FY21-FY24 MINING MANAGEMENT PLAN

Groote Eylandt Mining Company Limited (GEMCO)

Authorisation Number: 126-01 (GEMCO Mine – Western Leases)

Reporting period: FY2020

Planning Period: FY2021 – FY2024

30 November 2020[1]

CONTENTS Page

	Author	Reviewed By	Approved By
Date	07/07/2021	07/07/2021	07/07/2021
Name	**Melinda Simmons**	**Michael Smith**	**Mark Filtness**
Signature	Melinda Simmons		

I Mark Filtness (Vice President Operations) declare that to the best of my knowledge the information contained in this mining management plan is true and correct and commit to undertake the works detailed in this plan in accordance with all the relevant Local, Northern Territory and Commonwealth Government legislation.

SIGNATURE:

DATE: 07/07/2021

[1] Updated on 31 March 2021 in response to DITT's request for additional information and on 7 July 2021 following DITT's approval to exclude confidential and/or commercial in confidence information prior to publishing, as agreed by DITT.

Disclaimers

Information in this report that relates to Ore Reserve and/or Mineral Resource estimates was declared as part of South32's Annual Resource and Reserve declaration in the FY20 Annual Report (www.south32.net). The FY20 Annual Report was issued on 4 September 2020 and prepared by U Sandilands (MAusIMM) and J Harvey (MAusIMM) in accordance with the requirements of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (2012) (the JORC Code). South32 confirms that it is not aware of any new information or data that materially affects the information included in the original announcement. All material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and have not materially changed. South32 confirms that the form and context in which the Competent Person's findings are presented have not been materially modified from the original market announcement.

Information in this report that relates to production targets is based on Proved (82%) and Probable (18%) Reserves. The Ore Reserve estimate was declared as part of South32's Annual Resource and Reserve declaration in the FY20 Annual Report (www.south32.net) issued on 4th September 2020 and prepared by U Sandilands (MAusIMM) in accordance with the requirements of the JORC Code. South32 confirms that it is not aware of any new information or data that materially affects the information included in the original announcement. All material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and have not materially changed. South32 confirms that the form and context in which the Competent Person's findings are presented have not been materially modified from the original market announcement.

Information in this report that relates to exploration results is based on information and supporting documentation compiled by J Harvey. Mr Harvey is a full time employee of South32 and is a member of the Australasian Institute of Mining and Metallurgy (AusIMM). Mr Harvey has sufficient experience relevant to the style of mineralisation and type of deposit under consideration and to the activities being undertaken to qualify as a Competent Person as defined in the JORC Code. The Competent Person consents to the inclusion in this report of the matters based on the information in the form and context in which it appears.

This document may contain forward-looking statements, including statements about plans, strategies and objectives of management; and anticipated productive lives of projects, mines and facilities. These forward-looking statements reflect reasonable expectations at the date of this document, however they are not guarantees or predictions of future performance.

Contents

List of Figures

List of Tables

AMENDMENTS

GEMCO's current Mining Management Plan (MMP) for the Western Leases describes activities for the FY17-FY20 planning period (termed FY17-FY20 MMP). This MMP was submitted to the NT Department of Tourism, Industry and Trade (DITT)[2] on 30 September 2016 in support of an application to vary GEMCO's existing Authorisation (0126-01) under section 38 of the *Mining Management Act 2001* (NT). DITT approved this application on 5 January 2017. As per section 41 of the *Mining Management Act*, GEMCO has submitted a number of amendments to the FY17-FY20 MMP, as outlined in amendment documents for specific projects and the annual Operational Performance Report (OPR). These amendments are summarised in Table 0-1.

Table 0-1: Amendments to the FY17-FY20 MMP

MMP/OPR	Submission Date	DITT File Refernece	Authorisation Date	DITT File Reference
FY17-FY20 MMP	30/09/2016	MR2016/0430	05/01/2017	MDoc2017/00063
FY17 OPR	29/09/2017	MR2017/0377	21/09/2018	MDoc2018/05935
TSF13	17/10/2017	MR2017/0392	26/10/2017	MDoc2017/08872
FY18 OPR	27/09/2018	MR2018/0351	23/08/2019	MDoc2019/04138
TSF18	25/10/2018	MR2018/0386	12/12/2018	MDoc2018/07152
Rowell Highway	23/07/2019	MR2019/0225	17/10/2019	MDoc2019/04758
Angurugu Town Levee Realignment	09/08/2019	MR2019/0251	02/10/2019	MDoc2019/04758
TSF15	06/09/2019	MR2019/0278	16/12/2019	MDoc2019/05920
FY19 OPR	20/09/2019	MR2019/0300	13/03/2020	MDoc2020/01056
Dewatering Off Lease	11/12/2019	MR2019/0375	07/02/2020	MDoc2020/00461
TSF20	21/01/2020	MR2020/001	06/04/2020	MDoc2020/01460

This MMP describes activities to be undertaken in the FY21-FY24 planning period (termed FY21-FY24 MMP). This MMP has been prepared in support of an application to vary GEMCO's existing Authorisation for the Western Leases under section 38 of the *Mining Management Act*. This is considered a new MMP for the purpose of meeting the requirements outlined in section 40 of the *Mining Management Act*.

Table 0-2 below will be populated in accordance with section 41(3) of the *Mining Management Act* as part of any amendments to this FY21-FY24 MMP.

Table 0-2: Amendments to the FY21-FY24 MMP

Section	Amendment

[2] Previously the NT Department of Primary Industry and Resources (DPIR).

1 INTRODUCTION

1.1 Operator Details

Groote Eylandt Mining Company Pty Ltd (GEMCO) is a manganese mining operation located on Groote Eylandt in the Northern Territory (Figure 1-1). GEMCO has been operating since 1964 and is currently owned by South32 Ltd (60%) and Anglo American Plc (40%).

South32 is a globally diversified mining and metals company. The company produces bauxite, alumina, aluminium, energy and metallurgical coal, manganese, nickel, silver, lead and zinc at its operations in Australia, South Africa and South America. It also owns a high grade zinc, lead and silver development option in North America and has several partnerships with junior explorers with a bias to base metals. The company is listed on the Australian Securities Exchange (ASX), Johannesburg Stock Exchange and London Stock Exchange, and is headquartered in Perth.

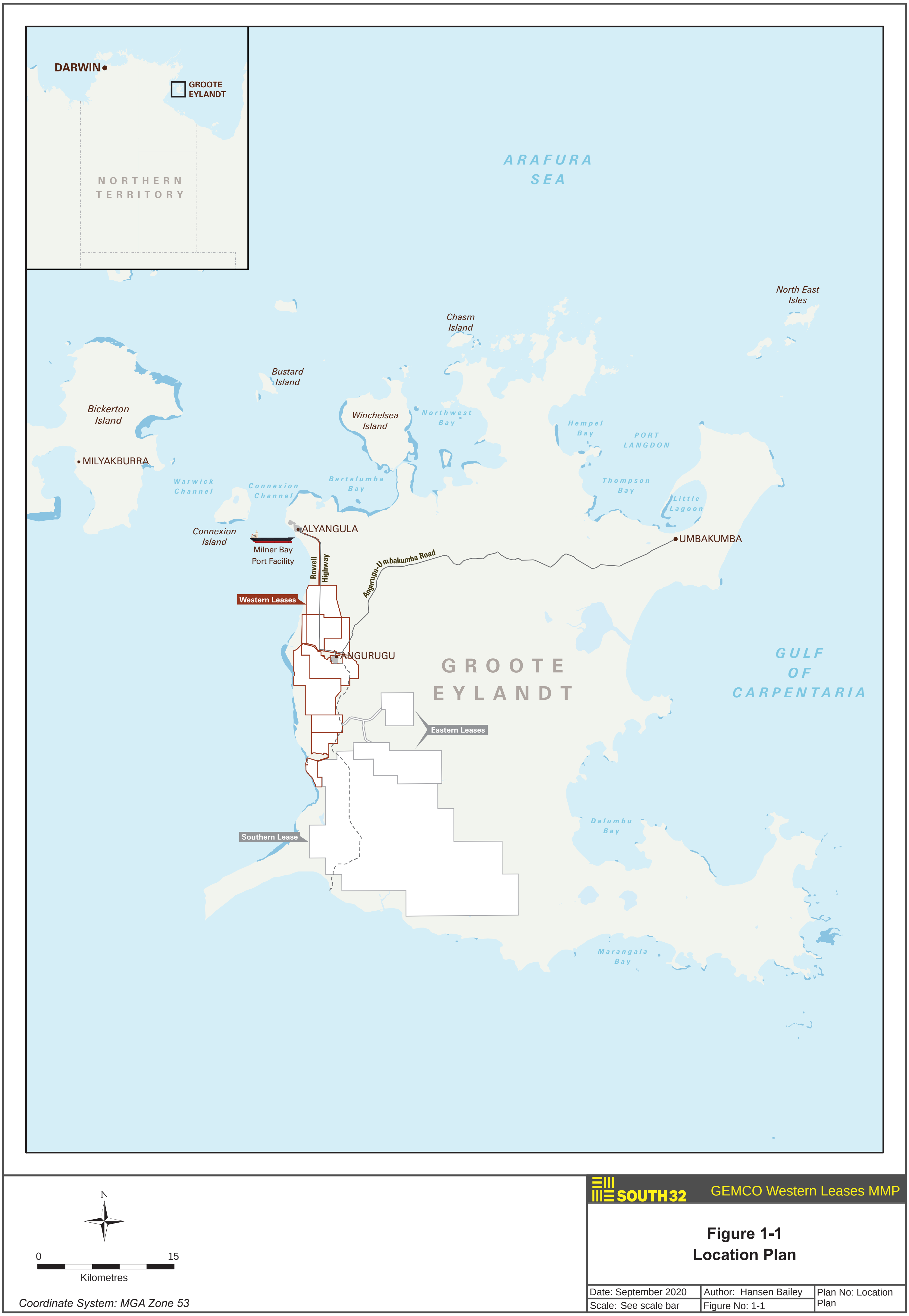
Anglo Operations (Australia) Pty Ltd is a wholly owned subsidiary of Anglo American Plc, a United Kingdom-based mining group that is listed on the London Stock Exchange. Anglo American Plc is one of the world's largest mining companies and has a diverse portfolio of interests in coal, iron ore, manganese, base metals, precious metals, and minerals.

GEMCO sells manganese ore to domestic and export markets and is currently one of the largest manganese ore producers in the world with key markets in China, South Korea, India and Japan.

Key GEMCO contacts for the purpose of this MMP are provided in Table 1-1.

Table 1-1 Key GEMCO Contacts

	Mark Filtness	Michael Smith
Title	Vice President Operations	Manager Technical Services
Postal Address	Rowell Highway Alyangula NT 0885	Rowell Highway Alyangula NT 0885
Phone	+618 8987 4388	+618 8987 4311
Email	Mark.Filtness@south32.net	Michael.Smith@south32.net



SOUTH32 GEMCO Western Leases MMP

Figure 1-1
Location Plan

Date: September 2020	Author: Hansen Bailey	Plan No: Location Plan
Scale: See scale bar	Figure No: 1-1	

1.1.1 *Organisational Structure and Responsibility*

GEMCO's workforce consists of operational teams and functional support teams. Operational teams report directly to GEMCO's Vice President Operations. Functional teams report directly to South32's Perth headquarters and indirectly to GEMCO's Vice President Operations. Figure 1-2 provides the organisation structure for GEMCO's leadership team.

The Manager Technical Services is responsible for maintaining the MMP and for preparing and implementing GEMCO's Environmental Management Plans (EMPs) and the annual Environmental Mining Report (EMR) (to replace the Operational Performance Report (OPR)). Overall accountability for all documentation and activities to be completed under this MMP is held by the Vice President Operations.

Contact details for these personnel are provided in Table 1-1.

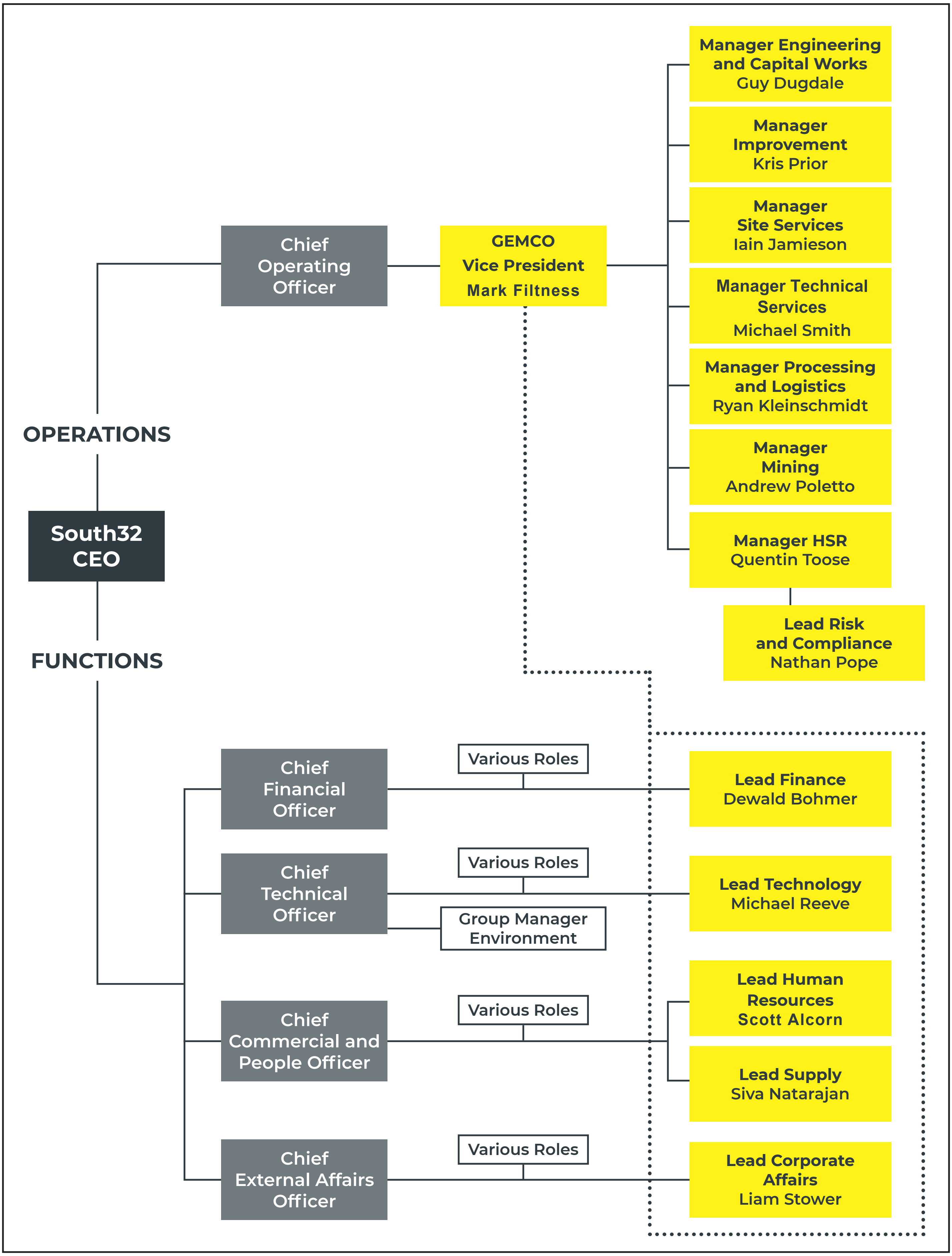
1.2 Title Details

GEMCO undertakes mining and exploration activities across a number of mineral tenements on Groote Eylandt. This MMP pertains to activities on GEMCO's existing mine, termed the Western Leases. The mineral and special purpose tenements associated with the Western Leases are listed in Table 1-2 and shown in Figure 1-3.

Figure 1-3 also illustrates the Eastern Leases, two approved but undeveloped mineral leases, and the Southern Lease, a mineral exploration licence. The Eastern Leases and Southern Lease are subject to separate mining authorisation and are shown in Figure 1-3 for context purposes only.

Table 1-2: Mineral and Special Purpose Tenements (Western Leases)

Title Number	Title Holder	Activity	Grant Date	Expiry Date
MLN951	GEMCO	Mining and associated activities	21/05/1965	20/07/2031
MLN952	GEMCO	Mining and associated activities	21/05/1965	20/07/2031
MLN953	GEMCO	Mining and associated activities	21/05/1965	20/07/2031
MLN956	GEMCO	Mining and associated activities	08/04/1974	29/09/2031
MLN957	GEMCO	Mining and associated activities	08/04/1974	29/09/2031
MLN958	GEMCO	Mining and associated activities	08/04/1974	29/09/2031
MLN959	GEMCO	Mining and associated activities	08/041974	29/09/2031
MLN960	GEMCO	Mining and associated activities	08/04/1974	29/09/2031
MLN961	GEMCO	Mining and associated activities	08/04/1974	29/09/2031
MLN2	GEMCO	Power line lease	30/09/1985	29/09/2031
MLN3	GEMCO	Bridge lease	20/12/1984	20/07/2031
SPL382	GEMCO	Cargo handling and wharf ancillary purposes	15/05/1974	29/05/2065
SPL383	GEMCO	Industrial area including stockpiling of ore	15/05/1974	29/05/2065
SPL392	GEMCO	Township lease	15/05/1974	29/05/2065
SPL393	GEMCO	Greenbelt around township	15/05/1974	29/05/2065

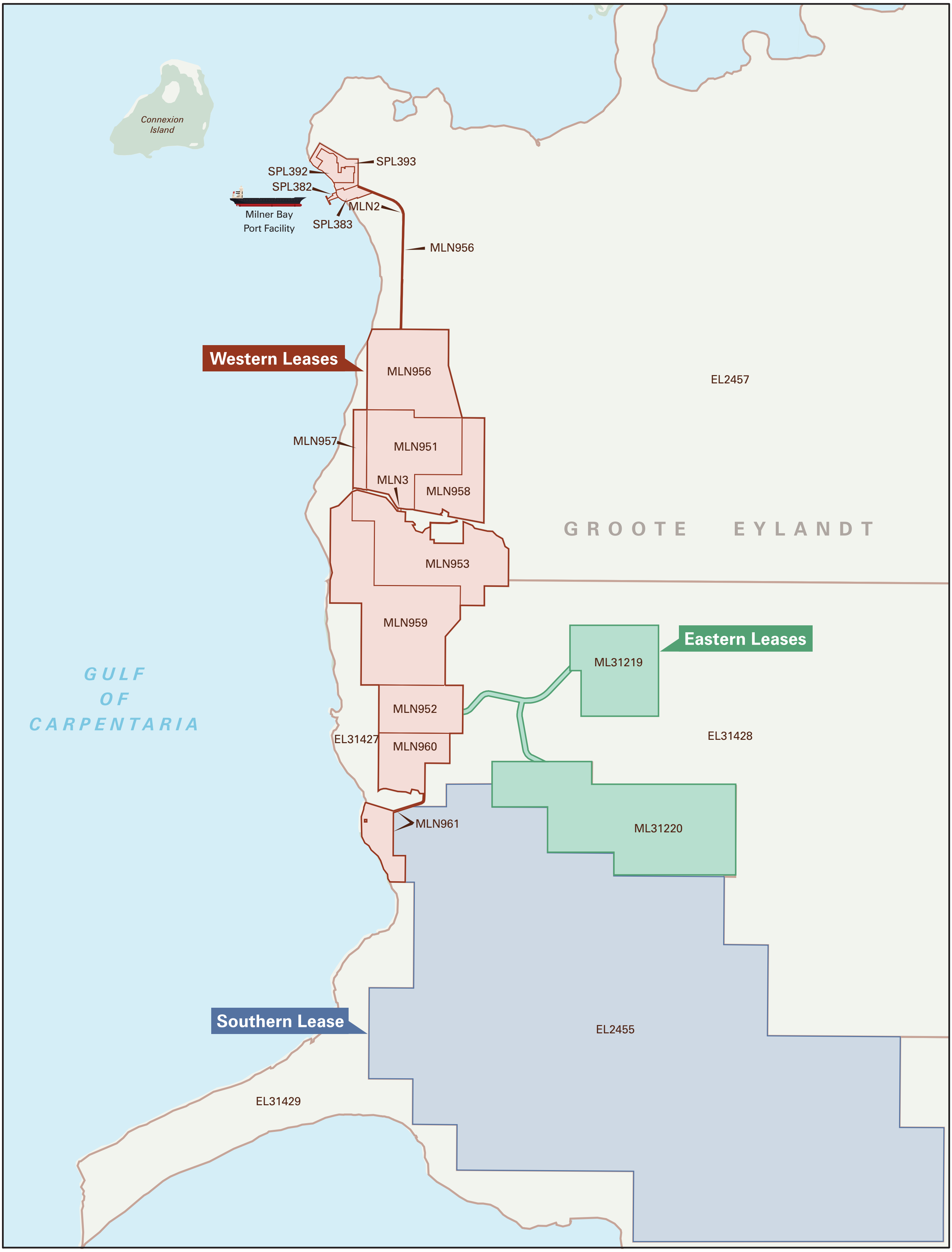


Hansen Bailey
ENVIRONMENTAL CONSULTANTS

SOUTH32 GEMCO Western Leases MMP

Figure 1-2
GEMCO Leadership Team

Date: November 2020	Author: Hansen Bailey	Plan No: GEMCO Leadership Team
Scale: See scale bar	Figure No: 1-2	



Legend

- Western Leases (Mineral Leases/Special Purpose Leases)
- Eastern Leases (Mineral Leases)
- Southern Lease (Exploration Licence - Granted)
- Exploration Licence - Application

Coordinate System: MGA Zone 53

SOUTH32 GEMCO Western Leases MMP

Figure 1-3
GEMCO Tenements

Date: September 2020	Author: Hansen Bailey	Plan No: GEMCO Tenements
Scale: See scale bar	Figure No: 1-3	

1.3 Project Description

1.3.1 *Location*

GEMCO's mining operation is located on Groote Eylandt in the Gulf of Carpentaria, approximately 650 kilometres (km) south-east of Darwin and 50 km off the coast of Arnhem Land (Figure 1-1).

Groote Eylandt is part of an archipelago of islands known as the Groote Eylandt Archipelago, which is Aboriginal land under the *Aboriginal Land Rights (Northern Territory) Act 1976* (Cth) (ALRA). The Anindilyakwa Land Council (ALC) is the statutory body responsible for activities within the Groote Eylandt Archipelago on behalf of the Traditional Owners. The Traditional Owners are an amalgamation of two cultures, the Warnindilyakwa and the Nunggubuyu (ALC, 2019). Both cultures speak Anindilyakwa as their first language, and the land, people and culture are also referred to by this term.

Groote Eylandt is largely undeveloped, and much of the island is still used for traditional Aboriginal practices such as hunting and gathering.

The main townships within the Groote Eylandt Archipelago are shown in Figure 1-1. These include the mining township of Alyangula, the two Aboriginal settlements of Angurugu and Umbakumba on Groote Eylandt and the Aboriginal settlement of Milyakburra on Bickerton Island. Alyangula is located on GEMCO's Special Purpose Leases (SPL292 and SPL293) and predominantly houses the mine workforce and their families. It also serves as the regional hub for Northern Territory and Commonwealth Government services on Groote Eylandt. Residential and commercial property developments on the fringes of Alyangula has seen new areas established (i.e. Pole 7) and existing areas expanded (i.e. Pole 13) in recent years.

There are also a number of small, rural Aboriginal settlements (termed "satellite communities") which typically have varying levels of use, from permanent residency to occasional visitation or sporadic residency. The largest satellite community, known as Malkala, is located approximately 6 km south of Alyangula and is permanently occupied by Aboriginal residents (Figure 1-4).

There are two main public roads on Groote Eylandt, namely the Rowell Highway and the Angurugu-Umbakumba Road (Figure 1-1). Both roads are sealed, two lane roads and provide access between Alyangula and the mine site, and Angurugu and Umbakumba. There are also various unsealed public access roads and tracks on the island that typically lead to satellite communities or recreation areas. Groote Eylandt is serviced by an airport near Angurugu, with regular flights to/from Darwin and Cairns. There are also regular barge services between Darwin and the Milner Bay Port Facility at Alyangula.

The Groote Eylandt Archipelago is located within the East Arnhem Local Government Area (LGA). This LGA is administered by the East Arnhem Regional Council (EARC), although the EARC do not manage any infrastructure on GEMCO's mining or special purpose leases. Groote Eylandt, and the marine area surrounding it, has significant ecological value and is considered an International Site of Conservation Significance in the NT (Harrison et al, 2009). The Groote Eylandt Archipelago has also been declared an Indigenous Protected Area (IPA). An IPA is an area of Indigenous-owned land or sea where the Traditional Owners have entered into an agreement with the Commonwealth Government to promote biodiversity and cultural resource conservation.

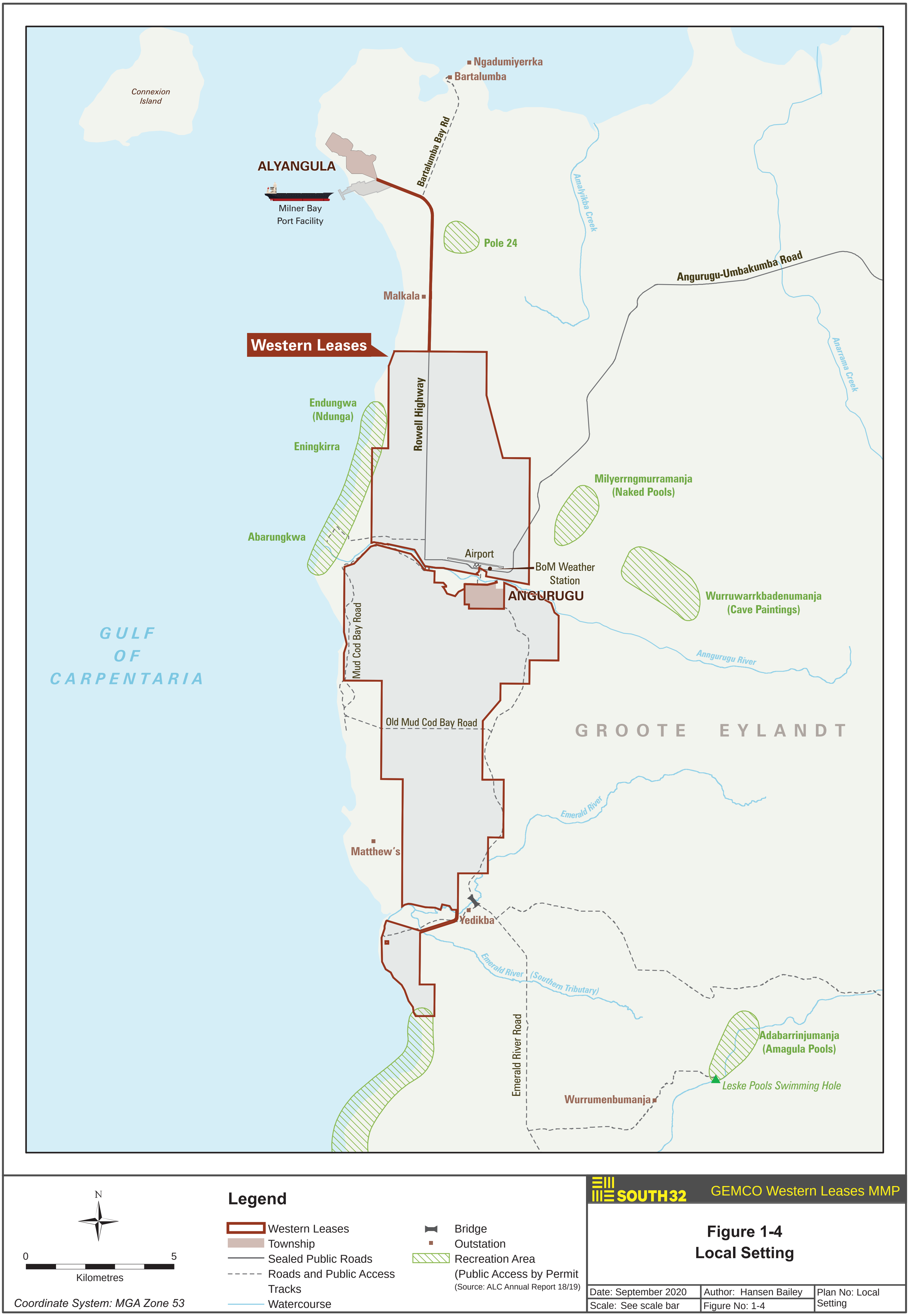
GEMCO's Western Leases is the main development on Groote Eylandt and extends over an area covering approximately 90 square kilometres (km^2) on the western side of the island (Figure 1-4).

The township of Angurugu is directly adjacent to the mine. The township of Alyangula and the Milner Bay Port Facility are located approximately 14 km to the north of the mine's processing facilities and main infrastructure area (Figure 1-4 and Figure 1-5).

The land within and surrounding the Western Leases comprises natural bushland that is mainly eucalypt dominated open forest, woodland and shrubland. The most common eucalypts are Darwin Woollybutt and Darwin Stringybark, but a wide variety of other native plants occur. Section 2.1.3 provides further detail on the fauna and flora values of the area.

The Western Leases area is characterised by low-lying plains with elevations ranging from sea level to approximately 50 metres (m) Australian Height Datum (AHD). There are two river systems that traverse the Western Leases, namely the Angurugu River and the Emerald River (Figure 1-4). The Angurugu River provides potable water for the mine site and Alyangula township and the Emerald River is predominantly used by the Traditional Owners for recreational purposes. Section 2.1.2 provides further detail on the topography of the area.

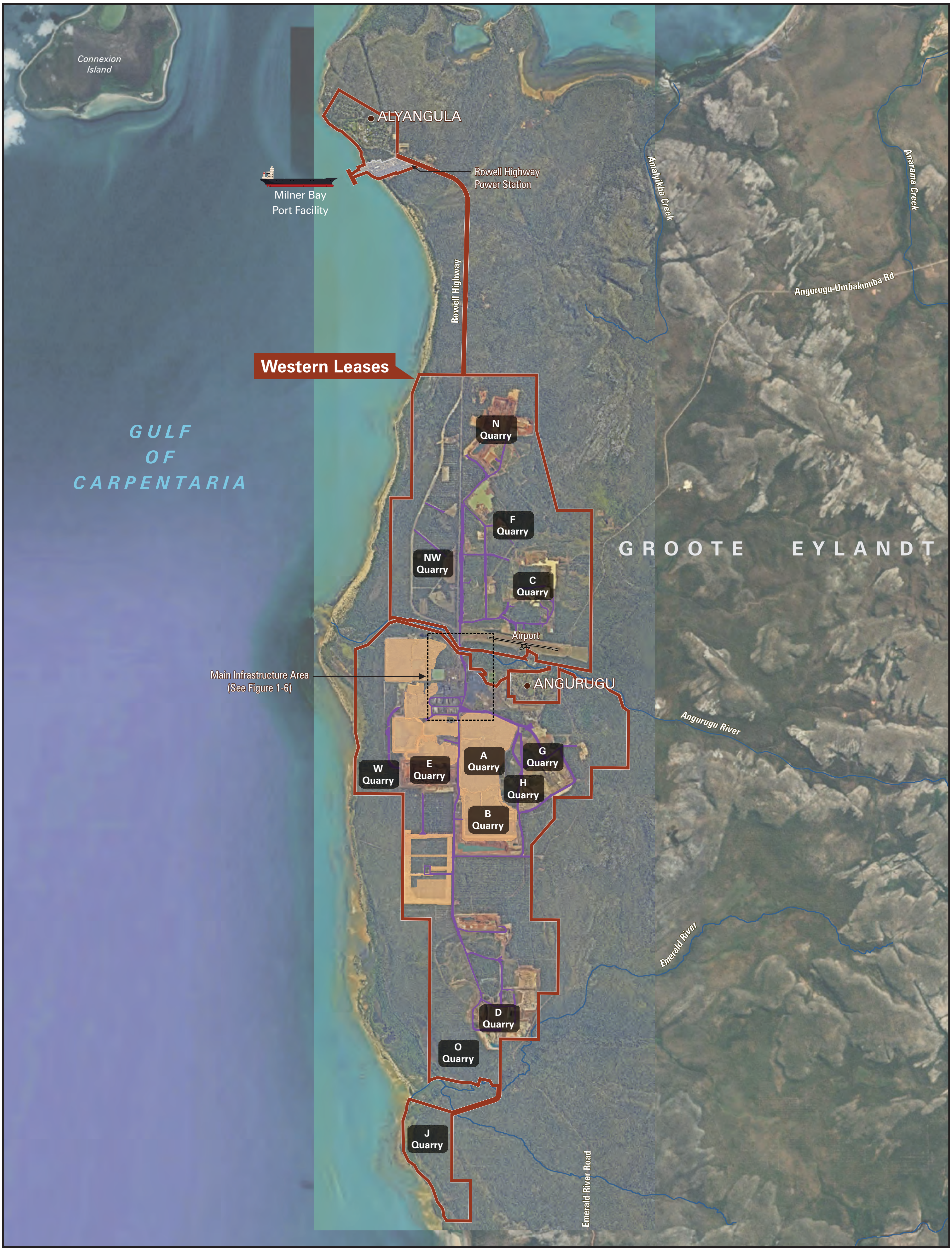
The Western Leases project layout is shown in Figure 1-5. Operations involve mining manganese ore by open cut mining methods across multiple quarries, washing and sizing the ore in the concentrator and transporting it to the Milner Bay Port Facility. Section 4 provides further detail on GEMCO's operational activities. Figure 1-6 illustrates the main infrastructure associated with the Western Leases including the concentrator, administration buildings, warehousing, maintenance workshop facilities, fuel storage, tailings storage facilities (TSFs) and mine water storages.



GEMCO Western Leases MMP

Figure 1-4
Local Setting

Date: September 2020	Author: Hansen Bailey	Plan No: Local Setting
Scale: See scale bar	Figure No: 1-4	



N

0 5
Kilometres

Coordinate System: MGA Zone 53

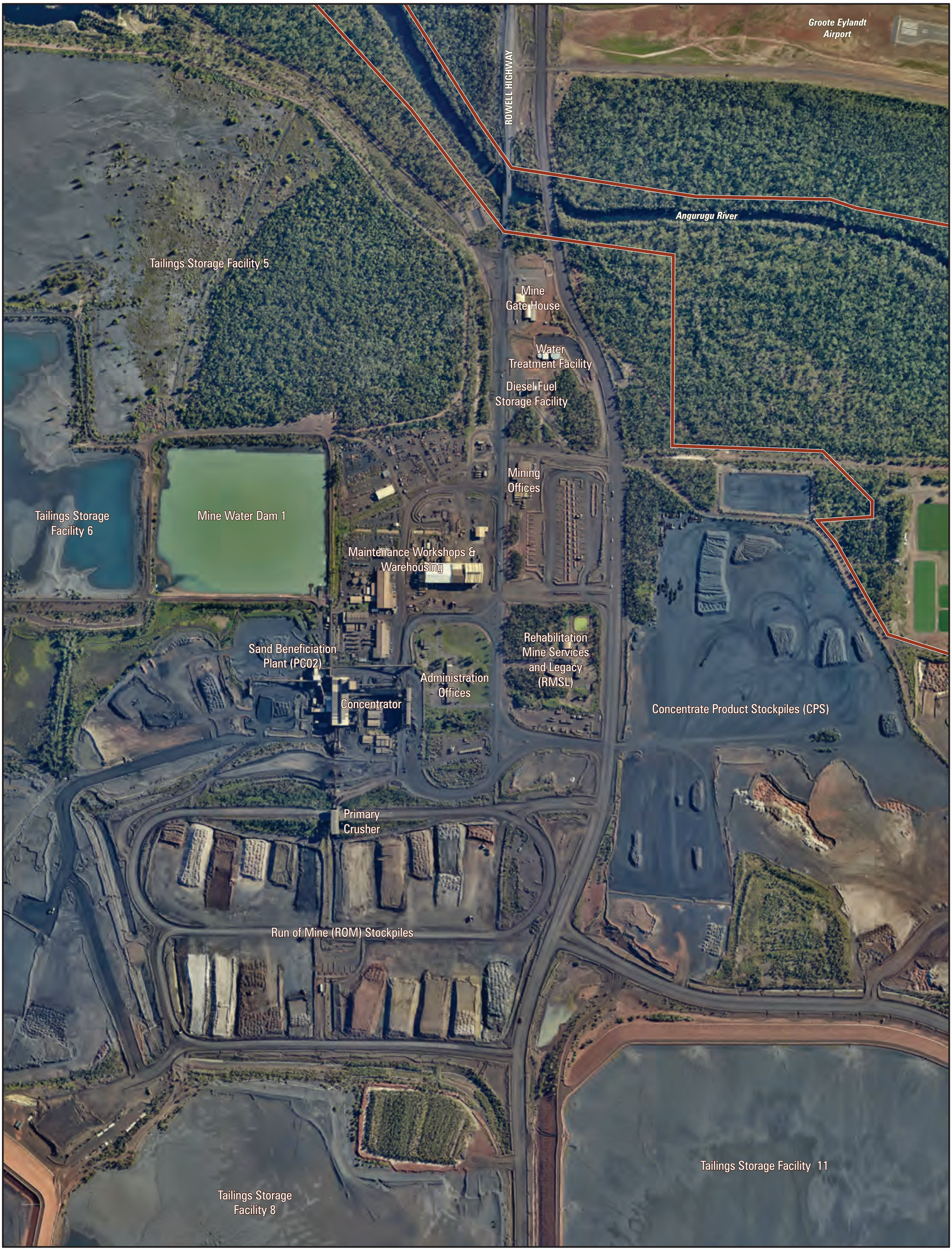
Legend

- Western Leases
- Tailings Storage Facilities
- Milner Bay Port Facility
- Haul Roads

SOUTH32 GEMCO Western Leases MMP

Figure 1-5
Project Layout

Date: September 2020	Author: Hansen Bailey	Plan No: GEMCO Western Leases Project Layout
Scale: See scale bar	Figure No: 1-5	



Coordinate System: MGA Zone 53

Legend

Western Leases

SOUTH32 GEMCO Western Leases MMP

Figure 1-6
Main Infrastructure Area

Date: September 2020	Author: Hansen Bailey	Plan No: Western Leases Main Infrastructure Area
Scale: See scale bar	Figure No: 1-6	

1.3.2 *Project Summary and Improvements*

1.3.2.1 *History of Development*

GEMCO commenced operations more than 55 years ago and operates in accordance with approvals under the *Mining Management Act 2001* (NT), *Mineral Titles Act 2010* (NT) and a Mining Agreement with the ALC. GEMCO has seen several capacity expansions during its operations, with the most recent arising from the construction of the Sand Beneficiation Plant (SBP) in 2016. The current production capacity from the Western Leases is approximately 6 million tonnes of manganese product per annum (Mtpa). Mining of GEMCO's Eastern Leases is expected to extend the life of the operation but will not change GEMCO's overall production rate. Section 4.4.2.12 provides further detail on the Eastern Leases project.

1.3.2.2 *Current Mine Status*

GEMCO's Western Leases are currently subject to active mining. Figure 1-7 and Figure 1-8 illustrate the layout of the mine (as at 30 June 2020) and the various types of land disturbance required to support the mining operations. Table 1-3 categorises the disturbance by type and by lease.

Table 1-3: Disturbance Tracking (30 June 2020)

Title Number	Disturbance Type (ha)											
	Active Mine	Airport	Associated Infrastructure(1)	Cleared(2)	Infrastructure(3)	Rehabilitation	Roads	Ore Stockpiles	Tailings	Topsoil Stockpiles	Undisturbed	TOTAL
MLN951	182	19	7	0	2	391	114	7	0	10	423	**1,155**
MLN952	111	0	2	0	8	227	24	0	0	0	295	**666**
MLN953	159	0	54	2	31	194	101	73	422	16	413	**1,464**
MLN956	197	0	12	2	20	247	87	0	0	9	606	**1,180**
MLN957	0	0	0	0	0	0	3	0	0	0	172	**175**
MLN958	72	91	0	0	0	200	32	0	0	0	290	**686**
MLN959	296	0	51	9	28	53	61	3	537	8	1,068	**2,114**
MLN960	146	0	3	1	0	60	18	5	0	0	333	**567**
MLN961	0	0	0	0	0	0	0	0	0	0	335	**335**
SPL382	0	0	0	0	0	0	0	0	0	0	8	**8**
SPL383	0	0	4	0	17	0	7	11	0	0	13	**51**
SPL392	0	0	0	1	93	0	12	0	0	0	4	**110**
SPL393	0	0	2	0	3	0	2	0	0	0	83	**90**
TOTAL(4)	**1,164**	**111**	**133**	**15**	**201**	**1,373**	**460**	**100**	**959**	**42**	**4,042**	**8,598**

(1) Includes infrastructure such as laydown yards and car parks
(2) An area that has been cleared for mining or infrastructure development but the topsoil has not been removed and the development has not yet occurred
(3) Includes all mine site and township buildings, pipelines and waste disposal facilities
(4) Total values may not equal the sum of values in each column due to rounding

Section 4.1 provides additional information in relation to the proposed operational activities and related disturbance to be undertaken during the term of this MMP.

N

0 2.5
Kilometres

Coordinate System: MGA Zone 53

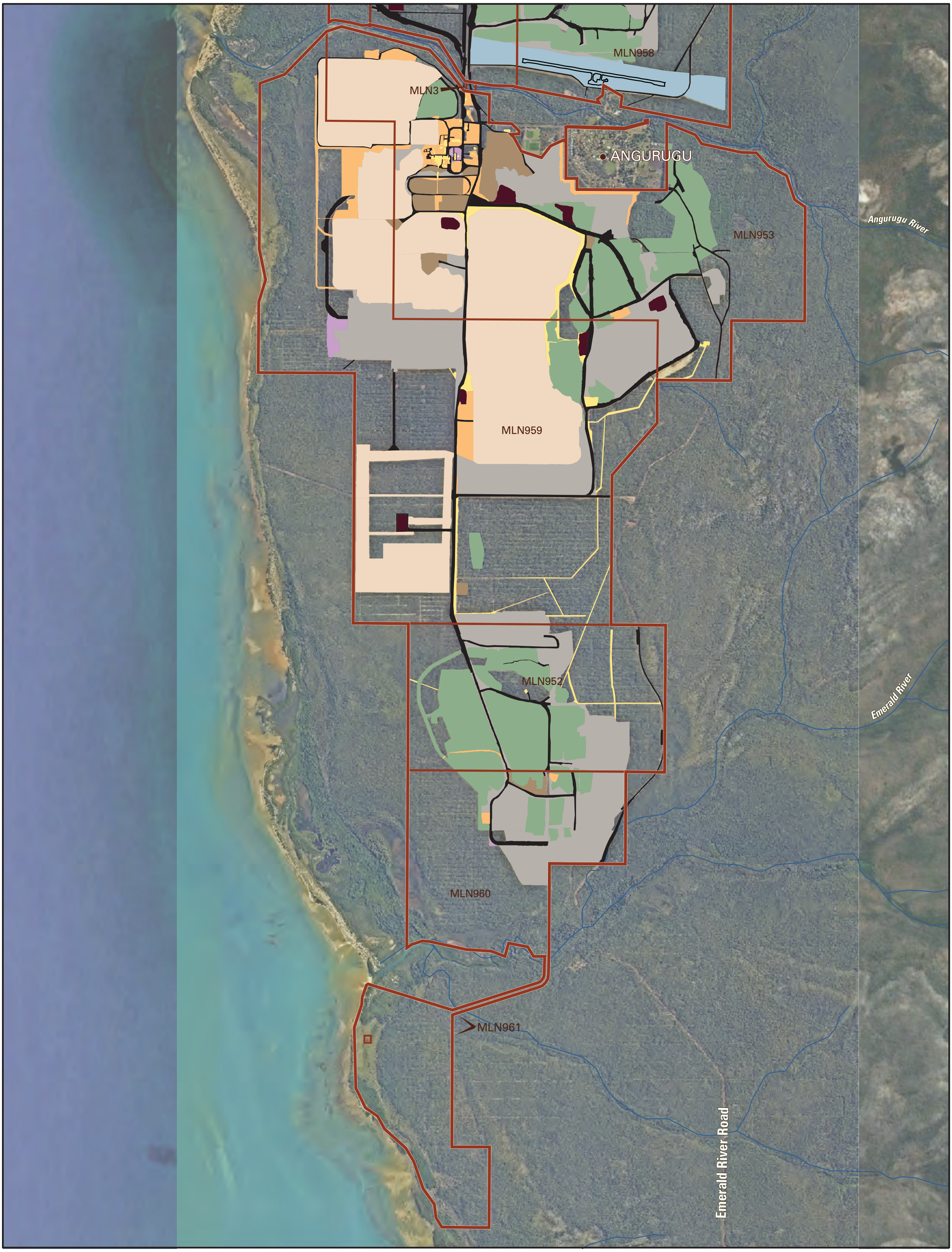
Legend

- Western Leases
- Active mine
- Tailings
- Rehabilitation
- Roads
- Stockpile
- Topsoil stockpile
- Infrastructure
- Associated infrastructure
- Airport
- Cleared

SOUTH32 GEMCO Western Leases MMP

Figure 1-7
Disturbance Tracking (Northern Region)

Date: September 2020	Author: Hansen Bailey	Plan No: Disturbance Tracking (Northern Region)
Scale: See scale bar	Figure No: 1-7	



N

0 2.5

Kilometres

Coordinate System: MGA Zone 53

Legend

- Western Leases
- Active mine
- Tailings
- Rehabilitation
- Roads
- Stockpile
- Topsoil stockpile
- Infrastructure
- Associated infrastructure
- Airport
- Cleared

SOUTH32 GEMCO Western Leases MMP

Figure 1-8
Disturbance Tracking (Southern Region)

Date: September 2020	Author: Hansen Bailey	Plan No: Disturbance Tracking (Southern Region)
Scale: See scale bar	Figure No: 1-8	

1.3.2.3 *DITT Site Inspections and Audits*

The NT Department of Industry, Tourism and Trade (DITT) completed one site inspection of the Western Leases during the FY20 reporting period. The inspection was undertaken over two days from 21 – 22 November 2019 and was attended by the following DITT representatives:

- Michelle Kassman (Senior Mining Officer, Mining Operations, DITT);
- Angelo Razafimamonjy (Mining Officer, Mining Operations, DITT); and
- Rojita Thapa (Mining Officer, Mining Operations, DITT).

No actions or recommendations were received from DITT as a result of this inspection.

2 SITE CONDITIONS

2.1 Physical Environment

2.1.1 *Climate*

Groote Eylandt experiences a tropical climate which is characterised by hot, humid summers (during which the majority of rainfall occurs) and dry winters. The prevailing winds in the region are from the east and southeast. However, during the active monsoon season between November and April, north-westerly winds draw in moist air from the ocean leading to heavy rainfall periods. These conditions are typically associated with intense storms and cyclones. There are on average two tropical cyclones that impact the Gulf of Carpentaria each year.

Climate data has been collected since May 1999 from the Bureau of Meteorology (BoM) weather station located at Groote Eylandt Airport (station number 014518) (Figure 1-4). GEMCO also collects climate data from five rain gauges and two automatic weather stations that were installed across the Western Leases in 2017. This data is available on Weatherzone and is used internally to understand localised weather conditions across the lease area.

Table 2-1 presents a summary of the primary meteorological parameters recorded at the BoM weather station, with a description of these records provided within the following sections. Evaporation is not monitored at this weather station. The nearest meteorological station measuring evaporation is located at the Gove Airport (station number 014508), from which data is used when an evaporation estimate is required. The long-term mean daily evaporation recorded at the Gove Airport weather station (between 1966 and 2017) is 5.9 millimetres per day (mm/day) (or 2,153 mm per year).

Table 2-1 Summary of Climate Statistics

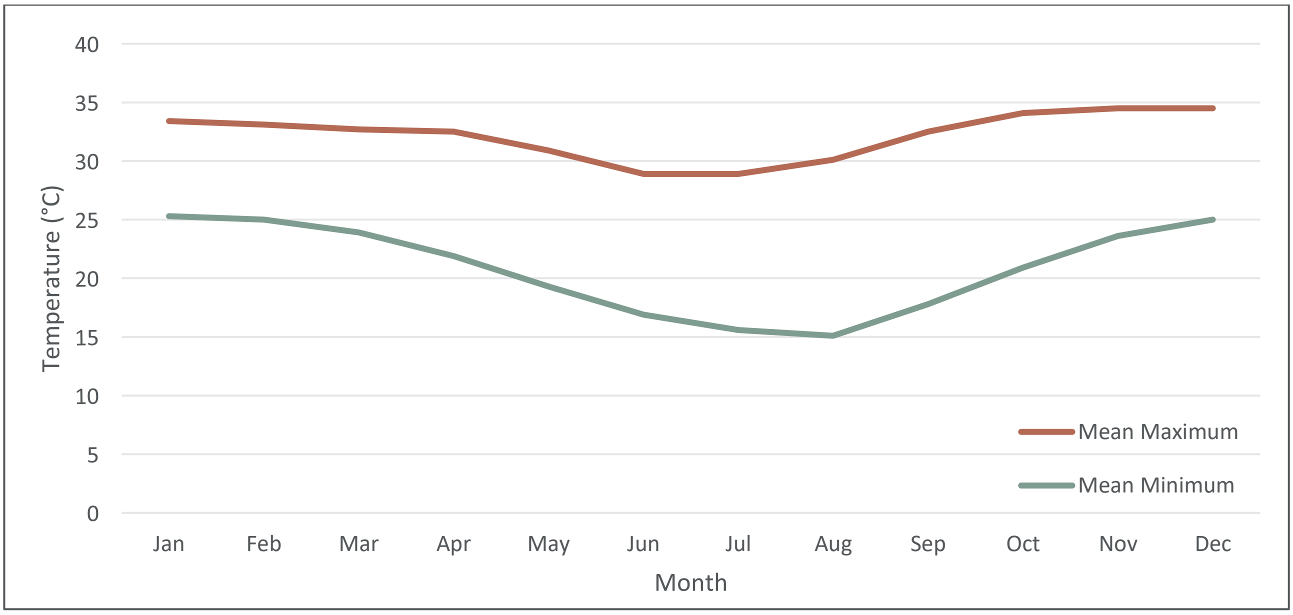
Month	Temperature(1) (°C)		Rainfall(1)		Relative Humidity(2) (%)		Wind Speed(2) (Km/H)	
	Mean Minimum	Mean Maximum	Mean (mm)	Mean Rain Days	9am	3pm	9am	3pm
January	25.3	33.4	238.2	18.2	77	68	12.5	12.3
February	25.0	33.1	229.3	16.5	78	69	11.6	11.8
March	23.9	32.7	290.0	18.9	79	70	8.3	11.8
April	21.9	32.5	149.4	13.4	75	65	9.0	14.1
May	19.3	30.9	32.6	7.1	70	56	9.1	15.0
June	16.9	28.9	4.9	3.6	69	57	11.6	15.7
July	15.6	28.9	2.8	2.7	70	51	10.7	16.6
August	15.1	30.1	1.3	1.9	65	46	11.3	16.5
September	17.8	32.5	7.5	2.1	61	49	13.1	16.1
October	20.9	34.1	26.6	3.7	61	50	13.2	16.1
November	23.6	34.5	118.8	10.0	65	56	12.7	13.9
December	25.0	34.5	176.9	13.0	71	62	12.6	13.2
ANNUAL	**20.9**	**32.2**	**1,290.3**	**111.1**	**70**	**58**	**11.3**	**14.4**

(1) Recorded between May 1999 and May 2020 at the BoM meteorological station at Groote Eylandt Airport
(2) Recorded between May 1999 and September 2010 at the BoM meteorological station at Groote Eylandt Airport

2.1.1.1 *Temperature*

The monthly mean temperatures are typical of the tropical climate, with relatively warm temperatures all year round and slightly cooler temperatures from June to August (Figure 2-1). The highest mean daily maximum temperature recorded was 34.5°C for November and December, and the lowest mean daily minimum temperature recorded was 15.1°C for August. Annual mean temperatures range between 20.9°C and 32.2°C.

Figure 2-1 Mean Minimum and Maximum Temperatures



2.1.1.2 *Rainfall*

The annual pattern of rainfall illustrates the tropical climate in the region, with the majority of rainfall occurring during November to April. The highest mean monthly rainfall recorded was 290.0 mm in March and the lowest mean monthly rainfall was 1.3 mm in August (Figure 2-2). Annual mean rainfall is 1,290.3 mm (Figure 2-3) with the past two years (2018 and 2019) experiencing below average rainfall.

Figure 2-2 Mean Monthly Rainfall

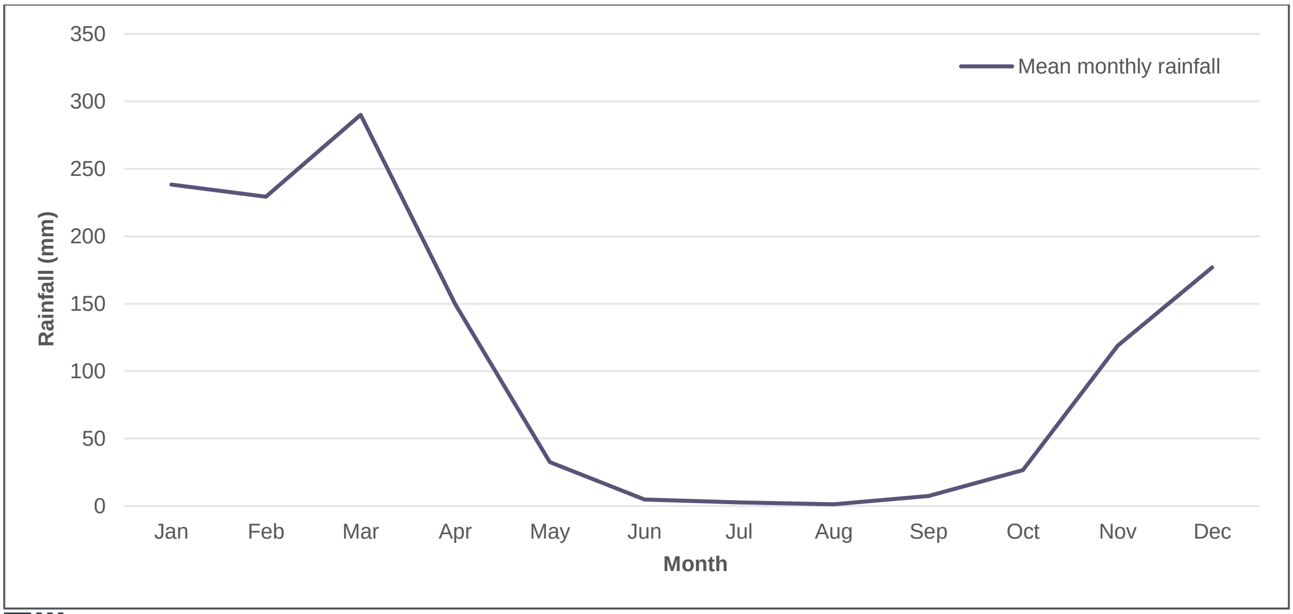
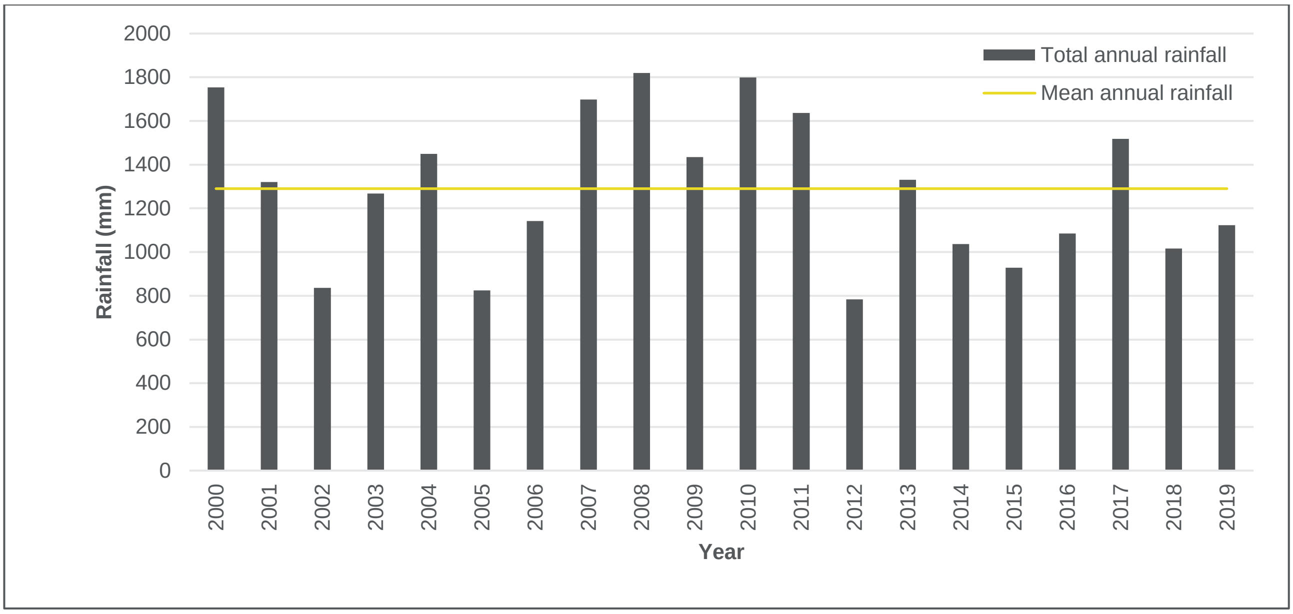


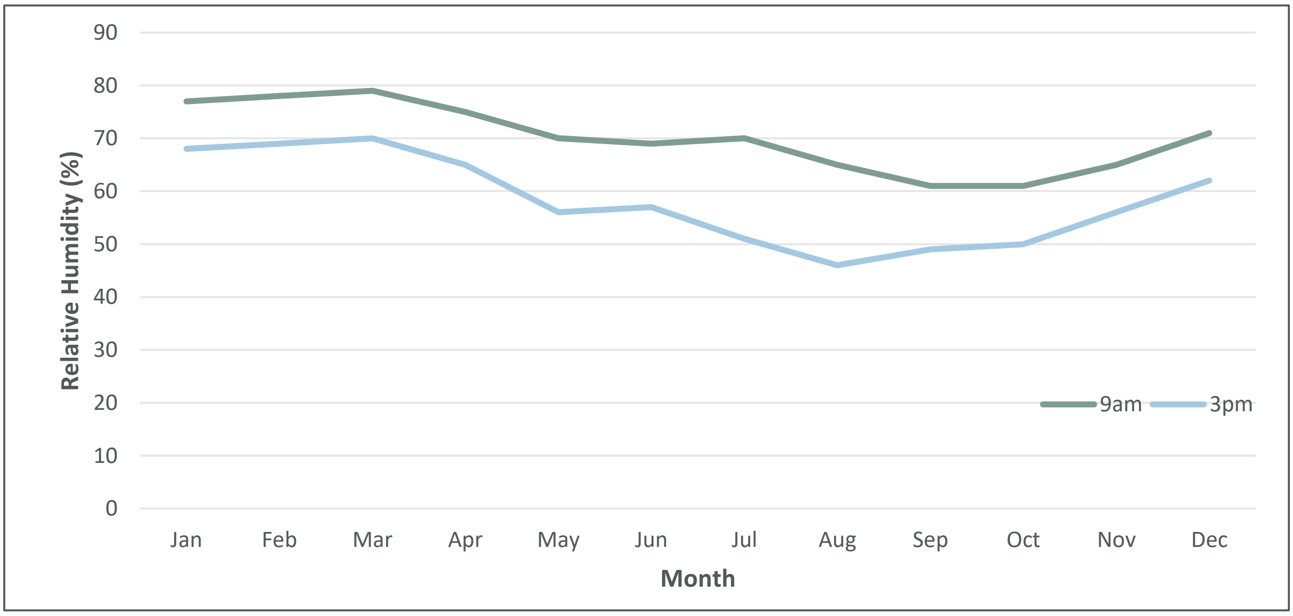
Figure 2-3 Annual Mean Rainfall



2.1.1.3 *Relative Humidity*

The higher average relative humidity during the morning (9am) compared to the afternoon (3pm) (Figure 2-4) is considered typical of the region and is due to moisture in the morning air evaporating as the day progresses. The higher variation in relative humidity between the morning (9am) and afternoon (3pm) over the winter months is due to a lack of rainfall at this time of year (Figure 2-2). The highest monthly average relative humidity value was recorded in March for both morning and afternoon values (79% and 70%, respectively).

Figure 2-4: Mean Relative Humidity Recorded at 9am and 3pm



2.1.1.4 *Wind*

Average wind speeds are predominantly moderate in nature (i.e. between 10 and 20 km/hr) during both the morning (9am) and afternoon (3pm) (Figure 2-5). Some strong easterly winds are prevalent during the afternoon (3pm), with light and calm conditions (i.e. wind speeds less than 7 km/hr) evident for the remaining periods throughout the day. Average wind speeds for the morning (9am) drops to the lowest towards the end of the wet season and gradually increases throughout the rest of the year. As shown in Figure 2-5, wind speeds recorded for the afternoon (3pm) peak towards the middle of the dry season. Wind direction varies throughout the year with prevailing winds from the southeast in the mornings and east in the afternoons (Figure 2-6). North-westerly winds during the active monsoonal periods (i.e. between November and May) are also evident in the records.

Figure 2-5 Mean Wind Speed Recorded at 9am and 3pm

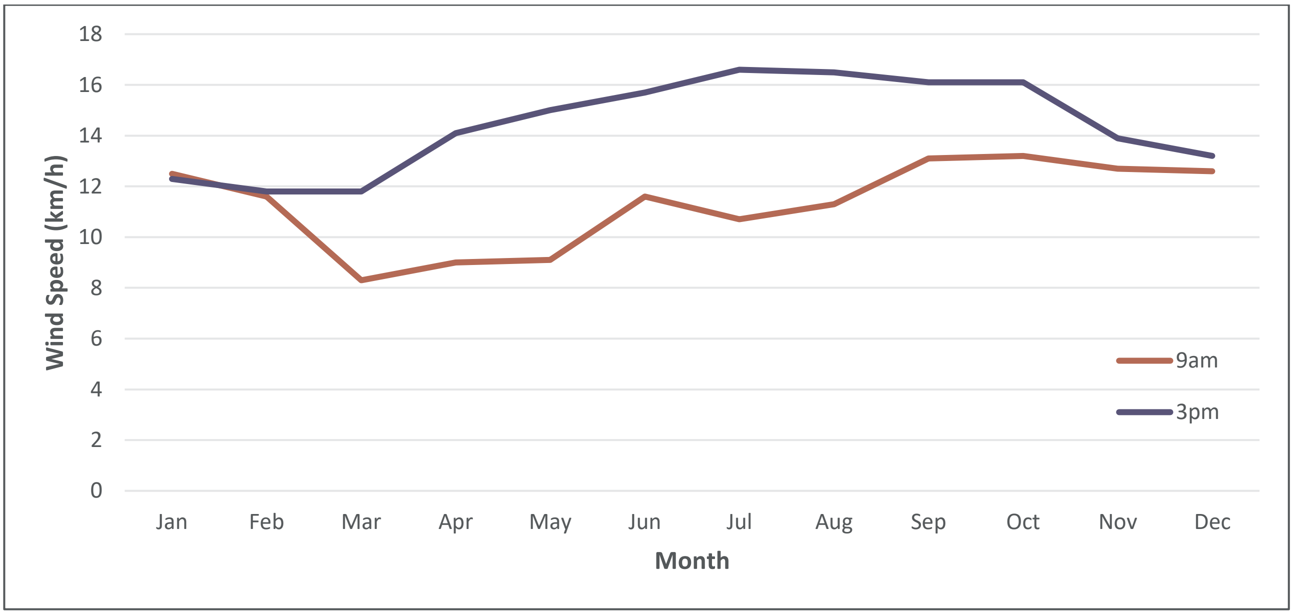
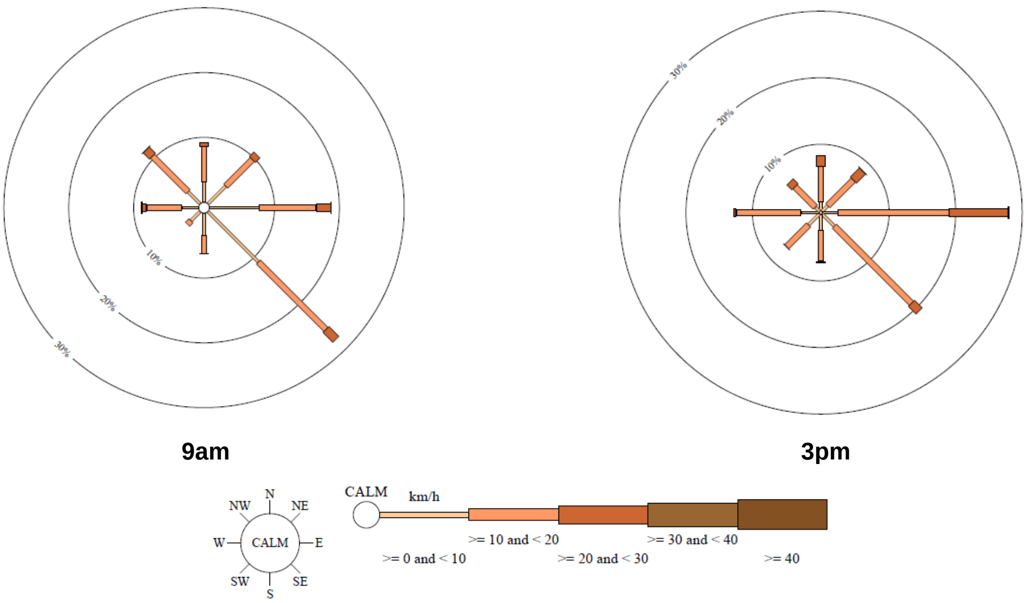


Figure 2-6 Wind Speed and Wind Direction (km/hr)



2.1.1.5 *Weather extremes*

Groote Eylandt experiences monsoonal rains and can experience cyclonic winds during the summer months. Flooding associated with cyclones, storms and monsoonal troughs can affect the region. GEMCO uses online weather systems (BoM and Weatherzone) to monitor weather conditions and has well-established controls and emergency response plans in place to assess and manage potential risks to personnel and/or equipment.

The greatest risk of bushfire usually occurs after the dry winter/early spring period and before the onset of rain over the summer months. It is at this time that lower humidity, high winds and lack of rain are common. GEMCO uses an online fire database (Northern Australia Fire Information) to track bushfires on its leases and has trained fire and emergency personnel and resources to respond if the fire poses a threat to personnel safety and/or GEMCO's assets.

2.1.2 ***Land Systems***

2.1.2.1 *Topsoil and Subsoil*

The Western Leases lie in the lowlands, west of the main plateau. The soils of planned disturbance areas are dominated by 'deep brown' and 'greyish yellow' to 'brown reddish' and 'dark brown' sandy earth loams and gradational contrast soils, with minor areas of mottled clayey sand subsoils and alluvial loamy sands relating to active drainage pathways (GT Environmental, 2017).

Vegetation communities appear to be strongly influenced by the underlying soils and geology. *Eucalyptus tetradonta* open-forest overlying laterite material and the *E. tetradonta* open-forest/low open-forest transition areas occur in areas where the soil type is an acid red earth. The soil is more gravelly in nature in the transition zone. An O horizon is not present in these soil profiles and soil depth increases from a few centimetres (cm) near the edge of the manganese ore outcrop to a depth of 10 m (Langkamp et al., 1979).

The dark brown A1 horizon is a hard setting sandy loam, 25 to 30 cm in depth. In laterite areas, less than 10% of the soil consists of ferro-manganiferous concretions, whereas in the transition areas these concretions make up more than 60% of the total soil. No mottles are present in these areas. The B-horizon extends down to the manganese orebody.

E. tetradonta low open-woodland occurs in association with the manganese orebody. The A horizon extends from very dark brown sand at the surface into a dark reddish-brown sandy B horizon from 5 to 20 cm. The surface soil is hard setting and has an earthy fabric. The surface soil is underlain by the lateritised manganese orebody which outcrops frequently leaving scattered pockets of soil. The shallow profile contains visually more than 60% coarse round or angular manganiferous concretions and is therefore a gravelly lateritic brown earth.

Callitris intratropica and *E. tetradonta* open forest occurs over sandstone material. The profile associated with this community is a sandy brown earth. The A1 horizon is 10 to 15 cm thick and is a dark yellowish brown sand grading into a dark brown sandy A2 horizon. The loamy sand of the B horizon extends to an average depth of 1 m and is underlain by sandstone bedrock boulders. The colour varies from a yellowish red to 50 cm depth to a dark red colour near the bedrock.

The pH in surface soils for all vegetation communities is commonly near neutral with the manganese surface soil being the most acidic (pH 5.8).

2.1.2.2 *Topography and Geology*

Groote Eylandt is dominated by Proterozoic arenites of the Dalumbu Sandstone forming a relatively low-lying plateau on the central and southern portions of the island. Headwater drainage systems incise the quartz-arenites to form radial drainage patterns. The low-lying plains to the north of the plateau are predominantly Mesozoic and Cainozoic strata overlying the Bartalumba Basalts. The majority of the western shoreline consists of the low-lying onlapping Cretaceous sediments which hosts the manganese deposit. The majority of GEMCO's mining lease area consists of Cretaceous sediments with the exception of a discontinuous narrow strip along the eastern boundary where the Proterozoic sandstone outcrops. Figure 2-7 shows the geology across Groote Eylandt, including the distribution of the manganese ore.

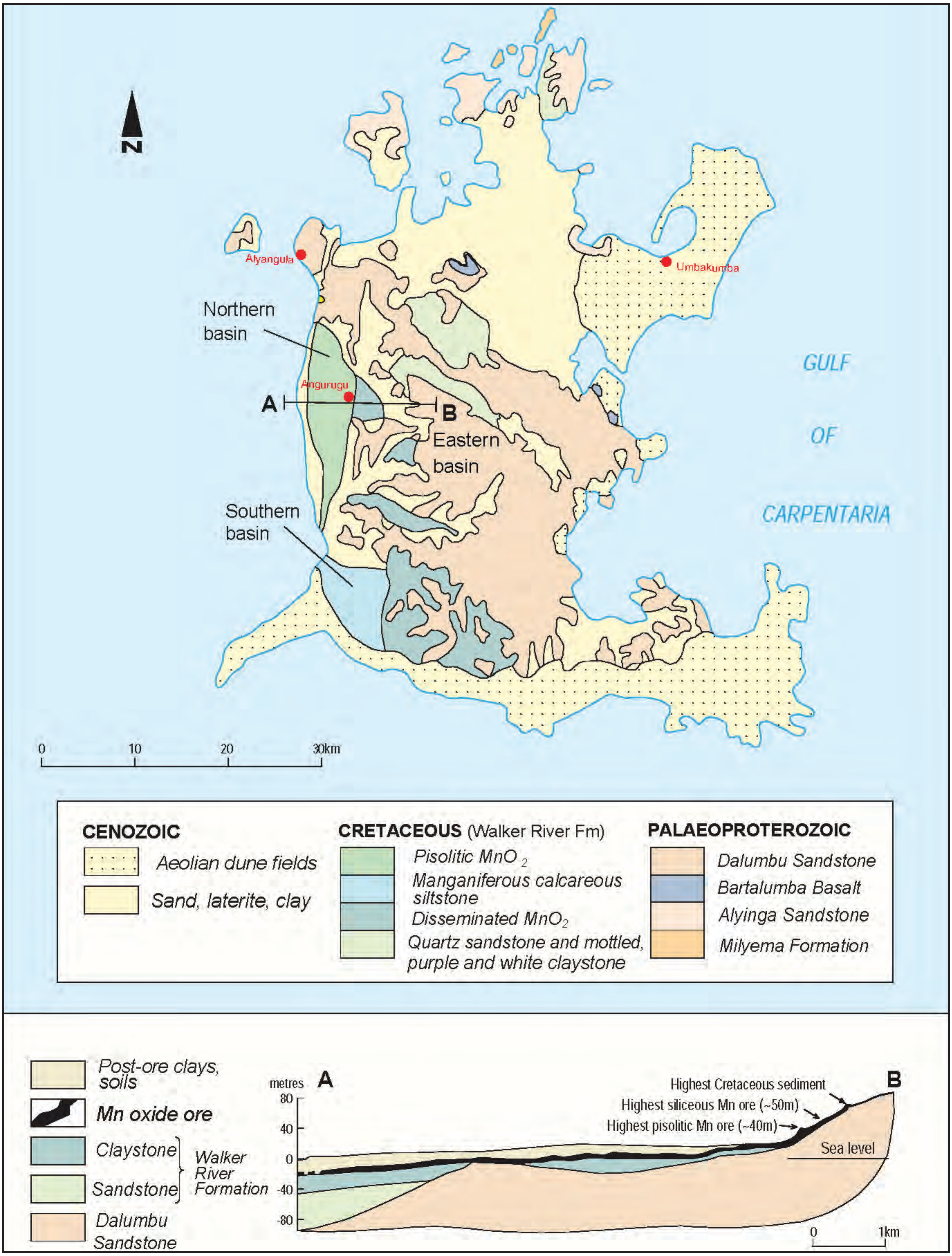
The Groote Eylandt manganese orebody is a sedimentary layer that gently undulates beneath the western plains of the island. It extends over an area of approximately 50 km^2 as an almost continuous horizon, varying in thickness up to 11 m and is essentially stratabound and strataform in character. The orebody consists of massive, pisolitic and oolitic manganese oxides. These oxides are thought to have originally been deposited as a chemical precipitate, forming a tabular sedimentary deposit in wave affected shallow sea-floor environments during a period of rising and falling sea levels. Following the deposition and subsequent cover by younger sediments, the western margins emerged from the sea during a worldwide drop in sea level. The depositional events were followed by a long period of tropical weathering which extensively modified the upper parts of the sediment profile. Pisolitic manganese oxides underwent partial to complete remobilisation and recrystallisation that resulted in the formation of hard cemented pisolite and massive manganese oxides.

In the present mining areas, the mined ore horizon is between 0.5 m and 10 m thick. The 'middle' mining horizon is typically a massive high-grade cemented ore and loose high-grade pisolite ore whereas the 'lower' mining horizon is a massive, high silica ore. The overlying clays and gravels were strongly oxidised and leached to form the laterites that are now excavated off the manganese ore as overburden. In most cases, overburden thickness averages between 15 m and 35 m. The lower part of the sediments below the manganese bearing beds comprise of clayey silt and fine to medium grained sand. Within the sand unit are sections of well-sorted, fine to medium grained marine sand of high transmissivity and storage, which frequently act as aquifers. Figure 2-8 presents an indicative geological stratigraphy representative of the current mining areas.

Lithologies intersected by GEMCO's mining operations are typically comprised of lateritic material that is not considered to be potentially acid forming. As a result, very little testing has historically been undertaken to assess the Acid Mine Drainage (AMD) characteristics of overburden (i.e. waste rock), manganese ore and tailings on GEMCO's Western Leases.

In 2012, representative sands tailings samples were tested to assess the AMD characteristics of sand tailings. This testing reaffirmed sands tailings at GEMCO are relatively benign. The run-off and seepage water quality arising from the sample tested was predicted to contain low dissolved metal and sulphate concentrations. This, together with the low salinity and non-acid forming nature of the materials tested, suggested that sands tailings are unlikely to generate acid or result in the mobilisation of metals and sulphates at levels which are likely to cause exceedance of the selected water quality guideline criteria.

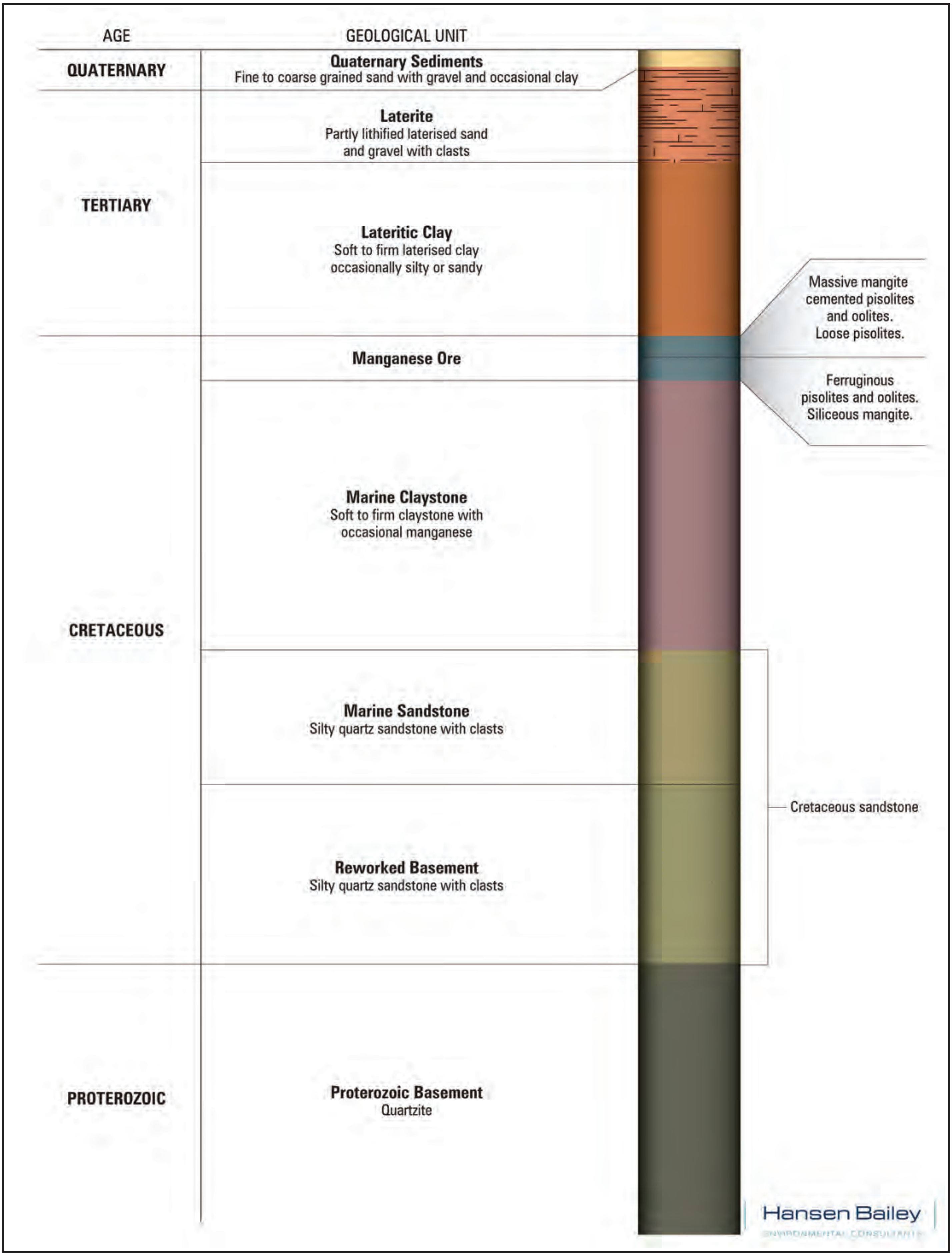
In 2019, qualitative screening was undertaken along the J Quarry Haul Road alignment to assess the presence of acid sulphate soils (ASS). Section 4.4.2.11 provides further detail on the J Quarry Access project and Figure 4-12 shows the location of the new haul road alignment and Emerald River bridge crossing location. Initial field investigations highlighted discrete pockets of potential ASS at the bridge crossing location (just downstream from the existing MLN961 tenement), however subsequent laboratory testing confirmed that only seven of 24 samples analysed met the criteria for ASS. These materials were identified to have a low capacity to generate further acidity as a result of sulphate oxidisation and it was recommended that the materials be appropriately managed via the application of lime. An ASS Management Plan will be developed by a qualified soil scientist during the Feasibility Study phase of the J Quarry Access project. This plan will outline the project management controls needed to manage the risk of potential ASS disturbance which may be encountered during construction of the Emerald River Bridge structure and haul road alignment.



SOUTH32 GEMCO Western Leases MMP

Figure 2-7
Geology of Groote Eylandt

Date: August 2020	Author:	Plan No: Geology of Groote Eylandt
Scale: See scale bar	Figure No: 2-7	



SOUTH32 GEMCO Western Leases MMP

Figure 2-8
Typical Geological Profile

Date: August 2020	Author: Hansen Bailey	Plan No: Typical Geological Profile
Scale: See scale bar	Figure No: 2-8	

2.1.2.3 *Vegetation*

The vegetation on Groote Eylandt is generally characterised by species and communities that are widespread across northern Australia, and strongly reflects the geology, topography and fire regime of the area. Previous vegetation mapping of the Western Leases area (Webb, 1992) (URS, 2012) was based on Map Units (MUs) defined by Webb (1992). However, recent island-wide vegetation mapping undertaken by the NT Department of Environment, Parks and Water Security (DEPWS) in 2017 defines vegetation communities using Vegetation Mapping Units (VMUs). These VMUs are based on the MUs defined by Webb (1992) but they are not identical. In 2018-2019, GEMCO engaged Cumberland Ecology to ground-truth DEPWS's mapping for the Western Leases and surrounding area. The VMUs recorded by Cumberland Ecology (2020) are listed in Table 2-2 and shown in Figure 2-9 and Figure 2-10.

The survey identified 62 VMUs and an additional 16 mixed VMUs (assigned to areas where VMUs intergraded) within the Western Leases and surrounding area. The most common vegetation communities within the Western Leases comprise open woodland to open forests that are dominated by *Eucalyptus tetrodonta* (Darwin Stringybark) and *Eucalyptus miniata* (Darwin Woollybutt) with a low shrub or tussock grass understorey (VMUs 10, 10a and 10b). These vegetation communities typically occur on the gently undulating sandy and lateritic soils and account for around 38% of the total surveyed area (Cumberland, 2020).

Also common are vegetation types that comprise a mix of *Eucalyptus tetrodonta*, *Eucalyptus miniata, Corymbia polycarpa* (Long-fruited Bloodwood) and *Callitris intratropica* (Northern Cypress Pine) with a low shrub/tussock/hummock grass understorey (VMUs 40, 40a 40b, 42 and 11). These vegetation types were found to be the more dominant communities growing on the lateritic plains and lowland areas.

Smaller areas of monsoon vine forests and *Melaleuca* spp. dominated open-forests and woodland are also present.

