.011**
Sediment type	**Type C** – soils, the bulk of which are coarse-grained (less than 33% finer than 0.02mm) and will settle relatively quickly in a sediment retention basin.
Sediment basin wall construction (earth)	**I.** – These soils are pervious and not recommended for general use in construction of sediment basins (above ground sediment basins avoided in design). However, they can be used in a zoned embankment or mixed with other materials. The recommended batter grades are 3:1 (H:V) upstream and 3:1 (H:V) downstream. (33.33% gradient)

ASS – Acid Sulphate Soils

As part of the assessment to identify those sites of low erosion hazard Section 4.4.1 of the Blue Book provides a simple procedure to be followed. This has been provided in **Table 9**. For sites calculated to be a Low erosion hazard the normal suite of erosion control measures are considered adequate.

Table 9: Erosion Hazard Assessment

Entity	Result	Source Location in Blue Book
The R-factor (rainfall erosivity)	2600	Map 9: Rainfall Erosivity of the Newcastle 1:250,000 topographic Sheet (Blue Book)
Recommended Batter slope	3:1 (H:V) = 33.33%	**Table 8**: Soil Characteristic Constraints to Development
Site slope – operational surface	<1%	Topography and water table gradient
Simple Erosion Hazard Calculation	**Existing** High **Operations** Batter areas – High Quarry floor and roads - Low	Section 4.4.1 and Figure 4.6 (Blue Book)

In accordance with Section 4.4.2 of the Blue Book, the erosion hazard according to the Soil Loss Class is required to be calculated. The equation used, definitions and calculated values have been provided in **Table 10**.

Table 10: Erosion Hazard Assessment according to the Soil Loss Class

Entity	Description	Source Location in Blue Book	Result
A	Computed soil loss (tonnes/ha/yr) **A = R K LS P C**	Appendix A (Table 4.2 The Soil Loss Classes (adapted from Morse and Rosewell, 1996)) - Landcom 2004	Batter Slopes: 97.4 tonnes/ha/yr Operational areas: 14.9 tonnes/ha/yr
R	the R-factor (rainfall erosivity)	Map 9: Rainfall Erosivity of the Newcastle 1:250,000 topographic Sheet (pB-11)	2600
K	Soil erodibility factor	Calculated using values in **Table 11** and Figure A2 (Appendix A Landcom 2004)	0.021 (RUSLE)
LS	Slope length/gradient factor	For batter areas - 3:1 (H:V) (**Table 8**) = 33.33% assumed maximum 10m Length slope	2.23
		For operational floor – 100:1-2 (H:V) = 1-2% with slope length of 50 m.	0.34
		Appendix A4 Table A1 (Landcom 2004)	
P	Erosion control practice factor	Appendix A5 Table A2 (Landcom 2004)	0.8 (Loose to 0.3m depth)
C	Ground cover and management factor	Appendix A6 Figure A5 (Landcom 2004)	1 (no vegetation cover)

Table 11: Soil erodibility factor K (RUSLE)

Entity	Description Selected
Texture grading	Coarse sand – 0.2 to 2.0 mm diameter (200 to 2,000 microns) = 77% (see **Table 8**)
Organic matter	Assumed to be <0.5%
Soil structure	2 – fine granular where particles are mostly 1 to 2 mm diameter
Profile permeability	1 – rapid, greater than 130 mm per hour (includes most Soil Hydrologic Group A)

The computed soil loss has been calculated as 97.4 tonnes/ha/yr. Utilising Table 4.2 (Section 4 Landcom 2004) the calculated soil loss fits into the top category in the table identifying:

- The Soil Loss Class has been identified as "**1**".
- The Erosion hazard being "**very low"**.

Table 4.3 (Section 4 Landcom 2004) identifies those times of the year that do not contribute significantly to the rainfall erosivity for different rainfall zones. It shows those lands where land disturbance activities can be undertaken only with the application of special measures (marked "yes") and those where special measures are not required (marked "no").

Figure 4.9 (Landcom 2004) identified the Newcastle area to be located within Rainfall distribution Zone 1. Along with the Soil Loss Class 1, Table 4.3 (Landcom 2004) identifies that there are no (0) periods during the year where special erosion control measures apply.

It is therefore concluded, the normal suite of erosion control measures are considered adequate. These control measures and their application are presented in **Section 7.3**.

5.2.3 Erosion and Sediment Controls

There are two key elements to effective erosion and sediment control:

- Minimising the extent of erosion.
- Managing eroded soils to avoid impacts on receiving environment.

These controls are detailed within **Section 7** and summarised below:

5.2.3.1 Design Specifications

Erosion and sediment controls for the development will be split into two components:

- Construction of the intersection, workshop and office areas. These areas will be managed consistent with the standard urban development construction controls with the following key parameters:
  - 10 year 2 hour storm event.
  - 85th percentile design storm event (note low lying areas near road are expected to have a higher clay content).
  - Avoid excavation where possible below the permissible floor level of 0.7m above highest groundwater table.
  - No dams or basins that have a base less than 0.7m above highest groundwater table.
- Operational controls will be generally based on Blue Book Volume 2E - Mines and Quarries for sandy soils. Operational activities comprise all activities outside the above construction areas and will include the following specifications:
  - Activities with a duration of less than 6 months (small resource sectors):
    - Temporary erosion controls: 5 year ARI.
    - Temporary sediment controls: 5 year ARI.
    - Sediment Basin (Type C): 1 Year for quality, spillway 20 years.
  - Activities with a duration of than 6-12 months (larger resource areas):
    - Temporary erosion controls: 5 year ARI.
    - Temporary sediment controls: 5 year ARI.
    - Sediment Basin (Type C): 1 Year for quality, spillway 20 years.
  - Activities with a duration of than more than 3 years (central spine road and office and workshop area):
    - Temporary erosion controls: 20 year ARI.
    - Temporary sediment controls: 20 year ARI.
    - Sediment Basin (Type C): 2 Year for quality, spillway 100 years.
  - Avoid excavation where possible below the permissible floor level of 0.7m above highest groundwater table.
  - No dams or basins that have a base less than 0.7m above highest groundwater table.

5.2.3.2 Site Specifications and Sizing

As the site is located on highly permeable sands, negligible runoff is expected. Permeability for the site is characterised below:

- Vertical infiltration rates in the sandy soils within the area, vary from an initial 83.6 mm/hour to a minimum of 25 mm/hour (ARR 2016 Table 5.3.11). Umwelt, (October 2016) reported observations of over 100 mm/hour within similar sand dune systems.

- For perspective the highest intensity 1% annual exceedance probability (AEP) occurs in a 1 hour storm with an intensity of 92.4 mm/hour decreasing to a 1% AEP 5 day event with intensity of 3.72 mm/hour.

Methodology for sizing stormwater containment is characterised below:

- Given the numerous changing catchments within the site as quarrying progresses, sediment control will be progressively accommodated within into the daily operations and final landform. Over a 1 ha disturbance area, up to 355 m^3 of basin storage would be required to satisfy storage requirements for sensitive environments as per Volume 2E Mines and Quarries. This volume will be adequately managed through providing low areas 150 mm or more deep over 2400 m^2 per hectare or roughly one quarter of the extraction area. Given the high infiltration rates and the rehabilitation that includes ripping of the floor area and placement of woody debris, this is considered likely to more than adequately cater for the required storage.
- Processing areas are approximately 5,000 m^2, accounting for some compaction of the area and reduced infiltration, a basin settling area of approximately 240 m^3 is required to meet the requirements of Volume 2E. This would equate to providing an area that is at least 150 mm deep over an area of 1,600 m^2 down gradient (south) of the processing area.
- Standard practice for basin sizing is to adopt the 85th percentile, 5 day rainfall depth for sensitive environments with longer duration, this has a total rainfall depth of 43.6 mm.
- Impervious hard stand area within the southern resource area is 8500 m^2, using the requirements from Volume 2E Mines and Quarries this requires an estimated 490 m^3 of basin storage. Given the limitations of creating basins on the site due to depth restrictions, this storage area will be accounted for within the road side table drains and infiltration zones, with incorporating check dams.
- Given the likely infiltration rates onsite, there would be expected to be negligible runoff.

5.2.3.3 Erosion Controls

Key erosion controls implemented onsite will include:

- Minimising disturbance area.
- Applying suitable stabilisation on temporary exposed batters, such as standard rehabilitation (e.g. logs and topsoil), geotextile, spray polymer, hydroseeding, hydromulch or mulch. The adopted method will be relevant to the duration of exposure and need to minimise contamination of sand resources.
- Topsoil stockpiles where required (to establish extraction areas) will have a maximum batter slope of 2:1 and maximum height of 2 m. These stockpiles should be protected from erosion consistent with the temporary batters.
- Progressive rehabilitation in accordance with the Biodiversity and Landscape Rehabilitation Plan. Rehabilitation includes placement of woody debris to provide catches for both wind-blown and water eroded sand/ soil.

5.2.3.4 Sedimentation Controls

Key sedimentation controls to be implemented onsite will include:

- Installation of sediment fence around excavation areas, these will double as a frog exclusion fence.

- Excavation of the land surface will create a depression where in the unlikely event of runoff occurring, water will collect and infiltrate. Where the landform does not result in a depression, 300mm high temporary bund to be installed.
- On the spine road between the weighbridge and Cabbage Tree Road, the road will be crowned to encourage water to drain off the road and into road side drains and adjoining extraction areas. Note. The EIS proposed a 10 m long, 0.6 m high drive-over bund (i.e. roll over), however RMS acceleration requirements make this unfeasible.
- The spine road will have 10 m long, 0.6 m high drive-over bund (i.e. roll over) installed to separate resource areas and encourage water to infiltrate within shallow road side table drains, these will be located at the following locations:
  - On the bitumen road within Sector 2 at the northern side of the Southern Resource Area.
  - On the northern end of the bitumen sealed road at the southern side of the Northern Resource, within Sector 3. A shaker grid (or a coarse ballast transition) will be installed on the northern side of this area to minimise loose rock entering the sealed surface.
- The roads will be constructed with a crowning profile to sheet stormwater water into shallow road side table drains, with regularly spaced mitre drains positioned within the resource area.
- If there is wash or transfer of material from the loamy product stockpile a low driveable bund (approximately 300mm) is to be installed around the loamy product stockpile to contain silt and organic material within the material process area.
- Sediment fence will be installed around the down gradient boundary of all topsoil stockpiles.
- Hard stand and car park areas surrounding the workshop and office area will have wide shallow table drains installed around the perimeter to encourage infiltration.
- Table drains will have batters of 1V:3H, with a base width of up to 2.4 m and depth of less than 0.3 m (assuming road level at 1 m above maximum groundwater).
- Check dams of up to 150mm high of jute/coir log, rock or sandbag check dams will be installed within table drain at centres of 50 m. The longitudinal slope of road and final landform is less than 0.5 % (extraction parallel to water table with gradient of approximately 0.15%). Jute / coir logs have a typical 2-4 year operational life depending on conditions before requiring replacement, as such will be used in shorter term locations to minimise replacement frequency.

Refer to **Figure 5** and **Appendix 4** for details of typical controls, also refer to NSW Blue Book.

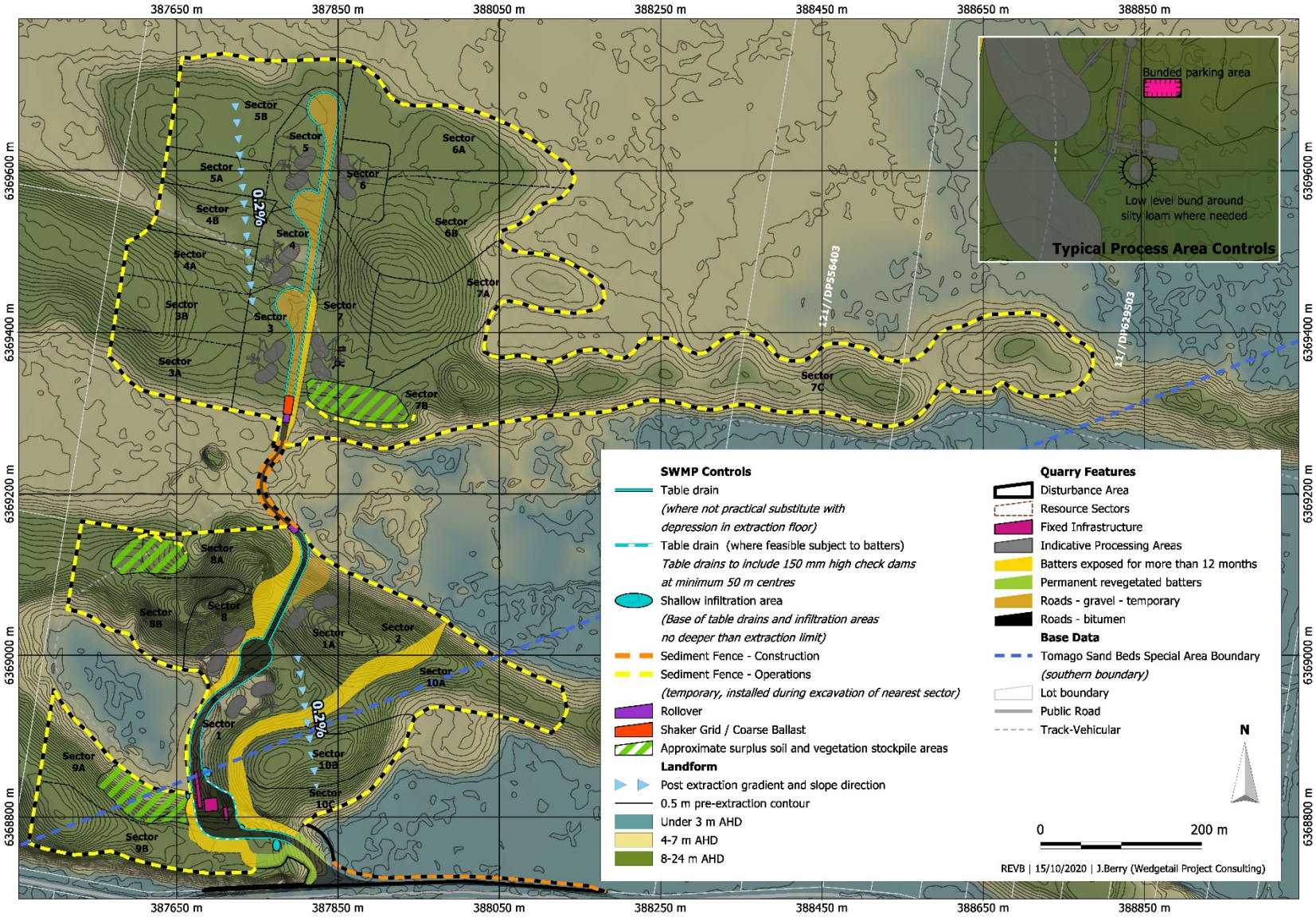

Figure 6: Indicative locations of key erosion and sediment controls over the project area

5.3 CONTINGENCY PLANNING

EPL 21264 requires the development of a Pollution Incident Response Management Plan (PRIMP) to manage potential risks of the project to the environment and community. This PRIMP is available at www.newcastlesand.com.au and is required to be reviewed annually and updated as required under the conditions of the EPL.

Table 12 outlines the contingency plan for the quarry in relation to water management. Where an event occurs that causes or threatens to cause material harm to the environment notification of the DPIE and EPA is required consistent with **Section 7.14** and the EPL.

Table 12: Contingency plan for potential impacts relating to water management at the quarry

Item	Outcome	Trigger	Response
1	Surface and groundwater quality adjacent to the quarry are protected from quarrying impacts.	Water monitoring program in Section 8, identifies an exceedance of trigger values as per Section 8.6.	Refer to Section 8.6.4
2	Protection of surrounding vegetation from change due to increased sediment runoff.	Water laden with sediment / sands leave the boundary of the quarry and vegetation is affected due to the change.	Review implementation of management controls and refer to Section 7.14.
3	No incidental extraction of groundwater during quarrying or a final land form that pools groundwater.	Water level monitoring detects groundwater levels are approaching trigger levels for the permitted quarry floor level as per the Maximum Extraction Depth Management Plan.	Refer to Maximum Extraction Depth Management Plan.
4	No contamination of sand from PFAS contaminated water or spreading of PFAS on the site.	PFAS monitoring within wash plant water detects PFAS above trigger values within wash plant water or sediments.	Refer to Section 5.3.1

5.3.1 PFAS in Feed Water and Sediments

Sampling undertaken of soil and water prior to commencing quarrying activities onsite demonstrated PFAS was not present within the sand or majority of groundwater or surface waters that occur onsite. PFAS has been detected in surface and groundwaters in some locations surrounding the site, but all occur below the level of extraction (refer to Section 3.7). However, to provide increased confidence in PFAS levels onsite and ensure PFAS is not unknowingly spread across the site or within the products, PFAS sampling will be undertaken of the wash water and wash plant sediments.

PFAS chemicals, if present within this system would be expected to be more prominently retained within the water and sediments with higher organic content, especially within a saturated environment (Brusseau et.al, 2018) as present in the wash plant. As such, if present in the system, the highest concentrations would be expected in the sediments and water retained onsite rather than the product sand sold from site.

It is not intended, but feasible, that equipment coatings within the wash plant have the potential to contain negligible concentrations of PFAS chemicals that will be released in minor amounts during the initial washing process, as such the trigger value adopted is that for drinking water, as a detection alone is unlikely to be a notable level.

In the event of a valid detection (confirmed by follow-up sample, or other quality control sample) of PFAS chemicals within the wash water or sediments that is greater than trigger values in **Table 20**, sand washing operations will be paused and an investigation undertaken, including notification of DPIE and EPA. The investigation will examine the following:

- PFAS concentration in feed water.
- PFAS concentration in feed sand.
- PFAS concentration in product sand.
- PFAS concentration in fines.

An investigation report will be prepared documenting results of the testing and recommended further steps for the management of PFAS on the site. No further washing of sand is to occur until this investigation is complete.

6. ROLES AND RESPONSIBILITIES

Roles used within this plan are defined below, responsibilities are outlined in **Section 7** or otherwise defined below.

6.1 KEY CONTACTS

Table 13 shows the key contacts available in the event of a complaint, enquiry or emergency.

Table 13: Key contacts

Contact	Name	Phone	Email
Quarry Manager	Shane Burton	0402 648 079	shane@newcastlesand.com.au
EPA – Incidents Line		131 555	
DPIE – Compliance		1300 305 695; or email: compliance@planning.nsw.gov.au	
DPIE-BCD		email: rog.hcc@environment.nsw.gov.au	
HWC – Faults and Emergencies		1300 657 000	

6.2 QUARRY OWNER

The Quarry Owner is WSS who operate the quarry under the wholly owned subsidiary of Newcastle Sand. The Quarry Owner is responsible for the development and assignment of a suitably qualified Quarry Manager and to provide sufficient support to the Quarry Manager to undertake the required actions defined in this plan.

6.3 QUARRY MANAGER

The Quarry Manager is the person who manages the Quarry and is responsible for the day to day activities on the site. The Quarry Manager reports to the Quarry Owner.

The Quarry Manager must read, understand and implement the practical application of this plan. All activities being undertaken on the quarry site are the responsibility of the Quarry Manager.

The responsibilities of the Quarry Manager are defined within the plan, in particular by **Section 7**.

6.4 ONSITE PERSONNEL

Onsite personnel constitutes all employees and contractors working on the site.

6.5 SUITABLY QUALIFIED PERSON

Where the Quarry Manager sub-contracts tasks within this management plan, the quarry manager is to satisfy themselves as to the suitability of the contractor for the task. A suitably qualified contractor will be able to demonstrate the following for the required task:

- Relevant qualifications or training (e.g. suitably targeted training course, Bachelor of Science or Engineering is likely to be suitable).
- Relevant experience (examples of past water sampling projects is likely to be adequate).

The Quarry Manager should retain suitable information and/or readily demonstrate the contractor is suitably qualified (e.g. via a copy of the proposal). An employee of Newcastle Sand may constitute a suitably qualified person if the above criteria (used for contractors) is satisfied.

7. MANAGEMENT CONTROLS

Table 13 describes the relevant water management actions and controls to be implemented for the Project. These controls incorporate the Statement of Commitments unless otherwise superseded by a Condition of the Development Consent.

Table 14: Water management control measures

Item	Action	Trigger/Timing	Responsibility	Reporting
7.1 GENERAL				
A	Induction to include awareness for all site personnel on the key elements of water management controls onsite, notably: • Presence, location and importance of the Tomago Sand Beds Special Area. • Restrictions on equipment and refuelling within the sand beds. • Requirement to control and notify Quarry Manager for all spills onsite. • Requirement to maintain separation from groundwater. • Requirement to have no discharges from the site.	Ongoing, prior to employees and contractors working onsite.	Quarry Manager	Induction
B	All activities are to ensure work areas do not extend land disturbance activities beyond five (preferable two) metres from the edge of work area.	At all times.	Quarry Manager	Nil
C	The boundary of the resource area will be delineated prior to construction and clearly marked. Each resource sector (or stage of clearing) should be delineated prior to commencing extraction.	At all times.	Quarry Manager	Survey plan of resource boundary
D	Install erosion and sediment controls onsite as specified within this document or otherwise in accordance with the Blue Book.	At all times	Quarry Manager	Nil
E	Offices, workshops and weighbridges to support the operation, where all structural footings / excavation limits for those facilities are limited to 1.0m above the predicted maximum groundwater level.	During construction	Quarry Manager	Nil

Item	Action	Trigger/Timing	Responsibility	Reporting
F	Connection of water and electrical utilities to the office and workshop. Utilities will be conveyed above ground where feasible, or kept below ground but above the highest predicted groundwater level where possible (e.g. outside the immediate connection with the existing utility).	During construction	Quarry Manager	Nil
G	Extraction of sand down to a level no lower than 0.7m above the highest predicted groundwater level, with a final landform of 1.0m above that level. Refer to the Maximum Extraction Depth Report for details on groundwater levels and verification of surface level.	Ongoing	Quarry Manager	Nil
I	Disturbance of potentially contaminated soils or potential hazardous building materials or pipe (e.g. fibre cement containing asbestos) must be reported to the quarry manager immediately and no further disturbance of area to continue. Quarry manager to determine need for formal classification.	Ongoing	Quarry Manager	Nil
7.2 WATER USE				
A	Water for potable use and dust suppression will be drawn from Hunter Water's reticulated water supply at Cabbage Tree Road. No groundwater will be extracted or utilised.	Ongoing	Quarry Manager	Annual HWC water usage reported in AEMR
B	Rainwater will be captured from the workshop and office roofed area and reused for dust suppression or within the workshop and facilities area, rainwater tanks to a minimum capacity of 20 kL will be used for storage of water.	Ongoing	Quarry Manager	Nil
B	The following water saving measures will be employed within the workshop and facilities area: • Leaking taps will be fixed quickly after identification. • Where feasible, pipework will be insulated, or the hot water boilers located close to taps to avoid wasting water while waiting for hot water to flow through. • Water efficient toilets will be installed and maintained these to minimise leaks. • Use collected rainwater for toilet flushing, cleaning, or dust suppression.	During construction & At all times	Quarry Manager	Nil
C	The following water saving measures will be employed within quarrying area: • Bitumen sealed access road to southern side of northern resource area to minimise dust suppression, increasing extent of bitumen where water use approaches 90% of estimate.	During construction & At all times	Quarry Manager	Nil

Item	Action	Trigger/Timing	Responsibility	Reporting
	• Grading product and landscape sand stockpile pads to shallow sumps to recovery bleed water and runoff to reduce HWC water use. • Use of conveyors will minimise length of access roads requiring dust suppression. • Investigation of use of additives to improve dust suppression on haulage roads (See Section 4.2.2.1). • Revegetation planting will where feasible plant in favourable weather conditions to reduce establishment watering.			
D	Water usage will be recorded and summarised as follows: • Volume of water drawn from the HWC network. • Volume of water transferred from site (e.g. septic / bunded water capture). • Comparison with estimated water use (Section 4.2), with following actions: o Where water use, with the inclusion of the wash plant, exceeds 27 ML/annum, additional bitumen sealing of gravel roads will be undertaken to reduce dust suppression water usage. o Where more than 20% above estimated maximum, review water usage areas and investigate methods to minimise usage where feasible.	Recorded quarterly or during offsite transfer and reported annually	Quarry Manager	AEMR
E	Estimated water usage by area the water is used will be reviewed, generally split as follows: • Increase in product sand moisture (assume average of 3% for all sand sold – noting unprocessed sand may be lower, processed may be higher, and it will be relative to time stockpiled and last rainfall). • Estimate of top up water volume introduced to wash plant. • Deducting product moisture increase from top up water gives estimated water lost within fines, leaks and uncaptured stockpile seepage. • Effluent disposal offsite provides estimate of usage at office. • All other water use as measured on the HWC Network metre is assumed to be in dust suppression of other stockpiles, batters and roads. Based on the above review, in comparison with Item D above (comparison of water use), potential for water saving measures will be reviewed. Where reasonable, feasible and economically achievable to apply and have demonstrated benefits for air quality in the area, these controls will be implemented within the following year.	Recorded monthly and reported annually.	Quarry Manager	AEMR

Item	Action	Trigger/Timing	Responsibility	Reporting
7.3 CONSTRUCTION EROSION AND SEDMENT CONTROL				
A	Contractors to provide erosion and sediment control works plan consistent with this plan to Quarry Manager for implementation prior commencing construction activities.	Prior to commencement of construction	Quarry Manager	ESC Works Plan
B	Install erosion and sediment controls on-site as specified within this document or otherwise in accordance with the Blue Book.	At all times	Quarry Manager	Nil
C	Erosion and sediment control works plan to be prepared and implemented with all internal road construction activities.	Prior to internal road construction	Quarry Manager	ESC Works Plan
7.4 CONSTRUCTION WATER MANAGEMENT				
A	**Groundwater and accumulated surface water in excavations** Prior to excavation for construction related activities below the maximum extraction level: • Review of groundwater levels for the area via measuring the nearest groundwater monitoring well to understand the potential for intersection of the groundwater table. • Review predicted rainfall during the proposed works period. Should there be a high likelihood for intersecting the groundwater table, excavations cannot be avoided due to rainfall or unexpected rainfall occurs, the following procedures should be followed: 1. Review latest PFAS water data (Department of Defence supplied data and site monitoring data) to understand if the excavation area is within an area of likely PFAS contamination. As of the date of Version 1 of this plan, published monitoring by Department of Defence showed potential for a low concentration plume frontage (0.02µg/L) opposite the road intersection. Analysis of groundwater and surface water onsite has not detected PFAS. 2. Where PFAS is expected, excavated soils will require testing and evaluation prior to disposal or transfer to outside the immediate intersection area (e.g. within the resource area). 3. Ensure suitable erosion and sediment controls are in place prior to excavation, including the inclusion of diversions around excavations.	During Construction	Quarry Manager	• DPIE notified in the event of PFAS Identification. • Internal, information to be retained includes, location where groundwater is intercepted, sample locations, laboratory results and volumes disposed offsite, including

Item	Action	Trigger/Timing	Responsibility	Reporting
	4. Intersected groundwater or accumulated surface waters must be contained in the excavation area OR pumped to a temporary holding tank located near the excavation until water can be analysed. 5. Suitably qualified persons are to collect representative samples of exposed groundwater or surface water and submit for laboratory analysis for PFAS constituents (minimum 28 analyte suite for standard analysis). 6. If PFAS is not detected, the contained water should be pumped and disposed to an adjacent area within the disturbance footprint where infiltration can occur or used for dust suppression. 7. If PFAS is detected,: o A suitably qualified person is to be engaged to assess levels against industry accepted criteria (currently HEPA NEMP 2020). o Water within the excavation will be disposed off-site to an approved licensed treatment facility OR allowed to dissipate within the excavation prior to works commencing. o Prior to recommencing works a site specific risk assessment will be completed by a suitably qualified person including identification of appropriate decontamination procedures for further works within the excavation. 8. Areas with detected PFAS concentrations are to be identified and clearly marked to ensure any further ground disturbance is done so with suitable controls. 9. Should excavations in the same spatial area be required to be undertaken within one (1) month of previous sampling at the same location, resampling of excavation water is not required.			disposal location. • Where used for dust suppression record approximate volume.
B	• No release of untested accumulated groundwater or surface water from within a trench off-site. • Water disposal documentation available for all water removed from site.	Reviewed following high rainfall and detection of PFAS.	Quarry Manager	Results included within AEMR
C	• Non-conformance includes failure to implement above controls resulting in exposure to water containing PFAS. • In the event of non-compliance an Incident Investigation and Corrective Actions Report will be completed.	Ongoing	Quarry Manager	Results included within AEMR Incident Investigation and Corrective Actions Report

Item	Action	Trigger/Timing	Responsibility	Reporting
7.5 EROSION CONTROLS				
A	Apply suitable stabilisation on temporary exposed batters, such as standard rehabilitation (e.g. logs and topsoil), geotextile, spray polymer, hydroseeding, hydromulch or mulch. The adopted method will be relevant to the duration of exposure and need to minimise contamination of sand resources.	On completion of batter	Quarry Manager	Record method in AEMR and review suitability annually
B	Topsoil stockpiles where required (to establish extraction areas) will have a maximum batter slope of 2:1 and maximum height of 2 m. These stockpiles should be protected from erosion consistent with the temporary batters.	On completion of batter	Quarry Manager	Nil
C	Progressive rehabilitation in accordance with the Biodiversity and Landscape Rehabilitation Plan. Rehabilitation includes placement of woody debris to provide catches for both wind blown and water eroded sand/ soil.	At all times	Quarry Manager	Nil
D	Final landform batters with edge of Project Boundary not to exceed 4H (horizontal) to 1V (vertical), 4H:1V.	During rehabilitation	Quarry Manager	Completion Report
7.6 SEDIMENT CONTROLS				
A	Installation of sediment fence around active excavation areas, these will double as a frog exclusion fence. Fence need and purpose to be evaluated in conjunction with fauna monitoring.	Prior to extraction within a sector, relocated to next sector on completion.	Quarry Manager	Nil
B	Maintain a bund / excavation at the downslope side of each of the extraction areas to contain any sediment and runoff that may be generated from disturbed areas on site.	During extraction of block.	Quarry Manager	Nil
D	If there is transfer of material from the loamy product stockpile, a low driveable bund (approximately 300mm) is to be installed around the loamy product stockpile to contain silt and organic material within the process area.	As needed.	Quarry Manager	Nil
E	Install within the spine road, two 10 m long, 0.6 m high drive-over bund (i.e. roll overs) (southern side of Northern Resource and northern side of Southern Resource) to separate resource areas and encourage water to infiltrate within shallow road side table drains and adjacent extraction areas.	During road construction	Quarry Manager	Nil

Item	Action	Trigger/Timing	Responsibility	Reporting
F	Construct roads with a crowning profile to sheet stormwater water into shallow road side table drains, with regularly spaced mitre drains positioned within the resource area.	During road construction	Quarry Manager	Nil
G	Sediment fence will be installed around the down gradient boundary of all topsoil stockpiles until stabilised.	Topsoil stockpiles	Quarry Manager	Nil
H	Table drains will have batters of 1V:3H, with a base width of 2.4 m and depth of less than 0.3 m (assuming road level more than 1 m above maximum groundwater).	During road construction	Quarry Manager	Nil
I	Check dams of up to 150mm high of jute/coir log, gravel filled sandbag check dams will be installed within table drain at centres of 50 m. The longitudinal slope of road and final landform is less than 0.5 % (extraction parallel to water table with gradient of approximately 0.15%). As jute / coir logs have a typical 2-4 year operational life depending on conditions before requiring replacement, gravel filled sand bags will be used in areas where duration of dam life exceeds 2 years.	During road construction	Quarry Manager	Nil
J	All laden trucks will have loads covered and be cleaned of material that may fall from vehicles prior to exiting the site.	Ongoing	Quarry Manager	Nil
7.7 SURFACE WATER SYSTEM MAINTENANCE				
A	Erosion and sediment controls will be monitored to ensure core objectives are met, and will be amended as necessary to ensure effective erosion and sediment control.	Monthly and after significant rainfall	Quarry Manager	Register of monthly / post major rainfall inspections.
B	Maintain erosion and sediment controls as required. The need for maintenance will be evaluated as follows: • Controls should be no more than 30% of normal capacity (i.e. sediment build up depth, i.e. check dams must have minimum of 100 mm exposed). • Check dams within table drains must be positioned to avoid scour around or under check dams. • Review structural integrity of the check dam materials (e.g. coir logs have a typical 2-4 year operational life depending on conditions before requiring replacement).	Monthly / post major rainfall inspections.	Quarry Manager	Register of monthly / post major rainfall inspections.

Item	Action	Trigger/Timing	Responsibility	Reporting
7.8 HYDROCARBON AND CHEMICAL STORAGE AND USE				
A	If obvious signs of contamination such as discoloured or odorous soils are encountered during site set-up and extraction, work will stop in the vicinity of the area and, if safe to do so, samples will be taken for analysis.	Ongoing	Quarry Manager	AEMR
B	The workshop includes an impervious fully bunded and undercover hardstand for refuelling, hydrocarbon and chemical storage, and a double skinned diesel storage and is located outside of the Tomago Sandbeds Special Area.	Ongoing	Quarry Manager	Nil
C	**Main Diesel Storage Tank Installation** Diesel storage tank must be located outside the Tomago Sand Beds and comply with AS1940: 2017, notably: • Section 5.8 of AS 1940: 2017 discusses the requirements for bunding around storage tanks. Specific attention is required to understand the required bund capacity, design and construction compound drainage and management of firewater. • Section 5.9 of AS 1940:2017 discussed the requirements for tanks that have integral secondary containment. Noting that the primary tank must comply with AS 1692 or equivalent and the secondary containment must be capable of holding the entire content of the primary tank. • Section 7 of AS 1940: 2017 discusses fuel dispensing requirements. • Section 8 of AS 1940: 2017 discusses tank filling requirements. • Despite the fuel tank design (i.e. self-bunded or not), the fuel storage, filling and dispensing compound should be constructed to contain and collect any spills that may arise from the filling and/or dispensing process. The compound must be capable of containing 9,000L or the maximum volume of liquid that can be discharged from the tank filling points having the greatest flow over 2 minutes (<200 L). • Note the requirement for separations distance from fill point to the tank when considering the compound design. • Section 5.11 of AS 1940: 2017 discusses the requirements for the installation of above ground storage tanks.	During design and construction.	Quarry Manager	Nil
D	Hazardous material stored onsite will be kept to the minimum practicable amount.	Ongoing	Quarry Manager	Nil

Item	Action	Trigger/Timing	Responsibility	Reporting
E	**Management of minor quantities of chemicals** • All chemicals considered to be minor quantities (i.e. oils, greases, de-greasers, flocculants and coagulants etc.), excluding domestic cleaning products, will be stored (i.e. when not in use) within a designated location of the workshop outside the Tomago Sand Beds. • The storage and use of chemicals in must comply with the requirements of Section 2 of AS1940: 2017.	Ongoing	Quarry Manager	Nil
F	Section 9 of AS1940: 2017 provides details on the requirements for operational and personal safety managing flammable and combustible liquids.	Ongoing	Quarry Manager	Nil

G	Processing plant area (moved around the site based on resource area) installed on site will include:
	• A covered and impervious bunded parking area for the overnight parking of equipment used for clearing in the Tomago Sand Beds area (e.g. bull dozer).
	• If power via electrical mains supply is unavailable, diesel generators will be required. If used, diesel generators will be:
	  ○ Internally self-bunded and include a lockable cowling to limit vandalism.
	  ○ If coupled to an external fuel tank. The external fuel tank is returned to the Office and Workshop Compound on conclusion of operations every day or immediately following mains electrical supply being returned. This is proposed in the context of reducing the risk of vandalism over the weekend, and limiting risks associated with the daily transport of the generator to and from processing plant area.
	• Flocculant and coagulant tanks in use within the wash plant will have appropriate bunding to capture spills.
		Ongoing	Quarry Manager	Nil

H	Mobile equipment used on site will: • Be refuelled over an impervious portable bund. • Include spill control kits. • Operators trained in the use and maintenance of spill control kits. • Return of all mobile equipment at end of each day to Office and Workshop Compound (excluding the equipment used in clearing, that may be stored within an impervious bunded hardstand within the Tomago Sand beds).	Ongoing	Quarry Manager	Nil

Item	Action	Trigger/Timing	Responsibility	Reporting
I	The processing equipment will include impervious bunding under the key hydraulic components to capture hydraulic leaks.	Ongoing	Quarry Manager	Nil
J	When plant and equipment is not operating, pressure will be removed from hydraulic lines and hydraulic fluid returned to the tank. Impervious bunding to 110% of capacity of the hydraulic fluid tank will be located under the relevant location of the equipment.	Ongoing	Quarry Manager	Nil
K	All diesel powered pneumatic tyred mobile plant will be removed from the Tomago Sandbeds Special Area at the end of each day's operation. This plant will be stored within fenced area with CCTV and back to base security at the Office and Worksop area located outside the Special Area for protection of equipment against vandalism and subsequent release of hydrocarbons.	Ongoing	Quarry Manager	Nil
7.9 HYDROCARBON SPILL RESPONSE				
A	Section 10 of AS1940: 2017 details the requirements for the emergency management of flammable and combustible incidents.	Ongoing	Quarry Manager	Nil
B	Any hydrocarbon spills on site will include the following response: • Immediate deployment of spill control kits. • Notifications of relevant stakeholders (e.g. EPA and HWC) consistent with the Pollution Incident Response Management Plan (PIRMP) for any spills estimated to be greater than 30 L. Recovery of all contaminated sands or gravels regardless of size for collection and offsite disposal at a licenced waste facility.	Ongoing	Quarry Manager	Nil
F	Personnel to be trained in spill containment and response procedures.	Ongoing	Quarry Manager	Training and Induction Register
G	Spill response kits will be kept and maintained onsite.	Ongoing	Quarry Manager	Nil
7.10 TOMAGO SANDBEDS AQUIFER				
A	The following activities will NOT occur within the Tomago Sandbeds Special Area: • No construction of quarry infrastructure (excluding roads, power lines and potable water pipelines required for servicing the quarry).	Ongoing	Quarry Manager	Nil

Item	Action	Trigger/Timing	Responsibility	Reporting
	• No establishment or use of onsite sewage pump out system including holding tank. • No storage of liquids other than water. • No equipment maintenance. • No refuelling of mobile equipment (other than tracked equipment with an impervious bunded area). • No storage of fuel-powered equipment outside of operating hours (other than equipment used for clearing activities, which must be stored within an impervious bunded area).			
7.11 GROUNDWATER				
A	The following wells are considered essential to the effective monitoring of water quality for the quarry site, where any of these wells are damaged or become unusable, a suitably qualified person will specify a suitable location and specification for a replacement monitoring well to be constructed nearby. Key monitoring wells are as follows: • BH11 and BH6 – Upgradient wells providing baseline control water quality. • BH9/BH9A, BH4, BH2, BH239S and BH7 – down gradient wells located between quarrying activities and likely receptors and expression at the surface.	New well installed as required if key monitoring well is removed.	Quarry Manager	The Soil and Water Management Plan updated as required.
B	Data loggers will be installed in selected monitoring wells to continuously monitor and provide additional data for input to the groundwater model.	Prior to operations	Quarry Manager	The Soil and Water Management Plan updated as required.
C	Implementation of the “Contingency Management Plan for Potential PFAS Disturbance during Construction Activities” for any potential incursion into groundwater during construction.	During construction	Quarry Manager	Contingency Management Plan for Potential PFAS Disturbance during Construction Activities

Item	Action	Trigger/Timing	Responsibility	Reporting
7.12 WATER MONITORING				
A	Implement water monitoring as specified in **Section 8**.	Monthly for initial 12 months, or until 12 months of data has been obtained, then reducing to quarterly thereafter, or as required by EPL.	Quarry Manager	Summary of results in AEMR
B	Provide an addendum to the Baseline Water Characteristics Report based on supplementary data collected during 2020/2021, once 12 months of data has been collected from all required sites, including an update on the Site-Specific Trigger Values where needed. Where surface water sites are dry, no monitoring is required.	2020/2021, update by December 2021.	Quarry Manager	Addendum to Baseline Water Characteristics Report.
C	Review water monitoring data against Trigger Response Actions in Section 8.6.	Monthly on receipt of the laboratory results.	Quarry Manager	Summary of results in AEMR
7.13 COMPLIANCE EVALUATION				
A	Monthly internal inspections.	Monthly	Quarry Manager	Monthly Inspection Report
B	Annual evaluation of the water management system within the AEMR against the following: • Accuracy of the site water balance and need to adjust plan accordingly to meet actual water use or other site restrictions. • Containment of sediments within the boundary of the resource area. • Containment of contaminants within bunded areas. • Surface and groundwater monitoring results that show negligible change in quality or quantity due to the presence of the quarry.	Annual	Quarry Manager	Summary of results in AEMR
C	Monitoring results will be screened as per the Trigger Response Actions in Section 8.6.	Monthly on receipt of the laboratory results.	Quarry Manager	Summary of results in AEMR

Item	Action	Trigger/Timing	Responsibility	Reporting
D	Water Trigger Investigation (see Section 8.6.4) The water trigger investigation will evaluate the following: • A review of the site conceptual site model to understand the risk potential of the exceedance; • Identify the potential for other sources to be present that may require confirmatory sampling (and include intrusive investigation if considered appropriate); • Recent climate and rainfall data; • Other activities within the catchment (both on and off the Site) in the preceding period; • Operational activities of the quarry in the preceding period; and • Historical potential for those quarry activities to cause exceedance. Where the above confirms that activities onsite have occurred that are likely to have resulted in the exceedance of the trigger value, an Incident will be reported as per **Section 7.14**.	Exceedance of previous data and trigger as per Section 8.6.	Quarry Manager	Water Trigger Investigation Report Incident Notification to HWC, EPA, DPIE – within 24 hours. Summary of incidents in AEMR
E	Independent Environmental Audits within 12 months of commencing quarrying operations and three-yearly thereafter as per Schedule 5, Condition 12.	1 year (i.e. May 2021), then three-yearly thereafter.	Quarry Manager	Audit Report
7.14 INCIDENT INVESTIGATION AND CORRECTIVE ACTIONS				
A	Notify the Secretary and relevant agencies in the event of an incident consistent with Schedule 5, Condition 8 of the Development Consent, where an incident is defined as a set of circumstances that: • Causes or threatens to cause material harm to the environment; and/or • Breeches or exceeds the limits or performance measures/criteria in this consent.	Immediately following incident	Quarry Manager	Evidence of notification
B	Where an incident occurs, consistent with Schedule 5, Condition 9 of the Development Consent Newcastle Sand will undertake the following sequence of reporting, investigations and controls: • Review the details of the incident including operational activities at the time and the nature of the incident. • Review of data against baseline data, health and ecosystem related criteria to determine the degree of change.	Non-compliance with criteria – report submitted within 7 days of the date of the incident.	Quarry Manager	Incident Investigation and Corrective Actions Report provided to HWC, EPA, DPIE within 7 days of event.

Item	Action	Trigger/Timing	Responsibility	Reporting

	• If due to failure or equipment or to follow operational procedures, undertake corrective actions to prevent recurrence.
	• If damage is not as a result of failure, review and refine procedures.
	• If operational practices cannot be improved and non-compliance persists:
	  ○ Consult with relevant stakeholders.
	  ○ Temporarily suspend activities identified to cause persistent non-compliance pending outcome of additional assessment.
	  ○ Identify severity of non-compliance and additional investigations required to assess resulting impact of non-compliance.			

7.15 COMPLAINTS				
A	Complaints will be recorded in a consultation register and managed and accordance with the Complaints procedure for the procedure outlined in Section 5.2.1.2 of the Project EMP.	Receipt of complaint	Quarry Manager	Complaints Register Summary in AEMR.
7.16 CONTINUOUS IMPROVEMENT				
A	All controls in this plan will be reviewed and if necessary, revised to confirm their applicability on an ongoing basis throughout the life of the Project and ensure continual improvement of management practices. In addition the following circumstances may trigger a review of this plan: • Internal monthly compliance inspections that identify a potential risk to the environment. • Non-compliance. • Change to the EPL. • HWC imposed water restrictions. • Annual review. • Modifications of the Consent. • Audit Report. The revised controls will be prepared in consultation with the NSW EPA, NSW Water and Hunter Water for approval by NSW DPIE.	Annually or as required depending on stated circumstances.	Quarry Manager	Summary in AEMR

8. WATER MONITORING PROGRAM

8.1 MONITORING SITES

This section describes the location of monitoring sites for the water monitoring program. Where sites are decommissioned or new locations adopted the plan is to be updated.

8.1.1 Groundwater Monitoring Sites

Attributes of the groundwater monitoring sites are described within **Table 14** and shown on **Figure 7**. Key monitoring sites (those essential for assessment of quarry performance) are shaded grey, other monitoring sites, may, during quarrying be removed and are not considered essential to the monitoring framework and will not be replaced. BH9A, will subject to EPA approval to replace BH9, and BH9 will become redundant.

Table 15: Details of Groundwater Monitoring Bores

Borehole (EPL 21264 site)	Easting (MGA)	Northing (MGA)	Surface (mAHD)[1]	Top of Casing (mAHD)	Bore Depth (m)	Screen Top (mBG)[2]	Screen Bottom (mBG)	Logger Installed
BH1	387741.2	6369495.8	8.21	8.64	9.45	6.45	8.6	-
BH2* (EPL.P1)	387704.7	6369175.1	7.40	7.79	9.45	5.6	8.6	Yes
~~BH3~~ (decommissioned)	~~387751.7~~	~~6368964.3~~	~~7.03~~	~~7.57~~	~~9.45~~	~~5.45~~	~~8.45~~	~~Yes~~
BH4* (EPL.P2)	387854.9	6368742.8	2.81	3.06	6.45	2.65	5.65	Yes
BH5	388768.5	6369334.7	6.76	7.36	9.28	8.1	5.1	-
BH6# (EPL.P3)	388729.7	6369582.2	3.01	3.62	4.95	3.9	2.4	-
BH7* (EPL.P4)	388827.7	6369245.3	2.60	2.98	4.95	2.6	4.1	-
BH8	389178.2	6369271.6	3.28	3.88	6.28	3	5.5	-
BH9* (EPL.P5)	387520.4	6368798.8	17.07	17.75	18.18	14.6	17.6	-
BH9A*	387654.7	6368739.0	10.03	10.75	12.0	9.0	12.0	Yes
BH10	387931.2	6369744.4	6.09	6.69	5.45	2	5	-
BH11# (EPL.P6)	387650.6	6369979.7	6.02	6.63	5.95	1.6	4.6	Yes
BH12	388202.9	6369332.9	8.06	8.67	8.39	4.8	7.8	-
MW239S*	388619.1	388619.1	2.98	3.04	4.0	1.0	4.0	Yes
# Upgradient control sites | * Down gradient monitoring site | BH3 in quarry area decommissioned.								

1. mAHD: This is the topographic height of the surface level relative to sea level.
2. mBG: This is the metres depth below ground surface level (e.g. The screen top of BH9A in mAHD is determined by Surface (10.03) – Screen Top (9.0m) = 1.03 m AHD)

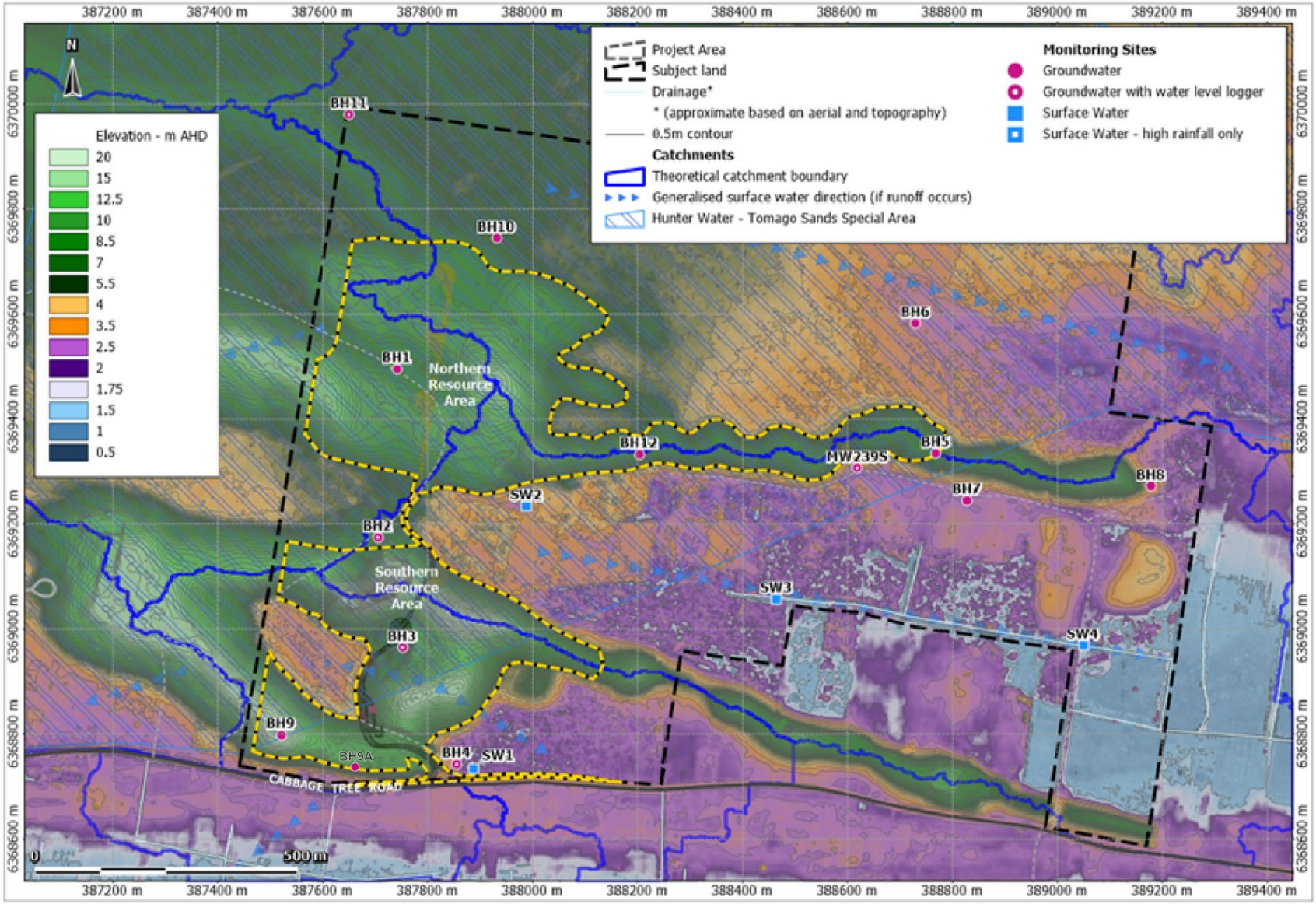

Figure 7: Water monitoring locations and elevation across the Subject Land and surrounds

NEWCASTLE SAND

8.1.2 Surface Water Monitoring Sites

A description of the proposed surface water monitoring sites is included within **Table 16**, shown on **Figure 7**, and in **Photographs 1 to 7**.

Table 16: Details of surface water monitoring sites

Name	Elevation	Easting MGA 94	Northing MGA 94	Location	Description	Quarry area with potential influence from quarry
SW1	Elevation: 1.0 – 1.5 m AHD Depth range: 0 – 0.5 m	387886.7	6368734	North east of the quarry intersection within apparent natural depression.	Isolated ponded area typically contains water, though does become dry at times. No connection to any drainage network, likely to be groundwater fed. Likely to currently receive runoff from Cabbage Tree Road.	• Located 15 m north of quarry intersection construction activities. • Culvert beneath proposed intersection will direct drainage to this area. • Area will be affected by intersection construction activities and quarrying in Year 8.
SW2	Elevation: 2.3 m AHD Depth range: 0 – 0.2 m	387988.3	6369234	South east of northern resource area within former RZM access track.	Isolated ponded area may not be suitable as monitoring location. Dependent on groundwater levels, was dry for entirety of 2019. No connection to any drainage network, likely to be groundwater fed.	• Located 45 m south east of Sector 7 (Year 6 of operations). • Within catchment of activities in Year 6. • Very low potential to receive runoff from short section of spine access road (200m to west).
SW3	Elevation: 1.1 m AHD Depth range: 0.5 – 1.0 m	388464.6	6369057	North side of constructed drainage channel partway between the site and WS4	Likely to always contain water. Located approximately 100 m east of the start of a constructed drainage channel.	• Located 350 m north east of Southern Resource area and 235 m south of Sector 7C of Northern Resource Area. • Within catchment of activities occurring in Year 2, Year 6 and Year 8.
SW4	Elevation: 1.0 m AHD Depth range: 0.5 – 1.0 m	389049	6368969	Eastern side of culvert on access track within drainage channel	Likely to always contain water. Located approximately 600 m east of the start of a constructed drainage channel.	• Within catchment of activities occurring in Years 2 to 8.

Name	Elevation	Easting MGA 94	Northing MGA 94	Location	Description	Quarry area with potential influence from quarry
WP1	Variable	-	-	Variable – wash plant	Taken from a suitable location within the system that enables the safe sampling of a sediment laden water sample. The best location for that sample will be subject to the final installation and design of the wash plant and associated water management system.	• For the purpose of detecting PFAS within the wash plant system.
SW5 (originally proposed by the author of this plan) has been removed from the monitoring program as it will not be reflective of operations occurring within the quarry for the following reasons: • Distance from site, SW5 is over 350m east of SW1 in a straight line. • SW1 provides a better representation of drainage to this area. • There is no direct flow from disturbance areas to this sampling point. • Flow at this site is very infrequent that has resulted in an absence of baseline data. • The site is difficult to safely sampling given significant wet weather only flow. • The dominant water source is from water draining from the adjacent private property. • Site inspection in April 2021 showed negligible flow occurring (despite high water levels), presence of rubbish (contaminant sources) in road side swale and CCA treated timbers on the private property directly upgradient (less than 30m away with near contiguous sitting water).						

Photograph 1: SW1 near southern edge of Subject Land north east of the intersection within topographically low area

Photograph 2: SW2, pooled water within depression on corner of abandoned RZM access road, looking toward the resource area

Photograph 3: SW3, looking south west toward disturbance area, within constructed drainage channel

Photograph 4: SW3, looking east within constructed drainage channel

Photograph 5: SW4 sample location on eastern side of culvert beneath access road with constructed drainage channel

8.2 SAMPLING METHODOLOGY

The methodology to be adopted during water sampling is detailed below. Monitoring is to be undertaken by a suitably qualified and competent individual.

8.2.1 Sample Collection

Water samples will be collected placed directly into clear plastic unpreserved bottle before being transferred into other preserved bottles (as required), or directly from the sampling equipment to preserved bottle.

Samples will be placed into appropriately preserved sampling bottles supplied by the laboratory. Samples for dissolved metal analyses will be filtered on site using 0.45 micron filter paper and placed in nitric acid preserved bottles.

Samples will be stored on ice in eskies while onsite and whilst in transit to the laboratory. See below for more details.

The decontamination of non-dedicated sampling equipment will be achieved by washing with a PFAS sampling compatible detergent (e.g. Liquinox or other suitable products) and deionised water. Decontamination will be conducted after the collection of samples at each sample location.

Samples will be sent to the laboratory accompanied by a chain of custody form and within relevant holding times.

8.2.1.1 PFAS sampling precautions

HEPA (2020) provides guidance to minimise cross-contamination, this includes the following sampling precautions:

- Attention should be given to the range of products that can cause PFAS contamination of samples, including new clothing, footwear, PPE and treated fabrics stain and water-resistant products, sunscreen, moisturisers, cosmetics, fast food wrappers, polytetrafluoroethylene (PTFE) materials (such as Teflon©), sampling containers with PTFE-lined lids, foil, glazed ceramics, stickers and labels, inks, sticky notes, waterproof papers, drilling fluids, decontamination solutions and reusable freezer blocks. These should not be worn or used during any stage of sampling (at site, during transport etc.) where sample contamination could affect analytical results.
- Prior to sample collection, any personnel handling decontaminated soil, sediment, or surface water sampling equipment that directly contacts the environmental media to be sampled must wash their hands with soap and rinse thoroughly in tap water before donning a clean, new pair of disposable nitrile gloves.
- Equipment that contacts soil, sediment, or surface water must not contain or be coated with Teflon® unless the Teflon® is internal to the equipment and does not contact the external environment. Teflon®-coated materials and aluminium foil may not come into contact with the sample.
- Avoid using equipment (such as pumping equipment, water meters, etc.) containing PTFE unless it has been confirmed not to impact water quality.
- During sample processing and storage, minimise the exposure of the sample to light.
- Chemical or gel-based coolant products (e.g. BlueIce®) to maintain samples at 4 °C following sample collection is not recommended.
- For each sample, the required minimum volume of groundwater is 250 mL per USEPA (2009).
- Use polypropylene or HDPE sample containers. Glass containers with lined lids are not suitable for PFAS analysis.
- Equipment recommended for obtaining groundwater samples includes low-flow peristaltic pumps using silicone or HDPE tubing or polypropylene HydraSleeves (or similar products). Consumable sampling equipment must not be reused.
- Avoid the use of labels, stickers and inks unless confirmed to be PFAS-free.
- Surface water must be collected by inserting a sampling container (polypropylene or HDPE) with the opening pointing down and the bottle opened underwater to avoid the collection of surface films.
- Decontamination of sampling equipment must avoid the use of detergents unless they have been confirmed to be PFAS-free. Use tap water (tested to ensure it is PFAS free) or deionised water instead.

8.2.2 Surface Water and Wash Plant

Surface water and Wash Plant samples will be collected using grab techniques, avoiding disturbance of sediment and will be placed directly into clear plastic unpreserved bottle before being transferred into other preserved bottles (as required).

The sampler will record the temperature, dissolved oxygen, pH, redox potential (Eh) and electrical conductivity (EC) and Turbidity in NTU immediately prior to sample collection. The sampler will record calibration details for the water quality meter.

Surface water levels will be recorded from marker posts installed during the initial sampling event to enable better evaluation of the water quality data.

8.2.3 Groundwater

The method of sampling would be determined based on the depth to water and yield of the monitoring bores. As needed, depending on the method of sampling groundwater bores will be purged and sampled during monitoring. Where purging is required, the well will be purged of 3 x the well volume (Bore Vol (L) = (TD mBTOC – DTW mBTOC) x 5. This formula is a simple field calculation to estimate the volume of groundwater within the well casing and surrounding filter pack. (Assumes a 50 mm diameter well and standard sand filter pack).

A water quality meter will be used to measure water quality parameters immediately before groundwater samples are collected. The sampler will record the temperature, dissolved oxygen, pH, redox potential (Eh) and electrical conductivity (EC) and Turbidity in NTU of groundwater. The sampler will record calibration details for the water quality meter.

8.2.4 Wash Plant Fines

A grab sample of concentrated wash plant fines most recently produced (i.e. not subject to excessive rainfall leaching) will be collected from the most suitable location onsite and placed within an appropriate sample container supplied by the laboratory for sampling of PFAS.

8.2.5 Equipment and Analysis

All field equipment used will be inspected and or calibrated daily prior to use. Calibration checks will be conducted as needed during sampling. Key equipment required for sampling includes:

- Water Quality Meter – temperature, dissolved oxygen, pH, redox potential and electrical conductivity (EC) and Turbidity in NTU.
- Water level dipper for groundwater.
- Suitable equipment for groundwater sampling (e.g. well specific bailers, low flow pumping / hydrasleeve etc).
- Water level marker posts.

All surface and groundwater samples will be analysed in a National Association of Testing Authorities (NATA) accredited laboratory. Quality assurance will be undertaken consistent with best practice and include the following quality control samples as appropriate to sampling analysis undertaken: Intra-lab (Duplicate), Inter-lab (Triplicate), Transport Blank and a Rinsate Blank.

8.3 BASELINE WATER QUALITY

Williamtown Sand Syndicate (WSS) engaged Kleinfelder Australia Pty Ltd (Kleinfelder) to undertake a 12 month surface water and groundwater monitoring program to establish baseline conditions. The baseline water quality program collected data on water flow and quality in water bodies and groundwater that could potentially be affected by the site operations.

Groundwater and surface water monitoring was conducted over 12 consecutive months from February 2019 through to January 2020 and was generally completed between the 11th and 18th of each month.

As noted in Section 3, there are no natural permanent flowing surface water drainage lines within the site, and the gradient of water flows within drainage channels on the Subject Land is very low.

The baseline water quality program included the following sites:

- Up to five (5) surface water locations SW1 to SW5 (refer to Section 8.1.2).
- Up to 13 groundwater bores (refer to Section 8.1.1). It is noted that some bores are likely to have restricted access due to root growth within the well, this may result in reduced sampling from some bores. Any reduction in sampling is unlikely to affect obtaining a reliable baseline water quality.

The Baseline Water Quality Report enabled the establishment of Site Specific Trigger Values for a range of analytes. Importantly the baseline water quality report identified some existing low level contamination onsite, ensuring a more reliable assessment of changes due to the quarrying activity alone. Key observations included:

- Low level contaminants in monitoring locations SW1 and BH4 adjacent to Cabbage Tree Road including PFAS and hydrocarbons. [Note. a low level detection in BH9 was detected after the baseline period, possibly related to sample contamination due to bailer sample extraction, no further detections have been observed].
- PFAS detection in SW4, BH6, and BH4 (as noted above).
- Low level metal contamination at BH8, likely associated with the former RZM storage yard, or “graveyard”.
- Higher iron concentrations in the northern half of the site, then southern side of the site.
- Likely contamination errors at BH1 and BH12 due to piezometer repairs that affected hydrocarbon results and potentially metal concentrations.

Based on DPIE’s review of the Baseline Water Quality Characteristics Report, the DPIE requested an extension of the Baseline data collection for the following sites and parameters on a monthly basis to compliment the existing baseline data collection, the following sites and analysis will be completed:

- BH1 and BH12 for TPH, TRH, BTEX.
- BH2, BH4, BH6, BH7, BH9, BH11, MW239S for the full suite of metals (As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn)
- BH2, BH11, MW239S, SW1, SW2, SW4 for PFAS
- BH9, BH11, SW2 for Cations, Anions, Alkalinity, Inorganics, pH

- BH9 was requested to be re-drilled to a more suitable depth at a location down gradient of the site.

Where surface water monitoring sites are dry, no further extension of monitoring is considered necessary. During the 2019 Baseline data collection period, SW2 (a former road depression), did not contain water, it may be previous observations of water in this location where coincidental with rainfall, and it does not constitute a reliable monitoring site.

By the end of 2021 (i.e. 12 months) the additional data collected from the above sites will be compiled into an addendum to the Baseline Water Characteristics Report update Site Specific Trigger Levels.

8.3.1 Baseline Water Characteristics Report

The baseline water characteristics report was prepared for data collected over 12 consecutive months from February 2019 through to January 2020 and was provided to DPIE and is available on the Newcastle Sand website (newcastlesand.com.au), and as **Appendix 6** to this document. The report provides more detailed analysis of the data collected.

An addendum to the report will be prepared by end of 2021 to update the site-specific trigger values and address data gaps identified in the 2020 baseline report.

8.4 WATER MONITORING PROGRAM

Table 17 documents the requirements for an extension to the baseline monitoring requirements at some sites instructed by DPIE as per Schedule 2, condition 4 of the consent in order to fill identified data gaps. The intent is to provide 12 months data on at least the groundwater to ensure there are no unforeseen water quality conditions in surface and groundwater, that has the potential to increase the adopted background trigger values. Surface water sites are more subjective to climatic conditions and may not be feasible to attain a full 12 months of data.

Table 17: Baseline water monitoring data gap monitoring to November 2021

Location	Monthly Baseline Extension to November 2021			
	Full Suite[1]	PFAS [2]	TPH, TRH, BTEX [3]	Metals [4]
BH9A, BH11, SW2*	X			
MW239S, SW1*, SW4*		X		
BH1, BH12			X	
BH4, BH6, BH7, MW239S				X

Location	Monthly Baseline Extension to November 2021			
	Full Suite[1]	PFAS [2]	TPH, TRH, BTEX [3]	Metals [4]
* Note. Surface water sites maybe dry depending on climatic conditions.				
[1] Depth, pH, EC and Full Suite: Ca, Mg, Na, K, pH, EC, Cl, F, SO_4, Alkalinity, Hardness & TDS (Calc'), Nitrate, Nitrite, Ammonia, Reactive Phosphorus, Total Phosphorus, Total Nitrogen, TKN, PFAS suite, TPH, TRH, BTEX, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn.				
[2] Depth, pH, EC and PFAS suite.				
[3] Depth, pH, EC and TPH, TRH, BTEX.				
[4] Depth, pH, EC and Metals: As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn.				

On approval of this SWMP, water quality monitoring will be undertaken consistent with **Table 18** and **Table 19**, along with the monitoring shown in **Table 17**, until the extension baseline monitoring is completed.

Table 18 provides a summary of the ongoing operational monitoring schedule for the site. **Table 19** provides a summary of the proposed testing schedule for the different monitoring events.

Table 18: Operational monitoring schedule

Location	Monthly	Quarterly	Annually
BH2, BH4, BH6, BH7, BH9, BH9A, BH11 and MW239S	X (BH9 until EPL updated, then only depth at BH9)	X (excluding BH9 other than depth)	X (excluding BH9 other than depth)
Wash plant water	X		
Wash plant fines		X	
BH8 SW1, SW2, SW3, SW4		X	X
BH1, BH5, BH12			X

Table 19: Water quality parameter testing schedule

Monthly	Monthly Wash Plant Water	Quarterly	Quarterly Wash Plant Fines	Annually
• Conductivity; • pH; • ORP; • Gauging water depth; • Turbidity (NTU); • Arsenic; • Iron; and • Manganese.	• Conductivity; • pH; • PFAS.	• Gauging water depth all available wells; • Conductivity; • pH; • ORP; • Turbidity; • Nutrients (Total Phosphorus, Total Nitrogen and Ammonia as N); • 8 metals (As, Ba, Cr, Cu, Fe, Mg, Ni and Zn);	• Conductivity; • pH; • PFAS.	• Gauging water depth all available wells; • Conductivity; • pH; • ORP; • General water quality parameters (Ca, Mg, Na, K, pH, EC, Cl, SO_4, Alkalinity, Hardness & TDS); • Nutrients (Total Phosphorus, Total

Monthly	Monthly Wash Plant Water	Quarterly	Quarterly Wash Plant Fines	Annually
		• Additional 2 metals (B and Co) for surface water; • TRH; and • PFAS.		Nitrogen and Ammonia as N); • Turbidity; • Metals (As, B, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Se, V, Zn); • TRH and BTEXN; and • PFAS.