Table 2-2 Vegetation Mapping Units

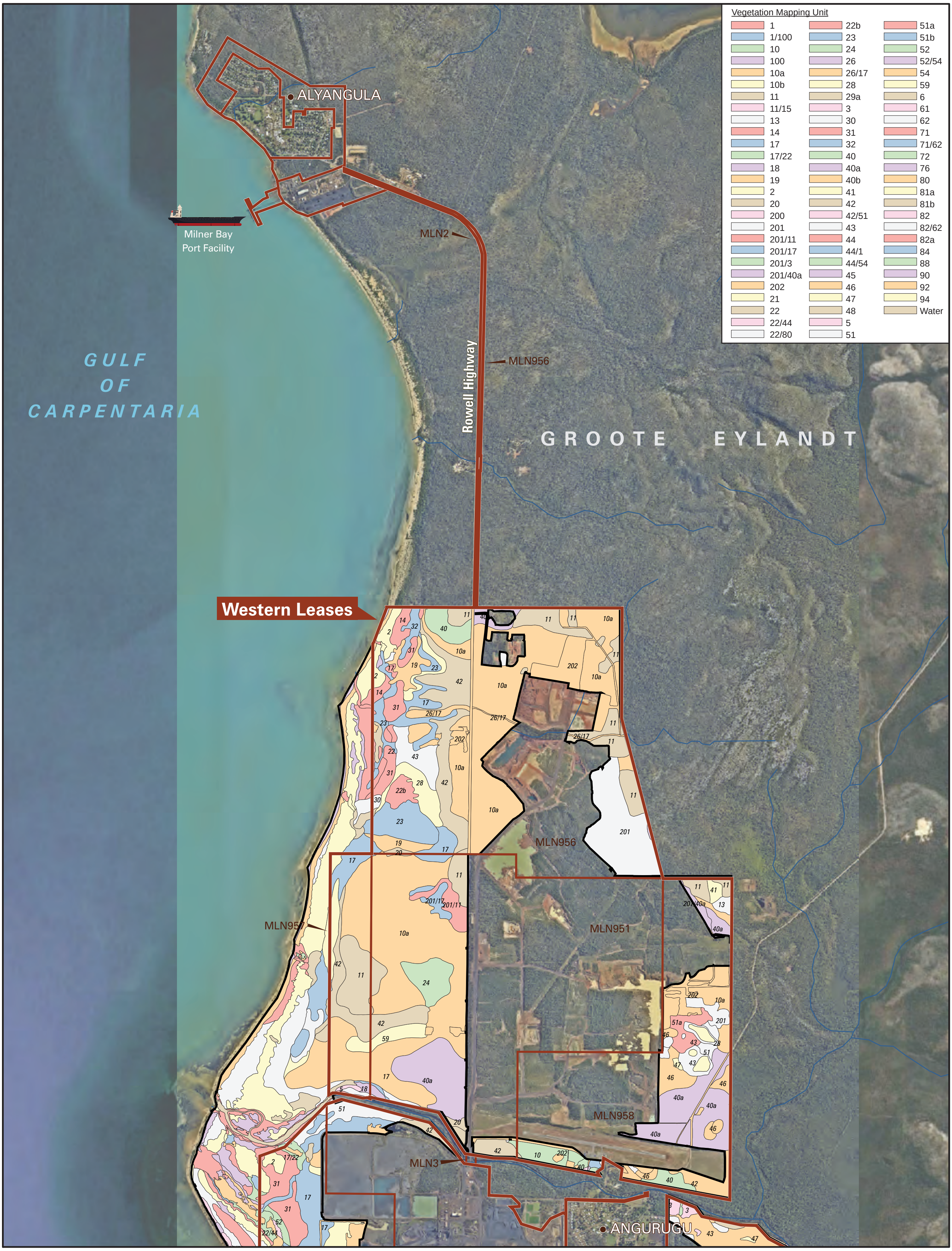
VMU	Name
Individual VMUs	
1	Mangrove low closed-forest/closed-forest
2	Dry coastal monsoon vine closed forests/low closed-forests
3	Dry sub-coastal (inland) monsoon vine-forests (includes Quaternary sands not associated with drainage and not coastal (often at margins of sandplain and consolidated lithologies)
5	Riparian monsoon vine-forests with *Melaleuca cajuputi* and/or *Melaleuca leucadendra*
6	Seepage monsoon vine-forests with *Melaleuca cajuputi* and/or *Melaleuca leucadendra* isolated emergents
10	*Eucalyptus tetrodonta/E. miniata* open-forest to woodland with low shrub or tussock grass understorey
10a	*Eucalyptus tetrodonta/E. miniata* open-forest with low shrub or tussock grass understorey on lowland plains and rises
10b	*Eucalyptus tetrodonta/E. miniata* open-forest with low shrub and mixed tussock/hummock grass understorey on upland plateau surfaces, mostly associated with deeply weathered land surfaces
11	*Eucalyptus tetrodonta/E. miniata /Callitris intratropica* open-forest with mixed shrub/tussock grass understorey
13	*Eucalyptus tetrodonta/E. kombolgiensis* Woodland with shrubby or open hummock grassland understorey

VMU	Name
14	*Acacia latescens / A. torulosa* tall shrubland; *Eucalyptus tetrodonta / E. kombolgiensis* open-forest; *Eriachne triseta /Schoenus sparteus* grassland (dune swale complex or on island sandstones)
17	*Melaleuca viridiflora* or *Melaleuca cajuputi* or *Melaleuca leucadendra* or *Melaleuca ferruginea* / *Eucalyptus polycarpa*/*Eucalyptus biglerita* open-forest with Pandanus spiralis and Mixed tussock grassland understorey
18	*Melaleuca leucadendra* and/or *Melaleuca cajuputi / Dillenia alata +/- Melaleuca viridiflora* open forest with fern/sedge understorey (Swamp Forests - Emerald River) Gullies in sandstone
19	*Melaleuca cajuputi* or *Melaleuca ferruginea / M. leucadendra* open forest with fern/bracken understorey. *Corymbia bella* and/or *Eucalyptus bigalerita* woodland occurs on the fringes
20	*Melaleuca cajuputi* / *Corymbia bella* or *Eucalyptus biglerita* open forest with shrubby understorey often including monsoon vine forest species
21	Mixed *Melaleuca* open forests/ monsoon vine-forests
22	*Melaleuca cajuputi* low closed-forest / *Dapsilanthus ramosus* sedgeland/closed sedgeland (permanent swamps/sedgelands)
22b	*Melaleuca cajuputi* shrubland/*Dapsilanthus ramosus* sedgeland/closed sedgeland (permanent swamps/sedgelands)
23	*Melaleuca cajuputi / M. viridiflora* low open-forest with *Dapsilanthus elatior* sedgeland understorey
24	*Eucalyptus tetrodonta +/- E. minata* low open forest/woodland with low tree or mixed perennial tussock grass/*Sorghum interjectum* tussock grassland understorey
26	Riparian woodland to open-forest of *Melaleuca leucadendra*, *Corymbia polycarpa, Eucalyptus tetrodonta* on ephemeral rivers/streams in drier sub-coastal lowlands
28	*Melaleuca* spp. (*M. viridiflora/M. cajuputi/M. ferruginea*) woodland to low woodland on alluvial plains with sedge understorey
29a	*Eucalyptus tetrodonta, Corymbia ferruginea* woodland on sandy lowland plains with tussock grass ground layer
30	*Eucalyptus tetrodonta, Corymbia kombolgiensis, Corymbia polycarpa* woodland with shrubby understorey of monsoon vine thicket woodland on deeply weathered lowlands and stabilised coastal sands in the east
31	*Eucalyptus tetrodonta, Corymbia kombolgiensis, Melaleuca viridiflora/leucadendra, Corymbia polycarpa, Corymbia foelscheana* open forest/woodland with shrubby understorey and tussock grasses on lowlands including stabilising sands in the east where transitional into VMU 30.
32	*Acacia* spp., *Melaleuca dealbata, Melaleuca viridiflora, Corymbia polycarpa, Asteromyrtus symphyocarpa* low woodland on quaternary sandplains
40	*Eucalyptus tetrodonta/E. miniata / E. polycarpa +/- Callitris intratropica* woodland with low shrub or tussock/hummock grass understorey
40a	*Eucalyptus tetrodonta/E. miniata +/- E. polycarpa* woodland with low shrub and tussock grass dominated understorey on lateritic plains and low rises (generally lowlands)
40b	*Eucalyptus tetrodonta +/- E. miniata +/- Callitris intratropica* woodland to open woodland with low shrub/hummock/tussock grass understorey on shallow rocky soils usually derived from sandstone. Plateaus, hills and rises.
41	*Callitris intratropica / Eucalyptus tetrodonta / E. kombolgiensis* open- woodland with hummock grassland understorey
42	*Eucalyptus polycarpa /E. tetrodonta /E. miniata* woodland with sedge spp./ low shrub understorey
43	*Melaleuca viridiflora / Eucalyptus polycarpa / Grevillea pteridifolia* open woodland with *Asteromyrtus symphyocarpa and Vetiveria elongata* tussock grassland
44	*Melaleuca leucadendra* or *Melaleuca cajuputi* woodland with Ischaemum spp. understorey adjacent to the estuarine zone
45	*Eucalyptus polycarpa* open- woodland with sedges, short tussock grass understorey. Also, areas of grassland
46	*Eucalyptus tetrodonta/E. miniata* low woodland with tussock grass understorey
47	*Eucalyptus tetrodonta/Corymbia polycarpa/Melaleuca viridiflora* low open woodland with *Asteromyrtus symphyocarpa* shrubland

VMU	Name
48	*Eucalyptus tetrodonta* and/or *Corymbia kombolgiensis +/- Corymbia polycarpa, Corymbia ferruginea* open woodland to woodland with *Acacia* spp., *Grevillea* spp., *Terminalia carpentariae* and mixed hummock/tussock grasses on sandstone
51	Alluvial woodland to open-woodland with Cor*ymbia bella, Corymbia polycarpa* and *Eucalyptus biglerita +/- Corymbia grandifolia, Corymbia foelscheana, Corymbia confertiflora, Eucalyptus tetrodonta, Eucalyptus tectifica, Erythrophleum chlorostachys*
51a	*E. bigalerita* woodland
51b	*Eucalyptus biglerita/Corymbia bella* open woodland
52	*Melaleuca viridiflora* and *Pandanus spiralis +/- Corymbia bella* and/or *Eucalyptus biglerita* and/or *Corymbia polysciada* (in north) open-woodland adjacent to estuarine zone. *Chrysopogon elongatus* tussock grassland
54	*Melaleuca acacioidies* low open woodland adjacent to estuarine zone
59	*Eucalyptus tetrodonta/Erythrophleum chlorostachys/Corymbia polycarpa* woodland on lateritic lowland plains
61	*Melaleuca ferruginea/Melaleuca viridiflora/Melaleuca cajuputi +/- Corymbia polycarpa* open woodland to low open woodland with *Pandanus spiralis*, *Grevillea pteridifolia* and 'wet' tussock grass ground layer (*Germania grandiflora*, *Ischaemum* spp.) and sedges (*Dapsilanthus* spp.) in wet dune swales and open drainage systems
62	Open-woodland to scattered trees of monsoon species on sand or cemented sand dunes (*Sterculia quadrifida, Diospyros humilis, Drypetes deplanchei, Santalum, Diospyros maratima, Pouteria sericea, Brachychiton paradoxus, Hakea arborescens*)
71	*Acacia spp., Pandanus spiralis* open shrublands to *Chrysopogon elongatus*, mixed annual grasses, *Tephrosia* spp., *Euphorbia* spp., *Tribulopsis angustifolia* grassland/forbland on active dunes
72	*Acacia* spp. and/or mixed species shrublands (*Melaleuca* spp., *Terminalia carpentariae, Buchanania obovata, Grevillea* spp., *Banksia dentata, Verticordia cunninghamii*) on coastal sandplains and stabilising dunes with mixed sedge/tussock grass ground layer (*Triodia microstachya, Dapsilanthus spathaceus, Schoenus sparteus*)
76	*Acacia* spp. with scattered monsoon species emergents closed tall shrubland to low open forest on cemented sand dunes
80	Eleocharis, Cyperus sedgeland
81a	Closed tussock grassland on margins of estuarine zone (*Heteropogon triticeus, Chrysopogon elongatus, Triodia* spp. (Dry)
81b	*Pseudoraphis spinescens, Paspalum scrobiculatum* closed grassland in wet swales or plains on quaternary coastal sands with emergent *Pandanus spiralis +/- Melaleuca* spp.
82	Grassland on stabilized primary dune, rearward cemented dunes and sandplains
82a	Tussock grassland on sandplains and stabilised dunes of *Sorghum plumosum* and *Chrysopogon elongatus*
84	*Lepironia* or *Dapsilanthus ramosus* and *Dapsilanthus elatior* sedgeland fringing permanent waterbodies
88	Brackish water sedge swamp - *Schoenoplectus littoralis, Eleocharis* spp., *Cyperus* spp.
90	Strand vegetation varying from samphire, grassland, and *Casuarina equisetifolia* open woodland
92	*Chrysopogon, Enneopogon, Canavalia, Cassytha, Triodia grassland*/forbland complex with scattered emergent low trees on frontal or active quaternary dunes and plains and cemented dunes on islands
94	Beach Sand
100	Saline Tidal Flats +/- emergent isolated trees and (chenopod) shrubs
200	Disturbed
201	Regrowth/Rehabilitation
202	Cleared
Combination VMUs	
1/100	Mangrove low closed-forest/closed-forest / Saline Tidal Flats +/- emergent isolated trees and (chenopod) shrubs

VMU	Name
11/15	*Eucalyptus tetrodonta/E. miniata /Callitris intratropica* open-forest with mixed shrub/tussock grass understorey / *Callitris intratropica* open forest; *Acacia* spp. Tall shrubland complex on sandstone
17/22	*Melaleuca viridiflora* or *Melaleuca cajuputi* or *Melaleuca leucadendra* or *Melaleuca ferruginea* / *Eucalyptus polycarpa*/*Eucalyptus biglerita* open-forest with Pandanus spiralis and Mixed tussock grassland understorey / *Melaleuca cajuputi* low closed-forest / *Dapsilanthus ramosus* sedgeland/closed sedgeland (permanent swamps/sedgelands)
22/44	*Melaleuca cajuputi* low closed-forest / *Dapsilanthus ramosus* sedgeland/closed sedgeland (permanent swamps/sedgelands) / *Melaleuca leucadendra* or *Melaleuca cajuputi* woodland with Ischaemum spp. understorey adjacent to the estuarine zone
22/80	*Melaleuca cajuputi* low closed-forest / *Dapsilanthus ramosus* sedgeland/closed sedgeland (permanent swamps/sedgelands) / Eleocharis, Cyperus sedgeland
26/17	Riparian woodland to open-forest of *Melaleuca leucadendra*, *Corymbia polycarpa, Eucalyptus tetrodonta* on ephemeral rivers/streams in drier sub-coastal lowlands / *Melaleuca viridiflora* or *Melaleuca cajuputi* or *Melaleuca leucadendra* or *Melaleuca ferruginea* / *Eucalyptus polycarpa*/*Eucalyptus biglerita* open-forest with Pandanus spiralis and Mixed tussock grassland understorey
42/51	*Eucalyptus polycarpa /E. tetrodonta /E. miniata* woodland with sedge spp./ low shrub understorey / Alluvial woodland to open-woodland with Cor*ymbia bella, Corymbia polycarpa* and *Eucalyptus biglerita +/- Corymbia grandifolia, Corymbia foelscheana, Corymbia confertiflora, Eucalyptus tetrodonta, Eucalyptus tectifica, Erythrophleum chlorostachys*
44/1	*Melaleuca leucadendra* or *Melaleuca cajuputi* woodland with Ischaemum spp. understorey adjacent to the estuarine zone / Mangrove low closed-forest/closed-forest
44/54	*Melaleuca leucadendra* or *Melaleuca cajuputi* woodland with Ischaemum spp. understorey adjacent to the estuarine zone / *Melaleuca acacioidies* low open woodland adjacent to estuarine zone
52/54	*Melaleuca viridiflora* and *Pandanus spiralis +/- Corymbia bella* and/or *Eucalyptus biglerita* and/or *Corymbia polysciada* (in north) open-woodland adjacent to estuarine zone. *Chrysopogon elongatus* tussock grassland / *Melaleuca acacioidies* low open woodland adjacent to estuarine zone
71/62	*Acacia spp., Pandanus spiralis* open shrublands to *Chrysopogon elongatus*, mixed annual grasses, *Tephrosia* spp., *Euphorbia* spp., *Tribulopsis angustifolia* grassland/forbland on active dunes / Open-woodland to scattered trees of monsoon species on sand or cemented sand dunes (*Sterculia quadrifida, Diospyros humilis, Drypetes deplanchei, Santalum, Diospyros maratima, Pouteria sericea, Brachychiton paradoxus, Hakea arborescens*)
82/62	Grassland on stabilized primary dune, rearward cemented dunes and sandplains / Open-woodland to scattered trees of monsoon species on sand or cemented sand dunes (*Sterculia quadrifida, Diospyros humilis, Drypetes deplanchei, Santalum, Diospyros maratima, Pouteria sericea, Brachychiton paradoxus, Hakea arborescens*)
201/3	Regrowth/Rehabilitation / Dry sub-coastal (inland) monsoon vine-forests (includes Quaternary sands not associated with drainage and not coastal (often at margins of sandplain and consolidated lithologies)
201/11	Regrowth/Rehabilitation / *Eucalyptus tetrodonta/E. miniata /Callitris intratropica* open-forest with mixed shrub/tussock grass understorey
201/17	Regrowth/Rehabilitation / *Melaleuca viridiflora* or *Melaleuca cajuputi* or *Melaleuca leucadendra* or *Melaleuca ferruginea* / *Eucalyptus polycarpa*/*Eucalyptus biglerita* open-forest with Pandanus spiralis and Mixed tussock grassland understorey
201/40a	Regrowth/Rehabilitation / *Eucalyptus tetrodonta/E. miniata +/- E. polycarpa* woodland with low shrub and tussock grass dominated understorey on lateritic plains and low rises (generally lowlands)

GEMCO is currently working with DEPWS to simplify the vegetation mapping by aligning the VMUs with Broad Vegetation Types found on the island.



N

0 2.5
Kilometres

Coordinate System: MGA Zone 53

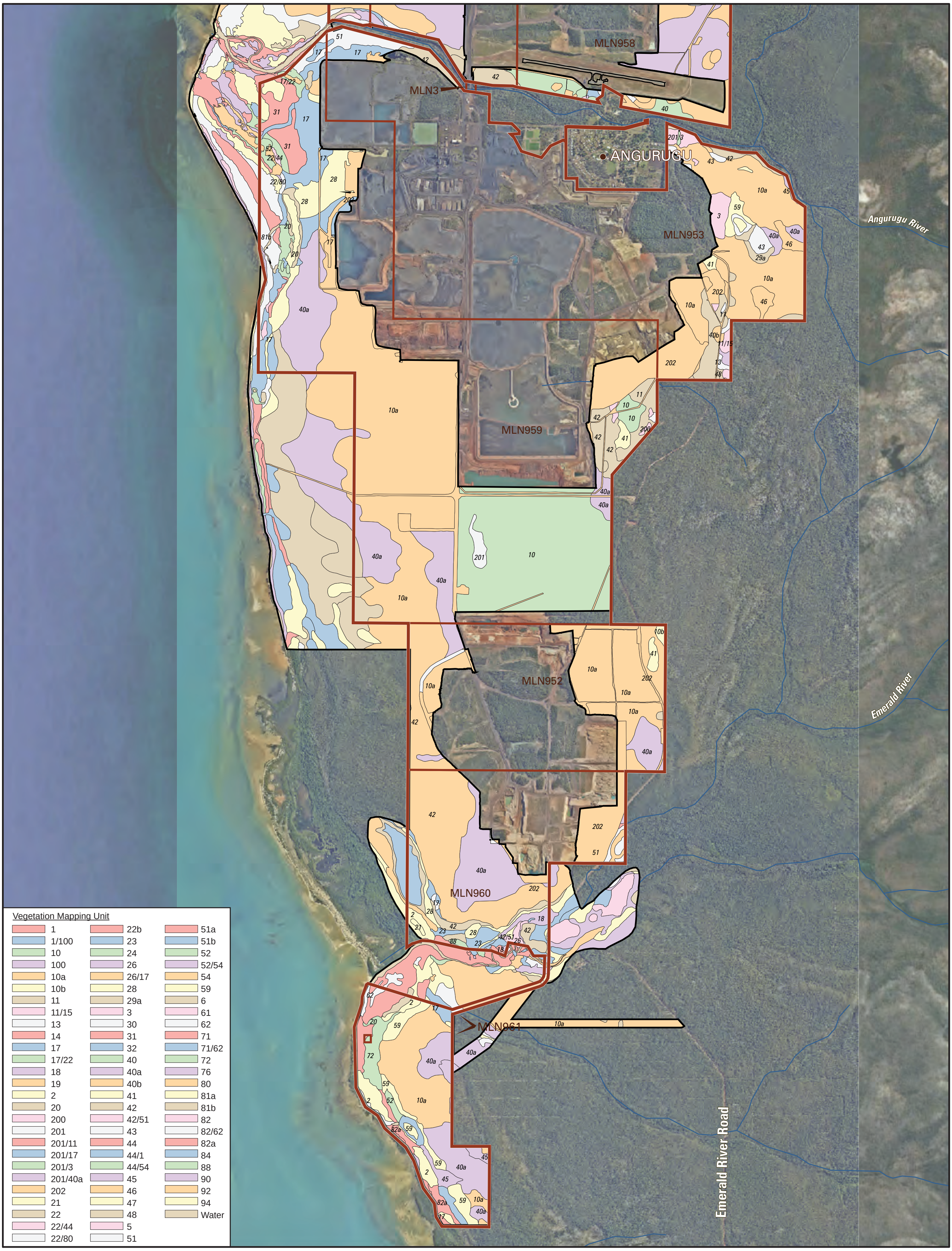
Legend

Western Leases
Study Area (Cumberland Ecology, 2020)

SOUTH32 GEMCO Western Leases MMP

Figure 2-9
Vegetation Communities
(Northern Region)

Date: September 2020	Author: Hansen Bailey	Plan No: Vegetation Communities (Northern Region)
Scale: See scale bar	Figure No: 2-9	



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Kilometres

Coordinate System: MGA Zone 53

Legend

Western Leases
Study Area (Cumberland Ecology, 2020)

SOUTH32 GEMCO Western Leases MMP

Figure 2-10
Vegetation Communities
(Southern Region)

Date: September 2020	Author: Hansen Bailey	Plan No: Vegetation Communities (Southern Region)
Scale: See scale bar	Figure No: 2-10	

2.1.3 *Flora and Fauna*

2.1.3.1 *Flora*

Species of Conservation Significance

The Commonwealth Protected Matters Search Tool (DAWE, 2020) indicates that no threatened ecological communities or flora species listed under the *Environment Protection and Biodiversity Conversation Act 1999* (Cth) (EPBC Act) are likely to be present on Groote Eylandt. The Northern Territory NR Maps tool (DEPWS, 2020) and NRM InfoNet database (NT Government, 2020) holds records for one threatened flora species on Groote Eylandt, namely *Hernandia nymphaeifolia* (Lantern Tree), which is listed as Vulnerable under the *Territory Parks and Wildlife Conservation Act 1976* (NT) (TPWC Act). All records of this species are located in the north eastern portion of Groote Eylandt.

URS (2012) identified one listed flora species, *Arenga australasica* near the Emerald River. This species was previously listed as Vulnerable under the *TPWC Act* and *EPBC Act*, but is now considered synonymous with *Arenga microcarpa*, a more widespread species which is not a listed species under the T*PWC Act* or *EPBC Act*. In recent surveys undertaken by Cumberland Ecology (2020), *Arenga microcarpa* was observed within monsoon closed forest north of J Quarry and near the coast west of the Rowell Highway (Figure 2-10).

Introduced Flora

The total number of weed species on GEMCO's Western Leases is 42. Most of these weed species are found within Alyangula with 22 species having invaded mine and rehabilitation areas.

Table 2-3 describes the classification of weeds within the Northern Territory in accordance with the *Weeds Management Act 2001* (NT) and other Commonwealth and Territory legislation.

Table 2-3: Weed Classifications

Classification	Description
A	**To be eradicated** Reasonable effort must be made to eradicate the plant within the NT
B	**Growth and spread to be controlled** Reasonable attempts must be made to contain the growth and prevent the movement of the plant
C	**Not to be introduced to the Territory** All Class A and B weeds are also considered to be Class C Weeds
Not Classified	**Weeds of environmental concern** Weeds that may threaten natural ecosystems but are not declared under the *Weeds Management Act 2001* (NT)
Weeds of National Significance (WoNs)	**Weed of National Significance** Weeds of National Significance are identified by the Australian Government.

Table 2-4 provides a list of priority weed species occurring, or having occurred, on the Western Leases and/or Alyangula.

Table 2-4: Significant Weed Species

GEMCO Priority	Common Name	Botanical Name	Classification	Location
1	Bellyache bush	*Jatropha gossypiifolia*	A/C; WoNS	Alyangula & Mine site
	Gamba grass	*Andropogon gayanus*	A/C; WoNS	Alyangula
	Grader grass	*Themeda quadrivalvis*	B/C; WoNS	Alyangula & Mine site
	Neem	*Azadirachta indica*	B/C	Alyangula & Mine site
	Prickly pear	*Opuntia sp.*	A/C	Alyangula
	Ornamental rubber vine	*Cryptostegia madagascariensis*	A/C; WoNS	Alyangula
2	Caltrop	*Tribulus terrestris*	B/C	Alyangula
	Candle bush	*Senna alata*	B/C	Alyangula
	Coffee bush	*Leucaena leucocephala*	Not declared	Alyangula & Mine site
	Gambia pea	*Crotolaria goreensis*	Not declared	Alyangula & Mine site
	Guinea grass	*Megathyrsus maximus*	Not declared	Alyangula & Mine site
	Mission grass (annual)	*Cenchrus pedicellatus*	Not declared	Mine site
	Mission grass (perennial)	*Cenchrus polystachios*	B/C	Alyangula & Mine site
	Singapore daisy	*Sphagneticola trilobata*	Not declared	Alyangula
3	Flannel weed	*Sida cordifolia*	B/C	Alyangula & Mine site
	Hyptis	*Hyptis suaveolens*	B/C	Alyangula & Mine site
	Mossman River grass	*Cenchrus echinatus*	B/C	Alyangula
	Paddy's lucerne	*Sida rhombifolia*	B/C	Alyangula
	Para grass	*Urochloa mutica*	Not declared	Alyangula & Mine site
	Snakeweed	*Stachytarpheta jamaicensis*	B/C	Alyangula & Mine site
	Wild passionfruit	*Passiflora foetida*	Not declared	Alyangula & Mine site
	Coffee senna	*Senna occidentalis*	B/C	Alyangula & Mine site

Section 5.6.3.6 provides further detail on the management of these species.

2.1.3.2 *Fauna*

Species of Conservation Significance

A total of 30 species of native mammals, 180 bird species, 61 reptile species and 15 amphibian species are known to occur within GEMCO's Western Leases based on a search of the Atlas of Living Australia database (CSIRO, 2020).

To date, five fauna species currently listed under the *EPBC Act* and/or the *TPWC Act* have been recorded within the Western Leases. A summary of these species is provided in Table 2-5.

Table 2-5: Threatened fauna species recorded within GEMCO's Western Leases

Species	EPBC Act Status	TPWC Act Status	Reference	Description of Location
Northern Hopping Mouse (*Notomys aquilo*)	Vulnerable	Vulnerable	Webb (1992), EWL Sciences (2008, 2009a, 2009b, 2009c) EMS (2008, 2012d, 2014a, 2014b, 2016, 2017, 2018a, 2018b, 2018c, 2019a, 2019b, 2019c, 2019d, 2020a, 2020b), Coffey Environments (2010), Cumberland Ecology (2015), Smith (2009), Firth (2008), Ward (2006, 2007), ALC (2018, 2019)	Recorded east of the northern quarries adjacent to the Western Leases boundary. Pre-2000 records from J Quarry (Webb, 1992).
Northern Quoll (*Dasyurus hallucatus*)	Endangered	Critically Endangered	EWL Sciences (2008, 2009c), EMS (2008, 2012d, 2014a, 2014b, 2016, 2017, 2018a, 2018b, 2018c, 2019a, 2019b, 2019c, 2020a, 2020b, 2020c) Webb (1992), Cumberland Ecology (2015)	Recorded at numerous locations across the Western Leases, including Alyangula.
Merten's Water Monitor (*Varanus mertensi*)	Not Listed	Vulnerable	EMS (2008) Webb (1992), EMS (2012b, 2018c), Cumberland Ecology (2015, 2016, 2019)	Recorded in the Western Leases area, including aquatic habitat adjacent to F3 pit.
Northern Masked Owl (*Tyto novaeholladiaea kimberli*)	Vulnerable	Vulnerable	URS (2012), EMS (2012a, 2014a, 2014b, 2016, 2017, 2018a, 2019a, 2019c, 2020b, 2020c), Cumberland Ecology (2016, 2019)	Recorded in open eucalypt forest and Melaleuca swap forest habitats in the Western Leases.
Ghost Bat (*Macroderma gigas*)	Vulnerable	Not Listed	EMS (2012a, 2012d, 2014a, 2016, 2017a, 2017c), Diete et al. (2015), Bardon (2015, 2020)	Recorded in *Eucalypt tetradonta*/*Callitris intratropica* within the Western Leases

Table 2-6 provides a list of threatened species with the potential to occur within GEMCO's Western Leases. These species have not been recorded on the leases in recent or historical surveys however they have been listed on the Commonwealth Protected Matters Database (DAWE, 2020) and/or identified by URS (2012) as having a possible presence in the area of the leases. Table 2-5 also lists several threatened migratory shorebirds that have been sighted on the coastal margins of the Western Leases and in the vicinity of the port.

Table 2-6: Threatened fauna species with the potential to occur within GEMCO's Western Leases

Species	EPBC Act Status	TPWC Act Status	Likely Presence within GEMCO's Western Leases
False Water Rat (*Xeromys myoides*)	Vulnerable	Not listed	Unlikely. Favours mangroves and areas with permanent water. Large areas of suitable habitat are not present in the Western Leases. Closest records are at the Arnhem Swamp on the northern Arnhem land coast.
Gouldian Finch (*Chelobia gouldiae*)	Endangered	Vulnerable	Not sighted on Groote Eylandt since a single report by Wilkins (1924)
Brush-tailed Rabbit-rat (*Conilurus penicillatus*)	Vulnerable	Endangered	Several recent (post-2000) records in the Eastern Leases. Older records associated with the Western Leases at Angurugu, but these may not be accurately geo-located.
Lesser Sand Plover (*Charadrius mongolus*)	Endangered / Migratory	Vulnerable	Coastal foreshore flats and near-coastal saline wetlands. Potential habitat near the port.
Greater Sand Plover (*Charadrius leschenaultii*)	Vulnerable / Migratory	Vulnerable	Coastal foreshore flats and near-coastal saline wetlands. Potential habitat near the port.
Eastern Curlew (*Numenius madagascariensis*)	Critically Endangered/Migratory	Vulnerable	Coastal foreshore flats and near-coastal saline wetlands. Potential habitat near the port.
Bar-tailed Godwit (*Limosa lapponica*)	Critically Endangered/Migratory	Vulnerable	Coastal foreshore flats and near-coastal saline wetlands. Potential habitat near the port.
Great Knot (*Calidris tenuirostris*)	Critically Endangered/Migratory	Vulnerable	Coastal foreshore flats and near-coastal saline wetlands. Potential habitat near the port.
Red Knot (*Calidris canutus*)	Endangered/Migratory	Vulnerable	Coastal foreshore flats and near-coastal saline wetlands. Potential habitat near the port.
Curlew Sandpiper (*Calidris ferruginea*)	Critically Endangered/Migratory	Vulnerable	Coastal foreshore flats and near-coastal saline wetlands. Potential habitat near the port.
Asian Dowitcher (*Limnodromus semipalmatus*)	Not listed/Migratory	Vulnerable	Coastal foreshore flats and near-coastal saline wetlands. Potential habitat near the port.
Green Turtle (*Chelonia mydas*)	Vulnerable	Not Listed	Marine, potential habitat near the port.
Flatback Turtle (*Natator depressus*)	Vulnerable	Not Listed	Marine, potential habitat near the port.
Hawksbill Turtle (*Eretmochelys imbricata*)	Vulnerable	Vulnerable	Marine, potential habitat near the port.
Pale Field Rat (*Rattus tunneyi*)	Not listed	Vulnerable	One specimen (skull only) in NT Museum from Angurugu (1972). The skull is damaged preventing some comparative measurements. Could be *R. tunneyi*, or less likely another *Rattus* species.

Section 5.6.3.4 provides further detail on the management of these species.

Table 2-7 provides a list of species that were formerly considered in threatened species assessments for Groote Eylandt but are no longer considered to be present on the island or have undergone a status change. There are previous records for these species on or near the Western Leases.

Table 2-7 Threatened fauna species formerly considered to be of significance within or adjacent to GEMCO's Western Leases

Species	EPBC Act Status	TPWC Act Status	Likely Presence within GEMCO's Western Leases
Carpentarian Antechinus (*Pseudantechinus mimulus*)	Not listed	Not listed	Records for this species are associated with sandstone habitats adjacent to the Alyangula town lease. Formerly listed as Vulnerable under the *EPBC Act* but was delisted in 2019.
Floodplain Monitor (*Varanus panoptes*)	Not Listed	Vulnerable	Formerly reported to occur on Groote Eylandt (Mahney et al., 2009). Recent genetic sampling indicates that the only large non-rock dwelling goanna present on Groote is the common Gould's goanna (*Varanus gouldii*)

Introduced Terrestrial Vertebrates

There are five feral animals currently known to be present on Groote Eylandt. These are the Domestic Dog (*Canis familiaris*), Asian Gecko (*Hemidactylus frenatus)*, House Mouse (*Mus musculus*), Rat (*Rattus sp*.) and Cat (*Felis catus*). The distribution of these species appears to be largely limited to areas in the vicinity of Angurugu, Umbakumba and Alyangula.

Cane Toads (*Rhinella marinus*) remain absent from the island due to a collaborative Quarantine and Biosecurity program led by GEMCO and the Anindilyakwa Land and Sea Rangers despite all adjacent mainland areas now being affected by this invasive species.

Aquatic Invertebrates

Aquatic invertebrates are good bio-indicators for the health status of aquatic ecosystems. In 2012, URS conducted a study that also sampled freshwater aquatic macro invertebrates within the Angurugu and Emerald River systems. Taxa diversity for Groote Eylandt was comparable with unimpaired samples from southern Gulf of Carpentaria drainage basins with 117 taxa sampled. No exotic macro invertebrates were recorded during the survey. A more recent study undertaken along the Emerald River (C&R Consulting, 2018) found a similar diversity of macro invertebrate taxa to the URS (2012) study (on comparison of raw data).

Ants

Surveys conducted by URS (2012) indicated that the ant fauna of Groote Eylandt is widely represented across the Top End with 95% of the species recorded during the survey found across the region. A total of 103 native ant species were recorded while 5 exotic species are known from the area: *Monomorium destructor*, *M. floricola, M. pharaonis, Paratrechina longicornis*, and *Tetramorium simillimum.*

2.2 Socio-Economic Environment

The Groote Eylandt Archipelago, which includes Groote Eylandt, Bickerton Island and a number of smaller, neighbouring islands, has a population of approximately 2,500 people (Australian Bureau of Statistics, 2017a). The Traditional Owners of the Groote Eylandt Archipelago have co-existed with GEMCO since the mine was established in the 1960s.

As the primary industry on Groote Eylandt, the GEMCO mine has played a significant role in the economic development of the island and in shaping the social fabric of the community. Royalties and a number of other related payments from the mine benefit the Traditional Owners of Groote Eylandt through investment in housing, infrastructure, services, and capacity development. Section 2.2.4 describes in the further detail the support GEMCO provides to the Groote Eylandt community.

2.2.1 *Current Land Use*

Groote Eylandt is Aboriginal land under the *ALRA* and is managed by the ALC on behalf of the Traditional Owners. In accordance with the *ALRA*, a Mining Agreement was signed by GEMCO and the ALC in 2006 authorising GEMCO to undertake mining activities on the Western Leases. Section 3.2 provides further detail on GEMCO's obligations under this Mining Agreement. The majority of Groote Eylandt is not open to the general public, however the ALC has nominated a number of recreation areas that can be accessed by the public, subject to a permitting system.

Key land uses on Groote Eylandt include the townships of Alyangula, Angurugu and Umbakumba, various satellite communities, mining and exploration activities (undertaken by GEMCO on Groote Eylandt and Winchelsea Mining Company Pty Ltd on Winchelsea Island), and traditional Aboriginal cultural practices such as hunting and gathering. There are also small scale eco-tourism activities on Groote Eylandt, including a resort near Alyangula.

There are five satellite communities in close proximity to the Western Leases, namely Malkala, Bartalumba, Ngadumiyerrka (also known as Little Paradise), Angaja and Yedikba (also known as Emerald River) (Figure 1-4). Malkala, Bartalumba and Ngadumiyerrka are permanently occupied by Aboriginal residents while Angaja and Yedikba have varying levels of occupancy, from occasional visitation to sporadic residency.

The Angurugu River mouth, Emerald River mouth and Mud Cod Bay are located on the coastline to the west of GEMCO's Western Leases and are popular locations for Aboriginal activities such as fishing and gathering bush foods (Figure 1-4). There are also a number of popular recreational swimming areas in proximity to the Western Leases including the Emerald River Bridge, Pole 24 and Milyerrngmurramanja (Naked Pools) (Figure 1-4).

There are no declared National Parks on Groote Eylandt and no commercial farming or agricultural practices are currently undertaken on the island, although the ALC have recently investigated the feasibility of aquaculture farming.

Figure 1-5 and Figure 1-6 illustrate the existing public and private infrastructure within the Western Leases and the surrounding area, including the power station, airport, port facility and main public roads.

2.2.2 *Identified Stakeholders and Consultation*

GEMCO undertakes consultation with stakeholders utilising a range of methods at varied frequencies. Engagement with stakeholders is planned annually and considers the specific engagement needs of the individual stakeholder.

GEMCO's Stakeholder Engagement Plan (SEP) outlines:

- Stakeholder organisation/name;
- Primary contact person and contact details;
- Relationship owner; and
- Engagement strategy (methods and frequency).

Interactions are recorded in the Stakeholder Relationship Manager (SRM) database.

Engagement methods range from low level engagement (i.e. access to the South32 website) to high level engagement (i.e. face to face meetings). The type of engagement defined for each stakeholder group is aligned to the level of engagement required, with high priority stakeholders requiring increased engagement. A summary of GEMCO's stakeholders and their relevant engagement priority and methods are detailed in Table 2-8. Table 2-9 and Table 2-10 describe in more detail the types of engagement methods utilised and the key engagement priorities for GEMCO.

Table 2-8: GEMCO Stakeholder Engagement - Summary

Stakeholder Group	Engagement Priority	Engagement Method										
		South32 website	*Social media*	*Site-wide and community briefs*	*Community events*	*Media releases and advertisements*	*Community Perception Surveys*	*Community Grants Program*	*Community Development Programs/Partnerships*	*Regular Community Engagement*	*Community Information Sessions*	*Face to face meetings and briefings*
Anindilyakwa Land Council (on behalf of the Anindilyakwa people)	H	x	x	x	x	x	x	x	x			x
Alyangula community	H	x	x	x	x	x	x	x	x	x	x	
Angurugu community	H	x	x	x	x	x	x	x	x	x	x	
Umbakumba community	H	x	x	x	x	x	x	x	x	x	x	
Milyakburra community	H	x	x	x	x	x	x	x	x	x		
Satellite communities	M				x	x	x	x	x			
Non-resident employees and contractors (FIFO)	H	x	x	x	x	x	x	x				
Northern Territory community	H	x	x			x		x				
Australian Government	H	x	x			x	x		x	x	x	x

Stakeholder Group	Engagement Priority	Engagement Method										
		South32 website	*Social media*	*Site-wide and community briefs*	*Community events*	*Media releases and advertisements*	*Community Perception Surveys*	*Community Grants Program*	*Community Development Programs/Partnerships*	*Regular Community Engagement*	*Community Information Sessions*	*Face to face meetings and briefings*
Northern Territory Government	H	x	x			x	x		x	x	x	x
Education	H	x	x	x	x	x	x	x	x	x	x	x
Police	H	x	x	x	x	x	x		x	x	x	x
Health	H	x	x	x	x	x	x	x	x	x	x	x
East Arnhem Regional Council	H	x	x	x	x	x	x	x	x	x	x	x
Aboriginal corporations	H	x	x	x	x	x	x	x	x	x	x	x
Businesses (local)	M	x	x	x	x	x	x	x		x		
Suppliers (non-local)	M	x	x			x	x			x		x
Interested Organisations	H	x	x			x				x		
State/National Media	L				x	x				x		x
Women	H	x	x	x	x	x	x	x	x	x	x	x
Elders	H	x	x	x	x	x	x	x	x	x	x	x
Children/youth	M	x	x	x	x		x	x	x			
Religious organisations	L	x	x	x	x	x	x	x	x			
Industry bodies	H	x	x	x	x	x	x		x	x	x	x
Community organisations (local)	L	x	x	x	x	x	x	x	x	x	x	x

H = High, M = Medium, L = Low

Table 2-9: GEMCO Engagement Methods

Objective	Engagement Method	Comments
Low Level Engagement	South32 website	Managed by South32 corporate and available to all stakeholders.
	Social media	GEMCO Community Facebook page managed by Corporate Affairs.
	Site-wide and community briefs	Information notices distributed to GEMCO employees and key stakeholders through a community email distribution list.
	Community events	Annual events sponsored by GEMCO in Alyangula such as Picnic Day, Australia Day and ANZAC Day.
	Media releases, advertisements and responses	Media releases and advertisements are supplied to local, state and national newspapers.

Objective	Engagement Method	Comments
Medium Level Engagement	Community Perception Survey	Conducted triennially, this is a survey that includes households in all four Groote Eylandt communities.
	Community Grants Program	This funding model is acknowledged as an important stakeholder engagement tool. Donation rounds are held tri-annually and are open to community organisations in GEMCO's local communities.
High Level Engagement	Community Development Partnerships	Community Development Programs are acknowledged as a method of intense engagement with a specific stakeholder.
	Regular Community Engagement	GEMCO's Corporate Affairs team conducts weekly community engagement in Angurugu and Umbakumba.
	Community Information Sessions	GEMCO conducts or attends regular community information sessions held by stakeholders on Groote Eylandt.
	Face to face meetings and briefings	This method of engagement, consisting of a personal one-on-one meeting between South32 and the stakeholder, is considered to be the best exchange of communication and consultation and is the preferred engagement method with high priority stakeholders.

Table 2-10: GEMCO Operational Engagement Priorities

Item	Description	Priority Stakeholder
Safe Operations	GEMCO undertakes internal engagement to create a shift in how GEMCO employees recognise hazards and respond to improve safety outcomes and external engagement to support a positive relationship between community members and GEMCO workforce.	Internal Workforce Neighbouring Communities NT Police Department of Chief Minister (DCM)
Social Licence to Operate	GEMCO operates on Aboriginal Freehold Land and recognises the importance of maintaining its social licence. Building and maintaining a positive working relationship with the Anindilyakwa people is essential to the delivery of GEMCO's business plan.	ALC Groote Eylandt Aboriginal Trust (GEAT) Neighbouring Communities NT Government
Life of Operation Planning and Execution	GEMCO undertakes regular engagement with the Traditional Owners, the ALC and the NT Government to ensure mining activities are endorsed by all stakeholders and the appropriate land access agreements and regulatory licences and approvals are in place and maintained.	ALC GEAT Neighbouring Communities Relevant Traditional Owners GEMCO – Planning DITT Department of Environment, Parks and Water Security (DEPWS)
Closure Planning	GEMCO is working closely with stakeholders to understand the impacts of closure and to work collaboratively on solutions to create a positive post mining legacy.	ALC GEAT DITT DEPWS DCM
GEMCO Air Emission Management	GEMCO has initiated significant work to understand its dust footprint and identify ways to better manage dust at the operation. Ensuring its workforce and external stakeholders are aware of these efforts facilitates alignment on goals and early advice of performance contrary to goals.	Internal Workforce NT Government ALC Neighbouring Communities

Item	Description	Priority Stakeholder
Near Angurugu Mining Activities	In FY21-23, GEMCO will be conducting civil and mining works adjacent to the community of Angurugu. Significant community engagement work occurred in FY20 and will continue to ensure the safe and sustainable operation adjacent to our neighbours.	Angurugu Community (including near neighbours) ALC Government Services Providers Groote Eylandt and Bickerton Island Enterprises (GEBIE) GEMCO – Planning, Projects and Mining Teams
Indigenous Participation	GEMCO maintains an Indigenous Employment and Participation Strategy to support increased employment outcomes for local Indigenous peoples. The most recent review of this strategy was completed in 2019 and will be delivered over the coming three years. Key targets include increasing direct employment and spend with local Indigenous people.	GEMCO Rehabilitation, Mine Services and Legacy Team (RMSL) Office of the Registrar of Indigenous Corporations (ORIC) organisations ALC Groote Eylandt Schools Relevant Government Service Providers

The ALC, as the representative body of the Traditional Owners of Groote Eylandt, is a high priority stakeholder (Table 2-8). GEMCO's engagement strategy with the ALC includes consideration of specific requirements under the Mining Agreement in place between both parties. In particular, Article 21 of the Mining Agreement outlines the requirement to establish a Mining Liaison Committee (MLC) with members from both GEMCO and the ALC. The MLC meet on a quarterly basis to review the progress of mining and discuss proposed activities and developments. Article 11 also outlines the requirement for GEMCO to submit any MMP amendments to the ALC for review and approval prior to submission to the NT Government. The ALC provided their endorsement of this MMP on 11 November 2020 (Appendix 9.3) and ongoing communication throughout the term of the MMP will be maintained utilising the MLC meeting forum.

2.2.3 *Workforce Description and Demography*

GEMCO has a permanent workforce of approximately 1,100 people, including both GEMCO employees and embedded contracting partner's personnel (agency contractors). As at 30 June 2020, GEMCO's workforce consisted of 855 employees and 212 agency contractors. In addition, GEMCO engages a facilities management contractor (ESS) to service the FIFO camp and Alyangula township who employ a further 125 personnel (approximately). These numbers are not anticipated to vary substantially during the MMP term however, GEMCO's temporary workforce of service contractors may increase by up to 20% for short-term maintenance activities or project work. GEMCO's temporary workforce averages the equivalent of approximately 275 full time roles.

The GEMCO workforce either live residentially on Groote Eylandt (15%) or fly in/fly out (FIFO) from Darwin or Cairns (85%). Approximately 50% of the workforce is aged 35 to 50 years and 14.3% are female, with 50% having worked at GEMCO for more than 5 years (as at 30 June 2020).

GEMCO has committed to employing local Indigenous people from Groote Eylandt since the mine commenced in 1964 and has a range of Indigenous participation strategies and plans in place. This includes GEMCO's Indigenous Employment Plan which focuses on:

- Establishing and maintaining a trained and qualified mentor network in the workforce;
- Implementing culturally appropriate recruitment and induction processes; and

- Maintaining a training program that gives the skills necessary for the job.

GEMCO's Indigenous Employment Plan (which forms part of South32's Reconciliation Action Plan) outlines GEMCO's commitment to increasing spend on local Indigenous businesses by 10% per annum and Indigenous employment by 5% per annum.

As at 30 June 2020, GEMCO's workforce consisted of 60 Indigenous personnel employed by GEMCO and a further 30 Indigenous personnel employed by GEMCO's contracting partners. This is an increase of approximately 40% for employees and 330% for agency contractors from the numbers reported in the FY17-FY20 MMP.

GEMCO continues to promote employment opportunities for the local Indigenous people and encourages all major contracting partners to do the same.

2.2.4 *Community Affairs*

South32's Community Standard (Appendix 9.9) outlines how operations understand their communities and develop appropriate plans to ensure that each operation can create shared benefit through its social and environmental leadership.

GEMCO defines its communities as those which are directly involved with GEMCO's operations. This includes:

- The Traditional Owners of Groote Eylandt;
- Residents of the Groote Eylandt communities of Angurugu, Alyangula, Umbakumba and Bickerton Island;
- The wider East Arnhem Region of the Northern Territory; and
- GEMCO's FIFO bases of Cairns and Darwin.

GEMCO regularly conducts social baseline assessments to better understand the social context in which it operates. The most recent Social Baseline Assessment was undertaken by the University of Queensland Centre for Social Responsibility in Mining (CSRM) in 2018 (CSRM, 2018). This assessment provides a detailed understanding of Groote Eylandt's social context and informs GEMCO's Community Investment Plan (CIP). An update to the social baseline assessment is planned to be completed in 2022.

2.2.4.1 *Community Investment Plan*

GEMCO's CIP is updated annually and establishes a framework for its investments in social and economic development on Groote Eylandt and its broader communities. Through this CIP, GEMCO seeks to develop strategic partnerships to support education, community health and safety, youth engagement, employment and business development. GEMCO's long-term and short-term social investment objectives, as outlined in the CIP, are as follows:

- **Long-term objective**: To support improved social outcomes for the Traditional Owners of Groote Eylandt. This can be achieved by working with the Traditional Owners (through the ALC), the Northern Territory Government and the Commonwealth Government to identify key areas for investment to support the realisation of a positive post-mining future for Groote Eylandt.

- **Short-term objective**: To have a positive social impact in the following identified areas:
  - Education;
  - Employment and Economic Development;
  - Review of current health services to identify the areas of need; and
  - Supporting the community and amenity of GEMCO's primary communities of Alyangula and Angurugu.

GEMCO's annual community investment program is outlined in Table 2-11.

Table 2-11: GEMCO's Annual Community Investment Programs

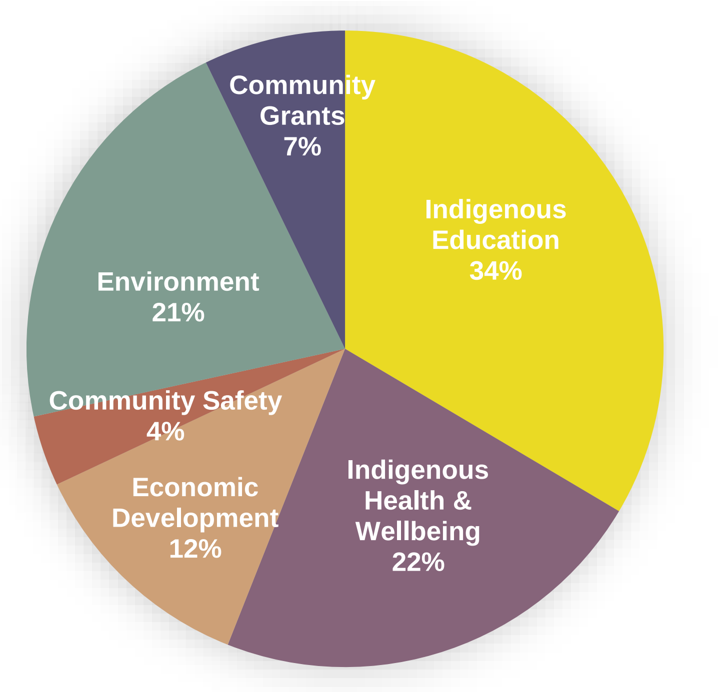
Mechanism	Purpose	Resource[1]	Timeframe	Implementation at Operation
Strategic investment	Projects aligned with focus areas, longer term sustainability	FY21 Value: $1.27m	Usually more than 1 year	Education • Graham (Polly) Farmer Foundation Partnership • Save the Children Health • MJD Foundation • Youth Sport and Recreation Program • Top End Health Mental Health Partnership Employment/Economic Development • Bush Medijina Community Development Program • GEBIE Youth Engagement Program • Safety • Indigenous Community Safety Program (Peacemakers) Environment • Indigenous Ranger Cadet Program
Donations	Ad-hoc discretionary spend to support operational objectives	FY21 Value: $120k	Grant funding released three times per calendar year for individual projects with a defined outcome	Supports community groups and not-for-profits to deliver programs of community benefit on Groote Eylandt. Grants are managed through the GEMCO Grants committee (senior GEMCO staff).
In-kind and Admin support	Company goods and services to support community benefit, including administration of employee / contractor time	Determined by operation. Can be strategic investment / donations beyond Community Investment Funding.	As determined by operation	GEMCO supports short and long-term community development projects through the provision of in-kind support. At GEMCO, this can include: • Seats on Charter Flights • Allocation of housing for community development projects • Professional support for community organisations (committee participation) • Access to GEMCO Freight service at low/no cost • Training provided to community organisations (e.g. First Aid) • Provision of low/no cost utilities

Mechanism	Purpose	Resource[1]	Timeframe	Implementation at Operation
				• Utilisation of GEMCO property maintenance • % Corporate Affairs employee time for community projects

(1) As a result of GEMCO's annual budget cycle, values for FY22-24 are not currently available but are expected to be in line with the FY21 values provided

The aims of each program are agreed in collaboration with engaged parties and progress is monitored through regular meetings and, depending on the scale and reach of the program, with reports set against specific goals or agreed program outcomes. The success of each program is also measured using the results of the subsequent Social Baseline Assessment (as mentioned in Section 2.2.4) and program specific monitoring of social impacts. The smaller Community Grants Program recipients are acquitted at the end of the agreed event or outcome. These grants are typically held within a 12-month period, whereas the larger legacy programs may extend over multiple years. Figure 2-11 provides an overview of the percentage of funding provided towards each target area for FY21-FY24.

Figure 2-11: Percentage of Funding Provided to Target Areas (FY21-FY24)



2.2.4.2 *Community Services*

GEMCO operates and maintains many of the essential services on Groote Eylandt including:

- **Rowell Highway Power Station**: Supplies power to the GEMCO mine site, Alyangula township (~1,000 residents), Pole 13 Aboriginal corporations (~100 residents), Malkala community (~120 Indigenous residents) and Angurugu community (~850 Indigenous residents).

- **Water and Sewerage:** Essential water and sewerage services are provided to the GEMCO mine site and Alyangula township. Water services are also provided to the Malkala community and Pole 13 Indigenous businesses.

- **Groote Eylandt Fuel Suppliers:** GEMCO's fuel bowsers are located in Alyangula and are utilised by most government services, residents and Indigenous community members as the primary source of fuel. This facility is supplied and maintained by GEMCO at no cost to the community.

- **GEMCO Medical Clinic:** In response to COVID-19, GEMCO established a General Practice Medical Clinic to reduce the impact of COVID-19 on existing services and provide scope for NT Health to increase its response in Indigenous communities. The GEMCO Medical Clinic is staffed by a residential doctor and two residential registered nurses who work closely with the NT Health Clinic in Alyangula.

- **Groote Eylandt Airport:** GEMCO contracts Aerodrome Management Services Pty Ltd (AMS) to manage the Groote Eylandt Airport. This facility supports GEMCO's FIFO operations, commercial Regular Public Transport (RPT) flights operated by Airnorth and light aircraft charter flights.

- **Fire and Emergency Services:** GEMCO provides Fire and Emergency Response support for the wider Groote Eylandt community. This team is often called on to provide support to NT Health to supplement ambulance capacity during periods of increased community activity.

- **Electrical Distribution and Repair**: GEMCO maintains a High Voltage lines crew to support repairs to power outages in Alyangula. During historical power outages in the Angurugu community, the NT Power and Water Corporation required GEMCO's support to conduct emergency repairs. GEMCO's resources on Groote Eylandt are essential for service continuity to communities in the region.

- **Housing for NT Government Services:** As at 30 June 2020, 12 NT Government employees providing essential services to Groote Eylandt were renting from GEMCO. These properties are all maintained by GEMCO's residential maintenance team.

- **Township Security:** GEMCO's security team provides additional support to the NT Police to ensure community order in challenging times. This important relationship is highly valued by NT Police and is vital to ensuring the safety of Groote Eylandt residents and the good order of the community.

2.2.4.3 *Community Affairs Performance*

GEMCO regularly monitors and responds to complaints and concerns received during community engagement. GEMCO's Complaints Management Procedure is reviewed annually and outlines how formal complaints are managed and closed. Complaints may be received directly from stakeholders or via formal communication from the ALC.

2.2.4.4 *Community Planning*

GEMCO plans to undertake several initiatives in the FY21-FY24 planning period to support the future mine path and GEMCO's preparation for closure. These include:

- **Social Impact Assessment towards Closure Works:** GEMCO has engaged the University of Queensland (CSRM) to undertake a social impact assessment and Traditional Owner visioning study to define GEMCO's pathway towards closure. This work will define how Traditional Owners would like to be engaged on this subject, will provide a blueprint for future infrastructure, final landform and social programs and support collaboration between GEMCO, the ALC and the NT Government. The project is planned to be completed in FY21.

- **Strategic Leadership and Governance Program:** GEMCO, in collaboration with the ALC, is seeking to support Traditional Owners in maturing community-based leadership and governance through a targeted pilot program on Groote Eylandt. The program will be delivered in partnership with a number of providers to deliver in-language and culturally relevant modules in community governance, change management, conflict resolution and cultural leadership.

- **Community Investment Programs:** GEMCO will continue to implement the community investment programs outlined in its CIP to support social and economic development on Groote Eylandt.

3 STATUTORY AND NON-STATUTORY REQUIREMENTS

GEMCO's Western Leases operate in accordance with the following approvals:

- Land owner approval granted in the form of a Mining Agreement between GEMCO and the ALC pursuant to the *Aboriginal Land Rights (Northern Territory) Act 1976* (Cth) (ALRA);
- Regulatory approval granted in the form of Mineral Leases under the *Mineral Titles Act 2010* (NT) and Special Purposes Leases under the *Special Purposes Leases Act 1953* (NT) (Table 1-2);
- Regulatory approval granted in the form of a Mining Authorisation (0126-01) under the *Mining Management Act 2001* (NT).

The following sections provide a summary of these key approvals, as well as other statutory and non-statutory requirements that GEMCO must adhere to.

3.1 Statutory Requirements

Table 3-1 summaries the key Commonwealth and Territory legislation applicable to the Western Leases.

Table 3-1 Relevant Commonwealth and Territory Legislation

Legislation	Administering Authority	Intent of Legislation	Relevance to the Western Leases
Mining			
Mineral Titles Act 2010 (NT)	NT Department of Industry, Tourism and Trade (DITT)	The *Mineral Titles Act* establishes a framework for granting and regulating mineral titles, including Mineral Leases (MLs), that authorise mining and associated activities.	The Mining Leases (MLs) associated with the Western Leases (Table 1-2) allow GEMCO to undertake mining and associated activities. A ML cannot be granted until a Mining Agreement under the *ALRA* is in place, and the grant of a ML is a precursor to the grant of Authorisation under the *Mining Management Act*.
Special Purposes Leases Act 1953 (NT)	NT Department of Infrastructure, Planning and Logistics (DIPL)	The *Special Purposes Leases Act* provides a system for granting and regulating leases for purposes other than pastoral, agricultural, mining and private residential use.	The SPLs associated with the Western Leases (Table 1-2) allow GEMCO to utilise the Alyangula township and Milner Bay port areas as part of its mining operation on Groote Eylandt. The SPLs were granted prior to the introduction of the *ALRA*. Therefore, the area associated with the SPLs is freehold Crown land.
Mining Management Act 2001 (NT)	DITT	The *Mining Management Act* aims to protect the environment by establishing a system whereby mining activities that will result in a substantial disturbance require an Authorisation.	GEMCO's Western Leases are currently authorised under the *Mining Management Act* (0126-01). GEMCO is required under this legislation to operate in accordance with an approved MMP. This MMP has been prepared to seek a variation to GEMCO's existing

Legislation	Administering Authority	Intent of Legislation	Relevance to the Western Leases
		Operators of mines who require an Authorisation under the *Mining Management Act* must submit an application to the NT DITT accompanied by an MMP.	authorisation to facilitate the continuation of the mining for FY21 – FY24.
Environment			
Environment Protection and Biodiversity Conversation Act 1999 (Cth) (EPBC Act)	Commonwealth Department of Agriculture, Water and Environment (DAWE)	The *EPBC Act* provides a framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and other matters, defined in the *EPBC Act* as matters of national environmental significance (MNES).	The Western Leases mining authorisation was granted prior to the introduction of the *EPBC Act*. Therefore, approval under the *EPBC Act* is not required (section 43A). However, GEMCO adheres to a range of internal environmental management plans aimed to minimise the potential for impacts to MNES listed under the *EPBC Act*. Section 5.6.3 provides further details.
Environmental Protection Act 2019 (NT) (EP Act)	NT Department of Environment, Parks and Water Security (DEPWS) - Environment Protection Authority (NT EPA)	The *EP Act* aims to promote ecologically sustainable development by establishing a framework for assessing potential environmental impacts of development projects.	The Western Leases mining authorisation was granted prior to the introduction of the *EP Act*. Therefore, approval under the *EP Act* is not required.
Territory Parks and Wildlife Conservation Act 1976 (NT) (TPWC Act)	NT Department of Tourism, Sport and Culture (DTSC) – Parks and Wildlife Commission	The *TPWC Act* provides for the declaration of land to be a sanctuary, park, reserve or protected area by the Administrator. The Act also provides for the protection of animals and plants and the preparation of management plans for parks and reserves.	No permits are required under the *TPWC Act* for disturbance associated with the Western Leases. However, GEMCO adheres to a range of internal management plans aimed to minimise the potential for impacts to threatened fauna and flora species listed under the *TPWC Act*. Section 5.6.3 provides further details.
Bushfires Management Act 2016 (NT)	DEPWS – Bushfires NT	The *Bushfires Management Act* provides a framework for the mitigation, management and suppression of bushfires in the NT and outlines when permits are required for the lighting of fires.	As the Western Leases are not located within a prescribed fire protection zone, fire breaks and permits to burn are not required under the *Bushfires Management Act*. However, a fire danger period may be declared over parts of the NT. In the event of such a declaration applying to the Western Leases, GEMCO would ensure that that a permit under the *Bushfires Management Act* is obtained prior to conducting controlled burns. Despite there being no legal

Legislation	Administering Authority	Intent of Legislation	Relevance to the Western Leases
			requirement for a permit to burn, GEMCO manages burning in accordance with PRO-4149 Permit to Clear and Burn Vegetation which involves an internal permitting process.
Marine Pollution Act 1999 (NT)	DEPWS	The purpose of the *Marine Protection Act* is to protect the marine and coastal environment by minimising intentional and negligent discharges of ship-sourced pollutants into coastal waters. The *Marine Pollution Act* applies to all vessels in NT waters.	GEMCO's operations are conducted adjacent to marine environments, including Milner Bay, Angurugu River and Emerald River. These environments are managed in accordance with STA-3085 Land and Biodiversity Management Plan. Section 5.6.3 provides further details.
Waste Management and Pollution Control Act 1998 (NT)	DEPWS	The *Waste Management and Pollution Control Act* provides for the protection of the environment through the encouragement of effective waste management, pollution prevention and control practices.	GEMCO operate a waste disposal facility in accordance with an Environmental Protection Licence (EPL289) issued under the *Waste Management and Pollution Control Act*. All waste is disposed in accordance with GEM-STA-3316 Waste Management Standard. Section 5.6.3.1 provides further details.
Water Act 1992 (NT)	DEPWS – Water Resources Division	The *Water Act* provides the legislative framework for water planning and entitlements for most water resources in the NT. The *Water Act* also provides for the investigation, allocation, use, control, protection, management and administration of surface water and groundwater resources.	Recent amendments to the *Water Act* mean mining and petroleum activities are now controlled under the Act. As a result of these amendments, GEMCO submitted an application to DEPWS on 24 March 2020 for a water abstraction licence. This licence (9291005) was granted on 23 October 2020.
Weeds Management Act 2001 (NT) (WM Act)	DEPWS – Weed Management Branch	The *WM Act* aims to protect the NT from the adverse impacts of weeds and identifies the responsibilities of all landholders in relation to the management of declared weeds and prevention of their spread.	Weed management is undertaken in accordance with GEM-STA-3091 Weed Management Plan. GEM-STA-3091 is structured to address weed risks in accordance with their declared status and the statutory requirements of any relevant weed management plans. Section 5.6.3 provides further details.
Biosecurity Act 2015 (Cth)	DAWE	The *Biosecurity Act* provides a framework for managing biosecurity risks such as diseases and pests that may cause harm to human, animal or plant	GEMCO's quarantine and biosecurity measures are outlined in GEM-STA-3091 Weed Management Plan and GEM-STA-3082 Cane Toad Management Plan. Both GEM-STA-3091 and

Legislation	Administering Authority	Intent of Legislation	Relevance to the Western Leases
		health.	GEM-STA-3082 are structured to address the requirements of applicable Statutory Weed Management Plans and the NT Biosecurity Strategy 2016 – 2026, respectively. Section 5.6.3 provides further details.
Health and Safety			
Public and Environmental Health Act 2011 (NT)	NT Department of Health	The *Public and Environmental Health Act* includes the objectives to monitor, assess and control environmental conditions, factors and agents, facilities and equipment and activities, services, and products that impact on or may impact on public and environmental health.	GEMCO has an extensive governance framework for managing the public and environmental health risks associated its accommodation facilities (including food preparation and potable water sources). This framework is designed to assist GEMCO with meeting its objectives in relation to public and environment health and to ensure compliance with the *Public and Environmental Health Act*.
Work Health and Safety (National Uniform Legislation) Act 2011 (NT)	Department of the Attorney-General and Justice	The *Work Health and Safety (National Uniform Legislation) Act* aims to promote health and safety in the workplace.	GEMCO has an extensive governance framework for managing health and safety risks associated with the operation of the mine site. This framework is designed to assist GEMCO with meeting its objectives in relation to health and safety and to ensure compliance with all applicable legislation.
Dangerous Goods Act 1998 (NT)	Department of the Attorney-General and Justice – NT WorkSafe Division	The *Dangerous Goods Act* aims to provide for the safe handling of dangerous goods.	GEMCO manage the storage, transport and handling of hazardous materials in accordance with this legislation. GEM-PRO-3177 Hazardous Materials Management outlines how materials are to be managed to minimise the potential for hazardous materials to pose risk to health, safety and environment across site. In addition, the web-based ChemAlert system is used to identify the location and volumes of dangerous goods across site. MSDS documentation is also kept on GEMCO's intranet with hard copies available at numerous locations across site. STA-3055 Crisis and Emergency Management outlines GEMCO's process for responding to emergencies involving bulk hazardous materials, such as hydrocarbon fuel fire.

Legislation	Administering Authority	Intent of Legislation	Relevance to the Western Leases
Culture and Heritage			
Aboriginal Land Rights (Northern Territory) Act 1976 (Cth) (ALRA)	Commonwealth Minister for Indigenous Australians	The *ALRA* provides a comprehensive scheme for the claiming and granting of freehold title to traditional Aboriginal land in the Northern Territory. It provides Aboriginal landowners with legal title to traditional lands and establishes Land Councils to assist Aboriginal people in the management of their land. The *ALRA* also outlines a process for obtaining consent from the Traditional Owners for both exploration and mining activities on Aboriginal land.	Groote Eylandt, including GEMCO's Western Leases, is Aboriginal land under the *ALRA* and the ALC is the Land Council responsible for managing this land. Consent for mining is obtained in the form of a Mining Agreement with the ALC. Section 3.2.1 provides detail on GEMCO's obligations under the Mining Agreement in place for the Western Leases.
Northern Territory Aboriginal Sacred Sites Act 1989 (NT) (Sacred Sites Act)	NT Aboriginal Areas Protection Authority (AAPA)	The *Sacred Sites Act* provides a framework for protecting sacred Aboriginal sites. Sacred sites are places in the landscape that have a special significance under Aboriginal tradition. The *Sacred Sites Act* provides a mechanism for registering sacred sites and issuing Authority Certificates in relation to sacred sites.	An Authority Certificate provides conditions for any works undertaken on or near sacred sites. Although it is not a requirement to be in possession of an Authority Certificate, having an Authority Certificate (and undertaking the work in accordance with the requirements of the certificate) indemnifies the holder against prosecution under the Act for damage to sacred sites in the area of the Authority Certificate. GEMCO is currently in the process of obtaining an Authority Certificate for sacred sites within the Western Leases and its immediate surrounding areas. Section 3.3.1 provides further details on the sacred sites survey undertaken by the ALC (2019) in support of this application for an Authority Certificate.
Heritage Act 2011 (NT)	DTSC - Heritage Branch	The *Heritage Act* provides protection for the following two classes of cultural heritage: • All places and objects formally assessed and added to the NT Heritage Register; and	It is a requirement of the *Heritage Act* that a Work Approval be obtained from DTSC prior to any disturbance of a heritage place or object as declared or protected under this Act. Section 3.3.2 provides further details.

Legislation	Administering Authority	Intent of Legislation	Relevance to the Western Leases
		• All Aboriginal and Macassan places and objects (whether previously documented or not), as listed in the Aboriginal and Macassan Sites Database.	

Table 3-2 provides details of the key licences and permits (excluding titles referred to in Table 1-2) held by GEMCO for the Western Leases under the applicable Commonwealth and Territory legislation.

Table 3-2: Western Leases Licences and Permits

Number	Licence/Approval	Authority	Grant/ Renewal	Expiry Date
EPL 289	Environmental Protection Licence (for Integrated Waste Management Facility)	NT EPA	01/07/2019	20/06/2024
64188	Permit to Interfere with Wildlife (snakes only)	NT Parks and Wildlife	22/11/2018	30/06/2020
9291005	Water Abstraction from Angurugu River (submitted to DEPWS on 24 March 2020)	DEPWS	23/10/2020	22/10/2025

3.2 Non-Statutory Obligations

3.2.1 *Mining Agreement*

GEMCO's non-statutory obligations for the Western Leases are chiefly embodied in the Mining Agreement between GEMCO and the ALC dated 4 October 2006.

GEMCO's general environmental obligations under the Mining Agreement are as follows:

- Ensure the project is designed and conducted so as to:
  - Preserve and protect the environment and natural hydrological systems;
  - Disturb the least amount of soil and vegetation possible;
  - Prevent erosion and pollution;
  - Prevent the introduction of exotic fauna and flora to the Groote Eylandt Archipelago without the prior consent of the ALC;
  - Restore mined quarry areas to a condition reasonably compatible with the surrounding environment;
  - Prevent disturbance to the residents of Aboriginal communities adjacent to the Mineral Leases; and

  - Progressively rehabilitate disturbed areas using technically appropriate and environmentally sound rehabilitation practices.

- Take all necessary steps to avoid the occurrence of, or mitigate the results of, a breach under the Mining Agreement or any other incident that may pose a significant risk to the environment or human health; and

- Establish programs to monitor the effects of GEMCO's mining operations on biota, water, sediments, soils, air and other aspects of the environment.

Section 4 of this MMP outlines GEMCO's operational activities and Section 5 and Section 6 describe GEMCO's environmental management structure. The processes described are designed to ensure compliance with GEMCO's environmental obligations under the Mining Agreement.

GEMCO's general cultural obligations under the Mining Agreement are as follows:

- Ensure all personnel are familiar with Aboriginal tradition and culture. It is mandatory for all GEMCO employees and contractors to complete cross-cultural training within the first few weeks of commencing work at GEMCO;

- Ensure all personnel comply with the Groote Eylandt Liquor Management Plan. GEMCO's mine site induction ensures all GEMCO employees and contractors are made aware of their obligations regarding the use of drugs and alcohol prior to commencing work at GEMCO; and

- Provide employment opportunities to Aboriginals or incorporated Aboriginal bodies. Section 2.2.3 provides details on GEMCO's Indigenous Employment Plan.

Section 3.3.1 outlines GEMCO's obligations under the Mining Agreement with regards to sacred sites and objects and the processes in place to ensure compliance with these obligations.

3.2.2 *South32 Corporate Standards*

South32's Code of Business Conduct (the Code) sets the standards of conduct expected from its people, partners and suppliers across all its operations, including GEMCO. The Code, together with South32's values of care, trust, togetherness and excellence, is to guide every decision made by every individual across the business.

The standards of conduct outlined in the Code include:

- **Health and Safety**: South32's number one priority is to ensure everyone goes home safe and well every day, and it is the responsibility of those who work for South32 to operate safely and prevent workplace injuries and illnesses, and be fit for work every day;

- **Inclusion, Diversity and Equity**: South32 value and strive to build inclusion, diversity and equity in the workplace and those who work for South32 are responsible for being inclusive, co-operating with one another and treating others fairly, with respect and dignity, and without discrimination;

- **Human Rights**: Those who work for South32 are expected to create and maintain a work environment that respects human rights, and conduct business in accordance with applicable laws and recognised international human rights;

- **Privacy**: South32 respect and protect the personal information and privacy of others and all personal information must be collected, managed and used in accordance with South32's Privacy Policy and applicable privacy laws.

- **Communities**: South32 seek to build and maintain trust with its host communities by complying with the commitments it makes towards these communities and working with community stakeholders to address concerns through regular, open and honest communication.

- **Environment**: South32 is an environmentally responsible business and those who work for South32 are responsible for being environmentally aware, complying with applicable laws and regulations, understanding the environmental risks and impacts of the work and minimising South32's footprint, and reporting actual or potential environmental incidents.

- **Government**: South32 recognise the authority of governments and always seeks open, non-partisan, ethical, legal and constructive relationships with government.

- **Fraud, Bribery and Corruption**: South32 prohibit fraud, bribery and corruption in any form, and complies with applicable anti-bribery and corruption laws wherever it conducts business.

- **Conflicts of Interest**: Those who work for South32 have a responsibility to act honestly and to identify and disclose a situation involving an actual, potential or perceived conflict of interest, and ensure nothing they do conflicts with their responsibilities to South32.

- **Fairness**: South32 compete fairly, ethically and comply with applicable competition laws across the globe, and its people must not engage in collusive or co-operative conduct with a competitor.

- **Suppliers**: South32 work towards effective, fair, equitable and streamlined procurement processes with its suppliers and aim to only work with suppliers who have strong values and standards of conduct and share South32's commitment to lawful business practices.

- **Economics**: South32 comply with applicable economic sanctions and its people must follow its sanction compliance due diligence and related screening processes.

- **Asset Protection**: South32 prohibit falsifying, stealing, concealing or otherwise tampering with company information and data in order to protect its company assets, including confidential information and intellectual property.

As a global company, South32 operate in accordance with applicable laws and regulations of the countries where it operates. It is mandatory to follow all company policies, standards, procedures and processes as they are relevant to each operation.

GEMCO has a suite of documentation to ensure compliance with South32's Code and corporate policies, in addition to meeting appropriate regulatory requirements. These standards, procedures and processes are detailed within this MMP where relevant.

3.2.3 *International and National Guidelines*

GEMCO conducts operations in accordance with a number of guidelines, codes of practice and best practice initiatives, as directed by South32's Code of Business Conduct and supporting documentation (South32/GEMCO policies and standards) or other regulatory bodies.

These are detailed within the relevant sections of this MMP and include guidelines relating to environmental management and monitoring, construction of tailings storage facilities and closure planning.

3.3 Sacred, Archaeological and Heritage Sites

3.3.1 *Sacred Sites*

As outlined in Section 3.1, the *Sacred Sites Act* provides protection to all sacred sites in the Northern Territory and is administered by the Aboriginal Areas Protection Authority (AAPA). To enhance the protection of sacred sites, Traditional Owners can elect to register or record a sacred site with the *AAPA*. The *Sacred Sites Act* also provides a mechanism for project proponents to lodge an application for an Authority Certificate with the *AAPA*. An Authority Certificate provides conditions for any works undertaken on or near sacred sites. Although it is not a requirement to be in possession of an Authority Certificate, having an Authority Certificate (and undertaking the work in accordance with the requirements of the certificate) indemnifies the holder against prosecution under the *Sacred Sites Act* for damage to sacred sites in the area of the Authority Certificate.

GEMCO is currently in the process of obtaining an Authority Certificate for the full extent of the Western Leases, which is anticipated to be finalised in FY21. This will provide the Traditional Owners with certainty that the sacred sites identified will be acknowledged and protected and will ensure mining is planned and executed without the risk of accidental damage to sacred sites. As a precursor to making an application for an Authority Certificate, GEMCO engaged the ALC to conduct a cultural heritage survey to confirm the location and extent of all sacred sites in or in close proximity to the Western Leases. This involved extensive field surveys, consultation with Traditional Owners and provision of a report documenting the findings of the assessment, including instructions for the management of sites (i.e. buffer zones).

Figure 3-1 and Figure 3-2 show the location of the sacred sites identified and their restricted work areas.

Until such time as an Authority Certificate is granted, GEMCO will continue to manage sacred sites in accordance with the ALC issued Instructions Report (2019) and the Mining Agreement in place for the Western Leases.

GEMCO's mine path is designed to avoid identified sacred sites and their buffer zones. GEMCO's Permit to Clear process also ensures both GEMCO and the ALC assess an area for cultural sites prior to disturbance. This is in addition to GEMCO's requirement to inform the ALC of the mine plan and associated works as part of the quarterly Mining Liaison Meetings. GEMCO acknowledges that these processes do not remove its obligations under the *Sacred Sites Act* should a site be damaged or entered upon without the consent of the Traditional Owners.

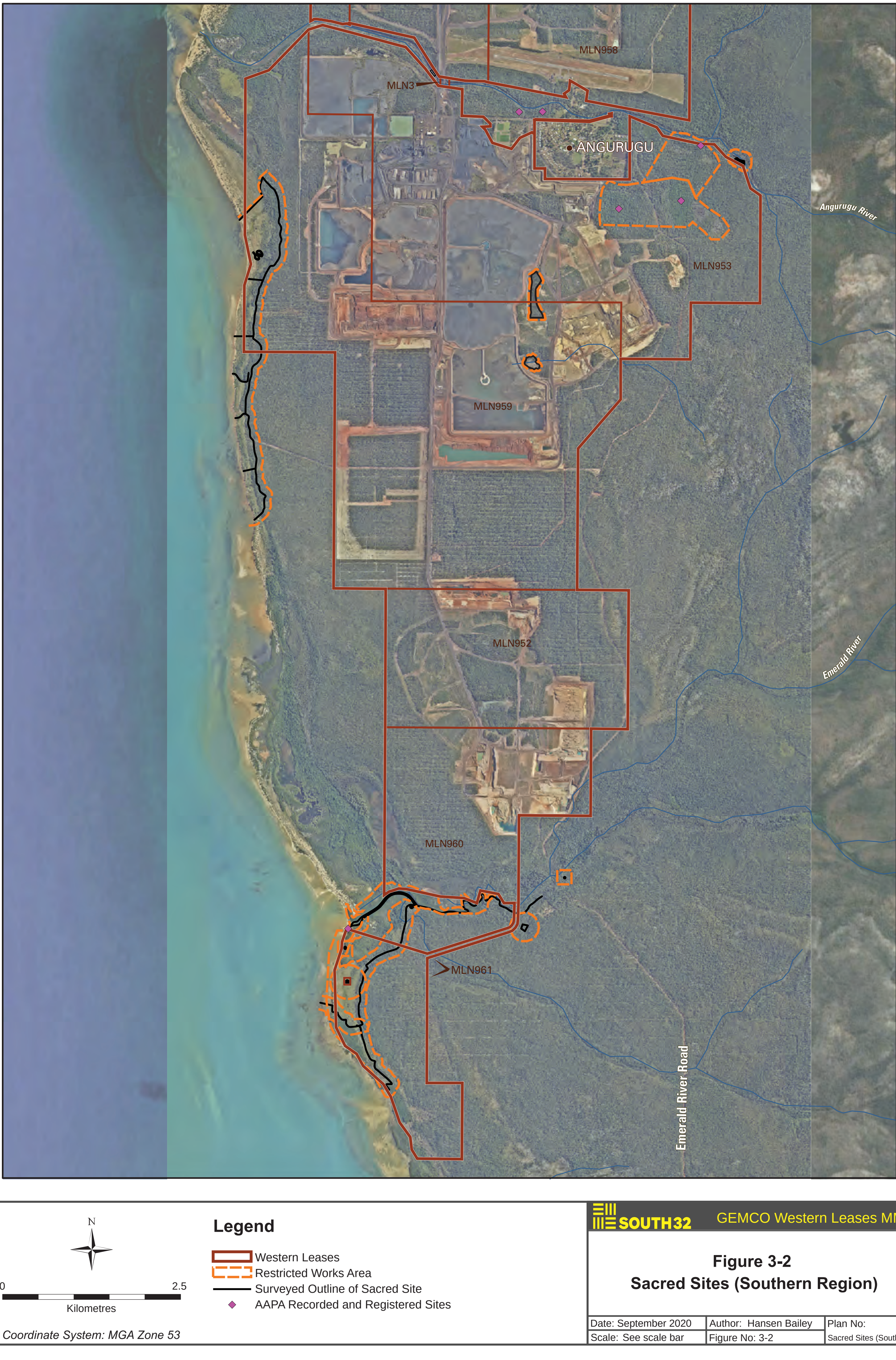
Legend

- Western Leases
- Restricted Works Area
- Surveyed Outline of Sacred Site
- AAPA Recorded and Registered Sites

SOUTH32 GEMCO Western Leases MMP

Figure 3-1
Sacred Sites (Northern Region)

Date: September 2020	Author: Hansen Bailey	Plan No: Sacred Sites (Northern Region)
Scale: See scale bar	Figure No: 3-1	



Legend

- Western Leases
- Restricted Works Area
- Surveyed Outline of Sacred Site
- AAPA Recorded and Registered Sites

Coordinate System: MGA Zone 53

SOUTH32 — GEMCO Western Leases MMP

Figure 3-2
Sacred Sites (Southern Region)

Date: September 2020	Author: Hansen Bailey	Plan No:
Scale: See scale bar	Figure No: 3-2	Sacred Sites (South)

3.3.2 *Heritage and Archaeological Sites*

Several pieces of legislation establish lists or registers which offer statutory protection to places and objects that are considered to have cultural values, including the *EPBC Act* and *Heritage Act* discussed in Section 3.1.

A search of public registers returned the following results:

- The World Heritage Register, the (Australian) National Heritage Register and the Commonwealth Heritage Register (established under the *EPBC Act*) do not list any sites within or in close proximity to the Western Leases.

- No declarations under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth) have been made for areas within or in close proximity to the Western Leases.

- The Northern Territory Heritage Register (established under the *Heritage Act*) lists the following sites, which are shown on Figure 3-3.