8.5 SITE SPECIFIC TRIGGER VALUES

Site specific trigger values for long-term monitoring during the operation of the sand quarry were developed during baseline monitoring and the initial activities onsite over a range of dry and wet conditions. An exceedance of a trigger value does not necessarily indicate that there is an unacceptable risk on site, but rather a trigger for further investigation or evaluation of management options, as trigger values use baseline data (down to 80th percentile), monitoring results may naturally exceed trigger values. The selection of the trigger value is based on balancing a highly conservative value that is likely to create unnecessary administration and more relaxed values that may not suitable protect the environment. **Section 8.6** provides details on the proposed action response should a trigger value be exceeded.

Table 20 presents the proposed trigger values for groundwater and surface water respectively along with a justification for selecting that value. The trigger values are to be applied to each sample location as stated within the Table. Suitability of these values should be reviewed on conclusion of the Baseline Water Monitoring Period, and when applicable guidelines are updated. Updates to trigger values are subject to DPIE approval.

Nationally accepted water quality guidelines; ANZECC (2000) *Australian and New Zealand Water Quality Guidelines for Fresh and Marine Waters, 80 & 95% species Protection for freshwater,* HEPA NEMP (2020) *PFAS National Environmental Management Plan* and ADWG (2011) *Australian Drinking Water Guidelines 6,* have been considered in developing site specific trigger values.

Additional analysis is conducted beyond those listed with trigger values in the tables below in order to inform understanding of water chemistry at the time of sampling and are not considered necessary to evaluate against trigger value.

Table 20: Site specific trigger values for Groundwater and Surface Water.

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
pH	pH units	4.2 – 6.5	4.2 – 6.5	Groundwater: 4.33-6.29 Surface Water: 3.82-7.29	Site wide	The majority of baseline results were found to be outside the pH range of 6.5-8.0 set in the ANZECC 2000 trigger values for a Lowland river in South-east Australia. The system is an acidic system, likely to vary considerably with groundwater levels especially in the low-lying areas. A range of 4.2 to 6.5 has been adopted across the site, slightly above the groundwater range, but less than the surface water range.
Electrical Conductivity @ 25°C*	µS/cm	500	500	Groundwater: 54 – 489 µS/cm Surface Water: 82 – 1090 µS/cm	Site wide	Concentrations across the Site vary, but on the whole is a freshwater environment, the adopted criteria has been adopted from slightly above the upper bounds of the site sampling data for groundwater, but below and at approximately the 80th percentile value for surface water. It is noted the ANZECC 2000 uses a range of 125 - 2200 for a lowland river in south-eastern Australia. No lower bound has been adopted given the likely negligible effects of changes at the lower bounds, given existing water is very fresh.
Total Phosphorus	mg/L	2	0.17	Groundwater: <0.01 – 2.76 mg/L (excluding outlying result of 31.8 mg/L) Surface Water: 0.01 – 0.17 mg/L	Site wide	The majority of baseline results were found to be elevated above the ANZECC 2000 trigger value of 0.05mg/L for a Lowland river in South-east Australia. It is therefore not considered appropriate to use this criterion. The majority of baseline sample results were less than 2mg/L, however it is noted that the highest value recorded was 2.76mg/L at BH3 (noting one sample event and the well is no longer operational) and 2.11mg/L in BH11. The third highest concentration of 1.97mg/L was located at BH8. The sample locations identified represent a large cross section of the Site therefore represent the likely range that could be expected at the Site. The highest recorded value was adopted for the surface water trigger value.

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
Ammonia as N	mg/L	0.5	0.2	Groundwater: 0.01 – 0.34 mg/L (excluding two outlying results of 0.5 and 0.72) Surface Water: 0.01 – 0.16 mg/L	Site wide	The detected range of <0.01-0.34mg/L (excepting two isolated outliers of 0.5 and 0.72mg/L) and was not found to be elevated above the ANZECC 2000 toxicant value and ADWG. Based on the results obtained it is considered that adopting the 0.5mg/L ADWG provides a logical value for a trigger response or groundwater and a more conservative level of 0.2 mg/L has been adopted to be closer to the maximum observed level. The ANZECC criteria is 0.9 mg/L standardised to pH 8 for 95% species protection, and trigger values increase as pH is reduced, for example at pH 6.0 the toxicant trigger value increases to 2.57 mg/L.
Total Nitrogen as N	mg/L	5.9	5.9	Groundwater: 0.3 – 5.9 mg/L (excluding outlying results of 85.5mg/L) Surface Water: 0.1 – 2.4 mg/L	Site wide	Results from the majority of locations were generally found to be elevated above the ANZECC 2000 trigger values, with the exception of BH1 where concentrations were recorded to be marginally lower than the initial criteria. The highest concentrations were recorded in BH11 (considered to be up hydraulic gradient of the Site) and BH2 located centrally on Site. Concentrations as high as 2.2mg/L (in BH7) were identified at locations down/ cross hydraulic gradient of the Site. It is evident that concentrations of Nitrogen can be found naturally across the Site and can be varied over time. Concentrations of Total Nitrogen are not expected to be elevated above the highest recorded value of 5.9mg/L, as such it adopted as the trigger value, noting trend analysis will aid in determining potential significant changes in water quality.

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
Turbidity	NTU	NA	1826	Groundwater: 0 – 3681 NTU Surface Water: 0 – 2474 NTU	All sites except SW1	A high degree of variability exists in turbidity values in the groundwater onsite given the difficulty in obtaining insitu samples without disturbing side walls of the 50mm piezometers. Criteria from ANZECC 2000 for a lowland river is south-eastern Australia is 6-50 NTU and applicable to surface water to assess associated light penetration and potential changes in sedimentation and associated ecological productivity. Surface water monitoring sites are relatively stagnant in nature throughout most of the year excepting during periods of high rainfall and associated natural surface water runoff. During high rainfall turbidity increases to over 1,100 NTU for SW1, SW3 and SW4. Outside these periods of high rainfall levels can range from less than 10 NTU to over 50 NTU. SW1 typically has the highest turbidity, likely owing to its proximity to impervious areas associated with Cabbage Tree Road and the resultant increase in surface runoff. Given difficulties in obtaining representative groundwater turbidity and minimal environmental risk associated with changes in turbidity, no trigger has been set for groundwater. The upper limit of recorded levels have been adopted for surface water sites, with SW1 split out from the others given the increased runoff.
			2474		SW1	

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
Dissolved Metals						
Arsenic	mg/L	0.003	0.006	Groundwater: <0.001 – 0.003 mg/L Surface Water: <0.001 – 0.006 mg/L	Site wide	Arsenic was not detected within the majority of groundwater locations with the exception of BH8 recording a maximum concentration of 0.003 mg/L. Previous monitoring by RCA in 2015, recorded 0.005 mg/L at BH8. Surface water samples (SW3 and SW4) from the excavated drainage channel show the highest and most frequent detections onsite. The ADWG limit for Arsenic is 0.01mg/L. The adopted trigger value has been taken as the maximum value obtained throughout the last 12 month baseline monitoring period which is more conservative than the ADWG for both surface water and groundwater.
Barium	mg/L	0.07	0.08	Groundwater: <0.001 – 0.07 mg/L Surface Water: <0.001 - 0.08 mg/L	Site wide	All results for Barium were found to be above the LOR. The highest concentration recorded was in BH6 (considered to be up/ cross hydraulic gradient of the Site). The highest level in surface water was recorded in SW3. The ADWG limit is 2 mg/L. The adopted trigger values have been taken to be one significant figure above the highest concentration, which are substantially lower than the ADWG.
Beryllium	mg/L	0.002	0.002	Groundwater: <0.001 mg/L Surface Water: <0.001 mg/L	Site wide	All results for Beryllium were found to be below the LOR of 0.001 mg/L. The ADWG limit is 0.06 mg/L. The adopted trigger value is twice the LOR and substantially less than the ADWG limit.
Boron	mg/L	0.10	0.10	Groundwater: <0.05-0.06 mg/L Surface Water: <0.05 - 0.14 mg/L	Site wide	The majority of results for boron in groundwater have been below the LOR, while surface water shows highest concentrations at SW1 adjacent to Cabbage Tree Road. The ADWG limit is 4 mg/L. The adopted trigger value is the 80th percentile level of surface water results, which is substantially lower than the ADWG limit.

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
Cadmium	mg/L	0.0002	0.0002	Groundwater: <0.0001 – 0.0002 mg/L Surface Water: <0.0001 – 0.0002 mg/L	Site wide	The majority of results for cadmium in groundwater and surface water have been below the LOR. Highest levels are near Cabbage Tree Road and former RZM machinery yards. The ADWG limit is 0.002 mg/L. The adopted trigger value is the maximum level measured onsite, which is 1/10th the ADWG limit.
Chromium (Cr IV)	mg/L	0.004	0.004	Groundwater: <0.001 – 0.004 mg/L Surface Water: <0.001 – 0.006 mg/L	Site wide	All locations have recorded concentrations of chromium at or marginally above LOR at varying times, with the majority of results below LOR of 0.001 mg/L. The ADWG limit is 0.05 mg/L. The adopted trigger value has been taken as the maximum value obtained throughout the baseline monitoring period, excluding one surface water sample at 0.006 mg/L. The trigger value is substantially more conservative than the ADWG.
Cobalt	mg/L	0.006	0.006	Groundwater: <0.001 – 0.003 mg/L Surface Water: <0.001 – 0.017 mg/L	Site wide	Several groundwater sites have recorded levels above the LOR, however the majority of samples taken are below the LOR of 0.001 mg/l, it is more likely to be present above LOR in surface waters and at its highest in SW1. The adopted criteria is the 80th percentile of sample results for surface water.
Copper	mg/L	0.083	0.033	Groundwater: <0.001 – 0.083 mg/L Surface Water: <0.001 – 0.033 mg/L	Site wide	Copper is generally higher in the south western portion of the monitoring network with the highest levels at BH4 and BH2. Within surface water concentrations varying between sites, but with highest at SW4. The ADWG limit is 2 mg/L. The adopted trigger value has been taken as the maximum values obtained throughout the baseline monitoring period. The trigger value is substantially more conservative than the ADWG.
Iron	mg/L	4.1	7.25	Groundwater: 0.05 – 4.1 (excluding up to 13 mg/L at BH1)	All sites except those stated below	Iron concentrations are highest (up to 32 mg/L) in the excavated drainage channels (SW3, SW4), compared with natural surface water pooling at SW1 and SW2 (maximum
		-	32		SW3, SW4	

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
		8.84	-	Surface Water: 0.1 – 32 mg/L	BH1	of 7.25 mg/L. This is likely due to wetting and drying cycles of the iron sulphides exposed within the low lying channels. BH1 is expected to have been contaminated by metal filings or fragments during well repair activities, with iron, zinc, nickel and chromium elevated, particularly at the start of the monitoring program and closest to when repair works were completed. The third highest value was adopted for the trigger at BH1 (assumes initial high values are directly related to repair works). There is no health based guideline set for iron in the ADWG or trigger value in ANZECC 2000.
Lead	mg/L	0.001	0.003	Groundwater: <0.001 – 0.001 mg/L Surface Water: <0.001 – 0.003 mg/L	Site wide	The majority of results for lead in groundwater and surface water have been below the LOR, the highest values have been recorded at SW1 adjacent to Cabbage Tree Road. The ADWG limit is 0.01 mg/L. The adopted trigger value is the maximum level measured onsite that are substantially lower than the ADWG limits.
Manganese	mg/L	0.136	0.841	Groundwater: 0.002 – 0.136 mg/L Surface Water: 0.003 – 0.841 mg/L	Site wide	Manganese is consistently present within surface water and groundwater. The highest levels were measured in SW1 and BH4 adjacent to Cabbage Tree Road. The ANZECC 2000 criteria is 1.9 mg/L, while the ADWG limit is 0.5 mg/L. Given the maximum levels measured onsite are substantially lower than relevant guidelines, the maximum levels have been adopted as the trigger value.
Mercury	mg/L	0.0001	0.0001	Groundwater: <0.001 mg/L Surface Water: <0.001 mg/L	Site wide	Mercury has not been detected above the LOR of 0.0001 mg/L at any site in surface water or groundwater. The ADWG limit is 0.001 mg/L. The adopted trigger value is the set at the LOR (i.e. detection).

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
Nickel	mg/L	0.02	0.02	Groundwater: <0.001 – 0.07 mg/L Surface Water: <0.001 – 0.02 mg/L	Site wide	Nickel in surface water is regularly detected above LOR and varies in concentration between sites and over time. The highest levels were at SW1. Nickel is routinely detected in groundwater, with the highest level detected in BHLL upgradient of the quarry, followed by BH3 and BH4. The ADWG limit is 0.02 mg/L, and ANZECC 2000 95% level is 0.011 mg/L. Nickel has been detected across the site at levels above both ANZECC and ADWG. The trigger level has been adopted at the ADWG level of 0.02 mg/L.
Selenium	mg/L	0.01	0.01	Groundwater: <0.01 mg/L Surface Water: <0.01 mg/L	Site wide	Selenium has not been detected above the LOR of 0.01 mg/L at any site in surface water or groundwater. The ADWG limit is 0.01 mg/L. The adopted trigger value is the set at the LOR (i.e. detection).
Vanadium	mg/L	0.01	0.01	Groundwater: <0.01 mg/L Surface Water: <0.01 mg/L	Site wide	Vanadium has not been detected above the LOR of 0.01 mg/L at any site in surface water or groundwater. No limit is set within ANZECC or ADWG guidelines. The adopted trigger value is the set at the LOR (i.e. detection).

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
Zinc	mg/L	0.085	0.535	Groundwater: <0.005 – 0.085 mg/L (excludes values of 1.27 mg/L, 0.362, 0.132 and 0.116 at BH1) Surface Water: <0.005 – 0.535 mg/L (excludes one value of 1.82 mg/L at SW4)	All sites except those stated below	Zinc was generally highest within SW1 (up to 0.535 mg/L) adjacent to Cabbage Tree Road seemingly associated with low water levels, excepting one anomalous value (assumed to be in error) of 1.82 mg/L that was measured at SW4 in April 2020 outside the baseline period. A level of 0.535 mg/L has been adopted for surface water. BH1 is expected to have been contaminated by metal filings or fragments during well repair activities, with iron, zinc, and chromium elevated, particularly at the start of the monitoring program and closest to when repair works were completed, the levels then trended down until significant rainfall events in February (0.652 mg/L) and March 2021 (0.596 mg/L) appeared to result in substantial increases. A trigger value slightly above the second highest value measured during the baseline period has been adopted, acknowledging the somewhat unpredictable changes in concentration. Aside from BH1, the highest zinc levels in groundwater have occurred at BH7. This maximum level has been adopted for the trigger value for groundwater. There is no health based ADWG limit for zinc, with aesthetic criteria set at 3 mg/L. The ANZECC 2000 80% level is 0.031 mg/L. Zinc is routinely detected across the site at levels substantially above ANZECC 80% levels, as such values approaching the maximum levels have been adopted.
		0.1	-		BH1	

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
Cations and Anions						
Sodium	mg/L	77	142	Groundwater: 4 – 77 mg/L Surface Water: 6 – 142 mg/L	Site wide	All surface water sites show varying concentrations of sodium above the LOR, with the highest levels recorded in SW1 during low rainfall conditions. Like surface water all boreholes show varied concentrations of sodium, with the highest levels at BH4, and MW239S. No specific ADWG or ANZECC level set. The highest recorded level has been adopted as the trigger value.
Calcium	mg/L	5	40	Groundwater: <1.0 – 5 mg/L Surface Water: <1.0 - 40 mg/L	Site wide	BH2, 4 and 6 routinely record levels above LOR, while other wells often have levels below the LOR. Within surface water the highest levels are recorded within SW1. No specific ADWG or ANZECC level set. The highest recorded level has been adopted as the trigger value.
Magnesium	mg/L	11	52	Groundwater: <1.0 – 11 mg/L Surface Water: 1.0 - 52 mg/L	Site wide	SW1 has the highest magnesium levels particularly during low rainfall conditions. Within groundwater the highest levels have been recorded in MW239S, while the lowest are typically in BH1 and BH2. No specific ADWG or ANZECC level set. The highest recorded level has been adopted as the trigger value.
Potassium	mg/L	2	8	Groundwater: <1.0 – 2 mg/L Surface Water: 1.0 – 8 mg/L	Site wide	Potassium in groundwater is frequently below the LOR of 1.0 mg/L, with BH6 and BH7 the only wells routinely recording levels at or slightly above the LOR. Within surface water, the highest levels are recorded within SW1 and SW4. No specific ADWG or ANZECC level set. The highest recorded level has been adopted as the trigger value.

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
Sulphate	mg/L	70	324	Groundwater: <1.0 – 41 mg/L (excluding one irregular value of 70 mg/L at BH8) Surface Water: 5 – 324 mg/L	Site wide	Highest levels in groundwater are typically at BH9A, BH4 and MW239S, with lowest levels routinely at BH1. Within surface water highest levels have been recorded in SW1 during low rainfall conditions. No specific ADWG or ANZECC level set. The highest recorded level has been adopted as the trigger value.
Chloride	mg/L	148	234	Groundwater: 10 – 148 mg/L Surface Water: 7 – 234 mg/L	Site wide	Highest levels in groundwater are typically at MW239S, with lowest levels routinely at BH1. Within surface water highest levels have been recorded in SW1 during low rainfall conditions. No specific ADWG or ANZECC level set. The highest recorded level has been adopted as the trigger value.
Fluoride	mg/L	0.2	0.8	Groundwater: <0.1 – 0.2 mg/L Surface Water: <0.1 – 0.8 mg/L	Site wide	The highest level for surface water was detected in SW4, followed by frequent high levels in SW1 during low rainfall conditions. Fluoride is typically highest in groundwater at BH7. ADWG sets a level of 1.5 mg/L, with no specific level set by ANZECC 2000. Key fluoride sources in the local area are likely to be associated with fallout from the Tomago Aluminium Smelter to the west of the site and seawater influence. The HWC potable water typically sets a level of 1 mg/L. The highest recorded level has been adopted for fluoride in surface water and groundwater, that are more conservative than ADWG.

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
Hydrocarbons						
TRH C_6 – C_{10} OR C_6 - C_{10} minus BTEX (F1)	µg/L	20	20	Groundwater: <20 µg/L (Excluding values of 30 and 1690 mg/L recorded at BH1 following well repair work) Surface Water: <20 µg/L	Site wide	Concentrations of TRH were identified to be below the LOR for the majority of monitoring with exceptions to BH1, BH4 and BH11. At BH1 this occurred following well repair work, where light fraction hydrocarbons were detected in two samples after the repair works. At BH4 (near Cabbage Tree Road and original site access road and intersection with Cabbage Tree Road) detections of the fraction generally associated with diesel (C_{16} – C_{34}) typically occur following rainfall and are expected to be the result of previous accidents, road runoff, or other past uses of this area, being flushed into the groundwater. The median detected concentration has been adopted as the trigger for BH4 acknowledging the past contamination. At BH11 (located upgradient of the quarry) two samples have returned concentrations for fractions generally associated with diesel (C_{16} – C_{34}), these have been isolated and cause is unknown (or are result of isolated contamination during sampling). ANZECC and the ADWG do not have any set criteria for these hydrocarbons fractions. Based on the understanding of the above, generally TRH is not identified within the groundwater or surface water across the Site. The Laboratory LOR has therefore been adopted as trigger values unless otherwise shown.
TRH C_{10} – C_{16} OR TRH C_{10} - C_{16} minus N (F2)	µg/L	100	100	Groundwater: <100 µg/L Surface Water: <100 µg/L	Site wide	
TRH C_{16} – C_{34}	µg/L	100	100	Groundwater: <100 - 700 µg/L Surface Water: <100 µg/L	Site wide (except BH4)	
		295	-		BH4	
TRH C_{34} - C_{40}	µg/L	100	100	Groundwater: <100 µg/L Surface Water: <100 µg/L	Site wide	

Analyte	Units	Adopted Site specific ground-water trigger value	Adopted Site specific surface water trigger value	Site wide surface and groundwater range	Location	Justification
PFAS						
Sum of PFOS+ PFHxS	µg/L	0.07	0.07	Groundwater: <0.01 µg/L Surface Water: <0.01 -0.07 µg/L	Site wide	PFAS analytes have been detected as follows: • For 3 of 5 samples for 12 months to January 2020 (or 12 of 16 samples to March 2021), the Sum of PFOS + PFHxS has been detected above LOR at SW4. • On 1 occasion for 12 months to January 2020 (or 2 occasions to March 2021) the Sum of PFOS + PFHxS has been detected above LOR at SW1. • 6:2 FTS has been detected on one occasion in BH9 (0.14 µg/L in August 2020, possibly related to sample method) and BH6 on one occasion (0.19 µg/L in December 2019). • PFDS has been detected on one occasion in BH4 (0.02 µg/L in September 2019). SW4 is located within an excavated drainage channel on the eastern extent of the site nearing areas of known higher PFAS concentrations associated with the Department of Defence site at Williamtown. Of the twelve detections of PFAS at SW4, they have comprised the following PFAS analytes at or above the LOR: • On 12 occasions this was Perfluorooctane sulfonic acid (PFOS) to a maximum of 0.05 µg/L (September 2019). • On two occasions Perfluorohexane sulfonic acid (PFHxS) was detected in addition to PFOS to a maximum of 0.03 µg/L (January 2021). SW1 is located adjacent to Cabbage Tree Road, on two occasions PFOS has been detected above LOR to a maximum of 0.02 µg/L (January 2020). The HEPA NEMP (2020) is the recognised national guidance for the investigation and management of PFAS in Australia. The NEMP 2020 guideline for drinking water and human health investigation levels for soil have been adopted for trigger values. For wash plant sediments, the HEPA NEMP (2020) for a residential setting with garden/accessible soil (HIL A) land use type owing to the low potential of the sands to be used in a residential setting and exposed nature of the final land use. It should be noted that the majority of washed sands are likely to be used and bound in concrete.
	mg/kg	<u>Wash Plant Sediments Only</u> 0.01 mg/kg		Nil	Wash plant sediments	
PFOA	µg/L	0.56	0.56	Groundwater: <0.01 µg/L Surface Water: <0.01 µg/L	Site wide	
	mg/kg	<u>Wash Plant Sediments Only</u> 0.1 mg/kg		Nil	Wash plant sediments	
Other PFAS	µg/L	NA	NA	PFDS (<0.02-0.02) 6:2 FTS (<0.05-0.19)	Site wide	

8.6 TRIGGER RESPONSE ACTIONS

Trigger values for the majority of analytes are provided in **Table 20** above. The following actions should be followed where analysis finds concentrations above the stated trigger values.

8.6.1 pH, EC, Metals, Ions & Nutrients

The following provides details on the response action required should an analyte concentration be found above the adopted trigger value:

1. Review data validity and context:
    a. Are concentrations outside range of previous monitoring data (see **Table 20**);
    b. Question result with the laboratory to determine if there were any laboratory errors;
    c. Record in the Sampling Report what operations that may cause the elevated concentration have been undertaken in the preceding period and the context to the sample location (e.g. up gradient/ down gradient and proximity); and
    d. Record in the Sampling Report the rainfall data and groundwater elevations and comment on potential for concentration change to be due to seasonal adjustments.
2. Where the result (confirmed by laboratory) is significantly above (e.g. more than 5x) the LOR and previous site-wide maximum (see **Table 20**) **AND** there is cause to suggest it may be related to quarrying activities, undertake followup sampling at the affected location for the analyte within 72 hours of receiving the first analysis.
3. Where the 72 hour followup sampling is not required (as per 2 above), but the result is above trigger value, re-sample location and elevated analyte in the following monitoring round to gauge if the previous exceedance was an isolated occurrence potentially due to unknown sampling error, laboratory error, an isolated natural change or may be symptomatic of broader changes in water quality.
4. Where two consecutive samples are:
    a. **ABOVE** the adopted trigger value, **BUT LESS** than previous data, this may suggest an incorrectly set trigger value that does not fully account for seasonal changes. Consider updating trigger value at next management plan update.
    b. **ABOVE** the adopted trigger value **AND** previous data this may indicate a more significant change in water quality and a Water Trigger Investigation will be undertaken in accordance with **Section 8.6.4**.

8.6.2 Hydrocarbons

The following provides details on the response action required should an analyte concentration be found above the adopted trigger value:

1. Review data validity and context:
    a. Are concentrations outside range of previous monitoring data (see **Table 20**);
    b. Question result with the laboratory to determine if there were any laboratory errors;
    c. Record in the Sampling Report what operations that may cause the elevated concentration have been undertaken in the preceding period and the context to the sample location (e.g. up gradient/ down gradient and proximity); and

d. Record in the Sampling Report the rainfall data and groundwater elevations and comment on potential for concentration change to be due to seasonal adjustments.

2. Where the result (confirmed by laboratory) confirms hydrocarbons are present (except at BH4) **AND** there is cause to suggest it may be related to quarrying activities, undertake followup sampling at the affected location for the analyte within 72 hours of receiving the first analysis:
   - Where TRH C_6 to C_{10} has been detected then BTEXN will also be analysed; and/or
   - Where TRH C_{16} to C_{40} has been detected then PAH will also be analysed.
3. Where two consecutive samples are:
   a. **ABOVE** the adopted trigger value **AND** for BH4 its previous data, this may indicate a significant change in water quality and a Water Trigger Investigation will be undertaken in accordance with **Section 8.6.4**.
4. Where a spill or potential pollution incident event has occurred that has the potential for material environmental harm (as deemed by the Quarry Manager), then sampling (or re-sampling) at the closest (down hydraulic gradient) location will be undertaken within 48 hours. An incident investigation in accordance with **Section 8.6.4** will be completed.

8.6.3 PFAS

The following provides details on the response action required should an analyte concentration be found above the adopted trigger value:

1. Review data validity and context:
   a. Are concentrations outside range of previous monitoring data (see **Table 20**);
   b. Question result with the laboratory to determine if there were any laboratory errors;
   c. Record in the Sampling Report what operations that may cause the elevated concentration have been undertaken in the preceding period and the context to the sample location (e.g. up gradient/ down gradient and proximity); and
   d. Record in the Sampling Report the rainfall data and groundwater elevations and comment on potential for concentration change to be due to seasonal adjustments.
2. Where the result (confirmed by laboratory) confirms PFAS is present at more than 2x the LOR (except at SW1 and SW4) **AND** there is cause to suggest it may be related to quarrying activities, undertake followup sampling at the affected location for the analyte within 72 hours of receiving the first analysis.
3. Where not significantly above, re-sample location and elevated analyte in the following monitoring round to gauge if result was an isolated occurrence potentially due to unknown sampling error, laboratory error, an or may be symptomatic of broader changes in water quality.
4. Where two consecutive samples are:
   a. **ABOVE** the adopted trigger value, **BUT LESS** than previous data range, this may suggest an incorrectly set trigger value, that does not fully account for the existing background environment. Consider updating trigger value at next management plan update.
   b. **ABOVE** the adopted trigger value **AND** previous data this may indicate a significant change in water quality and a Water Trigger Investigation will be undertaken in accordance with **Section 8.6.4**.

8.6.4 Water Trigger Investigation

Upon identifying the need to undertake a Water Trigger Investigation, Hunter Water Corporation (HWC), NSW Environmental Protection Agency (EPA) and Department of Planning Industry and Environment (DPIE) will be notified within 24 hours of receiving the results, with a subsequent written notice of the investigation within seven (7 days).

The need to complete a Water Trigger Investigation **does not indicate** that a notifiable incident has occurred. It is important to note that the quarrying activity introduces a limited range of potential contaminates into the site and that many trigger values, while set, are unlikely to be feasibly changed by the quarrying activity.

The water trigger investigation will evaluate the following:

- A review of the site conceptual site model to understand the risk potential (to people and the environment) of the exceedance;
- Identify the potential for other sources to be present that may require confirmatory sampling (and include intrusive investigation if considered appropriate);
- Recent climate and rainfall data;
- Groundwater and surface water levels;
- Other activities (not associated with the quarry) within the catchment (both on and off the Site) in the preceding period;
- Operational activities of the quarry in the preceding period; and
- Historical potential for those quarry activities to cause exceedance.

Where additional sampling is required the Water Trigger Investigation report will be submitted to HWC, EPA and DPIE within 30 days. The report will also be summarised in the Annual Review.

Where the Water Trigger Investigation Report determines changes are likely due to the quarry activities and an incident has occurred, the required incident reporting and notification procedures as outline in Section 7.14 will be followed.

8.7 SURFACE WATER DISCHARGES

The are no surface water discharges proposed or expected to be required for the operation of the project.

The water management system is designed based on the high infiltration capacity of the sand onsite, as such no discharge from site is expected.

In the event of a discharge occurring, the incident is required to be immediately notified if there is a risk of ‘material harm to the environment’ refer to **Section 7.14**.

8.8 THE EFFECTIVENESS OF THE WATER MANAGEMENT SYSTEM

The effectiveness of the water management system will be monitored by assessing the following:

- Accuracy of the site water balance and adjusting this plan accordingly to meet actual use.
- Containment of sediments within the boundary of the resource area.
- Containment of contaminants within bunded areas.
- Surface and groundwater monitoring results that show negligible change in quality or quantity due to the presence of the quarry.

8.9 REVIEW OF PFAS EXPOSURE PATHWAYS

Consistent with Schedule 5, Condition 48 of the Consent an annual review of PFAS exposure pathways will be completed by a suitably qualified and experienced independent expert approved by DPIE.

This PFAS exposure review will include a review of analytical results from the quarry's monitoring wells as well as considering any publicly available results from nearby wells monitored as part of Defence's On-going Monitoring Plan (OMP) for RAAF Williamtown, which may include data from the following Defence OMP wells:

- MW139
- MW177
- MW241
- MW107S-D

The PFAS Exposure Review will be placed on the website and included in the AEMR.

In addition to the above annual PFAS exposure review, where monitoring undertaken in this plan identifies potential changes in PFAS levels as per **Section 8.6.3**, DPIE will be notified and a Water Trigger Investigation undertaken as per **8.6.4**, and if potentially related to quarrying activities an Incident Investigation and Corrective Action Report will be completed.

9. REPORTING

9.1 MONITORING SUMMARY

In order to assess the success of management controls identified in **Section 7**, a number of monitoring programmes have been developed.

Table 21: Monitoring summary

Item	Monitoring Action	Timing	Responsibility	Reporting
A	Baseline Water Quality data gap monitoring as per **Table 17**.	Until November 2021 or 12 months of groundwater data	Quarry Manager	Results included in AEMR.
B	Surface and groundwater quality monitoring as per **Table 18** and **Table 19**.	As per **Table 18** and **Table 19**.	Quarry Manager	Results included in AEMR.
C	Wash plant process water and fines	As per **Table 18** and **Table 19**.	Quarry Manager	Results included in AEMR.
D	Review monitoring data against Site Specific Trigger Values and Actions as per **Section 8.6**.	Monthly on receipt of the laboratory analysis.	Quarry Manager	Monthly monitoring letter.
E	Erosion and sediment controls will be inspected to ensure performance is maintained.	Monthly and after a major rainfall event (e.g. 24 hour rainfall to 9am above 100 mm at Williamtown BOM).	Quarry Manager	Register of monthly / post major rainfall inspections.
F	General hydrocarbons management site inspections to identify potential leaks and any issues.	Weekly	Quarry Manager	Nil
G	Appropriate maintenance schedules for taps, toilets, plant and equipment must be followed to detect and repair leaks.	Ongoing	Quarry Manager	Register of equipment maintenance
H	Coagulant and flocculant use.	Monthly	Quarry Manager	Results included in AEMR.
I	HWC network water use.	Quarterly	Quarry Manager	Results included in AEMR.

NEWCASTLE SAND

9.2 REPORTING

The following soil and water items will be reported and/or recorded during the project:

Table 22: Reporting Requirements

Item	Report	Trigger	Responsibility	Reporting Authority
A	Baseline Water Characteristics Report that includes: • Statistical distribution of sampling results at each location. • Sites with potential to be influenced by initial construction activities. • Statistical distribution of sampling results considered to be unaffected by construction. • Comment on suitability of sites, frequency and analytes for ongoing monitoring.	Following the 12 months of monitoring	Quarry Manager	Internal / DPIE **COMPLETED**
B	Addendum to Baseline Water Characteristics Report	November / December 2021	Quarry Manager	Internal / DPIE
C	Water Trigger Investigation Report	Trigger Response Actions as per **Section 8.6.**	Quarry Manager	HWC, EPA, DPIE – within 24 hours
D	Incident Notification	Following identification of a non-compliance.	Quarry Manager	HWC, EPA, DPIE – within 24 hours
E	Material Harm Notification to potentially affected stakeholders	Incident that has resulted in or has potential to result in material impact to environment.	Quarry Manager	HWC, EPA, DPIE – within 24 hours
F	Incident Investigation and Corrective Action Report	Incident Notification Completion	Quarry Manager	HWC, EPA, DPIE – within 7 days
G	Monthly Inspection Report	Following monthly internal inspections	Quarry Manager	Internal
H	Three-yearly Independent Environmental Audits	Following three-yearly independent audit	Quarry Manager	DPIE
I	Annual Environmental Management Report (AEMR). AEMR to include: • Summary of all soil and water monitoring results and management actions undertaken in the 12-month period;	Annually at time agreed with DPIE	Quarry Manager	DPIE

Item	Report	Trigger	Responsibility	Reporting Authority
	• Summary of any soil or water non-compliances recorded in the 12-month period; • Summary of any soil or water - related complaints recorded in the 12-month period; • Summary of corrective actions and improvements to reduce impacts to soil and water. • Review of the site water balance. • Volume of water drawn from the HWC network. • Quantity of flocculant and coagulant used, including estimate of concentration based on tonnes washed. • Volume of water transferred from site (e.g. septic / bunded water capture). • Comparison with estimated water use (Section 5.2). Where more than 20% above estimated maximum, review water usage areas and investigate methods to minimise usage where feasible. AEMR will be uploaded to Project website within two weeks of final report being issued.			