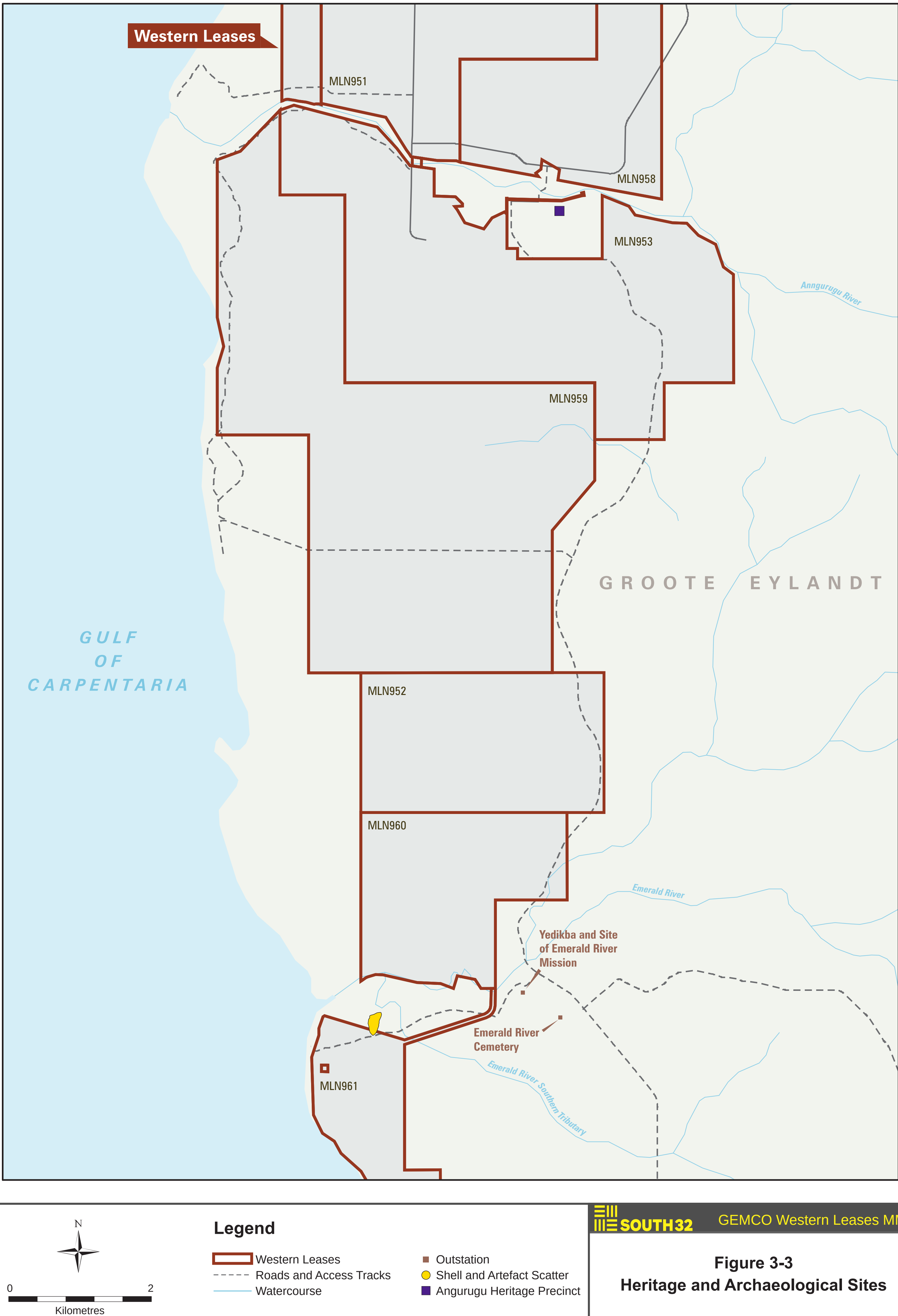
    - The Angurugu Heritage Precinct, which is located in the Angurugu township beyond the boundary of the Western Leases. This is the only ‘declared’ heritage site listed;

    - The Emerald River Cemetery, which is located south of the Emerald River beyond the boundary of the Western Leases; and

    - The site of the Emerald River Mission, which is located south of the Emerald River beyond the boundary of the Western Leases.

A review of available archaeological reports pertaining to the Western Leases and surrounding areas found one archaeological site located on the northern boundary of MLN961 (Figure 3-3). This site is described as a shell and artefact scatter (Sutton, 2013; ALC, 2019). The site is not within the proposed mining disturbance footprint and therefore, no impacts are predicted as a result of mining.

There are no operational restrictions associated with the sites described above. As with sacred sites, GEMCO’s Permit to Clear process ensures both GEMCO and the ALC assess an area for cultural heritage prior to disturbance.



Legend

- Western Leases
- Roads and Access Tracks
- Watercourse
- Outstation
- Shell and Artefact Scatter
- Angurugu Heritage Precinct

Coordinate System: MGA Zone 53

SOUTH32 GEMCO Western Leases MMP

Figure 3-3
Heritage and Archaeological Sites

Date: November 2020	Author: Hansen Bailey	Plan No: Heritage and Archaeological Sites
Scale: See scale bar	Figure No: 3-3	

4 OPERATIONAL ACTIVITIES

GEMCO's operations involve mining manganese ore by open cut mining methods, sizing and washing the ore in the concentrator and transporting the final product to the Milner Bay port facility for shipping. Figure 4-1 provides a schematic of the production process. Ongoing exploration activities and sustaining capital project works are also undertaken to support the progression of mining activities. The activities associated with mining, processing, exploration and projects are described in detail in the following sections.

For security purposes, Table 4-1 provides a summary of the operational disturbance and rehabilitation progression during the term of this MMP. Given the nature of GEMCO's planning processes for each of its operational activities (as described within the respective sections below), the forecast values provided are subject to change as plans are progressively refined. GEMCO will report on its performance against this MMP in annual EMRs and provide updated forecast values for the remaining years of the MMP if required.

Table 4-1 Summary of GEMCO Disturbance and Rehabilitation (ha)

Disturbance Type	Current (30 June 2020)	FY21	FY22	FY23	FY24
Total Forecast Disturbance	-	310	300	268	279
Total Forecast Rehabilitation	-	98	148	246	180
Cumulative Total Disturbance	4,556	4,866	5,166	5,434	5,714
Cumulative Rehabilitation	1,373	1,471	1,619	1,865	2,045
Cumulative Active Disturbance	3,183	3,395	3,547	3,569	3,669

Section 8.2 provides further detail on the costing of closure activities associated with GEMCO's current and proposed liability for security purposes.

4.1 Mining Activities

4.1.1 *Mining Process*

Mining activities are undertaken over a number of quarry regions simultaneously, with ore profile and composition differing between quarries. Quarry locations are named using alphabetical letters and may be further defined by their geographical location (e.g. B South Quarry). The location of the quarry areas within the Western Leases is shown in Figure 1-5. The quarries are typically mined in strips approximately 40 m wide, and generally between 400 m to 1,500 m long. Typical quarry depth varies between 10 and 25 m.

Open cut strip mining involves the following sequence of activities, as shown in Figure 4-2.

- Clearing vegetation using bulldozers.
- Stripping and recovering topsoil. Topsoil is stripped and pushed into windrows, before being picked up by loaders or excavators and placed into haul trucks. The topsoil is then either placed directly on areas that are ready for rehabilitation or temporarily stockpiled in designated areas for later use.

- Pre-stripping overburden. Overburden is excavated in order to gain access to the ore. When commissioning a new quarry, a fleet of excavators and haul trucks is used to remove the overburden. For future strips, the preferred method is dozer push stripping. This material is either temporarily stockpiled or placed directly within previously mined quarries. For routine mining operations, there is no further waste segregation.

- Drilling and blasting the manganese ore. The ore is drilled and blasted to break up the material so it can be easily handled. Mining areas located near Angurugu are not blasted in order to provide a safe stand-off distance from the community.

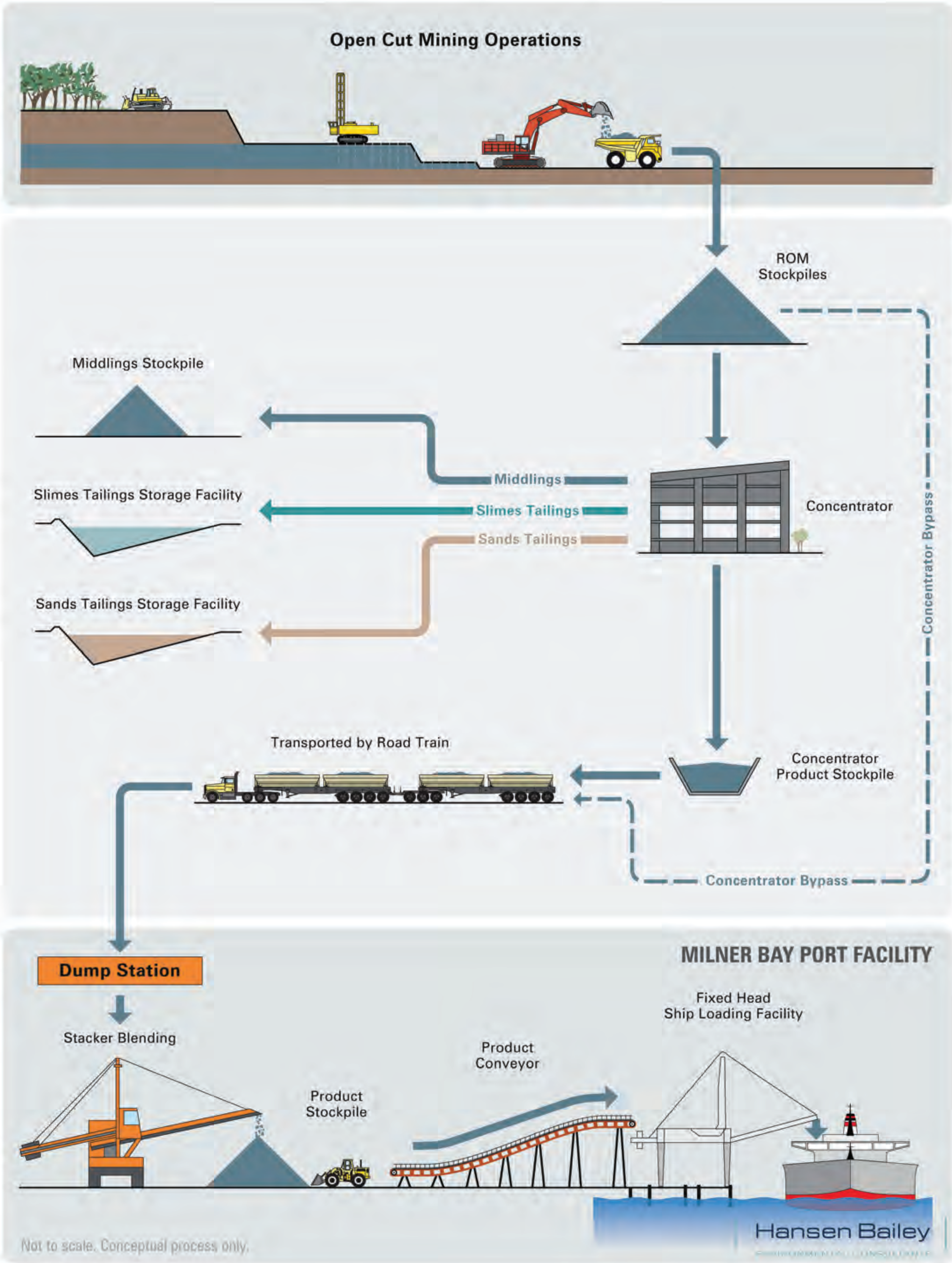
- Mining ore. A fleet of haul trucks and excavators is used to extract the ore and transport it via a network of dedicated haul roads to the Run of Mine (ROM) stockpile, located at the Primary Crushing Station (PCS).

- Backfilling quarries following ore removal. Dozers are used to backfill quarries with overburden up to the Post Mining Surface (PMS) level to create a stable and free draining landform.

- Topsoil replacement. Topsoil is spread over backfilled areas at an average depth of 0.3 m. The topsoil is then ripped.

- Revegetation of topsoil using seeds from native tree, shrub and grass species using aerial seeding as the primary seeding technique. Further detail on rehabilitation is provided in Section 4.1.3.3.

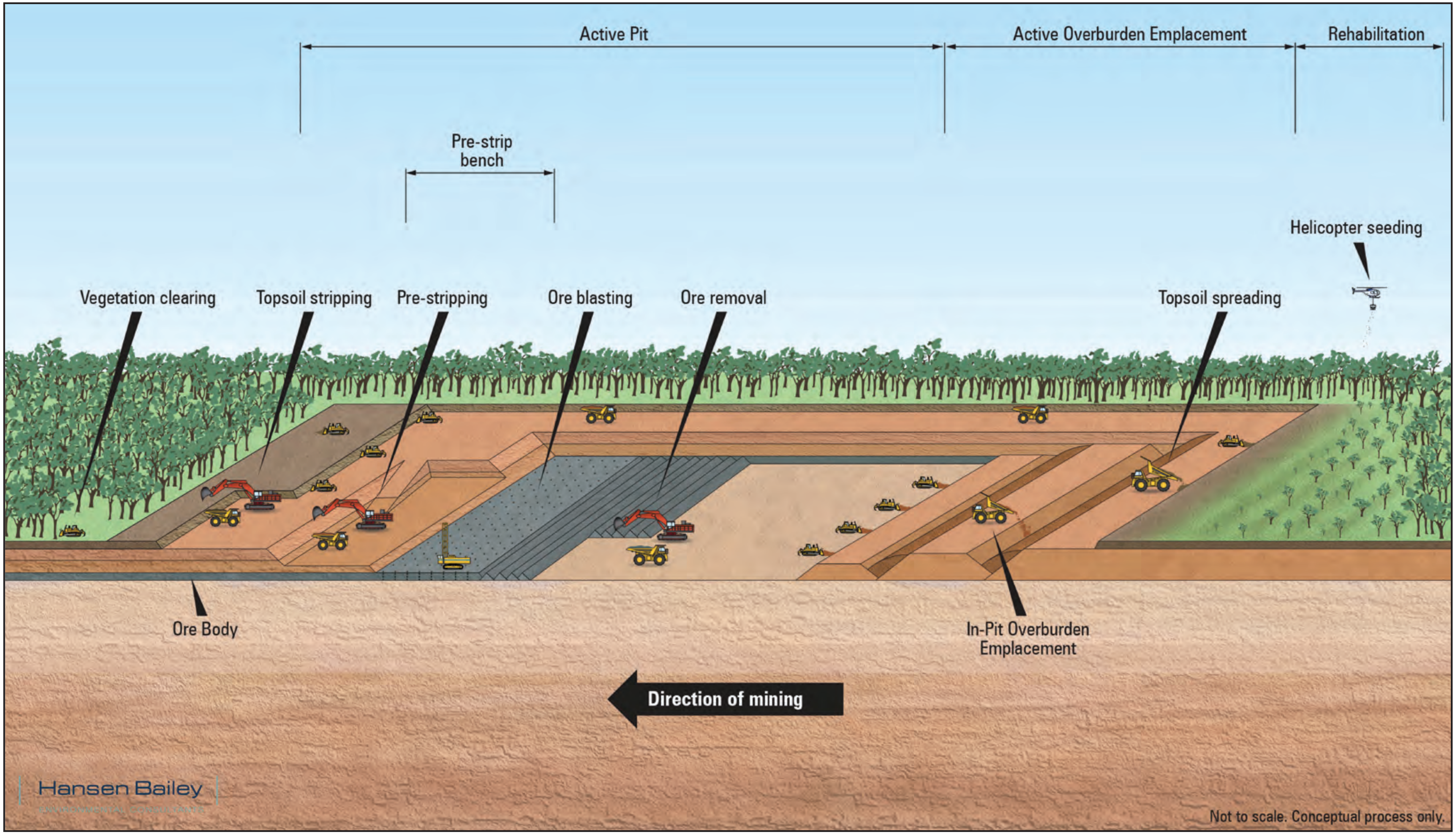
Since 2016, mining activities have also included the reclaiming of sands material from existing sands TSFs. This process involves a fleet of haul trucks and excavators to extract the sand tailings and transport it to designated stockpiles located near the concentrator (Figure 1-6). The processing of this sands material produces a manganese fines product known as PC02.



SOUTH32 GEMCO Western Leases MMP

Figure 4-1
Production Process

Date: August 2020	Author: Hansen Bailey	Plan No:
Scale: See scale bar	Figure No: 4-1	Production Process



SOUTH32 GEMCO Western Leases MMP

Figure 4-2
Open Cut Mining
Operations Schematic

Date: August 2020	Author: Hansen Bailey	Plan No: Open Cut Mining Operations Schematic
Scale: See scale bar	Figure No: 4-2	

4.1.2 *Mine Planning*

Mine planning at GEMCO is undertaken in an iterative and incremental manner whereby additional detail is progressively built into the mine schedule over time.

GEMCO's Life of Operations Plan (LoOP) is prepared by South32's Long Term Mine Planning team and is updated annually. The LoOP provides general direction for the areas to be mined for the remaining life of the orebody and is developed to determine predicted sales forecasts. It also provides the basis for developing the PMS to inform closure cost estimates and environmental assessment.

GEMCO's Technical Services team are responsible for delivering a series of shorter-term schedules, ranging from 2 years to 24-hours. These plans are a more detailed subset of the LoOP and elements such as quarry and cut sequences, production quantities and equipment hours are progressively refined over time. Various factors influence the schedule including market demands, weather, and environmental, cultural and social considerations.

4.1.3 *Mine Design*

Mine designs for each mining strip are prepared by the GEMCO Technical Services team to enable execution of the mine schedule.

Figure 4-3 illustrates the cross section of typical quarry designs for various stages in the mining process (as described in Section 4.1.1). Appendix 9.4 provides example mine designs for overburden pre-stripping (excavator and dozer push). The parameters adopted for each design consider a number of factors including productivity, cost, safety, environment and product requirement.

GEMCO employs a risk assessment methodology on all non-routine mine designs to effectively manage potential hazards. In areas where slope stability is a concern, GEMCO engages qualified geotechnical consultants to assess the risk of executing the proposed design. This may be in areas where mining is planned to occur adjacent to frequently travelled roads, near the base of tailings storage facilities or where geological drilling has indicated strata present with unfavourable stability conditions.

4.1.3.1 *Water Requirements*

Most quarries at GEMCO intersect the water table during the mining process. This results in a requirement for dewatering to ensure a safe and productive mining environment within the quarry. The volume of water entering the quarry determines the management of such water, however the usual process is to install drainage channels along the edge of the mining cut, drain the water to a sump, then pump water out of the quarry using pontoon pump(s) and pipelines. This water is either stored in non-active quarry voids for future use as process water or discharged into nearby bushland. Section 6 provides further details on water management.

4.1.3.2 *Ore and Product Stockpiles*

Ore is transported from quarries via a network of dedicated haul roads and stockpiled at the ROM located at the PCS (Figure 1-6). There are a few additional ore stockpiles built outside of the PCS area which generally consist of lower quality ore (Figure 1-7 and Figure 1-8). Given each quarry has different ore characteristics, stockpiles are built according to the quarry the ore comes from to store ore with similar characteristics. This enables optimised blending of ore for delivery to the concentrator. The stockpiles vary in size based on the rate of ore production and subsequent reclaiming for processing. They also vary in height depending on the material type and season. Surface water run-off from ore stockpiles is contained within surface drains which direct water to site storages for use as process water.

Washed ore is stored in the product storage bins at the concentrator or at the Concentrate Product Stockpiles (CPS) (Figure 1-6) prior to being loaded onto road trains. The CPS typically consists of product that does not initially meet stringent product specifications and may require blending. It may also store on-specification product if required and as such, serves to provide an additional buffer. The amount of product stored at the CPS can vary day to day based on concentrator throughput and subsequent reclaiming for shipment. Surface water run-off from the CPS is captured in a sediment pond installed as part of the Mine Stormwater Management project detailed in the FY17-FY20 MMP.

The washed ore is transported from the product storage bins or the CPS to the Milner Bay Port Facility by road train. The ore is then unloaded and stockpiled at the Milner Bay stockpile (Figure 1-7) facility according to grade and sizing. The stockpiles are reclaimed based on shipping requirements and optimisation of available port capacity. Surface run-off from the Milner Bay stockpiles drains to a containment facility to the east of the stockpiles. This facility is left to evaporate naturally.

The storage of PC02 product is distinct from the storage of ROM product described above. Due to its fine particle (0 - 2 mm), the PC-02 product has an innate ability to “hold” moisture and has the potential to liquify when agitated during transportation. Due to this liquefaction risk, PC02 has a Transportable Moisture Limit (TML). GEMCO manages any post-production moisture ingress by transferring the PC02 product directly from an enclosed product bin at the mine site into haul trucks with covered trailers for transport to the Milner Bay Port Facility. It is then unloaded at Miner Bay via a covered conveyer and stockpiled in a purpose-built storage shed. The shed has a fully enclosed roof and partially open sides that allow generous airflow and free drainage of any process water run-off.

4.1.3.3 *Rehabilitation*

Mine rehabilitation is designed using a PMS landform modelled to meet the following objectives:

- Reinstate the original pre-mined ground surface as closely as practicable;
- Reinstate surface drainage to minimise areas of standing water, unless the pre-mined surface contained such an area; and
- Minimise rehandling of overburden in construction of the PMS.

To achieve the PMS design objectives, the following activities are undertaken:

- Backfilling quarries with overburden up to the PMS level following ore removal;
- Contouring the post-mining landform to allow for adequate drainage of surface water, and installing any necessary erosion control works;
- Spreading topsoil, generally at a depth of 0.3 m. Topsoil that has been stripped ahead of mining is preferentially placed directly onto rehabilitated areas or is stockpiled for later use. The optimum time for replacement of topsoil is just prior to the onset of the wet season (i.e. early-mid October);

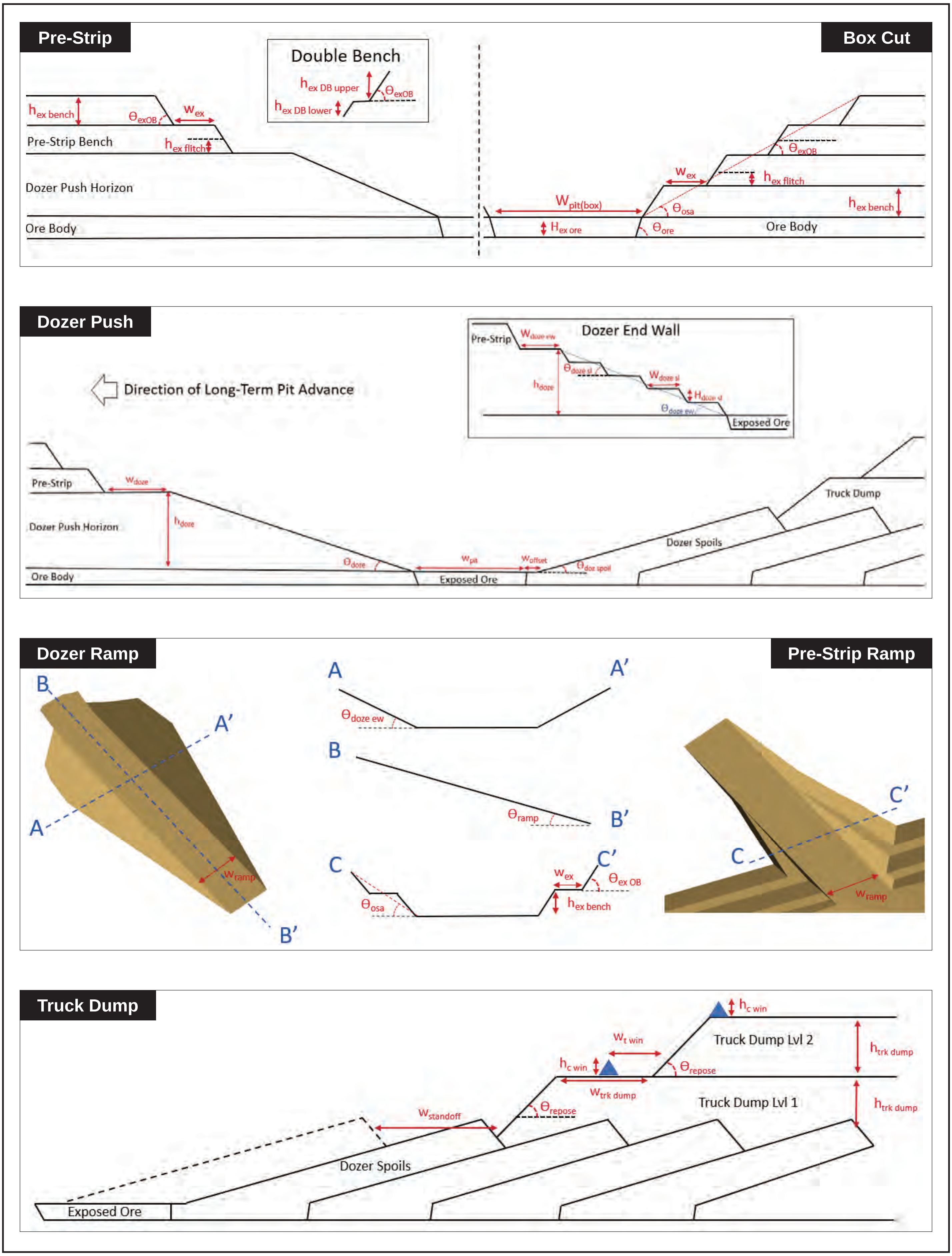
- Ripping the topsoil, with the aim of minimising the impact of compaction, promoting root, water and nutrient density and preventing runoff and erosion;

- Undertaking revegetation following topsoil spreading and ripping. Revegetation practices involve collecting, drying, cleaning and storing seeds from native species collected on Groote Eylandt, sowing seeds primarily using aerial seeding techniques and undertaking weed control; and

- Monitoring rehabilitation areas for performance against completion criteria and undertaking remediation as required.

Given the nature of mine planning at GEMCO, it is not possible to provide an engineered mine design showing the final PMS landform for the full extent of the Western Leases. Instead, example mine designs for overburden pre-stripping have been provided in Appendix 9.4. These designs provide an example of how the PMS landform is incorporated into designs for each mining cut.

The progressive rehabilitation process described above generally negates the need for Waste Rock Dumps under usual operation.



SOUTH32 GEMCO Western Leases MMP

Figure 4-3
Typical Quarry Designs

Date: August 2020	Author:	Plan No:
Scale: See scale bar	Figure No: 4-3	Typical Quarry Designs

4.1.4 *Mining Reserves and Geology*

GEMCO's Mineral Resources and Ore Reserves are reported each financial year in accordance with ASX Listing Rule requirements. The South32 Annual Report 2020 can be accessed online via the South32 Investor Centre: https://www.south32.net/investors-media/investor-centre/annual-reporting-suite.

It is noted that the Mineral Resources and Ore Reserves reported in the South32 Annual Report are expressed in dry metric tonnes, while most of the quantities in this MMP are expressed in wet metric tonnes

4.2 Processing Activities

4.2.1 *Treatment and Ore Processing Operations*

4.2.1.1 *Concentrator*

Manganese ore contained within the ROM stockpiles is fed into the concentrator where it is processed to a final product for transport. This process involves the following steps, as shown in Figure 4-4.

- ROM ore is crushed at the PCS and placed on a surge stockpile ahead of the concentrator.
- Crushed ore is fed into the concentrator and washed using a drum scrubber to remove clay components.
- Washed ore is screened into size fractions using vibrating screens. This results in two size fractions of ore (lump and fines) and two size fractions of waste material known as tailings (sands and slimes). Size fractions are classified in Table 4-2.
- The lump ore is fed into a rotating drum separator containing a ferrosilicon media[3]. The manganese ore is separated from waste materials (such as quartz and silica) based on density. The ore, being denser, adheres to the ferrosilicon and sinks to the bottom of the separator, enabling it to be removed. The less dense waste materials float to the top and overflow at the discharge end of the drum.
- The fine ore is fed into a series of cyclones which also contain a ferrosilicon media. Similar to the processing of lump ore, the heavier manganese is separated from waste materials based on density.
- Waste material from the rotating drum separator and cyclones is combined to form a course waste material known as middlings, which is stockpiled for later use in operational activities.
- Tailings are separated into the sands and slimes fractions using cyclones. Tailings are then pumped to purpose built TSFs, with the exception of some sands tailings which are pumped to the SBP for reprocessing.

[3] Ferrosilicon (approximately 15% silicon and 85% iron) is defined as non-hazardous under the hazardous chemicals rating system and ultimately oxidises after exposure to air and water.

Table 4-2: Size Fractions of Ore and Tailings

Size fraction	Minimum (mm)	Maximum (mm)
Lump Ore	6.7	75
Fines Ore	0.5	15
Sands Tailings	0.08	2
Slimes Tailings	N/A	0.1

The concentrator has a production capacity of approximately 5.2 Mtpa (wet tonnes) of manganese product and uses approximately 2,250 ML of water per month. The majority of the water used (approximately 65%) is recycled water, returned from the TSFs. Dam 1 is GEMCO's only purpose-built water storage facility (Figure 1-6) and it provides the concentrator with the main supply of water for processing. Dam 1 is fed by water dewatered from quarries. On the very rare occasion, a small portion of potable water is also utilised from the Angurugu River under licence.

4.2.1.2 *Sand Beneficiation Plant*

A SBP, also known as the PC02 plant, was commissioned in May 2016 and runs concurrently to the existing concentrator. The SBP is designed to process up to 2.68 Mtpa (dry) of feed material, producing 0.7 Mtpa (dry) of PC02 product (40% nominal manganese grade). PC02 processing involves the following steps, as shown in Figure 4-5.

- Sands material is reclaimed from an existing sands TSF (TSF feed) or is directed to the SBP from the concentrator (on-line feed).
- Material is screened to remove course reject material (> 2 mm) and fed into a series of reflux classifiers for sizing based on density (similar to the processing of lump and fines ore).
- The product from the reflux classifier is fed onto a horizontal vacuum belt filter for dewatering (to achieve an acceptable moisture level for transport).
- The reject stream (i.e. overflow from reflux classifiers) is pumped into a cyclone to separate slimes from sands. Tailings are then pumped to purpose built TSFs.

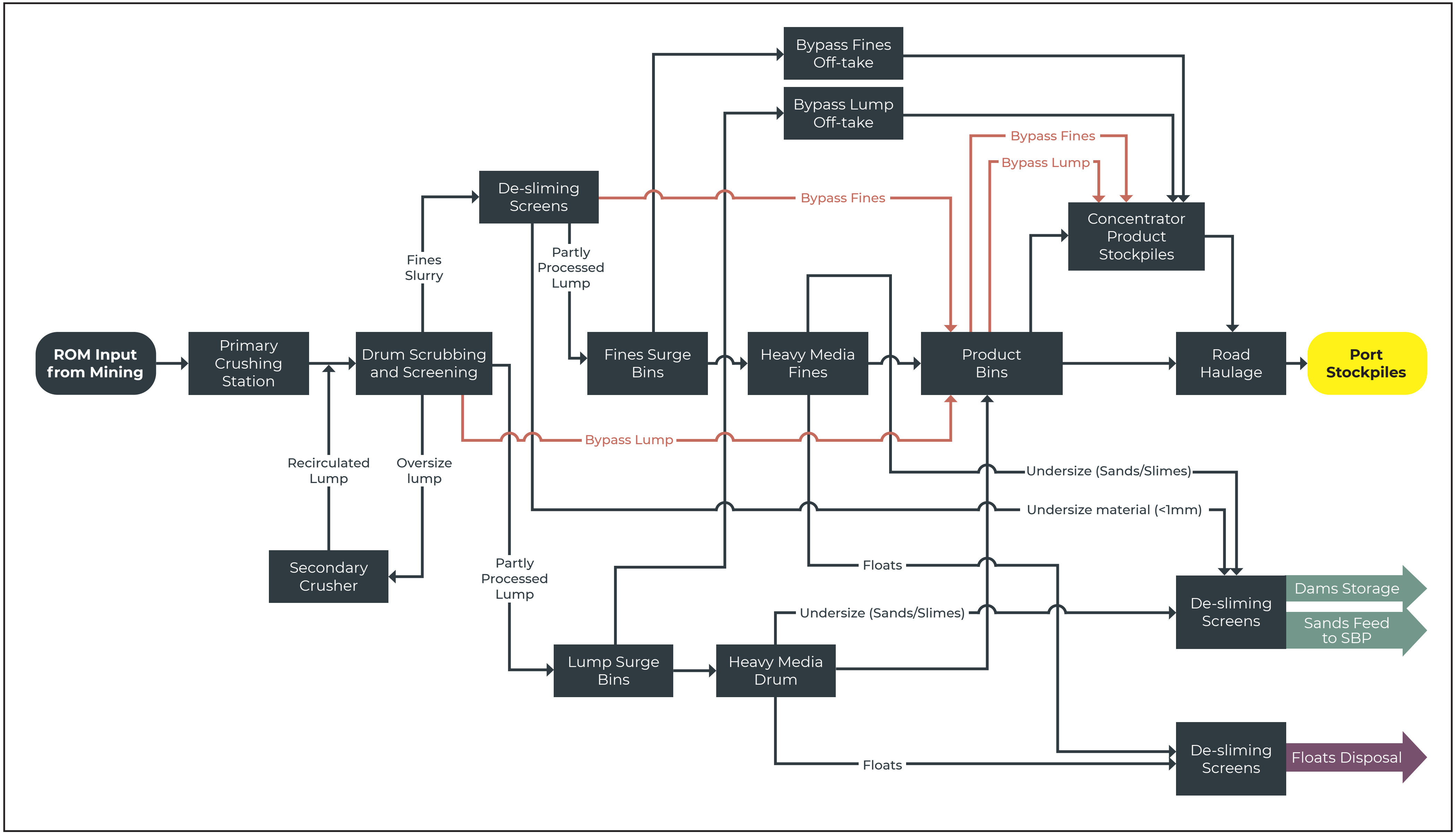


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Figure 4-4
Concentrator Process Flow Diagram

Date: Sept 2014	Author:	Plan No: Concentrator Process Flow Diagram
Scale: See scale bar	Figure No: 4-4	

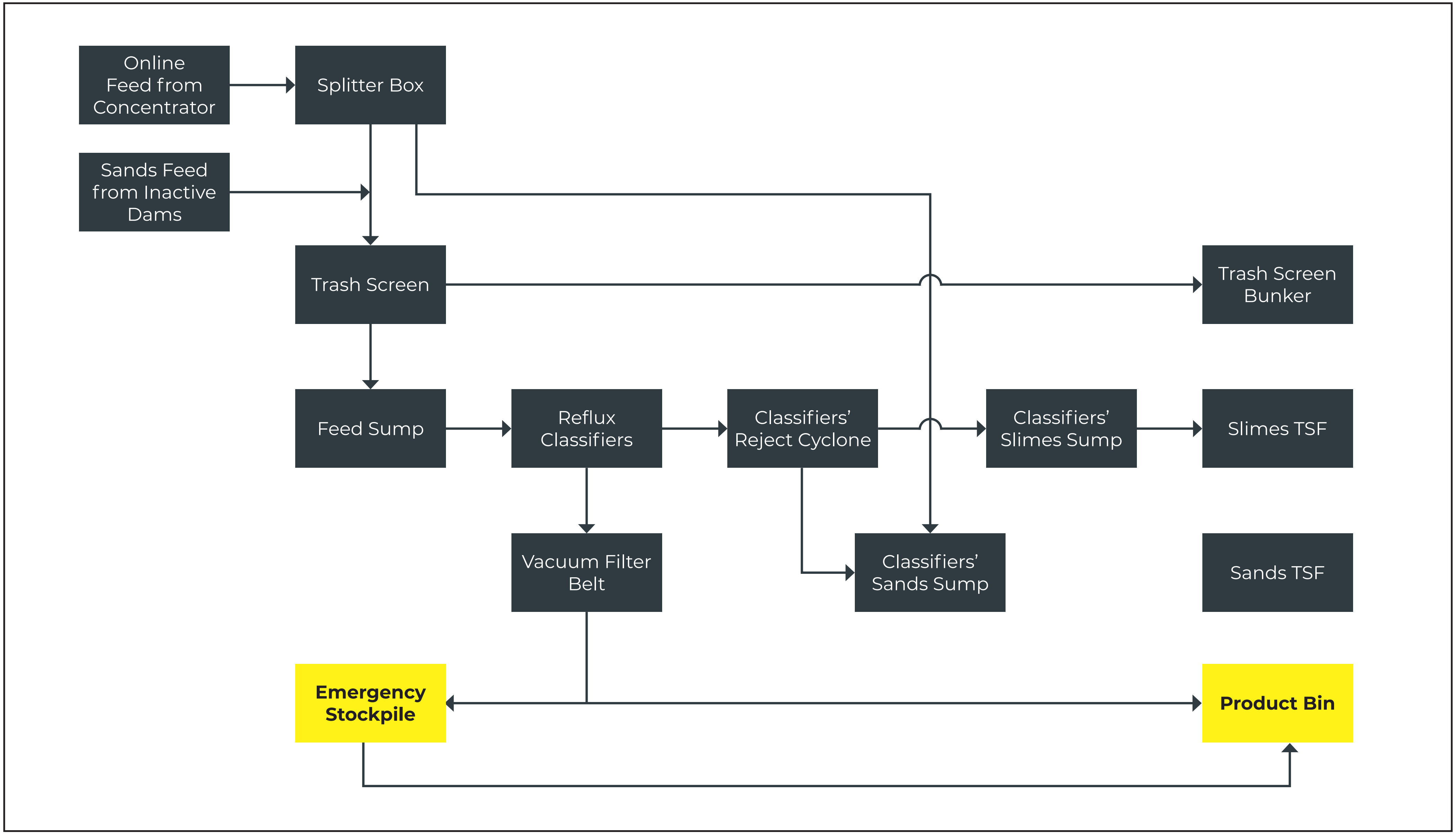

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Figure 4-5
SBP Process Flow Diagram

Date: August 2020	Author:	Plan No: SBP Process Flow Diagram
Scale: See scale bar	Figure No: 4-5	

4.2.2 *Tailings Storage Facilities (TSFs)*

As described in Section 4.2.1, the processing of manganese ore results in the production of concentrate products (manganese lump and fines) and waste products (middlings and tailings) (Figure 4-1).

Middlings vary from approximately 3% to 7% of the plant feed and are re-used as road base construction material or as stemming in blasting. Tailings comprise approximately 45% to 50% of the plant feed and are pumped (via overland pipelines) from the concentrator and PC02 plant to dedicated sands and slimes storage facilities.

Geochemical testing undertaken on middlings and tailings has confirmed that both materials typically contain low concentrations of metals (except manganese) and have negligible capacity to generate acid. Leachate from these materials is typically pH neutral and low in salinity and trace metals.

GEMCO's TSFs are conventional wet storage facilities typically constructed within mined quarry pits (excluding TSF15). All current active TSFs have been designed, constructed and are operated in accordance with the Australian National Committee on Large Dams (ANCOLD) Guidelines on Tailings Dams – Planning, Design, Construction Operation and Closure – Revision 1 (2019). This design includes a freeboard allowance below the spillway invert for the volume of a 1:100 Annual Exceedance Probability, 72-hour storm event (0.6 m). Compacted earth material (sourced from within GEMCO's leases) is used to construct elevated walls to create additional storage space and to ensure surface run-off does not enter the facility. Tailings slurry is deposited into active TSFs to develop a beach and maintain a tailings water decant pond. Tailings water (i.e. the supernatant water and rainfall runoff) that collects within the pond is decanted to Dam 1 where it is reused in processing operations.

Formal inspections of all TSFs are conducted daily by operational personnel and by specialist consultants on a semi-annual basis as per the requirements of the ANCOLD Guidelines (2019). GEMCO maintains an extensive groundwater and surface water monitoring network to ensure that no adverse environmental impacts arise from the storage of tailings (refer Section 6.5.5).

Table 4-3 provides a description of all current TSFs and Dam 1, and Figure 4-6 illustrates the location of these facilities.

Table 4-3: Description of TSFs and Dam 1

Facility	Surface area (catchment)	Design Capacity	Description
Dam 1	12 ha	200 ML	Dam 1 is the process water dam that feeds the concentrator. Dam 1 is fed from TSF11, TSF14, TSF16, B South and F3 water storage quarries and other stormwater catchment areas.
TSF5	42 ha	6.1 Mt	Slimes storage facility that has been decommissioned. TSF5 is undergoing a closure trial with the aim to progress successful rehabilitation across the surface of the facility (refer Section 4.4.2.4).
TSF6	24 ha	2.4 Mt	Slimes storage facility that has been decommissioned. TSF6 is undergoing a closure trial with the aim to progress successful rehabilitation across the surface of the facility (refer Section 4.4.2.4).
TSF7	77 ha	11.7 Mt	Slimes storage facility that has been decommissioned. TSF7 is undergoing a closure trial with the aim to progress successful rehabilitation across the surface of the facility (refer Section 4.4.2.4).
TSF8	38 ha	1.8 Mt	Sands storage facility that has been decommissioned. Sands tailings from TSF8 are scheduled to be reclaimed and re-processed through the SBP.
TSF9	N/A	16.7 Mt	Slimes storage facility that is encompassed by TSF11.
TSF10	20 ha	4.1 Mt	Sands storage facility that has been decommissioned. Sands tailings from TSF10 are scheduled to be reclaimed and re-processed through the SBP.
TSF11	229 ha	10.6 Mt	Active slimes storage facility that encompasses TSF9. Settled tailings has created capacity which can be utilized at a later date.
TSF12	N/A	1.9 Mt	Sands storage facility that is encompassed by TSF14.
TSF13	141 ha	13.9 Mm^3	Active slimes facility. Fill date is estimated to be Q4 FY23.
TSF14	N/A	5.4 Mt	Sands storage facility that is encompassed by TSF18.
TSF15	196 ha (TBC)	~14.1 Mm^3 (TBC)	New slimes storage facility currently under construction. Fill date is estimated to be 2026 (refer Section 4.4.2.1).
TSF16	62 ha	6.4 Mt	Inactive sands storage facility that adjoins TSF8 and TSF18. TSF20 is currently being constructed as a raise on TSF16.
TSF17	TBD	TBD	Proposed new slimes storage facility required to replace TSF15 (refer Section 4.4.2.3).
TSF18	59 ha	2.7 Mm^3	Active sands storage facility that adjoins TSF8, TSF10 and TSF16. It encompasses the former TSF12 and 14. Fill date is estimated to be Q3 FY21. It will be replaced by TSF20.
TSF20	N/A	5.6 Mm^3 (TBC)	New sands storage facility currently under construction that will encompass the former TSF16 (refer Section 4.4.2.2).

GEMCO TSF SITE PLAN
1:20,000

Project No. J20061
Scale: 1:20,000
Date: 15.07.2020
Datum: MGA 94 ZONE 53 AHD
Revision: A ISSUED FOR INFORMATION

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Red Earth Engineering Pty Ltd
ABN: 17 136 007 746
Phone: +61 7 3173 1714
admin@redearthengineering.com.au
108 Bowen Street, Spring Hill, QLD 4000

SOUTH32 GEMCO Western Leases MMP

Figure 4-6
TSF Site Plan

Date: August 2020	Author: Red Earth	Plan No:
Scale: See scale bar	Figure No: 4-6	GEMCO TSF Site Plan

GEMCO operates a life of operation planning process that includes the ongoing evaluation of existing tailings management strategies and procedures. This includes TSF construction and design principles, water management and ongoing monitoring. This planning process ensures that sufficient capacity is available to meet tailings storage requirements associated with ongoing and future mine production, whilst ensuring that tailings are stored and managed with no significant adverse environmental impacts.

Table 4-4 provides the tailings discharges densities used for planning purposes. Stored sands and slimes tailings typically settle to a density of 1.15 and 1.65 tonnes per cubic metre (t/m³), respectively.

Table 4-4 Tailings Discharge Densities

Waste Type	Densities (%)
Concentrator sand tailings discharge density	19.4
Concentrator slimes tailings discharge density	10.8
PC02 sand tailings discharge density	23.8
PC02 slimes tailings discharge density	4.8

Table 4-5 provides a summary of the tailings production for the FY21-FY24 planning period.

Table 4-5: Tailings Production (FY21-FY24)

	FY21	FY22	FY23	FY24	TOTAL
Sand tailings (Mt)	1.9	2.1	2.1	2.1	**8.2**
Slimes tailings (Mt)	2.15	2.3	2.3	2.3	**9.05**
Total	**4.05**	**4.4**	**4.4**	**4.4**	**17.25**
Cumulative Total	**4.05**	**8.45**	**12.85**	**17.25**	**17.25**

Section 4.4.2 outlines details of future TSFs construction projects for FY21- FY24.

4.3 Exploration Activities

GEMCO undertakes ongoing exploration drilling to improve the understanding of manganese mineralisation (depth, thickness, quality and continuity) across its lease areas.

Three phases of drilling are conducted at GEMCO:

- **Exploration Drilling:** Exploration drilling tests for potential mineralisation on exploration leases. This drilling is described in various Mining Management Plans covering exploration activities in the Southern and Eastern Leases and is not included in this MMP.

- **Resource Definition Drilling:** Resource definition drilling is designed to improve the confidence and to test the extent of mineralisation within the leases. Reverse circulation (RC) drilling is typically used for this phase of drilling, which is supplemented by diamond drilling for density and other geo-metallurgical properties. All Diamond Drill Holes (DDH) are located on existing RC drill pads.

- **Grade Control Infill Drilling:** Grade control RC infill drilling is conducted immediately ahead of mining (0-2 years) in order to improve the resolution of the geological model for short-term planning purposes. This phase of drilling is conducted within the short-term mining footprint and is closely followed by disturbance activities associated with preparation and extraction of the ore.

4.3.1 *Planned Exploration Activities*

Planning for exploration is conducted annually and is a sequential process whereby results from previous years are used to plan future drill locations.

Clearing of access tracks and drill pads is required to undertake exploration drilling activities. Clearing is carried out using a scrub dozer in accordance with GEM-PRO-4149 Permit to Clear and Burn Vegetation and related documents. Tracks are nominally 3 m wide and pads are typically 18 m by 10 m (including track width). Clearing is conducted using the "blade up" method, whereby the blade of the dozer is lifted to ensure topsoil is largely undisturbed and retains vegetative material (i.e. roots and tubers) and the soil seed bank. This facilitates natural regrowth of tracks and pads and therefore, no active rehabilitation is undertaken on the Western Leases. Exploration tracks and pads are left for vegetation to regenerate naturally and all holes are capped and filled immediately after drilling.

4.4 Projects

The following sections describe the sustaining capital projects completed in the FY20 reporting period and planned for the FY21-FY24 planning period. The location of these projects are shown on Figure 4-7 and Figure 4-8.

4.4.1 *Improvements Completed During FY20*

4.4.1.1 *TSF 13*

TSF13 is a relatively new tailings facility and was built to provide additional slimes tailings storage capacity. TSF13 was constructed over previously mined areas to minimise additional disturbance and provide in-pit storage of tailings. Construction of TSF13 commenced in FY18 and was completed in FY20. It has a storage capacity of approximately 13.9 Mm^3 and is anticipated to provide GEMCO with three years of slimes tailings storage.

An amendment to GEMCO's FY17-FY20 MMP was submitted to DITT in Q2 FY18 and received authorisation in Q2 FY18.

4.4.1.2 *TSF 18*

TSF18 involved a single wall raise on the existing TSF14 sands tailings facility and was built to provide additional sands tailings storage capacity. Construction of TSF18 commenced in Q3 FY19 and was completed in Q3 FY20. It has a storage capacity of approximately 2.7 Mm^3 and is anticipated to provide GEMCO with 20 months of sands tailings storage.

An amendment to GEMCO's FY17-FY20 MMP was submitted to DITT in Q2 FY19 and received authorisation in Q2 FY19.

4.4.1.3 *Emerald River Road and Angurugu Town Levee*

The Emerald River Road and the Angurugu Town Levee projects were undertaken to access manganese ore reserves in the north-eastern region of A Quarry, and to address ambient air, noise and visual related impacts caused by mining on the local community. This work involved realigning and bitumen sealing a section of the Emerald River Road located on the western and southern perimeter of the Angurugu township. In addition, the Angurugu town levee was realigned, extended and raised in accordance with recommendations identified as part of South32 / GEMCO's TSF risk management audit. A sound barrier fence was also installed as part of the overall levee wall resulting in a significant reduction in noise related impacts in the area. As part of the planning and engineering design works, GEMCO held a number of community consultation and engagement meetings with the ALC and Traditional Owners. This project was completed in Q4 FY20 and mining in the north-eastern area of A-North Quarry is planned to be completed by Q3 FY22.

4.4.1.4 *Sewage Treatment Facility*

The FY17-FY20 MMP identified the need to upgrade, repair or replace the existing Sewage Treatment Facility in Alyangula which was reaching its end of life. Following a decision to replace the existing facility, GEMCO engaged a third-party contractor (CRS Water) to design, fabricate, install and commission the new waste water treatment plant. The scope of work also included civil design of the layout and foundations, implementation of pipework and decommissioning of the existing facility. Execution of the project commenced in Q2 FY17 and was completed in Q1 FY21. The new Sewage Treatment facility is located in Alyangula, near the Milner Bay Port Facility.

4.4.1.5 *Water Treatment Plant*

In FY17 it was identified that GEMCO's existing Water Treatment Plant located at the Angurugu River was reaching its end of life. Execution work to construct a new facility adjacent to the Mine Gatehouse commenced in Q1 FY19 and was completed in Q4 FY20. The scope of work involved designing, fabricating, transporting, installing and commissioning a new 60 ML/day water treatment plant, as well as civil work to implement new piping, construct a weather resistant roof over the facility, install communications and power and fence the complex. The new water treatment plant provides for a more suitable and secure location, improved water treatment technology and complies with GEMCO's health and safety standards.

4.4.2 *Improvements Planned for FY21-FY24*

4.4.2.1 *TSF15*

TSF15 is a new slimes tailings facility currently under construction. It is designed to have a storage capacity of approximately 10.5 Mm^3 to 14.1 Mm^3 (with raise opportunity) and provide a nominal four to six years of additional slimes tailings storage. TSF15 is located on a greenfield area west of the D Quarry Haul Road and covers an area of approximately 250 ha (total disturbance).

An amendment to GEMCO's FY17-FY20 MMP was submitted to DITT in Q1 FY20 and received authorisation in Q2 FY20. At the time of preparing the MMP amendment, the TSF15 project was in pre-feasibility. Since this time, the design of TSF15 has been further refined as the project progressed through feasibility. Appendix 9.4 provides an update on the current TSF15 design (80%), which now incorporates the key design outcomes of the feasibility study.

Construction of TSF15 commenced in FY20 and is scheduled for completion in FY22.

4.4.2.2 *TSF20*

TSF20 involves a wall raise on the existing TSF16 sands tailings facility. It is designed to have a storage capacity of approximately 5.6 Mm^3 and provide a nominal three years of sands tailings storage.

An amendment to GEMCO's FY17-FY20 MMP was submitted to DITT in Q3 FY20 and received authorisation in Q4 FY20. Construction of TSF20 has commenced and is scheduled for completion in Q1 FY22.

4.4.2.3 *TSF17*

TSF17 is a new tailings facility scheduled for construction in FY22. This project, and the timing for commissioning of the facility, is designed to coincide with the predicted fill date of TSF13 and TSF15 (2026). A concept study on TSF17 was completed in Q4 FY20. The outcome of this study has recommended E-Quarry as the preferred location for TSF17. This area is planned to be mined in accordance with the LoOP and will therefore provide an area of approximately 170 ha of previously disturbed land on which to build the new storage facility. The project is currently in pre-feasibility. Prior to any construction work commencing, GEMCO will seek authorisation from DITT via an amendment to this F21-FY24 MMP.

4.4.2.4 *TSF 5, 6 & 7 Closure and Haul Road Construction*

TSF 5, TSF 6, and TSF 7 are inactive tailings storage facilities that have been identified for planned rehabilitation and closure. The closure of these TSFs is dependent on forecast surplus overburden and topsoil material being made available as part of the future development of E-quarry, which is located in close proximity to TSF5, 6 and 7. A key objective for this project is to design a free draining, stable landform that is acceptable to stakeholders and can be eventually handed back to the Traditional Owners. The project involves the construction of a new mine haul road approximately 2 km in length that will allow overburden and topsoil material to be hauled from E-South and W Quarries. Early works are scheduled to commence in Q2 FY21 with full scale earthworks scheduled to commence after the wet season in Q4 FY21. TSF5 and 7 are scheduled to be completed by FY23 and TSF6 closure work will continue beyond FY24.

4.4.2.5 *Rowell Highway Realignment*

The Rowell Highway is a sealed public road that provides the only access from Alyangula and the Milner Bay Port to GEMCO's mine entrance, the Groote Eylandt Airport and the Angurugu and Umbakumba communities (Figure 1-4).

To enable access to ore reserve below and to the west of the Rowell Highway in line with the LoOP, the highway needs to be relocated. A detailed assessment of several options was carried out as part of the feasibility study with the preferred alignment being located to the west of the existing Rowell Highway. This alignment was chosen because it avoids areas planned for future mine development, sensitive vegetation communities and areas of cultural heritage. The alignment occurs within GEMCO's existing tenements and the corridor will accommodate other ancillary services including the Alyangula potable water supply line, telecommunication services and power lines. The construction of the Rowel Highway realignment will also involve the relocation of GEMCO's explosive storage facilities currently managed by Orica (Explosive Store and Orica Facility).

The alignment received endorsement from the ALC in 2019. An amendment to GEMCO's FY17-FY20 MMP was submitted to DITT in Q1 FY20 and received authorisation in Q2 FY20. Construction of the highway realignment commenced in Q3 FY20 and is planned for completion in Q4 FY21.

4.4.2.6 *Northern Haul Road Realignment*

The Northern Haul Road runs parallel to the existing Rowell Highway, and provides access from the main infrastructure area to the northern limit of the active mining area. To enable the development of quarries within this area from Q1 FY22, the haul road will be relocated to the east of its existing alignment. Construction of the realigned haul road commenced in Q1 FY21 and is scheduled for completion in Q4 FY21. The selected haul road alignment has been designed with the objective of minimising GEMCO's overall disturbance footprint, and where possible, avoids established areas of rehabilitation and utilises previously cleared land. The length of the Northern Haul Road realignment is approximately 3.3 km.

4.4.2.7 *D Quarry Haul Road Realignment*

The existing D Quarry Haul Road is located adjacent to a number of areas planned to be mined. GEMCO's mine planning team is evaluating various haul road corridor options that will provide safe and suitable access to areas identified for mining in the LoOP. These haul road corridor options are not considered definitive at the time of preparing this MMP.

4.4.2.8 *Active Dewatering Trial*

Mine dewatering at GEMCO involves the removal of groundwater once it has entered the quarry. A groundwater dewatering project involving the installation of a network of groundwater monitoring and production bores will be designed to evaluate the benefits and impacts of active dewatering on mine productivity. An active dewatering strategy will aim to intercept groundwater prior to it entering quarries, improving the efficiency of mining by reducing the volume of water entrained in the overburden and ore material removed, and reducing the downtime from drain and sump maintenance.

4.4.2.9 *Milner Bay Port Maintenance Dredging*

The Milner Bay Port Facility was built in 1963. Since commencing operations, the size of vessels docking at the port has increased to the current maximum port limit. This has impacted on GEMCO's inherent ability to safely manage the port's berthing, mooring, warping and under keel clearance operations. This presents a risk to vessel safety and GEMCO's obligations to provide a safe port. This project seeks to undertake the following activities:

- Maintenance dredging of the bulk carrier berth pocket to provide adequate under keel clearance for vessels at the berth;

- Maintenance dredging of the tug berth to provide adequate draft clearance for current and future tugs to access the mooring location. GEMCO are in the process of purchasing a larger tug to accommodate the increase in chartered vessels at the port; and

- Maintenance dredging of the wharf maintenance vessel landing to provide adequate draft clearance for vessels involved in wharf maintenance.

A pre-feasibility study is currently underway to determine the most appropriate dredging and spoil methodology, the total area of dredging required and the environmental sampling and monitoring needed to inform the development of a Dredging Management Plan. Dredging of the tug berth is required prior to acceptance of the new tug (anticipated in Q1 FY22) however the other dredging activities described may extend to FY25. Prior to work commencing, an application to amend GEMCO's FY21-FY24 MMP will be submitted to DITT.

4.4.2.10 *Ndunga Creek*

Ndunga Creek is a small ephemeral waterway that flows east to west into the Gulf of Carpentaria and is located between the F3N and N quarries. Ndunga Creek is located over a known area of manganese ore and studies are underway to determine sustainable design alternatives that will provide access to this material. Ore extraction from this area is planned to occur between FY25–FY27. An engineered design creek diversion of Ndunga Creek that is supported by hydrology and flood modelling studies will be evaluated. If this project is determined to be feasible, an application to amend GEMCO's FY21-FY24 MMP will be submitted to DITT.

4.4.2.11 *J Quarry Access*

J Quarry is located south of the Emerald River (Figure 1-5) and is scheduled to be mined in FY24. The J Quarry mineral lease (MLN961) includes an access corridor over the Emerald River which was originally gazetted in 1974. Following a cultural heritage survey of the Western Leases by the ALC, a portion of the MLN961 tenement was found to extend over a known culturally sensitive sacred site and restricted work area, as well as areas of significant vegetation communities. An alternative haul road alignment and Emerald River bridge crossing location was subsequently identified and agreed in consultation with the ALC and Traditional Owners. This is reflected in a Haul Road Agreement signed between GEMCO and the ALC in July 2020. An application for an Access Authority covering the area of the haul road corridor outside MLN961 was submitted to DITT in September 2020.

The haul road commences in D Quarry (MLN960) and extends in a southerly direction to connect to the eastern boundary of J Quarry (MLN961), totalling approximately 3.8 km. It has been designed to provide a safe and suitable access corridor for the life of the GEMCO operation, including the potential for mining activities to occur in the Southern Lease (EL2455).

The bridge design consists of a single 36 m span steel girder bridge with reinforced concrete abutments and deck on a piled foundation. It crosses the river perpendicular and at a narrow reach that is approximately 22 m wide. The focus for the designed haul road alignment and bridge infrastructure was to reduce the constriction of overland flows across the flood plain, specifically on the southern side of the Emerald River, by allowing the road to overtop for relatively small events (i.e. 1 in 3-year to 1 in 5-year Annual Exceedance Probabilities). To achieve this, a 90 m section of the haul road that is close to the natural ground level elevation is proposed to serve as a trafficable causeway. This will reduce the flow under the bridge resulting in minimal scour potential to the Emerald River. The haul road and bridge design also consider the potential use of larger haul trucks in the future, as well as the risk of light vehicle and heavy mobile equipment interaction, which is seen as a broader site wide safety and haulage strategy for the operation.

The proposed haul road crosses an existing public access track that provides Traditional Owners access to the Emerald River mouth. The existing track traverses through a culturally sensitive site and, at the request of the ALC, GEMCO intends to realign the track from the Yedikba satellite community. A light vehicle underpass has been included as part of the overall design.

To provide access to the construction area on the southern side of the Emerald River, a 10 m wide access track will be constructed. The construction access track, which is located in EL2455, has been deliberately positioned over an existing exploration drill line to limit clearing, with the alignment positioned to become a possible future haulage route to the Southern Lease, providing direct access to mineralised areas in H and K deposits.

A component of early works comprising the construction of the haul road from D Quarry to the southern limit of the MLN960 lease boundary is planned during the 2021 dry season. Timing to undertake construction activities external to the existing GEMCO mineral leases, including the bridge crossing and haul road south of the Emerald River is subject to obtaining and securing both Northern Territory and Commonwealth environmental approvals.

4.4.2.12 *Eastern Leases*

GEMCO holds two mining leases (ML31219 and ML31220) which are commonly referred to as the 'Eastern Leases' (Figure 1-3). The Eastern Leases are located approximately 2 km east of the Western Leases at the closest point. The two leases cover a combined area of 4,414 ha.

A pre-feasibility study was completed for the Eastern Leases project in 2020 confirming the economic viability of the development. The development is a continuation of GEMCO's existing operations, rather than an expansion. It will be integrated with the Western Leases operation and will make use of GEMCO's existing processing and port facilities.

In May 2015, a draft Environmental Impact Study (EIS) for the project was lodged with the NT Environment Protection Authority (EPA) and the Commonwealth Department of Agriculture, Water and Environment (DAWE).[4] A Supplement Report to the draft EIS was subsequently lodged with the NT EPA in January 2016. Following a detailed coordinated review with other government agencies, the NT EPA issued GEMCO with an Environmental Assessment Report concluding that: '*the potential environmental impacts and risks of the Eastern Leases Project have been adequately identified and the evaluation of the significance of those impacts and risks has been appropriate*.'

Whilst the NT EPA concluded its assessment of the EIS in February 2016, the NT EPA does not issue a statutory approval for the development. Consequently, GEMCO will be required to seek approval from DITT under the *Mining Management Act 2001* (NT). This will involve preparation of an MMP for the development, incorporating the recommendations in the EIS Assessment Report as well as commitments from the EIS and Supplement Report. This MMP is currently scheduled for preparation during FY21.

DotE provided approval for the Eastern Leases project under the *EPBC Act* in June 2016. In June 2020, GEMCO applied to the Commonwealth Department of Agriculture Water and Environment (DAWE) to amend its EPBC Act approval conditions (EPBC 2014/7228) following a decision to realign a section of the haul road in proximity to a known habitat of the Northern Hopping-mouse. This application was approved by DAWE in July 2020.

In June 2016, GEMCO and the ALC signed a Mining Agreement and Haul Road Agreement under the *ALRA*. In July 2020, GEMCO received endorsement from the ALC in the form of an Amending Deed to the Haul Road Agreement to realign the section of haul road mentioned above. This allowed DITT to replot the Access Authority (AA31711) in July 2020.

[4] Previously the Department of the Environment (DotE).

Coordinate System: MGA Zone 53

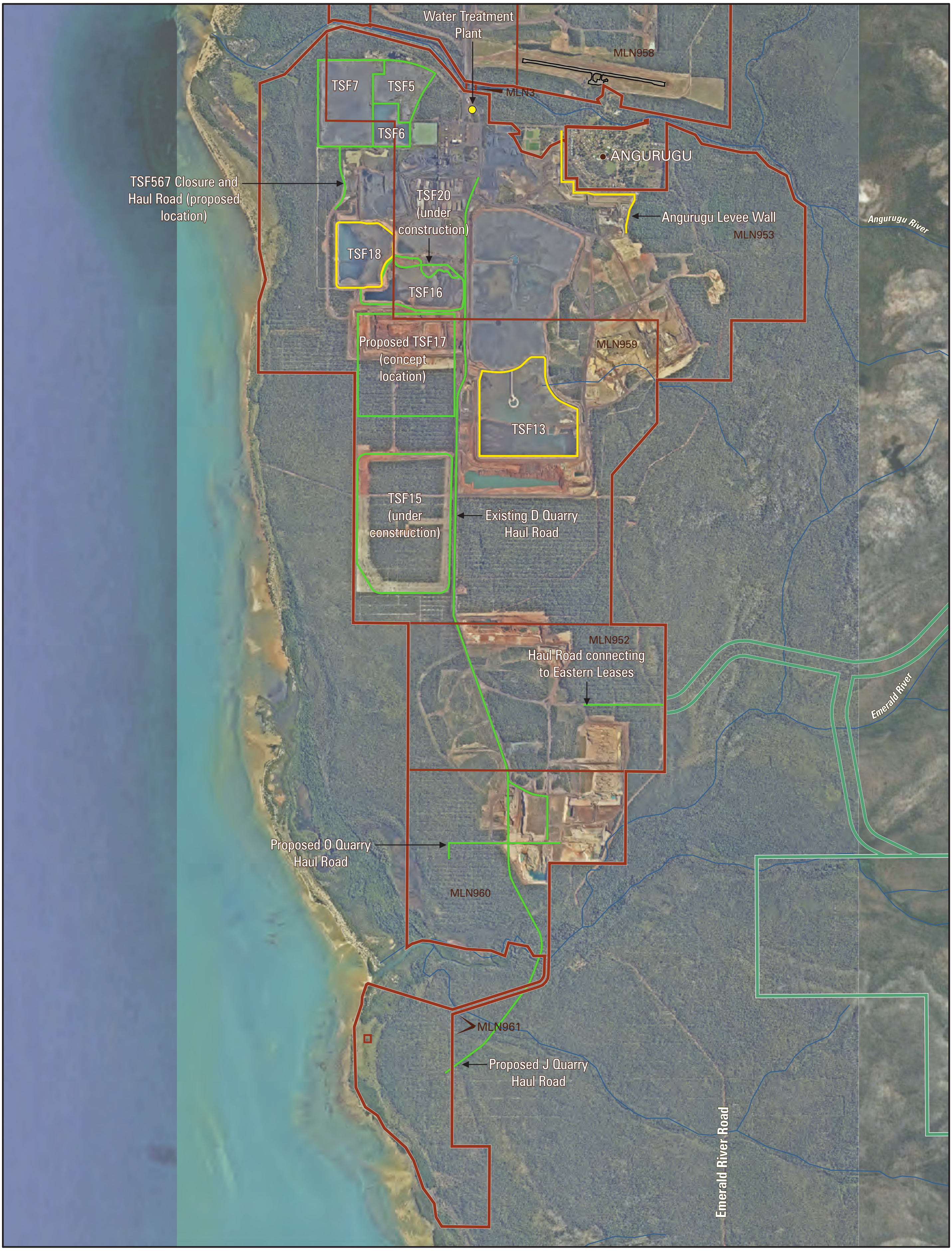
Legend

- Western Leases
- Projects Completed in FY20
- Projects Planned for FY21-24

SOUTH32 GEMCO Western Leases MMP

Figure 4-7
Project Locations (Northern Region)

Date: September 2020	Author: Hansen Bailey	Plan No: Project Locations (Northern Region)
Scale: See scale bar	Figure No: 4-7	



Legend

- Western Leases
- Eastern Leases
- Projects Completed in FY20
- Projects Planned for FY21-24

Coordinate System: MGA Zone 53

SOUTH32 GEMCO Western Leases MMP

Figure 4-8
Project Locations (Southern Region)

Date: September 2020	Author: Hansen Bailey	Plan No: Project Locations (Southern Region)
Scale: See scale bar	Figure No: 4-8	

5 ENVIRONMENTAL MANAGEMENT

5.1 Environmental Management Structure

Environmental management at GEMCO is undertaken by the Environment team, led by GEMCO's Manager Technical Services and supported by South32's global functions on an as-needed basis (Figure 1-2).

5.2 Environmental Policy

GEMCO commits to operating in an environmentally sustainable manner as outlined in the South32 Environment Standard included at Appendix 9.9. This document sets the minimum standard for South32 operations with regards to environmental management.

5.3 Environmental Commitments

GEMCO's environmental commitments are largely encompassed within the South32 Environment Standard.

5.3.1 *Commitments Contained in the MMP*

Table 5-1 summarises the environmental commitments contained within the MMP.

Table 5-1: Summary of Key Environmental Activities (FY21-FY24)

Commitment	Due Date	Section in MMP	Performance against Commitment
Milner Bay hydrocarbon remediation project	Ongoing	N/A	Hydrocarbon bioremediation activities will continue during the FY21 – FY24 MMP term. COVID-19 restrictions slowed the progress of lab-based microcosm research being undertaken by CSIRO – Land and Water but this work continues, and confidence remains in finding a site-specific enhanced bioremediation solution for Milner Bay. This work aims to determine the enhancements that could be applied to the microbial ecosystem to increase the rate of attenuation and to identify and overcome limiting factors affecting microbial breakdown. Once this research is completed (anticipated December 2021), planning will commence to design a pilot field trial to determine the in-situ effectiveness of the chosen treatment regime. Field trials are scheduled to occur from April / May 2022 and conclude around August 2022. If the results of the pilot trial prove to be successful, the project will be upscaled and a full-scale remediation program will commence from September / October 2022. This program is anticipated to run for approximately 3-5 years.
Vegetation Mapping	FY21	2.1.2.3	Baseline vegetation surveys across the Western Leases and surrounding areas have been undertaken to confirm (based on ground-truthing) the presence of vegetation communities based on desktop mapping undertaken by URS (2012) and DEPWS. Further work will be completed during the planning period to determine appropriate offsets (exclusion zones) designed to manage and mitigate any potential impacts caused by mining activities on sensitive vegetation communities.

Commitment	Due Date	Section in MMP	Performance against Commitment
Groundwater Impact Assessment	FY21	6.5.2	GEMCO will complete an assessment relating to the mobile workshop drain to ensure groundwater is not being impacted due to mining operations. Findings will be reported in the FY21 EMR.
Maintenance of coalescent plate separators	FY21	6.5.2	GEMCO will inspect all coalescent plate separators located at the mine site and port prior to the FY21 wet season and complete any necessary maintenance activities.

5.3.2 *Recommendations Resulting from Formal Environmental Assessment*

As outlined in Section 3.1, mining authorisation of GEMCO's Western Leases was granted prior to the introduction of environmental assessment legislation, namely the *EPBC Act* and the *EP Act*. Therefore, environment assessment under these pieces of legislation has not been undertaken and there are no recommendations included in this section.

5.3.3 *Commitments and Recommendations Register*

This section provides an update on recommendations and issues raised by DITT that remain active, or where GEMCO committed to additional actions, during the reporting period. Any previous recommendations raised by DITT have been adequately addressed within the annual Operational Performance Reports (FY17, FY18 and FY19).

5.3.3.1 *Operational Report(s)*

Table 5-2: Operational Performance Report 2019 (MDoc2020/01056)

Recommendation/ Issue	Section in MMP	Performance Against Commitment
Please provide an explanation as to why trigger values are not necessary for these sites	Section 6.5.5.4(i)	GEMCO has developed site specific trigger values for its active TSFs and will apply and report against these trigger values in FY21.
Provide an updated groundwater report with site-specific trigger values if ANZECC 95% for freshwater trigger value is not going to be used	Section 6.5.5.4(i)	GEMCO has developed site specific trigger values for its active TSFs and will apply and report against these trigger values in FY21.
Are there any additional monitoring bores scheduled for installation for the additional TSFs?	Section 6.4.4.3	TSF15 is under construction. Ten additional bores will be installed in seven locations as part of construction activities. These additional bores will be incorporated into GEMCO's scheduled Tailings Groundwater Monitoring Program once installation is complete. TSF20 involves a raise in height on the existing TSF16 embankment walls. The groundwater bores associated with TSF16 will continue to be monitored as part of GEMCO's Tailings Groundwater Monitoring Program.

5.3.3.2 *Project Approval(s)*

Table 5-3: MMP Amendment Approval - Rowell Highway Realignment (MDoc2019/04758)

Recommendation/ Issue	Section in MMP	Performance Against Commitment
Amendment accepted with no additional recommendations or issues raised	N/A	N/A

Table 5-4: MMP Amendment Approval – Angurugu Town Levee Realignment (MDoc2019/04758)

Recommendation/ Issue	Section in MMP	Performance Against Commitment
Amendment accepted with no additional recommendations or issues raised	N/A	N/A

Table 5-5: MMP Amendment Approval (TSF15 - MDoc2019/05920)

Recommendation/ Issue	Section in MMP	Performance Against Commitment
Amendment accepted with no additional recommendations or issues raised	N/A	N/A

Table 5-6: MMP Amendment Approval –TSF20 (MDoc2020/01460)

Recommendation/ Issue	Section in MMP	Performance Against Commitment
Amendment accepted with no additional recommendations or issues raised	N/A	N/A

Table 5-7: MMP Amendment Approval –Off Lease Dewatering (MDoc2020/00461)

Recommendation/ Issue	Section in MMP	Performance Against Commitment
Amendment accepted with no additional recommendations or issues raised	N/A	N/A

5.4 Environmental Training and Education

5.4.1 *Training and Inductions*

GEMCO is committed to educating its employees and contractors about their individual environmental responsibilities in order to facilitate effective environmental management. This is accomplished through the implementation of appropriate induction, training and education programs.

All personnel who will conduct work at the GEMCO operation are required to be inducted (visitors are excluded). The environmental section of the GEMCO induction includes an introduction to key environmental impacts and aspects as well as outlines the Environment Standard. Details include:

- Legal and other requirements: a summary of key environmental legislation and other requirements and the consequences of non-compliance;

- Land and Biodiversity: information on Groote Eylandt's threatened species and the importance of quarantine and biosecurity measures relating to Cane Toads, weeds etc.;
- Water: emphasis on the importance of water efficiency and the main water users;
- Dust: what GEMCO is doing to manage dust and how employees and contractors can manage this issue;
- Waste: where to dump waste appropriately and GEMCO's land-based spill response procedure;
- Incidents: how to report environmental incidents/hazards and the importance of doing so;
- Risk assessment: how to complete risk assessments and the importance of considering environmental risks and impacts.

Records of personnel who have completed the site induction are maintained by the GEMCO Training Department.

Environmental emergency response training is also completed in line with STA-3055 Crisis and Emergency Management Plan (CEMP). Routine training for both the Incident Management Team (IMT) and emergency response personnel is conducted via desktop and practical exercises (of varying levels) and specific IMT workshops.

The competency of personnel to adhere to GEMCO's environment procedures is validated through 'safety observations' (peer-to-peer audit) which are conducted regularly by all personnel. All GEMCO staff and contractors are subject to safety observations. The number of safety observations conducted across departments is reviewed regularly at site leadership meetings.

5.5 Environmental Emergency Preparedness and Response

Emergency preparedness and response procedures are an essential part of effective environmental management. GEMCO's CEMP provides a framework for responding to all crisis and emergency situations. By utilising the People, Environment, Assets, Reputation, Livelihood (PEARL) priorities system, incidents are managed to ensure any potential damage to the natural and social environment is minimised.

Appendix 8-J of the CEMP provides communication plans in case of an emergency. A list of emergency contacts is also contained in Appendix 8-B and includes both internal GEMCO contacts and key external aid agency contacts (including the Police and NT Health). Appendix 8-Q of the CEMP provides a guide for a post emergency review which involves feedback on what worked well and what requires improvement. Any improvements identified require action/s to be logged in GEMCO's risk management system Global360 (refer to section 5.6.1 and 5.6.2). The CEMP also outlines the requirement for GEMCO's emergency services personnel to undertake equipment maintenance and inspection activities to ensure response readiness.

Material environmental risks to the business include the threat of a Cane Toad incursion on the island and the potential release of hazardous materials to the environment.

The most likely type and scale of a Cane Toad incursion is the incursion of a single Cane Toad beyond quarantine areas at either the airport or following the unloading of a barge at the Milner Bay Port Facility. A comprehensive risk reduction plan is outlined in STA-3082 Cane Toad Management Plan (section 5.6.3.5).

In an effort to manage the risk of a release of hazardous materials to the environment, GEMCO has enforced the following procedures: PRO-3115 Land Based Spill Response (outlines the procedure for handling land-based spills), PRO-3052 Milner Bay Oil Spill Contingency (outlines the procedure for handling marine based spills) and PRO-3177 Hazardous Materials Management. The high-risk areas for environmental damage caused by hazardous materials are the diesel storage tanks (above ground) at the port, supply warehouse and mine site refuelling area. Response to hazardous materials spills is also in the Emergency Services routine drill schedule.

5.6 Implementation, Monitoring and Review

5.6.1 *Identification of Environmental Aspects and Impacts*

GEMCO has two primary risk registers which document all significant risks identified at the operation, including environmental risks. These include:

- **GEMCO's site-wide material risk register:** This register is maintained online in Global360. Global360 captures material and non-material risks for the operation, identifies risk and control owners accountable to manage the risks, documents how risks are controlled and schedules routine activities to ensure controls remain effective; and

- **Operational risk registers:** These registers cover relevant departmental risks, project risks and site strategic risks not currently managed within Global360.

Environmental risks are systemically identified taking into consideration the full range of operational activities (as described in Section 4) in relation to individual aspects of the environment. Aspects of the environment that are relevant to GEMCO's Western Leases operations include:

- Groundwater;
- Surface water;
- Ecology (including biodiversity issues relating to flora and fauna); and
- Social (including social issues relating to air quality, noise, visual amenity, socio-economics and cultural heritage).

5.6.2 *Risk Assessment*

Risk assessment and management is a key part of GEMCO's business and is undertaken in line with South32's Material Risk Management Standard. This document defines performance requirements for the identification, assessment, control and monitoring of risks that could materially impact corporate objectives and business plans. A risk assessment (identification, analysis and evaluation) must be conducted for all material risks to understand the nature and tolerance of the risk and controls must be designed, implemented and assessed to produce a residual risk that is tolerable.

Environmental risks are primarily identified using risk assessment tools such as a 'Take 5', Job Safety Analysis (JSA) or Workplace Risk Assessment and Control (WRAC).

The 'Take 5' is a process whereby personnel use a simple risk assessment tool (i.e. booklet) to assess the task at hand. If the Take 5 identifies significant risk, then a JSA must be undertaken.

A JSA requires a more detailed assessment of a job and involves:

- Breaking down the job into smaller tasks;
- Assessing the risk associated with each task; and
- Identifying controls to ensure the risks are tolerable.

A WRAC is a detailed assessment for projects or activities that may include several tasks. It involves:

- Reviewing a project or activity to identify all risk and relevant controls; and
- Assessing the risks and associated controls in line with GEMCO's risk management framework.

Risks are identified through a range of on-site and project activities, including safety observations, hazard identification and project specific risk assessments.

A residual risk score is calculated using the impact and likelihood matrices provided in Appendix 9.6. If a significant risk remains after the controls are in place (residual risk score >30), then the risk is captured within the relevant GEMCO operational risk register with the aim of introducing control measures that reduce the risk to an acceptable level.

Regular reviews of risk registers are conducted to identify any gaps and to document progress on actions arising from control action plans.

5.6.3 *Environmental Management Plans (EMP)*

Environmental management at GEMCO is guided by a range of risk-specific EMPs. These include the following:

- Water Management Plan (see Section 6);
- STA-3316 Waste Management Plan (see Section 5.6.3.1);
- STA-3085 Land and Biodiversity Management Plan (see Section 5.6.3.2);
- STA-27700 Rehabilitation Standard (see Section 5.6.3.3);
- STA-3056 Threatened Species Management Plan (see Section 5.6.3.4);
- STA-3082 Cane Toad Management Plan (see Section 5.6.3.5);
- STA-3091 Weed Management Plan (see Section 5.6.3.6); and
- STA-3080 Air Emissions Management Plan (see Section 5.6.3.7).

A summary of these EMPs is provided in the following sections and are available to DITT on request.

5.6.3.1 *Waste Management Plan*

Objectives and Targets

The primary objectives of the GEMCO Waste Management Plan are to:

- Ensure waste is managed in a safe and effective manner to reduce risk to human health and the environment; and
- Ensure compliance with regulatory requirements that apply to waste management. These include requirements outlined in the *Waste Management and Pollution Control Act 1998* (NT) and *Waste Management and Pollution Control (Administration) Regulations 1998* (NT) and the conditions of GEMCO's EPL289. Compliance with these conditions is reported annually to the NT EPA.

The plan applies to waste management activities within GEMCO's operational areas, excluding process waste (overburden, tailings and process water). It also addresses domestic waste generated from residential and small business activities in the townships of Alyangula and Angurugu.

Management and Mitigation Strategies

Waste management programs are designed to minimise the impact of waste to achieve an acceptable level of impact on the environment. The hierarchy of waste management applied at GEMCO is:

- **Eliminate:** Use products that do not generate a waste or use the product completely, leaving no residue;
- **Reduce:** Reduce the quantity of waste that is generated;
- **Reuse:** Use products that allow a secondary use for the waste product;
- **Recycle:** Determine an alternative use for the waste product, which may include reprocessing of the product; and
- **Disposal:** Remove waste from the mine site, which may include treatment of the product, incineration or deposit at a landfill site.

Waste products are eliminated, prevented and reduced wherever practicable. This is achieved by rationalising the number of products on site and finding alternative products that are recyclable and assist in volume reduction.

The following sections outline the management of the various waste streams generated by GEMCO and the Groote Eylandt community.

Domestic Landfill

GEMCO owns and manages an Integrated Waste Management Facility in accordance with EPL289. The facility is located to the east of the Rowell Highway approximately 9 km to the south of Alyangula (Figure 9-10). The wet tip, dry tip and green tip are located within the same compound, which is a fenced facility.

Signage clearly states the waste that can and cannot be disposed of at each tip inside the compound.

Facility staff also assist to ensure waste is being disposed of in the correct locations.

The Integrated Waste Management Facility is licenced to accept listed hazardous wastes, as defined in Schedule 2 of the *Waste Management and Pollution Control (Administration) Regulations*. There is signage located at the wet tip that indicates appropriate waste types for disposal in this area.

Management controls include weed control, provision of information, community awareness programs, management of cells, provisions of recycling items, listed waste depots and the promotion of recycling.

Rubber Waste

Once the life of a tyre has expired (e.g. retreading and or repair is no longer viable), it is stockpiled at various locations across site. Other rubber products (e.g. worn conveyor belts) are also stockpiled with the tyre waste. Small amounts of rubber products (other than tyres and conveyor belts) are sent to the dry tip for burial.

Once a sufficient volume of rubber waste is stockpiled, it is buried at depth by the Mining Department within active quarry areas as determined by the Mining, Planning and Environment Departments.

Scrap Steel

GEMCO currently sends high grade scrap steel off the island for recycling. Low grade uncontaminated scrap steel that is uneconomical to transport and recycle is disposed of in GEMCO's licensed landfill facility or in open mining voids. In the event light trucks and light vehicles are disposed, all lubricants, batteries, coolant and fuels are drained/removed prior to disposal. The location of any disposed items in open voids is recorded by the Technical Services Department.

Inert waste

During the planning period, GEMCO will utilise pit voids for the disposal of additional inert materials from project work (e.g. demolished building) that are not economically viable for recycling. Bulk clean-ups utilise significant room within the Integrated Waste Management Facility which results in additional tree clearing. Using available pit voids (tree clearing already undertaken) will assist in limiting GEMCO's disturbance footprint and rehabilitation requirements. Only inert materials that pose no risk to groundwater quality will be disposed in these voids. No waste defined as 'listed waste' under the *Waste Management and Pollution Control Act* will be disposed of in this manner. The location of any disposed items in open voids will be recorded by the Technical Services Department.

Bio-remediation Facility

Land farming is a bio-remediation process where contaminated soil is stockpiled and turned on a regular basis. Micro-organisms break down hydrocarbons into water and carbon dioxide. GEMCO operates a land farm to bioremediate hydrocarbon contaminated soil and absorbent material. This facility is located within the C Quarry area (Figure 1-5). Informational signage ensures that personnel using the area have sufficient information to use the facility. The facility is tested by the Environment Department to determine when soils contaminated with hydrocarbons have been remediated to an acceptable level for onsite disposal as backfill in quarries, with minimal risk to the environment. Land farming is conducted in accordance with PRO-3171 Land Farm Management.

Minor Storage/Hazardous Goods

Small amounts of assorted waste and hazardous products are stored at various areas across the mine site, wet tip, port and township. This includes storage by departments that produce large amounts of waste and therefore, manage the waste stream within the department (e.g. mobile workshop waste oil).

All wastes shipped off Groote Eylandt are taken to Darwin for repair, reuse, and/or recycling and/or disposal by contractors.

The Non-Process Infrastructure (NPI) Department maintain a large volume of the recycling regime at GEMCO and for Groote Eylandt. Examples of materials recycled on Groote Eylandt include but are not limited to:

- White goods;
- De-gassed air conditioners;
- Used fluorescents bulbs;
- Filters – drained and squashed in Intermediate Bulk Containers (IBC);
- Computers;
- PVC insulated cable;
- Oil;
- Batteries;
- Paint thinner;
- Asbestos;
- Printer cartridges; and
- Scrap metal (bins located around site).

The priority given to certain waste types is based on the risk associated with the waste. As GEMCO's operations are located 650 km from Darwin, the priority with waste management often lies more with suitable storage and transport systems until longer term arrangements can be made. At times this may mean waste materials are stored for longer than optimal timeframes, and for this reason, GEMCO operates a waste management (holding) facility.

Monitoring and Measurement

The Environment Department monitor landfill leachate on a quarterly basis at the locations shown in Section 6.4.4. Water quality data are compared against the Australian and New Zealand Guidelines (formerly ANZECC, 2000) for slightly to moderatly disturbed (95% species protection) freshwater and marine water ecosystems (ANZG, 2018).

Changes to Monitoring Programs

No changes were made to the monitoring programs outlined in the Waste Management Plan during the reporting period.

Effectiveness of Management and Mitigation Strategies

Management of the waste facilities is reviewed on a regular basis and actions issued if required.

The Waste Management Standard is reviewed as required in line with GEMCO's controlled document process.

Non-Conformance and Corrective Action

There were no non-conformances associated with waste management during FY20.

5.6.3.2 *Land and Biodiversity Management Plan*

Objectives and Targets

GEMCO's Land and Biodiversity Management Plan (LBMP) provides an overarching framework for managing the potential impacts to land and biodiversity resulting from GEMCO's operations. Potential impacts include loss of habitat for local flora and fauna, invasive flora and fauna species, impacts to surface water and groundwater, interference with cultural sites, site contamination and impacts to areas of conservation significance. The key objectives of the LBMP are to:

- Ensure compliance with relevant Commonwealth and Territory legislation (as outlined in Section 3.1);
- Ensure compliance with South32's Environment Standard (Appendix 9.9) which requires the collection of biodiversity baseline information, mandates the use of controls consistent with the biodiversity mitigation hierarchy and requires the effectiveness of the controls to be validated; and
- Improve current land and biodiversity management applications to ensure sustainable and functional ecosystems both during operations and post-closure.

To meet the objectives of South32's Environment Standard, GEMCO has developed the following biodiversity goals:

- Minimise impacts on biodiversity by protecting biodiversity values where possible or to enhance biodiversity where protection is not possible;
- Provide offsets where protection and enhancement of biodiversity values cannot be achieved;
- Ensure no loss of species; and
- Leave sustainable, functioning ecosystems that mimic regional landscapes.

To meet these objectives and goals, the LBMP includes information relating to:

- The location of designated protected areas and areas of high conservation value;

- A baseline assessment of the biodiversity values for all environments potentially impacted;
- Controls to mitigate biodiversity impacts including consideration of biodiversity offsets;
- A monitoring review program to assess the biodiversity impacts and effectiveness of the controls; and
- Contaminated sites and environmental liabilities.

Management and Mitigation Strategies

Two baseline terrestrial studies have been conducted for GEMCO's Western Leases area. An initial survey was undertaken by Webb in 1992 followed by a site wide Flora and Fauna Survey in 2012 by URS. The survey results provide a baseline of species found on the western side of Groote Eylandt. GEMCO uses this information, together with results from more recent terrestrial flora and fauna surveys, to manage impacts utilising the biodiversity mitigation hierarchy.

Another major biodiversity study was conducted within the marine environment. The Australian Institute of Marine Science conducted a study in 2011 – 2012 to assess the impact of mining operations on the surrounding coastal ecosystems. This study detailed potential contaminates caused by mining on the local species of fish, molluscs and coral. Recommendations arising from the study were incorporated into GEMCO's annual marine monitoring program in 2013. This monitoring program was reviewed in 2020 (Section 6.4.5).

GEMCO's land and biodiversity management framework is designed to prevent adverse impacts from occurring or, if this is not possible, to limit these to an acceptable level.

The four levels of management listed below are ordered from the highest conservation level (no impact) to the lowest conservation level (significant impact):

1. **Avoid:** avoiding impacts altogether.
2. **Minimise:** implementing decisions or activities that are designed to reduce the impacts of a proposed activity on biodiversity.
3. **Rehabilitate:** measures undertaken to restore or reclaim areas to agreed post-closure uses, recognising impacts to biodiversity have already occurred.
4. **Compensate:** offsetting for the impact by protecting substitute environments or improving knowledge to enhance future management measures through research and development.

Land disturbance and clearing requires approval from a number of stakeholders to ensure that all land related criteria, including areas of cultural or environmental significance, have been assessed prior to disturbance. This criteria is assessed through PRO-4149 Permit to Clear and Burn Vegetation and FRM-4862 Permit to Clear. When a disturbance request is received, an assessment is undertaken on the:

- Nature of disturbance;
- Tenure;
- Relativity of disturbance in relation to mine plan;

- Areas of environmental significance (e.g. riparian corridors, significant flora and fauna species, ecologically significant areas);
- Rehabilitation requirements; and
- Cultural clearance of disturbance areas, including consultation with the ALC.

All personnel must comply with the requirements outlined in the permit.

PRO-4144 Topsoil Management outlines the method used when direct placement of topsoil on areas that are ready for rehabilitation is not practicable and hence stockpiling is required. For each rehabilitation area, a clearing and topsoil record and rehabilitation record is maintained by the Technical Services Department. These are internal electronic records used to track the placement and location of topsoil stockpiles and the quality of rehabilitation efforts (including the management techniques applied to rehabilitation works).

Monitoring and Measurement

GEMCO undertakes biennial rehabilitation monitoring, annual marine monitoring and an ongoing Cane Toad detection program to measure and protect biodiversity at GEMCO.

Changes to Monitoring Programs

No changes were made to the LBMP monitoring programs during the reporting period.

There were some changes to the Rehabilitation Monitoring and Evaluation Procedure that are outlined in Section 5.6.3.3.

Effectiveness of Management and Mitigation Strategies

The LBMP is reviewed as required in line with GEMCO's controlled document process.

Non-Conformance and Corrective Action

There were no non-conformances associated with biodiversity during FY20.

5.6.3.3 *Rehabilitation Standard*

Objectives and Targets

GEMCO's Rehabilitation Standard outlines the requirements for mine site rehabilitation to ensure the rehabilitation strategy and management structure aligns with leading practices and meets GEMCO's obligations under the Mining Agreement (Section 3.2.1). The objectives of the Rehabilitation Standard are detailed in Table 5-8 below.

Table 5-8: Rehabilitation Objectives

Objective	Guiding Principles
Safe to humans and wildlife	Mine voids will be backfilled to the most practicable and cost-effective extent during operations. Tailings dams will be de-watered and capped to be made stable. Areas of unstable ground will be stabilised as appropriate to ensure that there is no risk to humans or animals. Hazardous materials will be removed or treated.
Non-polluting	Leachate will be managed to prevent mobilisation from sources of potential contaminants such as tailings. Contaminated land will be remediated to prevent runoff and seepage.
Stable	All residual slopes will be stabilised, where possible. Slopes will have vegetative cover preventing erosion. Above surface tailings dam walls will be reshaped and managed to prevent erosion.
Sustain an agreed post mining land-use	The post mining landform (areas previously mined, excavated, dumped over or topsoil stripped) will be re-seeded with local native tree and shrub species. Some areas of rehabilitation may be returned to alternative land-uses (grazing, agriculture) where agreed with Traditional Owners and where stabilisation of the post-mining landform will enable agreed alternative use.

Management and Mitigation Strategies

Rehabilitation requires the input and collaboration from a broad team at GEMCO including the Planning, Mining, RMSL, Environment, and Corporate Affairs teams.

The Rehabilitation Standard outlines the broad process of rehabilitation and the responsible department, including the following:

- Landform design: Undertaken by the Technical Services team and includes consideration of factors such as placement, height and footprint, effective drainage design, erosion minimisation and habitat effectiveness;
- Tree clearing requirements: Undertaken by the Mining team during the dry season to ensure the least amount of disturbance to vegetation and topsoil;
- Topsoil management: Undertaken by the Mining team, and includes stripping, movement, stockpiling, spreading and scarification of topsoil;
- Seed collection, management and rehabilitation seeding: Undertaken by RMSL as soon as possible following the completion of topsoil spreading and ripping and as close as possible to the start of the wet season; and
- Weed control: Undertaken by the RMSL team.

These processes are supported by a range of procedures and management plans including:

- PRO-4149 Permit to Clear and Burn Vegetation;
- PRO-4192 Vegetation Clearing; and
- PRO-4144 Topsoil Management.

Monitoring and Measurement

Rehabilitation monitoring is undertaken by the Environment team in accordance with GEMCO's PRO-3181 Rehabilitation Monitoring and Evaluation Procedure.

The monitoring program is designed to meet three key objectives:

1. **Scientific assessment:** to provide data on specific indicators from rehabilitated sites and a comparison against undisturbed reference sites;

2. **Evaluation of ecosystem development**: to quantify the condition of sites and assess the status of different aged rehabilitation sites on a trajectory of rehabilitation states directed towards completion criteria; and

3. **Continuous improvement:** to provide results which allow refinement of rehabilitation techniques and practice and assessment of specific management objectives.

Monitoring of rehabilitation includes flora and fauna surveys and topsoil quality monitoring.

The information obtained via the monitoring program enables GEMCO to identify sites where remedial work may be required and to assess long-term rehabilitation practices and make improvements to the program when necessary. All aspects of GEMCO's rehabilitation processes are subject to compliance audits to ensure outcomes are being met and compliance with the South32 Environment Standard is maintained.

Changes to Monitoring Programs

A review of GEMCO's rehabilitation completion criteria commenced during FY18. This involved an external consultant reviewing all rehabilitation control site data and the ranges recorded for each variable since monitoring began in 2005. At a high level, these variables include canopy cover, ground cover, key species, primary species and stand basal area. This review found that the range for some variables at the control sites differed from the rehabilitation completion criteria. Accordingly, minor changes to the rehabilitation completion criteria were implemented in FY20 to better align with the background conditions observed at control sites. These changes are reflected in GEMCO's Rehabilitation Monitoring and Evaluation Procedure. These criteria have been presented to the ALC and are available to DITT on request.

A new rapid assessment methodology was also implemented during the 2020 flora monitoring program. The new monitoring methodology enables GEMCO to respond to any issues in a timely and efficient manner to ensure rehabilitated sites transition to success, as well as optimising the monitoring program effort.

As communicated in the FY19 OPR, GEMCO completed an external review of its fauna monitoring program in rehabilitation areas during the 2019 dry season. This report recommended the realignment of the fauna rehabilitation monitoring to be consistent with the timing of the flora rehabilitation monitoring. It also recommended various updates to the fauna monitoring program methodology. GEMCO has accepted these recommendations with the intent of completing fauna monitoring concurrently with the flora rehabilitation monitoring going forward.

Effectiveness of Management and Mitigation Strategies

Rehabilitation monitoring is carried out biennially. All rehabilitation is subject to monitoring within the first two years. GEMCO has collated a significant amount of data and it is understood that, if problems are identified in the early phases, active management of rehabilitation can rectify the trajectory over time.

GEMCO has completed its 2020 flora rehabilitation monitoring program and plans to submit the results from this program within the FY21 EMR.

When rehabilitation monitoring identifies a non-conformance to the objectives of the Rehabilitation Standard, appropriate mitigation measures are put in place. Depending on the nature of the non-conformance, corrective action may include supplementary planting, weed control or complete reestablishment of areas of rehabilitation that are deemed unviable.

Non-Conformance and Corrective Action

There were no non-conformances associated with rehabilitation during FY20.

5.6.3.4 *GEMCO's Threatened Species Management Plan*

Objectives and Targets

The purpose of the GEMCO Threatened Species Management Plan (TSMP) is to minimise the potential impacts of mining and exploration activities on fauna species of conservation significance listed under the *EPBC Act* and the *TPWC Act* (as outlined in Section 2.1.3). The TSMP has been prepared to assist GEMCO in the implementation of appropriate fauna management measures and defines the reporting procedures for threatened fauna species during the operation of the mine and associated exploration activities. The main objectives of the TSMP are to:

- Guide all activities that have the potential to cause land disturbance within the Western Leases with regards to fauna management;
- Promote appropriate fauna management measures from mine planning to mine operations; and
- Undertake stakeholder consultation and collaboration regarding threatened species management on Groote Eylandt between GEMCO and the ALC.

Management and Mitigation Strategies

A three-level management hierarchy has been developed to broadly classify and assign the appropriate level of management response for threatened species on the Western Leases (Table 5-9). The TSMP describes how the management hierarchy is to be implemented. The category assigned to each species is not necessarily fixed, as changes in species records, their conservation significance (as listed by the *TPWC Act* or *EPBC Act*) or GEMCO's planned activities may require a change to the level of management response.

Table 5-9: Management Hierarchy for Threatened Species

	Level 1	Level 2	Level 3
Summary of Category	Species recorded on the Western Leases, and potential for significant impact to the species as a result of mining and/or exploration activities in the next five years (i.e., 2020 to 2025)	Species recorded on the Western Leases, and there is limited potential of significant impact to the species as a result of mining and/or exploration activities in the next five years (i.e., 2020 to 2025)	Species not previously identified on the GEMCO leases but known to be present in suitable habitat on Groote Eylandt, and therefore impact could potentially occur.
Level of Management Required	Implement higher level specific management plans and monitoring (TSMP Section 6.1), plus general environmental management measures and monitoring (TSMP Section 5).	Implementation of specific monitoring required (TSMP Section 5.2), plus general environmental management measures and monitoring (TSMP Section 5).	Implementation of general environmental management measures and monitoring (TSMP Section 5).
Species Currently in Category	Northern Hopping-mouse	Northern Quoll Merten's Water Monitor Yellow-spotted Monitor Northern Masked Owl Ghost Bat	Brush-tailed Rabbit-rat False Water Rat Pale Field Rat Lesser Sand Plover Greater Sand Plover

The following control measures are used at an operational level to minimise the potential impacts of the GEMCO mine and exploration activities on fauna:

- All mining and exploration activities will be undertaken in accordance with the TSMP;
- The area of land disturbance on the Western Leases will be kept to the practicable minimum and rehabilitation will be conducted progressively where mine scheduling allows; and
- The Technical Services team will retain all records of areas disturbed by mining operations.

When operational activities require the clearing of new areas, a permit is required before works commence. This process includes:

- Approval from the Technical Services Department, Environment Department, Corporate Affairs Department and the ALC;
- Assessment of the presence or absence of species of conservation significance in the area to be cleared, based on baseline survey results of the Western Leases area, vegetation type and sub-surface geology; and
- Clearance plans to identify the extent of the area authorised to be cleared, which is monitored for compliance by the GEMCO Technical Services Department.

The GEMCO Environment Department (or nominated delegate) will determine whether the coverage of the baseline surveys in the planned clearing area is adequate. If necessary, additional targeted pre-clearance surveys will be undertaken to improve GEMCO's knowledge of the distribution of fauna species of conservation significance. The GEMCO Environment Department (or nominated delegate) will include any operational fauna management requirements in the Permit to Clear form for the relevant planned clearing area. These management requirements are determined on a case-by-case basis.

In accordance with the Air Emissions Management Plan (AEMP), dust control measures such as road watering and progressive rehabilitation of disturbed areas will be used to minimise dust from the mine site adversely affecting fauna and its habitat.

Approval will be sought from the GEMCO Environment Department where controlled burning of adjoining native vegetation is required to reduce local fuel loads. Necessary precautions will be made by Technical Services and Mining personnel to prevent unwanted fires during mining operations.

The GEMCO Environment Department regularly review the conservation status of fauna species, and the development of State/Territory and Commonwealth fauna management strategies and action plans.

Monitoring and Measurement

An assessment of threatened species in an area proposed for clearing is undertaken as part of GEMCO's Permit to Clear process as required. The survey methodology utilised as part of any additional targeted pre-clearance surveys is outlined in Section 9.1. of the TSMP against each species.

During the reporting period, GEMCO completed a pre-clearance assessment of *EPBC Act* listed threatened fauna species and habitat for the proposed clearing areas associated with the FY21 Exploration Drill Plan, FY21 Mine Plan, the Rowell Highway (Section 4.4.2.5) and TSF15 (Section 4.4.2.1) projects. The final reports were received in FY20 and no priority species were recorded.

Changes to Monitoring Programs

No changes were made to monitoring programs within the TSMP during the reporting period.

Effectiveness of Management and Mitigation Strategies

The TSMP is reviewed in line with GEMCO's Controlled Document requirements.

Non-Conformance and Corrective Action

There were no non-conformances associated with the TSMP during FY20.

5.6.3.5 *Cane Toad Management Plan*

Objectives and Targets

The Cane Toad Management Plan establishes a framework to prevent the unwanted migration of Cane Toads to Groote Eylandt. It provides a risk analysis of the various pathways by which Cane Toads might arrive on Groote Eylandt and details operational controls to minimise the risk of unwanted migration, including procedures for early detection.

The objectives of the Cane Toad Management Plan are to:

1. **Maximise Cane Toad knowledge:** Public awareness and knowledge of Cane Toads and their potential impacts, management options and animal welfare must be raised to increase acceptance, capacity and surveillance efforts to detect and remove toads. Any control program must recognise that Cane Toads require animal welfare consideration and control must be targeted and not cause suffering to non-target animals.

2. **Detail current Cane Toad management techniques:** GEMCO acknowledges the risk of Cane Toad establishment through its mining related activities and implements a broad range of controls to prevent Cane Toad establishment on Groote Eylandt.

Management and Mitigation Strategies

The threat posed by Cane Toads is taken very seriously by GEMCO. As such, a range of controls are implemented to manage this risk. These controls include:

1. **Cane Toad awareness programs and signage**: This includes the provision of information in site inductions, during pre-start safety meetings, on charter and commercial flights and via promotional material (i.e. magnets);

2. **Cane Toad fencing**: Exclusion fencing is in place at all regular freight packing and shipping yards in Darwin and at the Milner Bay Port Facility and are subject to regular inspection;

3. **Cane Toad traps and monitoring devices**: Traps are in place at Darwin freight packing and shipping yards and the Milner Bay Port Facility. Monitoring devices are also installed in high risk habitat areas on Groote Eylandt which provide real time notification of any suspicious calls; and

4. **Quarantine and biosecurity inspection procedures**: Procedures include inspections and storage requirements of any equipment or other items bound for Groote Eylandt. For high risk freight, a Cane Toad detection dog is used to inspect the freight upon arrival on Groote Eylandt. Annual auditing of barge operators against Cane Toad control procedures and risk assessments is conducted by GEMCO.

Monitoring and Measurement

GEMCO's response to Cane Toad incidents is undertaken in accordance with PRO-3090 Cane Toad Response Plan. All events (including quarantine store interceptions, incursions, reported or suspected invasions, eradication of incursions, false alarms and near-misses) are recorded in Global 360 and are subject to GEMCO's investigation procedure as required. These records help quantify the risk by determining the frequency and type of incursion event. This increases GEMCO's understanding of the risk and helps to continually improve risk management to prevent Cane Toad incursions.

Changes to Monitoring Programs

In FY19, GEMCO initiated an external review and update of its response mechanisms to a Cane Toad incursion. This resulted in the development of a Cane Toad Response Plan (PRO-090) which was finalised in FY20. Following feedback from stakeholders, a review of the response plan will be undertaken in FY21.

In FY20, GEMCO undertook an initial study into the viability of utilising environmental DNA or eDNA for monitoring activities as an early response mechanism. This study and development of a monitoring program will continue in FY21.

The construction of a Cane Toad fence around GEMCO's warehouse facility (Figure 1-6) was also initiated in FY20 and will be completed during FY21.

Effectiveness of Management and Mitigation Strategies

The Cane Toad Management Plan describes the key controls and outlines all control owners and respective accountability. These controls are tested and inspected in line with South32's risk management framework.

Non-Conformance and Corrective Action

There were no non-conformances associated with the Cane Toad Management Plan during FY20.

5.6.3.6 *Weed Management Plan*

Objectives and Targets

The intent of the Weed Management Plan (WMP) is to provide a clear and consistent process for managing and preventing the occurrence and spread of weeds across the Western Leases area. The plan will also be used to inform weed management practises for the wider Groote Eylandt community and aligns with the Top End Weed Management Planning Guide produced by DEPWS (2018).

The specific objectives of the WMP are to:

- Comply with all applicable legislation, regulations and regional weed management plans;
- Prioritise weed species for control, with consideration to:
    - The declaration status of the species;
    - Any Statutory Weed Management Plan requirements;
    - Specific risks on Groote Eylandt; and
    - Feasibility of eradication or control;
- Identify priority treatment areas that may provide high value improvements in terms of eradication or containment over time;
- Outline control treatment options and timing for priority weed species; and
- Define longer term management actions that will ensure the intent and objectives of the WMP are met and provide for further improvement in weed management across Groote Eylandt.

Management and Mitigation Strategies

Weed spread prevention is the most successful and cost-effective type of weed management available. GEMCO has several procedures that aim to prevent the introduction of weeds and or mitigate their propagation and spread. These are summarised in Table 5-10 below.

Table 5-10 GEMCO Weed Management Procedures

South32 Procedure	Weed Management Actions	Responsibility
Quarantine Inspection (PRO-3198)	Barge inspections are conducted at the Alyangula freight port and require visual inspection of all barge freight including vehicle and equipment, for soil, seeds or plant matter. Container inspections are also conducted on board the barge.	Environment Specialist
Exploration and Weed Hygiene (PRO-4162)	Inspection and decontamination of all GEMCO and contractor vehicles and equipment prior to entry and upon exiting the exploration areas and grid tracks. If cleaning is required, this is conducted at a designated decontamination area. Contaminated debris is securely bagged and relocated to the GEMCO waste facility.	Exploration Teams and Environment Specialist
Vegetation Clearing (PRO-4192)	Earthmoving equipment must be washed thoroughly at the mine site wash-pad prior to commencing work if there is a possibility that weed seeds may be present on the machine. If clearing a site contaminated with weeds the equipment shall be washed on site prior to relocation. Minimisation of the clearing area and any related disturbance to land surface or native vegetation.	All operators
Topsoil Management (PRO-4144)	Identification, planned recovery and deposition of topsoil must be addressed prior to any ground disturbing activities. An appropriate area for receipt of cleared topsoil must be identified and prepared prior to stripping of topsoil to enable direct return of the soil resource. Where practicable, topsoil will be returned to an area that is near to its source within two weeks of stripping to maximise rehabilitation results. Stockpiling of topsoil is considered a last resort when there is no area available for direct return or remediation. Stockpiles are located in open areas away from sources of airborne weed seed. RMSL manages weed outbreaks on the stockpile and surrounding areas. If a stockpile becomes infested by weeds, RMSL and an Environment Specialist assess further management requirements prior to utilisation in rehabilitation or remediation areas.	Production Engineer (Rehabilitation and Backfill Planning) Environment Specialist and Superintendent RMSL
Rehabilitation Monitoring and Evaluation (PRO-3181)	Rehabilitation Monitoring shall be undertaken by the Environment Department and includes recording the presence and abundance of any weed species. This information is shared with and used by RMSL to assess weed management priorities, annual weed treatment programs and/or immediate actions.	Environment Specialist

In addition to the prevention strategies outlined above, GEMCO utilises the following weed control treatment methods:

- **Physical:** Hand pulling / grubbing, felling, slashing / mowing, cultivation, mulching, burial / capping;
- **Chemical:** aerial spray, foliar spray, basal bark, cut stump and soil application; and
- **Land management:** Quarantine, revegetation / rehabilitation, replacement planting, fire.

An annual weed management plan for each priority species is outlined within the WMP and aligns with the NT Weed Management Handbook (NT Government, 2015). GEMCO's RMSL team are responsible for weed control activities on the mining lease and in Alyangula.

Monitoring and Measurement

Pre and post-wet season monitoring is undertaken by the RMSL team at known weed locations and at priority treatment areas to verify weed treatment activities and outcomes. The results of these surveys are used to update GEMCO's weed mapping database in order to monitor the spread of weeds across the mining leases and identify priority areas for weed management.

Surveillance at newly established rehabilitation sites and areas disturbed by fire is also undertaken.

Changes to Monitoring Programs

An update to the WMP was finalised in FY20 but no changes were made to weed monitoring programs during the reporting period.

Effectiveness of Management and Mitigation Strategies

GEMCO is part of the Groote Eylandt Weed Working Group (GEWWG) led by the ALC Land and Sea Rangers. This group meets regularly to share knowledge and information, and to coordinate holistic weed management across the Groote Eylandt region. This includes review of GEMCO's WMP priorities and the success of treatment programs. The outcome of this discussion informs subsequent annual treatment and monitoring programs and updates to the WMP as required. A detailed review of the WMP is conducted every three years in consultation with the ALC, GEWWG and the Regional Weeds Officer.

Non-Conformance and Corrective Action

There were no non-conformances associated with the Weed Management Plan during FY20.

5.6.3.7 *Air Emissions Management Plan*

Objectives and Targets

The objective of air emissions management is to minimise the generation of dust from mining operations and to keep associated environmental risks to as low as reasonably practicable (ALARP). The Air Emissions Management Plan (AEMP) outlines the management strategies, actions and key performance indicators that are used to manage air emissions across the Western Leases area. The plan also outlines monitoring programs to understand air emission levels and allow for the effective and timely implementation of contingency measures if required.

The AEMP aims to ensure that:

1. Areas of high dust emissions are identified and are appropriately managed;

2. Adverse impacts to human health, the environment and public amenity associated with dust emissions are minimised;

3. All relevant legislation is complied with; and

4. Any complaints relating to dust emissions are received and dealt with in an effective and timely manner.

GEMCO's air emission guidelines are summarised in Table 5-11.

Table 5-11: GEMCO's Air Emission Guidelines (FY20)

Pollutant	Particle Size	Averaging Period	Guideline Value	Reference
Particulate Matter	PM_{10}	24 hours	50 µg/m³	NEPC 2016
Particulate Matter	PM_{10}	Annual	25 µg/m³	NEPC 2016
Manganese (PM_4) Mn	PM_4(1)	Annual	0.84 µg/m³	Internal Adopted Guideline Value (based on TCEQ chronic ReV(2))

(1) PM_4: The Reference Value (ReV) is based on Mn associated with respirable particles (being less than 5 µm in aerodynamic diameter). Because the current definition of respirable particles is ≤4 µm (ISO 2017), sampling methods have been adapted to enable quantification of Mn in the PM_4 fraction.
(2) The TCEQ chronic ReV is the Texas Commission on Environmental Quality's chronic Reference Value (ReV). The TCEQ chronic ReV has been adopted by GEMCO as the most current and scientifically appropriate health-based criterion for risk assessment.

GEMCO continues to ensure that it adopts the most current guidance values for PM_4Mn to protect the health of sensitive receptors. In FY19-FY20, GEMCO adopted the Texas Commission on Environmental Quality (TCEQ) reference value (ReV) as the most scientifically appropriate guidance value. TCEQ ReV is defined as an estimate of the guidance value threshold at which adverse health effects from manganese are not expected, even to sensitive members of the general population, and even when exposure occurs continuously over long periods of time (from one year to a lifetime). The TCEQ is derived from the most current scientific literature which was not included in the Agency for Toxic Substances and Disease Registry (ATSDR) derived minimum risk level.

Management and Mitigation Strategies

Health and environmental impacts of dust are influenced by particle size, chemical composition and concentration. The constituents of dust are important as certain compounds have negative health effects to humans.

The Ambient Air Quality National Environment Protection Measure (NEPM) provides criteria to protect human health from the effects of particulate matter (NEPC, 2003). There is currently a NEPM standard for PM_{10}, which South32 has adopted as its air emissions guideline.

GEMCO has High Volume Air Sampler (HVAS) monitoring units (Figure 9-3) in the townships of Alyangula and Angurugu. The sampling units are located in areas aimed to capture the highest risk of dust emissions given the prevailing winds during the wet and dry seasons. The township of Umbakumba, located on the far eastern side of the island, it is not expected to be impacted by current mining operations and is not included in the scope of the AEMP.

The HVAS monitoring units are sampled on a six-day basis to ensure that monitoring is conducted on every day of the week over a given period, which ensures random sampling. Filter papers are collected and dispatched to a NATA accredited laboratory for analysis. The filter papers are sampled for PM_{10} by weight and for PM_{10} manganese by acid digestion and Inductively Coupled Plasma Mass Spectrometry (ICPMS) analysis.

In addition to the HVAS monitors, GEMCO has a series of real time E-sampler monitors (Figure 9-3) which provide real time monitoring results and raise alerts for the operational teams to proactively assess dust emissions and respond accordingly. Further details on GEMCO's dust management activities are outlined within various supporting documents to the AEMP including PRO-3057 Dust Management Procedure – Mining, PRO-3059 Dust Management Procedure – Process and Logistics and PRO-3079 Smoke Management Procedure.

Monitoring and Measurement

During the FY20 reporting period, GEMCO undertook ambient air monitoring in accordance with its air monitoring program. This included HVAS monitoring units measuring both PM_{10} and manganese concentration across multiple size fractions on a 6-day frequency. Figure 5-1 provides a summary of the PM_{10} results for FY20 and Figure 5-2 and Figure 5-3 present the calculated Upper Confidence Limit (UCL) for a group of 12 months of data. The UCL for manganese concentration for each size fraction is presented and is used to infer the manganese concentration of PM_4 manganese results for the reporting FY20 period.

Figure 5-1: HVAS PM_{10} Monitoring Results for GEMCO Western Leases

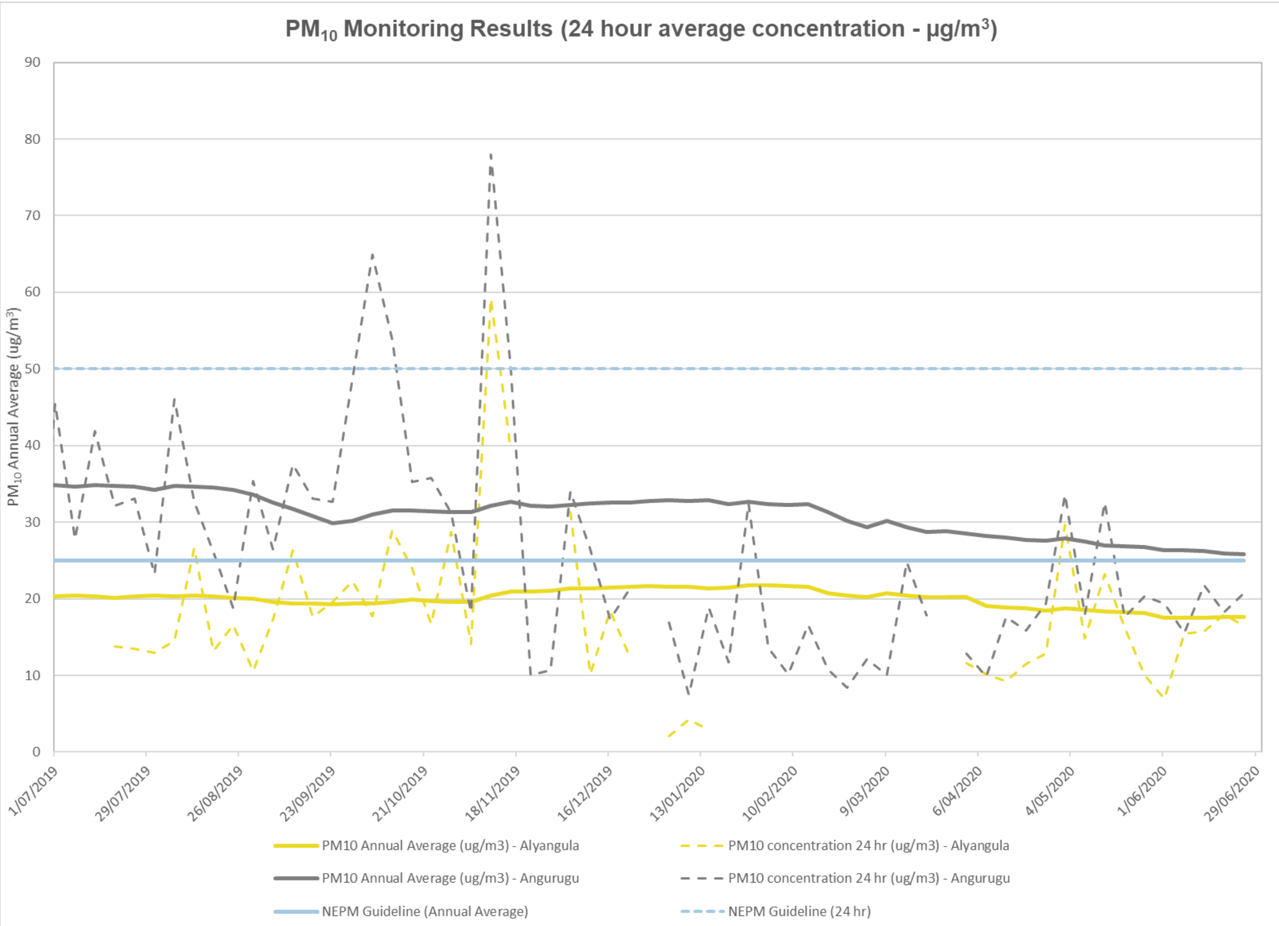


Figure 5-2: HVAS PM_4 Manganese Concentration Monitoring Results for Alyangula

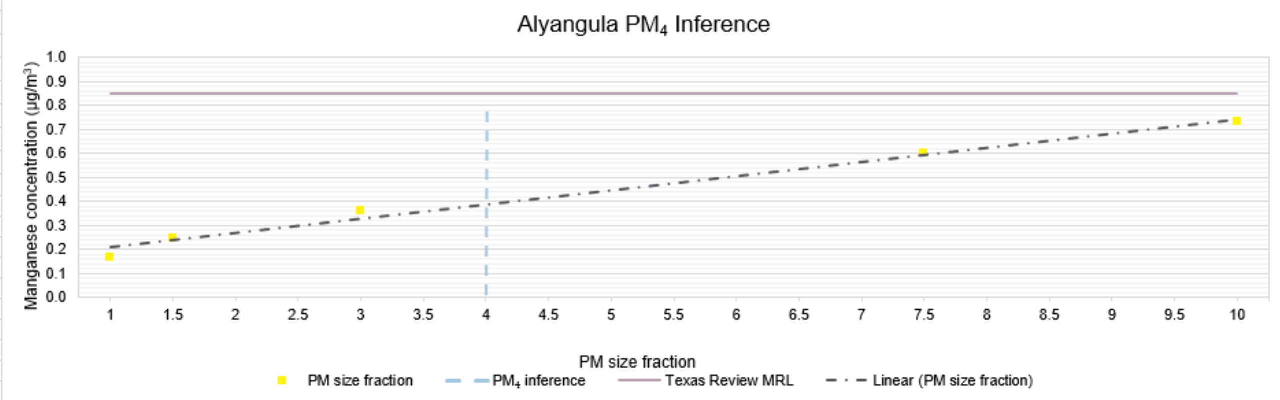
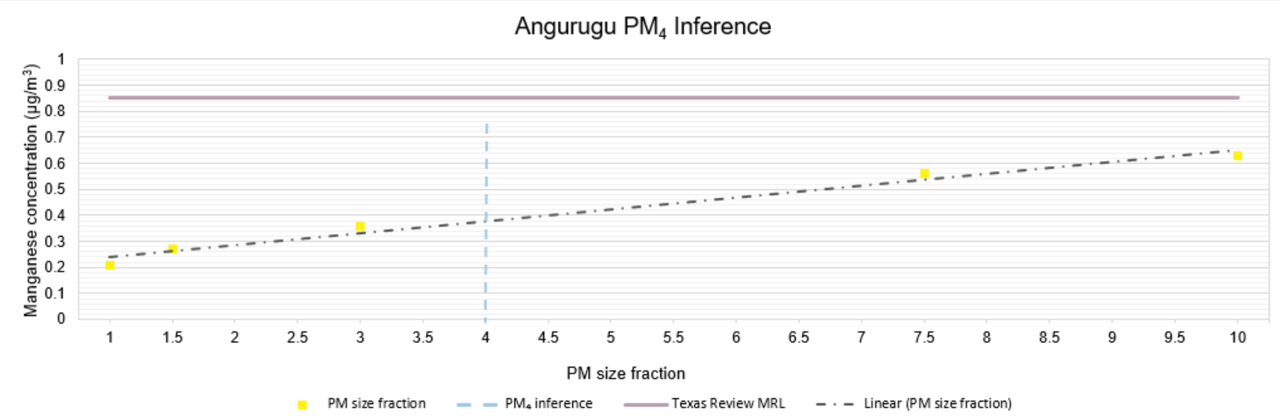


Figure 5-3: HVAS PM_4 Manganese Concentration Monitoring Results for Angurugu



Burning of native vegetation by local community members persists throughout the dry season predominantly affecting areas on the western side of Groote Eylandt. As a result of this activity, dust monitoring will often record high levels of PM_{10}. These results are considered outliers and are not recorded as a breach of the National Environment Protection Measures (1999) (NEPM guidelines) since these emissions are not sourced from mining activities.

Changes to Monitoring Programs

In FY21, GEMCO will commence the monitoring of PM_4 manganese directly rather than inferring PM_4 manganese from existing manganese fractions.

Effectiveness of Management and Mitigation Strategies

The AEMP is reviewed as required in line with GEMCO's controlled document process and in response to air emission monitoring results. The following section outlines improvements to GEMCO's dust control mechanisms identified for FY21.

Non-Conformance and Corrective Action

During the reporting period, there were five exceedances of the NEPM air quality guidelines (24-hour PM_{10}) as outlined in Table 5-12. One 24-hour PM_{10} exceedance was recorded at the Alyangula monitoring unit which coincided with one of the four 24-hour PM_{10} exceedances at the Angurugu monitoring unit. This event occurred on a day when the wind originated from an easterly direction. GEMCO does not have operational activities directly to the east of Alyangula or Angurugu and it was considered likely that a broader regional dust contribution resulted in this particular exceedance.

One of the four 24-hour PM_{10} exceedances at the Angurugu monitoring unit was related to weather events occurring when the wind originated from an easterly direction and there were active fires present to the east and north of Angurugu. GEMCO does not have operational activities to the east of Angurugu and it is suggested that broader regional dust contributions resulted in these exceedances.

Analysis of the remaining two 24-hour PM_{10} exceedances recorded at the Angurugu monitoring unit revealed that mining related activities were the likely source contributing to these events. As a result of these events, potential sources of dust from operations were investigated and a number of improvement measures have been implemented. These improvement measures include: 1) the formation of a Dust Working Group comprising key GEMCO personnel who are accountable for providing direction, support and oversight on the implementation of dust reduction projects; 2) the development of a dust Trigger Action Response Plan (TARP) which is linked to alerts from real time dust monitoring units located in Alyangula and Angurugu; 3) road pavement (bitumen) sealing of the Emerald River Road which surrounds the Angurugu community; and 4) pavement sheeting of the Concentrate Product Stockpiles (CPS). There were no subsequent 24-hour PM_{10} exceedances recorded at the Angurugu monitoring unit for the remainder of the reporting period.

The annual average PM_{10} at the Angurugu monitoring unit exceeded the NEPM air quality guidelines (annual average PM_{10}) for the reporting period as outlined in Table 5-12. GEMCO are currently progressing with a work program in response to this and have modified operations to reduce dust emissions to levels below FY19. In FY21, GEMCO will continue to implement changes and conduct trials to further enhance dust control mechanisms with the aim of reducing air emissions to meet NEPM guidelines.

As outlined in Table 5-13, the inferred annual average PM_4 manganese concentration at the Alyangula and Angurugu monitoring units was 0.39 µg/m^3 and 0.38 µg/m^3 respectively, which was below the TCEQ Chronic ReV of 0.84 µg/m^3.

Climatic conditions such as temperature inversions, intense moisture/humidity, smoke from fires and other non-mining activities can heavily influence the accuracy and increase the background levels of PM_{10} in the environment.

Table 5-12: NEPM PM_{10} Guideline Exceedances (FY20)

Monitor	PM_{10} 24 hr Exceedances	PM_{10} Annual Average Exceedances
Alyangula HVAS	1	0
Angurugu HVAS	4	1
Total	**5**	**1**

Table 5-13: PM_4 Manganese Concentration Monitoring Results

Monitor	PM_4 Mn TCEQ Chronic REV (µg/m^3)	PM_4 Mn Annual Average (µg/m^3)
Alyangula HVAS	0.84	0.39
Angurugu HVAS	0.84	0.38

5.7 Key Environmental Activities for the Oncoming Period

Key environmental activities for the oncoming planning period over and above activities considered business as usual have been described in Section 5.3.1.

6 WATER MANAGEMENT PLAN

GEMCO's water management plan (this section of the MMP) outlines how environmental and sustainability issues associated with surface water and groundwater are managed at GEMCO. The water management plan covers all surface and groundwater located both on the mine lease and in the receiving environments.

6.1 Current Conditions

GEMCO recognises that effective water management is important for sustainability of both the environment and the operation and is continually improving the processes and systems in place for collecting water accounting data. Water accounting is carried out in accordance with the Minerals Council of Australia User Guide, Water Accounting Framework for the Minerals Industry (2014). GEMCO's water balance flow diagram is provided in Figure 6-1.

GEMCO obtains water from four main sources:

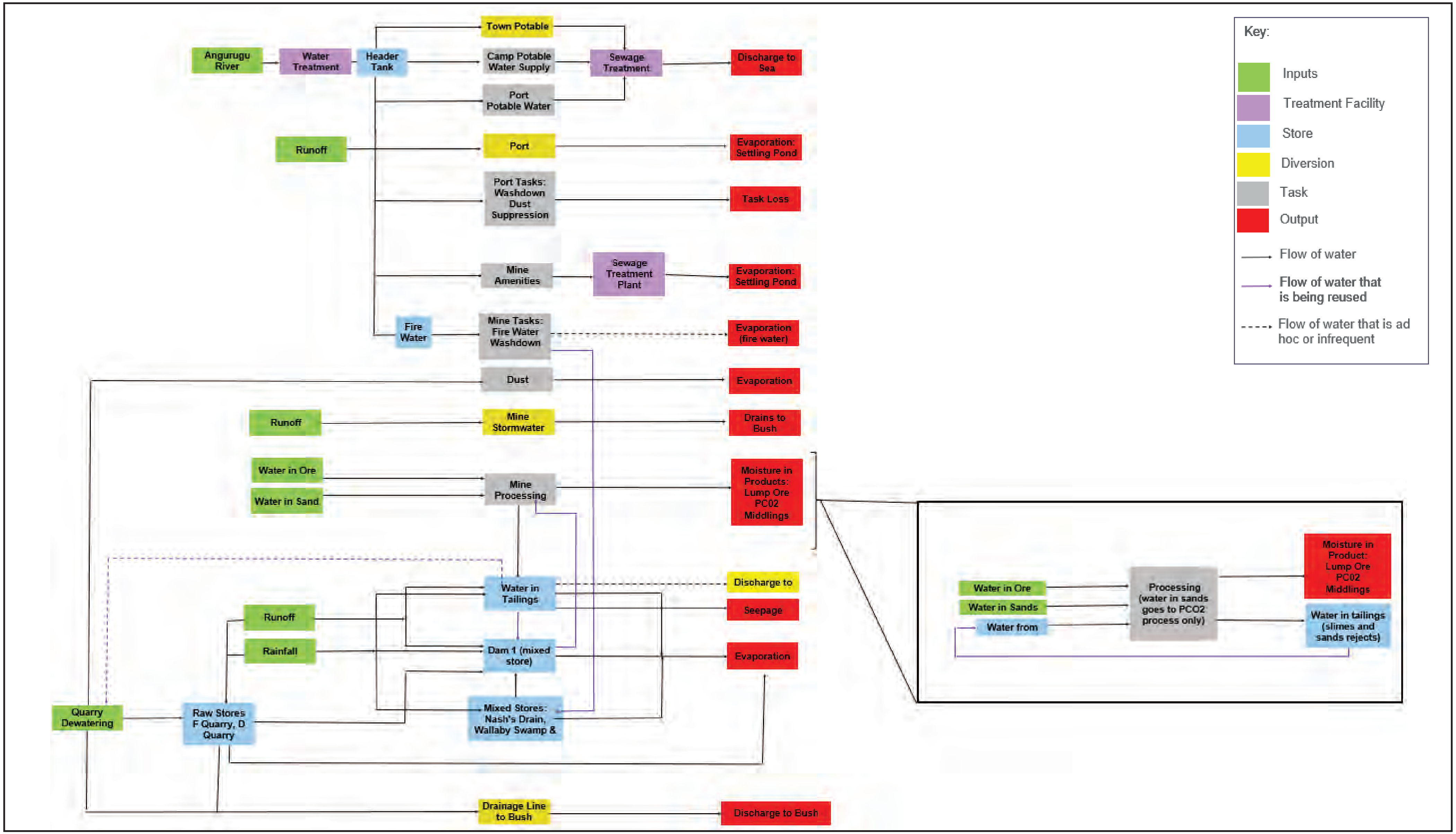
- Angurugu River: potable water for use at both the mine and Alyangula township;
- Quarries: groundwater and surface water runoff that collects in quarries for use in processing;
- Rainfall; and
- Rainfall runoff.

GEMCO is well placed to manage variability in rainfall and climatic conditions. Substantial storage capacity is available in the TSFs as well as within the various quarries. Total rainfall in FY20 was below the long-term average of 1,290 mm (Table 6-1).

Table 6-1: FY20 Total Rainfall

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
FY20 Rainfall (mm)(1)	0	0	0	50	92	19	99	230	151	87	23	0	**750**

Source: Bureau of Meteorology Climate Data Online (Station Number 014518)
(1) All values rounded to nearest whole number



SOUTH32 GEMCO Western Leases MMP

Figure 6-1
Water Balance Model

Date: August 2020	Author:	Plan No:
Scale:	Figure No: 6-1	Water Balance Model

6.1.1 *Surface Water*

6.1.1.1 *Surface Water Management Infrastructure*

A summary of the key surface water management infrastructure for GEMCO's operations is included in Table 6-2.

Table 6-2: Surface Water Management Infrastructure

Infrastructure	Description
Dam 1	Dam 1 is the process water dam that feeds the concentrator. It is fed from TSF11, TSF13, TSF16, TSF18, D North, B South and F3 water storage quarries and other stormwater catchment areas. Capacity of Dam 1 is 200 ML.
TSF11	Storage of slimes (current), capacity of 9.2 Mm^3.
TSF13	Storage of slimes (current) capacity of 14.2 Mm^3.
TSF18	Storage of sands (current), capacity of 3.5 Mm^3.
TSF16	Storage of sands (current), capacity of 4.8 Mm^3.
TSF15 (to be commissioned during FY21-FY24).	Storage of slimes (capacity of between 10.58 – 14.07 Mm^3)
TSF20 (to be commissioned during FY21-FY24)	Storage of sands (capacity of 5.625 Mm^3)
Angurugu River	Angurugu River runs between the northern and central quarries. A pump station is located at the town of Angurugu and is used to pump water to Alyangula and the mine site.
Chemical treatment facility	A new water treatment plant was commissioned in FY20. The plant treats water abstracted from the Angurugu River for potable water use in the Alyangula township and the mine. pH is adjusted, and chlorination occurs at the treatment plant. An additional chlorination plant exists at the water storage tanks in Alyangula.
Open channels	Nash's Drain is the main open channel and receives water from active quarries, as well as surface runoff from the concentrator via other settling ponds. Water is returned to Dam 1. Various other open channels exist around the quarries and are used to prevent stormwater from entering the quarries or to direct water to bushland.
Evaporation basins	TSF5, TSF6 and TSF7 are decommissioned tailings storage facilities and are used as additional water storage facilities and evaporation pans when required (pending rehabilitation closure project as described in section 4.4.2.4).
Sediment basins	Several sediment basins exist to improve the quality of stormwater runoff into the Angurugu River.
Waste treatment facility	Mine site sewage is piped to a sewage plant located south of the mining offices and released into a small containment dam where it biodegrades naturally. No licence is required for this discharge however groundwater monitoring bores were installed within the vicinity of this plant in 2010 to allow for monitoring of any potential impact to groundwater. A new sewage treatment plant was commissioned in August 2020 for the township of Alyangula. The plant is located adjacent to the Milner Bay Port Facility with treated effluent discharged into Milner Bay. Monthly monitoring is carried out on the treated effluent and in the receiving water body.
Tank storage	A potable water storage tank (header tank) is situated at the concentrator. Five potable water storage tanks are located at Alyangula.

Infrastructure	Description
Pumps	GEMCO has approximately 80 pumps of varying capacity that are used to transfer water across the operation.
Pipelines	The main pipelines on the mine site are for potable water and sewage. Numerous smaller pipelines exist within the concentrator. Portable pipelines are used to move water between quarries, storage areas and the concentrator.
Flow meters	GEMCO has 13 mobile flow meters that are utilised to measure pumping volumes around the various dams and quarries. These are on mobile skids which can be moved depending on dewatering activities.

6.1.1.2 *Alyangula Township*

Potable water for Alyangula and the mine site is sourced from the Angurugu River. A new water treatment facility was commissioned at the mine site during FY20 which adjusts the pH and chlorinates the water for potable use. This treatment plant also supplies potable water to the small communities of Malkala and Bartalumba Bay.

An additional treatment facility is located at the water storage tanks in Alyangula which provides secondary treatment if required. The township pipeline also supplies the port and power station. Potable water is used for all domestic purposes as well as irrigation of parks and the golf course.

In FY20, GEMCO was required to apply to DEPWS for a water abstraction licence following the introduction of the *Water Legislation Amendment Bill 2018*. This licence was granted on 23 October 2020.

6.1.1.3 *Port Facility and Milner Bay*

The port uses potable water from the Angurugu River for human consumption, dust suppression and for washing vehicles and equipment.

Surface water runoff from the port is managed by collection sumps and is pumped to a settling dam at the southern extent of the port. This system is designed to avoid sediment laden runoff from the area entering Milner Bay.

6.1.1.4 *Mining Areas*

In areas of the mining lease that are undisturbed, surface water follows the natural topography in a general east to west direction towards the coast. The exception to this occurs within the localised catchment areas which report directly to the Angurugu and Emerald Rivers. Water quality monitoring of the Angurugu and Emerald Rivers is conducted monthly.

Around active quarries, diversion drains are often established to limit the volume of water that enters these quarries. Excess water in quarries is either transferred to storages or discharged into nearby bushland.

6.1.1.5 *Mine Administration and Processing*

The mine administration areas use potable water from the Angurugu River for human consumption and at the equipment wash-down bay. The concentrator and other processing infrastructure uses water from a number of sources. Return water from the tailings dams provide the majority of water required by the processing circuit. Water added to the processing circuit via Dam 1 is sourced primarily from dewatered quarries. The service water, dust suppression and fire water systems are fed from a combination of return water and Angurugu River water.

Surface water runoff around the administration and processing areas follows a drainage system that connects to contained storage at the western side of the concentrator area into facilities called Wallaby Swamp and Nash's Drain. These facilities are setup with pumping infrastructure to transfer this water to the processing circuit via Dam 1.

Effluent from the mine site is piped to the rehabilitation plant and released into a containment dam for natural biodegradation. No licence is required for this facility. Groundwater monitoring bores were installed within the vicinity of this plant in 2010 to allow for monitoring of any potential impact to groundwater from the facility's operation.

6.1.1.6 *Wet Season Water Management*

GEMCO manages water volumes in storage facilities in accordance its risk management framework.

During the wet season, excess water contained in either quarries or TSFs may be transferred between other storage facilities to lessen the requirement for discharge to bushland. If water transfer between storage facilities is not an available option, quarry or TSF water may be discharged to bushland. In the event that discharge of TSF water to bushland is required, water quality analysis will be undertaken to ensure minimal environmental impact. Section 6.4.2 provides details on the water quality criteria used for this analysis.

Sampling is carried out on a regular basis during any managed discharge periods and the activity is reviewed on a monthly basis while water discharges may be occurring. Necessary corrective actions are implemented to ensure that discharged water is not directly released to waterways.

6.1.1.7 *Water Supply for Life of Mine*

Water supply options for the life of the GEMCO operation include abstraction from the Angurugu River, use of dewatered quarry water and recycled TSF decant water.

The main supply risk for the operation is the inability to abstract water from the Angurugu River which may be prompted by a legislative requirement, or limited recharge of the aquifer that feeds Angurugu River due to low rainfall or stakeholder demands. If this were to occur, the volume required would be sourced from dewatered quarry water or abstracted bore water. The risk of not being able to utilise dewatered quarry water or TSF decant water is currently considered low. GEMCO has improved the design of quarry dewatering networks over recent years to allow for improved transfer of quarry water from the northern and southern extents of the mine (e.g. F3 and DN quarry return lines back to Dam 1).

GEMCO continues to review and identify improvement opportunities associated with its water balance, including the monthly consumption of water, to ensure the long-term sustainable supply of water for the life of the operation.

6.1.2 *Groundwater*

6.1.2.1 *Groundwater Management Infrastructure*

A summary of groundwater management infrastructure is included in Table 6-3.

Table 6-3: Groundwater Management Infrastructure

Infrastructure	Description
Mine site monitoring bores	Numerous groundwater monitoring bores are located around the mine site to assess groundwater quality and groundwater levels. Data recorded from these monitoring bores is used for the development of groundwater models where required.
TSF monitoring bores	A number of groundwater monitoring bores are located around the GEMCO TSFs to assess potential seepage issues associated with the facilities.
Wet tip monitoring bores	Groundwater monitoring bores located at the wet tip are used for detecting potential contaminated leachate.
Dry tip monitoring bores	Groundwater monitoring bores located at the dry tip are used for detecting potential contaminated leachate.
Milner Bay Dissolved Phase Hydrocarbons (DPH) monitoring bores	Continually reviewing environmental risk and assessing ongoing legacy issues associated with the historic release of hydrocarbons at the Milner Bay port facility.
Milner Bay poly membrane	Following the discovery of leaked hydrocarbons, a poly membrane was installed at Milner Bay to prevent the migration of Phase Separated Hydrocarbons (PSH) into Milner Bay.

6.1.2.2 *Port Facility*

Groundwater monitoring bores have been installed and are periodically monitored at the port facility. The port groundwater monitoring program is described in detail within section 6.4.4.4, with the interpretation of water quality provided in section 6.5.6.

A High-Density Polyethylene (HDPE) membrane, installed to stem the movement of a historic below ground hydrocarbon release, is also located at the port. The non-aqueous phase liquid in the vicinity of the port loading facility is physically isolated from the marine environment. Actions to remove and remediate the area occurred in FY20 and are planned to continue throughout FY21.

6.1.2.3 *Mining and Tailings Areas*

Groundwater is intercepted in the majority of quarries across the mine site. However, the volume of water which is directly contributed to groundwater recharge typically varies depending on the quarry location and seasonal conditions. Critical to the mine planning process, is the method in which active mining areas will be dewatered. If the volume of groundwater inflows are expected to be high, mine water will be transferred to designated storage areas for later use in processing. If the inflow volumes are expected to be low, infrastructure may be setup to dewater to nearby bushland.

Groundwater monitoring bores have been installed across the GEMCO leases and are periodically monitored. Groundwater monitoring bores have been specifically installed around the TSFs and the wet and dry tips.

6.1.2.4 *Groundwater Modelling*

GEMCO has recently undertaken a Numerical Groundwater Modelling project to improve water management planning. Changing to a quarry water management approach guided by modelling predictions will allow GEMCO to plan infrastructure requirements, justify alternative quarry water management strategies and follow the mining plan with reduced restrictions from water. The numerical groundwater model characterises groundwater volumes to be removed from quarries and subsequently allows for infrastructure and water balance planning. The numerical model also predicts the influence of mine dewatering activities on the groundwater regime, identifying locations for further investigations in order to ensure sensitive receptors are not adversely impacted.

6.2 Information/Knowledge Gaps

No material information / knowledge gaps exist for the GEMCO Water Management Plan.

6.2.1 *Water Accounting*

The water categories that GEMCO currently reports on (in accordance with the Water Accounting Framework) have been provided in Table 6-4. Monthly flow volumes are collected using flow meters where possible (some estimates are also used).

Table 6-4: Water Accounting Framework Categories

Inputs	Flows Captured in Category
Type 1 Surface water	Rainfall into Dam 1, TSF11, TSF13, TSF16, TSF18, Quarry F3, Quarry DN, Wallaby Swamp and Nash's Drain.
Type 1 Groundwater	Water entrained in ore; quarry dewatering (for dust suppression and to supplement Nash's Drain, Dam 1 and Wallaby Swamp).
Type 2 Surface water	Rainfall runoff to Quarry F3, Quarry DN, Nash’s Drain, and TSF16; water abstracted from Angurugu River.
Type 2 Groundwater	Water entrained in ore and sands feed to PC02; quarry dewatering (for dust suppression and to supplement Nash's Drain, Dam 1 and Wallaby Swamp).
Outputs	Flows Captured in Category
Type 1 Other	Surface water evaporation (from quarries, dams, swamps etc.) plus task loss (water used for amenities and dust suppression).
Type 3 Groundwater	Seepage from tailings dams.
Type 2 Other	Entrainment in process outputs: middlings, final product, PC02 product.
Type 3 Other	Concentrator losses and port washdown water.
Type 3 Sea water	Water discharged to sea from port facility and sewage treatment plant.

6.2.1.1 *Water Account for FY20*

The quarterly breakdown of GEMCO’s reported water accounting figures are provided in Table 6-5.

Table 6-5: GEMCO Water Accounting Figures (FY20)

Description	Unit	FY2020 Q1	FY2020 Q2	FY2020 Q3	FY2020 Q4	FY20
Water Input (Type 1): Surface Water	Mega-litres	4.12	1,104.76	3,500.39	909.74	5,519.01
Water Input (Type 1): Groundwater	Mega-litres	2,480.76	2,363.07	1,413.76	1,602.35	7,859.94
Water Input (Type 2): Surface Water	Mega-litres	359.42	549.33	859.56	279.34	2,047.65
Water Input (Type 2): Groundwater	Mega-litres	359.93	379.81	375.05	378.88	1,493.67
Water Output (Type 1): Other	Mega-litres	4,027.12	4,698.74	3,182.96	3,615.37	15,524.20
Water Output (Type 2): Other	Mega-litres	85.91	94.87	85.30	86.82	352.90
Water Output (Type 3): Groundwater	Mega-litres	55.82	55.82	58.71	64.50	234.84
Water Output (Type 3): Sea Water	Mega-litres	71.24	65.98	56.09	52.86	246.17
Water Output (Type 3): Other	Mega-litres	1,010.01	959.67	672.59	661.89	3,304.16

6.3 Risk Management

6.3.1 *Identify Hazards and Rank Risks*

GEMCO's risk assessment framework is outlined in Section 5.6.1 and Section 5.6.2.

The GEMCO Environment Department are included in project and operational risk reviews where relevant to ensure all environmental risks related to water are considered. A summary of GEMCO's key risks related to water have been provided in Table 6-6. These risks are described within the Operational Risk Register of the respective Department.

Table 6-6 GEMCO's Key Risks Related to Water

Risk			Controls	
Risk Event	**Department**	**Direct Causes**	**Preventative**	**Mitigating**
Seepage of hydrocarbon from historical contamination event (Milner Bay)	Environment	Historic contamination event	High Density Polyethylene (HDPE) Barrier Milner Bay DPH monitoring program	Milner Bay DPH monitoring program
Groundwater contamination at Heavy Vehicle Fuel Pad (HVFP)	Mining	Historic contamination event	Oil water separator at HVFP Concrete pad at HVFP	Groundwater monitoring at HVFP
Contamination of groundwater from TSF seepage	Concentrator	Seepage of elevated concentrations of metals from TSF	Tailings dam management Solute transport modelling	Groundwater monitoring around TSFs Surface water monitoring of Angurugu River
Surface water run off at Port	Port	Heavy rain event combined with inadequate storm water infrastructure	Sediment basins Port stormwater pumping system Environment Awareness Programme	Sampling of a surface water run off event
Surface water run off at Mine Site	Road Haulage, Mining	Heavy rain event combined with inadequate storm water infrastructure	Mine site stormwater management infrastructure	River monitoring
Marine oil spill	Port	Loss of fuel during re-fuelling or from fuel infrastructure	Re-fuelling procedures Qualified contractor Infrastructure inspections/maintenance work orders	Oil spill response training Oil spill response procedure
Release of contaminated water (i.e. through pit dewatering)	Mining	Poor water management	Prioritise use of smectite water through concentrator Contaminated water not discharged Mine site water balance Water management planning	Sampling of discharge event

6.3.2 *Actions and Strategies in Response to Identified Risks*

GEMCO will continue to undertake water management and monitoring activities in the upcoming period as detailed within this Water Management Plan.

6.4 Water Monitoring Programs

6.4.1 *Surface Water Monitoring*

The natural surface water monitoring program involves the collection of both in-situ field readings and water samples at numerous locations along the Angurugu and Emerald Rivers (Figure 9-4). The program consists of monitoring sites situated both upstream (reference monitoring sites) and downstream (impact monitoring sites) of mining activities. Data collected from the downstream monitoring sites are analysed for various parameters against ANZG (2018) default guideline values (where available) using a 95% level of protection for aquatic ecosystems. The monitoring program is summarised in Table 6-7. The relevant analyte default guideline values for surface water are detailed in Table 6-8.

Abstraction from the Angurugu River is recorded as part of the monthly water accounting and water levels are measured weekly. GEMCO monitors abstraction volumes against the water abstraction licence (9291005) granted by DEPWS on 23 October 2020 pursuant to section 45 of the *Water Act 1992* (NT).

Table 6-7: River Monitoring Program

Location	Monitoring Parameters	Frequency
Angurugu River: AMP1, AMP2, AMP3, AMP4, AMP5, AMP6, AMP7	Temperature, pH, DO, EC, ORP, Turbidity, TSS Total and dissolved metals / metalloids: Al, Ba, Mn, Zn, Fe Major Anions: Cl, SO4 Alkalinity Major Cations: Ca, Mg, Na, K	1M
Emerald River: EMP1, EMP2, EMP3		
Pumping station	Flow meter reading	1M
Gauging station	River level reading	1W

Table 6-8: Surface Water Trigger Values

Analyte	Water Quality Trigger Value (µg/L)	
	Estuarine Environments	Freshwater Environments[1]
Site Code	AMP1, AMP2, AMP3, EMP3	AMP4, AMP5, AMP6, AMP7, EMP1, EMP2
Dissolved Aluminium	N/A[2]	55
Dissolved Manganese	390[3]	1,900
Dissolved Zinc	15	8

(1) Triggers values are only applicable to monitoring sites downstream of mining activities (impact monitoring sites).
(2) FY20 monitoring used a trigger value of 0.5 ug/L for Aluminium (based on the "low reliability" marine trigger value stated by ANZG 2018) however no trigger value will be applied for the FY21 – FY24 MMP term as there is currently no toxicant default guideline values for Aluminium in estuarine environments.
(3) A trigger value of 390 µg/L is applied to estuarine reaches of the Angurugu and Emerald Rivers as advised by the NT EPA (previously NT NRETAS). The ANZECC Steering Committee have approved revised/unpublished, moderate to high reliability trigger values for manganese in marine waters.

6.4.2 *Discharge Monitoring Program*

During FY20, GEMCO submitted an MMP amendment to seek authorisation for the release of dewatered quarry and TSF water beyond GEMCO's lease boundary. This was authorised by DITT on 7 February 2020. To manage the water quality from these discharge activities and fulfil the commitments within the MMP amendment, GEMCO will undertake monitoring at the locations shown in Figure 9-5 using the water quality criteria provided in Table 6-9. Discharge will be carried out where water quality is demonstrated to be below the defined trigger values. If particular analytes are exceeded, water will be contained until it can be demonstrated that the water quality meets these trigger values. GEMCO will continue to undertake monthly sampling, while pumping, to ensure the activities pose minimal risk to the environment.

In addition to commitments made within the MMP amendment, GEMCO obtained endorsement from the ALC for the proposed dewatering activities with the following conditions:

- ALC and Traditional Owners are to be notified seven days in advance of any discharge occurring and the proposed location(s);
- All discharge water must visually appear clean with minimal visual turbidity;
- The ALC is to be provided with laboratory results confirming the water quality is suitable for discharge; and
- Discharges off lease are not to occur between the months of July and October. Note, this condition has been modified for 2021, allowing discharge to the end of August if the mine water balance remains in surplus (subject to ALC review and approval each month).

GEMCO will present the data from this monitoring program, including the interpretation of results against the defined trigger values, to DITT and the ALC in the annual Environmental Mining Report.

Table 6-9: Water Quality Trigger Values for Discharge Monitoring Program

Analyte	Trigger Value (µg/L)	Sample Point	Sampling Frequency
Dissolved Aluminium	630	AS Quarry ASE Quarry BSC Quarry BSE Quarry DE Quarry DN Quarry DNE Quarry DS Quarry DSE Quarry DSS Quarry DSW Quarry ES Quarry F3 Quarry F3N Quarry G Quarry W1 Quarry WW1 Quarry W2 Quarry W4 Quarry TSF11 TSF13 TSF15 TSF16 / 20 TSF18	Prior to discharge off lease to confirm conformance to trigger value and then monthly while pumping
Dissolved Barium	20		
Dissolved Manganese	1,900		
Dissolved Iron	1,550		
Dissolved Zinc	110		
Total Recoverable Hydrocarbons (>C10 - C40 Fraction (sum))	0		

6.4.3 *Artificial Surface Water Monitoring*

GEMCO conducts water monitoring at artificial surface water locations at the mine site and the port (Figure 9-6). Details of the respective monitoring programs are detailed in Table 6-10, Table 6-11 and Table 6-12.

Table 6-10: Artificial Surface Water Monitoring - Mine

<table>
<tr><th>Site Codes</th><th>Location Descriptions</th><th>Monitoring Parameters</th><th>Frequency</th></tr>
<tr><td>RMS21</td><td>Nash’s Drain</td><td rowspan="3">TPH (C6 – C36), BTEX
Total and dissolved metals/metalloids: Al, Ba, Mn, Zn, Fe
Major Anions: Cl, SO_4, Alkalinity
Major Cations: Ca, Mg, Na, K
TSS</td><td rowspan="3">6M</td></tr>
<tr><td>RMS23</td><td>Dam 1</td></tr>
<tr><td>RMS35</td><td>Mine site wash pad discharge</td></tr>
<tr><td>RMS102</td><td rowspan="2">Mine site coalescent plate at tank</td><td rowspan="2">TPH (C6 – C36), BTEX</td><td rowspan="2">12M (after heavy rainfall)</td></tr>
<tr><td>RMS103</td></tr>
</table>

Table 6-11: Artificial Surface Water Monitoring – Port

Site Codes	Location Descriptions	Monitoring Parameters	Frequency
RMS37	Milner Bay coalescent plate separator at power station	TPH (C6 – C36), BTEX	12M (after heavy rainfall)
RMS104	Milner Bay coalescent plate separator at eastern tank	TPH (C6 – C36), BTEX	12M (after heavy rainfall)

Table 6-12: Artificial Surface Water Trigger Values

Analyte	Water Quality Trigger Value (µg/L)
Aluminium	55
Manganese	1,900
Zinc	8
Benzene	950
TPH	600
Toluene	180
Ethyl benzene	80
Metaxylene	75
Paraxylene	200
Orthoexylene	350

6.4.4 *Groundwater Monitoring Programs*

GEMCO undertakes groundwater monitoring at locations up and down the hydraulic gradient around the mine site, TSFs, wet tip, dry tip and the port.

The objectives of the groundwater monitoring program are to:

1. Monitor groundwater levels around the mine site to support dewatering and seepage studies;
2. Monitor for potential hydrocarbons in groundwater from bulk fuel storage facilities;
3. Monitor for potential seepage issues at the TSFs;
4. Detect potential contaminated leachate from the landfills; and
5. Continually review the environmental risk and assess ongoing legacy issues associated with the

historic release of hydrocarbons at the Milner Bay port facility by:

- Monitoring for phase-separated hydrocarbons (PSH) to ensure the integrity of the poly membrane is intact;
- Monitoring dissolved petroleum hydrocarbons (DPH) concentrations to determine any increasing trends in the concentrations of DPH in bores historically effected by DPH;
- Monitoring the number of bores effected by DPH to ensure there is not an increase in the number of bores effected by DPH; and
- Ensuring the protection of the marine environment by applying a trigger value at the most seaward monitoring wells (PF0600A, PF0600B, PF0600C and PF0600D).

Where relevant, water quality data are compared against the Australian & New Zealand Guidelines (formerly ANZECC, 2000) for slightly to moderately disturbed (95% species protection) freshwater and marine water ecosystems (ANZG, 2018).

Groundwater monitoring is also undertaken at a series of control sites, which are used as a comparison to locations potentially impacted by the mining operations, such as the TSFs.

6.4.4.1 *Mine Groundwater*

A network of 34 groundwater monitoring bores are strategically located around the mine footprint to monitor changes in groundwater levels and quality. Monitoring is undertaken on a quarterly to biannual basis (Figure 9-7). Bores MW7658 and DQMW4 will be removed from the monitoring network during the planning period due to the progression of mining.

The network can be divided into three smaller networks, which target auxiliary activities associated with GEMCO's operations. A summary of the monitoring program is presented in Table 6-13.

Table 6-13: Groundwater Monitoring Program – Mine Site

Monitoring Bores	Monitoring Parameters	Frequency	Trigger Values
Mining Areas			
MW7658, MW7660, MW7661, MW7666, MW8574, MW8575, MW8576, MW8632, MW8633, FCMW3	Depth to water	Biannual	N/A
FCMW4, FCMW5, FCMW6, FCMW1B, MW8567, MW8569, DQMW3, DQMW4	Depth to water Total and dissolved metals / metalloids: Al, Ba, Mn, Zn, Fe Major Anions: Cl, SO_4 Alkalinity Major Cations: Ca, Mg, Na, K Total hardness	Biannual	Al (pH>6.5) – 55 µg/L Mn – 1900 µg/L Zn – 8 µg/L
Sewage Ponds			
SPMW1, SPMW2, SPMW3	Depth to water Total and dissolved metals / metalloids: Al, Ba, Mn, Zn, Fe Major Anions: Cl, SO_4, Alkalinity Major Cations: Ca, Mg, Na, K Total hardness, Ammonia as N, nitrate as N, reactive phosphorus, methane, *E.Coli*	Biannual	N/A
Refuelling Stations			
NFMW1, NFMW2, NFMW3, NFMW4, NFMW5, FP6, FP8, FP11	TPH (C_6 – C_{36}), BTEX	Quarterly	Benzene – 950 µg/L Toluene – 180 µg/L Ethylbenzene – 80 µg/L o-Xylene – 350 µg/L m-Xylene – 75 µg/L p-Xylene – 200 µg/L TPH – 600 µg/L[1]

(1) ANZG (2018) criteria for lethal concentration 50 (LC50) in molluscs.

6.4.4.2 *Disposal Facilities*

A network of 12 groundwater monitoring bores are strategically located around the dry tip (DTMW1, DTMW2, DTMW3A and DTMW3B) and wet tip (WT002A, WT007, WT009, WT011A, WT012, WT015, WT025, WT029) (Figure 9-9 and Figure 9-10). Bores associated with the wet tip are monitored in accordance with EPL289. A summary of the monitoring program is presented in Table 6-14. Bore WT029 will be removed from the monitoring program during the planning period due to the progression of mining.

Table 6-14: Groundwater Monitoring Program – Disposal Facilities

Monitoring Bores	Monitoring Parameters	Frequency	Trigger Values
Wet Tip Disposal Facility			
WT002A, WT007, WT009, WT011A, WT012, WT015, WT025, WT029	Depth to groundwater pH, DO% Dissolved metals / metalloids: Mn, Zn, Fe, Ni, Pb Chloride Major Cations: K TDS, COD, Ammonium, Total Phosphorus, Total Organic Nitrogen, *E.Coli, Enterocoocci*	Quarterly	NA
Dry Tip Disposal Facility			
DTMW1, DTMW2, DTMW3A, DTMW3B	Total and dissolved metals / metalloids: Al, Ba, Mn, Zn, Fe Major Anions: Cl, SO_4, Alkalinity Major Cations: Ca, Mg, Na, K TDS, COD, Ammonium	Annually	NA

6.4.4.3 *Tailings Storage Facilities*

GEMCO maintains a network of 65 groundwater bores around the active and decommissioned tailings storage facilities to monitor changes in groundwater levels and quality on a biannual to annual basis (Figure 9-8). The TSFs are unlined and are formed against the Upper and Middle aquifers around the embankments and backfill material that directly overlie the Lower Aquifer across the base. A summary of the monitoring program is presented in Table 6-15.

A number of bores will be removed from the monitoring network during the planning period including:

- MW8613 and MW8614 due to the progression of mining;
- MW8640, MW8641, MW8642, MW8643, MW8644, MW8645, MW8646, MW8647, MW8648, MW8649 due to the construction of TSF20;
- MW8634S and MW8634D due to the installation of a dewatering channel; and
- MW8629 due to a bent casing.

The existing network of bores plus the installation of bores associated with the construction of new tailings facilities will continue to ensure that groundwater quality is properly monitored and managed.

Table 6-15: Groundwater Monitoring Program - Tailings

Monitoring Bores	Monitoring Parameters	Frequency	Trigger Values
Decommissioned Tailings Areas			
TDMW1, TDMW2, TDMW7, TDMW8, TDMW9, TDMW10, MW8582	Depth to water Total and dissolved metals / metalloids: Al, Ba, Mn, Zn, Fe Major Anions: Cl, SO_4, Alkalinity Major Cations: Ca, Mg, Na, K Total hardness	Annually	N/A
Active Tailings Areas			
TSF 11 MW8612, MW8613, MW8614, MW8615, MW8616, MW8617, MW8618, MW8619, MW8620, MW8621, MW8622, MW8623, MW8624, MW8627, MW8628, MW8629, MW8630, MW8634, MW8635, MW8636 ***TSF 13*** MW8650, MW8651, MW8652, MW8653, MW8654, MW8655, MW8657, MW8658, MW8659, MW8660 ***TSF14/18 / TSF16/20*** MW8593, MW8594 MW8595, MW8596, MW8597, MW8598, MW8599, MW8600, MW8601, MW8602, MW8603, MW8604, MW8605, MW8606, MW8607, MW8608, MW8609, MW8610, MW8640, MW8641, MW8642, MW8643, MW8644, MW8645, MW8646, MW8647, MW8648, MW8649	Depth to water Total and dissolved: Al, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Ni, Pb, V, Zn, Fe, U (total & dissolved) Major cations: Ca, Mg, Na, K. Major anions: chloride, sulphate & alkalinity (including carbonate, bicarbonate & hydroxide) Total Hardness	Biannual	Guidelines have been developed for upcoming period as detailed in Section 6.5.5.4(i).

6.4.4.4 *Port Facility and Milner Bay*

Groundwater monitoring occurs at the port facility to enable regular review of the environmental risk associated with a historic subsurface hydrocarbon release (Figure 9-11). Details of the monitoring program are outlined in Table 6-16.

Table 6-16: Groundwater Monitoring Program – Port

Monitoring Bores	Monitoring Parameters	Frequency	Trigger Value
PF0202, PF0259, PF0441A, PF0441D, PF0443, PF0614D, MBGW1, MBGW2, PF0406A, PF0406C, PF0432, PF0433, PF0600A, PF0600B, PF0600C, PF0600D, PF0601, PF0602, PF0652A, PF0652B, PF0653A, PF0653B, PF0653D, PF0900A, PF0900B, PF0901A, PF0901B, PF0903A, PF0903B	TPH (C6 – C36), BTEX	3M	500 µg/L[1] of Benzene and 80 µg/L[2] of ethylbenzene applied to PF0600A, PF0600B, PF0600C, PF0600D

(1) Trigger value for Benzene of 500 µg/L was derived by MEAG (which is consistent with ANZECC 2000) and is only applied to PF0600A, PF0600B, PF0600C and PF0600D as recommended by MEAG
(2) Default guideline from ANZG (2018).

6.4.5 *Sewage Monitoring Program*

Sewage effluent and mixing zone monitoring is undertaken in accordance with the conditions of the former Waste Discharge Licence WDL 163-01 and site-based protocols outlined in SWI-21577 Sewage Effluent and Plume Monitoring. Monitoring details are included in Table 6-17 and sampling locations are provided in Figure 9-12.

Table 6-17: Sewage Monitoring Program

Monitoring Site	Frequency	Monitoring Parameters	Trigger Value
RMS57 WDL67BC, WDL67B1, WDL67B2, WDL67B3, WPT021[2]	Monthly/ Neap Tide	pH	6-8.5
		Temp	N/A
		Turbidity	10 NTU
		TSS	10 mg/L
		DO	N/A
		BOD	N/A
		EC	N/A
		ORP	N/A
		Major cations Ca, Mg, Na, K	N/A
		Major anions Cl, SO_4, total alkalinity, hydroxide alkalinity	N/A
		Chlorophyll-a	<1 mg/m
		Total phosphorus	0.015-0.020 mg/L
		Filterable reactive phosphorus	0.008 mg/L
		Free ammonia	1 – 10 µg/L
		Nitrate and nitrite	10 µg/L
		Total nitrogen	0.1 mg/L
		TKN	
		Total suspended solids	10 mg/L
		TPH (C6-C36)	600 µg/L

Monitoring Site	Frequency	Monitoring Parameters	Trigger Value
		BTEX	
		Zinc (dissolved)	0.015 mg/L
		Copper (dissolved)	0.0013 mg/L
		Manganese (dissolved)[1]	140 µg/L
		Faecal Coliforms	
		Enterococci sp.	200 cfu/100 ml

(1) Trigger value of 140 µg/L is not published in ANZECC (2000) however was approved by the ANZECC Steering Committee for marine waters where corals are present.
(2) WPT021 is sampled quarterly only. NOTE: Trigger values are only applied to the area outside of the declared mixing zone (i.e. WDL67B3 and WPT021)

6.4.6 *Marine Monitoring Program*

During 2011, GEMCO engaged the Australian Institute of Marine Science (AIMS) to conduct the Milner Bay Project: Marine Environmental Survey (Trott 2012, referred to in GEMCO documents as AIMS, 2013). The full report from this project was provided in the 2013 GEMCO Water Management Plan. The AIMS project reviewed previous marine monitoring undertaken on behalf of GEMCO and conducted a comprehensive marine environmental survey within Milner Bay and designated control areas away from GEMCO operations. The work conducted by AIMS also included a review and assessment of the previously developed human health risk assessment relating to the consumption of seafood residing within Milner Bay. The key outcome of the AIMS project was the design of a practical marine environmental monitoring program (MEMP) that GEMCO could implement on a routine basis to ensure the effects of operations remained within acceptable parameters. The AIMS designed program detailed the monitoring of a comprehensive suite of metal, hydrocarbon and nutrient analytes within water, sediment and biota which, when compared to recommended trigger values, would act as an early warning mechanism of potential contamination.

Since that time, GEMCO have undertaken annual sampling of marine waters and sediments utilising the sampling methodology, locations and trigger values outlined by AIMS (2013), with a summary of results provided within the applicable annual OPR. As recommended by AIMS (2013), determination of the concentrations of a comprehensive suite of analytes within oysters (Saccostrea sp.) and two species of fish Stripey Snapper (Lutjanus carponotatus) and Tusk fish (Choerodon schoenleinii) is undertaken every second year. These species were originally selected due to the fact that samples were relatively easy to locate and collect; samples for comparison could be attained away from GEMCO operations; oysters are sessile or, in the case of Stripey Snapper and Tusk Fish, are considered to have limited geographic home ranges, meaning analyte concentrations should reflect the effects of local environmental conditions. Furthermore, within the Milner Bay Port area, these species are considered to be food items collected by fishers and therefore could be used as indicator species to indicate the risk to human health should seafood be consumed from the Milner Bay port area. The location of MEMP sample sites and sample type collected is provided within Table 6-18 and Figure 9-13 to Figure 9-15.

Table 6-18: Marine Monitoring Program Sample Locations

Site	Easting	Northing	Ocean Water	Ocean Sediment	Beach Seep	Beach Sand	Sewage Outfall Water/ Sediment	Oysters
Marine Monitoring Locations – Control North								
CN63	654448	8472830	X	X				
CN63A	655593	8472610	X	X				
CN64	655603	8472490	X	X				
CN65	655613	8472340	X	X				
CN66	655601	8472200	X	X				
CN68	655523	8471902						X
CN69	655416	8471980						X
CN72	655190	8472247						X
CN73	655180	8472200				X		
CN74	655169	8472230				X		
CN75	655158	8472230				X		
CN76	654996	8472270				X		
CN77	654975	8472270				X		
CN78	654920	8472193			X			
CN79	654899	8472204			X			
CN80	654780	8472205			X			
CN81	654769	8472205			X			
Marine Monitoring Locations - Port								
PN1	653153	8467780	X	X				
PN2	653024	8467740	X	X				
PN23	652693	8468456						X
PN24	653208	8467790						X
PN25	653292	8467479						X
PN26	653336	8467590						X
PN3	652904	8467690	X	X				
PN32	653336	8467550				X		
PN33	653336	8467570				X		
PN34	653336	8467590				X		
PN35	653347	8467610				X		
PN36	653347	8467630				X		
PN37	653336	8467610				X		
PN38	653336	8467610				X		
PN39	653336	8467580				X		
PN4	652775	8467680	X	X				
PN40	653336	8467580				X		
PN41	653336	8467530				X		
PN42	653336	8467530				X		
PN43	653324	8467413			X			
PN44	653347	8467601			X			

Site	Easting	Northing	Ocean Water	Ocean Sediment	Beach Seep	Beach Sand	Sewage Outfall Water/ Sediment	Oysters
PN5	653238	8467490	X	X				
PN6	653141	8467490	X	X				
PN7	653022	8467480	X	X				
PN8	652881	8467450	X	X				
P17	653183	8467310					X	
P18	653194	8467290					X	
P19	653205	8467280					X	
P20	653204	8467260					X	
P21	653151	8467350					X	
P22	653172	8467330					X	
P27	653205	8467402						X
P28	653291	8467324						X
PS29	653485	8467268						X
PS30	653561	8467179						X
PS45	653550	8467270				X		
PS46	653529	8467290				X		
PS47	653507	8467310				X		
PS48	653475	8467320				X		
PS49	653443	8467360				X		
PS9	653367	8467250	X	X				
PS10	653269	8467210	X	X				
PS11	653193	8467120	X	X				
PS12	653095	8467040	X	X				
PS13	653604	8467120	X	X				
PS14	653484	8467070	X	X				
PS15	653300	8466970	X	X				
PS16	653181	8466870	X	X				
Marine Monitoring Locations – Control South								
CS92	654203	8460803						X
CS93	654219	8459810			X	X		
CS94	654208	8459800			X	X		
CS95	654208	8459770			X	X		
CS97	654057	8459810	X	X				
CS98	653852	8459840	X	X				
CS99	653485	8459920	X	X				

Sample collection and analysis methods have remained consistent with those described within AIMS (2013) up to and including the most recent 2019 MEMP sampling.