10. REFERENCES

AECOM, 2017. RAAF Williamtown: Environmental Site Assessment, 2017. Report for Dept. of Defence. Available: http://www.defence.gov.au/Environment/PFAS/Williamtown/publications.asp

ANZECC 2000. *Australian and New Zealand Guidelines for fresh and marine water quality: National Water Quality Management Strategy, 2000,* Australian and New Zealand Environmental Conservation Council: Agriculture and Resources Management Council of Australia and New Zealand (ANZECC).

NSW Department of Primary Industries (2012). *NSW Aquifer Interference Policy: NSW Government policy for the licensing and assessment of aquifer interference activities*. NSW Government.

Brusseau, ML., Yan, N., Van Glubt, S., Wang, Y., Chen, W., Lyu, Y., Dungan, B., Carroll, KC., and Omar Holguin, F. 2018. *Novel methods for measuring air-water interfacial area in unsaturated porous media*. Water Res. 2019 Jan 1; 148: 41–50. Published online 2018 Oct 15.

Catchments & Creeks Pty Ltd, April 2010, *Check Dam Sediment Traps*, Version 2. Accessed at https://www.catchmentsandcreeks.com.au/index.html

Catchments & Creeks Pty Ltd, April 2010, *Construction Exits – Vibration Grids*, Version 2. Accessed at https://www.catchmentsandcreeks.com.au/index.html

Catchments & Creeks Pty Ltd, April 2010, *Sediment Fence*, Version 2. Accessed at https://www.catchmentsandcreeks.com.au/index.html

CRC Care, 2018. PFAS practitioner guide. https://www.crccare.com/files/dmfile/CRCCARETechreport43_PFASpractitionerguide_web.pdf

DECC 2008. *Managing Urban Stormwater: Soils and Construction, Volume 2E Mines and quarries, 2008, Department of Environment and Climate Change NSW in association with the Sydney Metropolitan Catchment Management Authority, New South Wales Government*.

FSANZ, 2017. Health Based Guidance Values for PFAS for Use in Site Investigations in Australia. https://www.health.gov.au/internet/main/publishing.nsf/Content/2200FE086D480353CA2580C900817CDC/$File/fs-Health-Based-Guidance-Values.pdf

HEPA (2020) PFAS National Environmental Management Plan, Version 2.0 (PFAS NEMP 2.0) https://www.environment.gov.au/system/files/resources/2fadf1bc-b0b6-44cb-a192-78c522d5ec3f/files/pfas-nemp-2.pdf

Kleinfelder 2020. *Newcastle Sands Baseline Water Quality Summary Report* prepared for Williamtown Sand Syndicate Pty Ltd. 14 September 2020.

Landcom 2004. Managing Urban Stormwater: Soils and Construction Volume 1 4th Edition, March 2004, Landcom, New South Wales Government. (The Blue Book)

National Health and Medical Research Council Australian Drinking Water Guidelines 2018.

NSW Government. *Environmental Planning and Assessment Act 1979*. Accessed at www.legislation.nsw.gov.au

NSW Government. *Hunter Water Regulation 2015 Part.2 Special Areas: Tomago Sandbeds Catchment*. Accessed at www.legislation.nsw.gov.au

NSW Government. *Water Management Act 2000*. Accessed at www.legislation.nsw.gov.au

NSW Government. Water Sharing Plan for the Tomago-Tomaree-Stockton Groundwater Sources 2003.

Tomago-Tomaree-Stockton Groundwater Management Plan 1996.

APPENDIX 1: REGULATORY CONSULTATION

Table 23: Summary of agency correspondence and issue resolution

Correspondence	Comment	Response
Letter sent to HWC 15 February 2019	*Response on 18 March 2019* • Clean water minimisation. Provide comment and clarification on the ways in which the project will minimise the use of potable water resources and alternatives to potable water use. • Potable Water Supply. Preliminary servicing advice was for lower volumes of water that is specified in the plan for the peak water usage. If these higher volumes are required a new application is required. • Stormwater Runoff from Roads. Further information is required on management of hydrocarbons from roads and controls to ensure that the check dams that use jute/coir are replaced prior to failure. • Maximum Extraction Depth Report (MEDR). Figure 1 and 2 of the MEDR does not display correctly. • Otherwise the MEDR is adequate.	• Amendment to Section 4.2 to include consideration dust suppressants and additional sealing of roads. • Annual review of water use and opportunities for reduction. • Clarification and justification of stormwater controls from haulage roads in Section 5.1.2. • Method to maintain and replace check dams, and preference to gravel filled bags where required use exceeds 2 years. • Figure 1 and 2 of the MEDR improved.

Clarification Email to HWC 4 April 2019	*Response by email on 16 April 2019*
	• *Question. What is available potable water for use on the site.*
	  ○ HWC Response. The connection is to a DN300 watermain directly from the Tomago Water Pump Station, there is no issue in terms of accessing required peak water use, new application would need to justify use.
	• *Question. Does HWC have a list of preferred products or any guidance on use or restriction of polymer sealants etc (e.g. RST products, GRT products, Wet Earth etc) within the Sand Beds area for the purpose of reducing potable water use.*
	  ○ HWC Response. No preferred products or guidance. The different options should be considered on their merit, with the sensitive location of the site taken into consideration.
	• *Question. What is expectation with respect to the dirty water from haulage roads, what is the expectation in that regard, especially in regards to hydrocarbons given the limited controls on other roads in the sand beds.*	

Correspondence	Comment	Response
	○ HWC Response. The stormwater management plan was a bit ambiguous in terms of what was considered to be dirty water, and what the treatment/management measures were intended to treat. Clarification would be valuable, with justification provided for why the chosen measures are considered appropriate given the location and acceptable practice in similar circumstances.	
Letter sent to EPA 15 February 2019	• Nil received.	• Nil required.
Letter sent to DPI Water 15 February 2019	• Recipient forwarded to Natural Resource Regulator (formerly DPI Water) water.referrals@nrar.nsw.gov.au • No response received.	• Nil required.
Email from Department of Planning and Environment 24 May 2019.	• Overall the Soil and Water Management Plan (SWMP) is a good document. Here are review comments that you must address and submit a revised SWMP for approval.	• Noted
	• 1. Page 19, first line of last paragraph – typo for "Norther(n)".	• Corrected
	• 2. Page 27, Section 4.2, third dot point – missing word (probably watering) after tube stock.	• Corrected – missing word as suggested.
	• 3. Page 28, section 4.2.2.1 – please use plain English- I have absolutely no idea what is meant by the last paragraph in this section.	• Paragraph removed. Wording adjusted to reflect the need to assess and justify the existing or proposed dust suppression options.
	• 4. Page 33, Section5.1.3, last paragraph. I don't understand what is being said in this paragraph. How would the shallow infiltration areas adjacent to the road be used as a source of dust suppression water? Firstly why would it not simply soak into the underlying sands?, and secondly, should in stay by the side of the road , how would the water be transferred into the water supplies used for dust suppression?	• Assumption is correct, paragraph deleted.
	• 5. Page 38, Section 5.2.3.3, last dot point – typo – debri(s).	• Corrected.

Correspondence	Comment	Response
	• 6. Page 53, Section 7.14. The reporting of incidents must be consistent with the conditions of consent which means immediately. I dislike the use of the word "suggest" in "Where monitoring or landowner complaints suggest the project is non-compliant. Please refer to the definition of "Incident" in the Definitions section of the consent and the requirements of condition 8 and 9 of Schedule 5 to ensure that these line up with the reporting requirements in Table 13.	• Section corrected as noted.
	• 7. Page 62, Section 8.2.2, second paragraph. Why is this paragraph here at all? It is about groundwater but is located within the section on surface water.	• Amended to reflect only surface water.
	• 8. Page 66, Section 8.5. Any change to the water monitoring locations or suite of analytes must be approved by a change to the SWMP approved by the Department's Secretary (or delegate).	• Sentence added to reflect need for approval.
Copy of updated version of the plan emailed to DPI Water 15 October 2020	•	• No response received.
Copy of updated version of the plan emailed to the EPA 15 October 2020	•	• No response received
Copy of updated version of the plan emailed to the HWC 15 October 2020	•	• No response received.
Copy of updated version of the plan provided to the DPIE 15 October 2020	• Comments received dated November 26 November 2020	• Sections amended as specified in Table below.

Correspondence	Comment	Response
Copy of updated version of the plan provided to the DPIE 5 January 2021	• Comments received dated April 2021	• Sections amended as specified in Table below.

DPIE Comments Table 1: Attachment A - Newcastle-Williamtown Sand Cabbage Tree Road Soil & Water Management Plan DPIE Review – November 2020

November 2020 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	Satisfactory (Yes/No)	Comment	Action Required	Newcastle Sand Comments / Response
Schedule 3 – Specific Environmental Conditions 12. **Water Supply** The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of operations under the consent to match its available water supply, to the satisfaction of the Secretary	**Yes**	□	Williamtown Sand must update the SWMP to address the DPIEs comments.	See responses below and in attached updated management plan.
13. The Applicant must not utilise, or otherwise interfere with, groundwater on the site, unless unavoidably associated with the construction and use of groundwater monitoring bores and the construction of quarry-related infrastructure.				Noted.
15. **Soil & Water Management Plan** (*SWMP*) The Applicant must prepare a Soil and Water Management Plan for the development to the satisfaction of the Secretary. This plan must:	**Yes**	• The Cabbage Tree Road updated SWMP was submitted 15 Oct 2020.		Noted.

November 2020 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
a) be prepared by suitably qualified and experienced person/s (*SQEP*) approved by the Secretary; b) be prepared in consultation with the EPA, Hunter Water and DPIE Water; c) be submitted to the Secretary for approval prior to commencing ground disturbing activities on the site, unless otherwise agreed by the Secretary; and	**Yes**	□		Noted.
d) include a: (i) Site Water Balance that includes: • details of: o sources and security of water supply; o water use and management on site; o any off-site water transfers; and o reporting procedures; and • measures to be implemented to minimise clean water use on site;	**Partial**	• Section 4.4: water balance volumes although reported in the AEMR should be appended to the SWMP. • Section 4.2.2.1 Should state they will evaluate the use of polymers (potentially providing 75% reduction providing there is no TSSA impact) and will seal the gravel road to reduce dust.	Please include water balance volumes as an Appendix. Please provide commitments to use polymers and seal the gravel road to reduce dust.	Volumes for 2019 included along with water use estimates in a new Appendix 5. Additional comments provided in Section 4.2.2.1. Bitumen sealing of the southern section of the road has been committed to, with the northern section subject to the degree of water usage relative to the EIS estimates.

November 2020 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
(ii) Surface Water Management Plan, that includes: • a program for obtaining baseline data on surface water flows and quality in water bodies that could potentially be affected by the development; • a detailed description of the surface water management system on site including the: o clean water diversion system; o erosion and sediment controls (ESC); o dirty water management system; and o water storages; and • a program to monitor and report on: o any surface water discharges; o the effectiveness of the water management system; o the quality of water discharged from the site to the environment; • o surface water flows and quality in water bodies that could potentially be affected by the development;	**Yes**	• The use of silt fences, like PPE, are the last and only a temporary form of defence.		Noted.
(iii) Groundwater Management Plan that includes: • A monitoring program to manage potential impacts, if any, on groundwater and any associated surface water source near the proposed extraction area that includes: o Identification of methodologies for determining threshold water quality criteria; o Regular testing of groundwater bores for the presence of	**Partial**	• Section 7 Table 12 7.13 Compliance Evaluation: C Monitoring shows results will be screened as per a Trigger Action Response Plan (TARP) as in Section 8.6 TRAP (as the Contingency Plan).	• Please provide the link to the Department of Defence PFAS groundwater risk zones map. • Please provide monitoring sites WBX where PFOS is greater than 0.07ug/L and SW near the	Section 3.7 updated to include the link to Department of Defence publications on Williamtown PFAS

November 2020 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
PFAS; o Contingency measures in the event of a breach of thresholds; and o A program to regularly report on monitoring; and • A Construction Environmental Management Plan to manage any intersection with groundwater encountered during provision of services to the site (such as water supply pipelines) and construction of quarrying-related facilities (such as weighbridges, offices and workshop buildings). This Plan must include sampling of any groundwater encountered during such activities and testing for presence of PFAS and include contingency protocols should any groundwater be found to contain PFAS.			intersection on an updated map.	and the NSW Government links. Updated section includes new Figure 5 based on the Department of Defence PFAS mapping and interpreted plumes.
16. **Tomago Sandbeds Special Area** (*TSSA*) The Applicant must operate the development so that it has a neutral or beneficial effect on the water quality of the Tomago Sandbeds Special Area	**Partial**	• • Section 2.1: *Hunter Water Regulation 2015*: Part.2 Special Areas: Tomago Sandbeds (*TSSA*) Catchment. • • Section 7 Table 12: Water Management Control Measures- bunding?	HC fixed and mobile "**impervious**" bunds needs clarification. Refer Other Comments below.	Text corrected in several locations to include impervious in bund descriptions.
17. The Applicant must not construct quarry infrastructure within the Tomago Sandbeds Special Area.	**Yes**	• □		Noted.

November 2020 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
18. The Applicant must establish and use an on-site sewage pump-out system, incorporating a holding tank, located outside of the Tomago Sandbeds Special Area.	**Yes**	•		Noted.
19. The Applicant must not store liquids other than water within the Tomago Sandbeds Special Area. Any liquids (other than water) kept on the site must be stored within a bunded and roofed area constructed in accordance with the relevant Australian Standards.	**Partial**	• Section 7 Table 12 7.8: (C) Diesel and (E) Chemical storage must comply with AS1940:2017 and bunded outside the TSSA.	Please include a specific commitment to conduct mobile plant refuelling within a impervious portable bund. Refer Other Comments below.	Corrected.
20. The Applicant must construct and use a fully bunded and undercover re-fuelling facility located outside of the Tomago Sandbeds Special Area for all mobile equipment re-fuelling operations, with the exception of tracked equipment. Refuelling of any tracked equipment within the Tomago Sandbeds Special Area must be conducted within a fully bunded and lined hardstand that is capable of holding both the tracked equipment and the fuel truck.	**Partial**	• Section 7 Table 12 7.8 B: A fully bunded and undercover “impervious” hardstand for fuel, hydrocarbon and chemical storage, and G, a covered and bunded “impervious” parking area for the overnight parking of tracked equipment will be constructed outside the TSSA; and I, Processing equipment will include “impervious” bunding to capture hydraulic leaks. Refer Other Comments below.		Corrected.
21. The Applicant must ensure that, outside of the operating hours during which quarrying operations are permitted, all fuel- powered equipment is removed from the Tomago Sandbeds Special Area to a secure storage,	**Yes**	•		-

November 2020 Comments Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3	Satisfactory (Yes/No)	Comment	Action Required	Newcastle Sand Comments / Response
except for equipment being used in vegetation clearing operations, which may be stored within a fully-bunded and lined hardstand area outside of operating hours. *Note: Operating hours for quarrying operations are shown in Table 1*				
Schedule 5 – Environmental Management, Reporting and Auditing **3. Management Plan Requirements** The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include: a) detailed baseline data; b) a description of: • the relevant statutory requirements (including any relevant approval, licence or lease conditions); any relevant limits or performance measures/criteria; and • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures; c) a description of the measures that to be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria; d) a program to monitor and report on the: • impacts and environmental performance of the development; and • effectiveness of any management measures (see (c)	**Partial**	• Section 8.8: TARP for PFAS monitoring and response needs to be changed.	PFAS monitoring and incident triggers need to be tightened. Refer Other Comments below.	Section 8.6 updated to improve response process clarity.

November 2020 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
above); e) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible; f) a program to investigate and implement ways to improve the environmental performance of the development over time; g) a protocol for managing and reporting any: • incidents; • complaints; • non-compliances with statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; and a protocol for periodic review of the plan				

DPIE Comments Table 2: Attachment A - Newcastle-Williamtown Sand Cabbage Tree Road Soil & Water Management Plan DPIE Review – November 2020

Other Comments – **November 2020**	**Comments / Response**
Provide a Glossary.	An abbreviations list with basic definition on some terms provided where considered necessary.
Reference all cited documents e.g. Catchments and Creeks (Grant Witheridge).	Corrected
Section 3.5 Are any of the man-made excavations, although described as (3.5.1) stagnant … swamp e.g. Photograph 1 (BH4/SW1), provided with any protection measures?	Erosion and sediment controls are implemented on the site to

Other Comments – **November 2020**	**Comments / Response**
	manage stormwater from the site. Stormwater from Cabbage Tree Road is managed by grassed swales.
Paragraph below Table 6: Please quantify the range of PFAS detections on the site.	Corrected
Section 5.1.2.1 and Table 12 Section 7.5 G & I: All bunding associated with hydrocarbon use and storage must comply with the requirements of AS1940:2017 to prevent contamination of the Hunter Water Special Catchment Areas. All references to suitably bunded areas must be impervious and prevent any chance of hydrocarbons escaping.	Corrected
Section 5.2.3.4 Dot-point 6 and Section 7.6 D in Table 12: Rewrite the sediment control to be: "*If there is wash or transfer of material from the loamy product stockpile a low driveable bund (approximately 300mm) is to be installed around the loamy product stockpile to contain silt and organic material within the material process area*".	Corrected
Section 6.1 the word compliant should be "*complaint*".	Corrected
Table 11 Change DPIE - Regional Operations – Newcastle to "*DPIE – Compliance*" phone number: 1300 305 695, and email: compliance@planning.nsw.gov.au. Table 11 Add a new entry: DPIE-BCD email: rog.hcc@environment.nsw.gov.au	Corrected
Section 6.5: Please clarify what "*certain tasks*" are envisaged to be undertaken by "*suitably qualified persons*".	Corrected
Please ensure that references in the text to re-numbered tables in the SWMP are correct or align.	Corrected
Table 12 Section 7.12 B: Why will the Addendum to the Baseline Water Characteristics Report not be available until December 2021?	Baseline reporting requested by DPIE is scheduled for completion in November 2021. Update to this plan and associated triggers would be expected by December 2021.
Please provide the Baseline Water Characteristics Report as an Appendix to the SWMP.	Updated – accessible as a separate file given size.
Table 19 Zinc: applicability of Site-Specific Trigger Value should not be site wide and should exclude BH1.	Updated.

Other Comments – **November 2020**	**Comments / Response**
Sections 8.6.1 & 8.6.2 DPIE considers the three-month period used to establish an exceedance of the Site-Specific Trigger Value as persistent is an excessive delay for a Water Trigger Value. Please revise Section 8.6 such that a persistent change is considered to occur when two sampling rounds exceed Trigger Values.	Section 8.6 has been updated to reflect the required change, whilst maintaining an acknowledgement of previous values.
Section 8.6.4 The last paragraph should be changed from 30-days to 7-days to be consistent with the requirements in the consent for notification of incidences.	This has been adjusted to include written notice within 7 days, however, it is noted that a Water Trigger Investigation report does not infer an incident has occurred.
Section 8.7 Is the reference to water management at the intersection still relevant now that the intersection is complete?	Correct, section adjusted to remove reference to the intersection.
App 1 Table 22 Please provide comments and responses from DPIE-W, EPA and HWC to DPIE.	This table provides comments on the DPIE comments, no further comment has been received from the EPA, HWC or DPIE-W.

DPIE Comments Table 1: Attachment A - Newcastle-Williamtown Sand Cabbage Tree Road Soil & Water Management Plan DPIE Review – April 2021

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
Schedule 3 – Specific Environmental Conditions 12. **Water Supply** The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of operations under the consent to match its available water supply, to the satisfaction of the Secretary	**Yes**	Water sources are adequately described in Section 4.1. Water uses are adequately described in Section 4.2.	Nil	Nil
13. The Applicant must not utilise, or otherwise interfere with, groundwater on the site, unless unavoidably associated with the construction and use of groundwater monitoring bores and the construction of quarry-related infrastructure.	**Yes**	Section 4.1 states groundwater is not to be extracted for use in quarry operations.	Nil	Nil
15. **Soil & Water Management Plan** (*SWMP*) The Applicant must prepare a Soil and Water Management Plan for the development to the satisfaction of the Secretary. This plan must:	**Yes**	• The Cabbage Tree Road SWMP (v1.1) was submitted on 02 May 2019 and approved by the secretary on 31 May 2019. • This updated version of the SWMP (v3) was submitted 5 Jan 2021.	Nil	Nil.
a) be prepared by suitably qualified and experienced person/s (*SQEP*) approved by the Secretary;	**Yes**	Author Jonathan Berry has been endorsed by the Secretary as suitably qualified and experienced.	Nil	Nil

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
b) be prepared in consultation with the EPA, Hunter Water and DPIE Water;	**Partial**	Appendix 1, Table 23 includes a summary of engagements with agencies in early 2019 for the previous (currently approved) version of the plan. The Departments notes WSSs statement that no responses were received from DPIE - Water, NSW EPA or HWC following engagement attempts on 15/10/2020. The Department notes that evidence of consultation is required under condition 2 of Schedule 5 of the consent, and future revisions of the SWMP will need to comply with this condition.	Please append agency engagement requests.	Now appended.
c) be submitted to the Secretary for approval prior to commencing ground disturbing activities on the site, unless otherwise agreed by the Secretary; and	**Yes**	The SWMP was submitted prior to ground disturbing activities.	Nil	Nil
d) include a: (i) Site Water Balance that includes: • details of: o sources and security of water supply;	**Partial**	• Section 4. Annual water usages do not reflect operational usages. EIS estimates are presented.	Please update section 4 to reflect measured operational water usages	Given operations have not been running for 12 months, and have been largely limited to the area immediately adjoining the wash plant, the EIS estimates are considered appropriate.

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
o water use and management on site; o any off-site water transfers; and o reporting procedures; and • measures to be implemented to minimise clean water use on site;		• Section 4.2 (specifically section 4.2.4) and Appendix 5 – do not clearly explain the assumptions made in the site water balance calculations.	Please update section 4.2 and/or Appendix 5 to provide further explanation of the assumptions used to generate the water balance calculations.	It is unclear what assumptions are not provided within the site water balance section, Section 4.2.4 is a summary only of water usage. An introductory sentence is now included.
		• Section 4.2.2.1 – states that bitumen sealing of the spine road through to the northern resource area boundary will be completed to minimise clean water use on site. It is not stated that this is complete or schedule for works.	Include a schedule for the sealing of internal haul roads in section 4.2	Only the southern portion through to the essentially processing plant is currently sealed. As operations proceed to the northern resource area, the spine road will be sealed through to the southern boundary of the Northern Resource Area – this is expected during 2021/2022. Additional comments provided in Section 4.2.2.1. Bitumen sealing of the southern section of the road has been committed to, with the northern section subject to the degree of water usage relative to the EIS estimates.
		• Section 4.3 – Off-site Water Transfer – refers to grey water but does not identify estimated or actual volumes and the provided reference to section 5.2 appears to be a	Update section 4.3 to accurately reflect volumes of off-site water transfers including grey water and incidental rainwater from bunded areas and correct	Section updated.

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
		typographical error, as Section 5.2 relates to erosion and sediment controls, not water volumes.	reference to the correct report section.	
(ii) **<u>Surface Water Management Plan</u>**, that includes: • a program for obtaining baseline data on surface water flows and quality in water bodies that could potentially be affected by the development; • a detailed description of the surface water management system on site including the: • o clean water diversion system; • o erosion and sediment controls (ESC); • o dirty water management system; and • o water storages; and • • a program to monitor and report on: • o any surface water discharges; • o the effectiveness of the water management system; • o the quality of water discharged from the site to the environment; • o surface water flows and quality in water bodies that could potentially be affected by the development;	**Partial**	Section 6.5 does not require that contractors for water sampling must be suitably qualified and experienced professionals.	In section 6.5, replace the word should, with will.	Updated.
		Section 6.5 states some works may be undertaken by Newcastle Sand staff in place of contractors, however documentation of training or experience logs are not identified.	Section 6 - Clearly describe: o How the quarry will evaluate suitability of staff or contractors for tasks o Information the Quarry will require and hold on personnel suitability of staff or contractors for tasks	Section updated. Where Newcastle Sand engages a contractor to complete the task, multiple people may undertake the task within that company. Newcastle Sand is required to ensure the contractor is suitably qualified, but specifying employees is note considered reasonable or necessary to ensure appropriate results.
		Table 17 does not include monitoring site SW5.	Commit to sampling SW5 within the program for monitoring and reporting.	SW5 has been removed from monitoring due to the distance from site, upgradient screening provided by SW4, rarity of flow, absence of baseline and difficulty in safely sampling the site, and the dominance in the water draining from the adjacent private property directly to this site. Site inspection in April 2021 showed negligible flow occurring and presence of treated timbers on the private

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
				property directly upgradient. Sampling of SW5 will not be reflective of operations occurring within the quarry site.
		Section 8.2.1.1. HEPA 2018 is referenced, which is not the most recent PFAS guideline.	Please update to the most recent and relevant guideline values (see condition 3 of Schedule 5).	Section updated.
		Section 8.2.2 water quality parameters listed are not consistent with section 8.2.4. Dissolved Oxygen (DO) is usually reported with EC, pH, Eh (Redox potential), and temperature for SW and GW water quality parameters.	Please check for consistency of Water Quality Parameters between sections 8.2.2 and 8.2.4. Please define the Water Quality Parameters for Surface Waters in section 8.2	Sections now 8.2.3 and 8.2.5 Field parameters shown for surface water and groundwater. All laboratory analysis shown in Section 8.4.
		Section 8.4 Table 16 title references groundwater wells but table includes surface (SW) locations.	Please update Table 16 title to refer to surface water and groundwater monitoring sites.	Updated.
		Section 8.4 Table 18 does not include DO, EC, pH, Eh (Redox potential), and temperature for SW and GW water quality parameters.	Please check and revise Table 18 against sections 8.2.2 and/or 8.2.4.	Updated
		Section 8.7 references section 7.13 regards material risk to the environment, however this reference appears to be incorrect.	Please correct the text cross referencing in section 8.7.	Updated, should have stated 7.14

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
		Section 9.1, Table 21. Does not define a major rainfall event trigger (mm) or mechanism of identifying that trigger.	Please define a major rainfall event trigger in Table 21.	Updated.
(iii) **Groundwater Management Plan** that includes: • A monitoring program to manage potential impacts, if any, on groundwater and any associated surface water source near the proposed extraction area that includes: o Identification of methodologies for determining threshold water quality criteria; o Regular testing of groundwater bores for the presence of PFAS; o Contingency measures in the event of a breach of thresholds; and o A program to regularly report on monitoring; and • A Construction Environmental Management Plan to manage any intersection with groundwater encountered during provision of services to the site (such as water supply pipelines) and construction of quarrying-related facilities (such as weighbridges, offices and workshop buildings). This Plan must include sampling of any groundwater encountered during such activities and testing for presence of PFAS and include contingency protocols should any groundwater be found to contain PFAS.	**Partial**	Groundwater management is referenced in sections 3.6, section 7.1 and section 8.	Nil	Nil
		Section 3.7, Table 6 contains data from 2017 whereas more contemporary data is contained in the discussion.	Please include the most contemporary data and update Table 6 of Section 3.7	Two tables are included to show the data collected by Defence and data collected by Newcastle Sand specifically for the quarry.
		Sections and 8.1.1 Table 14 refers to BH9 and BH9A. BH9A was installed to replace BH9, however is only constructed to a depth of 12m, instead of the 18m depth of BH9. The top of screen is also shallower in BH9A.	Please explain the difference in well depth and top of screen of the boreholes in section 8.1.1.	Note the use of mBG and mAHD, the relative bottom of screen levels of these are as follows: BH9: -0.53 m AHD BH9A: -1.97 m AHD BH4: -2.84 m AHD Explanatory note included in the table. BH9 had silted up, becoming shallower than initially drilled, and in conjunction with dry period resulted in water levels being below the screen level.

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
		Section 8.1.1 Table 14 notes level logger in BH9A is TBC.	Please update Table 14 with logger installation information.	Corrected.
		Section 8.2.2 and section 8.2.3 water quality parameters listed are not consistent with section 8.2.4.	Please review and update water quality parameters throughout section 8.	Corrected.
		Section 8.4, Table 18 is not consistent with section 8.2.4 with regard to field water quality parameters.	Please update water quality parameters in Table 18to be consistent with section 8.4.	Corrected.
		Section 8.5, Table 19. Some analyte trigger values selected appear to be higher than the existing guidelines ranges from ANZECC or ADWG. E.g. The value presented as being recorded during baseline monitoring (0.1 – 0.5mg/L) for Ammonia as N does not match the range of values in the justification (0.1- 0.34mg/L) in Table 19.	Please review all trigger levels in Table 19 of Section 8.5.	Trigger values reviewed and updated based on 2019 and 2020 data.
		Section 8.5, Table 19, the boundary condition for analysis of ammonia, as measured as [NH3-N] at pH 8, per the Water Quality Guidelines, but pH on the site is reported as lower than this at most locations. The environmental conditions	In Section 8.5, please state if freshwater or marine water values used to justify the criteria level, and state the species protection level used from the water quality guidelines in the justifications	Section updated to reflect ANZECC criteria correctly.

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
		selected for ammonia criteria are not included in the justification in Table 19.	for site specific trigger levels in Table 19.	
		Section 8.5, Table 19 does not include trigger level guideline range for all analytes.	Please revise guideline ranges in Table 19.	Tables have been updated to include some additional parameters, however it should be noted that additional analysis is conducted beyond those listed with trigger values in order to inform understanding of water chemistry at the time of sampling and are not considered necessary to evaluate against trigger value.
		Section 8.5, Table 19, Site-Specific Trigger Value for Zinc is not included for BH1.	Please update Table 19 with a trigger value for Zinc at location BH1.	BH1 is located within a track and has been damaged on numerous occasions (that have included zinc compounds), this has contributed to what is considered unrepresentative water quality data from this site.
		Section 8.5, Table 19, units for EC are incorrect.	Please correct units for EC in Table 19.	Corrected.
		Section 8.5, Table 19, the adopted EC trigger value is higher than the initial groundwater data from RCA in	Please revise and update the EC trigger values in Table 19	Given the range of climatic conditions that have occurred since 2015, including drought conditions, this has resulted in a slightly broader EC range. The

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
		2015 (Table 5) which indicated an EC range of 103.0-410.0 µS/cm. The adopted EC trigger level is higher than values from baseline sampling.		table has been adjusted to reflect a trigger that is closer to the background data.
		Section 8.5. EC for lowland rivers is presented as the baseline trigger from the ANZG Water Quality Guidelines (2000), however this is not representative of the site condition.	Please revise application of the Water Quality Guidelines and update EC trigger value in Table 19 of section 8.5.	Table updated.
		Section 8.5, Table 19, the turbidity trigger value selected is not consistent with "lowland rivers" (6-50 NTU), selected for EC. The site trigger level proposed as 1000 NTU.	Please revise and update the turbidity trigger values in Table 19 using existing site data and local reference values. Please revise application of the Water Quality Guidelines and update the turbidity trigger value.	The measurement of turbidity with groundwater is problematic due to the disturbance of silts and fines on the sides and surrounding the piezometers. Practically there is limited value in having a trigger value for groundwater, its purpose is primarily for assistance in understanding other results (e.g. are say metal / nutrient concentrations due to elevated silts in sample). Turbidity measurements within surface waters also have limited value in that the quarry is highly unlikely to be able to cause changes in turbidity given the lack of direct continuity for most sites from the disturbance area, and the

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
				negligible surface water flow at most sites. Have removed turbidity triggers and added note.
		Section 8.5, Table 19: Sediment disturbance is cited as a cause for variability in turbidity	Field water quality parameters must be documented before purging or sampling waters. Please update the water sampling methodology and Table 19.	Section 8.2.2 and Section 8.2.3 now both reflect that field data is collected prior to sample collection. For groundwater, collection of a sample in a 50mm tube with a probe 30mm wide without touching the sides is not realistically feasible.
16. **Tomago Sandbeds Special Area** (*TSSA*) The Applicant must operate the development so that it has a neutral or beneficial effect on the water quality of the Tomago Sandbeds Special Area	**Yes**		Nil	Nil
17. The Applicant must not construct quarry infrastructure within the Tomago Sandbeds Special Area.	**Yes**	Section 7, Management Controls, includes a commitment to not construct quarry infrastructure (excluding roads, power lines and potable water pipelines required for servicing the quarry) within the Tomago Sandbeds Special Area	Nil	Nil
18. The Applicant must establish and use an on-site sewage pump-out system, incorporating a holding tank, located outside of the Tomago Sandbeds Special	**Yes**	Section 5.1.2, part 2(a)(iv) states the use of septic tanks and removal by licenced contractors.	Nil	Nil

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
Area.				
19. The Applicant must not store liquids other than water within the Tomago Sandbeds Special Area. Any liquids (other than water) kept on the site must be stored within a bunded and roofed area constructed in accordance with the relevant Australian Standards.	**Yes**	Section 7 includes a commitment to not store liquids other than water within the Tomago Sandbeds Special Area	Nil	Nil
20. The Applicant must construct and use a fully bunded and undercover re-fuelling facility located outside of the Tomago Sandbeds Special Area for all mobile equipment re-fuelling operations, with the exception of tracked equipment. Refuelling of any tracked equipment within the Tomago Sandbeds Special Area must be conducted within a fully bunded and lined hardstand that is capable of holding both the tracked equipment and the fuel truck.	**Partial**	Section 7, Table 13, section 7.8, item (B) states that impervious fully bunded and undercover hardstand for fuel, hydrocarbon and chemical storage will be constructed outside of the Tomago Sandbeds Special Area	Please update if the hydrocarbon and chemical storage area in Table 13, section 7.8 B has been completed and update any related control measures as necessary.	Updated.
21. The Applicant must ensure that, outside of the operating hours during which quarrying operations are permitted, all fuel- powered equipment is removed from the Tomago Sandbeds Special Area to a secure storage, except for equipment being used in vegetation clearing operations, which may be stored within a fully-bunded and lined hardstand area outside of operating hours. *Note: Operating hours for quarrying operations are shown in Table 1*	**Partial**	Section 7, Table 13, point 7.10 (A), states that there will be no storage of fuel- powered equipment outside of operating hours (other than tracked equipment with an impervious bunded area). This is not consistent with the condition, which only permits equipment being used in vegetation clearing operations to be stored within the	Update Section 7 to specify that only equipment that is being used in vegetation clearing operations, and is within a fully bunded and lined hardstand area, may be stored within the Tomago Sandbeds Special Area outside of operating hours.	Updated.

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
		Tomago Sandbeds Special Area		
Schedule 5 – Environmental Management, Reporting and Auditing **3. Management Plan Requirements** The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include:	**Partial**	HEPA 2018 and CRC Care 2011 references are used throughout the Management Plan but are not the most recent relevant PFAS guidelines.	Update references for PFAS trigger values to the most recent and relevant guideline values throughout the management plan. Check and revise the application of the CRC Care 2011 references for relevance against the 2021 management plan	Updated.
		Food Standards Australia New Zealand (FSANZ) PFAS guideline criteria 2017 are referenced in 3.7.1, however these are not the most recent or relevant guidelines.	Please revise application of, and reference to, PFAS trigger level criteria throughout, specifically in Section 8.5, Table 13 and Section 3	Sections updated. FSANZ 2017 value of 0.07 for the sum of PFOS and PFHxS is based on Department of Defence documentation and remains current within HEPA NEMP 2.0.
		Tables 7 summary of PFAS results uses an outdated screening reference. The screening criteria used for PFAS in Table C within the baseline water report (appended to the SWMP) are not screened against the most recent (relevant) guideline criteria for screening PFAS.	Update the reference and relevant screening criteria for PFAS in Table 7 Update PFAS trigger values and screening data tables for throughout baseline water report.	Updated.

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
a) detailed baseline data;	**Yes**	Section 8.3. Note, baseline data gaps remain and have been considered by DPIE Compliance. Additional sampling is included in this SWMP under section 8.4 to reach the required detailed baseline dataset. Data gap monitoring will be ongoing to November 2021 or until a minimum 12 months data is collected.	Nil	Nil
b) a description of: • the relevant statutory requirements (including any relevant approval, licence or lease conditions); • any relevant limits or performance measures/criteria; and • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	**Partial**	Section 8.6. See comments on condition 15(d)(iii) regards data quality indicators for sampling and monitoring data.	See comments on condition 15(d)(iii)	Updated.
c) a description of the measures that to be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	**Partial**	Section 8.5 (c), Table 19 The justification stated for chromium is not in relation to relevant guidelines.	Please revise the value of chromium for the site environment against relevant guidelines in Table 19 of section 8.5. If the trigger is higher than the relevant guidelines, please explain.	Table 19 updated (now includes surface water) and improves reference to guidelines and trigger values.

April 2021 Comments ***Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3***	**Satisfactory (Yes/No)**	**Comment**	**Action Required**	**Newcastle Sand Comments / Response**
		Section 8.5 (c), Table 19; the relevant criteria' reference guidelines are not consistently presented	Please include the reference guideline with the relevant guideline values for all analytes in Table 19 of section 8.5	Table 19 updated to include surface water and more reference to guidelines and the majority of analytes now have a trigger value.
d) a program to monitor and report on the: • impacts and environmental performance of the development; and effectiveness of any management measures (see (c) above);	**Yes**	Section 8.6 presents the program to monitor and report on performance and effectiveness. Ensure comments under condition 3 of Schedule 5 (c) are consistent through the Soils and Water Management Plan	Nil	Nil
e) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Partial**	Section 5. Contingency measures are not identified clearly for impacts to or from surface waters.	Clarify contingency measures for impacts to or from surface waters in Section 5.	Section 5.3 inserted.
f) a program to investigate and implement ways to improve the environmental performance of the development over time;	**Partial**	Section 7.16 states improvement will be triggered annually at a minimum. Opportunities for improvements should be assessed more regularly.	Increase the frequency of investigating ways to improve environmental performance in section 7.16	Section adjusted. Frequency is variable. Commitment to make more regular changes to the controls in this plan does not appear feasible given the current review cycle has taken more than 6 months.
		Section 8.9: Review of PFAS Exposure Pathways section does not commit a clear methodology for reviewing	Please revise section 8.9 with a clear exposure risk review pathway.	Section updated.

April 2021 Comments *Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 15-21 & Schedule 5 Condition 3*	Satisfactory (Yes/No)	Comment	Action Required	Newcastle Sand Comments / Response
		pathways		
g) a protocol for managing and reporting any: • incidents; • complaints; • non-compliances with statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; and a protocol for periodic review of the plan.	**Yes**	Sections 7.13 and 7.14. Review of the plan is also required as part of ongoing improvement under condition 3 of Schedule 5 (c), (d) and (f)	Nil	Nil

DPIE Comments Table 2: Attachment A - Newcastle-Williamtown Sand Cabbage Tree Road Soil & Water Management Plan DPIE Review – April 2020

Other Comments – **April 2020**	**Comments / Response**
1. The follow Glossary terms or items are incorrect: ○ "DoI Water: Department of Industry – Water"; "Fe"; and RZM is not in the Glossary. Please update in the glossary and throughout the document. ○ Please include a glossary line for all regulated or detected compounds of PFAS.	Updated.
2. Section 2.2, Table 2 – Conditions of consent – several references to reports sections are incorrect. Please review and update Table 2.	Uncertain what references are incorrect.
3. Section 2.5. CRC Care (2011) reference is potentially superseded by locally adopted governmental guidelines, including the PFAS National Environmental Management Plan 2.0 (2020). Please check most recent guidance and update text references.	Updated – replaced by NEMP 2.0.
4. Section 3.1 - Site Description. Please update to clarify whether the left-in, left-out intersection access via Cabbage Tree Road has been constructed.	Updated.

Other Comments – **April 2020**	**Comments / Response**
5. Section 3.1, remove the reference to the "red zone" for PFAS management and replace with the NSW EPAs current management zone nomenclature of "Broader Management Zone", and to align with section 3.7.1.	Updated.
6. Section 3.7.1 health advice references Food Standards Australia New Zealand (FSANZ) 2017 guideline values. A more contemporary guideline on PFAS health advice is now available PFAS National Environmental Management Plan Version 2.0 (2020). The Department recommends that section 3.7.1 health advice is updated to include the contemporary advice contained within this more relevant guideline (see condition 3 of Schedule 5 of the consent).	Updated – Note this is based on EPA and Defence guidance for Williamtown. FSANZ 2017 criteria for drinking water is consistent with NEMP 2.0.
7. Section 6.1, Table 12 Change "DPIE - Regional Operations – Newcastle" to "DPIE – Compliance" phone number: 1300 305 695, and email: compliance@planning.nsw.gov.au.	Updated.
8. Section 8.4 (generally) and Section 8.3, paragraph 6 states that DPIE have requested an extension to the Baseline Quality Report. The further baseline testing is required to fill data gaps not addressed in the original Baseline Water Quality Characteristics Report. Remove any assertion that the baseline data gap monitoring required to address deficiencies in the original Water Quality Characteristics Report, is an extension or additional to the original requirement for baseline data reporting.	Updated.
9. Section 8.3 does not include all locations where PFAS have been detected in the baseline period. Paragraph 5, dot 2. Please check.	Dot 1 notes the PFAS detections at BH4. Updated.
10. Section 8.4, Table 18: Depth is listed twice in Quarterly and Annual columns. Please update.	Updated.
11. Section 8.5 contains typographic errors regards table numbering. Please update.\	Unclear what error is referred to, appears correct in current version, assume corrected.
12. Section 10. Please update the Aquifer Interference Policy reference.	Updated.
13. Justifications for site specific trigger values in section 5 of the baseline water report (appended to the SWMP) are not the most relevant guidelines. Please see comments above in relation to the conditions, and adopt any changes regards criteria for baseline or data monitoring, to the baseline water <quality> report. Please ensure future revisions refer to the latest guideline screening criteria.	Assume reference is to Section 8.5. Trigger values have been updated as per above instruction and will be updated in the November 2021 version accordingly.
14. The "Williamtown Red Zone" is referred to in the baseline water report in section 5.3.4. Please correct the terminology regards the investigation area throughout the baseline water reports in future revisions	Noted.

DPIE Comments Table 1: Attachment A - Newcastle-Williamtown Sand Cabbage Tree Road Soil & Water Management Plan DPIE Review – June 2021

Soil & Water Management Plan (SWMP) SSD-6125 Schedule 3 Conditions 12, 13, 15-21 & Schedule 5 Condition 3	Satisfactory (Yes/No)	Comment	April review - Action Required	June 2021 review – Action Required
Schedule 3 – Specific Environmental Conditions 12. **Water Supply** The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of operations under the consent to match its available water supply, to the satisfaction of the Secretary.	**Yes**	Water sources are adequately described in Section 4.1. Water uses are adequately described in Section 4.2.	Nil	Considered adequate. No further updates required.
13. The Applicant must not utilise, or otherwise interfere with, groundwater on the site, unless unavoidably associated with the construction and use of groundwater monitoring bores and the construction of quarry-related infrastructure.	**Yes**	Section 4.1 states groundwater is not to be extracted for use in quarry operations.	Nil	Considered adequate. No further updates required.
15. **Soil & Water Management Plan** The Applicant must prepare a Soil and Water Management Plan for the development to the satisfaction of the Secretary. This plan must:	**Yes**	• The Cabbage Tree Road SWMP (v1.1) was submitted on 02 May 2019 and approved by the secretary on 31 May 2019. • This updated version of the SWMP (v3) was submitted 5 Jan 2021.	Nil	Considered adequate. No further updates required.
a) be prepared by suitably qualified and experienced person/s (*SQEP*) approved by the Secretary;	**Yes**	Author Jonathan Berry has been endorsed by the Secretary as suitably qualified and experienced.	Nil	Considered adequate. No further updates required.
b) be prepared in consultation with the EPA, Hunter Water and DPIE - Water;	**Partial**	• Appendix 1, Table 23 includes a summary of engagements with agencies in early 2019 for the previous (currently approved) version of the plan. • The Departments notes WSSs statement that no responses were received	Please append agency engagement requests.	Please append agency engagement requests. **Now appended.**

		from DPIE - Water, NSW EPA or HWC following engagement attempts on 15/10/2020. • The Department notes that evidence of consultation is required under condition 2 of Schedule 5 of the consent, and future revisions of the SWMP will need to comply with this condition.		
c) be submitted to the Secretary for approval prior to commencing ground disturbing activities on the site, unless otherwise agreed by the Secretary; and	**Yes**	The SWMP was submitted prior to ground disturbing activities.	Nil	Considered adequate. No further updates required.
d) include a: (i) **Site Water Balance** that includes: • details of: o sources and security of water supply; o water use and management on site, including wash plant process water use and management; o any off-site water transfers; and o reporting procedures; and • measures to be implemented to minimise clean water use on site;	**Partial**	Section 4. Estimated annual water usages from EIS estimates are presented. Considered acceptable as the quarry has been operational for a short time.		Revised SWMP considered adequate. No further actions required.
		Section 5.1.2 details management of wash plant process water.		Considered adequate. No further updates required.
		Section 4.2.5 - water use summary provided. The water use summary has wash plant water use added following the approval of Mod 2, and states that a portion of the water for wash plant use satisfies the requirement for dust suppression.		Considered adequate. No further updates required.
		Appendix 5 does not include wash plant water use.		Please update Appendix 5 to incorporate wash plant water use, water re-use as part of the wash plant, or clearly indicate that appendix 5 contains EIS estimates only, for water use

				expected at the time of the EIS. **Updated**
		Section 4.2 (specifically section 4.2.4) and Appendix 5 – do not clearly explain the assumptions made in the site water balance calculations.		Response provided. Clarifications provided through other review comments. No further actions required.
		Section 4.2.2.1 – states that bitumen sealing of the spine road through to the northern resource area boundary will be completed to minimise clean water use on site.		Revised SWMP considered adequate. No further actions required.
(ii) **<u>Surface Water Management Plan</u>,** that includes: • a program for obtaining baseline data on surface water flows and quality in water bodies that could potentially be affected by the development; • a detailed description of the surface water management • system on site including the: o clean water diversion system; o erosion and sediment controls; o dirty water management system; including details of the type and dosing rate(s) of flocculants and coagulants; o water storages; o contingency measures for PFAS-containing or contaminated water and sediments; and • a program to monitor and report on: o any surface water discharges;	**Yes**	Section 6.5 does not require that contractors for water sampling must be suitably qualified and experienced professionals.		Revised SWMP considered adequate. No further actions required.
		Section 6.5 outlines documentation related to training, and experience of Newcastle Sand Staff or contractors undertaking water monitoring sampling.		Considered adequate. No further actions required.
		Table 17 does not include monitoring site SW5. Revised SWMP comment provided: *"SW5 has been removed from monitoring due to the distance from site, upgradient screening provided by SW4, rarity of flow, absence of baseline and difficulty in safely sampling the site, and the dominance in the water*		The Department notes that SW1 (not SW4) serves as a suitable monitoring location to evaluate any potential impacts to the receiving environment from the quarry operations. On this basis, the Department accepts the removal of SW5. Considered adequate. Please remove SW5 from Figure 7.

○ the effectiveness of the water management ○ system, including the effectiveness of water recovery during processing; ○ the quantity and type of flocculants and or coagulants used in the sand washing process; o potential PFAS detections in wash water and settlement products; ○ the quality of water discharged from the site to the environment; ○ surface water flows and quality in water bodies that could potentially be affected by the development;		*draining from the adjacent private property directly to this site. Site inspection in April 2021 showed negligible flow occurring and presence of treated timbers on the private property directly upgradient. Sampling of SW5 will not be reflective of operations occurring within the quarry site."*		**Updated**
		Section 8.2.1.1. HEPA 2018 is referenced, which is not the most recent PFAS guideline.	Please update to the most recent and relevant guideline values (see condition 3 of Schedule 5).	Revised SWMP considered adequate. No further actions required.
		Section 8.2.2 water quality parameters listed are not consistent with section 8.2.4. Dissolved Oxygen (DO) is usually reported with EC, pH, Eh (Redox potential), and temperature for SW and GW water quality parameters.	Please check for consistency of Water Quality Parameters between sections 8.2.2 and 8.2.4. Please define the Water Quality Parameters for Surface Waters in section 8.2	Revised SWMP considered adequate. No further actions required.
		Section 8.4 Table 16 title references groundwater wells but table includes surface (SW) locations.		Revised SWMP considered adequate. No further actions required.

		Section 8.4 Table 18 does not include DO, EC, pH, Eh/ORP (Redox potential), and temperature for SW and GW water quality parameters.		Revised SWMP considered adequate. No further actions required.
		Section 8.7 references section 7.13 regards material risk to the environment, however this reference appears to be incorrect.		Revised SWMP considered adequate. No further actions required.
		Section 9.1, Table 21. Does not define a major rainfall event trigger (mm) or mechanism of identifying that trigger.		Revised SWMP considered adequate. No further actions required.
(iii) **<u>Groundwater Management Plan</u>** that includes: • a monitoring program to manage potential impacts, if any, on groundwater and any associated surface water source near the proposed extraction area that includes: ○ Identification of methodologies for determining threshold water quality criteria; ○ Regular testing of groundwater bores for the presence of PFAS; ○ Contingency measures in the event of a breach of thresholds; and ○ A program to regularly report on monitoring; and	**Partial**	Groundwater management is referenced in sections 3.6, section 7.1 and section 8.		Considered adequate. No further updates required.
		Section 3.7, Table 6 contains data from 2017 whereas more contemporary data is contained in the discussion.	Please include the most contemporary data and update Table 6 of Section 3.7	Reference to the Defence publications on PFAS has been included within the text. Considered adequate. No further updates required.
		Sections and 8.1.1 Table 14 refers to BH9 and BH9A. BH9A was installed to replace BH9, however is only constructed to a depth of 12m, instead of the 18m depth of BH9. The top of screen is also shallower in BH9A.		Please check example values provided in additional note 2 of Table 15 (formerly table 14). The RL, or Reduced Level presented as mAHD in the example provided indicates that the water level values in mAHD may have been

• a Construction Environmental Management Plan to manage any intersection with groundwater encountered during provision of services to the site (such as water supply pipelines) and construction of quarrying-related facilities (such as weighbridges, offices and workshop buildings). This Plan must include sampling of any groundwater encountered during such activities and testing for presence of PFAS and include contingency protocols should any groundwater be found to contain PFAS. <(iii) continued >				incorrectly calculated. If BH9A well's screen was installed between 9m to 12mBG, from a ground level of 10.03 mAHD, the top of screen would be 1.03m AHD and base of screen would be -1.97m AHD. **Corrected as noted**
		Section 8.1.1 Table 14 notes level logger in BH9A is TBC.		Revised SWMP considered adequate. No further actions required.
		Section 8.2.2 and section 8.2.3 water quality parameters listed are not consistent with section 8.2.4.		Revised SWMP considered adequate. No further actions required.
		Section 8.4, Table 18 is not consistent with section 8.2.4 with regard to field water quality parameters.		Revised SWMP considered adequate. No further actions required.
		Section 8.5, Table 19. Some analyte trigger values selected appear to be higher than the existing guidelines ranges from ANZECC or ADWG. E.g. The value presented as being recorded during baseline monitoring (0.1 – 0.5mg/L) for Ammonia as N does not match the range of values in the justification (0.1- 0.34mg/L) in Table 19.	Please review all trigger levels in Table 19 of Section 8.5.	The surface water trigger level selected is more than double the concentration observed during baseline monitoring. Please adjust the surface water trigger level to more closely align with the uppermost observed value for Ammonia (as N) during the baseline monitoring period. **Surface water level adjusted to 0.2 mg/L, it is noted that this is very conservative as stated, when comparing to ANZECC or ADWG.**
		Section 8.5, Table 19 does not include trigger level guideline range for all analytes.		Revised SWMP considered adequate. No further actions required.
		Section 8.5, Table 19, Site-Specific Trigger Value for Zinc is not included for BH1.	Please update Table 19 with a trigger value for Zinc at location BH1.	Given the decreasing trend in zinc concentrations since early 2019, the proposed trigger value for BH1 (0.66 mg/L) is

				not considered reasonable. It is recommended that this trigger value is revised to align with the other groundwater monitoring locations or further justification is provided as to why the current trigger value has been adopted. **February and March 2021 were at 0.652 and 0.596 mg/L respectively possibly as a result of increased rainfall. Level has been left as is, with additional justification provided.**
		Section 8.5, Table 19, units for EC are incorrect.		Revised SWMP considered adequate. No further actions required.
		Section 8.5, Table 19, the adopted EC trigger value is higher than the initial groundwater data from RCA in 2015 (Table 5) which indicated an EC range of 103.0-410.0 µS/cm. The adopted EC trigger level is higher than values from baseline sampling.		Revised SWMP considered adequate. No further actions required.
		Section 8.5. EC for lowland rivers is presented as the baseline trigger from the ANZG Water Quality Guidelines (2000), however this is not representative of the site condition.		Revised SWMP considered adequate. No further actions required.
		Section 8.5, Table 19, the turbidity trigger value selected is not consistent with “lowland rivers” (6-50 NTU), selected for EC. The site trigger level proposed as 1000 NTU.	Please revise and update the turbidity trigger values in Table 19 using existing site data and local reference values. Please revise application of the Water Quality Guidelines and	Please provide trigger values for turbidity in surface water and groundwater. **Surface water monitoring sites are typically tannin rich and are stagnant or with little**

			update the turbidity trigger value.	**flow, there is limited potential for site activities to influence turbidity, and SW1 is influenced by Cabbage Tree Road. Groundwater sampling has tendency to disturb sediments. Given the diverse range of levels measured and limited risks, no trigger is considered relevant or necessary to assess the environmental performance of the quarry.**
		Section 8.5, Table 19: Sediment disturbance is cited as a cause for variability in turbidity	Field water quality parameters must be documented before purging or sampling waters. Please update the water sampling methodology and Table 19.	Revised SWMP considered adequate. No further updates required.
<(iii) continued >The Applicant must implement the Soil and Water Management Plan as approved from time to time by the Secretary. The Applicant must provide an updated Soil and Water Management Plan, inclusive of the wash plant and water and sediment management system, to the Secretary for approval. Construction of the water and sediment management system described in the MR (Mod 2) must not commence prior to the updated Soil and Water Management Plan being approved by the Secretary.	**Yes**	The revised SWMP includes detail on the wash plant and water and sediment management, however does not provide sufficient detail on monitoring of sediments.	-	Include provision (criteria and monitoring program) for PFAS monitoring of wash-water sludge sediment. **Table 18 includes provision of monthly surface water and quarterly sediment monitoring. Given the very low risk of PFAS being present (i.e. potable water being used, extract above groundwater level and no PFAS measured in sand), this is considered adequate. Criteria for sediments have been included in Table 20.**
Tomago Sandbeds Special Area 16. The Applicant must operate the development so that it has a neutral or beneficial effect on the water quality of the Tomago Sandbeds Special Area	**Yes**	-	Nil	Considered adequate. No further updates required.

17. The Applicant must not construct quarry infrastructure within the Tomago Sandbeds Special Area.	**Yes**	Section 7, Management Controls, includes a commitment to not construct quarry infrastructure (excluding roads, power lines and potable water pipelines required for servicing the quarry) within the Tomago Sandbeds Special Area	Nil	Considered adequate. No further updates required.
18. The Applicant must establish and use an on-site sewage pump-out system, incorporating a holding tank, located outside of the Tomago Sandbeds Special Area.	**Yes**	Section 5.1.2, part 2(a)(iv) states the use of septic tanks and removal by licenced contractors.	Nil	Considered adequate. No further updates required.
19. The Applicant must not store liquids other than water within the Tomago Sandbeds Special Area. Any liquids (other than water) kept on the site must be stored within a bunded and roofed area constructed in accordance with the relevant Australian Standards.	**Yes**	Section 7 includes a commitment to not store liquids other than water within the Tomago Sandbeds Special Area	Nil	Considered adequate. No further updates required.
20. The Applicant must construct and use a fully bunded and undercover re-fuelling facility located outside of the Tomago Sandbeds Special Area for all mobile equipment re-fuelling operations, with the exception of tracked equipment. Refuelling of any tracked equipment within the Tomago Sandbeds Special Area must be conducted within a fully bunded and lined hardstand that is capable of holding both the tracked equipment and the fuel truck.	**Yes**	Section 7, Table 13, section 7.8, item (B) states that impervious fully bunded and undercover hardstand for fuel, hydrocarbon and chemical storage will be constructed outside of the Tomago Sandbeds Special Area		Updated in Table 14 (formerly Table 13), part 7.8(B). No further edits required.
		Section 7, Table 13, section 7.8, item (G), indicates that tracked equipment may be fuelled via generators with an external fuel tank, but does not state that re-fuelling within the Tomago Sandbeds (of generators or tracked equipment) will be conducted within a fully bunded and lined hardstand that is capable of holding both the tracked equipment and the fuel truck.	Update section 7 to specify that refuelling of tracked equipment within the Tomago Sandbeds Special Area will be conducted within a fully bunded and lined hardstand that is capable of holding both the tracked equipment and the fuel truck.	Table 14 (formerly Table 13) Section 7.8 (G) has been updated to state that no refuelling of mobile equipment (other than tracked equipment within an impervious bunded area) will be undertaken within the Tomago Sandbeds Area. No further edits required.

		Section 7, Table 13, section 7.8, item (G), has additional text, that flocculant and coagulant tanks will have *appropriate* bunding to capture spills, but does not specify the bunding type or management.	-	Updated SWMP considered adequate. No further updates required.
21. The Applicant must ensure that, outside of the operating hours during which quarrying operations are permitted, *all fuel-powered equipment is removed from the Tomago Sandbeds Special Area* to a secure storage, except for equipment being used in vegetation clearing operations, which may be stored within a fully-bunded and lined hardstand area outside of operating hours. *Note: Operating hours for quarrying operations are shown in Table 1*	**Yes**	Section 7, Table 13, point 7.10 (A), states that there will be no storage of fuel-powered equipment outside of operating hours (other than tracked equipment with an impervious bunded area). This is not consistent with the condition, which only permits equipment being used in vegetation clearing operations to be stored within the Tomago Sandbeds Special Area		Updated SWMP considered adequate. No further updates required.
Schedule 5 – Environmental Management, Reporting and Auditing **3. Management Plan Requirements** The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include:	**Partial**	HEPA 2018 and CRC Care 2011 references are used throughout the Management Plan but are not the most recent relevant PFAS guidelines.		Updated SWMP considered adequate. No further updates required.
		Food Standards Australia New Zealand (FSANZ) PFAS guideline criteria 2017 are referenced in 3.7.1, however these are not the most recent or relevant guidelines.	Please revise application of, and reference to, PFAS trigger level criteria throughout, specifically in Section 8.5, Table 13 and Section 3	Comments covered elsewhere. No further edits required.
		Tables 7 summary of PFAS results uses an outdated screening reference. The screening criteria used for PFAS in Table C within the baseline water report (appended to the SWMP) are not screened against the most recent (relevant) guideline criteria for screening PFAS.	-	Considered adequate. No further updates required.

		The criteria value provided for PFOS is not consistent with the HEPA NEMP 2.0 (2020). The HEPA NEMP provides only a combined trigger value for "PFOS + PFHxS" for human health screening criteria. It is recommended that the PFOS (only) trigger levels are revised to reflect the ecological screening criteria set out in the HEPA NEMP 2.0.	-	Revise the PFOS (only) trigger levels to reflect the ecological screening criteria set out in the HEPA NEMP 2.0. **Section updated, PFOS only 99% protection value (rounded to LOR) adopted for all sites except SW1 and SW4 where it was previously recorded, at this location the drinking water criteria has been adopted.**
a) detailed baseline data;	**Yes**	Section 8.3. Note, baseline data gaps remain and have been considered by DPIE Compliance. Additional sampling is included in this SWMP under section 8.4 to reach the required detailed baseline dataset. Data gap monitoring will be ongoing to November 2021 or until a minimum 12 months data is collected.	Nil	Considered adequate. No further updates required.
b) a description of: • the relevant statutory requirements (including any relevant • approval, licence or lease conditions); • any relevant limits or performance measures/criteria; and • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	**Yes**	Section 8.6. See comments on condition 15(d)(iii) regards data quality indicators for sampling and monitoring data.		Considered adequate. No further updates required.
c) a description of the measures that to be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	**Yes**	Section 8.5 (c), Table 19 The justification stated for chromium is not in relation to relevant guidelines.		Updated SWMP considered adequate. No further updates required.

		Section 8.5 (c), Table 19; the relevant criteria' reference guidelines are not consistently presented		Updated SWMP considered adequate. No further updates required.
d) a program to monitor and report on the: • impacts and environmental performance of the development; and • effectiveness of any management measures (see (c) above);	**Yes**	Section 8.6 presents the program to monitor and report on performance and effectiveness. Ensure comments under condition 3 of Schedule 5 (c) are consistent through the Soils and Water Management Plan	Nil	Considered adequate. No further updates required.
e) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Partial**	Section 5. Contingency measures are not identified clearly for impacts to or from surface waters.	Clarify contingency measures for impacts to or from surface waters in section 5.	Additional section 5.3 comments noted. The new text relates to the EPL and contingency controls around wash waters, but does not sufficiently address wash plant sediments. Please update section 5.3.1 to reflect that wash plant sediments will be tested regularly. **Updated to include sediment testing.**
f) a program to investigate and implement ways to improve the environmental performance of the development over time;	**Yes**	Section 7.16 states improvement will be triggered annually at a minimum. Opportunities for improvements should be assessed more regularly.		Updated SWMP considered adequate. No further updates required.
		Section 8.9: Review of PFAS Exposure Pathways section does not commit a clear methodology for reviewing pathways		Updated SWMP considered adequate. No further updates required.

g) a protocol for managing and reporting any: • incidents; • complaints; • non-compliances with statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; and • • a protocol for periodic review of the plan.	**Yes**	Sections 7.13 and 7.14. Review of the plan is also required as part of ongoing improvement under condition 3 of Schedule 5 (c), (d) and (f)	Nil	Considered adequate. No further updates required.

Other Comments on SWMP
1. Section 8.5 states "*Locations monitored as part of the annual monitoring should be compared against currently available data for that location only as they have not been considered when developing the trigger values*." All locations must have sufficient baseline data to be able to derive a trigger value and assess each location on the baseline condition of the site and environment. If enough data is not available to generate a trigger level to assess annual monitoring against, sufficient baseline data must be collected, and a trigger value agreed with the Department, before annual sampling (only) can commence at these locations. **Text updated to remove ambiguity, no annual only monitoring proposed at this stage.** 2. Section 8.5 presents some trigger values based on the 80th percentile of the baseline values. In line with the AZNECC and ARMCANZ (2000) methodology, as updated, guideline values derived from the 80th percentile of the observed baseline value, must be reviewed after 2 years of monthly data collected, to align with the complete methodology and seasonal variability. If monthly data are not available for the two year period, or all locations will not be monitored monthly for the two year period, then using the 80th percentile derivation for trigger values is void, and an alternative method for selecting the appropriate trigger value, and associated location-by-location trigger values, must be provided. **As presented within Table 20, a range of trigger values have been adopted across the site, these have not been exclusively based on the 80th percentile. These are considered suitable for the protection of the local environment, from an activity that processes sand with potable water, above the water table.** 3. Section 8.3 does not include all locations where PFAS have been detected in the baseline period. Paragraph 5, dot 2. Please check if detections in BH9 were within the baseline period, and if these need adding to section 8.3, paragraph 5.

This detection was outside the baseline period, note included for clarity.

4. Section 8.5 in reference to annual trigger levels. Annual trigger levels should be submitted via a revised SWMP once the baseline monitoring period is complete. Levels may not be currently available, but the data collected monthly and quarterly should allow designation of the annual trigger levels. In lieu of Annual Trigger Levels for analytes, the lowermost observed value of the quarterly and monthly (from Table 20, formerly table 19) criteria should be applied.

Reference to annual trigger levels has been removed, along with added comment about revision post 2021 baseline monitoring extension period.

5. Please update reference to water quality parameter "Eh" to Oxidative Redox Potential or "ORP", and add the term to the glossary and update section 8.2.5.

Updated.

6. Table C of the Baseline Water Quality Report does not specify that the PFOS criteria is for *human health* or *ecological* (and to which species protections level) screening criteria. Noted that there is reference to "***" in the table notes, however, as *human health* versus *ecological criteria* have different screening values, it may be beneficial to present the BH data in one table and the SW data in a separate table, for PFAS. Contemporary human health and recreational water quality guidelines are in Table 1 of the NEMP 2.0 (2020). Ecological screening criteria for PFAS in water, and PFAS in soil draft criteria are separately indicated in the NEMP 2.0.

Noted, updates will be suggested to tables for future reporting.

7. In Table C of the baseline water quality report, "Sum of PFAS (WA DER List)" are not applicable to NSW. There is no need to report and screen against WA DER.

Noted, updates will be suggested to tables for future reporting in line with the updated trigger values.

8. 6:2 FtS has been added twice to the glossary

Updated. It was added twice due to the alphabetic ordering, and keeping it adjacent to other PFAS chemicals. Updated to be only alphabetic.

9. Section 8.5 states "*Where possible alignment of surface water and groundwater trigger values has been sort for simplicity, except where significant variation in levels occurred and these were above relevant guidelines*." Please consider the groundwater and surface water trigger values against the relevant legislation and guidelines. Check typographical error: Sort > sought.

Text corrected (removed), justification for levels stated for each parameter.

10. Check typographical error for "*µS/cm Micro-semen per centimetre – units for electrical conductivity*".

Updated.

NSW GOVERNMENT | Planning & Environment

Planning Services
Resource Assessments
Contact: Philip Nevill
Phone: 8275 1036
Email: philip.nevill@planning.nsw.gov.au

Mr Jonathan Berry
Senior Advisor
Kleinfelder Australia Pty Ltd
95 Mitchell Road
CARDIFF NSW 2285

Dear Mr Berry

Cabbage Tree Road Sand Quarry (SSD 6125)
Appointment of Suitably Qualified Experts

I refer to your letter dated 12 June 2018 requesting the Secretary's endorsement of suitably qualified and experienced persons to prepare various plans, reports and surveys required under the above development consent.