A comprehensive suite of analytes are monitored within each sample. In relation to metals and metalloids, the concentrations of aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, tellurium, thallium, uranium, vanadium and zinc are determined. In relation to hydrocarbons, AIMS (2013) identified 16 priority polycyclic aromatic hydrocarbons (PAH) for monitoring, those being, acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, infeno (1,2,3-cd) pyrene, naphthalene, phenanthrene and pyrene. In addition, hydrocarbons associated with diesel (C10-C40) are monitored although generally reported as TPH.

Total and bioavailable concentrations of analytes are analysed for both water and sediment samples (when applicable). However, in consideration that the overarching aim of the MEMP is to monitor biological effect, discussion within the annual reporting against the MMP is focussed on the more relevant bioavailable concentrations.

Sampling is generally conducted during neap tides of October, November or early December. Being late in the dry season, this time period was identified by AIMS (2013) as most likely to have minimal land runoff and neap tides would provide the least disturbed water column, therefore minimum variation would occur in data due to naturogenic sources.

6.4.7 *Analyte Concentration Trigger Values*

6.4.7.1 *Beach Seep and Ocean Water Sample Trigger Values*

In 2000, the Australia and New Zealand Environment and Conservation Council (ANZECC) in conjunction with the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) revised water quality guidelines to produce a document commonly referenced as ANZECC (2000). One of the outcomes of that publication was water quality concentration guideline values for a range of analytes below which provide protection for freshwater and marine ecosystems. Those guidelines were developed using a risk-based approach that integrated water and sediment quality with known biological responses to different types of industries.

Historically the concentrations utilised as trigger values for water and sediment samples by this MEMP have been those concentrations which ANZECC (2000) describes as providing protection to 95% of species and being appropriate to use for slightly to moderately disturbed marine ecosystems (i.e. ports with low levels of industrialisation). Those concentrations were prescribed within GEMCO's waste discharge licence and maintenance dredging permit. Furthermore, AIMS (2013) found these trigger values to be appropriate to satisfy the objectives of the MEMP. The ANZECC (2000) document has recently been superseded by the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018). However, the concentration values in relation to this program remained consistent with those proposed by ANZECC (2000). The concentrations of metal and metalloids within filtered marine water samples which would trigger further investigation within the MEMP are provided within Table 6-19.

Table 6-19: Default guideline values (µg/L) recommended to act as trigger values for the protection of 95% of species within slightly to moderately disturbed marine water systems (ANZG 2018)

Analyte[1]	DGV (µg/L)
Cadmium	5.5
Chromium (CrVI)	4.4
Cobalt	1
Copper	1.3
Lead	4.4
Manganese[2]	140
Mercury (inorganic)	0.4
Nickel	70
Silver	1.4
Vanadium	100
Zinc	15
Cadmium	5.5

(1) Only displaying analytes investigated by the MEMP which are assigned a recommend trigger value by ANZG (2018) or the superseded ANZECC (2000) document.
(2) Default Guideline Value (DGV) for Manganese is site specific to GEMCO as approved by the NT EPA (via the ANZECC Steering Committee).

The ANZECC (2000) document did not recommend a trigger value for manganese in marine water due to insufficient data. In consideration that manganese was likely to be the major metal environmental input from GEMCO operations, the NT EPA (via the ANZECC Steering Committee) approved a moderate to high reliability trigger value of 140 µg/L for manganese in marine water. ANZG (2018) only provides a low reliability marine trigger value of 80 µg/L for manganese in marine water which was calculated using the highly conservative assessment factor of 200 (i.e. dividing concentrations known to cause biological effects by a factor of 200). In consideration that ecosystems of Groote Eylandt, including those within the marine environment, have evolved in the presence of naturally high concentrations of manganese, and there has been no recorded evidence to manganese toxicity within marine waters, the adoption of the ANZG (2018) low reliability trigger value is considered inappropriate. Therefore, the approved 140 µg/L marine waters trigger value for manganese will continue to be used for the purposes of the MEMP.

6.4.7.2 *Beach and Marine Sediment Sample Trigger Values*

In relation to trigger values used for analytes within marine sediment samples, AIMS (2013) recommended comparison with the applicable interim sediment quality guideline (ISQG) provided by ANZECC (2000). These interim guidelines were reviewed by Simpson et al. (2013), Simpson and Batley (2016) and most recently ANZG (2018). However, these remain largely unchanged in relation to metal and metalloids monitored by the MEMP. The concentrations of metal and metalloids within marine sediment samples which would trigger further investigation are provided within Table 6-20.

Table 6-20: Sediment quality guideline values for metal and metalloids (mg/kg dry weight) recommended to act as trigger values for marine sediments (ANZG 2018)

Analyte[1]	SQGV (mg/kg dry weight)	SQGV High (mg/kg dry weight)
Antimony	2.0	25
Arsenic	20	70
Cadmium	1.5	10
Chromium	80	370
Copper	65	270
Lead	50	220
Mercury	0.15	1.0
Nickel	21	52
Silver	1.0	4.0
Zinc	200	410

(1) Analytes investigated that have no SQGV listed have not been assigned a value within ANZG (2018), Simpson and Batley (2016) or the superseded document ANZECC (2000).

ANZECC (2000) provided guideline values for a number of PAHs which were discontinued in later revisions of sediment guidelines values (SQGVs) by Simpson et al. (2013), Simpson and Batley (2016) and ANZG (2018) in favour of an 18 parent, Total PAH SGV normalised to 1% organic carbon (see Simpson et al. (2013) for reasoning). As mentioned, the methods utilised by the MEMP are those recommend by AIMS (2013), and comparison has historically been made with individual PAH and total PAH ISQGs provided by ANZECC (2000) (Table 6-21). This method has provided a useful time series data set for GEMCO and are equally or more conservative than more current guideline values. Given the knowledge gained in relation to hydrocarbon concentrations within sediment since 2014, and discussed below, there is scope to streamline future monitoring of PAHs within marine sediments while maintaining the MEMPs early warning mechanisms.

It is noted that within sediment, a number of analytes recommended by AIMS for inclusion within the analysis suite do not have recommended guideline values. Furthermore, the method of determining regional interim values as described by Simpson et al. (2013), Simpson and Batley (2016) and ANZG (2018) is not considered appropriate as no baseline data prior to GEMCO operations commencing is available (AIMS, 2013).

Table 6-21: Sediment quality guideline values for polycyclic aromatic hydrocarbons (µg/kg dry weight) recommended by AIMS (2013) to act as trigger values for marine sediments for the GEMCO MEMP

Polycyclic Aromatic Hydrocarbon (PAH)	SQGV (mg/kg dry weight)	SQGV High (mg/kg dry weight)
Acenaphthene	16	500
Acenaphthylene	44	640
Anthracene	85	1,100
Benz(a)anthracene	261	1,600
Benzo(a)pyrene	430	1,600
Chrysene	384	2,800
Dibenzo(a,h)anthracene	63	260
Fluoranthene	600	5,100
Fluorene	19	540
Naphthalene	160	2,100
Phenanthrene	240	1,500
Pyrene	665	2,600
Total PAHs	**4,000**	**45,000**

6.4.7.3 *Biota Sample Trigger Values*

In consideration that the inclusion of biota within the MEMP is primarily to ascertain if consumption of biota collected within the Milner Bay port area represents a risk to human health, the trigger value used for biota are primarily related to human health effects. As such, the maximum permissible concentration (MPC) prescribed by Food Standards Australia and New Zealand (FSANZ) within Australia New Zealand Food Standards Code – Schedule 19 of Standard 1.4.1 are used when available (Table 6-22).

Table 6-22: Maximum Permissible Concentrations (mg/kg) of Analytes relevant to the GEMCO MEMP

Analyte	Fish	Oysters
Arsenic (Inorganic)	2.0	1
Cadmium	-	2
Lead	0.5	2
Mercury	0.5	0.5

Due to the limited amount of analytes with MPCs, health-based guideline values (HBGV) were also provided by AIMS (2013) for a majority of metal and metalloids. In addition, AIMS (2013) provided a HBGV for four PAHs (Table 6-23).

Table 6-23: Health-Based Guideline Values for various Analytes recommended by AIMS (2013)

Analyte	Health-based Guideline Value (TDI or RfD in mg / kg of individual's body weight)	Source
Aluminum	1	JECFA 1989
Arsenic	0.003	FSANZ
Barium	0.02	RIVM
Cadmium	0.001	FSANZ, US EPA
Chromium	0.003	APVMA, US EPAb
Cobalt	0.0014	RIVM
Copper	0.5	FSANZ
Manganese	0.14	US EPA
Molybdenum	0.005	US EPA
Nickel	0.02	US EPA
Lead	0.0036	FSANZ, JECFA, RIVM
Strontium	0.6	US EPA
Uranium	0.003	US EPA
Vandium	0.002	RIVM 2003
Zinc	1	FSANZ
Fluoranthene	0.04	US EPA
Fluorene	0.04	US EPA, RIVM
Naphthalene	0.02	US EPA
Phenanthrene	0.04	RIVM

TDI =Tolerable Daily Intake; defined as "The daily intake of an analyte that, during a lifetime, appears to be without appreciable risk, on the basis of all the facts known at the time. It is generally measured in mg of ingested analyte per kg of body weight per day.
RfD = Reference Dose the US equivalent of TDI; defined as "An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime". It is generally measured in mg of ingested analyte per kg of body weight per day.

It should be noted that the values outlined within Table 6-24 are recommended HBGVs and should not be used as trigger values in the way that a Default Guideline Value (DGV), SQGV or MPC would be. Rather a HBGV is used to calculate the theoretical amount of a food item that could be consumed before ingesting greater than the recommended amount of a particular analyte.

The simplified equation commonly used for these assessments within Australia is provided below:

$$\frac{\text{HBGV for analyte}^{1} - \text{Mean dietary exposure to analyte}}{\text{Concentration of analyte within sample (e.g. oyster)}} = \text{Amount of sample that can be safely eaten}$$

(1) Adjusted for person's total body weight if health-based guidance value expressed on a per kilogram body weight basis.

The primary focus of biota discussion and comparison is of fish muscle (fillet) and oyster tissue analyte concentrations as this is the portion of the fish that is consumed by the majority of the Groote Eylandt population (SKM, 1998). Furthermore, liver concentration data has historically been reported as mg/kg dry weight, which is difficult to accurately incorporate into the health risk assessment because of the difficulty of reconciling the dry and weight wet data (AIMS, 2013).

6.5 Data Review and Interpretation

6.5.1 *Surface Water Monitoring*

6.5.1.1 *River Abstraction Volumes*

GEMCO's potable water abstraction from the Angurugu River for FY20 was 1,806.05 ML. A new water treatment plant was commissioned at the start of 2020 which has reduced the abstraction volume (2,133 ML for FY19).

6.5.1.2 *River Water Quality Results*

The results from water quality monitoring in the Angurugu and Emerald Rivers are presented in Table 6-24. Samples were not able to be collected from EMP3 in September 2019 and site AMP4, AMP5, AMP6, AMP7 during December 2019 due to these areas being closed for cultural reasons.

Dissolved manganese concentrations were low during the reporting period and did not exceed the freshwater or saltwater trigger value during any sampling event. While trigger values do not exist for barium and iron, these concentrations were low and in line with historical readings. Dissolved aluminium and zinc levels exceeded their respective trigger values at a number of monitoring sites upstream and downstream of the mining operations. These concentrations were however consistent with historical monitoring data and related to leaching of these elements from the soils within these areas. This occurs at a higher rate during periods of wet season rainfall run off. Overall, the dissolved metals data collected from the river monitoring program indicates that dissolved metals that are potentially derived from the GEMCO mining operation are unlikely to represent a significant environmental hazard to the estuarine environment of the Angurugu and Emerald Rivers.

Table 6-24: River Water Quality Monitoring Results - Metals

Sample Point	Sample Date	Dissolved Metals (µg/L)					Total Metals (µg/L)				
		Al	Ba	Fe	Mn	Zn	Al	Ba	Fe	Mn	Zn
Estuarine Monitoring Sites											
Trigger Levels		**0.5**			**390**	**15**					
AMP1	25/07/19	< 5	13.6	34	189	< 1	134	15.8	533	315	< 1
AMP1	21/08/19	< 5	12	12	208	< 5	278	13	1250	365	< 5
AMP1	26/09/19	< 5	10	7	62.2	< 5	109	12	159	125	< 5
AMP1	17/10/19	< 5	15	6	243	5	391	16	1,370	390	31
AMP1	25/11/19	< 5	14	10	155	< 5	58	15	149	189	< 5
AMP1	9/12/19	< 5	15	11	122	< 5	157	20	797	339	8
AMP1	14/01/20	< 5	20	29	105	< 5	37	20	136	130	< 5
AMP1	4/02/20	< 5	15.9	< 2	13.0	3	127	18.5	780	302	4
AMP1	26/03/20	48	7.5	90	138	1	128	8.2	409	177	1
AMP1	14/04/20	< 5	10	10	273	< 5	49	10	201	290	< 5

Sample Point	Sample Date	Dissolved Metals (µg/L)					Total Metals (µg/L)				
		Al	Ba	Fe	Mn	Zn	Al	Ba	Fe	Mn	Zn
AMP1	19/05/20	< 5	12	29	202	< 5	873	14	3,860	420	< 5
AMP1	17/06/20	< 5	14	6	147	< 5	41	13	167	193	< 5
AMP2	25/07/19	< 5	8.1	70	103	1	33	9.3	214	121	1
AMP2	21/08/19	< 5	9.2	81	137	< 1	21	10.4	276	174	2
AMP2	26/09/19	18	20	14	342	< 5	131	19	225	357	< 5
AMP2	17/10/19	5	14.3	47	166	6	18	16.6	242	199	23
AMP2	25/11/19	< 5	16.1	15	182	1	41	16.9	215	202	3
AMP2	9/12/19	< 5	19.0	11	115	< 1	28	18.5	210	136	5
AMP2	14/01/20	< 5	21	15	158	< 5	44	21	213	211	< 5
AMP2	4/02/20	< 5	13.3	< 2	140	5	37	12.9	297	191	8
AMP2	26/03/20	128	6.2	163	108	1	113	6.2	231	115	2
AMP2	14/04/20	31	8.3	79	211	< 1	124	9.5	293	287	2
AMP2	19/05/20	6	11.3	25	160	< 1	43	10.5	188	165	1
AMP2	17/06/20	< 5	11.3	13	156	< 1	24	11.9	226	182	2
AMP3	25/07/19	6	7.8	76	108	< 1	36	8.4	235	130	< 1
AMP3	21/08/19	5	8.1	107	96.8	< 1	42	9.2	480	127	2
AMP3	26/09/19	5	17.7	17	271	1	45	19.5	246	324	< 2
AMP3	17/10/19	< 5	11.8	58	136	21	20	12.4	255	165	51
AMP3	25/11/19	< 5	14.1	28	118	2	32	14.0	273	132	4
AMP3	9/12/19	< 5	16.1	18	92.7	< 1	20	14.5	217	100	4
AMP3	14/01/20	< 5	22	16	148	< 5	30	21	212	189	< 5
AMP3	4/02/20	< 5	11.0	< 2	128	5	20	10.7	324	150	6
AMP3	26/03/20	124	6.4	169	112	1	104	6.3	236	115	2
AMP3	14/04/20	49	7.2	133	170	< 1	111	7.8	312	265	1
AMP3	19/05/20	< 5	7.3	69	141	< 1	61	11.6	603	230	3
AMP3	17/06/20	< 5	15	7	222	< 5	24	13	170	236	< 5
EMP3	25/07/19	8	7.8	22	62.2	6	182	8.0	96	68.0	< 1
EMP3	21/08/19	10	7.1	32	63.3	< 1	29	7.3	77	68.3	< 1
EMP3	17/10/19	22	7.9	60	64.3	2	21	7.5	67	67.0	3
EMP3	25/11/19	10	12.1	24	85.9	2	53	12.3	95	90.2	4
EMP3	9/12/19	< 5	9.2	16	60.8	< 1	49	9.3	112	65.7	2
EMP3	14/01/20	7	11.4	91	89.0	< 1	66	11.4	289	97.0	1
EMP3	4/02/20	< 5	9.1	< 2	62.9	< 1	74	8.7	307	77.6	2
EMP3	26/03/20	25	13.4	61	104	< 1	73	13.0	205	110	1
EMP3	14/04/20	18	9.6	57	77.5	< 1	129	8.8	265	88.9	1
EMP3	19/05/20	7	8.2	23	64.6	< 1	51	7.1	105	59.0	< 1
EMP3	17/06/20	5	8.3	21	54.4	1	38	9.3	101	76.9	2

Sample Point	Sample Date	Dissolved Metals (µg/L)					Total Metals (µg/L)				
		Al	Ba	Fe	Mn	Zn	Al	Ba	Fe	Mn	Zn
Freshwater Monitoring Sites											
Trigger Levels		**55**			**1,900**	**8**					
AMP4	25/07/19	< 10	7	90	54	10	40	8	360	62	35
AMP4	21/08/19	40	8	< 50	56	< 5	30	10	380	65	< 5
AMP4	26/09/19	< 10	7	140	64	< 5	30	9	330	77	< 5
AMP4	17/10/19	< 10	8	130	53	6	< 10	8	350	76	21
AMP4	25/11/19	< 10	12	140	79	< 5	20	9	350	78	< 5
AMP4	14/01/20	< 10	8	140	49	< 5	10	10	280	56	< 5
AMP4	4/02/20	< 10	8	130	54	< 5	20	10	330	64	< 5
AMP4	26/03/20	200	6	180	45	< 5	200	8	340	53	< 5
AMP4	14/04/20	70	6	140	44	< 5	130	6	360	52	< 5
AMP4	19/05/20	< 10	6	100	20	< 5	30	8	270	35	< 5
AMP4	17/06/20	< 10	6	120	25	< 5	40	8	300	52	< 5
AMP5	25/07/19	< 10	7	200	78	19	20	9	380	96	62
AMP5	21/08/19	< 10	8	130	58	< 5	60	13	550	145	< 5
AMP5	26/09/19	< 10	8	140	55	< 5	20	8	330	58	< 5
AMP5	17/10/19	< 10	8	130	58	7	< 10	10	440	107	24
AMP5	25/11/19	< 10	8	130	67	< 5	20	9	400	66	< 5
AMP5	14/01/20	< 10	7	100	46	< 5	10	8	340	54	< 5
AMP5	4/02/20	< 10	8	130	57	< 5	40	11	700	82	6
AMP5	26/03/20	230	5	200	37	< 5	240	6	580	54	< 5
AMP5	14/04/20	60	6	360	110	< 5	190	8	1,220	136	< 5
AMP5	19/05/20	10	6	100	42	< 5	20	7	240	50	< 5
AMP5	17/06/20	< 10	7	120	46	< 5	20	7	240	47	< 5
AMP6	25/07/19	20	4	110	15	< 5	40	4	220	15	< 5
AMP6	21/08/19	10	4	120	18	< 5	30	5	310	18	< 5
AMP6	26/09/19	20	4	130	19	< 5	40	4	330	19	< 5
AMP6	17/10/19	10	4	100	15	< 5	10	5	380	34	16
AMP6	25/11/19	< 10	5	140	21	< 5	20	10	430	19	< 5
AMP6	14/01/20	10	4	140	14	< 5	10	4	330	14	< 5
AMP6	4/02/20	20	5	120	18	< 5	40	5	380	21	< 5
AMP6	26/03/20	140	3	140	17	< 5	180	4	260	24	< 5
AMP6	14/04/20	110	3	170	16	< 5	60	3	120	15	< 5
AMP6	19/05/20	20	4	80	10	< 5	30	4	140	12	< 5
AMP6	17/06/20	10	4	110	10	< 5	20	4	190	10	< 5
AMP7	25/07/19	< 10	14	190	86	< 5	10	14	420	92	< 5
AMP7	21/08/19	< 10	13	200	90	< 5	10	15	500	90	< 5
AMP7	26/09/19	10	12	230	71	< 5	20	13	440	72	< 5
AMP7	17/10/19	< 10	12	190	60	< 5	40	13	550	77	< 5
AMP7	25/11/19	< 10	12	150	67	< 5	20	14	560	67	< 5
AMP7	14/01/20	< 10	11	80	48	< 5	10	12	460	51	< 5

Sample Point	Sample Date	Dissolved Metals (µg/L)					Total Metals (µg/L)				
		Al	Ba	Fe	Mn	Zn	Al	Ba	Fe	Mn	Zn
AMP7	4/02/20	< 10	12	80	49	< 5	20	13	520	61	< 5
AMP7	26/03/20	240	6	180	41	< 5	340	7	680	48	< 5
AMP7	14/04/20	140	9	200	55	< 5	400	9	620	57	< 5
AMP7	19/05/20	< 10	11	110	49	< 5	20	12	410	49	< 5
AMP7	17/06/20	< 10	10	130	37	< 5	< 10	11	360	39	< 5
EMP1	25/07/19	50	7	< 50	43	14	60	9	290	146	< 5
EMP1	21/08/19	< 10	8	130	57	< 5	70	9	220	117	< 5
EMP1	26/09/19	30	7	< 50	46	< 5	70	10	100	114	< 5
EMP1	17/10/19	20	7	< 50	38	9	70	8	360	200	38
EMP1	25/11/19	30	10	< 50	66	< 5	130	12	440	213	< 5
EMP1	9/12/19	10	7	< 50	39	< 5	100	7	320	136	< 5
EMP1	14/01/20	30	8	< 50	45	< 5	40	8	60	53	< 5
EMP1	4/02/20	20	7	< 50	31	< 5	70	9	260	130	< 5
EMP1	26/03/20	70	10	50	66	< 5	100	13	210	120	< 5
EMP1	14/04/20	130	8	70	42	< 5	140	8	110	46	< 5
EMP1	19/05/20	20	6	< 50	28	< 5	30	7	50	30	< 5
EMP1	17/06/20	10	6	< 50	24	< 5	20	7	< 50	28	< 5
EMP2	25/07/19	50	8	< 50	52	10	30	8	120	57	< 5
EMP2	21/08/19	30	8	< 50	72	< 5	60	10	100	87	< 5
EMP2	26/09/19	30	8	< 50	80	< 5	50	8	90	92	< 5
EMP2	17/10/19	20	7	< 50	66	9	20	8	90	88	39
EMP2	25/11/19	30	11	< 50	101	< 5	40	12	70	102	< 5
EMP2	9/12/19	20	7	< 50	61	< 5	30	7	60	69	5
EMP2	14/01/20	30	9	< 50	70	< 5	30	9	60	77	< 5
EMP2	4/02/20	20	7	< 50	50	< 5	30	9	60	58	6
EMP2	26/03/20	90	12	70	99	< 5	80	13	100	115	< 5
EMP2	14/04/20	130	9	80	68	< 5	170	9	120	74	< 5
EMP2	19/05/20	20	7	< 50	49	< 5	20	8	60	51	6
EMP2	17/06/20	20	7	< 50	40	< 5	20	7	50	43	< 5

6.5.2 *Artificial Surface Water Quality Results*

Aluminium, manganese and zinc trigger levels were exceeded at RMS35 (mobile workshop drain). These concentrations are believed to be localised to the mobile workshop drain, and a groundwater assessment from bores adjacent to this drain indicates that the groundwater quality was not impacted by contaminants from the vehicle wash-down facility or mobile workshop. Elevated TPH concentrations at RMS35 also appear to be localised. RMS35 discharges into RMS21, which recorded low TPH concentrations, indicating that there is no significant transport of hydrocarbons away from RMS35.

Samples collected from coalescent plate separators at the port (RMS104 and RMS37) and the mine site (RMS102 and RMS103) show elevated levels of hydrocarbons. Of these separators, a single unit (RMS104) discharges directly into a drain which then flows into a natural waterway (i.e. Milner

Bay). Sampling of the drain downstream of the discharge point (RMS104 dstream) indicates hydrocarbon concentrations were elevated above the trigger value. The coalescent plate separators are now routinely inspected and maintained by GEMCO's Non-Process Infrastructure (NPI) Department. These inspections are scheduled in SAP (GEMCO's Enterprise Resource Planning Software) as part of an automated planning process. RMS103 is located at the heavy vehicle fuel pad on the mine site. At the time of reporting, the cause of the elevated TPH concentration recorded at this site during FY20 is unknown. GEMCO will continue to monitor RMS103 and will implement mitigation and remediation measures where necessary. While the concentration of hydrocarbons were elevated during this sampling event, further mixing is likely to have occurred prior to discharging into Milner Bay resulting in minimal risk to the bay.

The concentration of Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) were below the trigger values for all sample points for all sampling events during the reporting period with most concentrations below the limit of reporting (LOR).

GEMCO will monitor the bores associated with the mobile workshop drain during FY21. This will be undertaken in line with the previous assessment undertaken by URS (2014) to determine if groundwater is being impacted. The results of this will be reported in the FY2021 EMR and mitigations measures will be implemented to reduce contamination if unacceptable impacts are identified.

Table 6-25: Artificial Surface Water Quality Monitoring Results

Sample Point	Sample Date	Dissolved Metals (μg/L)					BTEX (μg/L)			TPH (μg/L)	Xylenes (μg/L)
		Al	Ba	Mn	Zn	Fe	Benzene	Toluene	Ethyl-benzene	C10-C36 Fraction (sum)	Total Xylenes
Trigger Levels		**55**		**1,900**	**8**		**950**	**180**	**80**	**600**	**300**
Mine Monitoring Sites											
RMS21	19/11/19	20	4	548	< 5	< 50	< 1	< 2	< 2	< 50	< 2
RMS21	20/02/20	50	15	2,160	< 5	60	< 1	< 2	< 2	< 50	< 2
RMS21	11/05/20	40	5	568	< 5	< 50	< 1	< 2	< 2	100	< 2
RMS23	19/11/19	10	1	153	< 5	< 50	< 1	< 2	< 2	< 50	< 2
RMS23	11/05/20	< 10	1	345	6	< 50	< 1	< 2	< 2	< 50	< 2
RMS35	19/11/19	1,400	6	2,580	20	410	< 1	< 2	< 2	2,560	< 2
RMS35	11/05/20	20	10	4,490	7	< 50	< 1	< 2	< 2	4,510	< 2
RMS102	14/04/20						< 1	< 2	< 2	9,880	< 2
RMS103	14/04/20						< 1	< 2	< 2	4,170,000	5
Port Monitoring Sites											
RMS37	11/04/20						< 1	< 2	< 2	6,280	< 2
RMS104	11/04/20						< 1	< 2	< 2	7,950	3
RMS104 (dstream)	11/04/20						< 1	< 2	< 2	1,280	< 2

6.5.3 *Mine Groundwater Monitoring*

6.5.3.1 *Hydrogeology and Recharge*

The hydrogeology beneath the active leases, based on the available drilling records and field observations, indicate there are three aquifers beneath the Western Leases, as follows:

- **Upper Aquifer**: unconfined, comprised of alluvium ranging between 1 to 12 m below ground surface with variable amounts of sand and influenced by rainfall infiltration during wet season. This unit transmits groundwater west towards the coastline and locally north or south towards Angurugu River. Localised mounding is present in this aquifer in the vicinity of operational TSFs and depressed in areas of pit development associated with mine dewatering;

- **Middle Aquifer**: aligned with the mangite orebody, it is the least permeable and is largely removed by mining operations; and

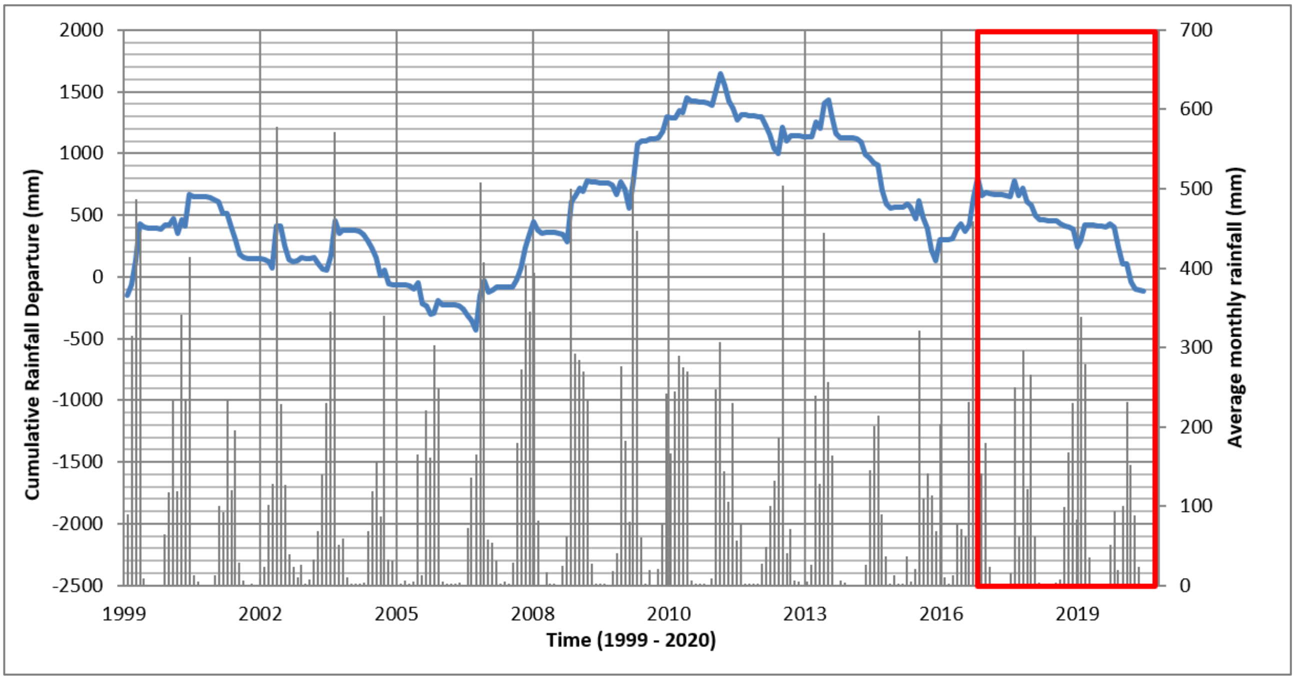
- **Lower Aquifer:** semi-confined fractured and weathered quartzite bedrock, and alluvial sand and gravel deposits residing along the base of a series of palaeovalleys that were eroded into the bedrock (below the orebody). This extensive and permeable aquifer transmits groundwater from the base of the bedrock escarpment (below the orebody) in the east to the coast in the west.

The climate experienced on Groote Eylandt is characterised by hot, humid summers (during which the majority of rainfall occurs) and dry winters.

The Cumulative Rainfall Departure (CRD) curve for Groote Eylandt Airport is shown in Figure 6-2. The CRD provides an assessment of monthly rainfall, higher or lower than the long-term monthly average, which allows for an assessment of rainfall recharge to hydrostratigraphic units. The CRD highlights below average wet season rainfall was recorded across most of the reporting period (since 2017).

As discussed in the following sub-sections, this resulted in reduced recharge to the Upper Aquifer (where most of the groundwater monitoring program bores are screened), with several bores noted as being dry. Water quality data was therefore, unavailable from these bores during the reporting period.

Figure 6-2: Cumulative Rainfall Departure Graph



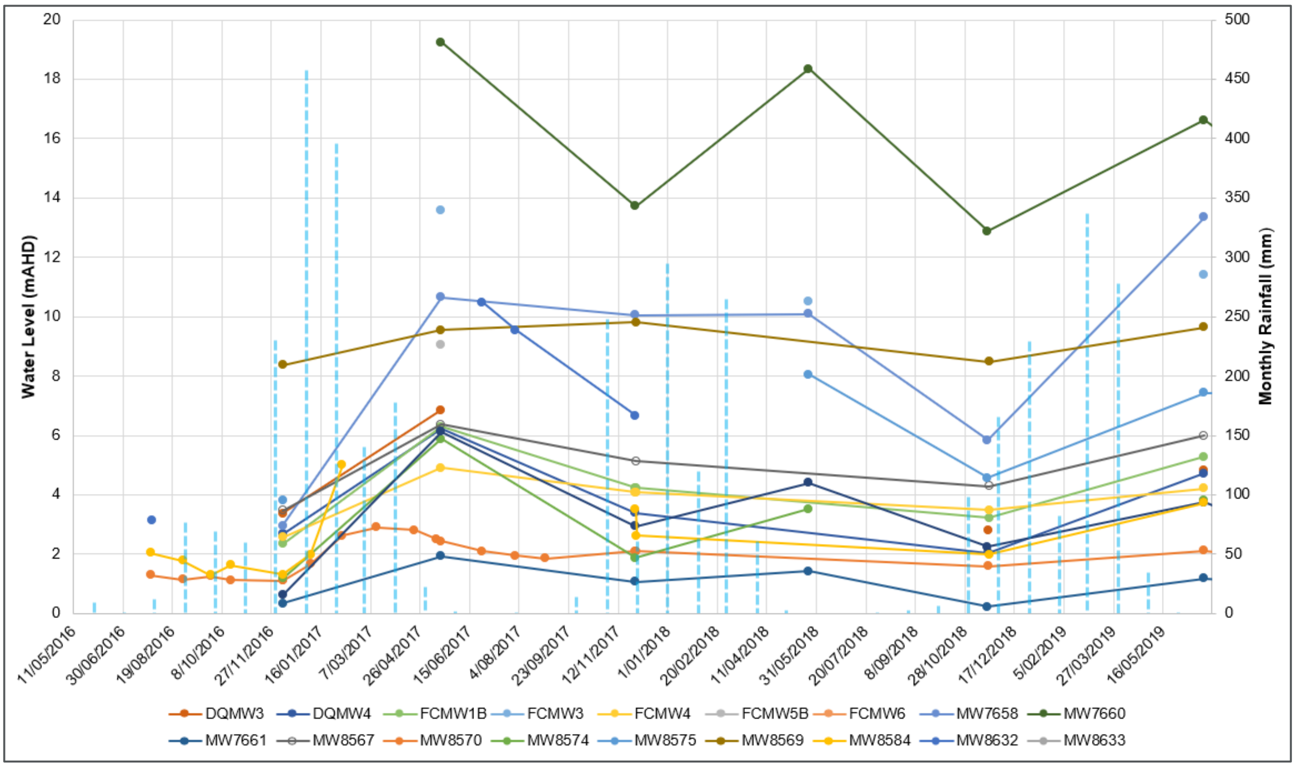
6.5.3.2 *Mine Site Groundwater Levels*

Monthly (prior to 2017 at select bores discussed above) and biannual groundwater level data collected from around the mine site is presented in Figure 6-3, as elevation in mAHD. Note, during the reporting period several monitoring bores were recorded as dry, and as such not all the bores in the monitoring network are presented in Figure 6-3.

Groundwater levels show a strong correlation with rainfall, with levels increasing during the wet season (November to April) and falling during the dry season (May to October). The groundwater levels during the reporting period maintained consistent trends which correlated well with the historical ranges identified in the Mine Closure Groundwater Assessment (AECOM, 2018).

Groundwater levels in MW7658 continue to be responding to groundwater abstraction, with lower levels recorded in 2018, before recovering in 2019. At bores MW8574 and MW8576, groundwater levels recovered from a low recorded in 2016 before fluctuating between 3 to 4 metres for the remainder of the reporting period.

Figure 6-3: Mine Site Groundwater Levels



6.5.3.3 *Mine Site Water Quality*

Groundwater quality results collected during the reporting period are presented in Table 9-3. In accordance with the required monitoring frequency, eight biannual sampling events were completed during the reporting period. Out of the eight monitoring events, groundwater quality samples were collected on five occasions, where there was a sufficient water column needed to collect a sample.

A summary of the exceedances of the ANZG (2018) guidelines during the reporting period were limited to concentrations of dissolved aluminium (0.055 mg/L), manganese (1.9 mg/L) and zinc (0.008 mg/L), as summarised in Table 6-26 (highlighted cells).

A single exceedance of dissolved manganese was recorded during the reporting period at bore MW8569 (2.27 mg/L) in November 2017. The concentration was below the historical maximum for the location (2.95 µg/L recorded in May 2015) however, subsequent sampling events confirmed the result to be an isolated occurrence and therefore not of concern.

Dissolved aluminium and zinc concentrations have consistently exceeded the ANZG (2018) guidelines of 0.055 mg/L and 0.008 mg/L, respectively during the reporting period. The consistent and uniform distribution of concentrations of aluminium and zinc across the mine site (up gradient and downgradient) suggests they are likely a natural feature of regional groundwater and unrelated to the mining activities. This is supported by the mean concentrations of aluminium (0.0861 mg/L) and zinc (0.122 mg/L) recorded in the Upper Aquifer of the Eastern Leases, which are inferred to represent background concentrations unimpacted by mining activities.

Table 6-26: Groundwater Exceedances – Mine Site

Monitoring Bore	Sample Date	Dissolved Metals (µg/L)		
		Aluminium	Manganese	Zinc[1]
Guidelines		**0.055**	**1.90**	**0.008**
DQMW3	08/12/2016	0.040	0.08	0.010
	23/05/2018	<0.010	0.16	0.010
	13/05/2020	0.020	0.04	0.013
DQMW4	08/12/2016	0.060	0.04	0.010
	30/11/2017	0.060	0.03	0.010
	23/05/2018	0.020	0.03	0.020
	13/05/2020	0.010	0.03	0.016
FCMW1B	08/12/2016	0.030	0.01	0.020
	17/05/2017	<0.010	0.01	0.010
	30/11/2017	<0.010	0.01	0.010
	14/05/2020	<0.010	0.13	0.015
FCMW4	08/12/2016	0.010	0.13	0.020
	17/05/2017	0.050	0.15	0.010
	18/05/2020	0.030	0.07	0.021
FCMW5B	17/05/2017	0.070	0.10	0.010
FCMW6	17/05/2017	<0.010	0.02	0.010
	22/05/2018	0.020	0.03	0.010
MW8567	08/12/2016	<0.010	0.03	0.020
	17/05/2017	<0.010	0.03	0.010
	30/11/2017	<0.010	0.04	0.010
	20/11/2018	<0.010	0.04	0.013
	14/05/2020	<0.010	0.04	0.019
MW8569	08/12/2016	0.060	1.20	0.040
	17/05/2017	0.020	0.36	0.010
	30/11/2017	<0.010	2.27	0.010
	22/05/2018	0.030	1.37	0.010
	20/11/2018	0.010	1.10	0.011
	28/11/2019	0.030	1.01	0.009
	14/05/2020	0.010	0.92	0.012
MW8570	08/12/2016	<0.010	0.04	0.030
	17/05/2017	<0.010	0.05	0.010
	30/11/2017	<0.010	0.07	0.010
	22/05/2018	<0.010	0.06	0.010
	20/11/2018	<0.010	0.06	0.012
	14/05/2020	<0.010	0.06	0.016

Monitoring Bore	Sample Date	Dissolved Metals (µg/L)		
		Aluminium	Manganese	Zinc[1]
MW8584	08/12/2016	0.070	0.09	0.040
	30/11/2017	<0.010	0.07	0.010
	22/05/2018	<0.010	0.04	0.010
	14/05/2020	0.020	0.04	0.011

(1) Zinc concentrations are not hardness modified.

6.5.3.4 *Fuel Tank and Refuelling Station Water Quality*

The NFMW and FP bores series are located around the mine site fuel storage tank (NFMW1 to NFMW4) and heavy vehicle fuel pad (NFMW5, FP6, FP8 and FP11). Bores FP6, FP8 and FP11 are located downgradient of NFMW5 (Figure 9-7).

Groundwater quality results collected during the reporting period are presented in Table 9-6 (Appendix 9.8). In accordance with the required frequency, 16 quarterly monitoring events were completed during the reporting period. Out of the 16 monitoring events, groundwater quality samples were collected on 15 occasions, where there was sufficient water column to collect a sample.

A summary of the exceedances recorded during the reporting period is provided as highlighted cells in Table 6-27.

Table 6-27: Groundwater Exceedances - Fuel Storage Tank and Refuelling Station

Sample Point	Sample Date	TPH (µg/L)	BTEX (µg/L)				
		C10-C36 Fraction (sum)	Benzene	Toluene	Ethylbenzene	Xylene	Naphthalene
Guidelines		**600**	**950**	**180**	**80**	**350**	**-**
NFMW3	31/05/2017	680	<1	<2	<2	<2	<5
	26/02/2020	3,390	<1	<2	<2	<2	<5
NFMW4	25/05/2018	610	<1	<2	<2	<2	<5
NFMW5	24/02/2017	2,460	<1	<2	<2	<2	<5
	31/05/2017	29,000	<1	<2	<2	<2	<5
	30/08/2017	267,000	<1	<2	<2	<2	<5
	19/02/2018	3,810	<1	<2	<2	<2	<5
	24/05/2018	30,100	<1	<2	<2	<2	<5
	04/03/2019	8,730	<1	<2	<2	<2	<5
	30/05/2019	1,400	<1	<2	<2	<2	<5
	20/08/2019	26,800	<1	<2	<2	<2	<5
	11/05/2020	174,000	<1	<2	<2	<2	<5

During the reporting period, long-chain hydrocarbon fraction TPH C_{10}-C_{36} was detected in 13 out of 31 groundwater samples around the mine site fuel storage tank (NFMW1 to NFMW4). On three occasions concentrations exceeded the ANZG (2018) trigger value of 600 µg/L at NFMW3 and NFMW4 (refer to Table 6-27). Concentrations of BTEXN have remained below the laboratory LOR since monitoring commenced in 2011.

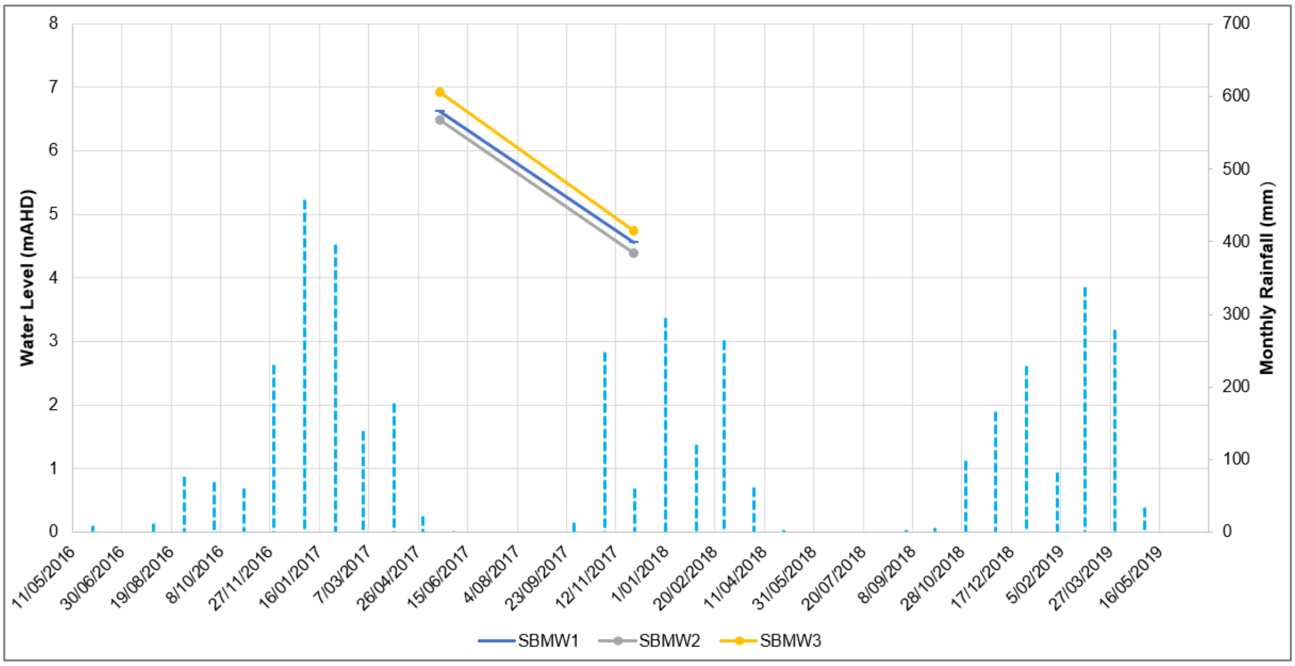
Around the heavy vehicle fuel pad (NFMW5, FP6, FP8 and FP11), concentrations of long-chain hydrocarbon fraction TPH C_{10}-C_{36} were detected in 28 out of 60 groundwater samples during the reporting period. Exceedances of the ANZG (2018) trigger value (600 µg/L) were limited to bore NFMW5, which has shown a constant trend since monitoring began in 2011. The TPH concentrations increase and decrease over the reporting period. The recent increase recorded in May 2020 suggests the plume is expanding or potentially more product is being released from the source.

Concentrations of TPH C_{10}-C_{36} within FP6, FP8 and FP11 (downgradient of NFMW5) were recorded below the laboratory LOR, except for two isolated detections at bore FP6 which remain below the ANZG (2018) trigger value (600 µg/L). Currently, the data suggests that impacts have not migrated laterally any considerable distance from the source point. Improvements to the hardstand have been undertaken to reduce fuel runoff which is believed to be the cause of the local contamination. GEMCO will continue to monitor these locations for natural attenuation to ensure that the plume extent remains within historical ranges.

6.5.3.5 *Sand Blasting Groundwater Levels*

Three groundwater monitoring bores are located around the sand blasting facility (SBMW1, SBMW2 and SBMW3) as shown in Figure 9-7. In accordance with the required frequency, eight biannual monitoring events were completed during the reporting period. Out of the eight monitoring events, groundwater quality samples were only collected on two occasions when there was sufficient water column to collect a sample (i.e. in May 2017 and May 2018). Groundwater levels (in mAHD) from the two sampling events are plotted on Figure 6-4 and show a falling water level trend, attributed to seasonal rainfall totals (May to October).

Figure 6-4: Sand Blasting Groundwater Levels



6.5.3.6 *Sand Blasting Water Quality*

Groundwater quality results collected during the reporting period are presented in Table 9-4 (Appendix 9.8). A summary of the exceedances of the ANZG (2018) guidelines during the reporting period were limited to concentrations of dissolved aluminium (0.055 mg/L) and zinc (0.008 mg/L), as summarised in Table 6-28 (highlighted cells).

The similar magnitude of exceedance and uniform distribution suggests the aluminium and zinc are likely a natural feature of regional groundwater and unrelated to the sand blasting facility. No other exceedances were recorded.

Table 6-28: Groundwater Exceedances - Sand Blasting Facility

Monitoring Bore	Sample Date	Dissolved Metals (µg/L)	
		Aluminium	Zinc[1]
Guidelines		**0.055**	**0.008**
SBMW1	17/05/2017	0.110	0.010
	22/05/2018	0.030	0.010
SBMW2	17/05/2017	0.060	0.020
	22/05/2018	0.090	0.010
SBMW3	17/05/2017	0.060	0.010
	22/05/2018	0.240	0.010

(1) Zinc concentrations are not hardness modified.

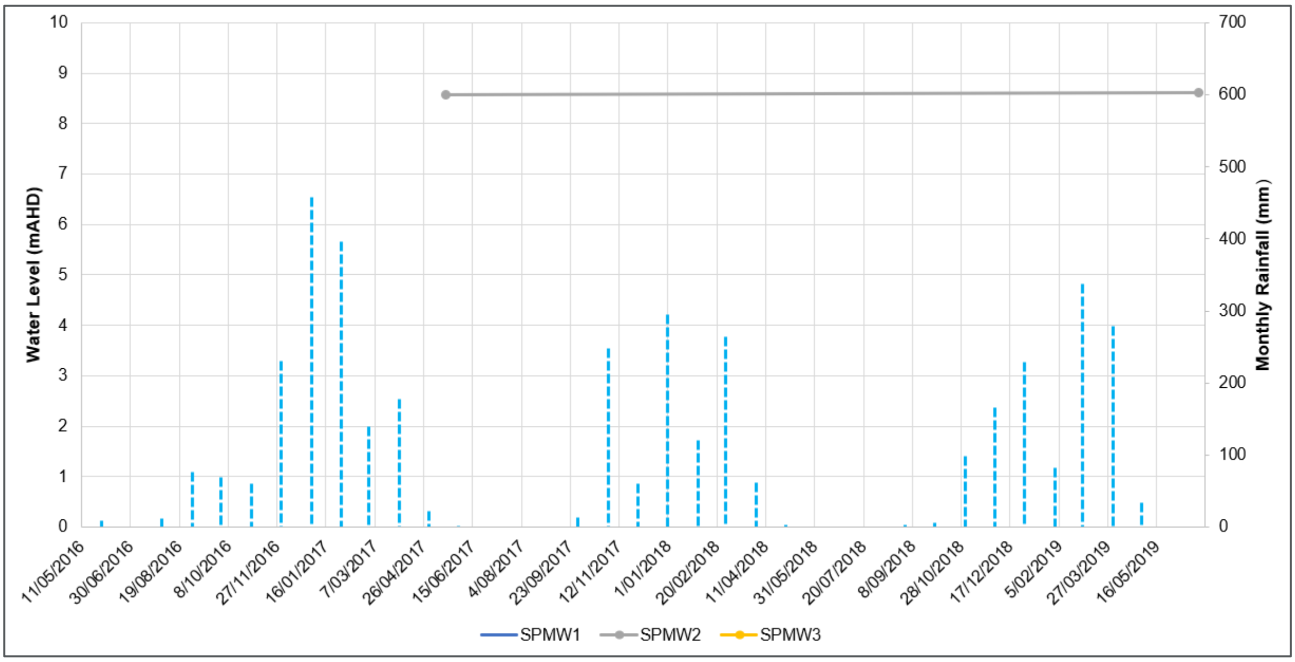
Changes to monitoring at the sand blasting facility

Monitoring around the sand blasting facility has historically been undertaken due to the potential for elevated zinc levels. Garnet sand blasting grit (i.e. environmentally benign product) has been used at the facility since 2010, replacing the previous abrasive medium known to contain high concentrations of zinc. Groundwater monitoring data collected between 2011 and 2018 around the sand blasting facility has confirmed that Zn concentration levels in this area are consistent with background groundwater quality conditions and are unrelated to the sand blasting facility. Other products that are used at the facility are non-hazardous and therefore do not pose any significant risk to the environment. GEMCO will cease groundwater monitoring around the sand blasting facility in the upcoming period.

6.5.3.7 *Mine Site Sewage Pond Groundwater Levels*

Three groundwater monitoring bores are located around the sewage pond in upgradient (SPMW3) and downgradient (SPMW1 and SPMW2) locations. In accordance with the required frequency, eight biannual monitoring events were completed during the reporting period. Out of the 16 monitoring events, groundwater quality samples were collected on two occasions, where there was sufficient water column to collect a sample (May 2017 and May 2018). Available groundwater levels data (in mAHD) collected during the reporting period is plotted below on Figure 6-5.

Figure 6-5: Sewage Pond Groundwater Levels



6.5.3.8 *Mine Site Sewage Pond Water Quality*

Groundwater quality results collected during the reporting period are presented in Table 9-4 (Appendix 9.8). A summary of the exceedances of the ANZG (2018) guidelines were limited to concentrations of dissolved aluminium (0.055 mg/L), manganese (1.9 mg/L) and zinc (0.008 mg/L), as summarised in Table 6-29 (highlighted cells).

Table 6-29: Groundwater Exceedances - Mine Site Sewage Pond

Monitoring Bore	Sample Date	Dissolved Metals (mg/L)			Leachate Indicators (mg/L)		
		Al	Mn	Zn[1]	K	NO_3N	NH_4N
Guidelines		**0.055**	**1.9**	**0.008**	**-**	**0.7**	**0.9**
SPMW2	17/05/2017	0.050	6.5	0.010	8	0.42	0.09
	22/05/2018	0.070	0.1	<0.005	17	18.6	<0.01

(1) Zinc concentrations are not hardness modified.

Based on the available data from the reporting period, the similar magnitude of exceedance and uniform distribution across all sampling locations supports that aluminium and zinc are likely a natural feature of regional groundwater and unrelated to the sewage pond facility.

While concentrations of potassium and nitrate (potential sewage indicators) were elevated during the May 2018 monitored event, an absence of ammonia (<0.01 mg/L), low concentrations of bicarbonate (32 mg/L) and high levels of dissolved oxygen (6.62 mg/L), suggest that the sewage pond is unlikely to be the source of these exceedances. The identified trends will be confirmed following a review of facility-wide water groundwater quality when water levels recover sufficiently (following a rainfall recharge event) to support consecutive rounds of sampling event.

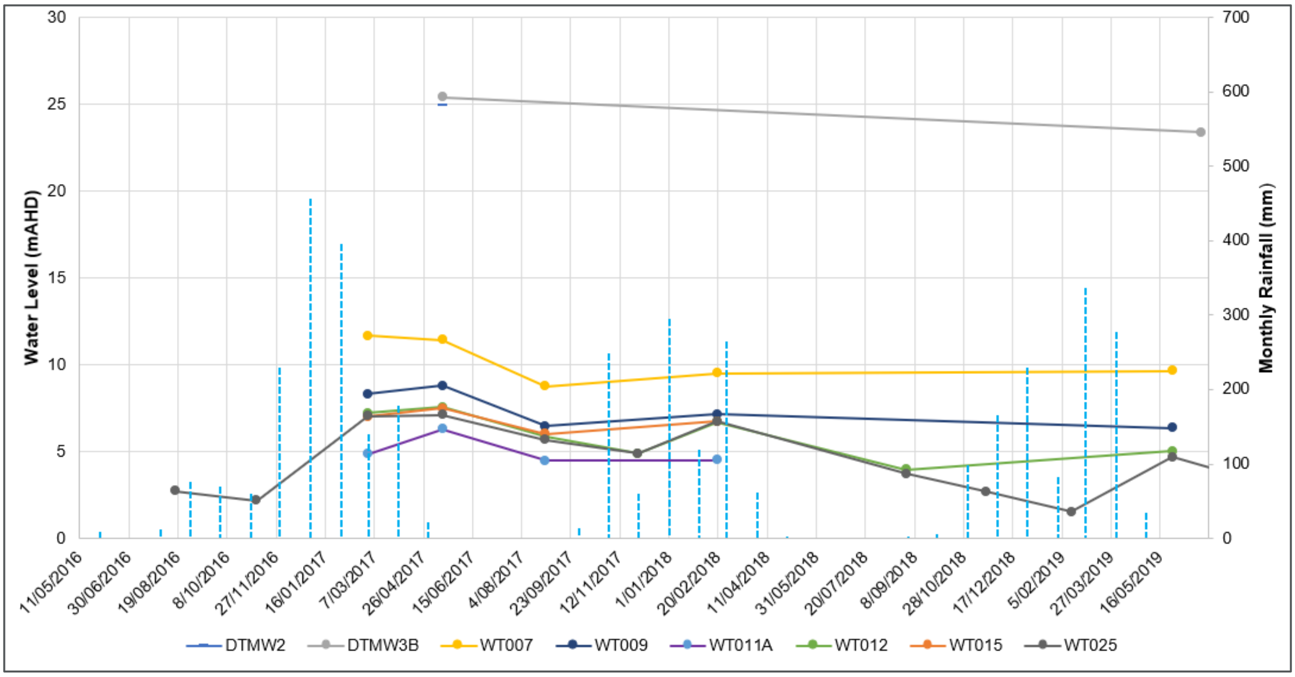
No other exceedances for the monitored parameters were recorded during the reporting period.

6.5.4 *Disposal Facilities Groundwater Monitoring*

6.5.4.1 *Wet and Dry Tip Groundwater Levels*

In accordance with the required frequency, 12 quarterly monitoring events (wet tip) and four annual monitoring events (dry tip) were completed during the reporting period. Between 2016 and 2020, several bores including DTMW1, DTMW3A, WT002A and WT029 were consistently reported as dry and unable to be sampled. Based on the available data (in mAHD), the water level in the monitoring bores around the wet and dry tips appear to respond independently of rainfall events in the area (Figure 6-6). While the monitoring bores around both tips have frequently been reported as dry, a pathway for vertical migration to the Lower Aquifer is currently unknown.

Figure 6-6: Wet and Dry Tip Groundwater Levels



6.5.4.2 *Wet and Dry Tip Water Quality*

Groundwater quality results collected during the reporting period are presented in Table 9-7 (Appendix 9.8). A summary of the exceedances of the ANZG (2018) guidelines were limited to concentrations of dissolved manganese (1.9 mg/L), nickel (0.011 mg/L), lead (0.0034 mg/L) and zinc (0.008 mg/L), as summarised in Table 6-30 (highlighted cells).

Table 6-30: Groundwater Exceedances - Dry and Wet Tips

Monitoring Bore	Sample Date	Dissolved Metals (mg/L)				Leachate Indicators (mg/L)		E.coli (CFM/ 100 mL)	Enterococci (CFM/ 100 mL)
		Mn	Ni	Pb	Zn[1]	K	NH_4N		
Guidelines		**1.9**	**0.011**	**0.0034**	**0.008**	**-**	**0.9**	**-**	**-**
DTMW2	15/05/2017	4.43	-	-	0.010	<1	-	-	-
DTMW3B	15/5/2017	0.61	-	-	0.010	<1	-	-	-
WT007	28/02/2017	0.04	<0.001	0	0.010	3	<0.01	10	<10
WT007	15/05/2017	0.01	<0.001	<0.001	0.010	3	0.05	<1	<10
WT007	22/05/2018	0.01	0.02	<0.001	0.010	3	0.04	210	190
WT009	28/02/2017	0.03	<0.001	<0.001	0.020	1	0.03	<10	<10
WT009	15/05/2017	0.01	0.01	<0.001	0.010	1	0.06	<1	<1
WT009	28/08/2017	0.03	<0.001	0.010	0.010	1	0.01	<1	<1
WT009	19/02/2018	0.02	0.01	<0.001	0.030	1	0.16	<1	<1
WT009	22/05/2018	0.02	0.01	<0.001	0.020	1	0.04	<1	<1
WT009	28/05/2019	0.014	0.003	<0.001	0.018	1	0.04	<1	<1
WT011A	28/02/2017	0.02	<0.001	<0.001	0.010	<1	0.09	7	<100
WT011A	15/05/2017	0.02	<0.001	<0.001	0.010	<1	0.06	<1	<1
WT011A	28/08/2017	0.02	0.01	<0.001	0.010	<1	0.04	<1	<1
WT011A	19/02/2018	0.15	0.01	<0.001	0.030	<1	0.14	2	<1
WT011A	22/05/2018	0.03	0.01	<0.001	0.020	<1	0.02	87	<10
WT012	28/02/2017	0.04	<0.001	<0.001	0.010	<1	0.03	<10	<10
WT012	15/05/2017	0.04	<0.001	<0.001	0.010	<1	0.1	<1	<1
WT012	30/11/2017	0.02	<0.001	<0.001	0.010	<1	0.27	6	< 2
WT012	19/02/2018	0.04	<0.001	<0.001	0.010	<1	0.36	<10	<10
WT012	22/05/2018	0.05	<0.001	<0.001	0.010	<1	0.07	1,000	<1
WT012	30/08/2018	0.021	0.001	<0.001	0.014	<1	0.06	<1	<1
WT012	28/05/2019	0.019	0.002	<0.001	0.010	<1	<0.01	<1	<10
WT015	28/02/2017	0.03	<0.001	<0.001	0.010	<1	0.21	<10	<10
WT015	15/05/2017	0.01	<0.001	<0.001	0.020	<1	0.05	<1	<1
WT015	19/02/2018	0.06	0.01	<0.001	0.020	<1	0.04	<1	<1
WT015	22/05/2018	0.01	<0.001	<0.001	0.020	<1	0.04	6	<1
WT025	28/02/2017	0.01	0.01	<0.001	0.010	<1	0.14	<2	<2
WT025	15/05/2017	0.01	<0.001	<0.001	0.010	<1	0.05	<1	<1
WT025	30/11/2017	0.02	<0.001	<0.001	0.010	<1	0.12	<2	<2
WT025	19/02/2018	0.01	<0.001	<0.001	0.020	<1	0.16	<1	<1
WT025	22/05/2018	0.01	<0.001	<0.001	0.020	<1	0.01	2	3
WT025	30/08/2018	0.019	0.001	<0.001	0.019	<1	0.02	<1	<1
WT025	19/11/2018	0.044	0.002	<0.001	0.030	<1	0.03	<1	<1
WT025	14/02/2019	0.035	0.012	0.002	0.031	<1	2.69	<1	1
WT025	28/05/2019	0.017	0.003	0.006	0.016	<1	0.06	2	<1

(1) Zinc concentrations are not hardness modified.

Concentrations of zinc recorded during the reporting period were within historical ranges for both the dry tip (0.010 to 0.050 mg/L) and wet tip (0.007 to 0.130 mg/L). The consistent magnitude of exceedances and uniform distribution across all sampling locations supports that zinc is likely a natural feature of regional groundwater and not a result of seepage from either tip.

The remaining exceedances during the reporting period for manganese (4.43 mg/L at DTMW2 on 15 May 2017), nickel (0.012 mg/L at WT025 on 14 February 2019) and lead (0.006 mg/L at WT025 on 28 May 2019) were localised, with subsequent sampling events confirming the results to be isolated occurrences.

An absence of landfill leachate indicators (potassium and ammonia), coupled with low total dissolved solids and high levels of dissolved oxygen, indicate that the metal concentrations are unlikely to be related to landfill leachate.

Low concentrations of E.coli and Enterococci bacteria were recorded during the reporting period. The results were attributed to frog faecal matter which was observed to be occupying the bores.

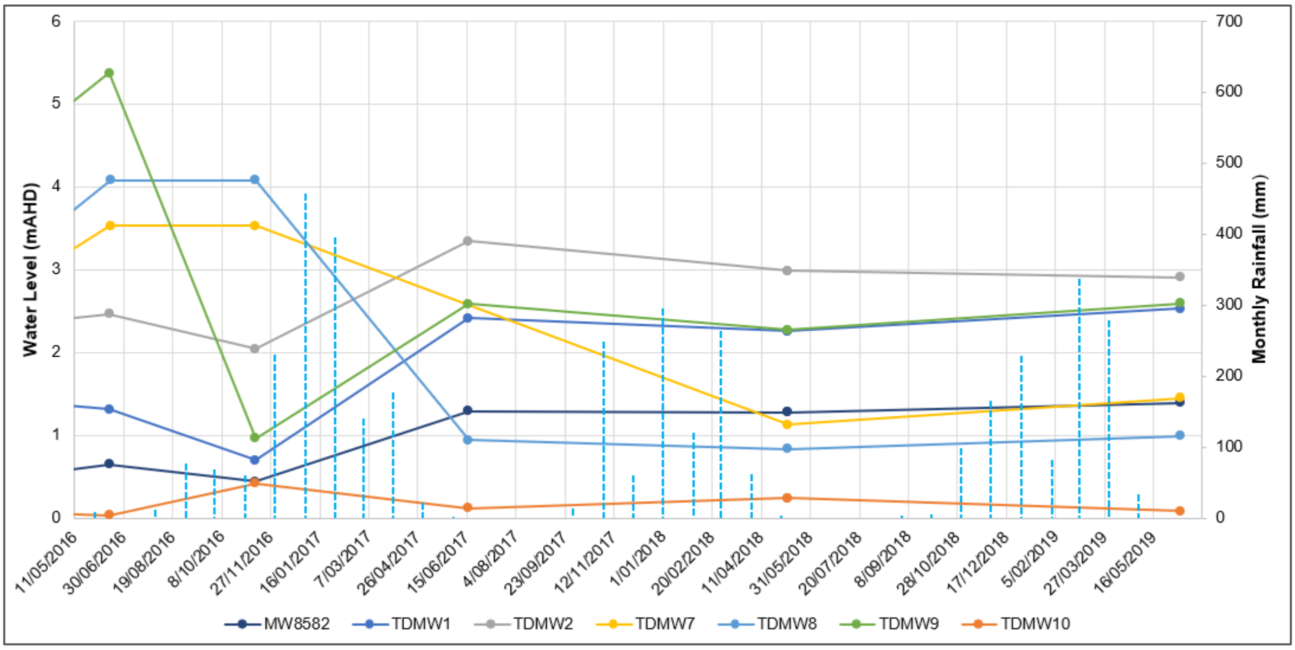
Data recorded during the reporting period, indicates that the landfill cap is reducing rainfall infiltration (albeit lower than average for the region), percolation, and migration of contaminates into the surrounding groundwater. It is therefore unlikely that significant volumes of leachate are currently being produced.

6.5.5 *Tailings Groundwater Monitoring*

6.5.5.1 *Decommissioned TSFs Groundwater Levels*

Groundwater levels surrounding the decommissioned tailings cells (TSF5, TSF6 and TSF7) are graphed in Figure 6-7 alongside rainfall. The inter-season variability appears to be relatively consistent across the latter half of the reporting period. With the exception of TDMW1, TDMW7, TDMW9 and TDMW10, the groundwater levels in 2017, 2018 and 2019 are higher than the same time in 2016. Between 2017 and 2020, groundwater levels have remained relatively stable, likely due in part to the ongoing inactivity of the decommissioned cells.

Figure 6-7: Decommissioned TSF Groundwater Levels



6.5.5.2 *Decommissioned TSFs Water Quality*

In accordance with the required frequency, four annual monitoring events were completed during the reporting period. The groundwater bores are located adjacent to the decommissioned tailings cells to determine whether there are any legacy seepage issues, particularly in relation to migration of metals towards the Angurugu River. Groundwater quality results collected during the reporting period are presented in Table 9-8, Table 9-9 and Table 9-10 (Appendix 9.8).

During the reporting period, manganese concentrations exceeded the ANZG (2018) trigger value (1.9 mg/L) on nine occasions at TDMW1, TDMW8, TDMW9 and TDMW10. Therefore, manganese concentrations have also been compared to 10 years of historical data to assess if exceeding concentrations are outside historical ranges.

In the context of the historical dataset (Figure 6-8), dissolved manganese concentrations continue to show seasonal variability following rainfall events, except during the 2019 wet season (Figure 6-9). Concentrations do display a pattern of increase, with subsequent sampling events recording concentrations above the ANZG (2018) guideline. This supported by exceeding concentrations being greater than the mean concentrations of manganese in the Upper Aquifer (0.705 mg/L) and Lower Aquifer (0.700 mg/L) of the Eastern Leases, which are inferred to represent background concentrations unimpacted by mining activities.

GEMCO will continue to review this trend and discuss any further findings as part of the FY21 EMR.

Figure 6-8: Decommissioned TSF Mn Concentrations (2008-2020)

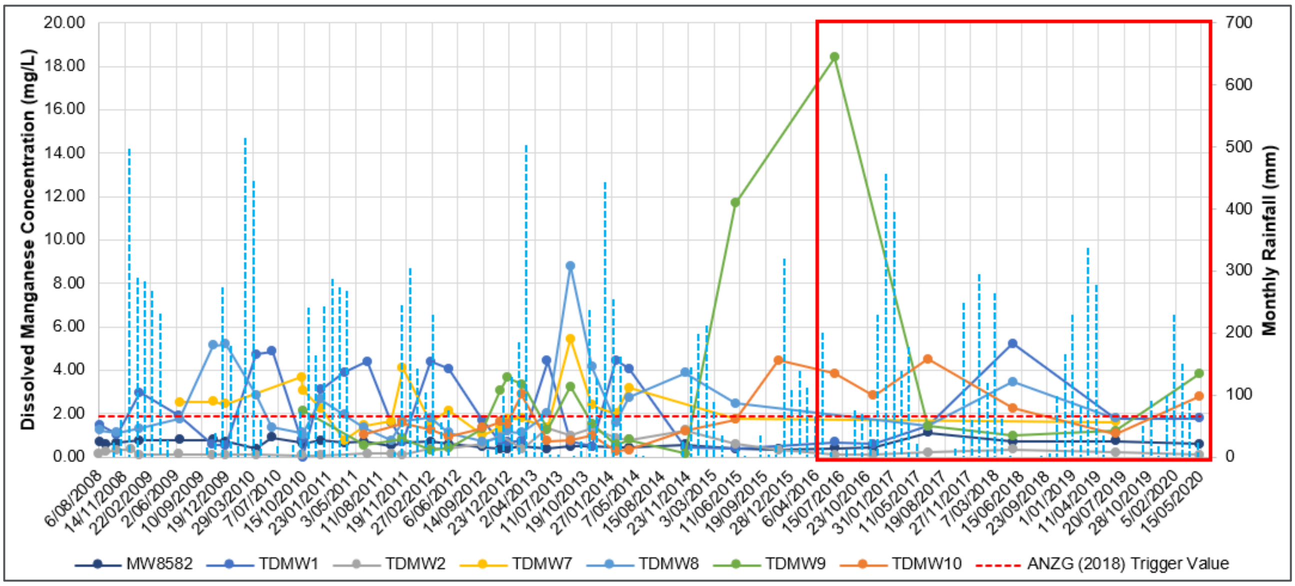
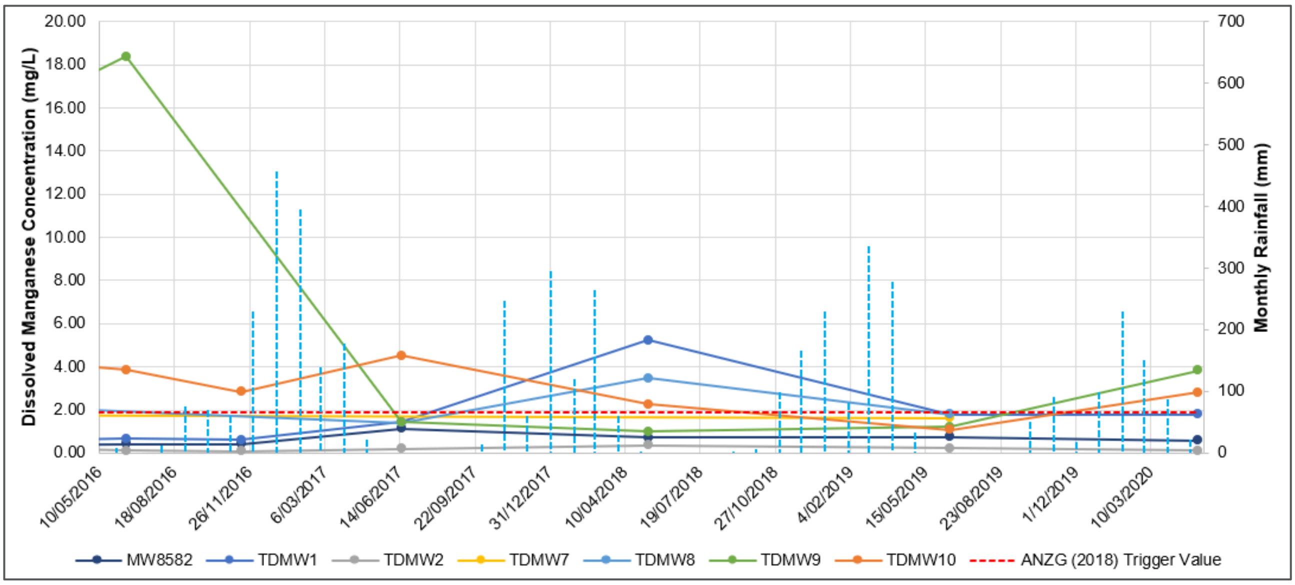


Figure 6-9: Decommissioned TSF Mn Concentrations (2016-2020)



6.5.5.3 *Active TSFs Groundwater Levels*

In accordance with the required frequency, eight biannual monitoring events were completed during the reporting period. Groundwater levels (in mAHD) surrounding the active tailings cells are plotted on Figure 6-10 and Figure 6-11 (TSF11 and TSF13), Figure 6-12 and Figure 6-13 (TSF14 and TSF16), for both the Upper (backfilled material in rehabilitated areas) and Lower aquifers.

Groundwater levels displayed similar fluctuations between the wet season and the dry season with lowest levels recorded just prior to the wet season and subsequent recharge (November 2017).

The groundwater levels in the Upper Aquifer on the eastern side of TSF11/13 (bores MW8616S, MW8617S, MW8618S, MW8635S and MW8636S) are some 10 metres higher than the remainder of the groundwater monitoring network. This is attributed to mounding across from TSF11 and is a consistent trend in groundwater levels that have been observed since 2015 (AECOM, 2018).

The area around MW8616 and MW8617 has previously been associated with seepage emanating from TSF11 cells, TSF9 and TSF11a. A groundwater model predicted that the water level near the toe of the embankment would rise by more than three metres as a result of the TSF pond seepage (URS, 2014; AECOM, 2016). Based on the groundwater level data collected during the reporting period, the groundwater levels in MW8616S and MW8616D have increased by 0.51 m (July 2016 to June 2019) and 4.29 m (July 2016 to June 2019), respectively. Given the absence of significant response to seasonal recharge at MW8616S (see Figure 6-10), the increase in water levels is attributed to seepage emanating from TSF11a.

At TSF14/16, groundwater levels in both the Upper and Lower Aquifers trended lower towards the end of 2018, before rebounding to the highest levels recorded during the reporting period. This is attributed to the mining of the TSF16 area, followed by use as a TSF.

The groundwater levels in both the Upper Aquifer (bores MW8641, MW8643, MW8645, MW8647, and MW8649) and Lower Aquifers (bores MW8640, MW8642, MW8644, MW8646, and MW8648) on the southern side of TSF14/16 are some 10 to 15 metres higher than the remainder of the groundwater monitoring network around the active TSFs.

Based on the modelling reports for each TSF, there was expected to be between 8 to 10 metres of mounding within the TSF14/16 footprint, as well as between 0.1 (TSF16) and 4 metres (TSF14) outside the footprint (AECOM, 2018). Regional baseline contours of groundwater levels indicate that dry season groundwater levels should decrease from about 10 to 12 metres, to 2 to 4 metres across TSF14/16 (AECOM, 2018). This was not observed during the reporting period. Therefore, the groundwater levels recorded on the southern side of TSF14/16 are expected to be the result of TSF seepage. The risk posed to the environment by this seepage is considered extremely low because the TSF water quality is generally below ANZG (2018) water quality guidelines (refer section 6.5.5.4).

Figure 6-10: Active TSF11/13 Groundwater Levels (Upper Aquifer)

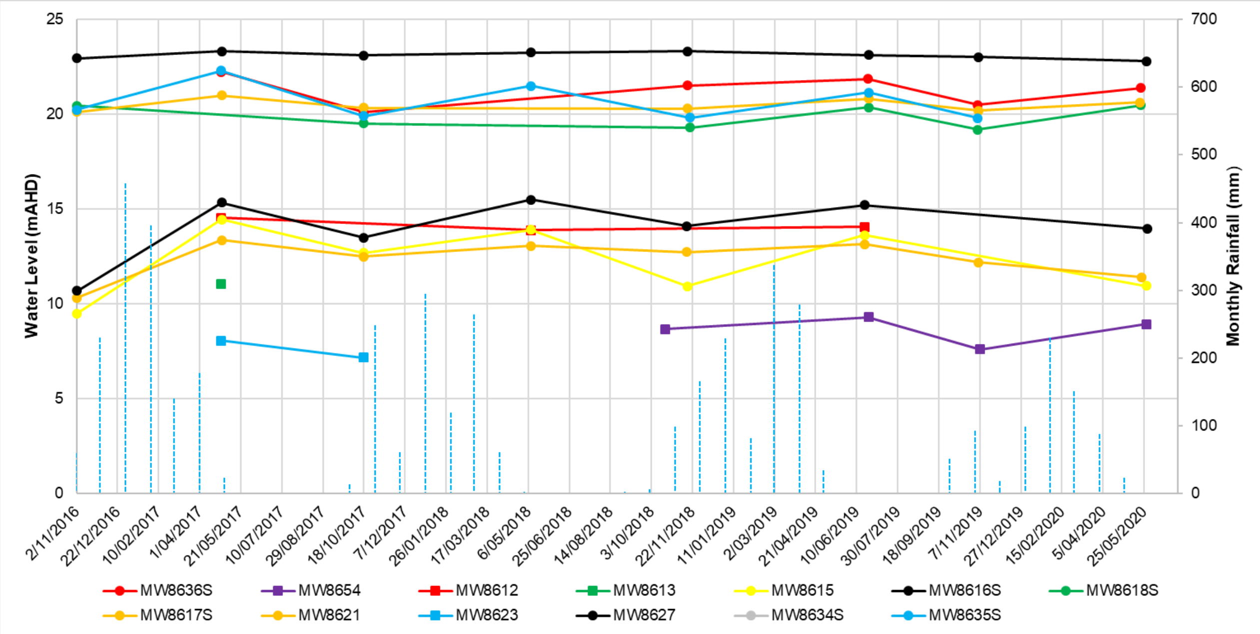


Figure 6-11: Active TSF11/13 Groundwater Levels (Lower Aquifer)

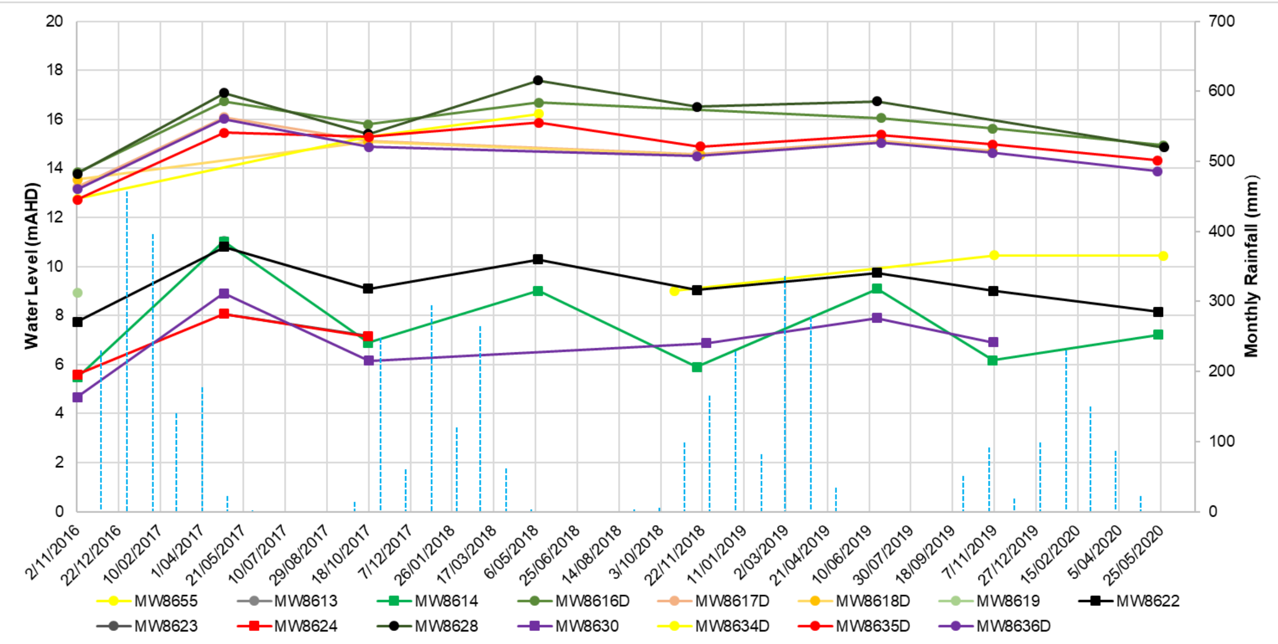


Figure 6-12: Active TSF14/16 Groundwater Levels (Upper Aquifer)

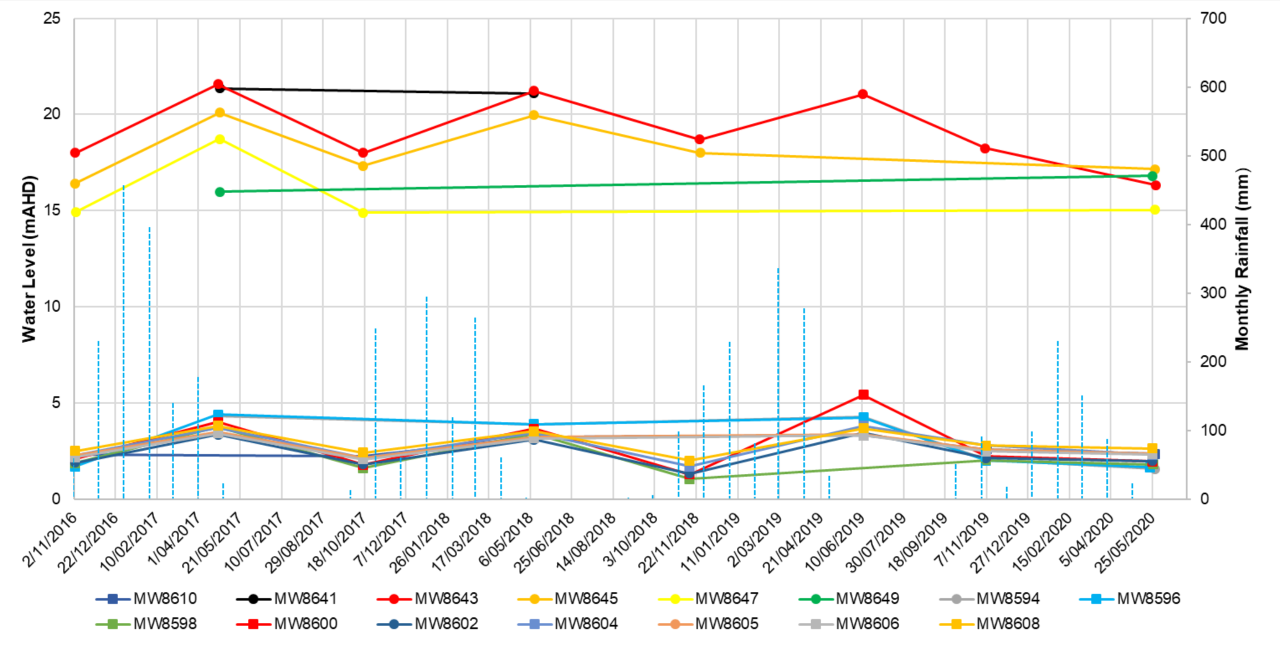
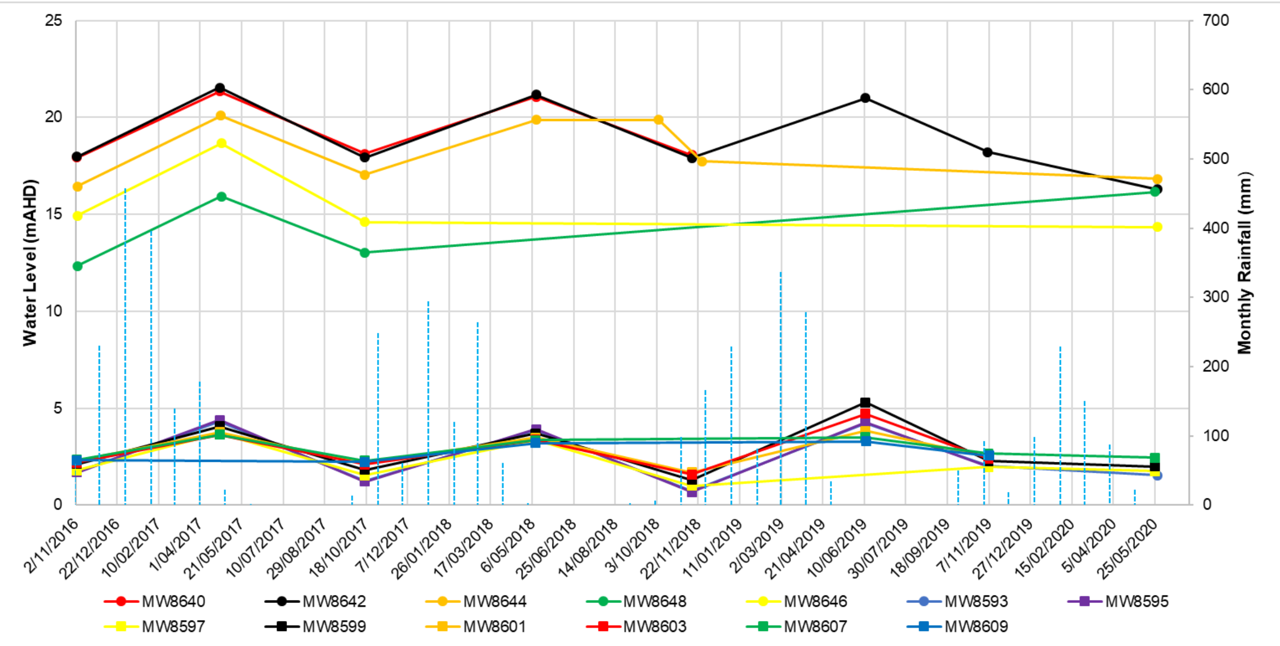


Figure 6-13: Active TSF14/16 Groundwater Levels (Lower Aquifer)



6.5.5.4 *Active TSFs Water Quality*

Biannual water quality sampling is undertaken at groundwater bores adjacent to active tailings facilities to understand the response to groundwater levels and chemistry from the facilities. Groundwater quality results collected during the reporting period are presented in Table 9-8, Table 9-9 and Table 9-10 (Appendix 9.8).

Groundwater models have been developed to simulate the solute transport of tailing seepage water to groundwater around TSF11 (URS, 2014), TSF13 (AECOM, 2016), TSF14/18 (URS, 2013; AECOM, 2018) and TSF16 (URS, 2015). As a result of a local groundwater mounding of the water table, the long-term simulations predict that seepage would migrate into the underlying backfilled material (in the absence of the Upper Aquifer) and into the Lower Aquifer, where it would be transported westwards. In the Upper Aquifer, concentrations of manganese and zinc attributed to seepage were predicted to migrate a small distance laterally, and be generally confined to the footprints of TSF11, TSF13 and TSF16. In the Lower Aquifer, concentrations of manganese and zinc were predicted to be 0.1 mg/L for manganese and 0.001 mg/L for zinc, at 1 km from the facility.

During the reporting period, manganese concentrations exceeded the ANZG (2018) trigger value (1.9 mg/L) on 10 occasions at TSF11/13 (MW8616D and MW8617) and TSF14/16 (MW8648). Manganese concentrations have also been compared to six years of available historical data to assess if exceeding concentrations are outside historical ranges (Figure 6-14, Figure 6-15, Figure 6-16 and Figure 6-17). The elevated concentrations of manganese correlate with the higher groundwater levels recorded on the eastern side of TSF11/13 (MW8616 and MW8617) and southern side of TSF14/16 (MW8648), which support that both the increase in water levels and manganese concentrations are attributed to seepage emanating from the TSFs.

The concentrations recorded in the Lower Aquifer during the reporting period deviate from the solute transport modelling of tailing seepage water to groundwater around TSF11/13 (AECOM, 2016) and TSF14/16 (URS, 2015). The elevated concentrations indicate localised mobilisation of manganese and will require further investigation. However, it should be noted that the modelling did not account for background concentrations of manganese. A review of the Eastern Leases groundwater dataset, considered representative of background concentrations, indicates that manganese solubility increases in anoxic conditions. This natural process is inferred to be occurring in the bores around the active TSFs, and therefore contributing (in part) to the elevated manganese concentrations recorded during this reporting period.

GEMCO will continue to review this trend and discuss any further findings as part of the FY21 EMR.

Figure 6-14: Active TSF11/13 Dissolved Mn Concentrations (Upper Aquifer)

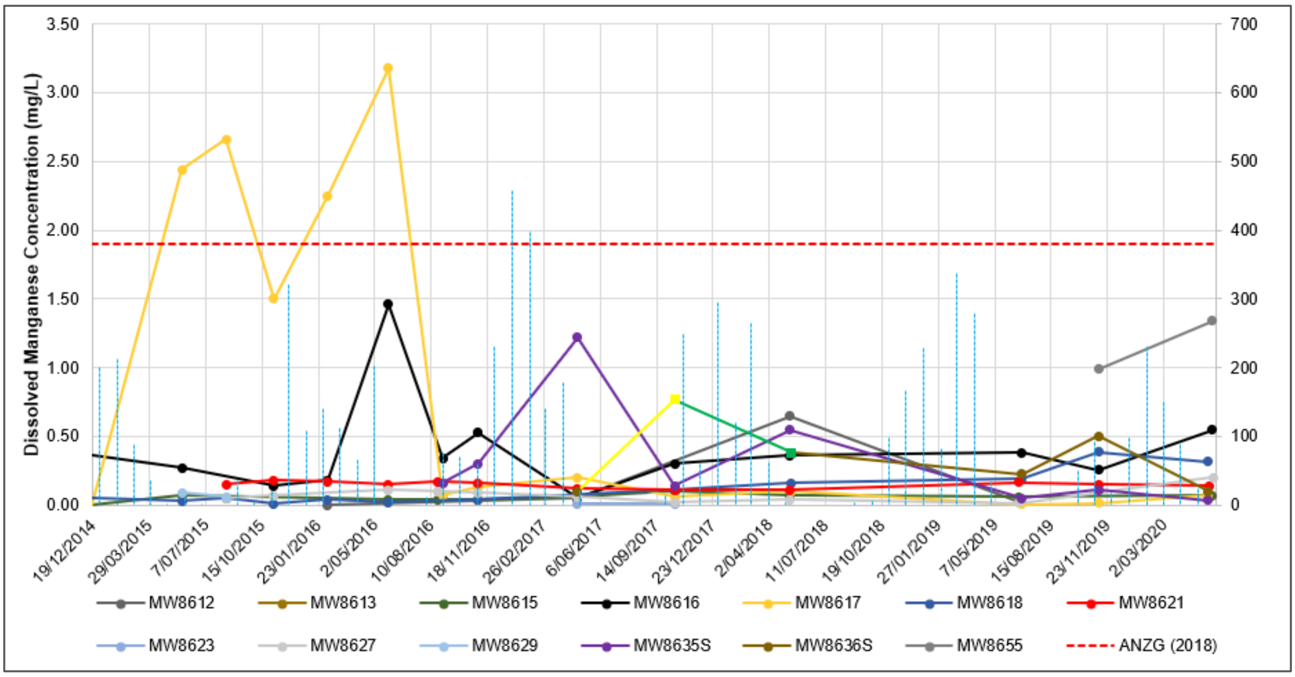


Figure 6-15: Active TSF11/13 Dissolved Mn Concentrations (Lower Aquifer)

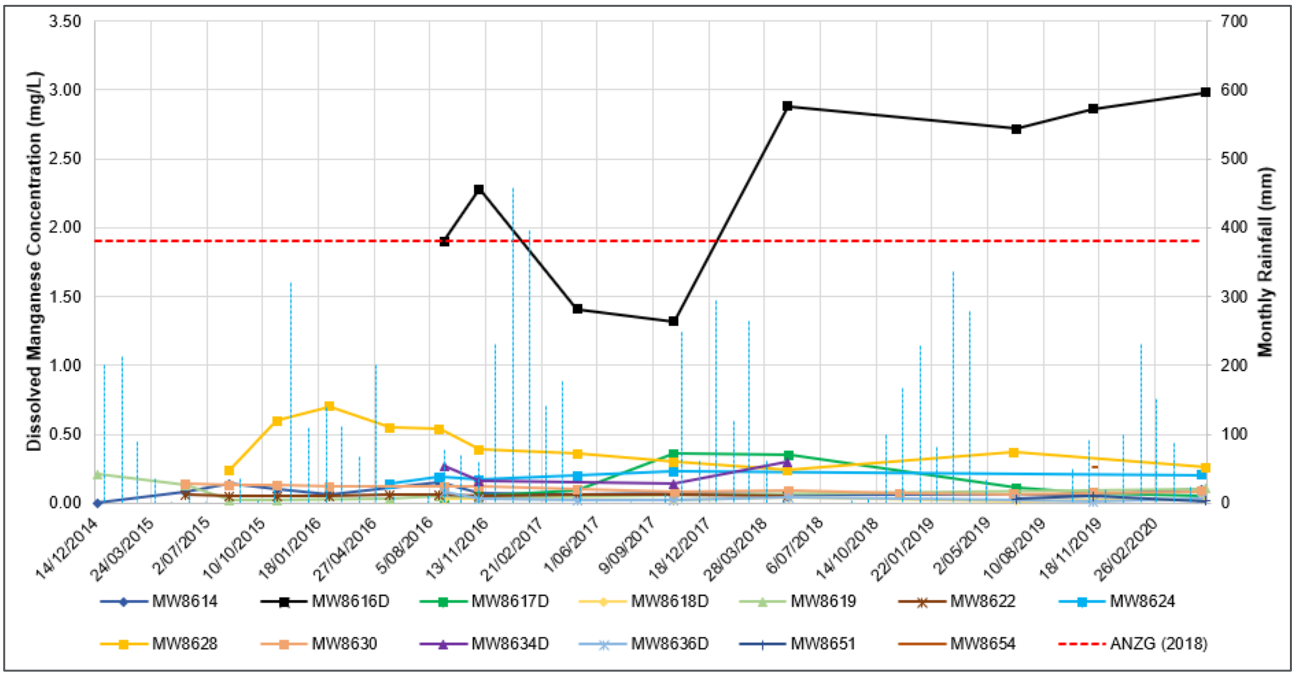


Figure 6-16: Active TSF14/16 Dissolved Mn Concentrations (Upper Aquifer)

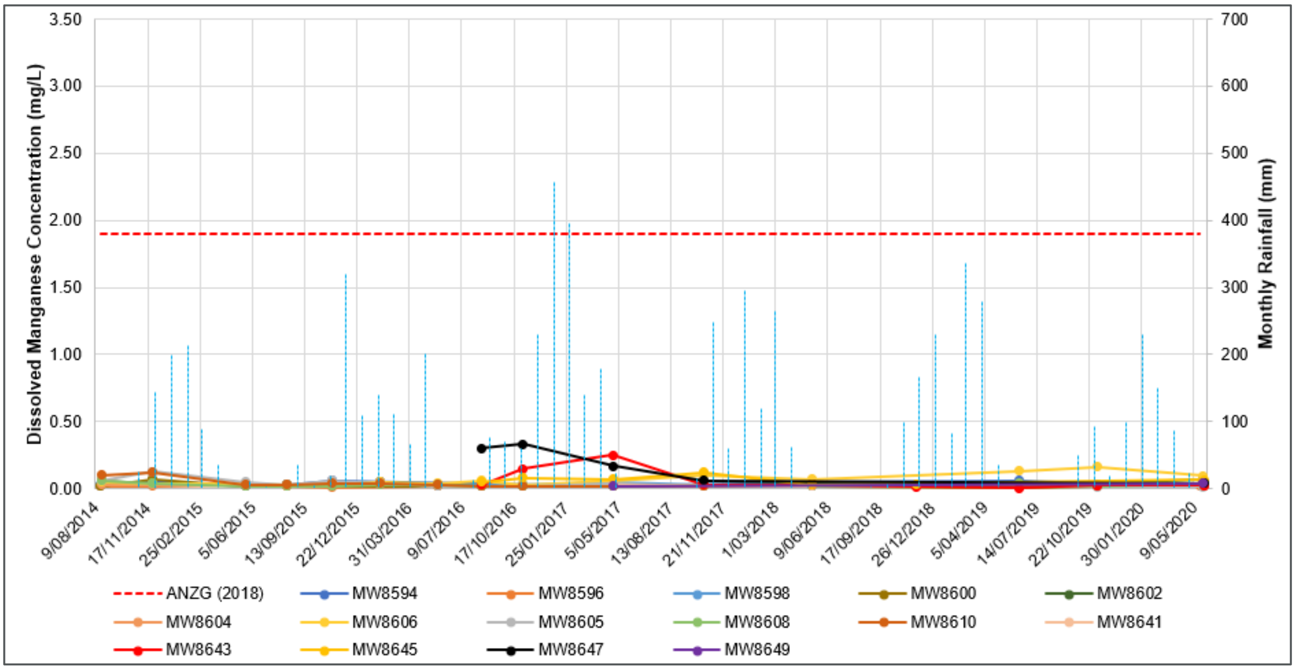
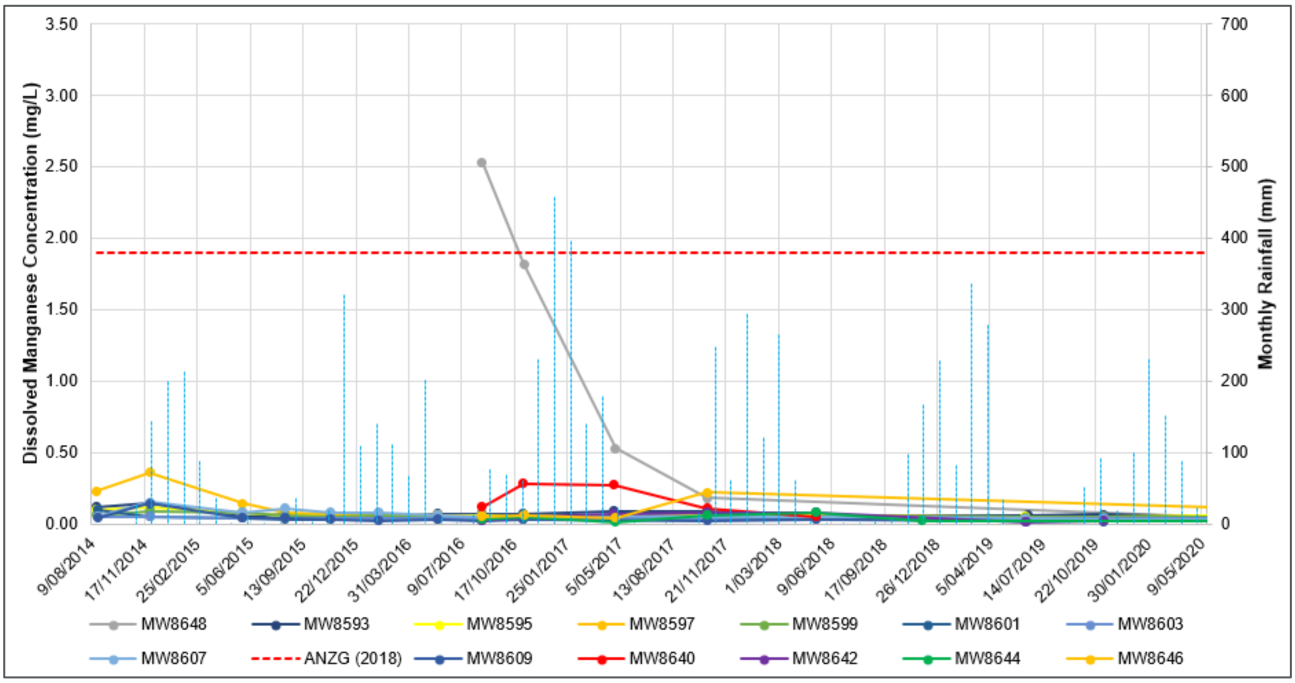


Figure 6-17: Active TSF14/16 Dissolved Mn Concentrations (Lower Aquifer)



Trigger values have not previously been placed on GEMCO's active tailings storage facilities, as it is not anticipated that any analytes of concern will be derived from the facilities. However, to ensure that this is appropriately managed, monitored and not just assumed, GEMCO have derived trigger values based on data collected from the Eastern Leases. The areas within the Eastern Leases is currently limited in development (i.e. exploration activities only), essentially undisturbed and is considered the best-available reference site for background groundwater quality (AECOM, 2019). The site-specific criteria based on 80th percentiles of data from the Eastern Leases have been derived for particular metals and are displayed in Table 6-31.

Table 6-31: Site Specific Criteria for the TSF Monitoring Program

Aquifer	Dissolved Metals (mg/L)					
	Al	Ba	Cu	Fe	Ni	Zn
Guidelines	**0.055**	**-**	**0.0014**	**-**	**0.011**	**0.008**
Upper Aquifer	0.137	0.067	0.056	0.086	0.013	0.017
Lower Aquifer	0.055	0.030	0.020	0.086	0.016	0.018

GEMCO will apply these site-specific trigger values to the bores along the western side of TSF14/18. Particle-tracking during modelling for TSF14/18 and TSF16 show that seepage is expected to migrate west, and that the bores along the western side of TSF14/18 should be in the correct place to pick up any changes. This includes the western ring of bores downgradient of TSF14/18. If guideline values for the western-most bores are exceeded, then bore MW7661 will be monitored as this represents the discharge zone downstream of the entire TSF domain. For TSF11, the criteria will apply to the bores along the north – MW8615, MW8619/8620 and MW8623/MW8624. For TSF13, the criteria will apply to MW8650/MW8651. It is noted that site-specific criteria should be applied to the upper and Lower Aquifer bores separately to be able to distinguish what is normal for each aquifer.

6.5.6 *Port Facility Groundwater Monitoring Results*

Benzene is used as an indicator of contamination from the DPH plume into the groundwater at Milner Bay. Reasons for this include:

- Criteria data for TPH (C6-C36) is not provided within the ANZG (2018) guidelines;
- ANZG (2018) provides a moderate reliability trigger value for benzene;
- Benzene has carcinogenic properties and is considered to be of high risk to human health;
- Benzene is highly volatile and highly mobile; and
- Historic contamination included unleaded fuel as well as diesel.

With the exception of a single sample from PF900A during July 2019, the concentrations of benzene were low during the reporting period (Table 6-32 and Table 6-33).

GEMCO places trigger values on sites PF600A, PF600B, PF600C and PF600D to indicate any risk to the marine environment (with regards to DPH and Phase Separated Hydrocarbons (PSH)). The benzene and TPH concentrations for these bores were all under the LOR, excepting one TPH result of 100 µg/L (Table 6-33).

Table 6-32: Milner Bay DPH Monitoring Results

Sample Point	Sample Date	Benzene (µg/L)	Sample Point	Sample Date	Benzene (µg/L)
MBGW1	31/07/19	< 1	PF0652A	31/07/19	< 1
MBGW1	7/10/19	< 1	PF0652A	7/10/19	< 1
MBGW1	15/01/20	< 1	PF0652A	15/01/20	< 1
MBGW1	15/04/20	< 1	PF0652A	15/04/20	< 1
MBGW2	31/07/19	< 1	PF0652B	31/07/19	< 5
MBGW2	7/10/19	< 1	PF0652B	7/10/19	8
MBGW2	15/01/20	< 1	PF0652B	15/01/20	6
MBGW2	15/04/20	< 1	PF0652B	15/04/20	< 1
PF0201	31/07/19	14	PF0653A	31/07/19	< 1
PF0201	7/10/19	< 1	PF0653A	7/10/19	< 1
PF0201	15/01/20	< 1	PF0653A	15/01/20	< 1
PF0201	15/04/20	< 1	PF0653A	15/04/20	< 1
PF0202	31/07/19	65	PF0653B	31/07/19	< 1
PF0202	7/10/19	113	PF0653B	7/10/19	7
PF0202	15/01/20	53	PF0653B	15/01/20	42
PF0202	15/04/20	< 1	PF0653B	15/04/20	3
PF0259	31/07/19	< 1	PF0653D	31/07/19	< 1
PF0259	7/10/19	< 1	PF0653D	7/10/19	< 1
PF0259	15/01/20	< 1	PF0653D	15/01/20	< 1
PF0259	15/04/20	< 1	PF0653D	15/04/20	< 1
PF0406A	31/07/19	< 1	PF0900A	31/07/19	752
PF0406A	7/10/19	< 1	PF0900A	7/10/19	21

Sample Point	Sample Date	Benzene (µg/L)	Sample Point	Sample Date	Benzene (µg/L)
PF0406A	15/01/20	< 1	PF0900A	15/01/20	< 1
PF0406A	15/04/20	< 1	PF0900A	15/04/20	2
PF0406C	31/07/19	1	PF0900B	31/07/19	< 1
PF0406C	7/10/19	< 2	PF0900B	7/10/19	< 1
PF0406C	15/01/20	5	PF0900B	15/01/20	< 1
PF0406C	15/04/20	< 1	PF0900B	15/04/20	< 1
PF0415	31/07/19	< 1	PF0901A	31/07/19	< 1
PF0415	7/10/19	< 1	PF0901A	7/10/19	< 1
PF0415	15/01/20	< 1	PF0901A	15/01/20	< 1
PF0415	15/04/20	< 1	PF0901A	15/04/20	< 1
PF0432	31/07/19	< 1	PF0901B	31/07/19	< 1
PF0432	7/10/19	< 1	PF0901B	7/10/19	< 1
PF0432	15/01/20	< 1	PF0901B	15/01/20	< 1
PF0432	15/04/20	< 1	PF0901B	15/04/20	< 1
PF0433	31/07/19	< 1	PF0902A	31/07/19	2
PF0433	7/10/19	< 1	PF0902A	7/10/19	< 1
PF0433	15/01/20	< 1	PF0902A	15/01/20	< 1
PF0433	15/04/20	< 1	PF0902A	15/04/20	< 1
PF0441A	31/07/19	< 1	PF0902B	31/07/19	< 1
PF0441A	7/10/19	< 1	PF0902B	7/10/19	< 1
PF0441A	15/01/20	< 1	PF0902B	15/01/20	< 1
PF0441A	15/04/20	< 1	PF0902B	15/04/20	< 1
PF0441D	31/07/19	< 1	PF0903A	31/07/19	< 1
PF0441D	7/10/19	< 1	PF0903A	7/10/19	< 1
PF0441D	15/01/20	< 1	PF0903A	15/01/20	< 1
PF0441D	15/04/20	< 1	PF0903A	15/04/20	< 1
PF0601	31/07/19	1	PF0903B	31/07/19	< 1
PF0601	7/10/19	2	PF0903B	7/10/19	< 1
PF0601	15/01/20	< 1	PF0903B	15/01/20	< 1
PF0601	15/04/20	5	PF0903B	15/04/20	< 1
PF0602	31/07/19	< 1	PF0614D	31/07/19	< 1
PF0602	7/10/19	< 4	PF0614D	7/10/19	< 1
PF0602	15/01/20	2	PF0614D	15/01/20	< 1
PF0602	15/04/20	13	PF0614D	15/04/20	< 1

Table 6-33: DPH Sensitive Receptor Monitoring Results

Sample Point	Sample Date	Benzene (µg/L)	TPH C10-C36 Fraction (µg/L)
Trigger Levels		**500**	**-**
PF0600A	31/07/19	< 1	< 50
PF0600A	7/10/19	< 1	< 50
PF0600A	15/01/20	< 1	100
PF0600A	15/04/20	< 1	< 50
PF0600B	31/07/19	< 1	< 50
PF0600B	7/10/19	< 1	< 50
PF0600B	15/01/20	< 1	< 50
PF0600B	15/04/20	< 1	< 50
PF0600C	31/07/19	< 1	< 50
PF0600C	7/10/19	< 1	< 50
PF0600C	15/01/20	< 1	< 50
PF0600C	15/04/20	< 1	< 50
PF0600D	31/07/19	< 1	< 50
PF0600D	7/10/19	< 1	< 50
PF0600D	15/01/20	< 1	< 50
PF0600D	15/04/20	< 1	< 50

6.5.7 *Sewage Monitoring Water Quality Results*

Sewage effluent and mixing zone monitoring is undertaken in accordance with the conditions of the former Waste Discharge Licence (WDL163-01). Table 6-34 provides results of field parameters for all sites. Several erroneous recordings were obtained from the turbidity and conductivity sensors during the reporting period and have been omitted from the dataset (shown as dashes). These sensors have since been replaced. In line with the former discharge licence, trigger values are applied to the boundary of the declared mixing zone (sites WDL67B3 and WPT021). There were no sampling events where the trigger value for pH or turbidity was breached during the reporting period.

Table 6-34: Sewage Effluent Field Results

Sample Point	Sample Date	pH	Temp (°C)	Turbidity (NTU)	Clark DO (mg/L)	Conductivity (µS/cm)
Trigger Levels		**6-8.5**	**-**	**10**	**-**	**-**
RMS57	25/07/2019	6.4	25.5	54.8	4.3	57,255.6
RMS57	8/08/2019	6.3	26.8	2.3	8.0	501.9
RMS57	5/09/2019	4.3	26.7	1.2	8.1	334.1
RMS57	17/10/2019	6.5	26.0	29.3	3.6	598.3
RMS57	25/11/2019	8.3	29.8	2,217.7	7.7	679.8
RMS57	9/12/2019	7.6	30.3	-	8.7	2.6
RMS57	14/01/2020	6.9	30.5	24.6	2.9	491.4
RMS57	4/02/2020	6.5	35.5	48.1	3.3	400.1
RMS57	26/03/2020	6.7	30.4	37.6	1.6	291.0
RMS57	14/04/2020	6.6	29.2	26.3	2.3	265.2

Sample Point	Sample Date	pH	Temp (°C)	Turbidity (NTU)	Clark DO (mg/L)	Conductivity (µS/cm)
RMS57	19/05/2020	7.0	28.3	34.6	3.7	665.7
RMS57	17/06/2020	7.0	29.2	-	5.3	621.8
WDL67B1	25/07/2019	8.2	22.9	3.4	8.8	-
WDL67B1	8/08/2019	8.2	23.6	3.9	7.0	54307.0
WDL67B1	5/09/2019	8.2	23.9	4.0	4.2	151,612.5
WDL67B1	17/10/2019	8.2	28.1	4.9	6.3	60,411.3
WDL67B1	25/11/2019	8.2	30.6	6.9	4.9	111,490.1
WDL67B1	9/12/2019	8.1	30.5	-	6.4	56,474.3
WDL67B1	14/01/2020	8.0	30.9	-	5.5	55,318.5
WDL67B1	4/02/2020	8.1	31.0	0.8	5.6	55,327.6
WDL67B1	26/03/2020	8.2	29.9	1.6	5.8	58,210.5
WDL67B1	14/04/2020	8.2	29.4	2.2	5.7	67,543.2
WDL67B1	19/05/2020	8.2	27.2	1.2	6.7	58,218.3
WDL67B1	17/06/2020	8.3	25.7	1.5	6.7	55,380.8
WDL67B2	25/07/2019	8.2	22.8	3.5	8.9	-
WDL67B2	8/08/2019	8.2	23.6	3.8	7.0	54,334.7
WDL67B2	5/09/2019	8.2	24.0	3.8	4.3	151,558.6
WDL67B2	17/10/2019	8.1	28.1	4.6	6.2	60,465.8
WDL67B2	25/11/2019	8.2	30.6	7.9	5.0	111,262.5
WDL67B2	9/12/2019	8.1	30.5	-	6.4	56,434.7
WDL67B2	14/01/2020	8.0	30.9	-	5.4	55,359.2
WDL67B2	4/02/2020	8.1	31.0	0.7	5.6	55,317.5
WDL67B2	26/03/2020	8.2	29.9	2.1	5.8	58,176.0
WDL67B2	14/04/2020	8.2	29.4	2.8	5.7	67,602.5
WDL67B2	19/05/2020	8.2	27.3	1.7	6.7	58,236.1
WDL67B2	17/06/2020	8.3	25.7	1.5	6.7	55,523.3
WDL67B3	25/07/2019	8.2	22.9	3.8	8.8	-
WDL67B3	8/08/2019	8.2	23.6	4.1	7.0	54,313.6
WDL67B3	5/09/2019	8.2	23.9	3.6	4.2	152,130.6
WDL67B3	17/10/2019	8.1	27.8	4.4	5.8	60,362.9
WDL67B3	25/11/2019	8.2	30.6	8.0	5.0	111,158.6
WDL67B3	9/12/2019	8.1	30.5	-	6.5	56,470.4
WDL67B3	14/01/2020	8.0	30.8	-	5.1	55,370.6
WDL67B3	4/02/2020	8.1	31.0	0.7	5.5	55,247.8
WDL67B3	26/03/2020	8.1	29.5	1.6	5.6	58,046.0
WDL67B3	14/04/2020	8.1	29.2	1.8	5.6	67,317.1
WDL67B3	19/05/2020	8.1	27.3	0.9	6.7	58,277.1
WDL67B3	17/06/2020	8.3	25.7	1.8	6.7	55,578.7
WDL67BC	25/07/2019	8.2	22.8	3.7	8.8	-
WDL67BC	8/08/2019	8.2	23.7	5.5	6.9	54,135.2
WDL67BC	5/09/2019	8.2	23.9	4.2	4.3	151,350.0

Sample Point	Sample Date	pH	Temp (°C)	Turbidity (NTU)	Clark DO (mg/L)	Conductivity (µS/cm)
WDL67BC	17/10/2019	8.1	28.0	5.2	6.3	60,340.9
WDL67BC	25/11/2019	7.2	32.1	7.2	4.9	104,493.0
WDL67BC	9/12/2019	8.0	30.6	-	6.6	56,370.6
WDL67BC	14/01/2020	7.9	30.8	-	5.6	55,188.6
WDL67BC	4/02/2020	8.0	31.3	1.1	5.5	54,955.1
WDL67BC	26/03/2020	8.2	30.1	2.0	5.9	58,249.2
WDL67BC	14/04/2020	8.1	29.5	5.0	5.7	67,811.0
WDL67BC	19/05/2020	8.1	27.2	0.7	6.7	58,268.3
WDL67BC	17/06/2020	8.3	25.6	1.6	6.7	55,830.3
WPT021	5/09/2019	8.2	25.0	8.9	4.4	147,245.0
WPT021	25/11/2019	8.1	30.0	5.4	4.7	109,103.7
WPT021	26/03/2020	8.3	30.7	2.1	6.0	57,407.9
WPT021	17/06/2020	8.3	25.6	1.5	6.7	55,930.8

Laboratory data collected from effluent monitoring is provided in Table 6-35 with trigger levels applied to WDL67B3 and WPT021. There is no manganese data for September, October and November 2019 as this was accidently omitted by the laboratory. To ensure there is consistency in the analytes being measured and any accidental omissions are prevented in the future, GEMCO now uses standard analyte suites tailored to each monitoring program.

During the FY20 sampling period, the concentration of nitrate and nitrite, chlorophyll a and total suspended solids (TSS) was low and below the trigger value. Total nitrogen, ammonia, and total phosphorus exceeded their respective trigger values on a limited number of occasions. However, similar levels were also recorded at the background site (WDL67BC) and the concentrations are in line with historical data for these sites.

The concentration of TPH was below the LOR at all sampling points within Milner Bay for all of the sampling events.

Metal concentrations were low throughout the sampling period. Manganese concentrations were below the trigger value during every sampling event and zinc concentrations were below the LOR for every sampling event. The detection limit for zinc is slightly above the trigger value so there is uncertainty as to whether this may have been exceeded on occasions.

Table 6-35: Sewage Effluent Compliance Monitoring Results

Sample Point	Sample Date	(TPH) C10-C36 (µg/L)	BOD Lab (mg/L)	TSS (mg/L)	NOx (µg/L)	N Total (mg/L)	P Total (mg/L)	Enterococci (CFU per 100 mL)	Chlorophyll a (mg/m3)	Mn (Dissolved) (mg/L)	Zn (Dissolved) (mg/L)	Ammonia as N (mg/L)	Nitrate and Nitrite as N (mg/L)	Reactive Phosphorus as P (mg/L)
Trigger Levels		**600**	**-**	**10**	**-**	**0.1**	**0.015-0.020**	**200**	**<1**	**0.14**	**0.015**	**0.01**	**0.01**	**0.008**
RMS57	25/07/19	1,760	44	25	0.04	23.9	3.34	< 2	< 2	0.500	0.040	20.4	0.04	2.77
RMS57	5/09/19	3,220	64	41	0.02	26.5	3.67	23,000	< 3		0.022	20.8	0.02	2.62
RMS57	17/10/19	2,650	15	31	0.19	23.4	3.14	29	< 2		0.029	18.9	0.19	2.64
RMS57	25/11/19	2,440	44	42	0.02	26.4	3.78	20,000	< 4		0.029	22.6	0.02	2.96
RMS57	9/12/19	2,860	< 2	21	0.01	22.3	3.24	2	< 3	0.613	0.030	11.3	0.01	2.80
RMS57	14/01/20	2,490	49	33	< 0.01	20.1	2.92	15,000	< 4	0.549	0.023	19.5	< 0.01	2.40
RMS57	5/02/20	2,640	< 2	28	0.03	18.8	3.10	2	< 3	0.769	0.031	16.7	0.03	2.66
RMS57	26/03/20	2,700	19	43	< 0.01	23.5	3.13	80,000	< 4	0.534	0.021	19.5	< 0.01	2.20
RMS57	14/04/20	3,020	87	33	0.01	18.7	2.63	23,000	< 3	0.563	0.028	13.5	0.01	2.44
RMS57	19/05/20	2,730	71	45	< 0.01	20.1	2.92	83	< 2	0.428	0.032	17.5	< 0.01	2.50
RMS57	17/06/20	1,960	< 2	116	0.04	37.9	4.80	< 2	< 7	1.39	0.055	31.6	0.04	3.34
WDL67B1	25/07/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	1.12	< 0.01	< 0.01
WDL67B1	8/08/19	< 50	< 2	8	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.04	< 0.01	< 0.01
WDL67B1	5/09/19	< 50	< 2	< 5	0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.05	0.01	< 0.01
WDL67B1	17/10/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.17	< 0.01	< 0.01
WDL67B1	25/11/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.02	< 0.01	< 0.01
WDL67B1	9/12/19	< 50	< 2	5	< 0.01	< 1	< 0.10	< 1	1	0.006	< 0.025	< 0.01	< 0.01	< 0.01
WDL67B1	14/01/20	< 50	< 2	< 5	< 0.01	< 0.5	< 0.05	< 1	< 1	< 0.005	< 0.025	0.01	< 0.01	< 0.01

Sample Point	Sample Date	(TPH) C10-C36 (µg/L)	BOD Lab (mg/L)	TSS (mg/L)	NOx (µg/L)	N Total (mg/L)	P Total (mg/L)	Enterococci (CFU per 100 mL)	Chlorophyll a (mg/m3)	Mn (Dissolved) (mg/L)	Zn (Dissolved) (mg/L)	Ammonia as N (mg/L)	Nitrate and Nitrite as N (mg/L)	Reactive Phosphorus as P (mg/L)
Trigger Levels		**600**	**-**	**10**	**-**	**0.1**	**0.015-0.020**	**200**	**<1**	**0.14**	**0.015**	**0.01**	**0.01**	**0.008**
WDL67B1	5/02/20	< 50	< 2	8	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.04	< 0.01	< 0.01
WDL67B1	26/03/20	< 50	< 2	< 5	< 0.01	0.6	0.06	< 1	< 1	< 0.005	< 0.025	0.02	< 0.01	< 0.01
WDL67B1	14/04/20	< 50	< 2	6	0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.06	0.01	< 0.01
WDL67B1	19/05/20	< 50	< 2	< 5	< 0.01	< 0.5	< 0.05	5	< 1	< 0.005	< 0.025	0.04	< 0.01	0.01
WDL67B1	17/06/20	< 50	10	< 5	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.03	< 0.01	< 0.01
WDL67B2	25/07/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.04	< 0.01	< 0.01
WDL67B2	8/08/19	< 50	< 2	6	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.02	< 0.01	< 0.01
WDL67B2	5/09/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.05	< 0.01	< 0.01
WDL67B2	17/10/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.14	< 0.01	< 0.01
WDL67B2	25/11/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.02	< 0.01	< 0.01
WDL67B2	9/12/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	2	0.007	< 0.025	< 0.01	< 0.01	< 0.01
WDL67B2	14/01/20	< 50	< 2	< 5	< 0.01	< 0.5	< 0.05	< 1	< 1	< 0.005	< 0.025	< 0.01	< 0.01	< 0.01
WDL67B2	5/02/20	< 50	< 2	10	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.10	< 0.01	< 0.01
WDL67B2	26/03/20	< 50	< 2	7	< 0.01	0.9	0.05	< 1	< 1	< 0.005	< 0.025	0.24	< 0.01	< 0.01
WDL67B2	14/04/20	< 50	< 2	< 5	< 0.01	< 1	< 0.10	3	< 1	< 0.005	< 0.025	0.09	< 0.01	< 0.01
WDL67B2	19/05/20	< 50	< 2	< 5	< 0.01	< 0.5	< 0.05	4	< 1	< 0.005	< 0.025	0.04	< 0.01	0.01
WDL67B2	17/06/20	< 50	2	< 5	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.10	< 0.01	< 0.01
WDL67B3	25/07/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.07	< 0.01	< 0.01
WDL67B3	8/08/19	< 50	< 2	5	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.06	< 0.01	< 0.01
WDL67B3	5/09/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.04	< 0.01	< 0.01

Sample Point	Sample Date	(TPH) C10-C36 (µg/L)	BOD Lab (mg/L)	TSS (mg/L)	NOx (µg/L)	N Total (mg/L)	P Total (mg/L)	Enterococci (CFU per 100 mL)	Chlorophyll a (mg/m3)	Mn (Dissolved) (mg/L)	Zn (Dissolved) (mg/L)	Ammonia as N (mg/L)	Nitrate and Nitrite as N (mg/L)	Reactive Phosphorus as P (mg/L)
Trigger Levels		**600**	**-**	**10**	**-**	**0.1**	**0.015-0.020**	**200**	**<1**	**0.14**	**0.015**	**0.01**	**0.01**	**0.008**
WDL67B3	17/10/19	< 50	< 2	< 5	< 0.01	1.3	< 0.10	< 1	< 1		< 0.025	0.20	< 0.01	< 0.01
WDL67B3	25/11/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.02	< 0.01	< 0.01
WDL67B3	9/12/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	10	< 1	< 0.005	< 0.025	< 0.01	< 0.01	< 0.01
WDL67B3	14/01/20	< 50	< 2	< 5	< 0.01	< 0.5	< 0.05	< 1	< 1	< 0.005	< 0.025	< 0.01	< 0.01	< 0.01
WDL67B3	5/02/20	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.02	< 0.01	< 0.01
WDL67B3	26/03/20	< 50	< 2	7	< 0.01	0.7	0.05	< 1	< 1	< 0.005	< 0.025	0.09	< 0.01	< 0.01
WDL67B3	14/04/20	< 50	< 2	6	0.01	< 1	< 0.10	< 1	< 1	0.006	< 0.025	0.09	0.01	< 0.01
WDL67B3	19/05/20	< 50	< 2	< 5	< 0.01	< 0.5	< 0.05	3	< 1	< 0.005	< 0.025	0.03	< 0.01	< 0.01
WDL67B3	17/06/20	< 50	3	8	< 0.01	< 1	< 0.10	1	< 1	< 0.005	< 0.025	0.03	< 0.01	< 0.01
WDL67BC	25/07/19	< 50	< 2	7	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.04	< 0.01	< 0.01
WDL67BC	8/08/19	< 50	< 2	11	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.06	< 0.01	< 0.01
WDL67BC	5/09/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.03	< 0.01	< 0.01
WDL67BC	17/10/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.22	< 0.01	< 0.01
WDL67BC	25/11/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.02	< 0.01	< 0.01
WDL67BC	9/12/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	2	< 0.005	< 0.025	< 0.01	< 0.01	< 0.01
WDL67BC	14/01/20	< 50	< 2	< 5	< 0.01	< 0.5	< 0.05	< 1	< 1	< 0.005	< 0.025	< 0.01	< 0.01	< 0.01
WDL67BC	5/02/20	< 50	< 2	12	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.04	< 0.01	< 0.01
WDL67BC	26/03/20	< 50	< 2	8	< 0.01	1.0	0.08	< 1	< 1	< 0.005	< 0.025	0.06	< 0.01	< 0.01
WDL67BC	14/04/20	< 50	< 2	< 5	0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.10	0.01	< 0.01
WDL67BC	19/05/20	< 50	< 2	< 5	< 0.01	< 0.5	< 0.05	< 1	< 1	< 0.005	< 0.025	0.07	< 0.01	< 0.01

Sample Point	Sample Date	(TPH) C10-C36 (µg/L)	BOD Lab (mg/L)	TSS (mg/L)	NOx (µg/L)	N Total (mg/L)	P Total (mg/L)	Enterococci (CFU per 100 mL)	Chlorophyll a (mg/m3)	Mn (Dissolved) (mg/L)	Zn (Dissolved) (mg/L)	Ammonia as N (mg/L)	Nitrate and Nitrite as N (mg/L)	Reactive Phosphorus as P (mg/L)
Trigger Levels		**600**	**-**	**10**	**-**	**0.1**	**0.015-0.020**	**200**	**<1**	**0.14**	**0.015**	**0.01**	**0.01**	**0.008**
WDL67BC	17/06/20	< 50	< 2	11	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.10	< 0.01	< 0.01
WPT021	5/09/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.03	< 0.01	0.02
WPT021	25/11/19	< 50	< 2	< 5	< 0.01	< 1	< 0.10	< 1	< 1		< 0.025	0.02	< 0.01	< 0.01
WPT021	26/03/20	< 50	< 2	< 5	< 0.01	1.7	0.12	< 1	< 1	< 0.005	< 0.025	0.13	< 0.01	< 0.01
WPT021	17/06/20	< 50	3	< 5	< 0.01	< 1	< 0.10	< 1	< 1	< 0.005	< 0.025	0.02	< 0.01	< 0.01

6.5.8 *Marine Monitoring Program*

6.5.8.1 *Marine Environmental Monitoring conducted during 2019 and comparison to samples collected since 2014*

Consistent with MEMP sampling conducted since 2013, water and sediment samples were collected during December 2019 from beach and ocean sampling sites detailed in Table 6-18. Samples were analysed by Charles Darwin University in accordance with techniques recommended by AIMS (2013). This document provides comparison and discussion between the current results and the trigger values recommended by AIMS (2013). When applicable, comparison and discussion between samples collected within the port zone and those collected within control zones is also provided. Biota samples were collected during 2019, with oysters being collected at all locations indicated within Table 6-18, and seven individual Stripey Snapper and seven individual Tusk fish being collected within the port area. The concentrations of analytes within biota samples were compared to applicable MPCs prescribed by FSANZ (2017) and, when further investigation was warranted, to HBGVs recommended by AIMS (2013).

A comparison of applicable current data collected between 2015 and 2018 is provided and discussed below. In order to facilitate these comparisons, and to indicate that a sample was indeed collected and analysed, samples for which the concentrations of analytes were found to be below the laboratory LOR were considered to be half the LOR.

Minor terminology changes have been incorporated for ease of interpretation. Water trigger values are referred to as Default Guideline Values (DGVs) to reflect current terminology used within the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018). Sediment trigger values are referred to as SQGVs to reflect terminology used by Simpson and Batley (2016) and provide differentiation from water trigger values. Trigger values specific to GEMCO operations are referred to as Site Specific Trigger Values (SSTV's) in accordance with ANZG (2018). Trigger values for PAH's are referred to as AIMS recommended TVs as these do not appear within current regulations but are retained for reasons discussed previously. These are nomenclature changes purely to align this document with revised standards. As discussed previously, the vast majority of concentrations recommended within updated regulations align with those detailed in ANZECC (2000) and recommended by AIMS (2013).

6.5.8.2 *Water Samples collected from Beach Seep Site*

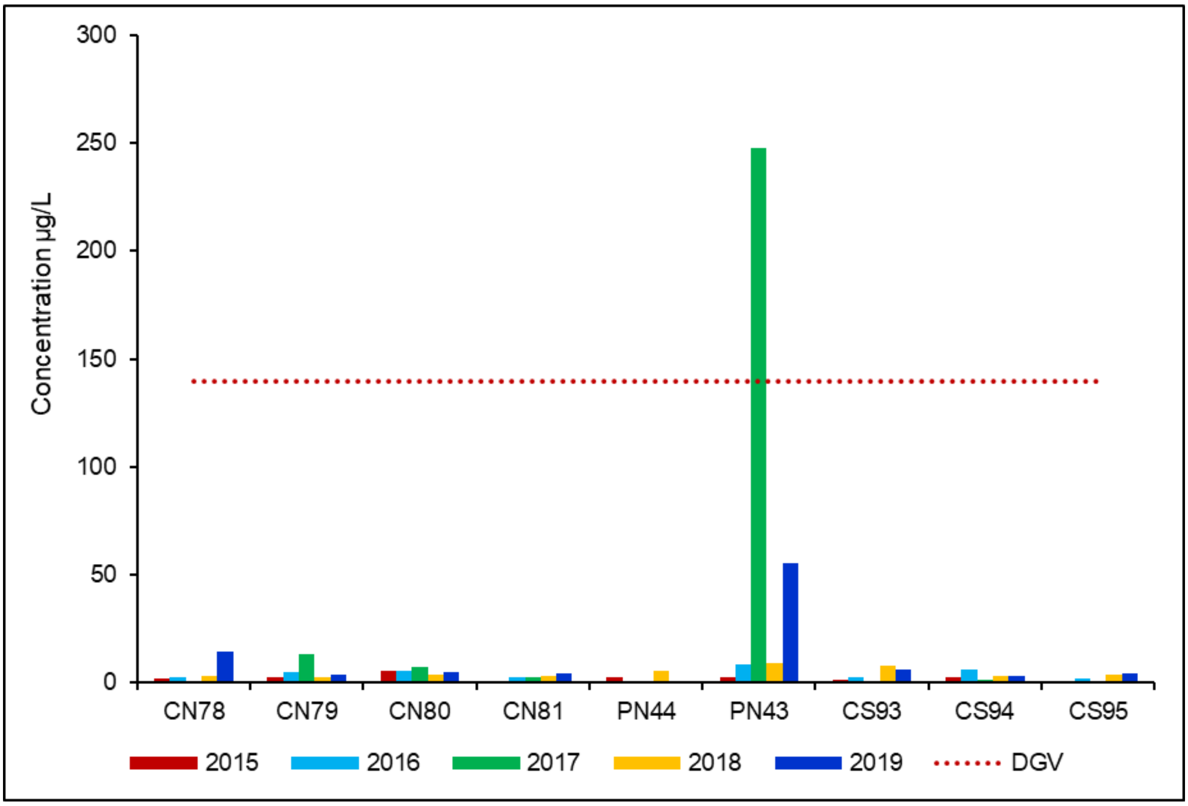
In relation to 2019 beach seep water samples, the concentrations of all hydrocarbon analytes monitored were below the LOR. The bioavailable concentrations of monitored metal and metalloids were below the applicable guideline value and in most cases below the LOR, with the exception of the copper within the sample collected at CS93. The concentration of copper at that site was reported as 2 µg/L, which marginally exceeded the 1.3 µg/L DGV for copper (Table 6-36). The concentration of copper at CS94 and CS95, located directly adjacent CS93, was below the 1 µg/L reporting limit (Table 6-36). Furthermore, CS93 is geographically removed and up current in relation to GEMCO operations. Therefore, the origin of copper within the CS93 water sample is very likely naturogenic rather than anthropogenic. Munksgaard and Parry (2004), Peerzada et al. (1990) and Peerzada et al. (1992) state that copper concentrations within the natural marine environment of Northern Australia characteristically exceed trigger values and in a majority of cases do not pose a threat to the environment. During 2019, the bioavailable concentration of manganese at PN43 was 55.7 µg/L which, although well below the site specific guideline value of 140 µg/L, was noticeably higher than all other sites (Table 6-36). However, as shown in Figure 9-13, this site is directly adjacent GEMCO manganese loading facilities therefore some elevation in manganese is expected. In comparison to beach seep samples analysed since 2014, there is no evidence of increasing concentrations of bioavailable manganese at PN43 (Figure 6-18).

The bioavailable concentrations of remaining analytes with assigned guideline values, were close to, or below, the applicable reporting limit and therefore well below respective guideline values (Table 6-36). Analytes without assigned guideline values were found to have relatively uniform concentrations throughout the study area and did not exhibit any discernible spatial relationship with GEMCO operations.

Table 6-36: Bioavailable Concentration of Metal and Metalloids within Beach Seep Water (2019)

Analyte	Al	As	Ba	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG DGV 95%		***4.5***			***5.5***	***4.4***	***1***	***1.3***		***4.4***	***140***	***0.4***	***70***			***100***	***15***
Reporting Limit	***<5.0***	***<0.5***	***<1***	***<100***	***<0.2***	***<0.5***	***<0.2***	***<1.0***	***<5.0***	***<0.2***	***<0.5***	***<0.1***	***<0.5***	***<2.0***	***<0.1***	***<0.5***	***<5.0***
CN78	<5	2	7	4,940	<0.2	<0.5	<0.2	<1	<5	<0.2	14.4	<0.1	<0.5	23	3.4	2	<5
CN79	<5	2	8	4,080	<0.2	<0.5	<0.2	<1	<5	<0.2	4	<0.1	<0.5	26	3.3	1.9	<5
CN80	6	1.9	7	3,940	<0.2	<0.5	<0.2	<1	6	<0.2	4.8	<0.1	<0.5	24	3.2	2.1	<5
CN81	<5	1.9	7	3,910	<0.2	<0.5	<0.2	<1	<5	<0.2	4.3	<0.1	<0.5	21	3	2	<5
PN43	36	0.8	28	3,000	<0.2	<0.5	<0.2	<1	12	<0.2	55.7	<0.1	<0.5	16	2.9	1.4	<5
PN44	<5	0.8	10	3,680	<0.2	<0.5	<0.2	<1	<5	<0.2	0.5	<0.1	1.4	20	2.6	1.1	<5
CS93	<5	1.5	8	5,840	<0.2	<0.5	<0.2	2	<5	<0.2	6.1	<0.1	0.9	24	2.8	1.7	14
CS94	6	1.2	7	5,740	<0.2	<0.5	<0.2	<1	6	<0.2	3.2	<0.1	<0.5	23	2.7	1.1	<5
CS95	<5	1.2	7	5,610	<0.2	<0.5	<0.2	<1	6	<0.2	4.2	<0.1	<0.5	23	2.8	1.1	<5

Figure 6-18: Bioavailable Concentration of Manganese within Beach Seep Water



6.5.8.3 *Water Samples collected from Ocean Water Sites*

The concentration of all hydrocarbon parameters monitored were below reporting limits for all ocean water samples collected within the study area during 2019. With regards to bioavailable metal and metalloid concentrations, the concentration of copper exceeded the 1.3 µg/L guideline value at sites PN1B, PN5B located north of the loading jetty, and site PS9B located south of the loading jetty (Figure 9-13). The concentrations recorded at those three sites were 9 µg/L, 3 µg/L and 2 µg/L, respectively (Table 6-37). In all three instances, the exceedance of copper was recorded in the sample taken at the base of water column, while the corresponding sample taken from surface water was less than the 1.0 µg/L LOR. The concentrations of copper at sites directly adjacent were also below the LOR in all instances. The magnitude and geographical pattern of copper observed at these locations, and within the surrounding port area, is consistent with that reported in previous years (Figure 6-19). It is therefore apparent that elevated copper concentrations remain extremely localised and are unlikely to represent an environmental risk. In relation to remaining analytes with assigned guideline values, the bioavailable concentrations recorded from 2019 samples were close to, or below, the applicable reporting limit and therefore well below respective guideline values (Table 6-37). Analytes without assigned guideline values were found to have relatively uniform concentrations throughout the study area and did not exhibit any discernible spatial relationship with GEMCO operations.

Aside from the previously discussed analyte concentrations within beach seep and ocean water samples, the following observations can be drawn from data collected between 2014 and 2019.

- Within marine waters Arsenic (III) is known to be more toxic than Arsenic (V) however Arsenic (III) is uncommon in marine waters. Concentrations of total arsenic within beach seep and ocean water samples have historically remained below 4.5 µg/L and the vast majority below 2 µg/L. The low reliability marine guideline for Arsenic (V) is 4.5 µg/L. However, this has an assessment factor of 200 due to limited data (ANZG, 2018). There does not appear to be spatial relationship between arsenic concentrations and GEMCO activity and this analyte is not considered to represent an environmental risk within the port or control areas.

- The concentrations of cadmium within beach seep and ocean water samples have always been less than the 0.2 µg/L reporting limit at all sites while the DGV for cadmium is 5.5 µg/L. GEMCO's operations do not appear to affect cadmium concentrations within marine waters.

- The concentration of chromium within beach seep and ocean water samples have rarely been greater than the laboratory reporting limit 0.5 µg/L. Water samples which have recorded measurable chromium have generally been from control sites however the 4.4 µg/L DGV has never been exceeded. The two instances between 2014 and 2019 in which chromium was detected in the port area the concentrations were less than 25% of DGV (PN43 2015 and 2016).

- The concentration of mercury within beach seep and ocean water samples has never been greater than the laboratory reporting limit 0.1 µg/L.

- The concentration of nickel within beach seep and ocean water samples has rarely been greater than the laboratory reporting limit 0.5 µg/L. Interestingly nearly all water samples which recorded measurable nickel were recorded within samples collected from port area during 2016, however all detections have been below 2 µg/L. The DGV for nickel is 70 µg/L.

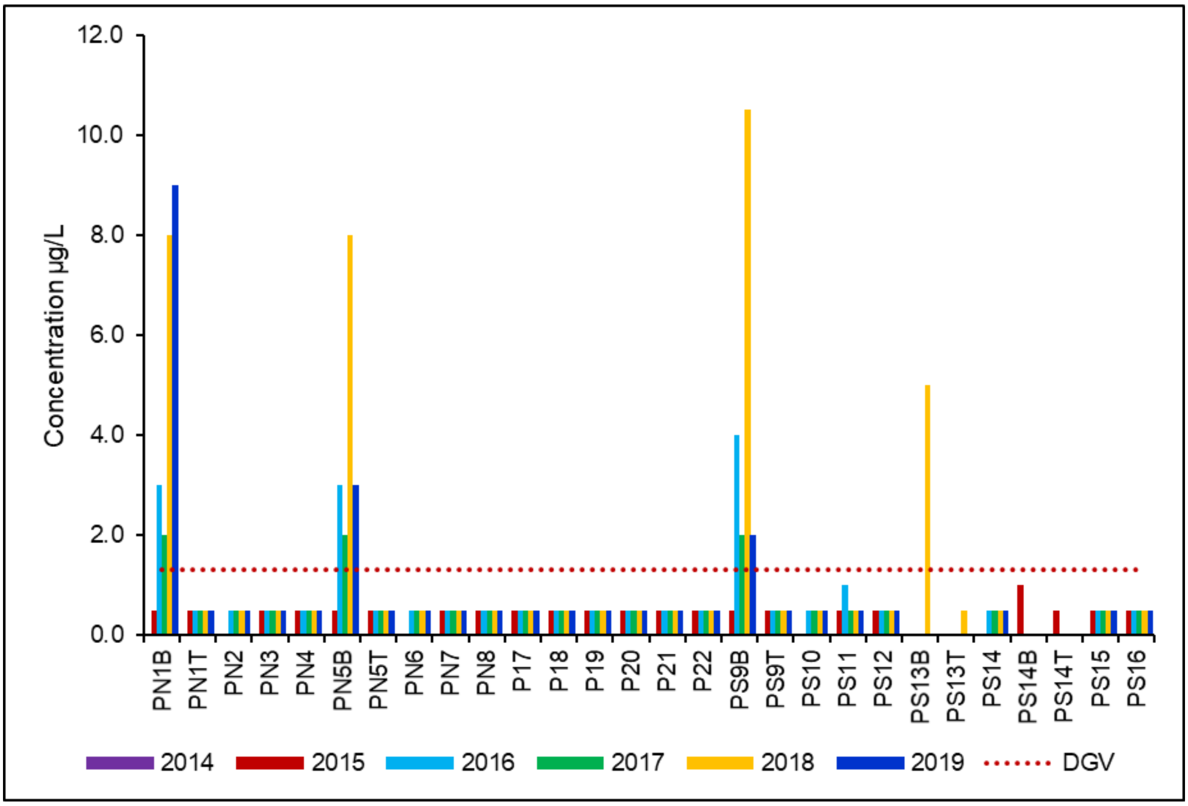
- Vanadium concentrations are consistent throughout the survey area for both beach seep and ocean water samples and have historically ranged been 1 and 4 µg/L while the DGV is 100 µg/L.
- Uranium concentrations are consistent throughout the survey area for both beach seep and ocean water samples. All concentrations have been less than 7 µg/L although the majority have been less than 4 µg/L. The is no DGV for uranium although limited ecotoxological testing would suggest chronic effects would not be detectable until at least 10 times these concentrations assuming that all the uranium present is U(Vi) which is also unlikely.

Table 6-37: Bioavailable Concentration of Metal and Metalloids within Ocean Water Samples (2019)

Analyte	Al	As	Ba	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG DGV 95%		***4.5***			***5.5***	***4.4***	***1***	***1.3***		***4.4***	***140***	***0.4***	***70***			***100***	***15***
Reporting Limit	***<5.0***	***<0.5***	***<1***	***<100***	***<0.2***	***<0.5***	***<0.2***	***<1.0***	***<5.0***	***<0.2***	***<0.5***	***<0.1***	***<0.5***	***<2.0***	***<0.1***	***<0.5***	***<5.0***
CN63	<5	1.4	6	4470	<0.2	<0.5	<0.2	<1	<5	<0.2	1.3	<0.1	<0.5	29	3.4	1.7	<5
CN63A	<5	1.4	6	4080	<0.2	<0.5	<0.2	<1	<5	<0.2	1.4	<0.1	<0.5	31	3.3	1.8	<5
CN64	<5	1.6	6	3950	<0.2	<0.5	<0.2	<1	<5	<0.2	1.4	<0.1	<0.5	32	3	1.5	<5
CN65	<5	1.5	6	3810	<0.2	<0.5	<0.2	<1	<5	<0.2	4.1	<0.1	<0.5	34	3.3	1.7	<5
CN66	<5	1.6	5	3980	<0.2	<0.5	<0.2	<1	<5	<0.2	1.4	<0.1	<0.5	34	3.1	1.5	<5
PN1B	<5	1.4	6	4420	<0.2	<0.5	<0.2	9	<5	<0.2	13.2	<0.1	1	20	3	1.6	7
PN1T	<5	1.5	6	3920	<0.2	<0.5	<0.2	<1	<5	<0.2	6.3	<0.1	<0.5	20	3.1	1.6	<5
PN2	<5	1.5	6	4090	<0.2	<0.5	<0.2	<1	8	<0.2	4	<0.1	<0.5	19	2.9	1.6	<5
PN3	<5	1.3	5	4180	<0.2	<0.5	<0.2	<1	<5	<0.2	1.8	<0.1	<0.5	21	2.9	1.9	<5
PN4	<5	1.4	6	4210	<0.2	<0.5	<0.2	<1	<5	<0.2	1.1	<0.1	<0.5	20	2.9	1.5	<5
PN5B	<5	1.3	6	4240	<0.2	<0.5	<0.2	3	<5	<0.2	11.2	<0.1	<0.5	19	2.9	1.6	8
PN5T	<5	1.4	6	4070	<0.2	<0.5	<0.2	<1	41	<0.2	9.1	<0.1	<0.5	21	2.7	1.7	<5
PN6	<5	1.3	5	3620	<0.2	<0.5	<0.2	<1	<5	<0.2	4.2	<0.1	<0.5	19	2.8	1.5	<5
PN7	9	1.3	5	4400	<0.2	<0.5	<0.2	<1	<5	<0.2	1.6	<0.1	<0.5	21	2.8	1.7	<5
PN8	<5	1.4	4	4280	<0.2	<0.5	<0.2	<1	<5	<0.2	1	<0.1	<0.5	19	2.7	1.5	<5
P17	<5	1.4	5	5360	<0.2	<0.5	<0.2	<1	<5	<0.2	6.1	<0.1	<0.5	22	2.8	1.8	<5
P18	<5	1.5	6	3820	<0.2	<0.5	<0.2	<1	<5	<0.2	3.6	<0.1	<0.5	23	2.8	1.6	<5
P19	<5	1.1	6	4860	<0.2	<0.5	<0.2	<1	<5	<0.2	1.8	<0.1	<0.5	22	2.9	1.7	<5
P20	<5	1.4	5	3600	<0.2	<0.5	<0.2	<1	<5	<0.2	1.7	<0.1	<0.5	22	2.6	1.6	<5
P21	<5	1.2	5	3810	<0.2	<0.5	<0.2	<1	<5	<0.2	3.5	<0.1	<0.5	22	2.7	1.6	<5
P22	<5	1.1	5	4630	<0.2	<0.5	<0.2	<1	<5	<0.2	3.7	<0.1	<0.5	20	2.8	1.6	<5

Analyte	Al	As	Ba	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG DGV 95%		***4.5***			***5.5***	***4.4***	***1***	***1.3***		***4.4***	***140***	***0.4***	***70***			***100***	***15***
Reporting Limit	***<5.0***	***<0.5***	***<1***	***<100***	***<0.2***	***<0.5***	***<0.2***	***<1.0***	***<5.0***	***<0.2***	***<0.5***	***<0.1***	***<0.5***	***<2.0***	***<0.1***	***<0.5***	***<5.0***
PS9B	<5	1.4	5	4480	<0.2	<0.5	<0.2	2	<5	<0.2	6.4	<0.1	<0.5	20	2.7	1.3	<5
PS9T	<5	1.4	4	4420	<0.2	<0.5	<0.2	<1	<5	<0.2	6.6	<0.1	<0.5	19	2.7	1.4	<5
PS10	<5	1.3	5	4030	<0.2	<0.5	<0.2	<1	<5	<0.2	3.2	<0.1	<0.5	21	2.7	1.4	<5
PS11	<5	1.4	5	4230	<0.2	<0.5	<0.2	<1	<5	<0.2	1.4	<0.1	<0.5	20	2.6	1.7	<5
PS12	<5	1.2	4	4540	<0.2	<0.5	<0.2	<1	<5	<0.2	0.8	<0.1	<0.5	21	2.5	1.6	<5
PS14	<5	1.4	5	3940	<0.2	<0.5	<0.2	<1	<5	<0.2	1.8	<0.1	<0.5	20	2.9	1.5	<5
PS15	<5	1.2	4	4120	<0.2	<0.5	<0.2	<1	<5	<0.2	1.6	<0.1	<0.5	21	2.8	1.4	<5
PS16	<5	1.2	4	4470	<0.2	<0.5	<0.2	<1	<5	<0.2	1.2	<0.1	<0.5	20	2.7	1.5	<5
CS97	<5	1.3	6	4760	<0.2	<0.5	<0.2	<1	<5	<0.2	6.8	<0.1	<0.5	21	2.9	1.6	<5
CS98	<5	1.4	6	5020	<0.2	<0.5	<0.2	<1	<5	<0.2	9.6	<0.1	<0.5	22	2.9	1.4	<5
CS99	<5	1.6	6	4680	<0.2	<0.5	<0.2	<1	<5	<0.2	8.1	<0.1	<0.5	22	3	1.8	<5

Figure 6-19: Bioavailable Concentration of Copper within Ocean Water Samples



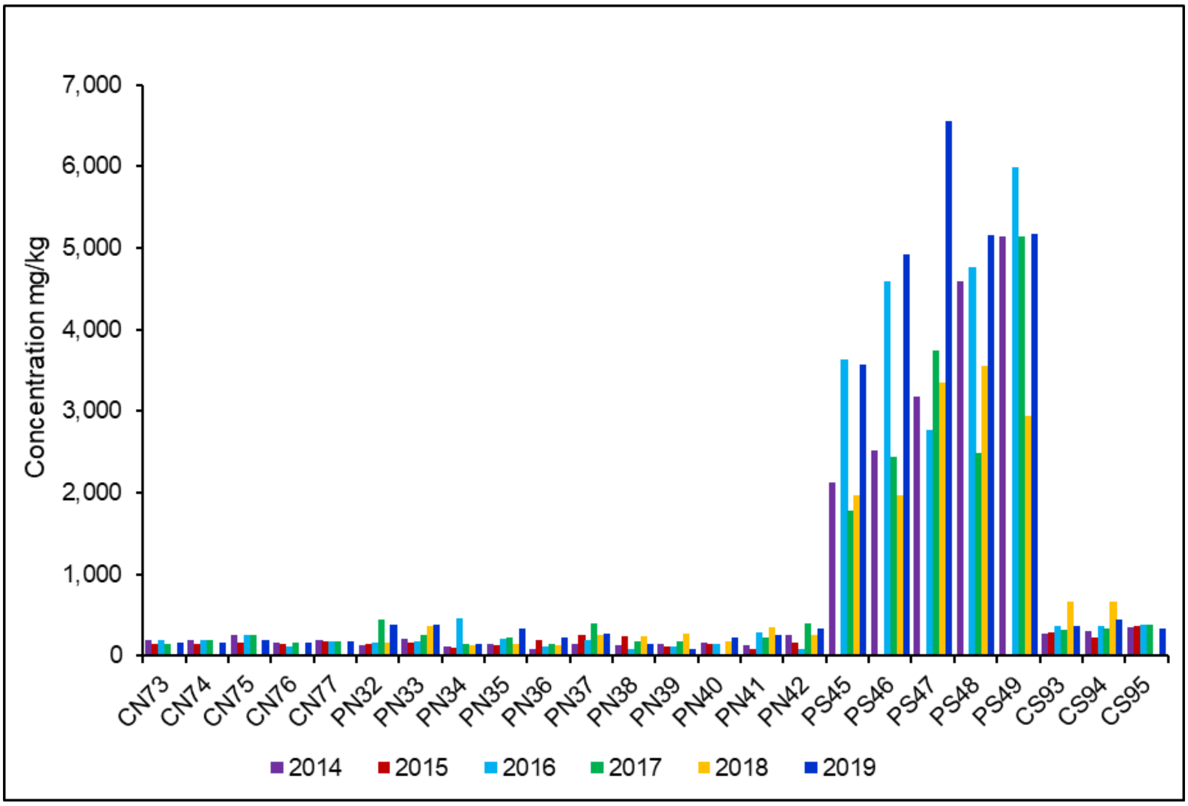
6.5.8.4 *Beach Sediment Sites*

During 2019, the concentrations of all hydrocarbon analytes monitored at beach sand sites were below the LOR in all instances. In relation to the bioavailable metal concentrations within beach sand samples, no exceedances of any applicable guideline value were recorded (Table 6-38). In many cases, the concentrations of bioavailable metals within beach sand sites were below or close to the applicable LOR. The bioavailable concentration of manganese was approximately 10 times greater at sample sites PS45 to PS49 in comparison to remaining beach sand sites including PN sites (Table 6-38). The concentration of manganese at these five sites is unsurprising given the proximity to GEMCO manganese stockpiles (Figure 9-13). Neither Simpson and Batley (2016) or ANZG (2018) prescribe a guidance value for manganese. Considering that bioavailable concentration of manganese within water samples taken close to these sites was well below the GEMCO's SSTV of 140 µg/L (Table 6-37 and Table 6-38), and that concentrations of manganese within Oysters (*Saccostrea* sp.) close to PS45 and PS49 were relatively consistent with other port sites (see biota discussion), it is unlikely that the current concentrations of manganese at sites PS45 to PS49 represent a true environmental risk. Furthermore, the bioavailable concentrations of manganese at sites PS45 to PS49 have remained relatively consistent since 2014, indicating GEMCO's operations are not having a cumulative affect at those sites (Figure 6-20).

Table 6-38: Bioavailable Concentration of Metal and Metalloids (mg/kg dry weight) within Beach Sand (2019)

Analyte	As	Cd	Cr	Cu	Pb	Mn	Hg	Ni	Zn
Reporting Limit	***<1***	***<0.1***	***<1.0***	***<1.0***	***<1.0***	***<10***	***<0.1***	***<1.0***	***<0.5***
SQGV	***20***	***1.5***	***80***	***65***	***50***	***-***	***0.15***	***21***	***200***
SQGV-High	***70***	***10***	***370***	***270***	***220***	***-***	***1***	***52***	***410***
CN73	6.3	<0.1	2.2	<1.0	<1.0	163	<0.1	1.4	2.0
CN74	7.6	<0.1	1.7	<1.0	<1.0	157	<0.1	1.2	2.0
CN75	7.4	<0.1	1.5	<1.0	<1.0	194	<0.1	<1.0	1.0
CN76	5.1	<0.1	1.8	<1.0	<1.0	162	<0.1	1.6	2.0
CN77	3.4	<0.1	2.3	1.2	<1.0	170	<0.1	1.4	2.0
PN32	2.8	<0.1	<1.0	<1.0	<1.0	389	<0.1	<1.0	3.0
PN33	1.7	<0.1	<1.0	<1.0	<1.0	391	<0.1	<1.0	3.0
PN34	<1.0	<0.1	<1.0	<1.0	<1.0	153	<0.1	<1.0	2.0
PN35	<1.0	<0.1	<1.0	<1.0	1.4	336	<0.1	<1.0	2.0
PN36	<1.0	<0.1	<1.0	<1.0	<1.0	225	<0.1	<1.0	2.0
PN37	<1.0	<0.1	<1.0	<1.0	<1.0	268	<0.1	<1.0	2.0
PN38	<1.0	<0.1	<1.0	<1.0	<1.0	151	<0.1	<1.0	2.0
PN39	<1.0	<0.1	<1.0	<1.0	<1.0	91	<0.1	<1.0	2.0
PN40	<1.0	<0.1	<1.0	<1.0	<1.0	222	<0.1	<1.0	2.0
PN41	<1.0	<0.1	<1.0	1.6	3.0	255	<0.1	<1.0	30
PN42	<1.0	<0.1	<1.0	<1.0	1.5	334	<0.1	<1.0	6.0
PS45	2.9	<0.1	1.0	7.8	8.8	3,070	<0.1	1.4	149
PS46	4.5	<0.1	1.4	<1.0	1.5	4,920	<0.1	1.7	9.0
PS47	4.2	<0.1	2.0	<1.0	2.2	6,550	<0.1	1.3	9.0
PS48	5.6	<0.1	1.6	<1.0	<1.0	5,100	<0.1	1.6	6.0
PS49	2.2	<0.1	1.2	<1.0	1.4	5,170	<0.1	1.1	20
CS93	5.6	<0.1	1.3	<1.0	<1.0	374	<0.1	<1.0	1.0
CS94	5.9	<0.1	1.4	<1.0	<1.0	439	<0.1	<1.0	<0.5
CS95	5.0	<0.1	1.5	<1.0	<1.0	331	<0.1	<1.0	1.0

Figure 6-20: Bioavailable Concentration of Manganese within Beach Sediment



6.5.8.5 *Ocean Sediment Sites*

In relation to sediment collected from ocean sites during 2019, the bioavailable concentration of zinc was found to exceed the 200 mg/kg SQGV at P17, P18 and P21 where concentrations of 234 mg/kg, 221 mg/kg and 288 mg/kg were recorded, respectively (Table 6-39). Furthermore, the zinc concentration at Site P22 was found to exceed the SQG-high value of 410 mg/kg being 458 mg/kg (Table 6-39). The bioavailable zinc concentration was found to reduce to near background (control area) concentrations at sites immediately adjacent these sites (Figure 6-21), indicating elevated concentrations were extremely localised and unlikely to represent an environmental risk. As discussed within recent GEMCO OPRs, these sites are located directly adjacent the GEMCO sewage outfall, and have previously recorded bioavailable zinc concentrations greater than the 200 mg/kg SQGV. In comparison to concentrations recorded between 2014 and 2018, the current exceedances are considered less and represent a general decrease in the concentration of bioavailable zinc at sites surrounding the sewage outfall (Figure 6-22).

For sediment samples collected during 2019, the bioavailable concentration of lead showed a geographical distribution similar to that reported for zinc, that is, the bioavailable concentration was greater at sample sites immediately adjacent the sewage outfall (Sites P17 to P22). However, only one site was found to exceed the SQGV of 50 mg/kg for lead, that site being P22, where a marginal exceedance of 51 mg/kg was recorded (Table 6-39). Consistent with the conclusions of GEMCO marine monitoring conducted between 2014 and 2018 the current results indicated that elevated lead concentrations remain localised to sites immediately adjacent the sewage outfall (Figure 6-23). As was the case with zinc, the current concentrations of bioavailable lead indicate a general decrease since 2014, particularly at sties P17, P21 and P22 (Figure 6-24).

The bioavailable concentration of cadmium at site CN63 was reported as 2.1 mg/kg, which exceeds the 1.5 mg/kg SQGV for this analyte. In consideration that CN63 is geographically removed from industrial activities (Figure 9-14); the bioavailable concentrations measured at every other site, including those within the port, were below the 0.1 mg/kg LOR (Table 6-39); and the historically bioavailable cadmium concentrations measured by this program have rarely been greater than the 0.1 mg/kg, this result is considered to be the result of either a naturogenic anomaly, sample contamination or laboratory error. There was no other exceedance of any applicable metal or metalloid SQGV during 2019. As would be expected the bioavailable concentration of manganese within sediments collected within the port area was greater than those collected within control areas to the north and south (Table 6-39). As discussed, neither Simpson and Batley (2016) or ANZG (2018) prescribe a guidance value for manganese. However, the comparison with data collected between 2014 and 2019 indicates that the concentration of bioavailable manganese within sediment at ocean sites within the vicinity of the port have remained relatively consistent since 2014, indicating GEMCO's operations are not having a cumulative affect at those sites (Figure 6-25).

Within ocean sediment sampled in 2019, the vast majority of hydrocarbon concentrations monitored were below or close to the LOR. There was a single exceedance of the AIMS recommended trigger value of 16 µg/kg for acenaphthene at PN7, where 30 µg/kg was recorded (Table 6-40). The concentrations of other hydrocarbons at PN7, which recorded concentrations greater than the 10 µg/kg LOR, were well below the applicable AIMS recommended trigger values. Overall the sum of monitored polycyclic aromatic hydrocarbons, although greater within port sediments in comparison to control areas, were well below the AIMS recommended trigger value of 4,000 µg/kg at all sites sampled during 2019 (Table 6-40, Figure 6-26). Furthermore, the presence of sewage / grey water outfall derived hydrocarbons within port sediments appeared to continue the decreasing trend as noted in recent GEMCO marine monitoring reports (Figure 6-27). The concentrations of monitored hydrocarbons within marine sediments were not considered to represent a risk to the marine environment during 2019.