The Department has reviewed the proposed list of persons and accompanying information in support of their appointment, and is satisfied that these persons are suitably qualified. The Secretary endorses the appointment of the following persons:

Expert	Management Plan / Report / Survey	Condition
Will Minchin, Hydrogeologist, Watershed HydroGeo	Maximum Extraction Depth Report and Soil and Water Management Plan	condition 11, Schedule 2, and condition 15, Schedule 3
Jonathan Berry, Senior Advisor, Kleinfelder Australia Pty Ltd	Maximum Extraction Depth Report; Soil and Water Management Plan; and Aboriginal Heritage Management Plan	condition 11, Schedule 2; condition 15, Schedule 3; and condition 32, Schedule 3
Brendan Grant, Principal Environmental Consultant, Kleinfelder Australia Pty Ltd	Soil and Water Management Plan	condition 15, Schedule 3
Bevan Harris, Senior Environmental Consultant, Kleinfelder Australia Pty Ltd	Soil and Water Management Plan	condition 15, Schedule 3,
Paul Rheinberger, Principal Archaeologist, Maxim Multicon Pty Ltd	Heritage Archival Recording and Report	condition 31, Schedule 3
Penny McCardle, Principal Archaeologist and Forensic Anthropologist, McCardle Cultural Heritage Pty Ltd	Aboriginal Heritage Management Plan	condition 32, Schedule 3
William Bartolo, Bartolo Safety Management Services	Radiation Survey	condition 46, Schedule 3

If you wish to discuss this matter further, please contact Philip Nevill at the details listed above.

Yours sincerely

Howard Reed 14.6.18
Howard Reed
Director Resource Assessments
as the Secretary's nominee

Kleinfelder Australia Pty Ltd
95 Mitchell Road
CARDIFF NSW 2285
T| +61 2 4949 5200
www.kleinfelder.com.au
ABN: 23 146 082 500
NEWCASTLE OFFICE

15 February 2019
File Ref: Water - DPI.docx
Document Ref: NCAL19_DPIWater_WSS

NSW Department of Primary Industries
Level 11, 323 Castlereagh Street
Sydney NSW 2000

Attention: Kerry Lee

Delivered by email: kerry.lee@dpi.nsw.gov.au

Subject: Cabbage Tree Road Sand Quarry – Soil Water Management Plan and Maximum Extraction Depth Report Consultation

The Cabbage Tree Road Sand Quarry was approved 9 May 2018 by the NSW Department of Planning and Environment under application SSD-6125 issued to the Williamtown Sand Syndicate.

Condition 11 of Schedule 2 requires the preparation of a Maximum Extraction Depth Report in consultation with Hunter Water and Department of Industry Water, with approval by the Secretary of the Department of Planning and Environment. This plan has been prepared by Will Minchin of Watershed HydroGeo.

Condition 15 of Schedule 3 of the Consent conditions requires the preparation of a Soil and Water Management Plan in consultation with the Environmental Protection Authority, Hunter Water and Department of Primary Industry Water, with approval by the Secretary of the Department of Planning and Environment. This plan has been prepared by Kleinfelder and Will Minchin of Watershed HydroGeo.

Accordingly, please find attached a copy of the Management Plan for your review. It would be appreciated if you can supply any feedback you may have on the plans by 1 March 2019.

Should you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

Jonathan Berry B.App.Sc (Hons)

Senior Advisor
Environmental Management
jberry@kleinfelder.com

Mobile: 0421 440 139

Attached: *Soil and Water Management Plan dated 15 February 2019*
Maximum Extraction Depth Report

Kleinfelder Australia Pty Ltd
95 Mitchell Road
CARDIFF NSW 2285
T| +61 2 4949 5200
www.kleinfelder.com.au
ABN: 23 146 082 500
NEWCASTLE OFFICE

15 February 2019
File Ref: Water - EPA.docx
Document Ref: NCAL19_EPA_WSS

Regional Operations Unit - Hunter
NSW Environmental Protection Authority
PO Box 488G,
Newcastle NSW 2300

Attention: Steve Clair
Delivered by email: Steve.Clair@epa.nsw.gov.au

Subject: Cabbage Tree Road Sand Quarry – Soil Water Management Plan and Maximum Extraction Depth Report Consultation

The Cabbage Tree Road Sand Quarry was approved 9 May 2018 by the NSW Department of Planning and Environment under application SSD-6125 issued to the Williamtown Sand Syndicate.

Condition 11 of Schedule 2 requires the preparation of a Maximum Extraction Depth Report in consultation with Hunter Water and Department of Industry Water. This plan has been prepared by Will Minchin of Watershed HydroGeo.

Condition 15 of Schedule 3 of the Consent conditions requires the preparation of a Soil and Water Management Plan in consultation with the Environmental Protection Authority, Hunter Water and Department of Primary Industry Water, with approval by the Secretary of the Department of Planning and Environment. This plan has been prepared by Kleinfelder and Will Minchin of Watershed HydroGeo.

Accordingly, please find attached a copy of the Management Plan for your review. It would be appreciated if you can supply any feedback you may have on the plans by 1 March 2019.

Should you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

Jonathan Berry B.App.Sc (Hons)

Senior Advisor
Environmental Management
jberry@kleinfelder.com

Mobile: 0421 440 139

Attached: *Soil and Water Management Plan dated 15 February 2019*
Maximum Extraction Depth Report

Kleinfelder Australia Pty Ltd
95 Mitchell Road
CARDIFF NSW 2285
T| +61 2 4949 5200
www.kleinfelder.com.au
ABN: 23 146 082 500
NEWCASTLE OFFICE

15 February 2019
File Ref: Water - HWC.docx
Document Ref: NCAL19_HWC_WSS

Hunter Water Corporation
PO BOX 5171
HRMC NSW 2310

Attention: Malcolm Withers

Delivered by email: malcolm.withers@hunterwater.com.au

Subject: Cabbage Tree Road Sand Quarry – Soil Water Management Plan and Maximum Extraction Depth Report Consultation

The Cabbage Tree Road Sand Quarry was approved 9 May 2018 by the NSW Department of Planning and Environment under application SSD-6125 issued to the Williamtown Sand Syndicate.

Condition 11 of Schedule 2 requires the preparation of a Maximum Extraction Depth Report in consultation with Hunter Water and Department of Industry Water. This plan has been prepared by Will Minchin of Watershed HydroGeo.

Condition 15 of Schedule 3 of the Consent conditions requires the preparation of a Soil and Water Management Plan in consultation with the Environmental Protection Authority, Hunter Water and Department of Primary Industry Water, with approval by the Secretary of the Department of Planning and Environment. This plan has been prepared by Kleinfelder and Will Minchin of Watershed HydroGeo.

Accordingly, please find attached a copy of the Management Plans for your review. It would be appreciated if you can supply any feedback you may have on the plans by 1 March 2019.

Should you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

Jonathan Berry B.App.Sc (Hons)

Senior Advisor
Environmental Management
jberry@kleinfelder.com

Mobile: 0421 440 139

Attached: *Soil and Water Management Plan dated 15 February 2019*
Maximum Extraction Depth Report

From: Jonathan Berry
To: peter.jamieson@epa.nsw.gov.au
Subject: SD6125 Cabbage Tree Sand Quarry - Updated SWMP
Date: Thursday, 15 October 2020 2:26:00 PM
Attachments: image001.png
WSS_SWMP_V3_October2020.pdf

Hi Peter,

Further to the original copy of this document provided in February 2019, please find enclosed an updated version of the Soil and Water Management Plan for the Cabbage Tree Road Sand Quarry (SSD_6125). The quarry operates under EPL 21264. A modification to EPL 21264 will be made in coming weeks, to change BH9 to BH9A, a new deeper bore located down gradient of the site that was requested by DPIE. With the extended dry period BH9 was too shallow to have regular water for sampling in 2019. BH9A rectifies this matter.

Key changes included:

- Amendments to the Trigger Response Actions based on 12 months of Baseline Water Quality data.
- Minor amendments to the surface water controls based practical limitations observed in site works to date and minor changes in layout as built.
- Update to proposed water monitoring program, that includes additional monitoring requested by DPIE.

Should you have any comments, please provide feedback by 29 October 2020. Should you require a tracked changes version to better see changes to the last version, please let me know.

Jonathan Berry
Principal Advisor

M: 0421 440 139
www.wedgetail.com.au

WEDGETAIL
PROJECT CONSULTING

Wedgetail Consulting Pty Ltd
ABN: 93 640 388 683

'I acknowledge Aboriginal people as the traditional custodians of the land on which I work and pay my respects to Elders past, present and emerging.'

From: Jonathan Berry
To: water.referrals@nrar.nsw.gov.au
Subject: SD6125 Cabbage Tree Sand Quarry - Updated SWMP
Date: Thursday, 15 October 2020 2:26:00 PM
Attachments: image001.png
WSS_SWMP_V3_October2020.pdf

To whom it may concern

Further to the original copy of this document provided in February 2019, please find enclosed an updated version of the Soil and Water Management Plan for the Cabbage Tree Road Sand Quarry (SSD_6125).

Key changes included:

- Amendments to the Trigger Response Actions based on 12 months of Baseline Water Quality data.
- Minor amendments to the surface water controls based practical limitations observed in site works to date and minor changes in layout as built.
- Update to proposed water monitoring program, that includes additional monitoring requested by DPIE.

Should you have any comments, please provide feedback by 29 October 2020. Should you require a tracked changes version to better see changes to the last version, please let me know.

Kind Regards

Jonathan Berry
Principal Advisor

M: 0421 440 139
www.wedgetail.com.au

WEDGETAIL
PROJECT CONSULTING

Wedgetail Consulting Pty Ltd
ABN: 93 640 388 683

'I acknowledge Aboriginal people as the traditional custodians of the land on which I work and pay my respects to Elders past, present and emerging.'

From: Jonathan Berry
To: John Simpson
Subject: SSD6125 Cabbage Tree Sand Quarry - Updated SWMP
Date: Thursday, 15 October 2020 2:26:00 PM
Attachments: image001.png
WSS_SWMP_V3_October2020.pdf

Hi John,

Further to the original copy of this document provided in February 2019, please find enclosed an updated version of the Soil and Water Management Plan for the Cabbage Tree Road Sand Quarry (SSD_6125). I think Holy may have reviewed the previous copy, but thought I would provide to you on account of your more recent involvement on the project. There have been no changes to the requirements of HWC raised in the preparation of the last version.

Key changes included:

- Amendments to the Trigger Response Actions based on 12 months of Baseline Water Quality data.
- Minor amendments to the surface water controls based practical limitations observed in site works to date and minor changes in layout as built.
- Update to proposed water monitoring program, that includes additional monitoring requested by DPIE.

Should you have any comments, please provide feedback by 29 October 2020. Should you require a tracked changes version to better see changes to the last version, please let me know.

Kind Regards

Jonathan Berry
Principal Advisor

M: 0421 440 139
www.wedgetail.com.au

WEDGETAIL
PROJECT CONSULTING

Wedgetail Consulting Pty Ltd
ABN: 93 640 388 683

'I acknowledge Aboriginal people as the traditional custodians of the land on which I work and pay my respects to Elders past, present and emerging.'

NEWCASTLE SAND

APPENDIX 2: RELEVANT STATEMENT OF COMMITMENTS CROSS REFERENCE

As noted within the Development Consent, the Statement of Commitments shall apply, unless superseded or made redundant by an approved management plan or the Conditions of Approval.

SOC Item	Commitment	Timing	Comment / Status
Erosion, Sediment Control and Soil Management			
a)	• A construction environmental management plan (CEMP) including erosion and sedimentation controls has been prepared and implemented for all construction activities proposed.	Prior to commencement of Project construction	Refer to CEMP
b)	• Erosion and sediment control plans (ESCP) to be prepared and implemented with all internal road construction activities.	Prior to internal road construction	SWMP Section 7.3
c)	• Vegetation and soil excavated during the initial block construction will be stockpiled (vegetation and then topsoil) within an area adjacent to the processing plant. The initial area of cleared vegetation and topsoil will be used to supplement other extraction areas over the life of the project that are deficient in organic matter.	During construction/ Ongoing	Operational process
d)	• During excavation of each new extraction zone, vegetation and topsoil cleared will be laid over the previous extracted zone to encourage regrowth and rehabilitation.	Ongoing	Refer to the Biodiversity and Rehabilitation Management Plan
e)	Install erosion and sediment controls on-site as required in accordance with the: • Erosion and Sediment Control Regional Policy (PSC, 2002b) and the Code of Practice for Managing Urban Stormwater – Soils and Construction (Landcom, 2004).	At commencement of project	SWMP Section 7.1, 7.5 and 7.6
f)	• Maintain erosion and sediment controls as required and consistent with the Code of Practice for Managing Urban Stormwater – Soils and Construction (Landcom, 2004).	Monthly / post major rainfall inspections.	SWMP Section 7.7

SOC Item	Commitment	Timing	Comment / Status
g)	• Maintain a bund at the downslope side of each of the extraction areas to contain any sediment and runoff that may be generated from disturbed areas on site.	During extraction of block.	SWMP Section 7.6 B
h)	• Maintain a low level bund around the silty loam stockpile to limit potential for offsite transport and spread.	During establishment of processing areas	SWMP Section 7.6 D
i)	• Final landform batters with edge of Project Boundary not to exceed 4H (horizontal) to 1V (vertical), 4H:1V.	During rehabilitation	SWMP Section 7.5 D
j)	• Disturbance of potentially contaminated soils or potential hazardous building materials or pipe (e.g. fibre cement containing asbestos) must be reported to the quarry manager immediately and no further disturbance of area to continue. Quarry manager to determine need for formal classification.	As required	SWMP Section 7.1
k)	• Erosion and sediment controls will be monitored to ensure performance is maintained.	Monthly and after significant rainfall	SWMP Section 7.7 A
l)	• The post extraction landform must be surveyed on completion of the primary site rehabilitation works and the results presented in the form of plans to demonstrate compliance with the extraction limit of 1 m above highest predicted groundwater level.	Ongoing	SWMP Section 7.1 G – also see Maximum Extraction Depth Report
8.3.8	**Water Management**		
a)	Water management controls will be revised and updated on determination of the project to ensure management measures proposed adequately reflect the requirements of the Conditions of Consent. • The revised controls will be prepared in consultation with the NSW EPA, NSW Water and Hunter Water for approval by NSW DPE.	Prior to commencement of operations	SWMP Section 7.1 & 7.4
b)	• Water for potable use and dust suppression will be drawn from Hunter Water's reticulated water supply at Cabbage Tree Road. No groundwater will be extracted or utilised.	Ongoing	SWMP Section 7.2 CEMP 5.4.1.3
c)	• Surface water will be contained onsite through incorporation of bunds around the perimeter of the resource area. Most of the bunds will be created as a result of the extraction process being topographically lower than the adjacent surfaces. The bund will also be incorporated into the access	Ongoing	CEMP 5.4.1.2 A SWMP Section 7.4

SOC Item	Commitment	Timing	Comment / Status
	road through a trafficable mound that ensures all surface water within the resource area must percolate vertically into the groundwater.		
d)	• Rainwater will be captured from the workshop and office roofed area and reused for dust suppression.	Ongoing	SWMP Section 7.2 B
e)	• All impervious areas will be shaped such that water sheds to infiltration areas constructed in areas adjoining rehabilitated areas.	Ongoing	CEMP Section 5.4.1.2 A
f)	• WSS will consult with DPI Water with regards to the locations of and construction of proposed groundwater monitoring points, installation of loggers and selection of sampling points.	Prior to construction	SWMP Section 8.1.1
g)	• WSS will install groundwater monitoring wells, so that monitoring can be performed immediately up and down gradient of the main extraction areas after destruction of existing bores.	As required if monitoring bore removed	SWMP Section 7.11 A
h)	• Data loggers will be installed in monitoring wells to continuously monitor and provide additional data for input to the groundwater model.	Prior to construction	SWMP Section 7.11 B
i)	• Trigger levels for monitoring will be developed in consultation with DPI Water to ensure the groundwater table is not intersected.	Prior to construction	SWMP Section 8.6
j)	• Management protocols for PFAS for sub-water table disturbance during construction.	Prior to construction	CEMP Section 5.4.1.1 A
k)	• WSS will update the groundwater model every two years from commencement of quarry activities to determine maximum predicted groundwater level along with updated topography showing the progress of the quarry.	Every 2 years	SWMP Section 3.6.1 and Appendix 3
l)	• The quarry floor height will be reviewed every two years against the revised groundwater model (refer to Rehabilitation section for establishing the adopted level), unless trigger levels determine a review is required.	Every 2 years	MED MP Section 8.3.8 F

SOC Item	Commitment	Timing	Comment / Status
m)	• No equipment maintenance will occur within Tomago Sandbeds Special Area.	Ongoing	SWMP Section 7.10 A
8.3.9	**Hydrocarbon Controls**		
a)	• If obvious signs of contamination such as discoloured or odorous soils are encountered during site set-up and extraction, work will stop in the vicinity of the area and, if safe to do so, samples will be taken for analysis.	Ongoing	SWMP Section 7.8 A
b)	• A fully bunded and undercover hardstand for fuel, hydrocarbon and chemical storage will be constructed outside of the Tomago Sandbeds Special Area.	Ongoing	SWMP Section 7.8 B
c)	• Personnel to be trained in spill containment and response procedures.	Ongoing	SWMP Section 7.9 F
d)	• Hazardous material stored onsite will be kept to the minimum practicable amount.	Ongoing	SWMP Section 7.8 D
e)	• Spill response kits will be kept and maintained onsite.	Ongoing	SWMP Section 7.9 G

f)	Processing plant area (moved around the site based on resource area) installed on site will include:
	• A bunded parking area for the overnight parking of the bull dozer.
	• If power via electrical mains supply is unavailable, diesel generators will be required. If used, diesel generators will:
	  ○ Be located within a bunded area.
	  ○ Include an internal double skinned and self bunded diesel storage tank.
	  ○ Be refuelled as required within the bunded refill area.
	• Be returned to the Office and Workshop Compound on conclusion of operations each Saturday. This is proposed in the context of reducing the risk of vandalism over the weekend, and limiting risks (e.g. electrical and diesel) associated with the daily transport of the generator to and from processing plant area.
		Ongoing	SWMP Section 7.8 G

SOC Item	Commitment	Timing	Comment / Status
g)	Mobile equipment installed on site will: • Be refuelled at a lined and bunded refuelling area. • Include spill control kits. • Operators trained in the use and maintenance of spill control kits. • Return of all mobile equipment at end of each day to Office and Workshop Compound (excluding the bull dozer).	Ongoing	SWMP Section 7.8 H
h)	• Electric screen and air separator installed on site will include bunding under the electric screen and air separator plant to capture hydraulic leaks.	Ongoing	SWMP Section 7.8 I
i)	• Refuelling of equipment will be undertaken over a bunded concrete pad by a registered contractor. No fuel or diesel will be stored on site contained in plant and equipment. Oils and grease will be stored in a bunded area.	Ongoing	Wording changed from concrete to impervious bunding or lining. SWMP Section 5.1.2.1 and Section 7.8 E
j)	Mobile plant used in the extraction process will be refuelled outside of the Tomago Sandbeds Special Area, including: • Pneumatic tyred loaders (2x full time) • Dump Trucks (campaign usage as required for extraction area 7C). • Sales truck (Daily). • Trailer mounted diesel generator to power processing plant interim or back up in the event electricity is not available.	Ongoing	SWMP Section 7.8
k)	All diesel powered pneumatic tyred mobile plant will be removed from the Tomago Sandbeds Special Area at the end of each day's operation, including: • Loaders x 2 (daily) • Dump trucks (campaign usage as required for extraction area 7C). • Sales trucks (daily) • Trailer mounted diesel generator (where used) • This plant will be stored within fenced area with CCTV and back to base security at the Office and Worksop area located outside the Special Area.	Ongoing	SWMP Section 5.1.2.1
l)	• When plant and equipment is not operating, pressure will be removed from hydraulic lines and hydraulic fluid returned to the tank. The tank will be bunded to 110% of capacity.	Ongoing	SWMP Section 7.8 J
m)	The tracked plant will be refuelled on a fully bunded and lined hardstand. The following plant that are permitted to be refuelled on the fully bunded and lined hardstand area within the Tomago Sandbeds Special area include:	Ongoing	Wording changed to impervious bunded area. SWMP

SOC Item	Commitment	Timing	Comment / Status
	• 1 x Dozer (Maximum of 3 campaigns of 2 weeks each, 42 days per year). • 1x Excavator (Maximum of 3 campaigns of 2 weeks each, 42 days per year).		Section 5.1.2.1 & 7.10 A
n)	Any hydrocarbon spills on site will include the following response: • Immediate deployment of spill control kits. • Notifications of relevant stakeholders (e.g. EPA and HWC) consistent with the Pollution Incident Response Management Plan (PIRMP) for any spills estimated to be greater than 30 L. • Recovery of all contaminated sands or gravels regardless of size for collection and offsite disposal at a licenced waste facility.	Following Spill	SWMP Section 7.9 B
o)	• Appropriate maintenance schedules for plant and equipment must be followed to detect and repair leaks.	Ongoing	SWMP Section 9.1 F

NEWCASTLE SAND

APPENDIX 3: SUMMARY OF CURRENT GROUNDWATER MODELLING

1.1 GROUNDWATER MODEL ASSUMPTIONS

The modelling of Umwelt (2015 and 2016) was reviewed against checklists from the relevant guidelines (Barnett *et al*, 2012). The key features and assumptions of the current model are outlined as follows. Section references refer to Umwelt 2015 and 2016 reports.

1.2 MODEL LAYERING

The groundwater model uses 1 layer to represent the Tomago Sandbeds, with the bas elevation of the model being set at a constant -40 mAHD. This is a simplification of the thickness of the aquifer but should not affect the ability of the model to simulate the water table.

1.3 MODEL PARAMETERS

Umwelt (2015) specified a constant horizontal hydraulic conductivity of 32.5 m/d for the Tomago Sandbeds. This is a reasonable value (between 20-50 m/d, as per Section 1.3.4), although possibly slightly high for a uniform value. Umwelt specified a vertical K of 3.5 m/d, which again seems reasonable, although given that the model has a single layer then it is irrelevant to the simulation.

Modelled specific yield is set at 14.7%.

The match between the modelled values and field data is considered reasonable (**Section 1.3.4**). The match between Sy values is less certain, but appropriate given caveats around the uncertainty in Sy measurements obtained from the analysis of pumping test in this area (AECOM, 2017).

1.4 MODEL EXTENT

Figure 8 shows the extent of the model in relation to the quarry (site) boundary [red line], RAAF Williamtown [black line] and Fullerton Cove [blue area to the south of the quarry]. The extent is appropriate for simulating heads around the quarry.

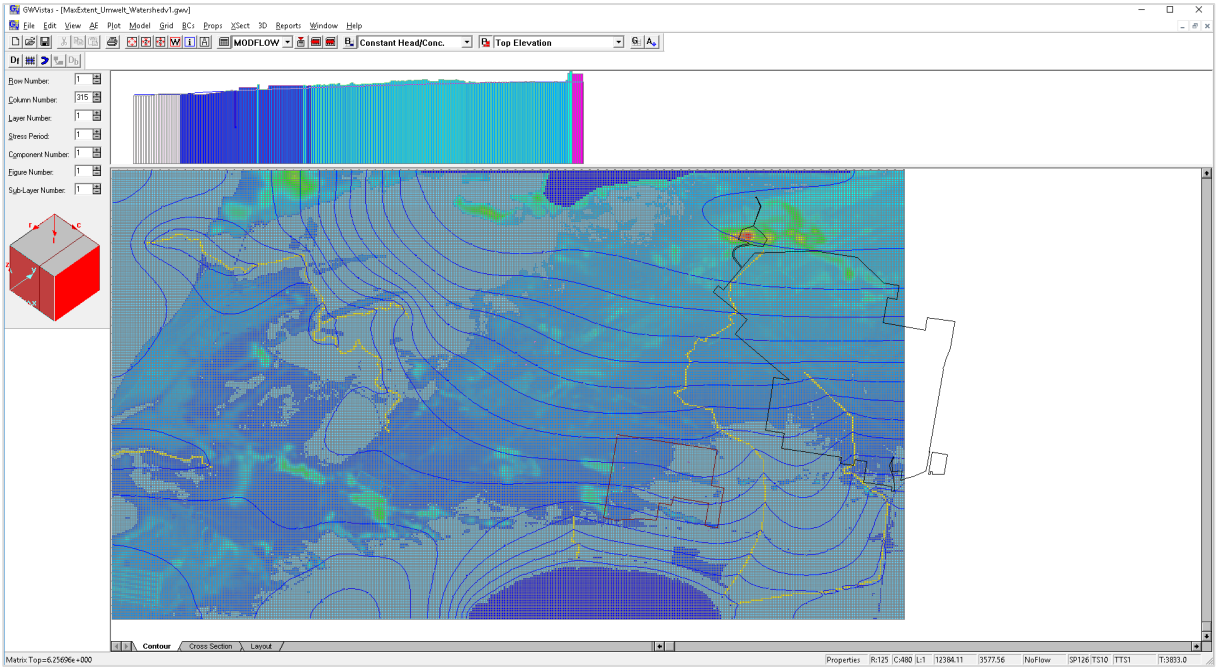

Figure 8: **(Appendix 3) Screenshot of the Umwelt groundwater model in Groundwater Vistas**

1.5 MODEL BOUNDARY CONDITIONS

The Umwelt groundwater model employs a number of important boundary conditions.

- Constant head at Fullerton Cove, set to 0.6 mAHD, which is appropriate (Figure 7).
- Constant head at Grahamstown Dam, set to 7.75 mAHD. The level itself is reasonable, but in reality, this waterbody does not interact with the groundwater in the Tomago Sandbeds due to the clay liner installed along the southern wall/bank of the reservoir.
- Recharge and evapotranspiration are estimated as % of rainfall and potential evaporation (PE). As stated in Umwelt (2015), recharge is set to 35% of rainfall, while evapotranspiration from the water table is set to a maximum rate of 60% of PE. Extinction depth for evapotranspiration has been set at a base level of 2.5 m, and lower value of 1 m also considered. These are appropriate for the area around the quarry.

- Watercourses are represented using MODFLOW ‘Drain’ package (yellow lines on Figure 7), which accounts for baseflow, but not leakage.
- The model does not incorporate pumping from the HWC borefields. As noted by Umwelt, this makes the predictions more conservative with respect to high groundwater levels, so is appropriate.

1.6 FUTURE VERIFICATION AND REVISION

The model will be verified/updated every two years from commencement of quarry activities to determine maximum predicted groundwater level along with updated topography showing the progress of the quarry.

APPENDIX 4: STANDARD ESC CONTROL DIAGRAMS

Sourced from Catchments & Creeks Pty Ltd https://www.catchmentsandcreeks.com.au/index.html

Check Dam Sediment Traps

SEDIMENT CONTROL TECHNIQUE

Type 1 System		Sheet Flow		Sandy Soils	✓
Type 2 System		Concentrated Flow	✓	Clayey Soils	✓
Type 3 System	[1]	Supplementary Trap	✓	Dispersive Soils	

[1] Generally considered a 'supplementary' sediment trap that should not be used as a site's primary sediment trap; however, substantial check dam sediment traps can be constructed (e.g. Photo 2).

Symbol CDT 

Photo 1 – Sandbag check dam sediment traps

Photo 2 – Rock check dam sediment traps

Key Principles

1. Check dams are primarily used as drainage control devices for the control of flow velocity; however, most check dams will also collect small qualities of sediment.
2. The sediment trapping ability of check dams can be improved by excavating a sediment collection pit up-slope of the dams.
3. The critical design parameter is the total surface area of ponding up-slope of the dams.
4. The critical operational issues relate to the frequency of sediment removal from the traps. If the check dams are being used as sediment traps, then they must be de-silted on a regular basis.

Design Information

This fact sheet specifically addresses the design of check dam sediment traps. For guidance on the design of flow control check dams, refer to the separate drainage control fact sheet on Check Dams.

Check dams can be constructed from rock, sandbags, plastic grids (*Triangular Ditch Checks*), or compost-filled *Filter Socks*. Compost-filled socks provide the added advantage of being able to adsorb some dissolved and fine particulate matter. Straw/hay bales must **not** be used.

As a rock check dam increases in size (say, height > 500mm) it begins to function as a *Rock Filter Dam*, in which case the design rules specified for *Rock Filter Dams* applies.

If used for velocity control, check dams should be spaced down the drain such that the **toe** of the check dam is level with the **crest** of the immediate downstream check dam.

If used primarily as a sediment trap, the check dams should be installed such that the total surface area of ponding (Figure 1) upstream of the check dams is maximised.

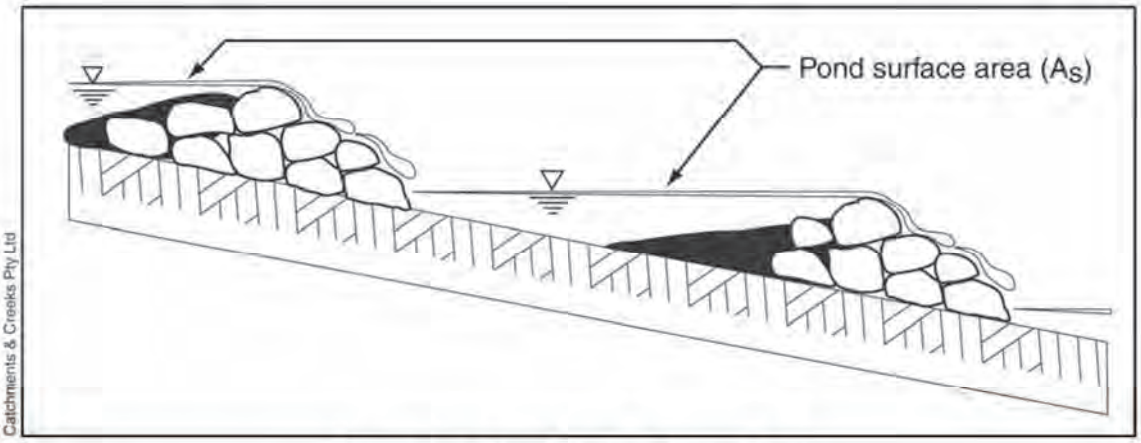

Figure 1 – Check dam sediment trap

Maximum allowable channel gradient is 10% (1 in 10).

Maximum recommended crest height of around 500mm. Check dams with a height exceeding 500mm should be checked for hydraulic stability.

The crest invert should be at least 150mm lower than outer edges (Figure 2). This is to reduce the potential for water to bypass around the edge of the check dam, and to allow the concentration of flow in the centre of the channel.

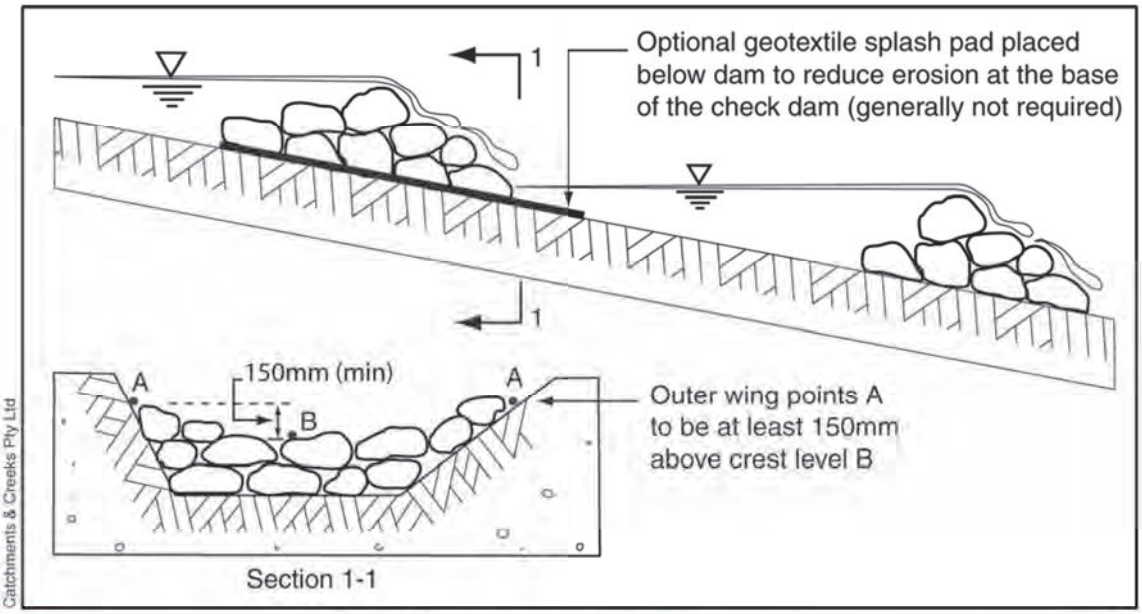

Figure 2 – Profile of rock check dam

The crest of the check dam should be curved (vertically) such that flow first spills over the centre of the dam. Ideally, the crest of each dam should be at least 150mm lower than the bank elevation at the outer edges of the structure.

The purpose of a curved crest profile is to:

- minimise the quantity of water bypassing around the edge of the check dam; and
- to concentrate flow into the centre of the channel.

Use of a flat crest profile can cause erosion (rilling) down the banks of the drain.

Maximum bank slope of rock face is 2:1 (H:V). For check dams higher than 0.5m the slope of the downstream face may need to be significantly flatter than a 2:1 slope.

If a check dam is likely to significantly choke a drainage channel causing water to overtop the channel, and if such overtopping is likely to cause drainage or erosion problems, then the hydraulic capacity of the check dam and channel should be checked. Refer to guidelines provided within the fact sheets for drainage control *Check Dams* for advice.

(a) Rock size (rock check dams):

Typical rock size of 150 to 350mm.

(b) Compost-filled socks:

Typical sock diameter of 200 to 250mm.

Placed in a U-shape pointing downstream and embedded at least 100mm into the soil or otherwise anchored to prevent water passing under the socks. The larger socks generally have the ability to seal well on solid and earth surfaces without additional anchorage.