Table 6-39: Bioavailable Concentration of Metal and Metalloids (mg/kg dry weight) within Ocean Sediment (2019)

Analyte	As	Cd	Cr	Cu	Pb	Mn	Hg	Ni	Zn
Reporting Limit	***<1***	***<0.1***	***<1.0***	***<1.0***	***<1.0***	***<10***	***<0.1***	***<1.0***	***<0.5***
SQGV	***20***	***1.5***	***80***	***65***	***50***	***-***	***0.15***	***21***	***200***
SQV-High	***70***	***10***	***370***	***270***	***220***	***-***	***1***	***52***	***410***
CN63	4.6	2.1	9.6	1.9	7.0	302	<0.1	3.3	8.0
CN63A	5.2	<0.1	6.2	<1.0	5.0	323	<0.1	2.1	5.0
CN64	5.0	<0.1	8.3	1.5	5.4	299	<0.1	2.4	6.0
CN65	3.6	<0.1	6.9	1	5.1	328	<0.1	2.1	5.0
CN66	7.7	<0.1	1.8	<1.0	2.4	229	<0.1	1.1	2.0
PN1	4.9	<0.1	1.4	<1.0	1.1	1,660	<0.1	<1.0	2.0
PN2	5.3	<0.1	2.2	<1.0	1.4	1,850	<0.1	1.5	3.0
PN3	6.6	<0.1	2.8	1.9	6.3	2,270	<0.1	1.5	8.0
PN4	6.2	<0.1	3.5	1.3	7.6	2,700	<0.1	1.3	10
PN5	3.4	<0.1	2.3	1.3	3.5	5,810	<0.1	1.4	19
PN6	2.7	<0.1	2.0	<1.0	5.3	3,060	<0.1	1.4	15
PN7	3.6	<0.1	3.1	2.8	13.4	3,580	<0.1	2.3	25

Analyte	As	Cd	Cr	Cu	Pb	Mn	Hg	Ni	Zn
Reporting Limit	***<1***	***<0.1***	***<1.0***	***<1.0***	***<1.0***	***<10***	***<0.1***	***<1.0***	***<0.5***
SQGV	***20***	***1.5***	***80***	***65***	***50***	***-***	***0.15***	***21***	***200***
SQV-High	***70***	***10***	***370***	***270***	***220***	***-***	***1***	***52***	***410***
PN8	4.4	<0.1	3.0	1.4	5.1	1,260	<0.1	1.6	8.0
CS97	6.8	<0.1	2.5	<1.0	<1.0	388	<0.1	<1.0	<0.5
CS98	4.7	<0.1	3.0	<1.0	<1.0	622	<0.1	1.1	1.0
CS99	1.7	<0.1	2.7	<1.0	1.6	576	<0.1	1.1	2.0
P17	1.5	<0.1	2.4	18.8	21.7	1,540	<0.1	2.4	234
P18	2.5	<0.1	1.8	20.2	30.2	2,130	<0.1	3.1	221
P19	5.9	<0.1	3.1	2.9	6.3	3,000	<0.1	3.0	37
P20	2.0	<0.1	4.5	1.4	4.0	1,640	<0.1	2.1	5.0
P21	4.6	<0.1	2.9	32.9	43.2	3,070	<0.1	4.0	288
P22	2.8	<0.1	3.3	37.5	50.9	3,490	<0.1	4.9	458
PS10	4.5	<0.1	1.6	1.0	4.1	1,070	<0.1	1.9	5.0
PS11	5.2	<0.1	2.0	<1.0	5.7	1,260	<0.1	1.2	8.0
PS12	<1.0	<0.1	<1.0	<1.0	<1.0	70	<0.1	<1.0	2.0
PS13	5.6	<0.1	1.6	<1.0	1.5	961	<0.1	<1.0	1.0
PS14	3.6	<0.1	2.3	<1.0	2.9	806	<0.1	1.4	3.0
PS15	6.0	<0.1	1.6	<1.0	2.8	552	<0.1	<1.0	2.0
PS16	3.6	<0.1	1.8	<1.0	2.0	163	<0.1	<1.0	2.0

Table 6-40: Polycyclic Aromatic Hydrocarbons (µg/kg dry weight) within Ocean Sediments (2019)

PAH	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(a)pyrene TEQ (zero)	Benzo(g.h.i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a.h)anthracene	Fluoranthene	Fluorene	Indeno(1.2.3.cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	Sum of PAH
AIMS recommended TV	**16**	**44**	**85**	**261**	**430**			**N/A**	**384**	**63**	**600**	**19**	**N/A**	**160**	**N/A**	**240**	**665**	**4,000**
AIMS recommended TV-high	**500**	**640**	**1,100**	**1,600**	**1,600**				**2,800**	**260**	**5,100**	**540**		**2,100**		**1,500**	**2,600**	**45,000**
Reporting Limit	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
CN63	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
CN63A	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
CN64	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
CN65	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
CN66	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PN1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PN2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PN3	<10	<10	<10	30	40	50	20	20	40	<10	80	<10	20	<10	<10	40	60	420
PN4	<10	<10	<10	40	50	70	40	30	50	<10	70	<10	30	<10	10	40	60	510
PN5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PN6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PN7	30	<10	<10	60	60	80	40	30	60	<10	150	<10	30	<10	20	70	110	780
PN8	<10	<10	<10	20	20	30	20	10	20	<10	40	<10	10	<10	<10	20	30	240
P17	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	30	<10	<10	<10	<10	30	20	80
P18	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

PAH	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(a)pyrene TEQ (zero)	Benzo(g.h.i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a.h)anthracene	Fluoranthene	Fluorene	Indeno(1.2.3.cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	Sum of PAH
AIMS recommended TV	**16**	**44**	**85**	**261**	**430**			**N/A**	**384**	**63**	**600**	**19**	**N/A**	**160**	**N/A**	**240**	**665**	**4,000**
AIMS recommended TV-high	**500**	**640**	**1,100**	**1,600**	**1,600**				**2,800**	**260**	**5,100**	**540**		**2,100**		**1,500**	**2,600**	**45,000**
P19	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	10
P20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
P21	<10	<10	<10	<10	10	10	<10	<10	10	<10	20	<10	<10	<10	<10	10	20	90
P22	<10	<10	<10	30	40	60	20	20	60	<10	120	<10	20	<10	10	60	90	580
PS10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	20	<10	<10	<10	<10	10	10	50
PS11	<10	<10	<10	20	20	30	20	10	40	<10	60	<10	20	<10	<10	30	40	320
PS12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	<10	<10	<10	10	10	30
PS13	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PS14	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PS15	<10	<10	<10	40	40	50	20	20	50	<10	80	<10	20	<10	10	30	70	470
PS16	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
CS97	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
CS98	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
CS99	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Figure 6-21: Bioavailable Concentration of Zinc within Ocean Sediment (2019)

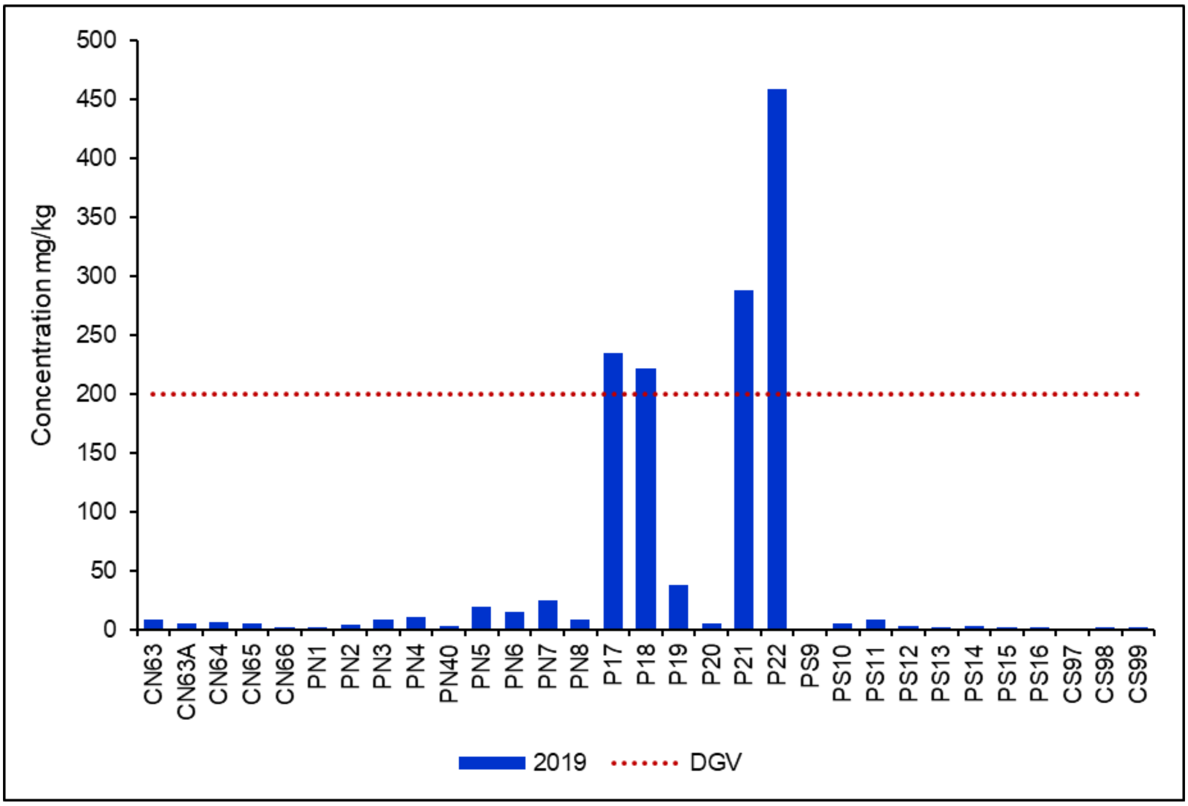


Figure 6-22: Bioavailable Concentration of Zinc within Sediment collected at sites P17 to P22

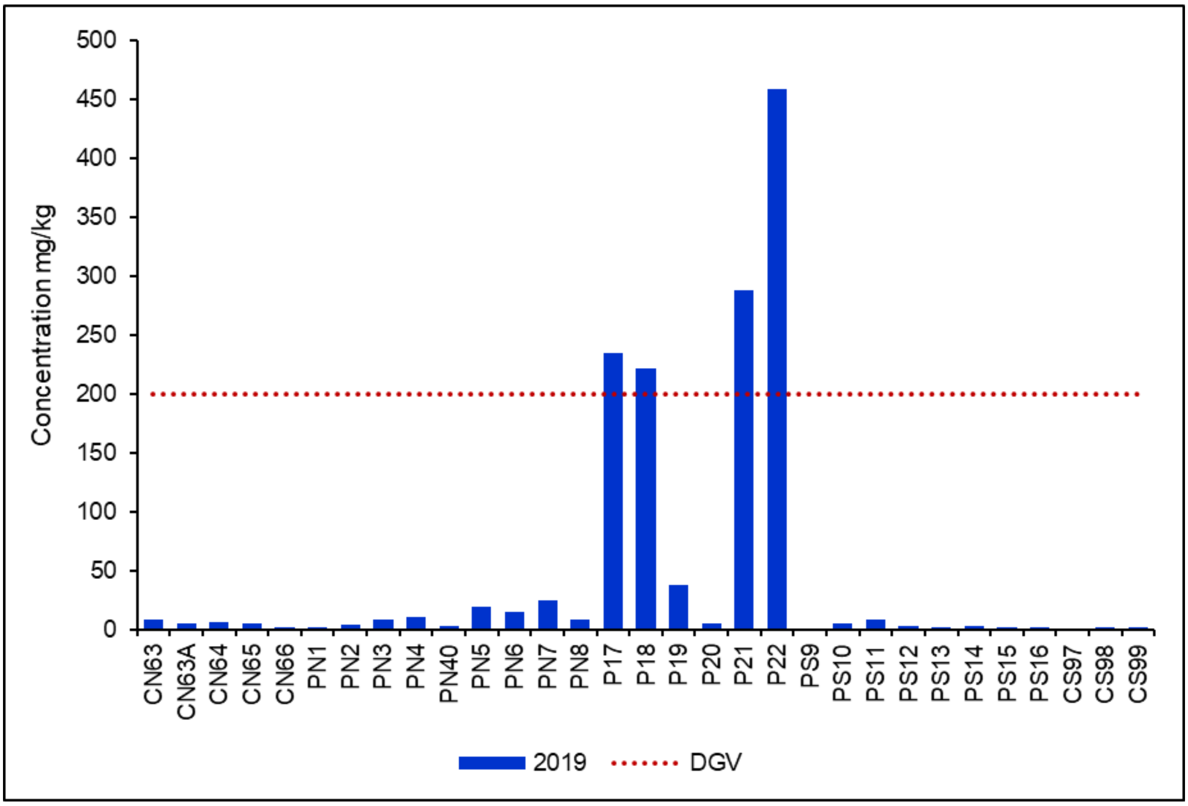


Figure 6-23: Bioavailable Concentration of Lead within Sediment collected at Ocean Sites (2019)

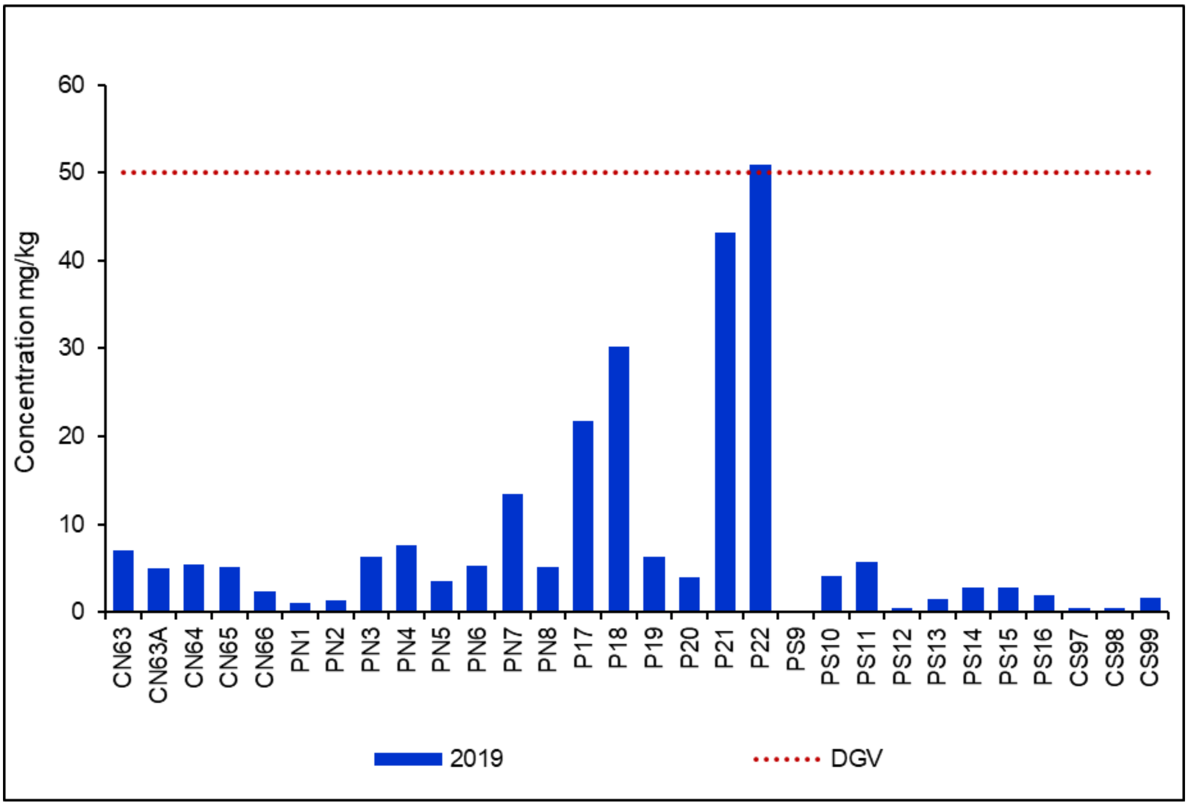


Figure 6-24: Bioavailable Concentration of Lead within Sediment collected at sites P17 to P22

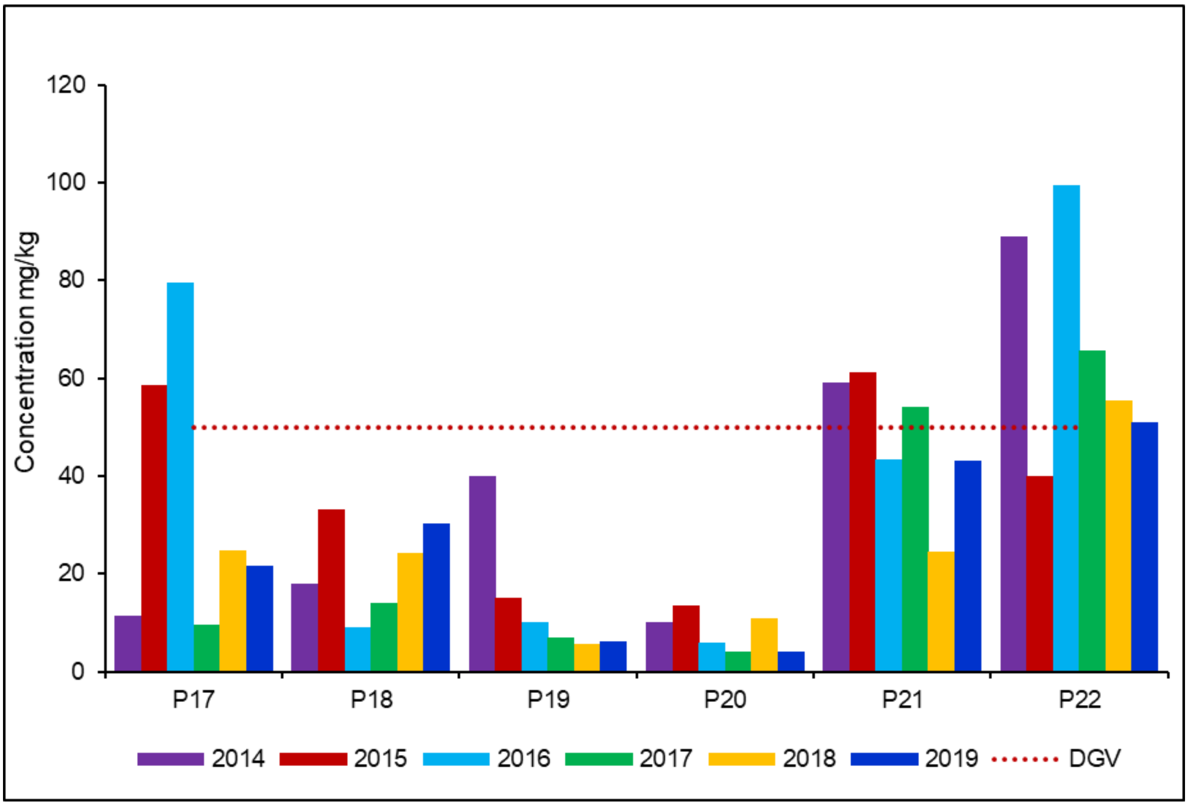


Figure 6-25: Bioavailable Concentration of Manganese within Sediment collected at Ocean Sites

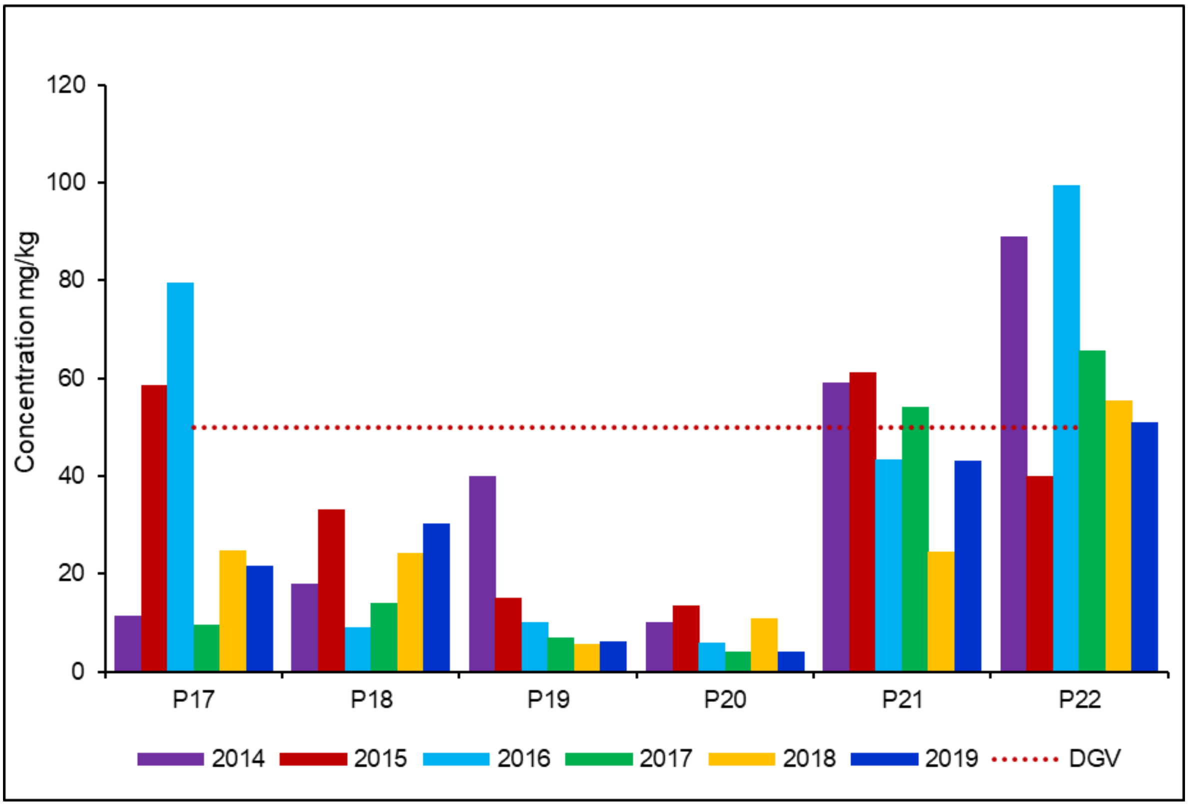


Figure 6-26: Polycyclic Aromatic Hydrocarbons within Sediment collected at Ocean Sites

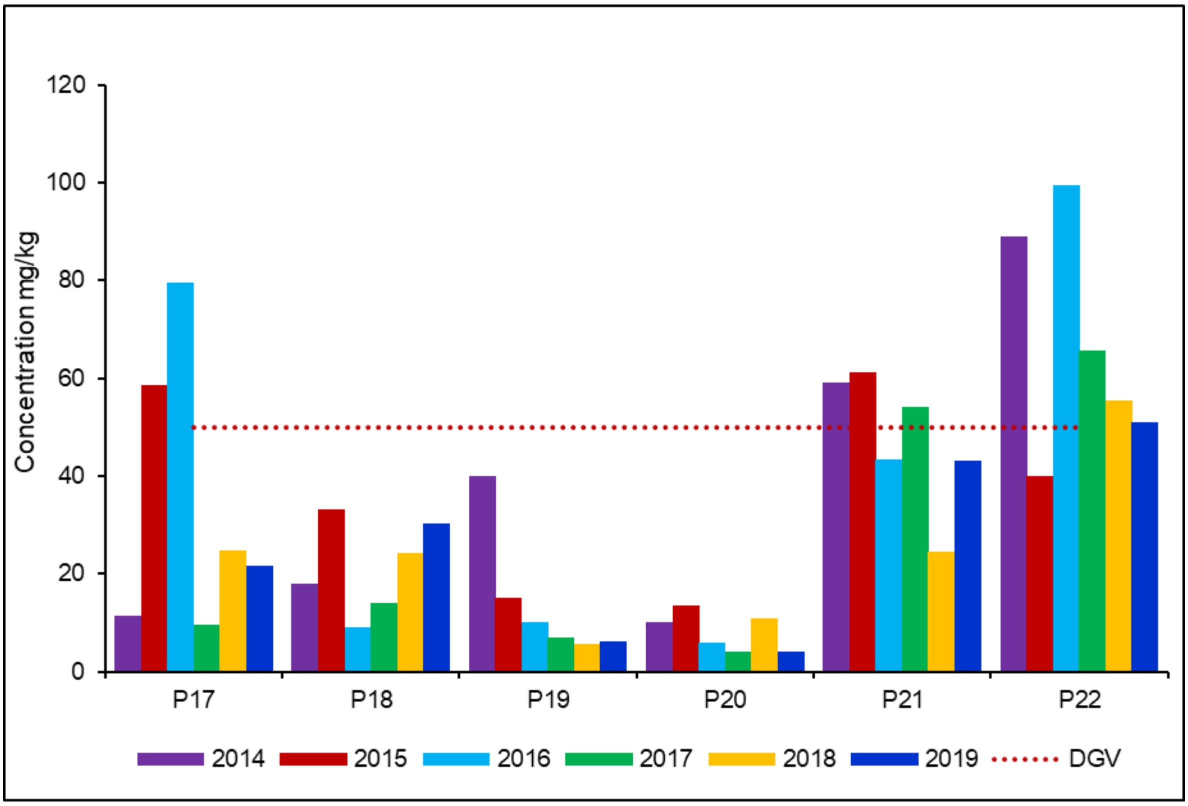
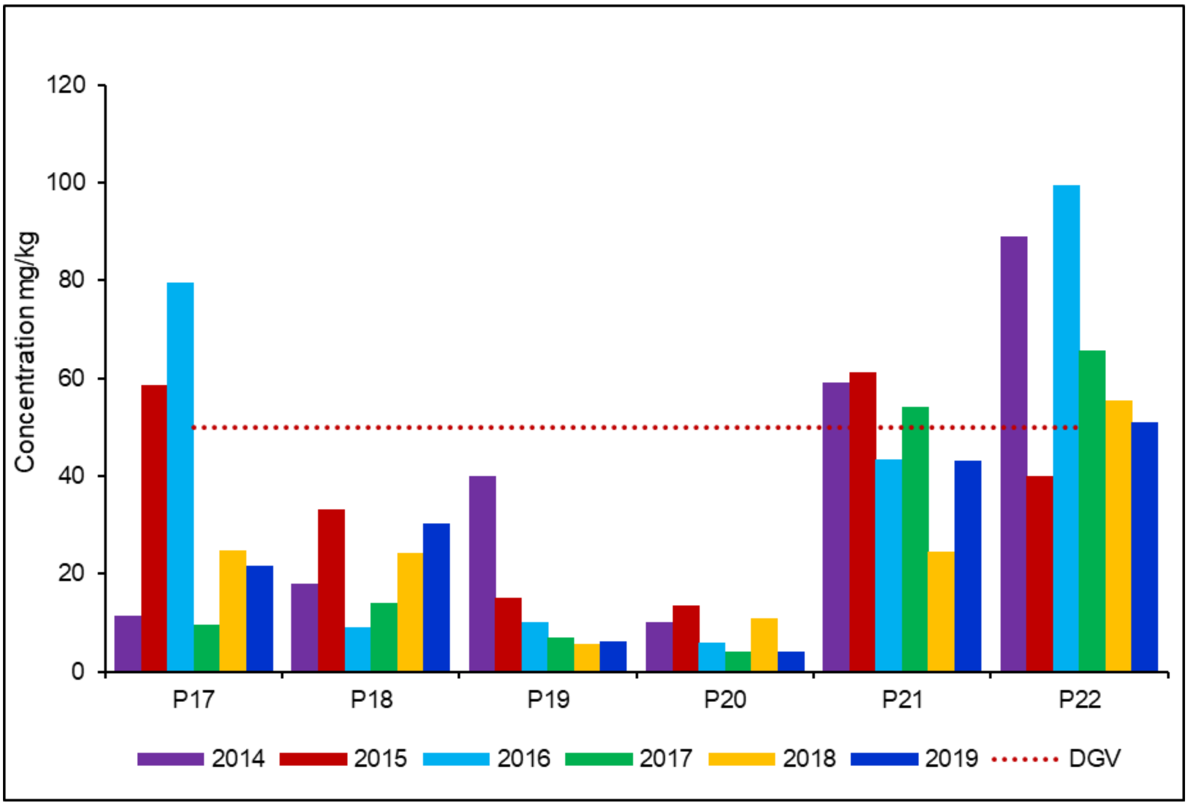


Figure 6-27: Polycyclic Aromatic Hydrocarbons within Sediment collected at Ocean Sites in the vicinity of GEMCO operations



6.5.8.6 *Biota Monitoring*

The GEMCO marine monitoring program includes the sampling of select biota on a biannual basis for the purpose of assessing the risk to public health through consumption. During 2019, samples of Stripey Snapper (*L. carponotatus*) and Tusk fish (*C. schoenleinii*) were attained within the port area while oysters (*Saccostrea sp.*) were collected from sites within the control areas and within the vicinity of the port (Table 6-18, Figure 9-13 to Figure 9-15).

In relation to biota samples collected in 2019, no fish muscle (fillet) samples were found to exceed any applicable MPC. Furthermore, polycyclic aromatic hydrocarbons for which AIMS provided a guidance value were well below the applicable trigger value (Table 6-41). Other hydrocarbons investigated were below or close to the laboratory LOR.

The concentration of lead within Stripey Snapper fillets was at least 250 times below the MPC while the concentration of lead within Tusk Fish fillets was at least 80 times below the MPC (Table 6-41). To provide further context to this result, the current highest lead muscle concentration, which was 0.006 mg/kg for a tusk fish sample, would allow for the consumption of 13,197 grams (adult) and 4,860 grams (child) of fillet per day before reaching the Health Based Guidance Value (HBGV) for lead.

In consideration that analyte concentrations within biota are monitored to provide insight into what (if any) risk the consumption of biota poses to human health, additional investigation was undertaken into analytes what were, in some instances, shown to have higher concentrations within port area water and sediment samples in comparison to control areas. In addition to lead previously discussed those analytes were considered to be zinc, copper and manganese. In relation to zinc, the mean concentration within Stripey Snapper fillets was 2.86 (± 0.13) mg/kg, while tusk fish fillets recorded a mean concentration of 2.88 (± 0.08) mg/kg. The concentration of zinc within fish fillets approved for human consumption, analysed by FSANZ for the 23rd Australian Total Dietary Study, was 3.9 mg/kg. Therefore, it can be concluded that, in relation to zinc, there is no additional risk to human health from consuming these species captured in close proximity to port operations in comparison to store bought fish. In relation to copper, the mean concentration within Stripey Snapper fillets was 0.15 (± 0.04) mg/kg, while Tusk Fish fillets recorded a mean concentration of 0.10 (± 0.01) mg/kg. The concentration of copper within fish fillets approved for human consumption, analysed by FSANZ for the 23rd Australian Total Dietary Study, was 0.65 mg/kg. Therefore, it can be concluded that, in relation to copper, there is no additional risk to human health from consuming these species captured in close proximity to port operations in comparison to store bought fish. In relation to manganese, the mean concentration within Stripey Snapper fillets was 0.12 (± 0.03) mg/kg, while Tusk Fish fillets recorded a mean concentration of 0.46 (± 0.24) mg/kg. The concentration of manganese within fish fillets approved for human consumption, analysed by FSANZ for the 23rd Australian Total Dietary Study, ranges from 1.8 to 3.8 mg/kg. It can therefore be concluded that, in relation to manganese, there is no additional risk to human health from consuming these species captured in close proximity to port operations in comparison to store bought fish. Remaining analyte concentrations investigated within the two fish species during 2019 were very low and to exceed HBGV would require the consumption of impractical amounts for an extended time period. Overall, the current results confirm the conclusions of the FY17-FY20 MMP and FY18 OPR that the consumption of Stripey Snapper or Tusk Fish captured in the vicinity of the Milner Bay Port Facility does not pose a greater risk to human health than consuming fish sold commercially for human consumption.

No oyster sample collected in 2019 was found to exceed any applicable MPC. As was the case with the fish fillets, PAHs for which AIMS (2013) provided a guidance value for were well below the applicable trigger value (Table 6-42). Other hydrocarbons investigated were below or close to the laboratory LOR.

In relation to lead, concentrations ranged from 0.009 mg/kg to 0.026 mg/kg, although all except one site recorded concentrations between 0.017 to 0.026 mg/kg (Table 6-42). These concentrations are considered low in comparison to the MPC of 2 mg/kg, and would allow an adult to consume 3,045 g of oyster tissue per day before ingesting the amount of lead that would result in a measurable increase in blood pressure (the metric on which the HBGV for lead is set in adults). This amount is far greater than the 800 g estimated local resident annual oyster intake calculated by SKM (1998) during the original dietary and health risk assessment study. In general, lead concentrations were greater in 2019 in comparison to 2015 and 2017 including control sites (Figure 6-28). However, the small magnitude of concentration changes in comparison to the MPC allows us to draw the conclusion that this is insignificant from a public health risk perspective.

The concentrations of cadmium were greatest within oyster samples collected from the control site CS92, where a concentration of 1.49 mg/kg was recorded (Table 6-42). This concentration is approximately 75% of the 2 mg/kg MPC and would allow for an adult to consume 41 grams of oyster tissue per day before ingesting sufficient cadmium to breach the HBGV for that analyte. The highest concentrations of cadmium within oysters sampled in the vicinity of the Port were approximately 50% of the MPC, although most sites were closer to 25%. Naturally occurring, relatively high, concentrations of cadmium within oysters is well documented throughout Northern Australia (see for example Munksgaard et. al. (2017)) and is linked to particular algae species within the oysters diet rather than water or sediment concentrations. In comparison to 2015 and 2017, cadmium concentrations have remained stable between and within sites (Figure 6-29).

Oyster copper concentrations were higher relative to remaining sites at PN25 and PN26 (Table 6-42) which is consistent with 2015 and 2017 data (Figure 6-30). From a public health risk perspective, an adult could consume approximately 250 g of oyster tissue from PN26 before exceeding the HBGV. However, the HBGV of the more toxic, but naturally occurring, cadmium would be reached before exceeding the copper HBGV at this site. Copper concentrations at remaining sites were relatively similar between sites and with data from previous years (Figure 6-30).

Oyster zinc concentrations were also greater at PN25 and PN26 relative to the remaining sites (Table 6-42) which is also consistent with 2015 and 2017 data (Figure 6-31). The current, simplified, FSANZ HBGV for zinc is 1 mg/kg of body weight per day, however this HBGV was set based on the fact zinc inhibits copper absorption (NHMRC, 2006). Therefore, it is unlikely that zinc concentrations at PN25 and PN26 represent a true public health risk, if oysters are consumed at the rates and frequency consistent with that reported by SKM (1998).

The concentration of manganese within oysters collected in the vicinity of the port during 2019 was slightly greater than control areas (Table 6-42), although 2019 concentrations were generally reduced in comparison to 2015 and 2017 (Figure 6-32). In consideration that many other common foods such as breakfast cereals contain 23 to 35 mg/kg of manganese (FSANZ, 2011), and less than 5% of ingested manganese is absorbed by the body (NHMRC, 2006), concentrations within the port area which ranged from 3.85 to 8.86 mg/kg are unlikely to represent a health risk.

Overall, GEMCO’s operations do not appear to have resulted in bioaccumulation of any analyte investigated within oysters between 2015 and 2019. If consumed at levels estimated by SKM (1998) it is unlikely that oysters relatively close to GEMCO’s operations represent any greater risk to human health than oysters collected from other parts of Groote Eylandt, particularly in consideration that naturally occurring cadmium is likely to be the analyte which theoretically limits consumption across the majority of the region.

Table 6-41: Concentrations of select analytes within Stripey Snapper and Tusk fish (2019)

Analyte	As Total	As inorganic	Cd	Cu	Hg	Mn	Pb	Zn	Naphthalene	Fluorene	Phenanthrene	Fluoranthene
				Metal and metalloid data in mg/kg					Hydrocarbon data in µg/kg			
LOR	***0.02***	***0.1***	***0.001***	***0.02***	***0.02***	***0.01***	***0.001***	***0.09***	***2***	***2***	***2***	***2***
MPC / HBGV		***2***			***0.5***		***0.5***		***20***	***40***	***40***	***40***
Stripey 1 muscle	1.36	<0.1	0.001	0.09	0.11	0.08	0.001	2.56	0	0	4	0
Stripey 2 muscle	1.45	<0.1	<0.001	0.10	0.11	0.12	0.002	2.69	0	0	5	0
Stripey 3 muscle	1.33	<0.1	<0.001	0.13	0.12	0.09	<0.001	3.43	0	0	0	0
Stripey 4 muscle	2.42	<0.1	<0.001	0.11	0.18	0.27	<0.001	3.35	0	0	0	0
Stripey 5 muscle	9.35	<0.1	<0.001	0.09	0.15	0.09	<0.001	2.59	0	0	0	0
Stripey 6 muscle	0.26	<0.1	0.001	0.13	0.16	0.04	<0.001	2.62	0	0	0	0
Stripey 7 muscle	2.70	<0.1	<0.001	0.42	0.22	0.16	<0.001	2.82	0	0	0	0
Mean (± SE)	**2.69 (1.06)**	**<0.1**	**0.001 (0)**	**0.15 (0.04)**	**0.15 (0.01)**	**0.12 (0.03)**	**0.001 (0)**	**2.86 (0.13)**	**0**	**0**	**1.3**	**0**
Tusk Fish 1 muscle	24.61	<0.1	0.001	0.10	0.10	0.19	0.002	3.03	0	0	0	0
Tusk Fish 2 muscle	18.14	<0.1	<0.001	0.10	0.09	0.43	0.006	3.22	0	0	0	0
Tusk Fish 3 muscle	12.38	<0.1	<0.001	0.12	0.18	0.20	0.004	2.98	0	0	0	0
Tusk Fish 4 muscle	23.69	<0.1	<0.001	0.08	0.09	0.11	<0.001	2.48	0	0	0	0
Tusk Fish 5 muscle	28.67	<0.1	<0.001	0.12	0.16	2.00	0.003	2.90	0	0	0	0
Tusk Fish 6 muscle	18.58	<0.1	0.003	0.11	0.08	0.16	0.001	2.81	0	0	0	0
Tusk Fish 7 muscle	19.57	<0.1	<0.001	0.09	0.11	0.15	<0.001	2.71	0	0	0	0
Mean (± SE)	**20.81 (1.86)**	**<0.1**	**0.002 (0)**	**0.10 (0.01)**	**0.12 (0.01)**	**0.46 (0.24)**	**0.003 (0)**	**2.88 (0.08)**	**0**	**0**	**0**	**0**

Table 6-42: Concentrations of select analytes within Oysters (2019)

Analyte	As Total	As inorganic	Cd	Cu	Hg	Mn	Pb	Zn	Naphthalene	Fluorene	Phenanthrene	Fluoranthene
	Metal and metalloid data in mg/kg								Hydrocarbon data in µg/kg			
LOR	***0.02***	***0.1***	***0.001***	***0.02***	***0.004***	***0.01***	***0.001***	***0.09***	***2***	***2***	***2***	***2***
MPC / HBGV		***1***	***2***		***0.5***		***2***		***20***	***40***	***40***	***40***
CN68	2.75	<0.1	0.511	25.7	0.013	1.14	0.020	58	0	0	6	0
CN69	2.92	<0.1	0.510	25.5	0.011	1.00	0.017	59	0	0	8	0
CN72	4.07	<0.1	0.616	46.3	0.019	1.55	0.025	66	3	0	8	0
PN23	6.71	0.1	0.501	63.0	0.018	8.86	0.026	433	0	0	0	0
PN25	7.22	<0.1	0.284	87.5	0.014	8.71	0.026	711	0	0	0	0
PN26	7.75	0.1	0.270	155.4	0.016	7.88	0.025	917	0	0	4	0
P27	6.51	0.1	1.190	32.2	0.017	4.37	0.018	321	0	0	0	0
P28	5.38	0.1	1.005	40.8	0.022	3.85	0.017	448	0	0	0	0
PS29	4.61	0.1	0.746	36.3	0.017	8.29	0.023	397	0	0	4	0
PS30	4.55	0.1	0.835	29.6	0.015	8.67	0.019	275	0	0	3	0
CS92	1.26	<0.1	1.493	19.4	0.016	1.02	0.009	59	0	0	3	0

Figure 6-28: Concentration of Lead within Oyster samples

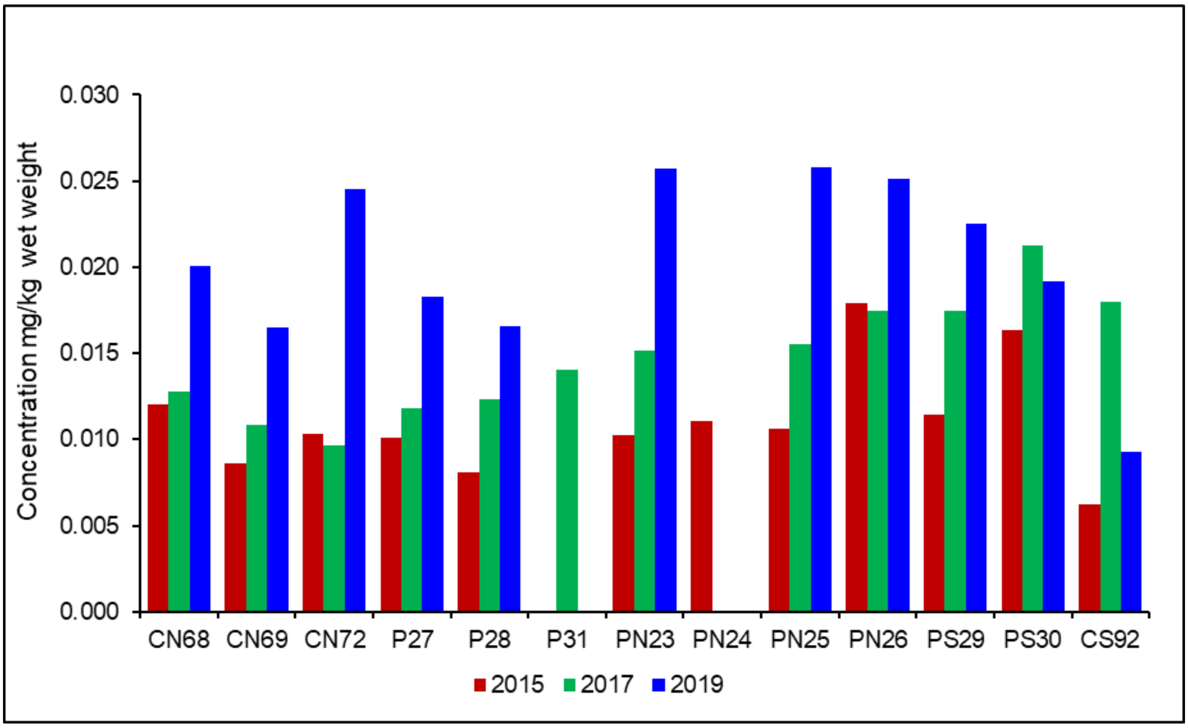


Figure 6-29: Concentration of Cadmium within Oyster samples

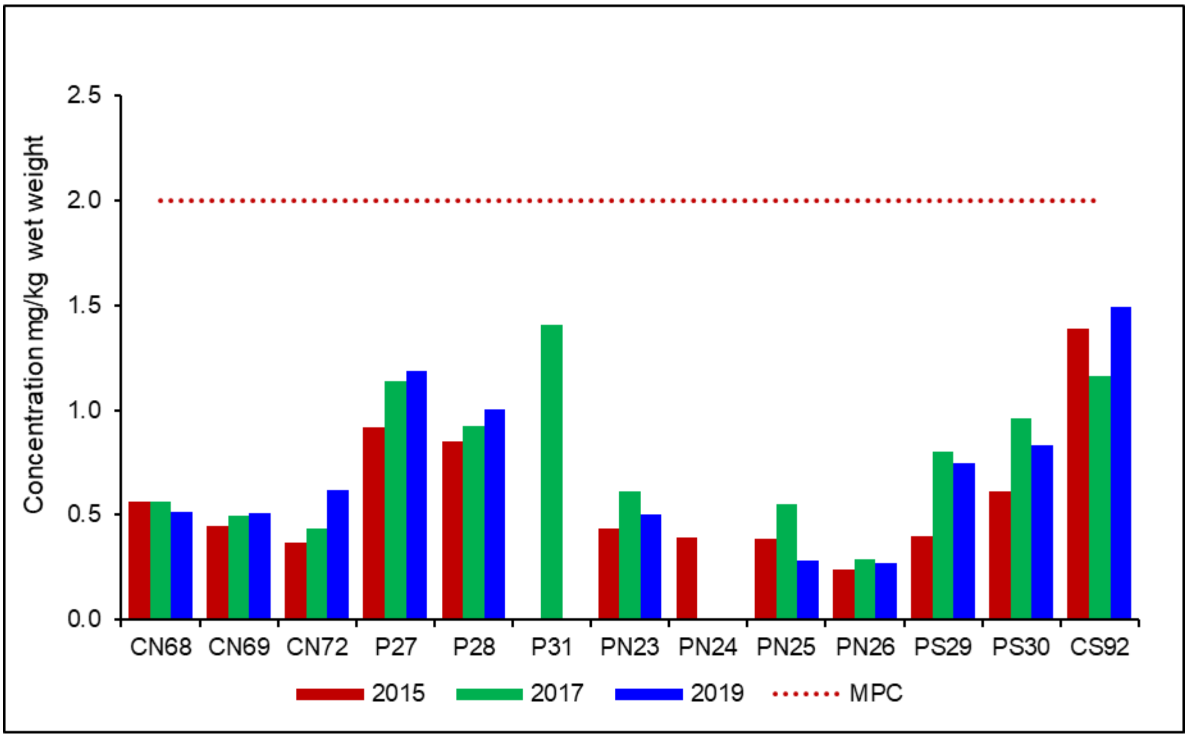


Figure 6-30: Concentration of Copper within Oyster samples

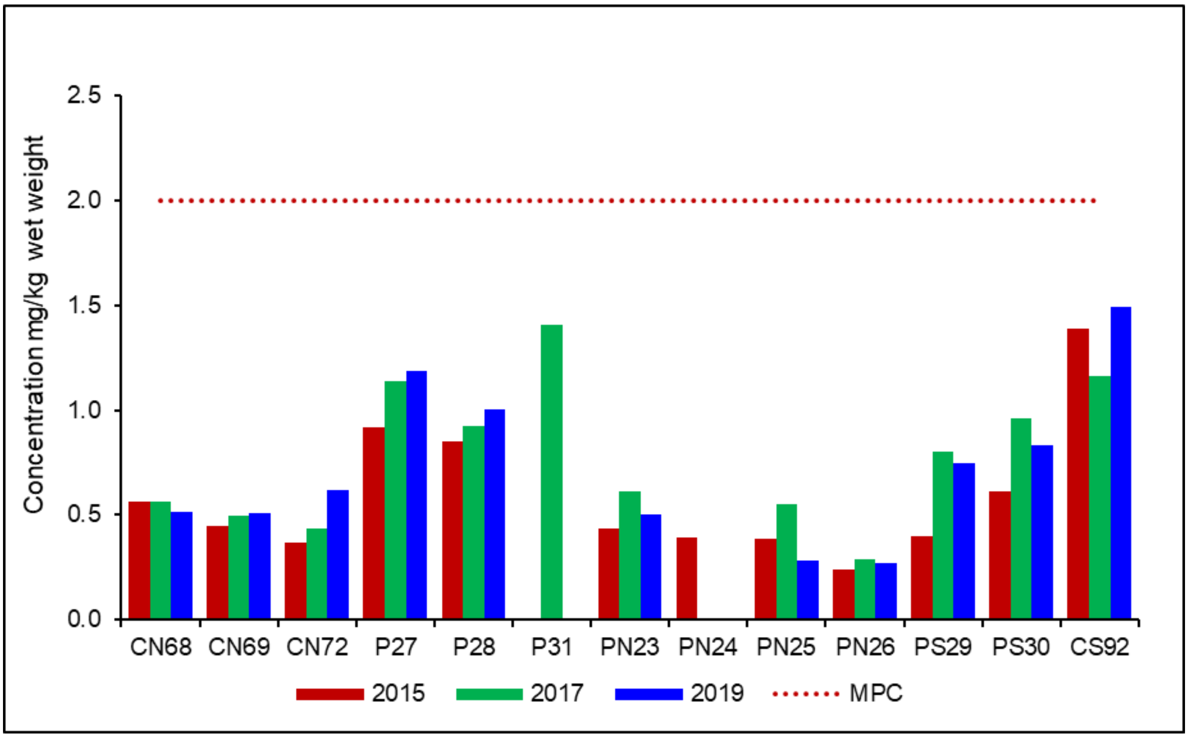


Figure 6-31: Concentration of Zinc within Oyster samples

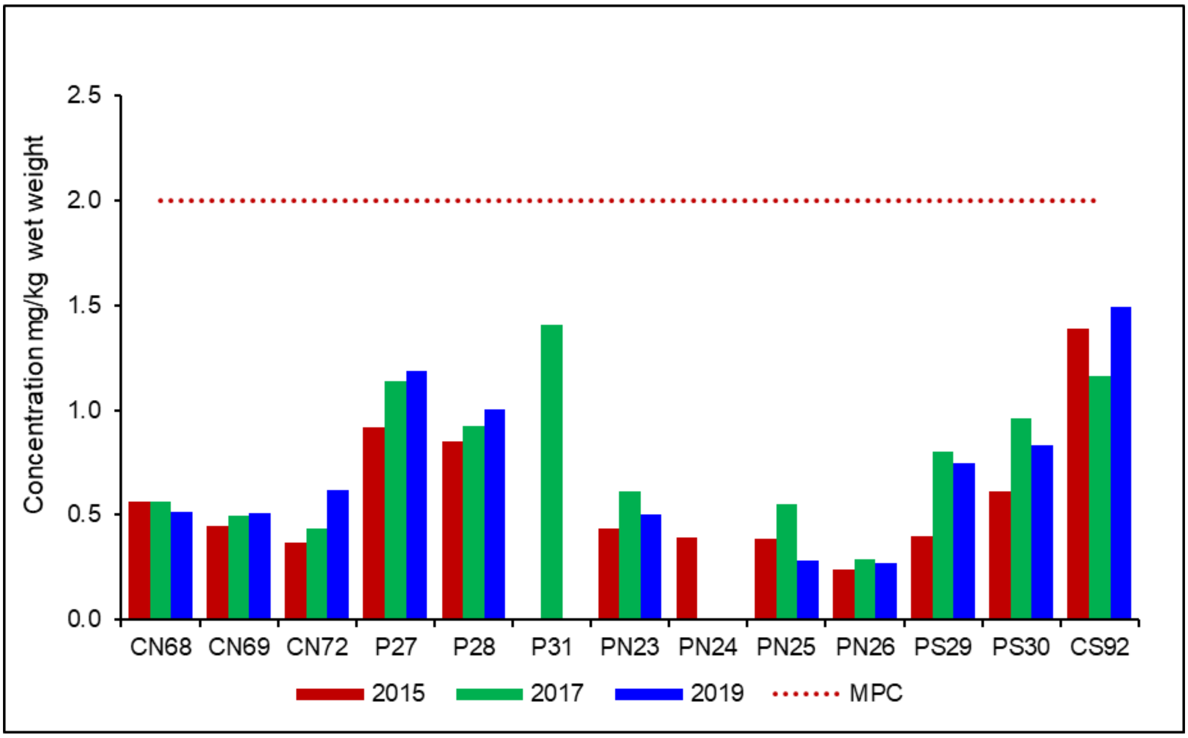
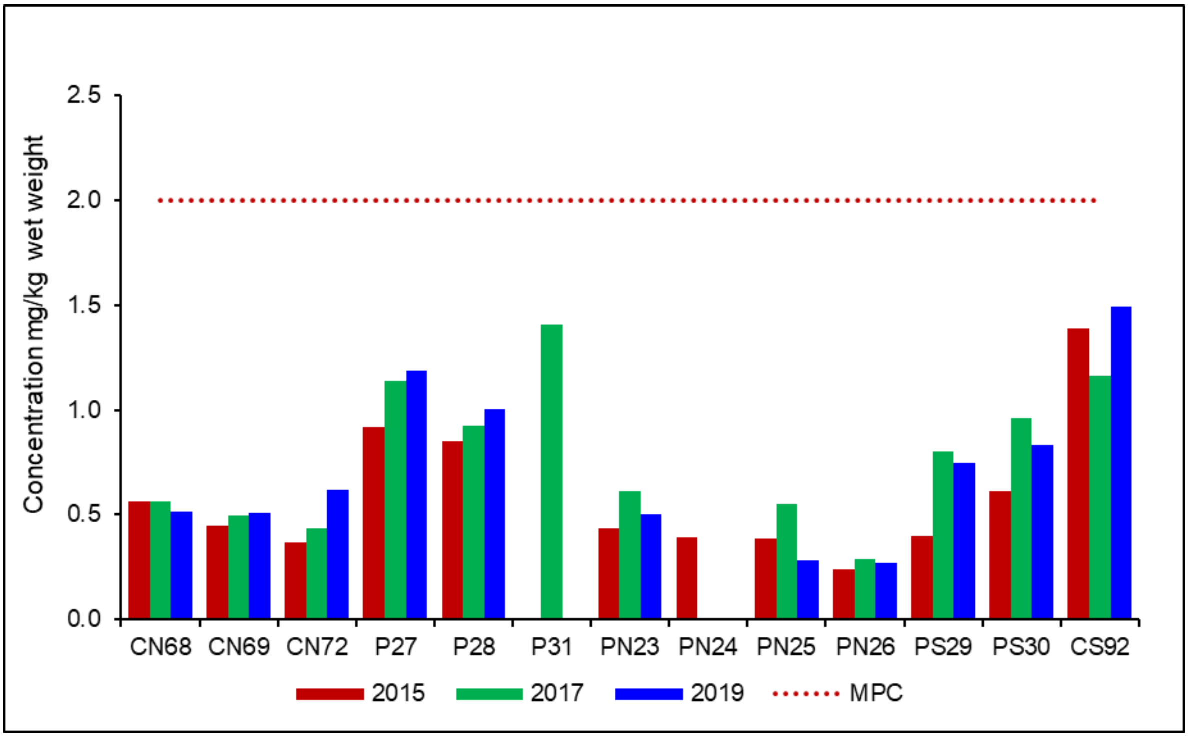


Figure 6-32: Concentration of Manganese within Oyster samples



6.5.8.7 *Changes in Marine Environmental Monitoring Program for Upcoming Period*

The current analysis suite has been investigated since 2013. There is now a large data set which indicates a number of metal and metalloids analysed are rarely above the LOR or if detected, are in very low concentrations and orders of magnitude below the applicable DGV / SQGV. Furthermore, several have little or no environmental consequence and the presence of which is not related to GEMCO's operations. Metal / metalloid type analytes that are in this category and will be removed in the upcoming period without compromising the MEMP are presented in Table 6-43.

Table 6-43: Metal and Metalloid Analytes which could be removed from Sample Suite of Analysis

Beach Seep / Ocean Water	Beach Sand / Marine Sediment	Biota
Aluminium	Aluminium	Aluminium
Barium	Barium	Barium
Beryllium	Beryllium	Beryllium
Boron	Boron	Boron
Cadmium	Cadmium	Calcium
Calcium	Calcium	Chromium
Chromium	Chromium	Cobalt
Cobalt	Cobalt	Iron
Iron	Iron	Magnesium
Magnesium	Magnesium	Molybdenum
Mercury	Mercury	Nickel
Molybdenum	Molybdenum	Phosphorus
Nickel	Nickel	Silver
Phosphorus	Phosphorus	Strontium

Beach Seep / Ocean Water	Beach Sand / Marine Sediment	Biota
Selenium	Selenium	Tellurium
Silver	Silver	Uranium
Strontium	Strontium	Vanadium
Tellurium	Tellurium	
Thallium	Thallium	
Uranium	Uranium	
Vanadium	Vanadium	

6.6 Management

6.6.1 *Actions Proposed over the Planning Period and their Potential to Impact on Water Quality*

GEMCO has committed to a series of actions/projects as indicated in Section 5.3 of this MMP. Updates on GEMCO's progress and performance with regard to water management commitments associated with these projects will be reported in GEMCO's annual EMR.

Monitoring programs may be reviewed and adjusted in the interest of continuous improvement to ensure programs are tailored to risk profiles, address any significant knowledge gaps and are conducted at an appropriate frequency.

7 INCIDENT REPORTING

Environmental incident reporting is carried out in accordance with GEMCO's Event Management Procedure (PRO-3151 Event Management Procedure). The severity of each environmental incident is assessed against the DITT Guideline on Environmental Incident Reporting and all Severity Class 2 and above incidents are reported to DITT under Section 29 of the *Mining Management Act 2001* (NT). Any relevant incidents that occur off-lease are reported to the NT EPA.

8 CLOSURE PLANNING

South32 implemented a Closure Standard in 2019. There are four key elements to the Closure Standard, namely:

- Closure Planning;
- Closure Provisioning;
- Progressive Rehabilitation; and
- Closure Execution (including post closure monitoring and relinquishment).

As a signatory to the International Council on Mining and Metals (ICMM), South32 is aligned to the ICMM's guiding principal of "encouraging responsible closure" and develops all Company closure plans in accordance with the Integrated Mine Closure – Good Practice Guide (ICMM, 2018).

The most recent version of the GEMCO Closure Plan was submitted to DITT in October 2018. The 2018 GEMCO Closure Plan:

- Incorporates feedback from DITT on the 2016 version of the GEMCO Closure Plan as accepted in correspondence from DITT in December 2018;
- Has been reviewed and endorsed by the ALC;
- Is structured in accordance with the *WA Department of Mines and Petroleum and Environmental Protection Authority, Guidelines for Preparing Mine Closure Plans*, 2015 (WA DMPEPA, 2015), which supersedes the former June 2011 version;
- Meets the requirements of South32's Closure Standard[5]; and
- Aligns with the ICMM's Integrated Mine Closure – Good Practice Guide.

The Closure Plan covers all mining operations undertaken by GEMCO on Groote Eylandt (including leases, special purpose leases, sub-leases and Section 19 ALRA Agreements) and applies to the management of the approved mine at all stages of the mine life.

In accordance with South32's Closure Standard, the GEMCO Closure Plan:

- Must be updated every three years (i.e. next update scheduled for October 2021); or
- Updated where there is a significant scope change (i.e. Eastern Leases commencement).

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[5] The 2018 GEMCO Closure Plan 2018 was finalised prior to the implementation of the South32 Closure Standard. Given a draft Closure Standard was in place at the time of preparing the 2018 GEMCO Closure Plan, the requirements were well understood and no subsequent amendments were required.

8.1 Life of Operation Plan – Unplanned Closure

The GEMCO Closure Plan is integrated with the GEMCO Life of Operations Plan (LoOP). As the LoOP is updated and reforecast annually, unplanned closure within or at the end of this MMP reporting period is considered unlikely.

Unplanned closure could result from a number of internal or external factors. As such, the specific nature of GEMCO's response to unplanned closure would be tailored to meet the individual circumstances driving the decision. For example, closure driven by a loss of stakeholder support would require a different approach than closure driven by a sudden drop in metal prices making the resources uneconomic.

In the event of unplanned closure, GEMCO would:

- Immediately suspend operations and implement GEMCO's Care and Maintenance Plan. As part of undertaking this step, all relevant internal and external stakeholders would be updated of the decision to move to unplanned closure through a series of stakeholder forums;
- Advise all relevant internal and external stakeholders of the decision to move to unplanned closure through a series of stakeholder forums;
- Instigate a Project Feasibility Study. During this period operations would remain in active Care and Maintenance. This phase of work will potentially take between 1 and 2 years. Key outputs of the feasibility study would include:
    - Update the closure risk assessment for GEMCO closure;
    - Host stakeholder forums to collaborate on closure risks and opportunities;
    - Formalise and agree on Closure Completion Criteria and next land use opportunities;
    - Complete required technical studies to close any identified closure knowledge gaps;
    - Submit a Detailed Closure Plan and Closure Execution Plan for approval by ALC, DITT, NT EPA and other external stakeholders as required;
    - Develop an updated schedule for closure execution; and
    - Continue monitoring of Care and Maintenance activities to ensure continued compliance to operating licences and approvals.
- The GEMCO operations would remain in active Care and Maintenance until all internal and external approvals are granted to allow for the commencement of closure activities. Closure execution would be undertaken as per the Closure Execution Plan, with the broad approach would be:

- Sourcing, securing and mobilisation of closure teams to GEMCO;
- All assets agreed to remain for future use clearly demarcated for preservation;
- Decommissioning and de-energisation of non-essential infrastructure;
- Demolition and disposal of fixed process infrastructure and assets in accordance with the agreed closure schedule;
- Closure and rehabilitation earthworks to pit voids, stockpiles and TSFs in accordance with the agreed closure schedule;
- Gradual, sequenced demolition and disposal of remaining non-process infrastructure as they become redundant;
- Continued monitoring as per licence requirements; and
- Establishment of the agreed post-closure monitoring network and monitoring frequency to monitor compliance to agreed completion (i.e. success) criteria post closure.

The Detailed Closure Plan and Closure Execution Plan would be domain based and draw on the existing 2018 GEMCO Closure Plan as well as ongoing rehabilitation experience gained by the GEMCO Rehabilitation Team. For detail on proposed remediation techniques, end land use objectives, materials required (and their availability).

Where there are programs that require action over an extended period of time (e.g. remediation of Milner Bay), GEMCO will develop appropriate governance arrangements for the continued implementation of these programs in consultation with key stakeholders.

8.2 Background for Costing of Closure Activities

Table 8-1 summarises the mining disturbance across the GEMCO operation used for the security estimate. Figure 1-7 and Figure 1-8 provide a visual representation of current disturbance as at 30 June 2020. Various figures included within Section 4 provide an indicative representation of proposed disturbance for FY21 – FY24 (where possible). The information in Table 8-1 is accurate as at 30 June 2020. Disturbance tracking is conducted on a quarterly basis across the operation taking into consideration progressive rehabilitation as well as new or expanded activities.

Table 8-1: GEMCO Disturbance Summary (ha)

Disturbance type	Current (30 June 2020)	Proposed (FY21-24)	Total
Site Infrastructure	444	-	444
Quarries / Active Mining	1,179	924	2,103
Tailings Storage Facilities and Dams	959	96	1,055
Stockpiles	142	20	162
Exploration	N/A	17	17
Haul Roads	225	100	325
Access Tracks	234	0	234
Rehabilitation	1373	672	2045

Closure costing has been developed in line with the NT DITT Security Calculation Procedure (2016). Where applicable, costs per unit (i.e. $/Ha, $/m^3) and individual items costs have been developed using GEMCO rates or a third-party estimate. The total number of units and material quantities requiring rehabilitation is based on the disturbance data above.

9 APPENDICES

9.1 Abbreviations and units

Table 9-1: Abbreviations

Abbreviation	Description
AAPA	Aboriginal Areas Protection Authority
AEMP	Air Emissions Management Plan
AIMS	Australian Institute of Marine Science
ALARP	As low as reasonably practicable
ALC	Anindilyakwa Land Council
ALRA	*Aboriginal Land Rights (Northern Territory) Act 1976 (Cth)*
AMD	Acid Mine Drainage
ANCOLD	Australian National Committee on Large Dams
ANZECC	Australian and New Zealand Environment Conservation Council (2000)
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASS	Acid Sulphate Soil
ASX	Australian Securities Exchange
ATSDR	Agency for Toxic Substances and Disease Registry
BoM	Bureau of Meteorology
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CEMP	Crisis and Emergency Management Plan
CIP	Community Investment Plan
CPS	Concentrator Product Stockpiles
CRD	Cumulative Rainfall Departure
CSRM	Centre for Social Responsibility in Mining
DAWE	Commonwealth Department of Agriculture, Water and Environment
DCM	Department of Chief Minister
DEPWS	NT Department of Environment, Parks and Water Security
DGV	Default Guideline Value
DIPL	NT Department of Infrastructure, Planning and Logistics
DITT	NT Department of Tourism, Industry and Trade
DDH	Diamond Drill Hole
DotE	Commonwealth Department of the Environment
DPH	Dissolved Petroleum Hydrocarbons
DPIR	NT Department of Primary Industry and Resources
DTSC	NT Department of Tourism, Sport and Culture
EARC	East Arnhem Regional Council
EIS	Environmental Impact Study
EMP	Environment Management Plan
EMR	Environmental Mining Report
EP Act	Environmental Protection Act 2019 (NT)

Abbreviation	Description
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
FIFO	Fly-in, Fly-out
FSANZ	Food Standards Australia and New Zealand
FY	Financial Year
GEAT	Groote Eylandt Aboriginal Trust
GEBIE	Groote Eylandt and Bickerton Island Enterprises
GEMCO	Groote Eylandt Mining Company Pty Ltd
GEWWG	Groote Eylandt Weed Working Group
GIS	Geographical Information System
HDPE	High-density Polyethylene
HBGV	Health Bases Guideline Values
HVAS	High Volume Air Sampler
IMT	Incident Management Team
IBC	Intermediate Bulk Container
ICPMS	Inductively Coupled Plasma Mass Spectrometry
IPA	Indigenous Protected Area
ISQG	Interim Sediment Quality Guidelines
JSA	Job Safety Analysis
LBMP	Land and Biodiversity Management
LGA	Local Government Area
LoOP	Life of Operation Plan
LOR	Limit of Reporting
MEMP	Marine Environmental Monitoring Program
MLs	Mining Leases
MLC	Mining Liaison Committee
MMP	Mining Management Plan
MNES	Matters of National Environmental Significance
MPC	Maximum Permissible Concentration
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measures (1999)
NPI	Non Process Infrastructure
NT EPA	Northern Territory Environment Protection Authority
OPR	Operational Performance Report
ORIC	Office of the Registrar of Indigenous Corporations
PAH	Polycyclic Aromatic Hydrocarbons
PCS	Primary Crushing Station
PEARL	People, Environment, Assets, Reputation, Livelihood
PMS	Post Mining Surface
PSH	Phase Separated Hydrocarbons
RC	Reverse Circulation
RMSL	Rehabilitation, Mine Services and Legacy

Abbreviation	Description
ROM	Run of Mine
SEP	Stakeholder Engagement Plan
SBP	Sand Beneficiation Plant
SPL	Special Purpose Lease
SQGV	Sediment Quality Guideline Values
SRM	Stakeholder Relationship Manager
TCEQ	Texas Commission on Environmental Quality
TML	Transportable Moisture Limit
TPH	Total Petroleum Hydrocarbons
TPWC Act	Territory Parks and Wildlife Conservation Act 1976 (NT)
TSMP	Threatened Species Management Plan
TSF	Tailings Storage Facility
UCL	Upper Confidence Limit
WM Act	Weeds Management Act 2001 (NT)
WMP	Water Management Plan
WoNs	Weeds of National Significance
WRAC	Workplace Risk Assessment and Control
WRD	Waste Rock Dump

Table 9-2: Units

Unit	Description
%	Percent
cm	Centimetre
ha	Hectare
kt	Kilograms per tonne
km	Kilometres
km/hr	Kilometres per hour
km^2	Square kilometres
mm	Millimetres
mm^3	Cubic millimetre
mm/day	Millimetres per day
m	Metres
m^3	Cubic metres
ML	Million litres
Mt	Million tonnes
Mtpa	Million tonnes per annum
MWh	Megawatt hour
PM_{10}	Particulate matter 10 micrometres or less in diameter
PM_4	Particulate matter 4 micrometres or less in diameter
$\mu g/m^3$	Micrograms per cubic metre

9.2 Mining Management Plan Checklist

Y / N	Page/s	Requirement	Department's Comment
Y	Title Page	Has the plan been endorsed by a senior representative of the company?	
Y	1	**Introduction:** Have Operator details been included?	
Y	3-4	Is the company structure described?	
Y	3	Are title details included?	
Y	11-14, 83-90	Is there a project summary and description improvements?	
Y	15-34	**Site Conditions:** Have all the physical environment conditions for the site and surrounds been identified?	
Y	35-39	Have the current land uses and users and stakeholders been identified?	
Y	40-45	Have Community Affairs been described?	
Y	46-54	**Statutory and Non-Statutory Requirements:** Has all legislation relevant to the operation and associated permits and approvals been identified? Have all non-statutory obligations been identified and included?	
Y	54-58	Have Aboriginal and heritage sites been identified?	
Y	59-91	**Operational Activities:** Have all operational activities relating to mining, processing, exploration and any related activities for the site been addressed in the MMP?	
N	N/A	**Waste Rock Characterisation:** Have results of waste rock characterisation been included and discussed? Has a waste characterisation report been included? Does the MMP include a waste rock management plan?	
Y	3-4, 92	**Environmental Management:** Has the Environmental Management structure and responsibilities been outlined?	
Y	92-94, 289	Has the Environmental Policy been included? Has a register of environmental commitments been included?	

Y / N	Page/s	Requirement	Department's Comment
		Has a summary of all recommendations from the Environmental Impact Assessment been included and addressed if the project has been formally assessed?	
Y	94-95	Has training and induction been addressed?	
Y	95-96	Is there an Environmental Emergency and response plan?	
Y	96-97	Have all environmental aspects and potential impacts been identified? Has a risk assessment been carried out?	
Y	97-116 (summary included)	Have Environmental Management Plans (EMP's) for identified risks been developed and included?	
Y	97-116	**EMPs:** Do all EMP's include: • objectives and targets • management and mitigation strategies • monitoring and measurement • discussion and analysis of results • non-conformances and corrective actions?	
Y	117-121	**Water Management:** Has a comprehensive description of surface water conditions been included?	
Y	118, 121-124	Has a comprehensive groundwater model been described?	
N	N/A	Have information or knowledge gaps been identified and described for water management?	
N	N/A	Are there comprehensive details (including scopes of work) on actions proposed to be taken to respond to any identified information or knowledge gaps?	
Y	124-125	Have hazards been identified that could result from activities related to the operation and rank the associated risks of impacts to both surface and groundwater?	
Y	125	Are all strategies and actions that will be undertaken to manage any risks identified included?	
Y	125-141, 217-230	Has the water monitoring program been detailed?	
Y	142-198, 231-288	Has all monitoring data been included?	

Y / N	Page/s	Requirement	Department's Comment
Y	142-198	Has an interpretation of data by a suitably qualified person been included?	
Y	142-198	Has a discussion of trends over time been detailed?	
Y	142-198	Have details of remedial/corrective strategies and scopes of work been included?	
Y	142-198	Have proposed actions been detailed?	
Y	199	**Incident Reporting:** Has a table of all incidents recorded on site been included and discussed?	
Y	200-202 (summary included) GEMCO's 2018 Closure Plan previously submitted to DITT.	**Closure Planning:** Has a Life of Operation Plan – Unplanned Closure plan been included? Are all disturbances described? Are remediation activities that would be required in the event of unplanned closure described? Are activities required to achieve end land use objectives, described?	
Y	202-204, Security Calculation Tool	Does the MMP include a detailed costing of closure activities for the life of plan? Have all past disturbances and those proposed for the next reporting period been identified and included?	
Y	Various	**Maps and Plans:** Maps and plans have scale, scale bar, legend and north point? Datums used are MGA94 or GDA 94 (expressed in decimal degrees) with elevations based on AHD?	

9.3 ALC Letter of Endorsement

11 November 2020

Delivered by email

Ms Jo-Anne Scarini
Vice President Operations
GEMCO
ALYANGULA NT 0885

Via Email: Jo-Anne.Scarini@south32.net
John Hansen John.E.Hansen@south32.net

Dear Jo-Anne,

Re: Endorsement for FY21-24 Mine Management Plan.

Thank you for the opportunity to consider GEMCO's FY2021-2024 Mine Management Plan (MMP).

The Anindilyakwa Land Council (ALC) have considered the plan and provided considered comments and questions. The ALC has received GEMCO's responses to the ALCs comments and appreciate the opportunity for ongoing dialogue around the ALCs concerns.

The ALC is satisfied with GEMCO's FY21-24 MMP and can now provide in principle support for its submission.

If you require further clarification around this letter please contact Ross McDonald Mining & Environment Manager 08 8987 4008 rmcdonald@alcnt.com.au.

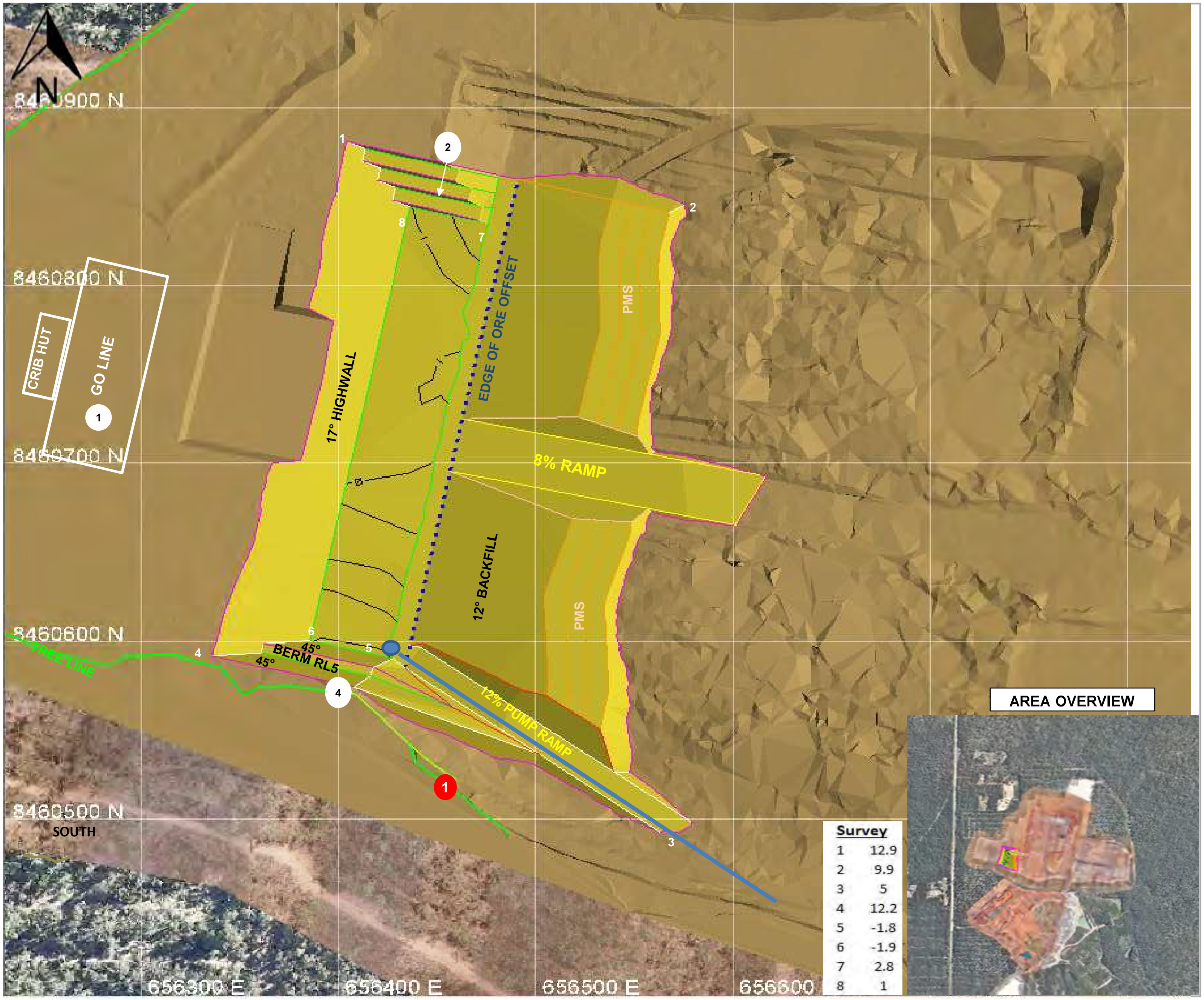
Yours Sincerely,

Tony Wurramarrba
Chair
Anindilyakwa Land Council

9.4 Example Mine Designs

Overburden Pre-stripping (Excavation)
Overburden Pre-Stripping (Dozer Push)

N3_07_01-03_DZ



PARAMETER	STANDARD	DESIGN
Highwall Angle	17°-20°	17º
Backfill Angle	10°-12°	12º
Endwall Angle	17°-25°	18-30º
Edge of Ore Offset	5 Metres	10 Metres
Pit Floor Width	40 Metres	40 Metres
Ramp Width	25-40 Metres	30 Metres
Ramp Gradient	< 9 %	8%
Ramp Length		180 Metres
Volume	In-Situ BCM	124,129
Mass	Tonnes	131,102

HAZARDS*

1.Significant site to south of design. Do not go past treeline

*NB: Hazards indicative only - Ops inspection of area required.

INSTRUCTIONS

1. Setup crib hut and go line as indicated and remove any pipes in the area.
2. Commence dozing from north to south targeting top of ore.
3. Install 8% backfill ramp and tie into existing access road.
4. Utilise the 1200 excavator to assist with achieving the southern end wall, with ~7m batters at 45º and a 5m catch berm at RL5
5. Install 12% pump ramp at the southern end of the pit. .

* Doze direction may change depending on pit conditions however the southern wall will still require hybrid assist.

APPROVALS

Engineer Design: Kevin Lu
Signature: Date: 22/7/20
Prod Planning Peer Review: Annette Au
Signature: A Au Date: 22.07.20
Supt. Prod Planning: Angus Phelps
Signature: Angus Phelps Date: 22/07/20
Supt. Planning Services: Chloe Cavill
Signature: CACavill Date: 22/07/20
Supt. Prod Mining: Andy Graham
Signature: Andy Graham Date: 22/7/20

ENGINEER DESIGN CHECKLIST

Design Checks	Yes	No	Comments
Have I physically inspected the work area with the Production Superintendent (or representative) and gained plan feedback?			
Have all critical risks in the work area been identified on the plan?			
Have wall/backfill angles been designed within geotechnical guidelines for the material type and / or area?			1200 Excavator to assist to achieve south end wall
Is there a history of geotechnical failure in previous cut/s?			
Have wall/backfill angles been designed within operational work standards for type of machinery completing the task?			
Has the design been checked against the current MORE line, tree clearing limits and sacred sites / areas of significance?			Close to Ngunda creek and treeline.
Has the design been checked against known site infrastructure (roads, powerlines, pipelines, exploration drillholes, laydown yards, buildings etc.)?			
Have ramps, roads and intersections been designed to comply with GEMCO standards (GEM-STA-4218)?			
Has water management been adequately identified on the mine plan (low spots, pumping infrastructure, pump ramps etc.)?			
Has a dozer spoil fit been completed for the design?			
Has a dump location been identified (for prestrip & topsoil plans only)?			N/A
Are catch berms and/or windrows required?			Along highwall and open faces.
Have crest and toe lines been clearly identified on work plan?			
Does the design include or provide access to the pit crest for lighting plants and pit inspections?			
Are pit design parameters entered correctly on work plan?			
If the design covers more than one cut/block, have they been identified on the plan?			
Has previous cut reconciliation information been incorporated into the design?			

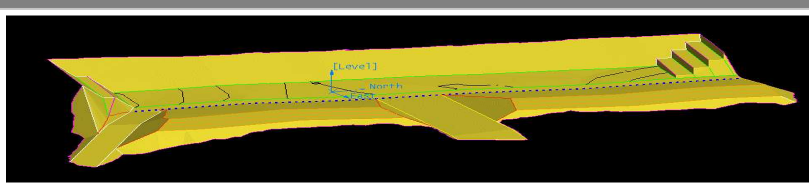
Engineer Design Sign-Off: **Name:** Kevin Lu **Date:** 22/7/20

Enabling Activities	Yes	No	Comments
Does Survey have all the correct set-out information?	✓		
Has the design been uploaded into ProVision?	✓		
Has the signed-off plan been uploaded to SharePoint (Secured and Unsecured)?	✓		
Has the Plan Tracker been updated?	✓		

Engineer Design Sign-Off: Isabela Protacio **Name:** Isabela Protacio **Date:** 23/07/2020

Data Management	Location
Design layer names (strings and triangulations):	Z:\Planning\Area_Name\N3\Short_Term\N3_07_01-03_DZ
Mining cuts layer:	FY21_CUTS_V1
Survey as-built surface:	Z:\Planning\Area_Name\N3\Short_Term\n3_07_dz_asb20200722.00t
Top of ore model / surface:	Z:\STGM\Current Surfaces\NQ\OBSF20200519.00t
Bottom of ore model / surface:	Z:\STGM\Current Surfaces\NQ\BOTSF20200410.00t

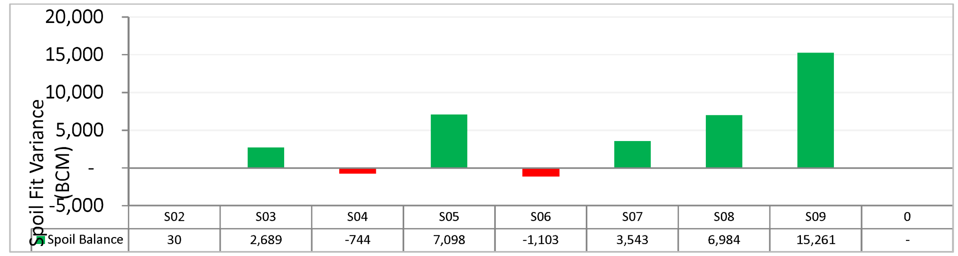
Isometric View



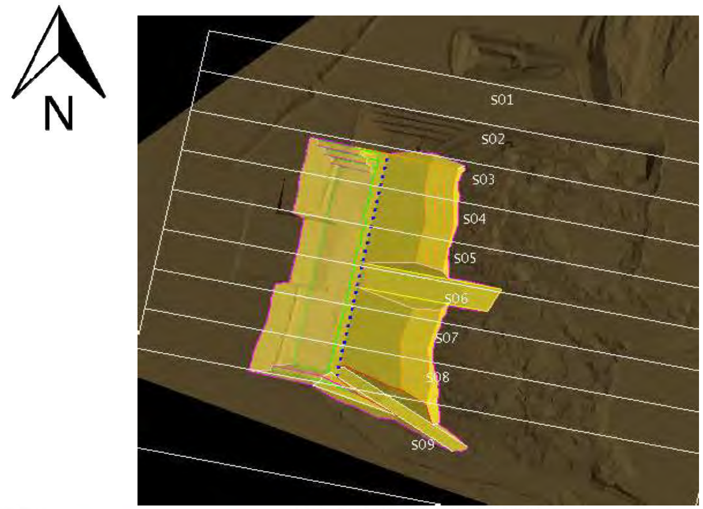
SPOIL BALANCE & PROFILE

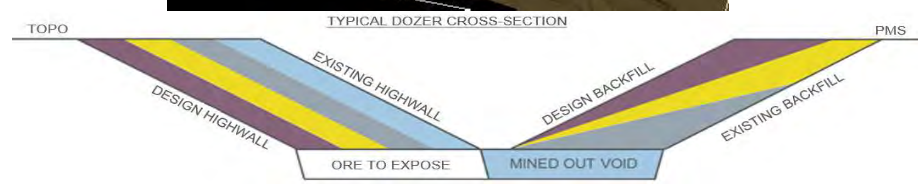
N3_07_01-03_DZ_Dozer-Push Spoil Balance **Swell Factor:** 10%

Comments: Push section 06 into section 07 if required



	S02	S03	S04	S05	S06	S07	S08	S09	0
Spoil Balance	30	2,689	-744	7,098	-1,103	3,543	6,984	15,261	-





DESIGN QUANTITIES			Volume	OB Quantity
Block ID	**OB Thickness (m)**	**Moisture**	**In-Situ (BCM)**	**ROM (t)**
N3_07_01	13	10%	57,580	113,433
N3_07_02	14	10%	11,458	22,573
N3_07_03	13	10%	55,091	108,529
TOTAL	**13**	**10%**	**124,129**	**244,535**

N3_09_01-02_PS

PARAMETER	STANDARD	DESIGN
Batter Angle	45°	45°
Flitch Height	3-4m	3-4m
Berm Width	5-10m	N/A
Pit Floor Width	40m	55m
Cut Length		100m
Ramp Width	25-40m	30m
Ramp Gradient	<= 9 %	9%
Volume	In-Situ BCM	22,461
Mass	ROM Tonnes	44,248
ROM Density	1.8-2.1	1.97

HAZARDS*

*NB: Hazards indicative only - Ops inspection of area required.

INSTRUCTIONS

1. Set up area and access from the east as per STA-4218.
2. Drop into ramp for a bottom load truck shovel circuit. Bottom load from north to south until design surface **N3_09_01-02_PS** has been achieved

CROSS-SECTION A-A'

APPROVALS

Engineer Design: Nathan Colacino
Signature: Nathan Colacino Date: 2/8/20
Prod Planning Peer Review: Adam Topic
Signature: ATopic Date: 28/08/20
Supt. Prod Planning: Angus Phelps
Signature: Angus Phelps Date: 28/08/20
Supt. Planning Services: Rick Guerini
Signature: R Guerini Date: 28/08/20
Supt. Prod Mining: EUNM for JL
Signature: MEun Date: 28/08/2020

ENGINEER DESIGN CHECKLIST

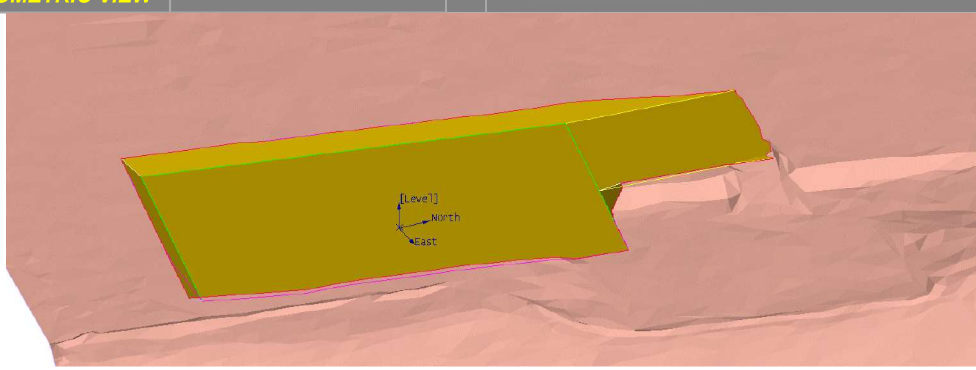
Design Checks	Yes	No	Comments
Have I physically inspected the work area with the Production Superintendent (or representative) and gained plan feedback?	✓		Discussed with PC 3/8/20 Nathan Colacino
Have all critical risks in the work area been identified on the plan?			
Have wall/backfill angles been designed within geotechnical guidelines for the material type and / or area?			
Is there a history of geotechnical failure in previous cut/s?			
Have wall/backfill angles been designed within operational work standards for type of machinery completing the task?			
Has the design been checked against the current MORE line, tree clearing limits and sacred sites / areas of significance?			
Has the design been checked against known site infrastructure (roads, powerlines, pipelines, laydown yards, buildings etc.)?			
Have ramps, roads and intersections been designed to comply with GEMCO standards (GEM-STA-4218)?			
Has water management been adequately identified on the plan (low spots, pumping infrastructure, pump ramps etc.)?			
Has a dozer spoil fit been completed for the design?			
Has a dump location been identified?			
Are catch berms and/or windrows required?			
Does the design include or provide access to the pit crest for lighting plants and pit inspections?			
Are pit design parameters entered correctly on work plan?			
Has previous cut reconciliation information been incorporated into the design?			

Engineer Design:	Nathan Colacino	Signature:	Nathan Colacino	Date:	2/08/2020

Enabling Activities	Yes	No	Comments
Does Survey have all the correct set-out information?	X		
Has the design been uploaded into ProVision (strings and triangulations)?	X		
Has the signed-off plan been uploaded to SharePoint (Secured and Unsecured)?	X		
Has the Plan Tracker been updated?	X		
Has the signed plan been emailed to the Designs distribution list?	X		

Engineer Design:	Adam Topic	Signature:	Atopic	Date:	28/08/20

ISOMETRIC VIEW



HAUL ROUTES

Priority #1 Dump	N1S Dump	1-Way Distance	1.8 km
Priority #2 Dump	F5E Dump	1-Way Distance	5.0 km

Data Management	Location
Design layer names (strings and triangulations):	Z:\Planning\Area_Name\N3\Short_Term\grdesigns.dgd/N3_09_01-02_PS
Mining cuts layer:	FY21_CUTS_V1
Survey as-built surface:	Z:\Planning\Area_Name\N3\Short_Term\n3_09_MT_ASB200801
Top of ore model / surface:	Z:\STGM\Current_Surfaces\NQ\OBSF_20200519
Bottom of ore model / surface:	Z:\STGM\Current_Surfaces\NQ\BOTSF_20200410

DESIGN QUANTITIES

Block ID/Stage	Vol(bcm)	ROM RD	ROM Tonnes
N3_01	22,461	1.97	44,248
TOTAL	**22,461**	**1.97**	**44,248**

KEY DESIGN CONCEPTS

> Pre-strip for dozer strip 9

9.5 TSF15 Design Update

TSF15 - Slime Tailings Storage Facility Design Update Memorandum

SOUTH32

EXECUTIVE SUMMARY

Approval from the Department of Primary Industries and Resources (DPIR) was provided in January 2020 as an amendment to South 32's Groote Eylandt Mining Company (GEMCO) approved mine management plan (Authorisation number: 126-01) to clear the proposed greenfield site and construct a new Slimes Tailings Storage Facility (denoted TSF15). The need for this work was identified in GEMCO's Mine Management Plan, 30th September 2016.

TSF15 is proposed to be constructed over a green-fields part of the mine site. The terrain in the proposed TSF footprint slopes gently toward the west and south-west at about 0.6%. An embankment will be constructed along the eastern perimeter with heights typically less than 7 m above natural ground surface level and northern, southern and western perimeters with heights typically less than 13 m above natural ground surface level.

GHD were engaged to initially to undertake the prefeasibility civil and mechanical design of the facility consistent with the requirements of ANCOLD 2012 "Guidelines on Tailings Dams". The prefeasibility civil design included, consequence category assessment, embankment layout and geometry, dam break analysis, seepage assessment, ground water modelling and stability assessment, water management, borrow source investigations and foundation investigations. During the prefeasibility stage Red Earth Engineering Pty Ltd (REE) were engaged by GEMCO to undertake the geotechnical investigation and to also provide geotechnical interpretation of it's findings of the proposed TSF15 site and GEMCO proposed embankment materials.

During the prefeasibility phase REE in collaboration with mining operations presented a concept design for the mine embankment initiative (MEI). The MEI concept design showed substantial business benefits of a synergy between mining overburden cut and the construction of a new green-fields tailing facilities at GEMCO. REE since have been engaged to provide a final TSF design incorporating both MEI construction methodology and conventional contractor methods of construction and also certification of the MEI.