The crest of the sock **must** be at least 100mm lower than the lowest ground level immediately adjacent to the ends of the sock.

(c) Erosion control at toe of check dams:

Erosion downstream of each check dam will be minimised if the dams are correctly spaced such that the crest of each dam is level with the toe of the nearest upstream dam.

Where necessary, the risk of erosion at the toe of each check dam may be reduced by forming each check dam on a sheet of geotextile fabric (e.g. filter cloth or woven fabric) that extends downstream of the dam a distance at least equal to the height of the dam (Figure 1).

(d) Optimisation of sediment trapping performance:

Sediment collection may be optimised by:

- excavating a sediment collection pit up-slope of the dam (Figure 3); however, always check potential safety issues;
- using compost-filled filter socks in place of rock or sandbags.
- placing a layer of clean aggregate on the up-slope face of the dam (minor improvement in performance);
- placing a layer of filter cloth on the upstream face of the check dam.

Also refer to the sediment control fact sheet for *Rock Filter Dams* for the design of Type 2 sediment traps.

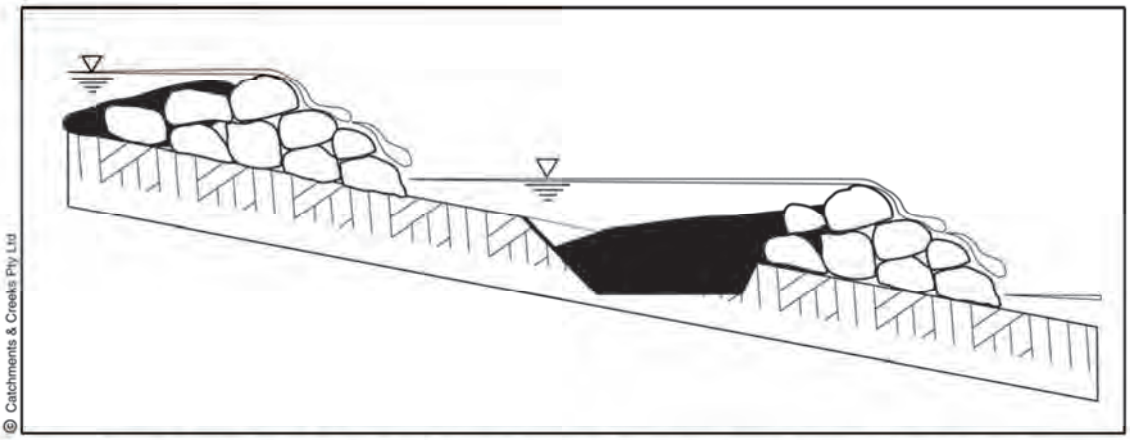

Figure 3 – Check dam sediment trap with optional sediment collection pit

Warning:

Check dams should **not** be used to control erosion within drains formed from dispersive soil. In circumstance where it is unavoidable, then the exposed dispersive soil should be covered with non-dispersive soil, and stabilised with an appropriate channel liner. Refer to guidelines provided within the fact sheets for drainage control *Check Dams* for further advice.

Description

Check dam sediment traps can be constructed from either semipervious or impervious materials typically rock, sandbags, or compost-filled filter socks.

Check dams should not be constructed from straw bales.

Purpose

Check dams are primarily used for drainage control purposes to control invert erosion within minor drainage channels.

However, check dam can also be used as minor sediment traps to supplement a site's sediment control system.

Limitations

Check dam sediment traps have relatively low sediment trapping efficiency and are generally only suitable for the capture of coarse sediment.

Limited to drain slopes less than 10%.

Not suitable for use in watercourses.

Should not be placed directly on dispersive soils, or within drains cut into dispersive soils.

Advantages

Quick and inexpensive to install and maintain.

Compost-filled filter socks can adsorb limited quantities of dissolved and fine particulate matter from that portion of the water passing through the socks.

Disadvantages

Can cause damage to grass cutting equipment if the rocks are not removed from the drainage channel after vegetation establishment.

Problems often occur when rock check dams are specified in shallow drains (<500mm deep). In such cases, the dams can significantly reduce the flow capacity of the drain.

Special Requirements

Installation of an excavated sediment collection pit can reduce maintenance.

Public safety issues must be addressed.

Care must be taken to prevent failure caused by water undermining or bypassing the dams.

Straw bales must **not** be used to form the dams.

Common Problems

Hydraulic problems often occur when rock check dams are specified in shallow drains.

Sediment not removed from the check dams on a regular basis (only required when the check dams are specifically used as sediment traps).

Site Inspection

Ensure the sediment traps are appropriate for the type of channel.

Ensure the crest is below the height of the outer wings of each dam.

Ensure the dams are appropriately spaced.

Check for potential safety risks.

Check if the sediment traps need de-silting.

Materials

- Rock: 150 to 300mm equivalent diameter, hard, erosion resistant rock.
- Sandbags: geotextile bags (woven synthetic, or non-woven biodegradable) filled with clean coarse sand, clean aggregate, or compost.

Installation (Rock Check Dam)

1. Refer to approved plans for location and installation details. If there are questions or problems with the location or method of installation contact the engineer or responsible on-site officer for assistance.
2. Prior to placement of the sediment trap, ensure the drainage channel is deep enough to prevent water being unsafely diverted out of the drain once the check dams are installed.
3. Locate each check dam sediment trap as directed within the approved plans, or otherwise at such a spacing to achieve the required sediment trapping outcomes.
4. If the check dams are also being used to control erosion within the drainage channel, then locate each successive check dam such that the crest of the immediate downstream dam is level with the channel invert at the immediate upstream check dam.
5. Construct each check dam to the dimensions and profile shown within the approved plan.
6. Where specified, the check dams must be constructed on a sheet of geotextile fabric used as a downstream splash pad.
7. Each check dam must be extended up the channel bank (where practicable) to an elevation at least 150mm above the crest level of the dam.

Installation (Compost-filled socks)

1. Refer to approved plans for location and installation details. If there are questions or problems with the location or method of installation contact the engineer or responsible on-site officer for assistance.
2. Prior to placement of the sediment trap, ensure the drainage channel is deep enough to prevent water being unsafely diverted out of the drain once the check dams are installed.
3. Locate each sock as directed within the approved plans, or otherwise at such a spacing to achieve the required sediment trapping outcomes.
4. Place each sock to the lines and profile shown in the approved plan or as directed by the site supervisor.
5. Ensure each sock extends up the channel banks (where practical) to a level at least 100mm above the crest level of the check dam.

Maintenance

1. Inspect each check dam and the drainage channel at least weekly and after runoff-producing rainfall.
2. Correct all damage immediately. If significant erosion occurs between any of the check dams, then check the spacing of the dams and where necessary install intermediate check dams or a suitable channel liner.
3. Check for displacement of the check dams.
4. Check for soil scour around the ends of each check dam. If such erosion is occurring, consider extending the width of the check dam to avoid such problems.
5. If severe soil erosion occurs either under or around the check dams, then seek expert advice on an alternative treatment measure.
6. De-silt sediment trap if the sediment level exceeds 1/3 the crest height.
7. Dispose of collected sediment in a suitable manner that will not cause an erosion or pollution hazard.

Removal

1. When construction work within the drainage area above the check dams has been completed and disturbed areas sufficiently stabilised to restrain erosion, the dams must be removed, unless the sediment traps are to remain as a permanent feature.
2. Remove collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
3. Remove and appropriately dispose of all materials including any geotextile fabric.
4. Stabilise the disturbed channel with a lining of fabric and rock, or establish vegetation as appropriate.

Construction Exits – Vibration grids

SEDIMENT CONTROL TECHNIQUE

Type 1 System		Sheet Flow		Sandy Soils	✓
Type 2 System		Concentrated Flow		Clayey Soils	[1]
Type 3 System		Supplementary Trap	✓	Dispersive Soils	

[1] Reduced efficiency should be expected for clayey soils, especially during wet weather.

Symbol

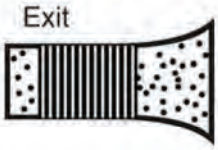

Photo 1 – Vibration grid and rock pad

Photo 2 – Vibration grid

Key Principles

1. The critical design parameter is the length of the vibration grid.
2. Vibration grids operate best during dry weather, thus the adjoining rock ramps are essential for sediment control during wet weather.
3. The sediment trapping ability of the adjoining rock ramps is directly related to the 'volume' of open voids between the rocks, which is related to the uniformity of the rock size, and the length and depth of rock.

Design Information

Vibration grids are most commonly formed from metal angle (e.g. 100x100x10mm) at approximately 270mm spacing. The metal grid must not be placed directly on the ground, but elevated above a suitable sediment collection chamber (e.g. an inverted box culvert).

Recommended minimum length of the vibration grid is 4m, but the overall minimum length of the stabilised construction exit (i.e. grid plus rock ramps) is 15m.

Minimum width of 3m or 2.5m per lane.

An adequate sediment storage collection chamber is required under the vibration grid.

An access track between the vibration grid and the sealed roadway must be stabilised with rock as per the requirements for *Rock Pads*.

The rock pad/ramp is to be made safe for foot traffic if it crosses an open footpath.

Rock must placed on filter cloth (minimum 'bidim' A24 or equivalent) if located on clayey or unstable soils.

Figures 1 and 2 show the typical layout of a vibration grid within an extended rock pad. The rock pad normally needs to be formed above natural ground level to accommodate the sediment collection chamber beneath the vibration grid.

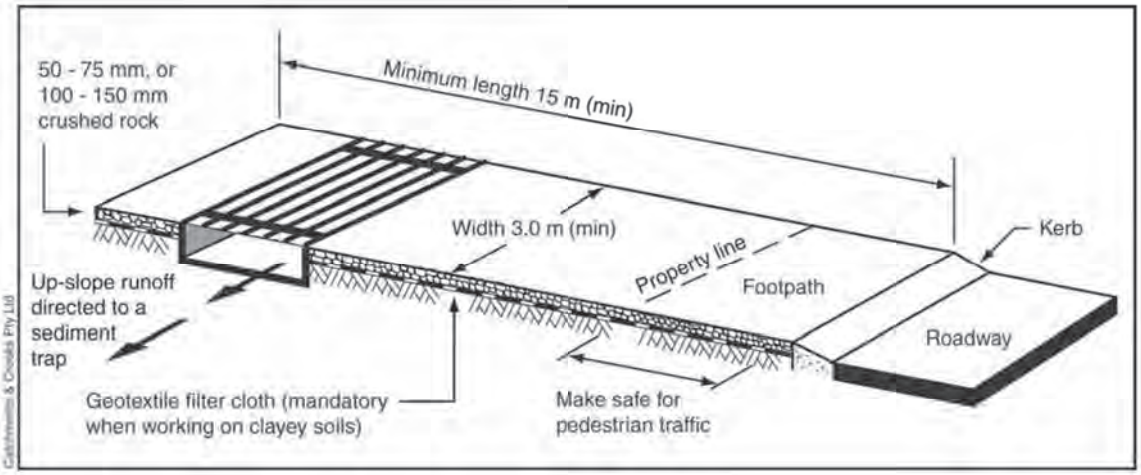

Figure 1 – Typical layout of vibration grid with rock ramps

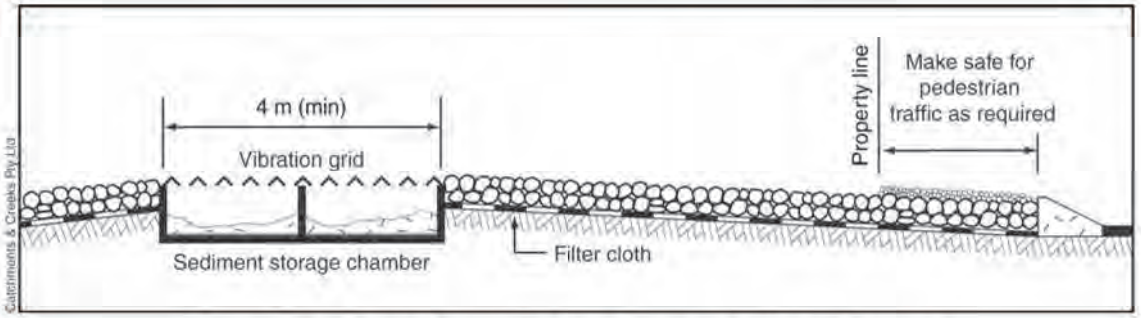

Figure 2 – Typical layout of vibration grid with rock ramps

There are many variations in the design of vibration grids as can be seen in Photos 2, 3 and 4. Figure 3 shows the typical dimensions of a vibration grid formed from metal angles.

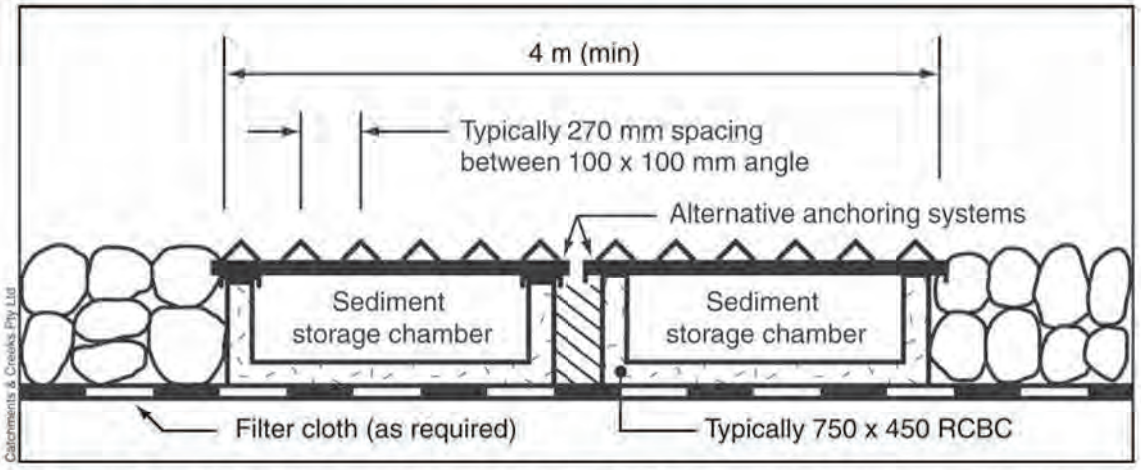

Figure 3 – Typical arrangement of vibration grid and sediment collection chamber

Photo 3 – Vibration grid

Photo 4 – Vibration grid

One of the regular problems associated with the use of vibration grids is the reluctance of owner-drivers to use the grids due to possible truck damage. An alternative design concept, which is in the early stages of development, is the use of a coarse rock layer on top of the grid (Figure 4) to reduce damage to trucks while maintaining the unit's full sediment trapping ability. Alternatively, heavy duty decking mesh (Figure 5) can be used. Both these systems more closely simulate the sediment trapping actions of traditional rock pads.

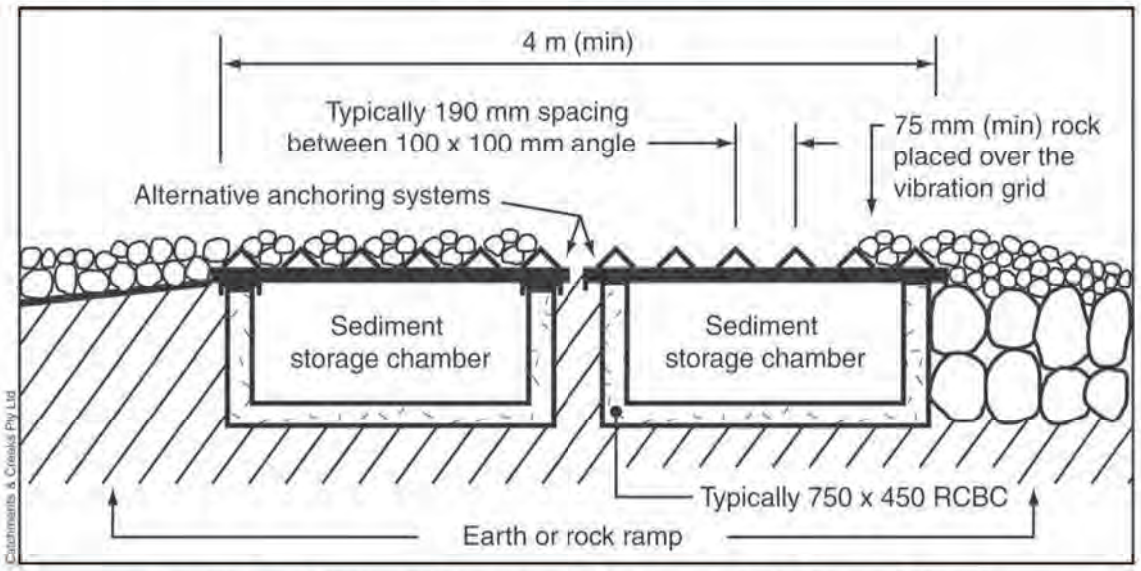

Figure 4 – Alternative conceptual design using rock upper course

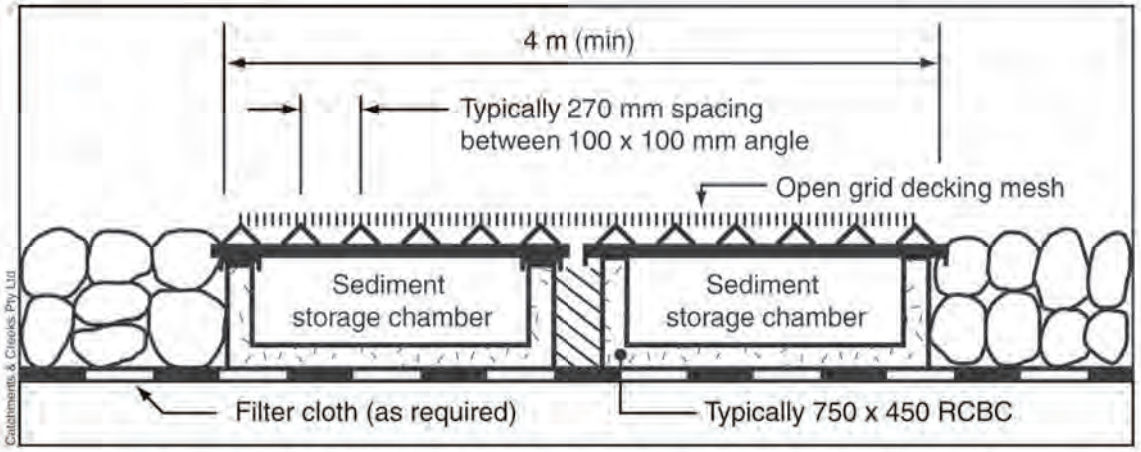

Figure 5 – Alternative conceptual design using upper mesh layer

Description

'Construction exit' is a general term referring to *rock pads, vibration grids* and *wash bays*.

Vibration grids typically consist of prefabricated metal grids (Photos 2, 3 & 4) placed on concrete sediment collection chambers.

Purpose

The basic aim of a vibration grid is to help prevent sediment being released onto public roads via the entry or exit road.

Principally used to vibrate dry, sandy soil from vehicle tyres.

Stabilised construction exits are one of the few sediment control measures that are required during both wet and dry weather.

Limitations

Vibration grids are 'supplementary' sediment traps typically of low sediment trapping efficiency.

Sediment trapping efficiency is generally related to the soil type and weather conditions.

The vibration grid is most effective during dry weather conditions. The associated rock ramps are most effective during wet weather conditions.

Generally not used on building sites.

Vibration grids (in isolation from a rock pad) are not effective in removing cohesive (sticky) soil from vehicle tyres.

Advantages

The prefabricated units can be hired.

Welded steel grids can be constructed then reused for several years.

A combined vibration grid and rock pad is generally more effective than a rock pad in isolation.

Disadvantages

Requires regular maintenance including de-silting the sediment collection chamber and adding/replacing rock.

Location

Located at site entry points, or where vehicles pass from unsealed roads onto sealed roads.

It is important to locate the construction exit such that vehicles cannot bypass the vibration grid when exiting the site.

The construction site entry/exit point may not necessarily be located at the permanent site entry/exit point.

Vibration grids should be set back from the public roadway to allow maximum deposition of sediment.

Common Problems

Inadequate maintenance.

Inadequate sediment storage volume below the grid.

Sediment not regularly removed from the rock ramps or collection chambers.

Drainage not adequately controlled at the entry/exit point, allowing sediment-laden stormwater runoff to wash onto public roads.

Special Requirements

The vibration grid must be set inside either a rock pad or sealed roadway.

Surface water flowing over the construction exit sediment trap must be directed to a sediment trap.

The vibration grid must not become a source of sediment runoff onto the adjacent road.

A square-edged shovel and large stiff-bristled broom must be available on-site for maintenance.

Rock must be placed on filter cloth (minimum 'bidim' A24 or equivalent) if placed on clayey or unstable soils.

Site Inspection

Check for excessive sedimentation on the associated rock ramps/pad.

Check for sediment tacked onto the road.

Check if an additional layer of rock is required on the rock ramps.

Ensure surface runoff is directed to a suitable sediment trap.

Materials

- Rock: well graded, hard, angular, erosion resistant rock, nominal diameter of 50mm to 75mm (small disturbances) or 100 to 150mm (large disturbances). All reasonable measures must be taken to obtain rock of near uniform size.
- Footpath stabilising aggregate: 25 to 50mm gravel or aggregate.
- Geotextile fabric: heavy-duty, needle-punched, non-woven filter cloth ('bidim' A24 or equivalent).

Installation

1. Refer to approved plans for location and dimensional details. If there are questions or problems with the location, dimensions, or method of installation, contact the engineer or responsible on-site officer for assistance.
2. Clear the location of the vibration grid, removing stumps, roots and other vegetation to provide a firm foundation so that the rock is not pressed into soft ground. Clear sufficient width to allow passage of large vehicles, but clear only that necessary for the exit. Do not clear adjacent areas until the required erosion and sediment control devices are in place.
3. Grade the location of the vibration grid so that runoff from the unit will not flow into the street, but will flow towards an appropriate sediment-trapping device.
4. Ensure that the installation of the vibration grid includes adequate sediment storage volume under the grid. Where necessary, install suitable precast sediment collection chambers.
5. Place a rock pad/ramp forming a minimum 200mm thick layer of clean, open-void rock over the roadway between the vibration grid and the sealed street to prevent tyres from picking up more soil after they have been cleaned.
6. The total length of the vibration grip and rock ramps should be at least 15m where practicable, and as wide as the full width of the entry or exit and at least 3m. The rock ramp should commence at the edge of the off-site sealed road or pavement.
7. Flare the end of the rock pad where it meets the pavement so that the wheels of turning vehicles do not travel over unprotected soil.
8. If the footpath is open to pedestrian movement, then cover the coarse rock with fine aggregate or gravel, or otherwise take whatever measures are needed to make the area safe

Maintenance

1. Inspect vibration grid prior to forecast rain, daily during extended periods of rainfall, after significant runoff-producing rainfall, or otherwise at fortnightly intervals.
2. If sand, soil, sediment or mud is tracked or washed onto the adjacent sealed roadway, then such material must be physically removed, first using a square-edged shovel, and then a stiff-bristled broom, and then by a mechanical vacuum unit, if available.
3. If necessary for safety reasons, the roadway shall only be washed clean after all reasonable efforts have been taken to shovel and sweep the material from the roadway.
4. When the voids between the rock becomes filled with material and the effectiveness of the rock ramps are reduced to a point where sediment is being tracked off the site, a new 100mm layer of rock must be added and/or the rock pad must be extended.
5. Ensure any associated drainage control measures are maintained in accordance with their desired operational condition.
6. Dispose of sediment and debris in a manner that will not create an erosion or pollution hazard.

Removal

1. The vibration grid should be removed only after it is no longer needed as a sediment control device.
2. Remove materials and collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
3. Re-grade and stabilise the disturbed ground as necessary to minimise the erosion hazard.

NOTE: ALSO SEE FROG EXCLUSION FENCE DESIGN IN BIODIVERSITY PLAN - STANDARD FENCE WITH NON-VERTICAL INSTALL TO PERMIT FROG EGRESS

Sediment Fence

SEDIMENT CONTROL TECHNIQUE

Type 1 System		Sheet Flow	✓	Sandy Soils	✓
Type 2 System		Concentrated Flow	[1]	Clayey Soils	[2]
Type 3 System	✓	Supplementary Trap		Dispersive Soils	

[1] Not recommended in areas of concentrated flow—refer to *U-Shaped Sediment Traps*.

[2] Very limited capture of fine clay particles, but still useful for trapping sand and silt.

Symbol SF or SF

Photo 1 – Installation of a sediment fence

Photo 2 – Sediment fence located down-slope of multi-dwelling building site

Key Principles

1. Primarily used to collect coarse sediments. Sediment fences have a poor capture rate of the finer sediment particles, thus operators should not expect to see any significant change in the colour or turbidity of water passing through the fence.
2. Treatment is primarily achieved through gravity-induced 'settlement' resulting from the temporarily ponding of sediment-laden water up-slope of the fence. 'Filtration' is only a secondary function of the fabric, if at all.
3. Critical to the effectiveness of a sediment fence is the 'surface area' of the pond that forms up-slope of the fence. Therefore, sediment fences need to be installed such that the total surface area of ponding up-slope of the fence is maximised.
4. Optimum performance can be achieved by installing the fence in a manner that allows water to pond either:
   - uniformly along the fence (i.e. a fence located along a line of constant elevation); or
   - at regular intervals along the fence (i.e. a fence installed at a slight angle to the slope, but with regular 'returns' installed along the length of the fence).
5. Woven and composite fabrics perform slightly different tasks and their selection depends on site conditions.
6. Though often referred to as 'silt fences', a sediment fence is unlikely to trap significant quantities of fine silts (< 0.02mm), thus the term is considered an inappropriate description.
7. A sediment fence in its standard installation is only suitable for the treatment of 'sheet' flows. If concentrated flow exist, such as in a minor drain, then a *U-Shaped Sediment Trap*, or other more appropriate sediment trap should be used.

Design Information

Table 1 provides the recommended **maximum** slope length up-slope of a sediment fence.

Table 1 – Recommended maximum slope length up-slope of a sediment fence on non-vegetated slopes [1]

Batter slope			Horizontal spacing (m)	Vertical spacing (m)
Percentage	Degrees	(H):(V)		
1%	0.57	100:1	60 [2]	0.6 [2]
2%	1.15	50:1	60	1.2
4%	2.29	25:1	40	1.6
6%	3.43	16.7:1	32	1.9
8%	4.57	12.5:1	28	2.2
10%	5.71	10:1	25	2.5
15%	8.53	6.67:1	19	2.9
20%	11.3	5:1	16	3.2
25%	14.0	4:1	14	3.5
30%	16.7	3.33:1	12	3.5
40%	21.8	2.5:1	9	3.5
50%	26.6	2:1	6	3.0

[1] Maximum recommended spacings is based on minimising the risk of rill erosion on low to moderately erodible soil. In areas of highly erodible soil, the slope length may need to be reduced.

[2] Recommended maximum slope length above a sediment fence is 60m.

The maximum slope lengths presented in Table 1 for land slopes steeper than 2% may be represented by Equation 1.

$$\text{Maximum } \textbf{horizontal} \text{ slope length (m)} = 100/(\text{batter slope (\%)})^{0.64} \qquad \text{(Eqn 1)}$$

The allowable flow rate per meter length of sediment fence should, wherever possible, be determined from actual fabric testing. However, the actual flow rate at any point in time will depend on the degree of sediment blockage of the fabric.

In the absence of testing data, preliminary design flow rates can be obtained from Table 2.

Table 2 – Typical as-new and design flow rates for sediment fence fabric [1]

Depth up-slope of fence (m)	'As new' flow rate (L/s/m)		'Design' flow rate (L/s/m) [2]	
	Woven fabrics	Composite	Woven fabrics	Composite
0.2	2.6	4.8	1.3	2.4
0.4	5.6	10.6	2.8	5.3
0.6	9.0	17.8	4.5	8.9
0.8	12.6	26.2	6.3	13.1

[1] Flow rates are based on simplified test results that may not extrapolate well to actual field conditions.

[2] Suggested 'design' flow rates are based on an assumed 50% sediment blockage of the fabric.

Technical Note:

Australian Standards indicate that the flow rate through geotextiles for a given hydraulic head can be determined by extrapolating the measured flow rate at a hydraulic head of 100mm. Such analysis is **not** appropriate for woven fabrics such as sediment fence fabric. Hydraulic performance must be determined by appropriate physical testing at or above the required hydraulic head.

(a) Choice of fabric

Woven fabrics (Photo 3) are generally preferred on large sites when the service life is expected to extend over several storm events. Composite fabrics (Photo 5) are generally preferred on small soil disturbances such a building sites, or when the sediment fence is the last line of defence prior to the runoff discharging from the site or entering a water body.

Table 3 provides guidance on the selection of the preferred sediment fence fabric.

Table 3 – Preferred use of sediment fabrics

Fabric type	Preferred conditions of use
Woven fabrics	• Large sites when the service life is expected to extend over several storm events. • Up-slope of a Type 1 or Type 2 sediment trap.
Composite non-woven fabrics with a woven backing	• Small soil disturbances such a building sites. • When the sediment fence constitutes the last line of defence up-slope of a water body.

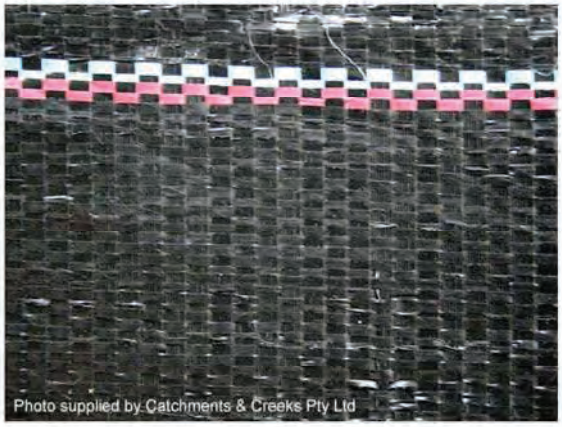

Photo 3 – Traditional woven sediment fence fabric

Photo 4 – Shade cloth MUST NOT be used

Composite fabrics, incorporating a non-woven fabric with woven fabric backing, typically have a higher flow rate (when first installed) due to the additional needle punching required to 'sew' the two fabrics together.

Composite fabrics are installed with the woven fabric as the down-slope face of the fence.

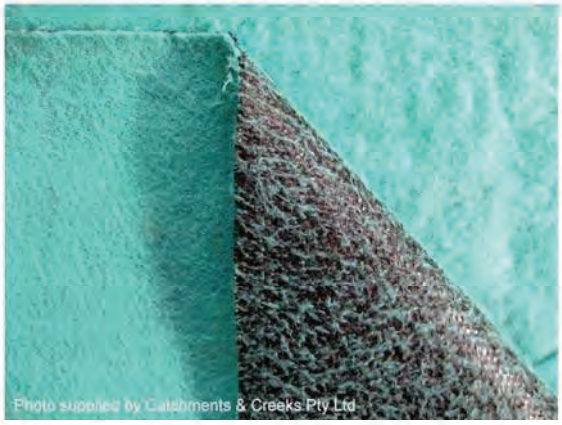

Photo 5 – Composite fabric with the woven (black) backing being the down-slope face of the sediment fence

Photo 6 – Filter cloth MUST NOT be used unless used in the construction of a 'Filter Fence' adjacent to a stockpile

Sediment fence fabric must be manufactured from either woven UV-stabilised polyester or polypropylene fabric, or a non-woven geotextile reinforced with a UV-stabilised polyester or polypropylene mesh.

Table 4 provides the recommended material properties of woven fabrics.

Table 4 – Recommended woven sediment fence material property requirements

Material property	Test method	Units	Typical value
Flow rate	AS 3706.9	$L/s/m^2$ (under 100 mm head)	15
Wide strip tensile strength	AS 3706.2	kN/m	10 both directions
Pore size (EOS) (O_{95})	AS 3706.7	mm x 10^{-3}	< 250
Mass per unit area	AS 3706.1	gsm	90
UV resistance	AS 3706.11	% retained (672 hours)	
Width	–	mm	730–910

Table 5 provides the recommended material properties of composite fabrics.

Table 5 – Recommended composite sediment fence material property requirements

Material property	Test method	Units	Typical value
Flow rate	AS 3706.9	$L/s/m^2$ (under 100 mm head)	145
Wide strip tensile strength	AS 3706.2	kN/m	17 both directions
Pore size (EOS) (O_{95})	AS 3706.7	mm x 10^{-3}	110
Mass per unit area	AS 3706.1	gsm	225
UV resistance	AS 3706.11	% retained (672 hours)	
Width	–	mm	730–910

(b) Location of a sediment fence

Wherever practical, the sediment fence should be installed along the contour, thus maintaining sheet flow conditions across the fence. If located at an angle to the contour, the fence needs to be installed with regular 'returns' to avoid water concentrating along the fence. Even if the fence is located along the contour, the use of regular returns is still recommended (refer to Figure 1).

The maximum spacing of fence 'returns' should be 20m if the fence is installed along the contour, or 5 to 10m (depending on slope) if located at an angle to the contour (Figure 2).

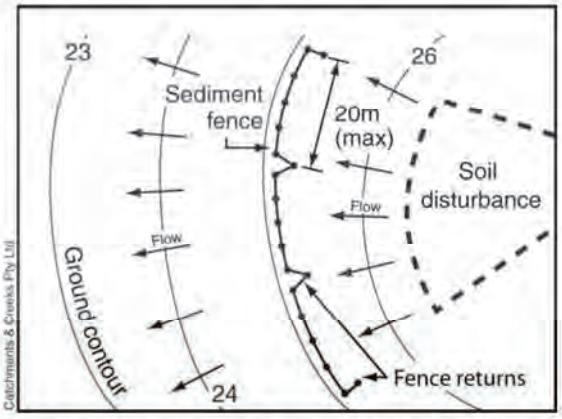

Figure 1 – Fence installed along the contour

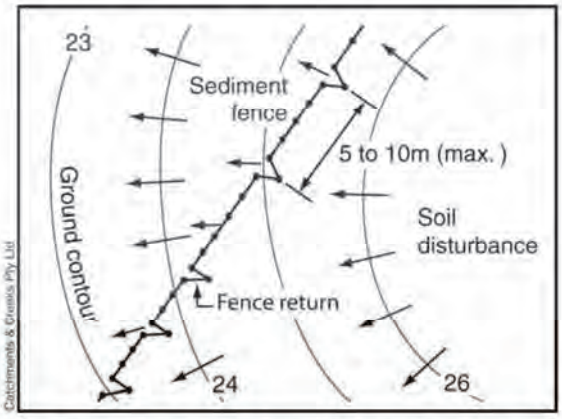

Figure 2 – Fence install down a slope

Wherever practical, allow at least 4.5m between the sediment fence and a single-storey building; 7.5m between the fence and a multiple-storey building; and at least 2m between the fence and the toe of a fill slope or stockpile (Figure 3).

A double sediment fence (Figure 4, Photo 8), or sediment fence with up-slope straw bale (Photo 7) can be used to reduce the risk of shifting fill damaging the fence.

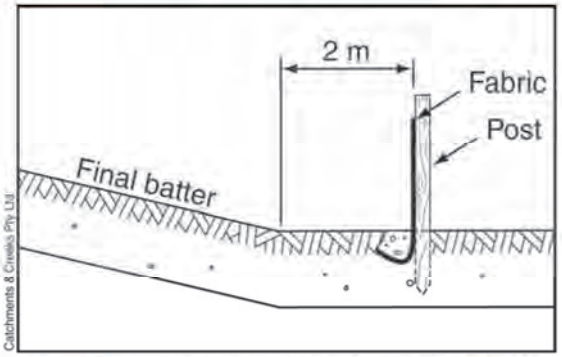

Figure 3 – Fence installation at base of slope

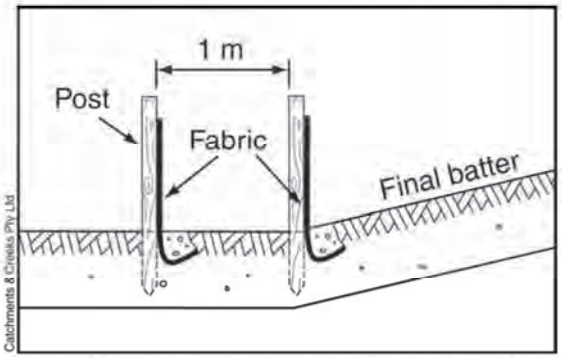

Figure 4 – Double sediment fence installed at the based of a fill slope

Photo 7 – Use of straw bales to prevent direct contact of stockpiles with the fence

Photo 8 – Double sediment fence

(c) Installation of a sediment fence

At least 300mm of fabric must be buried in either a 200mm trench (Figure 8, Photo 13), or under a continuous 100mm high layer of sand or aggregate (Photo 15), but **not** earth.

Straw bales can be placed up-slope of the fence (Figure 9) to retain settled sediment away from the fabric, thus improving the ease of ongoing maintenance (i.e. sediment removal). Alternatively, a small trench can be formed along the contour, up-slope of the fence.

Both ends of the fence should be turned up the slope to minimise the risk of flow bypassing around the ends of the fence (Figure 5, Photo 21).

Support posts should be spaced no greater than 3m if the fence is supported by a top support wire or weir mesh backing (Figure 7), otherwise no greater than 2m (Figure 6). The recommended maximum spacing of support posts is summarised in Table 6.

Table 6 – Maximum spacing of support post

Maximum post spacing	Installation condition
2m	No support wire or backing mesh.
3m	Support weir attached along top of the fabric at 1m intervals. Wire mesh or PVC safety mesh backing.

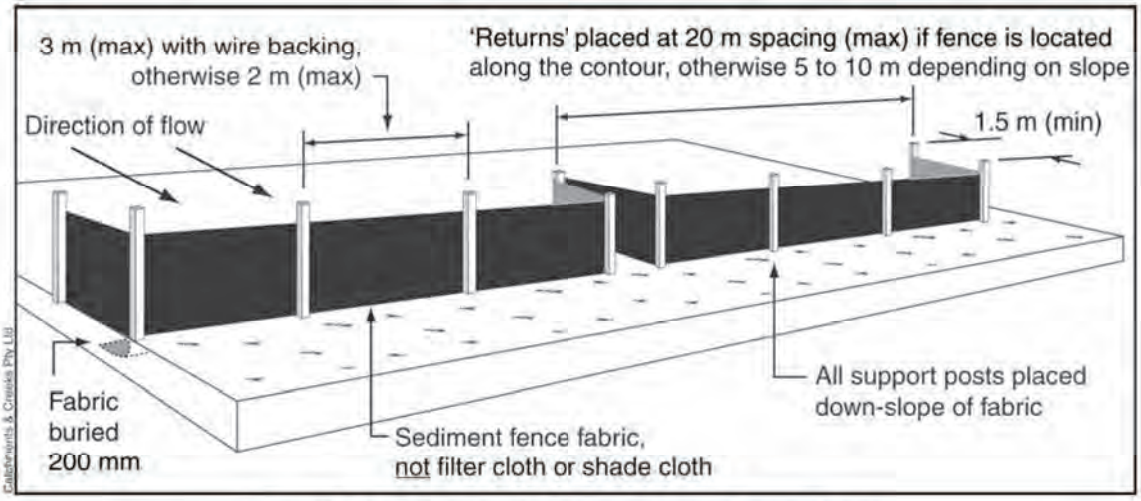

Figure 5 – Typical installation of a sediment fence

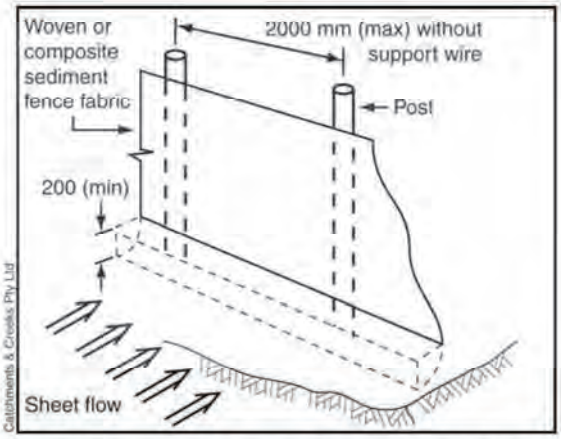

Figure 6 – Installation of a sediment fence without wire backing

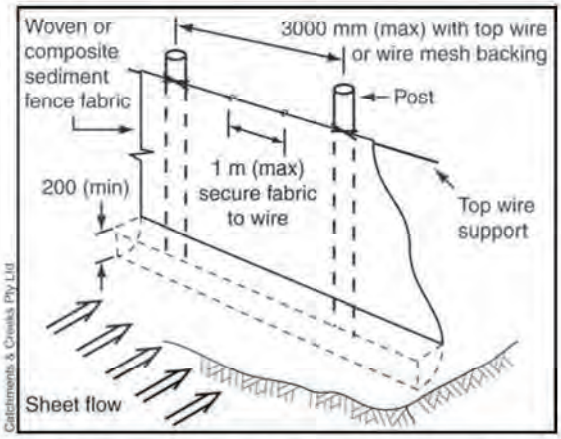

Figure 7 – Installation of a sediment fence with top wire support

Wherever possible, construct the sediment fence from a continuous roll. To join fabric either attach each end to individual stakes (Figure 10), holding the stakes together, rotate the stakes 180 degrees, then drive the two stakes into the ground; or overlap the fabric to the next support post (Figure 11).

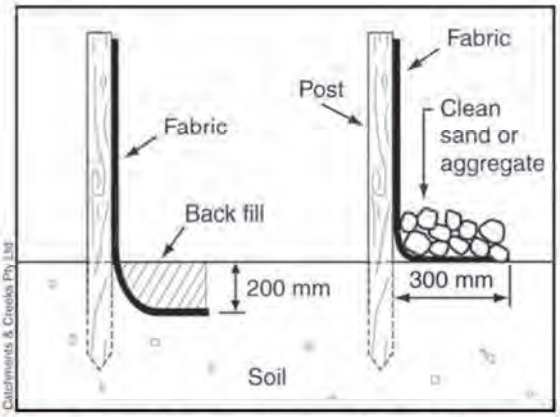

Figure 8 – Anchoring the fabric

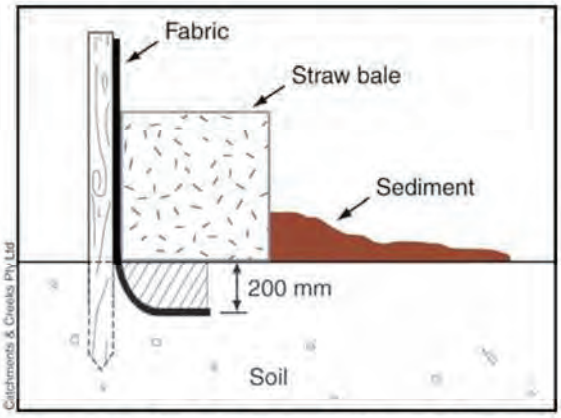

Figure 9 – Use of straw bales as a fabric-sediment separator

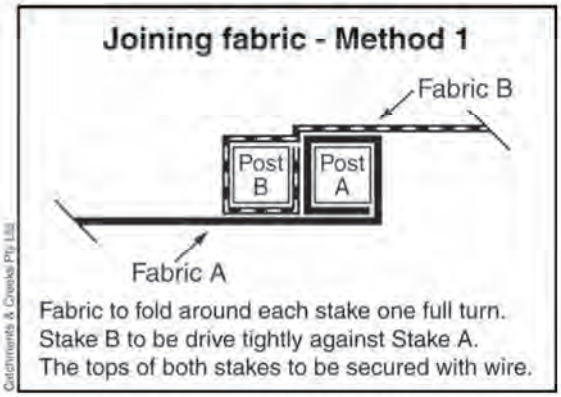

Figure 10 – Joining fabric (Option 1)

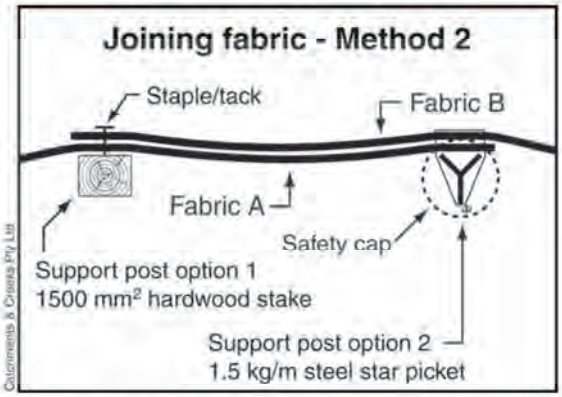

Figure 11 – Overlapping fabric (Option 2)

Photo 9 – Sediment fence placed along the contour

Photo 10 – Use of fence 'returns'

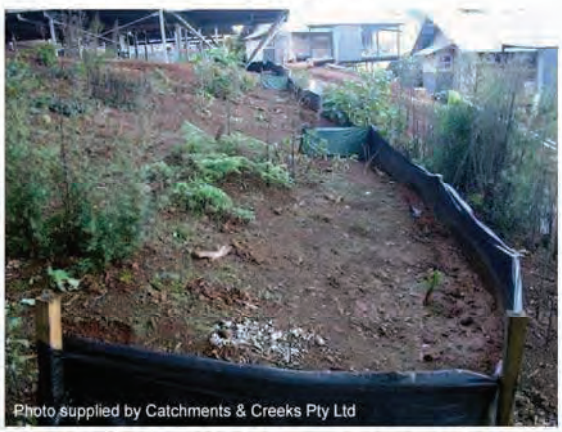

Photo 11 – Placement of fence off the contour with regular fence 'returns'

Photo 12 – Alternative design of a fence 'return'

Photo 13 – Trenching the fabric

Photo 14 – Inappropriate installation

Photo 15 – Bottom of fabric buried under aggregate

Photo 16 – Inappropriate use of sand to bury the fabric

Photo 17 – Straw bales placed up-slope of fence to separate sediment and fabric

Photo 18 – Inappropriate installation of the posts up-slope of the fabric

Photo 19 – Inappropriate junction

Photo 20 – Gaps in fence are not allowed

Photo 21 – Installation without backing weir/mesh

Photo 22 – Installation with top wire support

Photo 23 – Installation with weir mesh

Photo 24 – Installation using fence support

Photo 25 – Installation with safety fencing used as support

Photo 26 – A sediment fence braced for possible high flows

Photo 27 – Example of tacking

Photo 28 – Safety cap on a steel stake

Photo 29 – Flow diversion by fence

Photo 30 – No end return

Photo 31 – Damage by shifting fill

Photo 32 – Fence placed too close to fill

Photo 33 – Evidence of hydraulic wash-out under fence caused by poor trenching

Photo 34 – Sediment not removed after storm

Photo 35 – Flow allowed to bypass the fence

Photo 36 – Spill-through weirs must not discharge onto unstable land

(d) Use of spill-through weirs

Where appropriate, spill-through weirs can be installed into the fence to reduce hydraulic pressure and reduce the risk of hydraulic failure.

The required width (W) of the spill-through weir depends on the nominated design flow rate. The weir flow equation for a rectangular spill-through weir is provided below as Equation 2, as well as tabulated in Table 7.

$$Q = 1.7\, W\, H^{3/2} \qquad \text{(Eqn 2)}$$

where: Q = Design flow rate (usually 0.5 times the 1 in 1 year ARI peak discharge) [m^3/s]
W = Weir width [m]
H = Hydraulic head = height of upstream water level above weir crest [m]

Table 7 – Flow rates passing over a spill-through weir (m^3/s)

Hydraulic head, H (m)	Spill-through weir width, W (m)									
	0.3	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
0.10	0.016	0.027	0.054	0.081	0.108	0.134	0.161	0.188	0.215	0.242
0.15	0.030	0.049	0.099	0.148	0.198	0.247	0.296	0.346	0.395	0.444
0.20	0.046	0.076	0.152	0.228	0.304	0.380	0.456	0.532	0.608	0.684
0.25	0.064	0.106	0.213	0.319	0.425	0.531	0.638	0.744	0.850	0.956
0.30	0.084	0.140	0.279	0.419	0.559	0.698	0.838	0.978	1.12	1.26
0.35	0.106	0.176	0.352	0.528	0.704	0.880	1.06	1.23	1.41	1.58
0.40	0.129	0.215	0.430	0.645	0.860	1.08	1.29	1.51	1.72	1.94

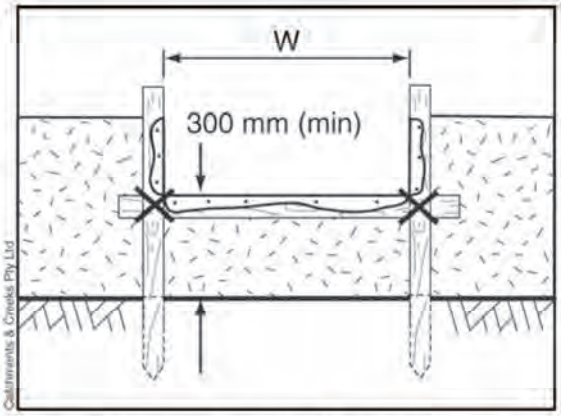

Figure 12 – Spill-through weir profile

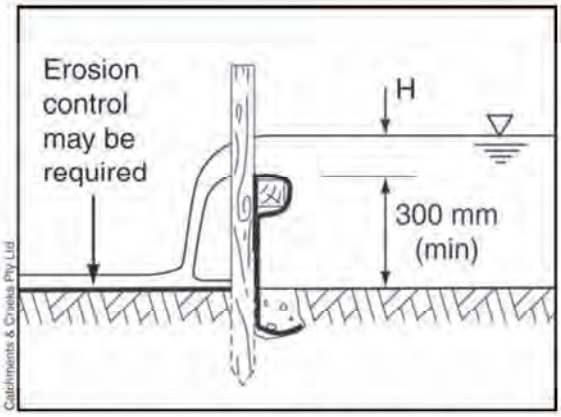

Figure 13 – Side profile of a spill-through weir

Photo 37 – Spill-through weir (down-slope side) with rock splash pad

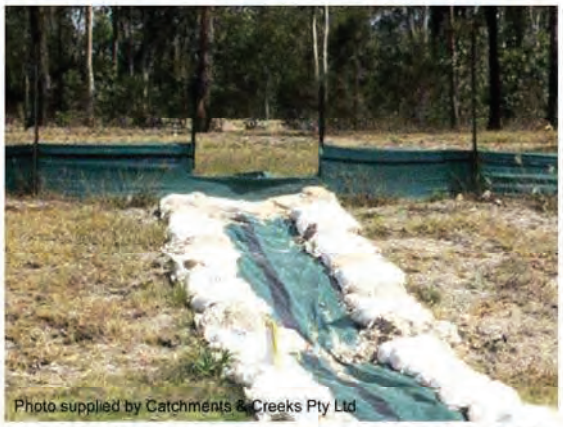

Photo 38 – Spill-through weir with outlet chute

Photo 39 – Spill-through weir with up-slope aggregate filter

Photo 40 – Inappropriate placement of fence and installation of spill-through weir

If large sediment flows are expected, then a *Coarse Sediment Trap* can be used as an outlet structure for a sediment fence as shown in Figure 14. However, in most circumstances, a more elaborate outlet system would be required such as a Type 1 or Type 2 sediment trap.

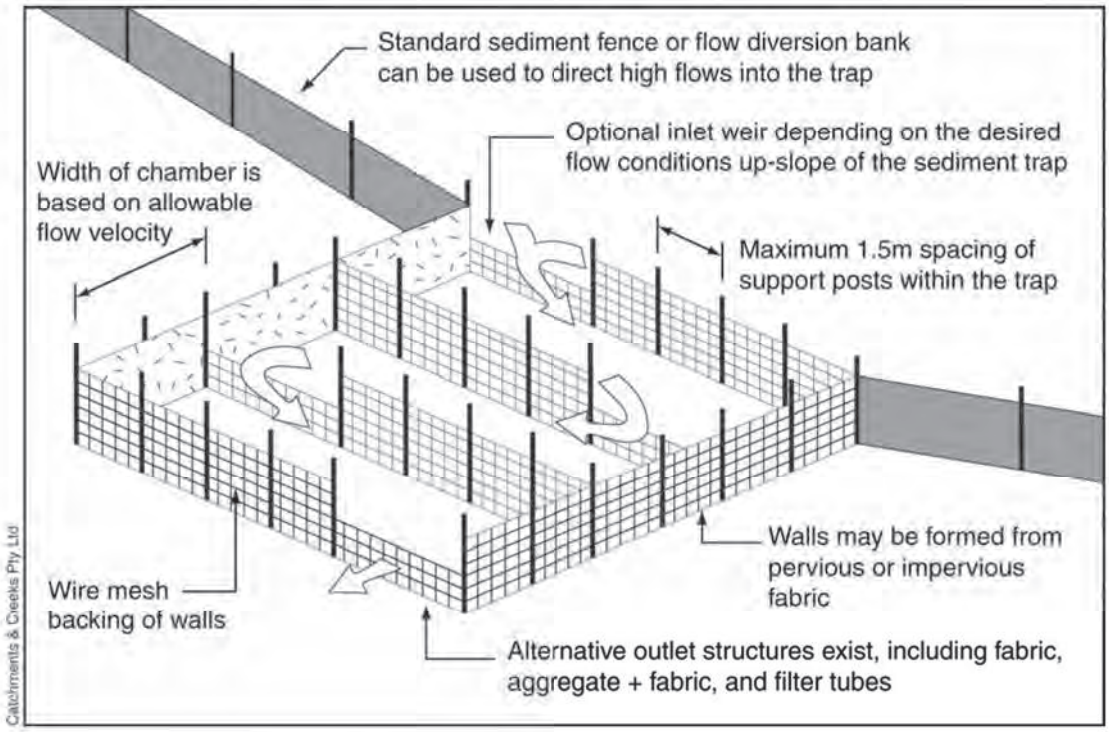

Figure 14 – Coarse sediment trap outlet structure

Description

A sediment fence consists of specially manufactured woven fabric attached to support posts. The typical height of the fence is around 600 to 700mm.

Most sediment fences are self-supporting; however, in appropriate circumstances the fence may be attached to an existing porous structure such as a property fence.

The fabric may be manufactured from either woven fabric, or a composite of woven and non-woven fabrics. The incorporation of a woven fabric is essential for the control of water flow needed to allow adequate temporary ponding up-slope of the fence.

Purpose

Used as a Type 3 sediment trap on small catchments, or as a supplement to Type 1 or 2 sediment traps on large catchments.

Limitations

Though often referred to as a 'silt fence', these Type 3 sediment traps have little impact on fine silts (< 0.02mm).

A sediment fence in its standard installation is only suitable for the treatment of 'sheet' flows. If concentrated flow exist, such as in a minor drain, then a *U-Shaped Sediment Trap*, or other more appropriate sediment trap should be used.

Most fabrics have an effective service life of around 6 months (check with manufacturer or distributor).

Advantages

Reasonably easy to install.

Has the ability to control sediment runoff close to the source of the erosion.

Disadvantages

Time-consuming to install, which often results in poor installation.

Easily damaged by construction equipment and shifting earth (Photos 31 & 32).

Can cause the concentration of stormwater runoff if poorly located, or installed.

Sediment fences are one of the most missed used sediment control devices, usually because they are either not installed in appropriate locations, or are installed in a manner that does not allow adequately water ponding up-slope of the fences.

Common Problems

If not installed along the contour, a sediment fence can result in flows being deflected along the fence (Photo 29).

If the ends of the fence are not turned up the slope, water and sediment can pass around the end of the fence (Photo 30).

If gaps exist in the fence (Photos 19 & 20), then water is prevented from ponding up-slope of the fence, thus sedimentation does not occur.

Excessive spacing between support posts is a common problem. In extreme cases this can result in the fabric sagging close to the ground.

Fabric not adequately connected to the support posts or backing wire.

The bottom of the fabric not adequately buried into the ground or under a suitable layer of sand or aggregate. If such fences are subjected to significant storms, the bottom of the fence can 'blow-out' causing erosion down-slope of the fence (Photo 33).

Spill-through weirs may not have been installed in large catchments or areas of high rainfall, thus increasing the risk of flow damage to the fence.

Crest of spill-through weir set too close to the ground (should be at least 300mm above ground level).

Crest of spill-through weir is set above the ground level at the ends of the fence, thus allowing flow bypassing rather than discharge over the weir (Photo 40).

Special Requirements

Woven fabrics are generally preferred on large sites when the service life is expected to extend over several storm events. Composite fabrics are generally preferred on small soil disturbances such a building sites, or when the sediment fence is the last line of defence prior to the runoff entering a water body.

Ideally, the sediment fence should be installed along the contour, thus maintaining sheet flow conditions across fence. If located across the contour, the fence should be installed with regular 'returns' to avoid water concentrating along the fence.

At least 300mm of fabric must be buried in either a 200mm trench, or under a continuous, 100mm high layer of sand or aggregate, but not earth.

Straw bales can be placed up-slope of the fence to retain bulk sediment away from the fabric, thus improving the ease of sediment removal. Alternatively, a small trench can be formed along the contour, up-slope of the fence. However, in all cases the aim should be to minimise high sediment flows so that such fence modifications become the exception, not the rule!

Where appropriate, spill-through weirs can be installed into the fence to reduce hydraulic pressure and reduce the risk of hydraulic failure.

Location

Install along the contour wherever possible.

Allow at least 4.5m between the fence and single-story buildings; 7.5m between the fence and multiple-story buildings; and at least 2m between the fence and the toe of a fill slope or stockpile.

Site Inspection

Ensure the sediment fence will adequately pond water up-slope of the fence.

Ensure the fabric is adequately buried.

Check the spacing of support posts/stakes.

Check for excessive sediment deposition.

Investigate the source of excessive sediment deposits.

Ensure the selection of appropriate fabric (i.e. woven or composite).

Check for damage to the fabric.

Check for erosion down-slope of any spill-through weirs.

Ensure the fence is not concentrating or diverting flows in an undesirable manner.

Materials

- Fabric: polypropylene, polyamide, nylon, polyester, or polyethylene woven or non-woven fabric, at least 700mm in width and a minimum unit weight of 140GSM. All fabrics to contain ultraviolet inhibitors and stabilisers to provide a minimum of 6 months of useable construction life (ultraviolet stability exceeding 70%).
- Fabric reinforcement: wire or steel mesh minimum 14-gauge with a maximum mesh spacing of 200mm.
- Support posts/stakes: 1500mm^2 (min) hardwood, 2500mm^2 (min) softwood, or 1.5kg/m (min) steel star pickets suitable for attaching fabric.

Installation

1. Refer to approved plans for location, extent, and required type of fabric (if specified). If there are questions or problems with the location, extent, fabric type, or method of installation contact the engineer or responsible on-site officer for assistance.
2. To the maximum degree practical, and where the plans allow, ensure the fence is located:
   (i) totally within the property boundaries;
   (ii) along a line of constant elevation wherever practical;
   (iii) at least 2m from the toe of any filling operations that may result in shifting soil/fill damaging the fence.
3. Install returns within the fence at maximum 20m intervals if the fence is installed along the contour, or 5 to 10m maximum spacing (depending on slope) if the fence is installed at an angle to the contour. The 'returns' shall consist of either:
   (i) V-shaped section extending at least 1.5m up the slope; or
   (ii) sandbag or rock/aggregate check dam a minimum 1/3 and maximum 1/2 fence height, and extending at least 1.5m up the slope.
4. Ensure the extreme ends of the fence are turned up the slope at least 1.5m, or as necessary, to minimise water bypassing around the fence.
5. Ensure the sediment fence is installed in a manner that avoids the concentration of flow along the fence, and the undesirable discharge of water around the ends of the fence.
6. If the sediment fence is to be installed along the edge of existing trees, ensure care is taken to protect the trees and their root systems during installation of the fence. Do not attach the fabric to the trees.
7. Unless directed by the site supervisor or the approved plans, excavate a 200mm wide by 200mm deep trench along the proposed fence line, placing the excavated material on the up-slope side of the trench.

8. Along the lower side of the trench, appropriately secure the stakes into the ground spaced no greater than 3m if supported by a top support wire or weir mesh backing, otherwise no greater than 2m.
9. If specified, securely attach the support wire or mesh to the up-slope side of the stakes with the mesh extending at least 200mm into the excavated trench. Ensure the mesh and fabric is attached to the up-slope side of the stakes even when directing a fence around a corner or sharp change-of-direction.
10. Wherever possible, construct the sediment fence from a continuous roll of fabric. To join fabric either:
    (i) attach each end to two overlapping stakes with the fabric folding around the associated stake one turn, and with the two stakes tied together with wire (Method 1); or
    (ii) overlap the fabric to the next adjacent support post (Method 2).
11. Securely attach the fabric to the support posts using 25 x 12.5mm staples, or tie wire at maximum 150mm spacing.
12. Securely attach the fabric to the support wire/mesh (if any) at a maximum spacing of 1m.
13. Ensure the completed sediment fence is at least 450mm, but not more than 700mm high. If a spill-though weir is installed, ensure the crest of the weir is at least 300mm above ground level.
14. Backfill the trench and tamp the fill to firmly anchor the bottom of the fabric and mesh to prevent water from flowing under the fence.
15. If it is not possible to anchor the fabric in an excavated trench, then use a continuous layer of sand or aggregate to hold the fabric firmly on the ground.

Additional requirements for the installation of a spill-through weir

1. Locate the spill-through weir such that the weir crest will be lower than the ground level at each end of the fence.
2. Ensure the crest of the spill-through weir is at least 300mm the ground elevation.
3. Securely tie a horizontal cross member (weir) to the support posts/stakes each side of the weir. Cut the fabric down the side of each post and fold the fabric over the cross member and appropriately secure the fabric.
4. Install a suitable splash pad and/or chute immediately down-slope of the spill-through weir to control soil erosion and appropriately discharge the concentrated flow passing over the weir.

Maintenance

1. Inspect the sediment fence at least weekly and after any significant rain. Make necessary repairs immediately.
2. Repair any torn sections with a continuous piece of fabric from post to post.
3. When making repairs, always restore the system to its original configuration unless an amended layout is required or specified.
4. If the fence is sagging between stakes, install additional support posts.
5. Remove accumulated sediment if the sediment deposit exceeds a depth of 1/3 the height of the fence.
6. Dispose of sediment in a suitable manner that will not cause an erosion or pollution hazard.
7. Replace the fabric if the service life of the existing fabric exceeds 6-months.

Removal

1. When disturbed areas up-slope of the sediment fence are sufficiently stabilised to restrain erosion, the fence must be removed.
2. Remove materials and collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
3. Rehabilitate/revegetate the disturbed ground as necessary to minimise the erosion hazard.

NEWCASTLE SAND

APPENDIX 5: WATER BALANCE VOLUMES

Water Usage Estimates (as determined during the EIS process)

Dust Suppression – no Wash Plant

During a typical year, where the length of gravel road is reduced (e.g. yrs 1, 2, 3, part yr 4, part yr 6, 7, 8), the following usage is expected:

- Site facilities: 1.5 kL/day, 312 days per year – 0.47 ML per year.
- Dust suppression: 42 kL/day, 226 days per year (accounting for rainfall) – 9.4 ML
- Revegetation: 300 kL in only one campaign – 0.3 ML per year.
- **Total of 10.2 ML/yr, of which 9.7 ML would be drawn from the HWC network.** Where a dust suppressant additive is approved for use it may be feasible to reduce this use to less than 5 ML per year.

During the worst-case years of production (longest extent of gravel road – e.g. part yr 4, yr 5 and part yr 6), the following water usage is estimated:

- Site facilities: 1.5 kL/day, 312 days per year – 0.47 ML.
- Dust suppression: 125 kL/day, 226 days per year (accounting for rainfall) – 28.25 ML.
- Revegetation: 300 kL in three separate campaigns – 0.9 ML.
- **Total of 29.65 ML/yr, of which 29.2 ML would be drawn from the HWC network.** Where a dust suppressant additive is approved for use it may be feasible to reduce this use to less than 10 ML per year.

The Wash Plant (Modification Report)

The wash plant will process sand at up to approximately 150 tonnes per hour, (the same as the air separator). While the system is essentially closed, water is lost due to a more consistent increase in the moisture content of the product sand. Sand will enter the plant at approximately 3 - 6 %, with the product sand leaving the plant at about 10%. It is expected the field moisture capacity (i.e. the typical product sold) is likely to settle at 7-8%. Excess water bleeding from stockpiles (i.e. about 1-2%) will be captured and re-circulated. On average, this is expected to effectively consume water at 30 L/tonne (i.e. an increase in existing moisture by 3 % on average). Annually, if processing 60% of the product, this equates to 9.5 ML per annum, or about 1/3 of the estimated peak water usage and just under the 10.2 ML estimated for batter and stockpile dust suppression.

Within the EIS the dominant peak water use was for dust suppression on the gravel road in the northern resource area, accounting for up to 28 ML per annum. Where the water use across the site approaches the maximum demand estimates, additional water saving measures can

be introduced as needed to reduce water usage, such as bitumen sealing or dust suppressant additive application to the gravel road.

[Note. As the wash plant water will be split between landscape sand and dust suppression of batters the water consumption will be dependent on the quantum of landscape sand production.]

Reporting

Water usage reporting is to include the following:

- Volume of water drawn from the HWC network.
- Volume of water transferred from site (e.g. septic / bunded water capture).
- Volume of water used to top up the Wash Plant.
- Comparison with estimated water use (Section 5.2). Where more than 20% above estimated maximum, review water usage areas and investigate methods to minimise usage where feasible.

Actual Water Usage

Annual water usage will be recorded in the following table including where any additional measures were investigated to minimise water consumption.

Calendar Year	EIS Forecast Usage	Water Used Total drawn from HWC Network	Water Used Wash plant only portion of Total	Usage vs Estimate	Sewage Transferred offsite*	Water Saving Investigations
August 2019 to 31 December 2019	9.7 ML	3,087 kL over 139 days – equating to 8.1ML/year	NA	**Lower**	5.4 kL	• Static polymer for batters • Mobile polymer for haulage roads.

Calendar Year	EIS Forecast Usage	Water Used Total drawn from HWC Network	Water Used Wash plant only portion of Total	Usage vs Estimate	Sewage Transferred offsite*	Water Saving Investigations
2020	9.7 ML	5.68 ML	NA	**Lower**	32 kL	• Irrigation system installed to improve batter dust suppression. • Additional sweeping of roads to minimise dust suppression. • Batter revegetation as opposed to stabilisation.
2021						
2022						
2023						
2024						
2025						

* From 2020 onwards, septic waste is disposed on a per tank basis as opposed to an exact volume, each disposal event is up to 4 kL, as such actual disposal is likely to be lower.

APPENDIX 6: BASELINE SUMMARY REPORT

Kleinfelder 2020. *Newcastle Sands Baseline Water Quality Summary Report p*repared for Williamtown Sand Syndicate Pty Ltd. 14 September 2020.