REE were awarded the feasibility design incorporating the new MEI construction methodology in March 2019 with the key design requirements that the dam was to be designed and constructed to ANCOLD 2019 "Guidelines on Tailings Dams". In order to achieve a robust design outcome and along with acceptable GEMCO risk outcomes, mine delivered compaction trials were developed along with additional laboratory testing of mine placed materials between February 2020 to April 2020. In May 2020 the proven construction methodology and verification controls were approved by the designer and reviewed by Dr Bruce Brown.

Along with the synergy benefits of the mine operation delivering embankment materials for TSF construction it has also provided other business benefits including safer conservative batter angles both during and post construction and provides the added benefit of batters being closer to final closure batter rehabilitation requirements (entire western embankment wall 1:6 downstream batter with 1:4 of remaining embankment due to mine operational constraints). REE Mine embankment initiative (MEI) design was reviewed by external technical expert Andie Fourie and endorsed by Dr Bruce Brown (PhD., P.Eng.) as meeting the requirements of ANCOLD 2019 (see attached).

Suitable embankment borrow materials have been confirmed in the central quarry mining pits as well as within the impoundment of the TSF. As part of the material requirements for TSF15, and potential future civil works at GEMCO, there is also a need to source durable rock materials from within the GEMCO lease. Potential sources of suitable material include existing F5 and G-Quarry white rock locations and have recently been investigated for rock quality and quantity verification.

A groundwater impact assessment conducted by WSP (2019) indicated that there is a localised groundwater mound within the facility which is generally contained within the extent of the TSF and which extends to approximately 90 m to the north and 100 m to the south of the TSF. The assessment concluded that mounding is unlikely to affect the coastal receptor due to the operation of TSF15, in combination with the pre-existing TSF operations. Seepage from the TSFs is likely to increase recharge to the underlying aquifer systems, increasing the amount of water to be received at the coast. WSP also provided a ground water monitoring plan targeted to two aquifers (Upper and Lower Aquifer) of the facility, which will be implemented by GEMCO to monitor for impacts (if any) on the regional groundwater during the operation and closure of TSF15.

A dam break assessment has previously been submitted and TSF15 and has been reviewed by a third party (Appendix A). Dam break assessment has also been reviewed by REE in feasibility for the purpose of consequence category assessment which resulted in consensus with GHDs assessment. Both “sunny day” and “rainy day” failure scenarios of the embankments have been assessed which potentially could impact mining crews, the public and the environment downstream. From this assessment the Population at Risk (PAR) during a “sunny day” failure was estimated at approx. 9 mining operation personnel could be in the area (1 to 10 PAR) with an assessed severity level of damage of ‘Major’, a ‘High C’ Dam Failure Consequence Category rating has been adopted for PFS design.

The Dam Spill Consequence Category is assessed as ‘Very Low’ for design, with spill water likely to flow towards the ocean in the south, south-west. The designer in order to be consistent with the design storage allowances at GEMCO for other tailings storage facilities, has a adopted the equivalent criteria for a ‘low’ dam spill consequence category.

Early works construction of TSF15 and MEI commenced in FY2020 and is anticipated to be complete in FY2022. A detailed program of works for TSF15 is currently being prepared in collaboration with the Contractor. During the MEI and contractor construction, GEMCO will engage an experienced geotechnical tailing’s engineer to supervise the works and ensure the facility is built in accordance with the design intent. A certification report detailing the construction activities will be prepared prior to commissioning TSF15.

GEMCO have continued to engage Dr Bruce Brown, an independent technical expert (ITE), to review of the TSF15 design documentation throughout the feasibility design process and is currently reviewing the 80% design documentation.

TSF15 - Slime Tailings Storage Facility
Design Update Memorandum

SOUTH32

Contents

TSF15 - Slime Tailings Storage Facility
Design Update Memorandum

SOUTH32

1 Introduction

1.1 General

An approval from the Northern Territory (NT) Department of Primary Industry and Resources (DPIR) has been provided in the form of an amendment to South32's Groote Eylandt Mining Company (GEMCO) approved Mine Management Plan (MMP) (Authorisation number: 126-0) in January 2020.

Since TSF15 MMPA approval at prefeasibility design stage some of the design information within the previous MMPA has become obsolete or ambiguous. The purpose of this memorandum is to update the DPIR on the feasibility design outcomes since the previous TSF15 MMPA submission.

This document provides the following for TSF15:

- Outlines the design development process;
- Addresses the management of environment impacts;
- Addresses the management of heritage and cultural impacts;
- Outlines the scope of works proposed;
- Outlines the minimum quality control requirements enforced on the Contractor;
- On-going maintenance and monitoring requirements; and
- Closure Plan.

1.2 Reference

The references utilised in this document are listed below:

- GHD (2019): GEMCO TSF15 Pre-Feasibility Design
- WSP (2019): TSF15 Groundwater Impact Assessment,
- REE (2019): TSF15 Geotechnical Investigation Factual Report
- REE (2020a): TSF15 MEI Design Report
- REE (2020b): TSF15 Design Report

1.3 Background

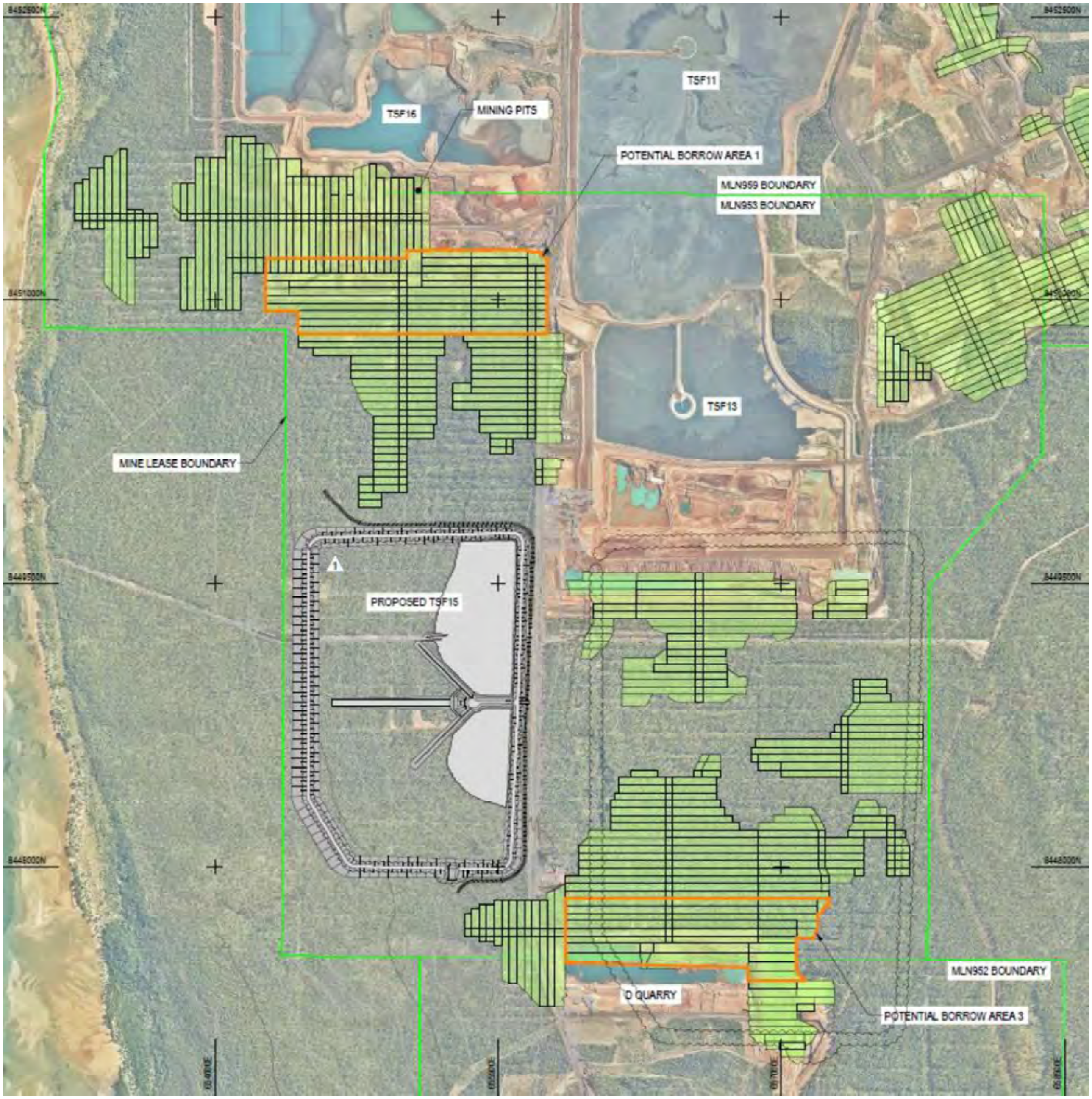
The processing of manganese ore at GEMCO results in the production of concentrate products (manganese lump and fines) and waste products, including middlings (gravels), sand tailings and slime tailings. The production rates of concentrate and waste vary depending on the ore feed into the processing plant.

The sands and slimes tailings streams are currently separated to enable future mining of the sand tailings. Both streams are pumped from the processing plant via buried welded HDPE pipes and discharged into separate purpose-built facilities (i.e. sands TSFs and slimes TSFs). The supernatant water from these facilities is returned to Dam 1 (a purpose-built water storage facility) and recycled in the processing operations.

GEMCO carries out regular quarterly inspections and life expectancy reconciliations of the active TSFs. The most recently completed life expectancy estimates of the active slime's storage facilities indicate that TSF15 will be required to be operational by August 2022 (includes business requirement of an additional 6 months before the anticipated exhaustion date of TSF11/TSF13).

Figure 1 shows the location of the existing tailings storage facilities managed by GEMCO and the location of the proposed slimes tailings storage facility TSF15.

Figure 1 – TSF15 Locality Plan



1.4 Scope of Works (General)

The scope of works for TSF15 comprises construction of a 10.46 Mm^3 capacity tailings storage facility to provide a nominal four years of slimes tailings storage. An opportunity to undertake a Contractor raise of the facility has also been accounted for in the design which would provide and addition 3.59 Mm^3 (14.05 Mm^3) and up to 15 months of additional slimes tailings storage.

The proposed location of TSF15 (refer Figure 1) has a plan area of 221 hectares (ha) and is located south of W1 and E-South ore areas and immediately southwest of, TSF13 which is the current active slimes tailings storage facilities.

The project works for TSF15 broadly involves the following:

- Tree clearing, grubbing, topsoil stripping;
- Removal of loose unsuitable foundation material;
- Foundation preparation beneath the perimeter embankments;
- Profiling of the impoundment floor;
- Preparation of a rock quarry to supply materials for TSF15;
- Decant construction;
- Embankment construction;
- Spillway construction;
- Tailings delivery pipe work installation; and
- Decant infrastructure and pipe work installation.

1.5 General

For TSF15, GEMCO commissioned REE to undertake the feasibility civil design and Dr Bruce Brown of Bruce Brown Consulting to provide an independent peer review. REE in partnership with GPA Engineering, were also engaged to undertake the mechanical design.

The civil design development process was based on ANCOLD (2019) and involved the following:

- Risk assessment and design basis development;
- Geotechnical investigation and construction material assessment;
- Review of existing tailings and process water characterisation;
- Review of PFS Dam break modelling and consequence category assessment;
- Operating requirements;
- Water balance and stormwater management;
- Seepage, contaminant transport and groundwater mounding impacts assessment;
- Review of site-specific seismic assessment;
- Stability analysis including seismic and adjacent blasting from mining operations; and
- Detailed engineering, technical specification and design report preparation.

The development process is further discussed in the following subsections.

1.6 Regulatory Guidelines and Consequence Category

It is understood that the Northern Territory Department of Primary Industry and Resources (DPIR) does not have specific regulatory guidelines for the design of tailings dams, however, generally default to the relevant ANCOLD Guidelines. Therefore, the design for TSF15 was undertaken to comply with the requirements of the ANCOLD 2019 Guidelines.

The Consequence Category of the proposed tailings storage facility TSF15 is classified in accordance with the

ANCOLD Guidelines. The ANCOLD Guidelines provides recommended Consequence Category for tailings dams based on the worst case of the Severity Level of Damage combined with the Population at Risk. These criteria utilise expected Population at Risk (PAR), and the Severity of Damage or Loss.

For the proposed TSF15, at feasibility it is assumed that the critical failure scenario is a sunny day failure with operations working downstream of the embankment.

- Population at Risk - (PAR) is between 1 and 10; and
- Severity of Damage or Loss is “major”

REE reviewed GHD PFS Dam Failure Consequence of ‘High C’ and provided the same Consequence Category of ‘High C’ based on a PAR of 1 to 10 with a damage severity level of ‘major’ (ANCOLD 2019).

The Dam Spill Consequence Category is assessed as ‘Very Low’ for design however in order to remain consistent with the design storage allowances at GEMCO for other tailings storage facilities, the designer has adopted the equivalent design criteria for a ‘low’ dam spill consequence category.

1.7 Current Land Use

The site proposed for TSF15 consists of mostly virgin ground. The terrain in the proposed TSF footprint slopes gently toward the west and south-west at about 0.6%. The site is bounded to the north by E-South ore area, south by D-North ore area, the west by the mine lease boundary and the east by the current D-Quarry Haul Road, refer Figure 1.

1.8 Geotechnical Investigations

REE were engaged to undertake both the initial geotechnical investigations of the proposed TSF15 site (see figure and also undertake the interpretation of the site conditions. Along with initial investigations they were also engaged to undertake several follow up investigations as part of the ongoing design of the facility.

The initial investigation comprised of:

- 37x piezocone tests (CPTu)
- 17x pore pressure dissipations
- 7x seismic dilatometer tests (SDMT)
- 3x vane shear tests (VST)
- 41x test pits, including geotechnical logging and sampling
- 41x dynamic cone penetrometer (DCP) tests.

Along with the following laboratory testing:

- 26x moisture content
- 26x soil particle density
- 26x particle size distributions
- 26x Atterberg limits and linear shrinkage tests
- 10x standard compaction tests
- 12x triaxial consolidated undrained tests
- 3x permeability tests
- 10x pin-hole dispersion tests

The following follow up investigations where undertaken as part of the design process:

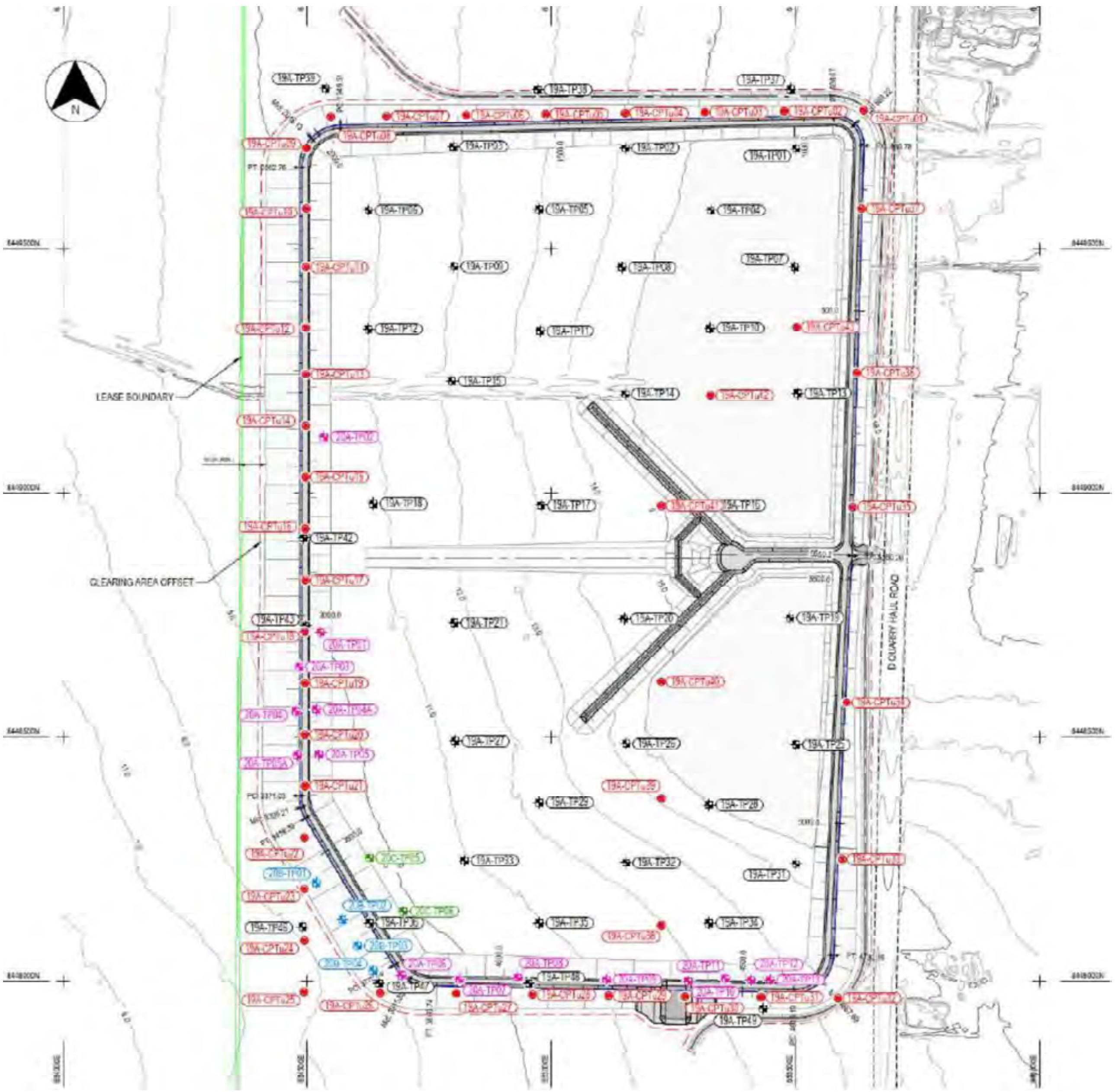
- MEI overburden Investigation
- Foundation compressible layer investigation
- Unsuitable investigation
- Compaction trials

Further testing as part of these investigation included but was not limited to:

- Atterberg limit tests
- Particle size distribution tests
- Particle specific gravity tests
- Standard compaction tests
- Triaxial unconsolidated undrained shear tests
- Clod density tests
- Hole erosion tests
- Clay minerology tests

Typical subsurface profile consists of 0.15 m and 0.2 m of topsoil overlying locally deposited alluvial soils (unsuitable) of a thickness of between 0.2 and 0.9 m, on top of a deep lateritic profile including a duricrust composing of localised irregular ferruginous nodules in a matrix of pisolitic gravels and sandy clay. Although bedrock was not encountered in the investigation due to CPT refusal, the manganese oxide ore-bearing bedrock formation is anticipated between depths of 22 to 26m below ground surface level.

Figure 2 – TSF15 Geotechnical Investigations



1.9 TSF15 Embankment Concept

The embankment design comprises of a 22m wide crest width with gradual 1:4 upstream and 1:4 to 1:6 downstream batters. The robust geometry including a base embankment width of between 50 m on the east to about 130m on the west is provided to accommodate the delivery clay embankment materials by the mine operation.

Figure 3 – TSF15 Mine Delivered Embankment - Typical Cross Section

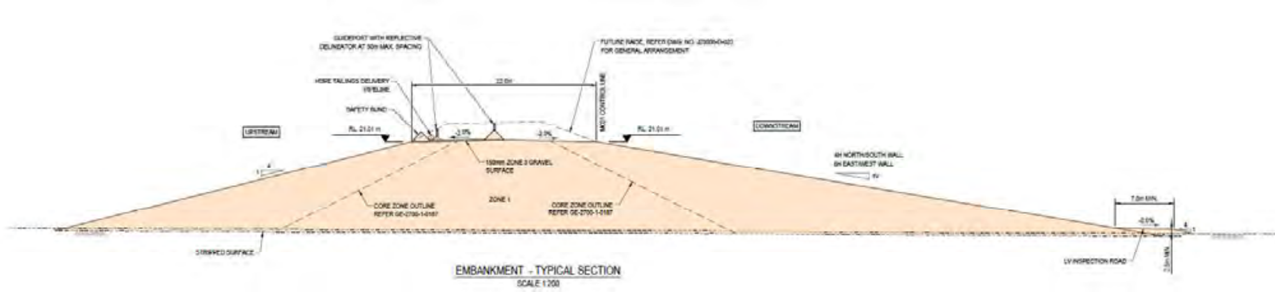
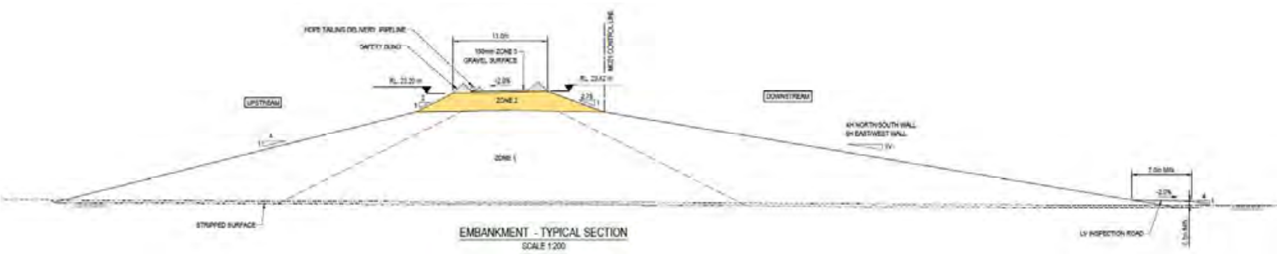


Figure 4 – TSF15 Contractor Raise – Typical Cross Section



1.10 Construction Materials

Construction materials for the tailings storage facility embankments will be sourced from gravelly or sandy CLAY material encountered within the TSF impoundment and from similar mine overburden materials from the central quarry operations. No additional disturbance for suitable embankment material is required outside the existing GEMCO mining path or TSF15 footprint.

Rock materials used for erosion protection, spillway and decant embankment will be sourced from on-lease white rock quarries and road surfacing materials will be sourced from the middlings by-product produced by the GEMCO concentrator plant.

1.11 Tailings Geochemical Characteristics

TSF 15 is designed to store slimes tailings produced at the GEMCO Concentrator and PC02 plant. Basis of design data included rheology studies of the slimes tailings undertaken by Paterson & Cooke, 2020 and geochemical characterisation of the slimes tailings AECOM, 2017.

1.12 Water Management Criteria

The main design criteria for water management is summarised in Table 1. The water management criteria are in accordance with the requirements of Subsection 5.2 'The Water Balance' of ANCOLD 2012 "Guidelines on Tailings Dams", for a **"high"** dam failure consequence category and **"low"** environmental spill consequence category.

Table 1 Water Management Design Criteria

Parameter	Value	Reference

Wet Season Storage Allowance (WSSA)	1:5 year AEP wet season	ANCOLD 2019
Extreme Storm Storage Allowance (ESSA)	1: 100 AEP, 72 hr flood	ANCOLD 2019
Contingency freeboard	No allowance required due to environmental Consequence Category of 'Low' in accordance with ANCOLD	ANCOLD 2019
Spillway Capacity	1:100,000 AEP or PMF	ANCOLD 2019
Wave Freeboard Allowance for Design Flood	1:10 AEP Wind Speed	ANCOLD 2019

1.13 Seepage Assessment and Groundwater Impact

At the GEMCO site, the Western leases comprises catchment of the Angurugu River (the largest catchment with the area of 171.9km^2), Emerald River (99.1km^2 located south of the Angurugu River) and Ndunga Creek (25.85km^2 located to the north of the Angurugu River). The water table under the site occurs at depth ranging between approximately 0.72m and 15.76m below the ground surface and is affected by seasonal variations (up to 2.92m) from rainfall recharge with general rise from November to early March. The water table is generally shallower closer to the coast.

During the bore census completed in February 2019 by WSP, groundwater levels were measured at all available bores (total of 124 bores including 91 shallow bores, 32 deep bores and 1 bore with unknown depth) and used to perform the groundwater model calibration. Majority of the bores are located adjacent to TSFs. There is currently one deep monitoring bore installed and screened in either intermediate aquifer zones, targeting the manganese ore or sand within the lower aquifer within the footprint of proposed TSF15.

There are 6 hydrogeological units, identified from surface to increasing depth: Upper Aquifer, Aquitard, Middle Aquifer, Aquitard, Lower Aquifer and Aquitard. Groundwater levels generally show the mounding water table near operational tailings facilities and depressing in pit areas associated with quarry dewatering or localised groundwater extraction.

Based on the recent bore monitoring survey (Feb 2019) and interpretation, in general, shallow portions of the upper aquifer flow in a westerly direction towards the coast, west of the TSFs. To the northward, however, it flows adjacent to Angurugu Creek. In general, groundwater in the Lower Aquifer flows towards the west; south-west and north-west towards the ocean. Vertically groundwater flows downward, from the Upper Aquifer to the Lower Aquifer.

Based on a previous study conducted by AECOM (2018) which comparing the historical and recent groundwater quality at the GEMCO site with the Australian Drinking Water Guidelines (NHMRC, NRMMC, 2001), an average water quality concentration for all datasets meet the guideline criteria except for pH, which is generally lower than the aesthetic values. Groundwater on site is characterised as sodium-chloride type for the Upper Aquifer, with comparison to the Lower Aquifer.

At the GEMCO site, the main source of groundwater recharge is derived from rainfall, which directly infiltrate into the Upper Aquifer or via infiltration from streambeds. Seepage losses from TSF operation is also identified as an additional course of infiltration to the Upper Aquifer. Groundwater discharge occurs through the baseflow from the Angurugu Creek and further discharging to the ocean or by means of evapotranspiration. Borefield operation or localised dewatering can be identified as the other sources of discharge.

A steady state calibration of the model was undertaken by simulating groundwater levels obtained in February 2019 by WSP (2019). Using the calibrated model, various scenarios were simulated to assess the potential effect of TSF15 on local groundwater flow and seepage influx seeping through the base of TSF15. The results showed good correlation between simulated and observed heads and they were considered acceptable for a regional scale model.

Based on the impact assessment, the simulated potential long-term, steady state, seepage flux through the base of the TSF15 to the underlying strata is approximately 670m^3/day, simulating a head level in TSF15 of 20mAHD. Seepage flux sensitivity analysis was also conducted using a hydraulic conductivity of tailings, between 0.1 and 10 times the adopted value to provide a potential range of seepage flux through the base of TSF15. The result ranged between 100 and 1,900m^3/day. Predicted increases in groundwater levels showed that there was a localised groundwater mound within the facility, with the 0.5m contour. It generally contained within the extent of the TSF, which extends to approximately 90m to the north and 100m to the south of the TSF.

For a post closure after the TSF operational period, the phreatic surface within TSF15 will lower, together with the underlying groundwater mound, as the tailings dewater and the TSF capped, to reduce rainfall infiltration. Groundwater levels are expected to reach equilibrium, with the final water table elevation and rate of seepage, controlled by groundwater recharge from infiltration through the final cover materials and hydraulic conductivity of the tailings after they have consolidated.

As for effect of cumulative impact, based on the result of the groundwater level map with the simulated TSF15 mounding, relative to ground surface indicates that the groundwater levels are likely to be well below ground surface. Mounding is unlikely to affect the coastal receptor due to the operation of TSF15, in combination with the pre-existing TSF operations. Seepage from the TSFs is likely to increase recharge to the underlying aquifer systems, increasing the amount of water to be received at the coast. As such, it is unlikely to have any environmental impacts from mounding or direct seepage from the facility.

It should be noted that the proposed raise on TSF15 will increase the height of the ground water mounding and will need to be remodelled prior to design finalisation.

1.14 Site Specific Seismic Analysis

AECOM have previously carried out a site-specific seismic assessment for Groote Eylandt in order to develop the following:

- a probabilistic ground motion response spectra at the GEMCO site for various return periods for both rock site and soil site conditions,
- a suite of five time histories to represent the 1,000 year ARP response spectrum for each of these two site conditions

The basis of the site-specific seismic assessment included two earthquake source models which were given equal weights in the probabilistic seismic hazard analysis. The first source model is an updated version of the AUS5 source model used by ES&S (2006). This model is based on the approach of Brown and Gibson (2004), which uses geological criteria to identify zones of uniform seismic potential, and then uses historical seismicity to characterize the seismic potential of each zone. The second earthquake source model was derived by Risk Frontiers (Hall et al., 2007) based on the spatial smoothing of historical seismicity.

The assessment results were used in the formation of the slope stability assessment of the TSF15 embankments.

1.15 Stability Assessment Criteria

The target minimum factors of safety (FoS) for the design loading conditions are adopted from ANCOLD (2019), as shown in Table 2.

Table 2 - FOS Criteria

Parameter (1)	Value	Reference
Static long term drained Factor of Safety (FoS)	1.5	ANCOLD (2019)
Short-Term Undrained FoS (potential loss of containment)	1.5	ANCOLD (2019)
Short-Term Undrained FoS (no potential loss of containment)	1.3	ANCOLD (2019)
Post Seismic FoS	1.0-1.2 (2)	ANCOLD (2019) (3)

Notes:
1. See Section 6.1.3 of ANCOLD (2019) for description of loading conditions.
2. To be related to the confidence in selection of residual shear strength. 1.0 may be adequate for use with lower bound results.
3. Cyclically reduced undrained/drained shear strength and/or liquefied residual shear strength for potentially liquefiable materials.

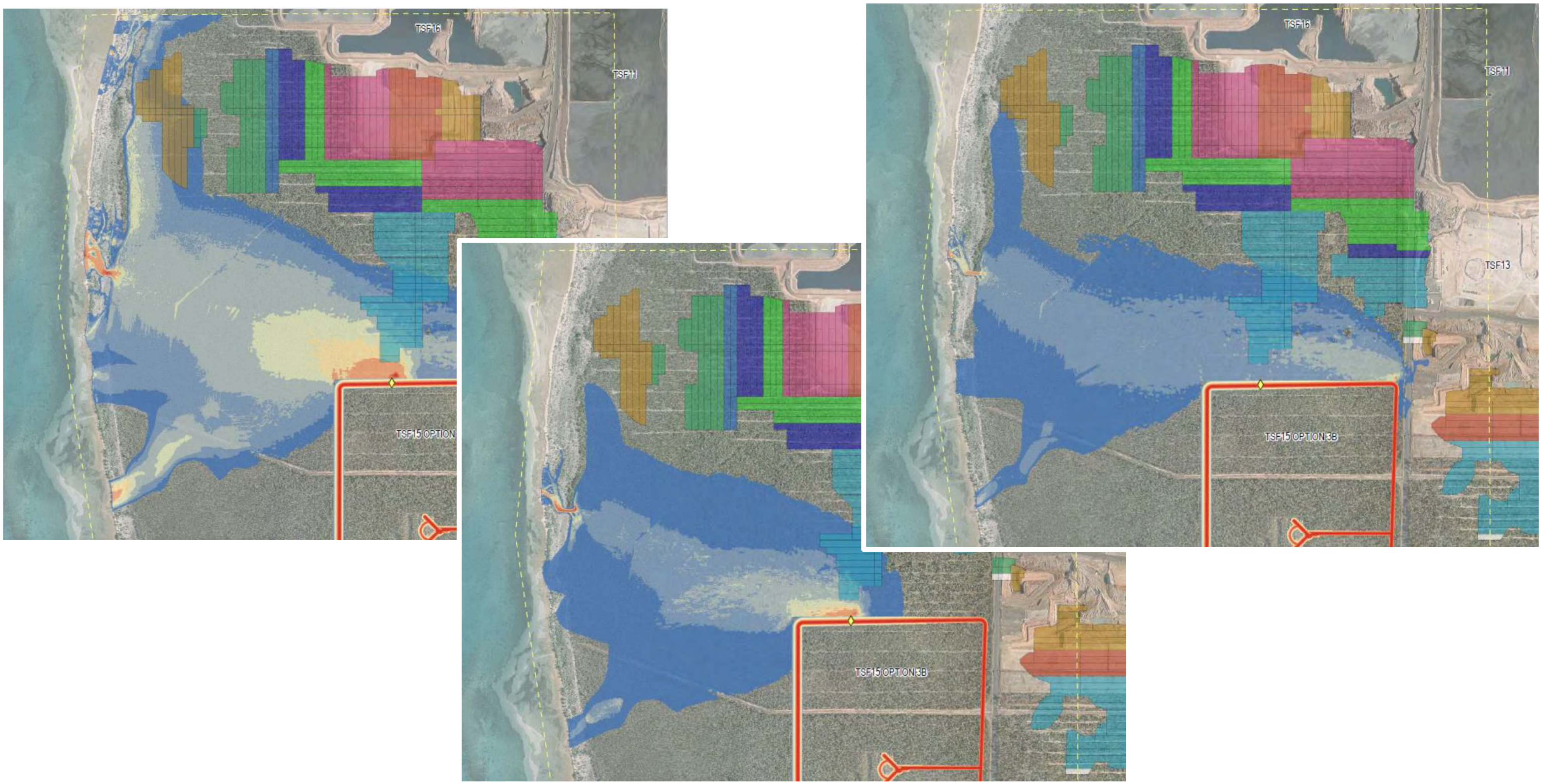
1.16 Dam Break Analysis

A preliminary dam break analysis has been carried out in the PFS phase and a review undertake by a third party (Appendix A). Analysis was undertaken on the following failure scenarios '"sunny day failure", "rainy day failure – no break" and "rainy day failure – break"

The results show that no communities are subject to flooding, however E Quarry mining operations to the north of the facility is anticipated at the same time of the anticipated operation of the facility FY2021 and FY2025 and has controlled the location of the dam break for relevant risk assessments.

Based on an assessment of PAR of "1 to 10" combined with a severity level of "major", the Consequence Category for TSF15 is estimated as being "High C" based on ANCOLD Guidelines (2019).

Figure 5 – Dam Break Outputs



1.17 Design Review

REE Mine embankment initiative (MEI) design was reviewed by designers external technical expert Dr Andie Fourie (B.Sc Eng., MSc Eng., PhD.) and GEMCO third party independent reviewer Dr Bruce Brown (PhD., P.Eng.) as meeting the requirements of ANCOLD (2019). Table 3 below shows the status of the design as of the 3rd September 2020.

Table 3 – Design Review Status

Design Report	Reviewer	Status
GHD PFS TSF15 Design and Dam Break	Bruce Brown	Complete
REE FS TSF15 MEI Design including Factual Geotechnical Report	Andy Fourie and Bruce Brown	Complete
REE FS TSF15 Design including Interpretive Geotechnical Report	Andy Fourie and Bruce Brown	Under Review (1)

[1] REE final design for the proposed TSF15 was produced as a draft in August 2020. The submission of the report included:

- Draft Design Report
- 80% Design Drawings
- BOQ/MTO Quantities

The most recent design submission also included the following appendices:

- Basis of design
- Factual Geotechnical Report
- Interpretive Geotechnical Report
- Seepage Analysis & Slope Stability Outputs
- Fill liquefaction assessment
- Foundation settlement analysis
- Piping failure risk calculations
- Water balance model results
- Spillway sizing calculations sheet
- Technical Specification
- Operations, Maintenance & Surveillance (OMS) Manual
- Preliminary closure landform concept layout and sections
- Safety in Design Assessment
- Failure Modes & Effects Analysis
- Independent review comments

These documents are currently under review and will be subject to internal Company reviews, designer's external technical expert and independent third party review by Dr Bruce Brown.

2 Environment Management

2.1 Storm-Water Management

The proposed TSF15 design comprises perimeter embankments on all sides, as such there are no upstream catchments which need to be managed by the TSF.

The overall contributing catchment area to the TSF15 spillway is approximately 167 Ha.

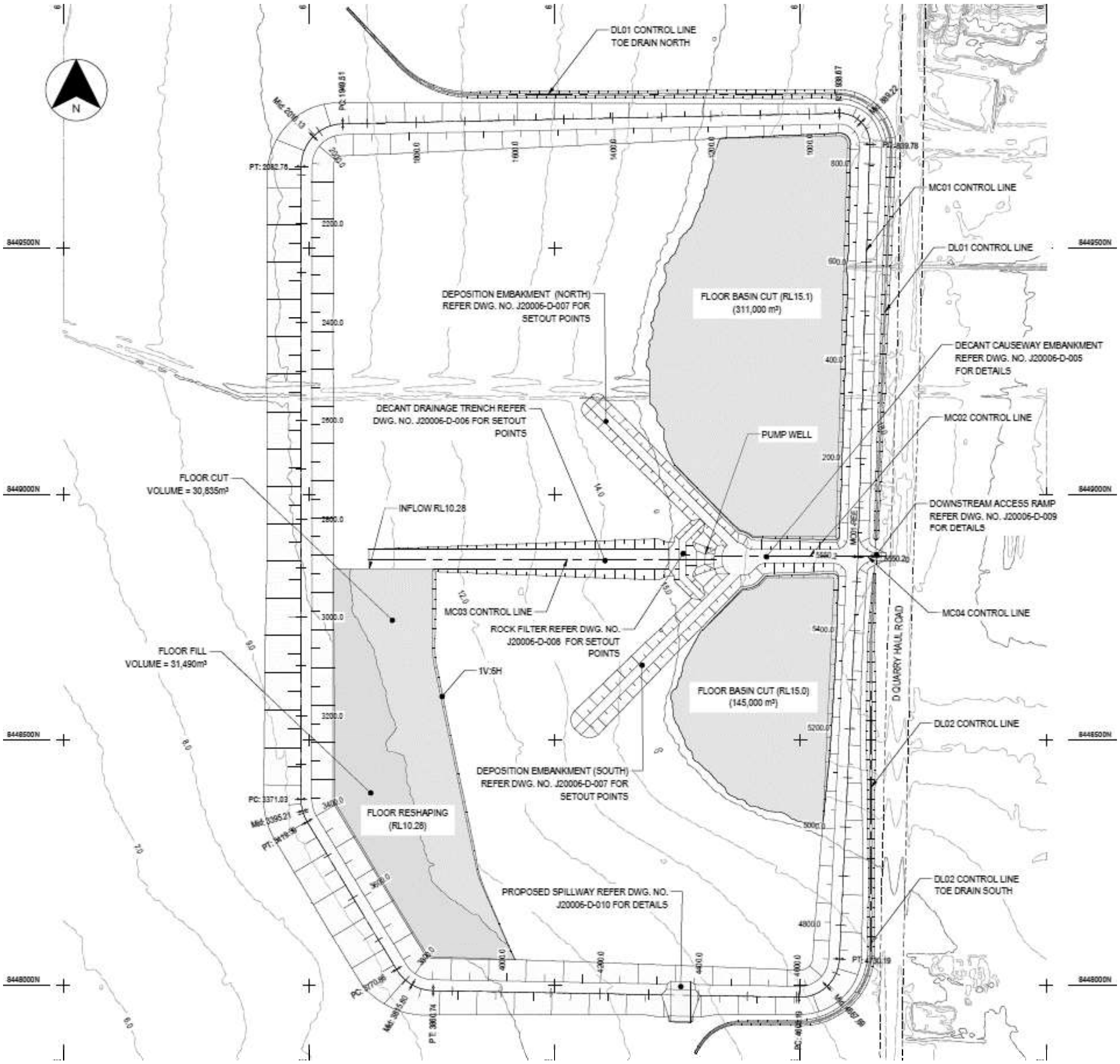
ANCOLD recommended water management design criteria for a 'High C' consequence category facility has been adopted, including:

- Minimum extreme storm storage allowance (below spillway, i.e. non-spill storage requirement for a dam spill consequence category of 'Low'):
  - 1:100 AEP, 72 hr flood
  - Contingency freeboard
    - Wave Run-up – Nil
    - Additional Freeboard – Nil
- Minimum design floods for spillway design and wave-freeboard allowance during operational phase (i.e. for a dam failure consequence category of 'High C'):
  - 1:100,000 AEP, critical duration event
  - Wave run-up for 1:10 AEP wind.

Stormwater flows emanating from the eastern catchments upstream of the TSF15 footprint will need to be diverted to minimise erosion damage of the embankment toe, particularly along the eastern embankment of the proposed TSF. The existing stormwater diversion drain around the eastern and southern perimeter of TSF13 currently flows towards the west, through a culvert underneath D Quarry Haul Road and discharges into the TSF15 footprint. A diversion drain has been designed to divert water from the eastern side of the TSF through to the northern and southern embankments discharging west.

A general overview of the operational stormwater management design shown in Figure 6.

Figure 6 – General Arrangement Plan



During construction, the contractor's Environmental Management Plan (EMP) will manage stormwater run-off from the site of works including access tracks, borrow pits and construction footprint. GEMCO's Execution Team including HSEC specialists will oversee the appropriateness, completeness, implementation and ongoing performance of the contractors EMP during the works and direct improvements where necessary. The contractors EMP will be reviewed against GEMCOs risk-specific Water Management Plan as referenced in GEMCOs latest MMP.

2.2 Environment Management During Construction

The construction contractors will be required to prepare a site-specific Environment Management Plan (EMP) to be reviewed and approved by GEMCO environmental personnel prior to commencement of works. The EMP will detail how the contract will manage environmental risks during construction including:

- Vegetation clearing
- Dust suppression
- Stormwater run-off management
- Spill containment

The risks and controls within these documents will be reviewed and aligned with GEMCO's risk-specific environment management plans (EMPs) referenced within the MMP:

- Water
- Waste
- Land and Biodiversity
- Threatened Species
- Cane Toad
- Air Emissions Management Plans
- Rehabilitation Standard

2.3 Heritage Management

Groote Eylandt is Aboriginal land, and in accordance with the wishes of the traditional owners and relevant legislation, various procedures are in place to protect both the Aboriginal culture and the environment. The construction Contractor is required to follow these procedures at all times.

All Contractor personnel will attend Cross Cultural Awareness Training conducted by GEMCO prior to the commencement of the works.

Any items that may be of cultural significance found in the work areas must remain undisturbed by the Contractors, and their occurrence immediately reported to the GEMCO Execution Team for referral to GEMCO Corporate Affairs.

The construction Contractor will be required to prepare a project specific Communities Management Plan which must include, as a minimum, the following:

- A detailed process of how the Contractor will identify and manage any risks to items or areas of Cultural Heritage Significance; and
- Demonstration of a system to identify, mitigate and or respond to feedback in relation to potential or actual community impacts from operations.

In accordance with the GEMCO Permit to Clear Vegetation Procedure, any area which requires clearing must be clearly pegged-out and approved by the Anindilyakwa Land Council (ALC) prior to the permit being provided to the Execution Team to commence clearing.

Licensed surveyors will be utilised to peg-out the clearing area for the proposed borrow to ensure the correct area is inspected and subsequently cleared.

3 Construction Works

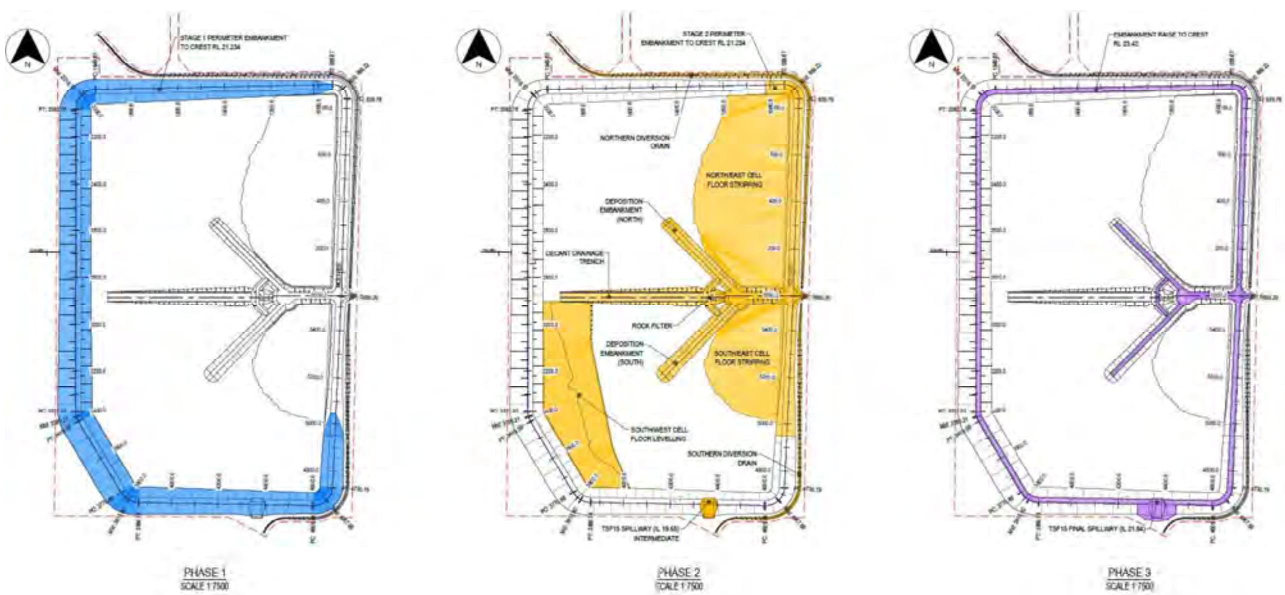
3.1 Construction Program

Anticipated construction period of TSF15 is between FY2020 and FY2022. The project has been broken down into three construction phases. The status as of the 3rd September 2020 is provided in table 4 below.

Table 4 – TSF15 Construction Phases

Construction Phase	Period	Status
Phase 1 – Early Works and MEI Embankment Construction	CY20	Commenced
Phase 2 – Impoundment, Decant, Spillway, Crest and Toe Roads	CY21	Tender
Phase 3 – Perimeter Embankment Raise	CY21/CY22	On Hold

Figure 7 – TSF15 Construction Phases



3.2 Clearing and Grubbing Works

Following advice from GEMCO's environmental department, felled vegetation will be pushed into stockpiles and burned.

In order to manage the clearing process, GEMCO's Permit to Clear Vegetation Procedure will be strictly followed, vegetated areas will be recorded and assessed prior to clearing so that areas of Cultural or Environmental significance can be identified and protected. The major characteristics of each site will be recorded and photographed so that this information can be accessed for rehabilitation purposes.

The following questions must be answered and satisfied prior to submission of the Permit to Clear Vegetation.

- Has the proposed clearing area been disturbed previously?
- Additional to routine rehabilitation, are there any special rehabilitation requirements?
- Is this clearing necessary and at this time of year?
- Are adequate plans in place for salvage of topsoil material?
- Are adequate plans in place for disposal of vegetation?
- Are there any environmental issues with clearing this area?
- Has the vegetation been classified?
- Have any habitat trees, vegetation monitoring sites or bores been identified within the area proposed for clearing?
- Are there any weeds present in the area? Note what action the operator must take to avoid spreading them?

The key risks associated with clearing and grubbing and the controls proposed to reduce the likelihood of the risks are summarised in Table 5.

Table 5 - Key Risks Clearing and Grubbing

Risk	Control
Spreading of unwanted flora (i.e. weeds)	Area inspected for weeds by the GEMCO Environmental Department. If weeds identified, equipment will be washed down prior to travelling on and off site.
Clearing of incorrect area or over clearing	Survey peg-out undertaken by professionally qualified surveyors.
Destruction of Environmentally significant vegetation	Survey peg-out of the proposed clearing area. Inspection of the proposed clearing area will then be undertaken by GEMCO's Environmental Team.
Destruction of Culturally significant sites	Survey peg-out of the proposed clearing area. Inspection of the proposed clearing area will then be undertaken by the Anindilyakwa Land Council (ALC), Traditional Owners of the proposed clearing area. Written endorsement from the ALC confirming the area has been inspected and no Cultural Significant sites exist within the proposed clearing area obtained prior to clearing being undertaken.
Fire out break	All equipment is fitted with fire suppression to contain any equipment fires. Fire extinguishers are located on each piece of equipment.

Information collected on permits is also utilised in Corporate reporting, annual reports, Land Council and is entered into GEMCO's Rehabilitation Liability Calculator and GIS layer.

3.3 Topsoil Stripping

The key risks associated with topsoil stripping and the controls proposed to reduce the likelihood of the risks are summarised in Table 6.

Table 6 - Key Risks Topsoil Stripping

Risk	Control
Topsoil quality reduced	Area for re-use will be identified prior to clearing commencing. Stockpiling (if required while re-use location is prepared) will be restricted to a maximum height of 2.5 m, and the duration of storage in stockpiles will be minimised prior to re-use to ensure the topsoil quality is maintained.
Erosion and sediment transportation	Topsoil stripping and re-use will be undertaken during dry weather only, between July and November with

	preference given to the months of October-November. If the soil is to be relocated it should be pushed, moved and ripped preferably within 7 days and 14 days at the most of being disturbed if used for rehabilitation.
Dust generation	The Contractor is required to have a water truck designated to the project full time and will regularly wet the exposed surface to reduce the generation of dust.

Together with a topsoil stockpile of approximately 66,000 m^3 of well-preserved soil currently located within the TSF15 footprint, a nominal strip thickness of 150-200 mm across the 220 ha undisturbed area would generate approximately 450,000 m^3 of topsoil. To manage these large material quantities, maintain GEMCO's operating and closure requirements and to capture both internal and external stakeholder concerns, a topsoil management plan (TMP) has been developed (GEM-18029-PFS-TMP-001).

Three alternatives for managing the topsoil have been identified and have been described in detail in the TMP:

- progressive rehabilitation (also known as direct replacement/return);
- rehabilitation of other projects; and
- stockpiling.

3.4 Foundation Preparation

The works involve preparation of the sub-grade prior to embankment fill placement. Foundation preparation shall conform to the designers requirements specified below:

1. Remove topsoil and loose alluvium and other unsuitable materials from the embankment footprint until very stiff residual or extremely weathered materials are reached
2. Subgrade to be proof rolled with a fully laden water truck (min weight 10 tonnes)
3. Foundation features will be trimmed back at a slope no greater than 1V:5H to achieve even surface
4. Areas having weak or compressible soils will be excavated

3.5 Embankment Construction

The designer has given the following key requirements for perimeter embankment gravely or sand clay materials: The embankments must be constructed using Earth Fill materials from the designated borrow areas to the shapes, zones and other requirements shown on the designers drawings. These materials will comprise lateritic gravelly and sandy clay material (designers PSD requirements), free of topsoil, perishable matter, smectite clays, vegetable matter of all kinds, including stumps, roots and all other objectionable materials, together with weak, loose, friable or softened soils sourced from the nominated borrow area. Borrow material shall be tested prior to use to verify conformance with the following material specifications:

Table 7 – Embankment Construction Requirements

Zone	Liquid Limit	Plastic Index	Permeability
Phase 1 & 2 - Zone 1 Mining Delivered Embankment Materials	<55%	>8 % and <40%	1 x 10 -8 m/s
Phase 3 - Zone 2 Contractor Placed Embankment Materials	<60%	>8 % and <40%	1 x 10 -8 m/s

Table 8 – Embankment Construction Requirements

Zone	Thickness	Compaction	OMC Moisture
Phase 1 & 2 - Zone 1 Mining Delivered Embankment Materials	0.5 m	93%	- 3% to + 3%
Phase 3 - Zone 2 Contractor Placed Embankment Materials	0.3 m	96%	-1% to +2%

Perimeter embankment materials are to be tested to designers testing frequency requirements in a NATA accredited laboratory.

4 Construction Certification and Quality Assurance

The success of a tailings facility depends heavily on the manner in which it is constructed. GEMCO will engage a suitably qualified and experienced dams engineer (referred to as the 'Responsible Engineer' in accordance with ANCOLD Guidelines) to undertake supervision, inspection and assessment of the construction to ensure the following:

- construction meets the design intent;
- necessary inspection and test points are approved;
- material properties align with required specification;
- photographic documentation of construction process;
- 'as-built' and marked-up construction drawings prepared for record and future reference;
- design has been carried out in accordance with ANCOLD guidelines and certification of the construction meets the design intent and specifications.

A Construction Report detailing the above will be obtained prior to commissioning TSF15.

A quality assurance system shall be developed for the project and will detail how each requirement of the Technical Specification will be met. The quality assurance system must include a method of lot registration for recording and/or cross-referencing records of conformance or non-conformance related to the lot that is practical for the works and ensures traceability and identification.

The 'Responsible Engineer' is responsible for approval of the quality assurance system which will be developed and approved prior to any works commencing. The construction contractor is responsible for engaging and managing an independent geotechnical testing authority (GTA), reporting directly to the 'Responsible Engineer', to perform testing of earthworks.

5 Ongoing Operation, Maintenance and Monitoring Plans

The GEMCO Concentrator Department will be responsible for operation and maintenance of the tailings storage facility. The civil design engineers have prepared a detailed Operations and Maintenance Manual which will be followed by the GEMCO to ensure the operation of the facility aligns with the design intent.

TSF15 includes geotechnical instrumentation and monitoring equipment including extensometers, vibrating wire piezometers and survey monuments which will be installed by the project execution team and monitored and reviewed against operational triggers by the operation as per the designers recommendations and trigger actions.

In addition to the ongoing operation and maintenance activities, GEMCO will carry out routine daily inspections of the facilities during operation. These inspections will include checking the tailings delivery and decant infrastructure and embankments.

In addition to the quarterly inspections, an annual geotechnical assessment will be undertaken by an experienced geotechnical engineer to assess slope stability and review the design in accordance with the relevant guidelines or standards.

Any maintenance required will be undertaken by GEMCO in accordance with the design drawings and construction specification. It is envisaged that maintenance will be limited to the removal of vegetation and backfilling of erosion channels and can be easily undertaken by the existing GEMCO fleet currently on Groote Eylandt.

With respect to groundwater monitoring, 10 additional bores are proposed to be installed at seven locations adjacent to the western, southern and northern perimeters of TSF15 to monitor groundwater levels and groundwater quality and to also assist with establishment of interim site-specific trigger values. These additional bores will effectively extend the monitoring network previously established around the existing TSFs and add to the existing datasets collected. Access tracks will be provided to all bores, with the additional bores to be incorporated into the existing groundwater monitoring program.

Data obtained from the monitoring network will be regularly assessed to identify and manage any potential impacts associated with the TSF. The data will also assist with validating the civil design assumptions and performance of the facility.

To ensure monitoring is undertaken in a consistent and safe manner, groundwater monitoring of the additional bores will be undertaken in accordance with GEMCO's groundwater monitoring safe work instruction (i.e. SWI-50439 Low Flow (Micro Purge) Groundwater Sampling).

Before finalising the TSF15 design an operational manual will be provided by the designer.

Figure 8 – Instrumentation and Monitoring Locations

6 Closure and Rehabilitation Planning

The above ground tailings storage facilities will require a different level of management to the rest of the GEMCO site. This is because the tailings need to be protected from erosion and other destructive loads so that the tailings are kept contained in the long term.

It is recognised that considerable stakeholder consultation is required for the purposes of assessing and agreeing on the most beneficial post-mine closure landform. Stakeholder consultation for this purpose will be undertaken closer to the time of mine closure, and therefore, in the absence of agreed post closure infrastructure, it is assumed that the tailings dams will remain in-situ and will be rehabilitated using a combination of capping, battering, re-contouring and plant growth.

Rehabilitation trials have been conducted on a section of TSF5, a decommissioned slimes tailings facility, with some success. Rehabilitation was conducted in 2005 and involved capping the TSF with 500 mm of overburden and 300 mm of topsoil. Annual monitoring is conducted at two sites (three transects in each site) in the area, with the results indicating that sections of the trial plot are on the trajectory for success, with some areas requiring some remedial works. Figure below shows the designers closure concept of the TSF.

Figure 9 – Closure Landform Concept

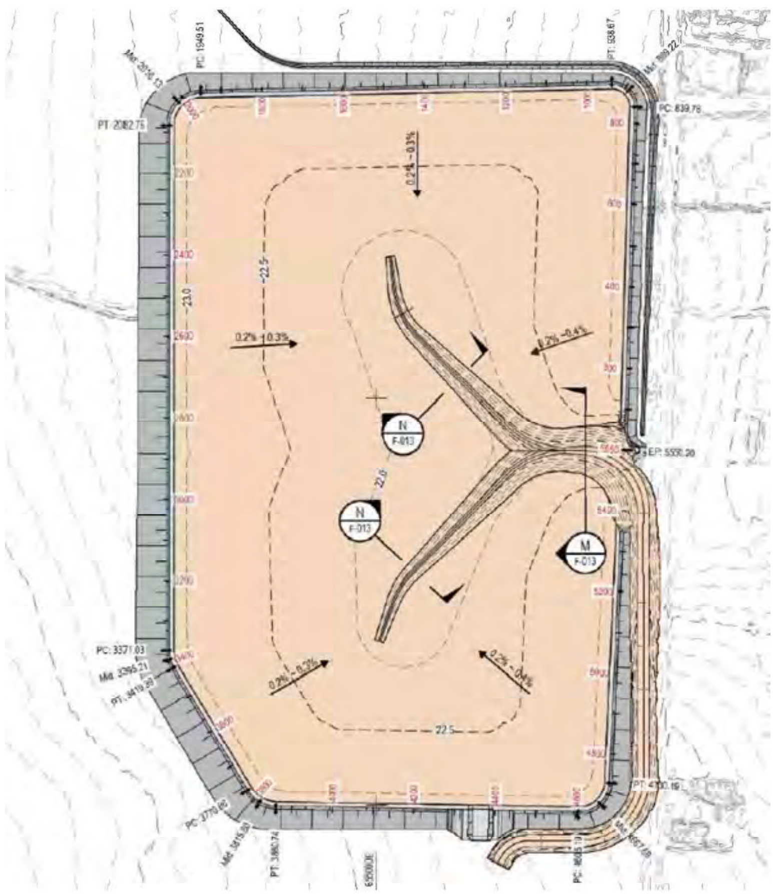
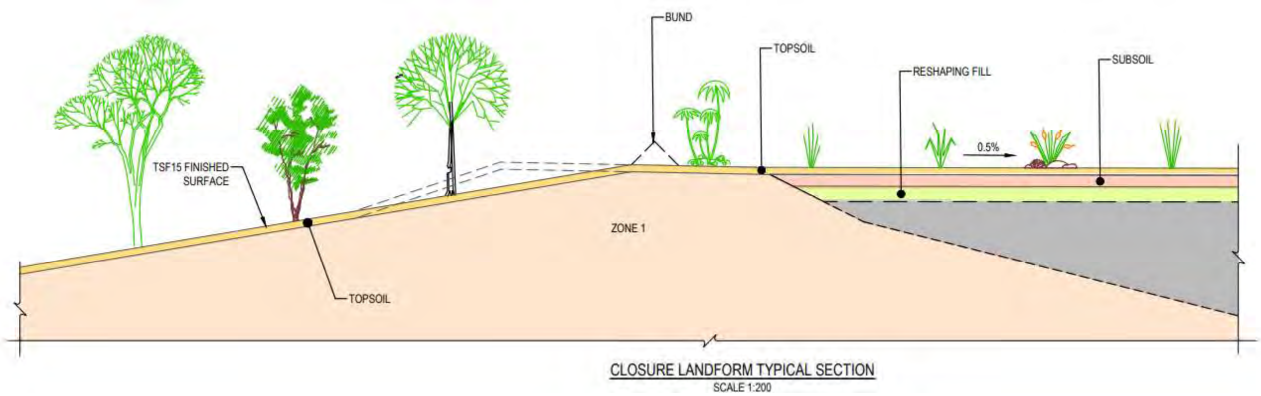


Figure 10 – Closure Landform Typical Section



9.6 Risk Assessment Matrix

Figure 9-1: Risk Impact Table
Figure 9-2: Risk Likelihood Table
(available on request)

9.7 Environment Management Diagrams

SOUTH32 GEMCO Western Leases MMP

Figure 9-3
Dust Monitoring Locations

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:69,318	Figure No: 9-3	Dust.mxd

Legend

Surface Water Monitoring Locations

N

0 1.75

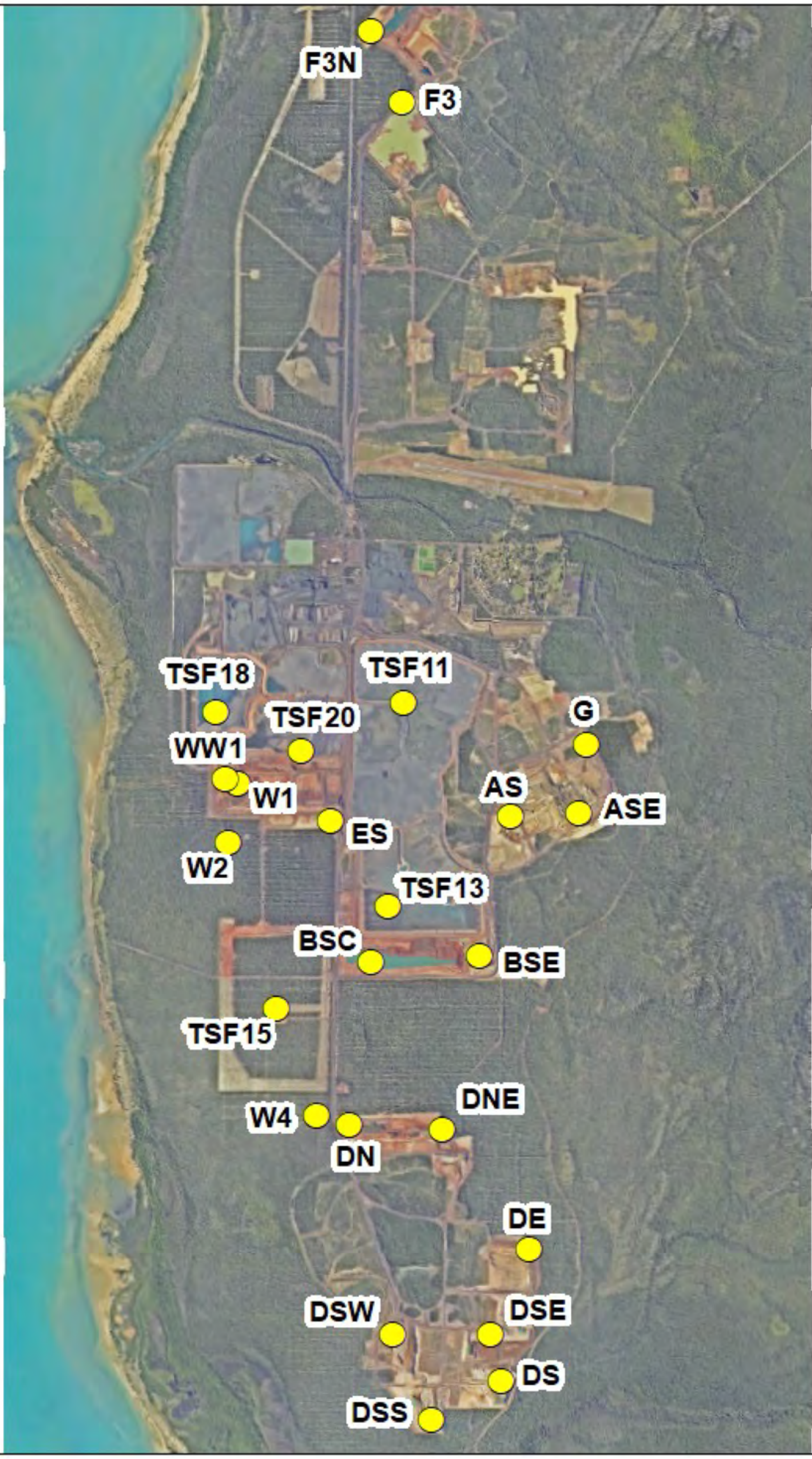
Kilometres

Coordinate System: MGA Zone 53

SOUTH32 GEMCO Western Leases MMP

Figure 9-4
Surface Water
Monitoring Locations

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:53,105	Figure No: 9-4	SurfaceWater.mxd



N

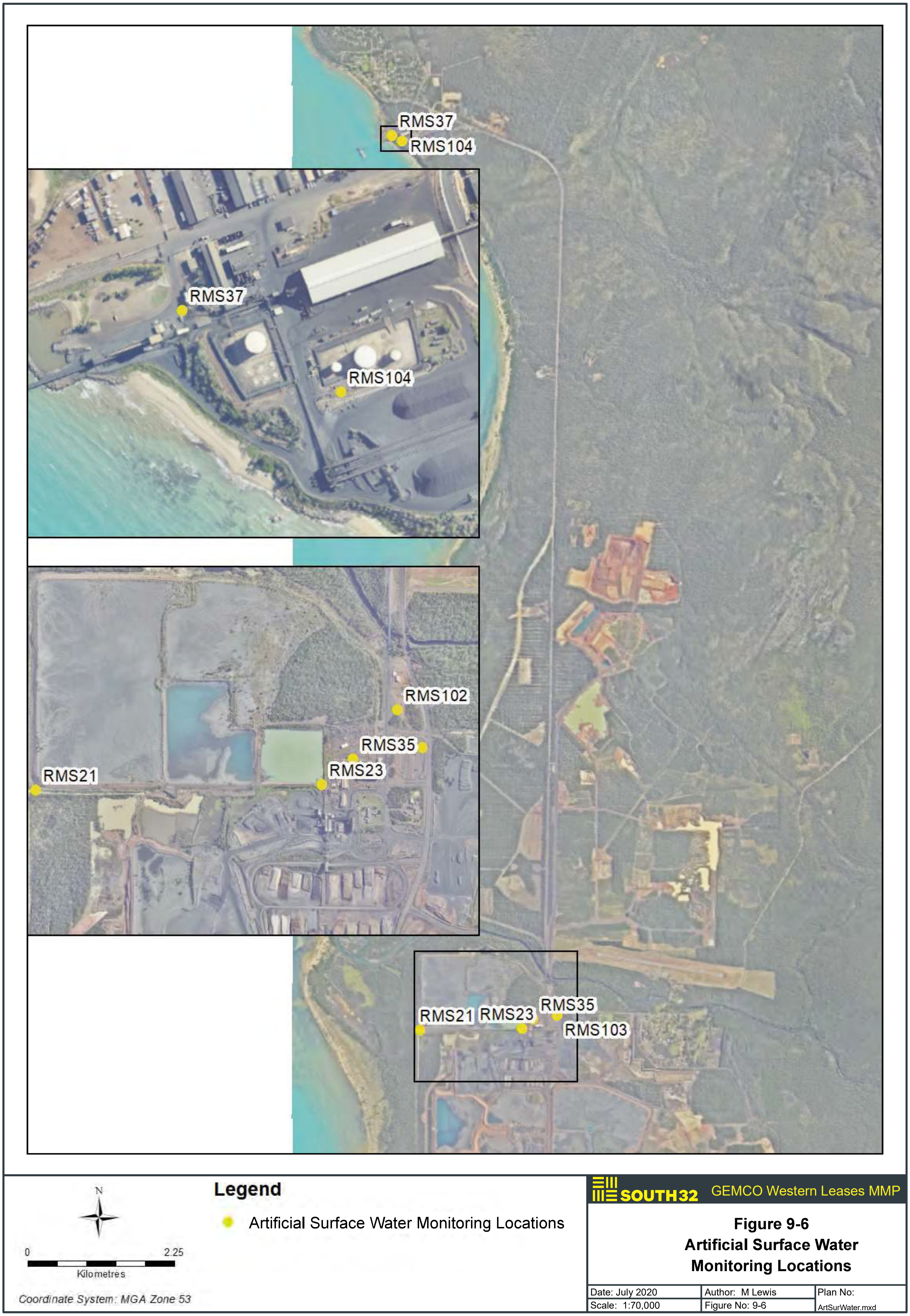
0 2.25
Kilometres

Coordinate System : MGA Zone 53

SOUTH32 GEMCO Western Leases MMP

Figure 9-5
Dewatering Source and Monitoring Locations

Date: March 2021	Author: J Barnett	Plan No:
Scale: 1:66,259	Figure No: 9-5	Discharge.mxd



SOUTH32 GEMCO Western Leases MMP

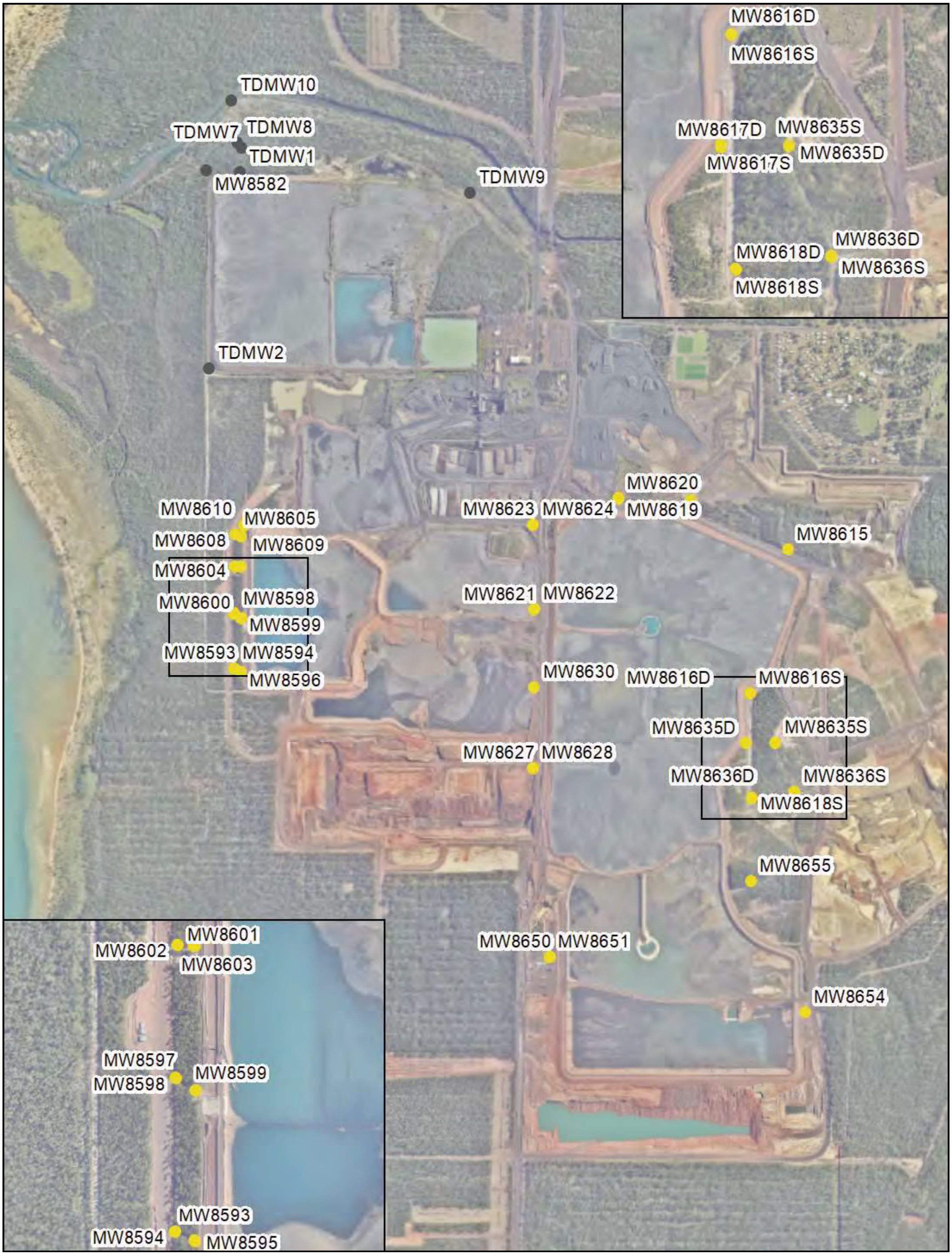
Figure 9-6
Artificial Surface Water Monitoring Locations

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:70,000	Figure No: 9-6	ArtSurWater.mxd

SOUTH32 GEMCO Western Leases MMP

Figure 9-7
Mine Site Groundwater Monitoring Locations

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:70,000	Figure No: 9-7	GroundWater.mxd



Coordinate System: MGA Zone 53

Legend

- Annual Groundwater Program
- Bi-annual Groundwater Program

SOUTH32 GEMCO Western Leases MMP

Figure 9-8
Tailings Groundwater Monitoring Locations

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:30,000	Figure No: 9-8	Tailings Groundwater.mxd

N

0 0.125
Kilometres

Coordinate System: MGA Zone 53

Legend

Groundwater Monitoring Locations

SOUTH32 GEMCO Western Leases MMP

Figure 9-9
Decommissioned Dry Tip
Groundwater Monitoring Locations

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:3,836	Figure No: 9-9	DTGroundwater.mxd

N

0 0.25
Kilometres

Coordinate System: MGA Zone 53

Legend

Groundwater Monitoring Locations

SOUTH32 GEMCO Western Leases MMP

Figure 9-10
Wet Tip Groundwater
Monitoring Locations

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:7,561	Figure No: 9-10	WTGroundwater.mxd

N

0 0.075

Kilometres

Coordinate System: MGA Zone 53

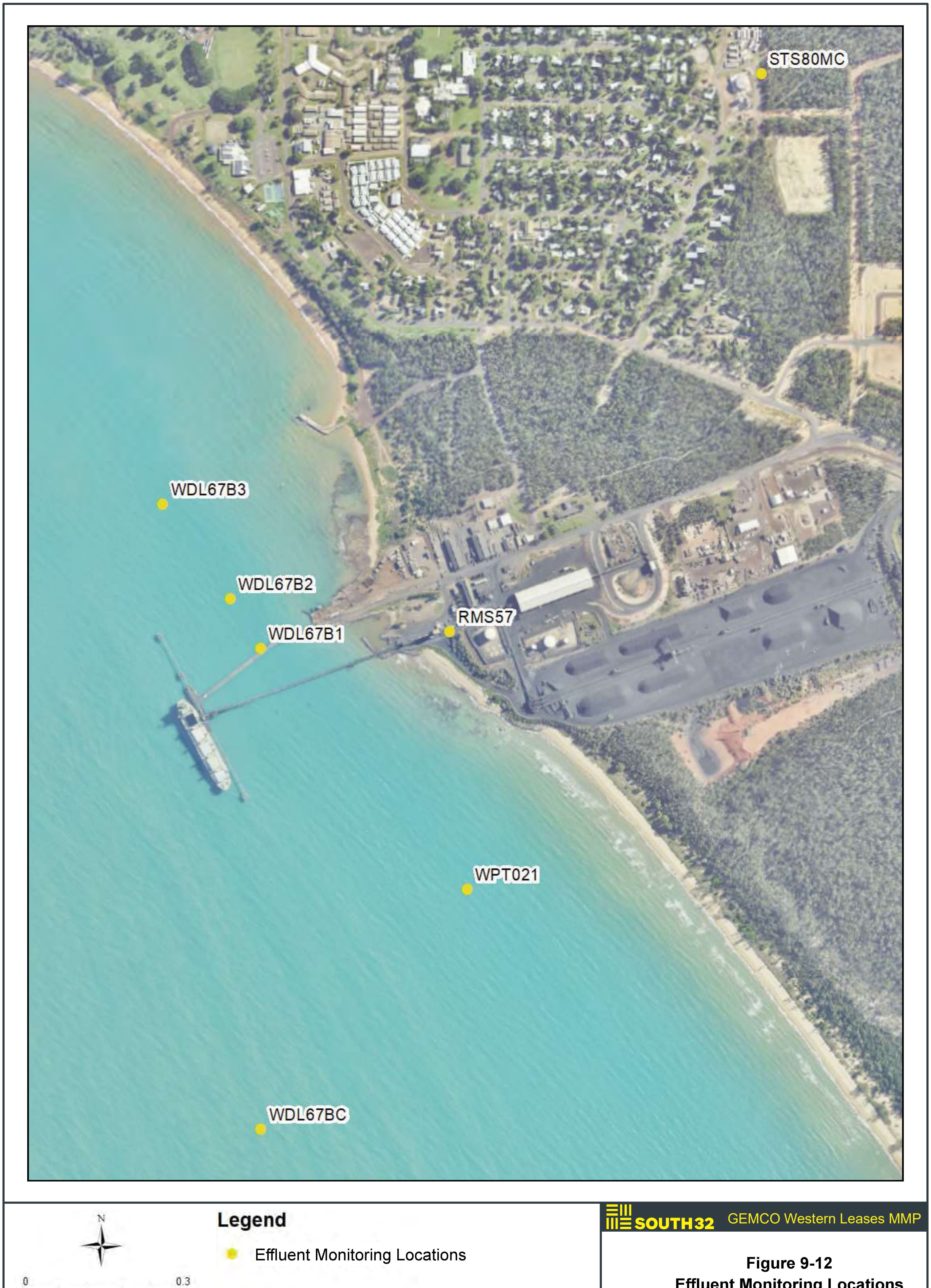
Legend

Milner Bay Monitoring Locations

SOUTH32 GEMCO Western Leases MMP

Figure 9-11
Milner Bay
Monitoring Locations

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:2,154	Figure No: 9-11	MilnerBay.mxd

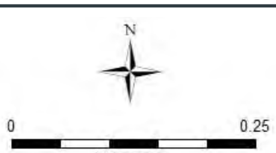


Coordinate System: MGA Zone 53

SOUTH32 GEMCO Western Leases MMP

Figure 9-12
Effluent Monitoring Locations

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:8,914	Figure No: 9-12	Marine.mxd



Coordinate System: MGA Zone 53

Legend

- Beach Sand
- Beach Seep
- Offshore Water & Sediment
- Oysters
- STP Outfall

SOUTH32 GEMCO Western Leases MMP

Figure 9-13
Marine Monitoring Locations - Port

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:7,297	Figure No: 9-13	Marine.mxd

N

0 0.25
Kilometres

Coordinate System: MGA Zone 53

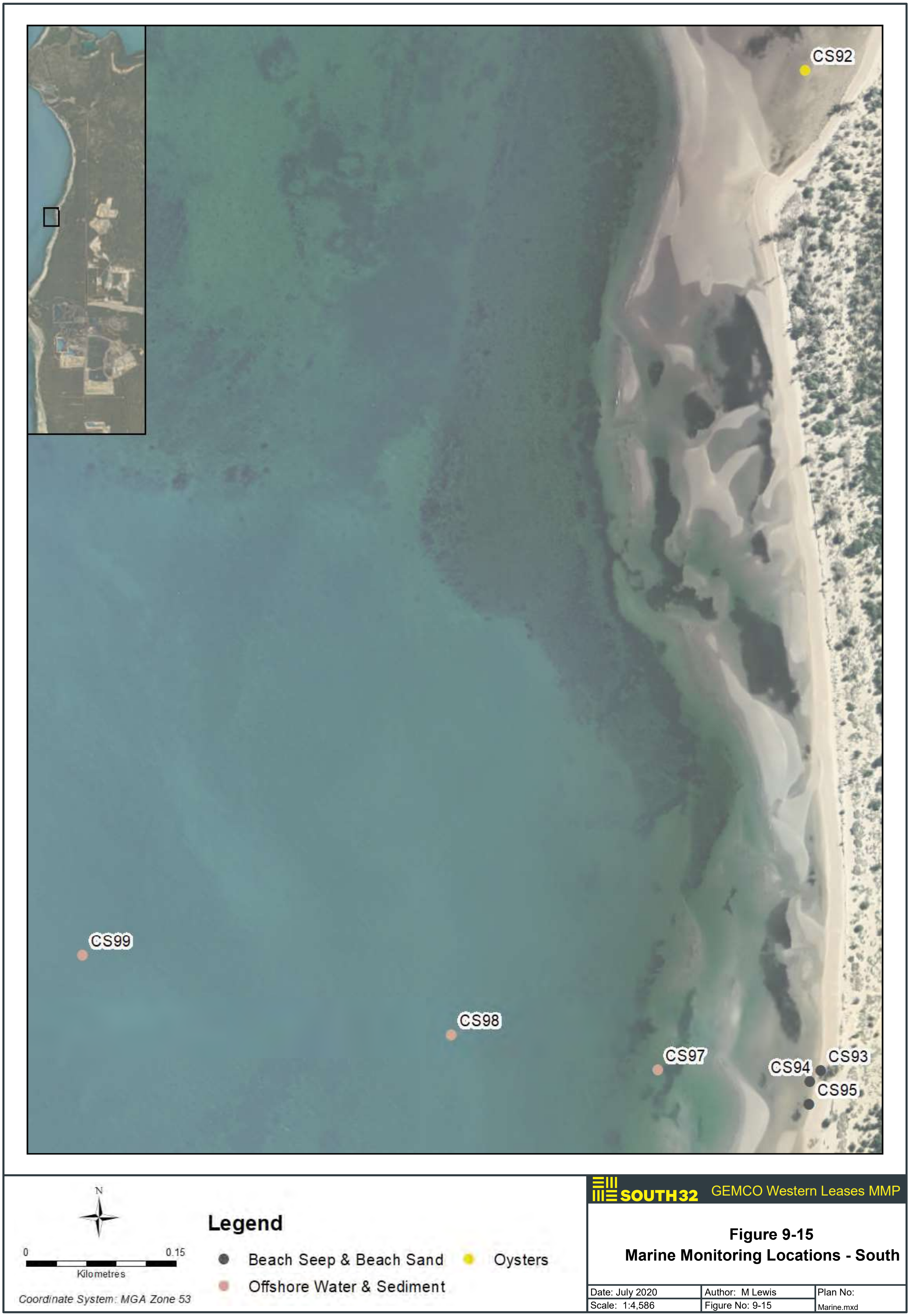
Legend

- Beach Sand
- Beach Seep
- Offshore Water & Sediment
- Oysters

SOUTH32 GEMCO Western Leases MMP

Figure 9-14
Marine Monitoring Locations - North

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:7,628	Figure No: 9-14	Marine.mxd



SOUTH32 GEMCO Western Leases MMP

Figure 9-15
Marine Monitoring Locations - South

Date: July 2020	Author: M Lewis	Plan No:
Scale: 1:4,586	Figure No: 9-15	Marine.mxd

9.8 Water Monitoring Results

Table 9-3: Groundwater Quality Results – Mine Site

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)					Total Metals (mg/L)					Cations (mg/L)				Anions (mg/L)				
		Al	Ba	Mn	Zn	Fe	Al	Ba	Mn	Zn	Fe	Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		**0.055**	-	**1.9**	**0.008**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DQMW3	8/12/2016	0.04	0.01	0.08	0.01	0.08	10.4	0.15	2.08	0.01	6.77	<1	<1	<1	9	3	<1	-	1	-
DQMW3	17/05/2017	<0.01	<0.001	0.05	<0.005	<0.05	6.22	0.09	1.36	<0.005	3.95	<1	<1	<1	7	4	<1	-	1	<1
DQMW3	23/05/2018	<0.01	0.01	0.16	0.01	<0.05	10.6	0.42	8.74	0.02	8.58	2	<1	1	10	9	<1	-	2	5
DQMW3	20/11/2018	<0.01	0.003	0.06	<0.005	<0.05	13.7	0.218	3.73	0.01	11.4	<1	<1	<1	8	2	<1	10	1	-
DQMW3	26/06/2019	<0.01	0.004	0.064	<0.005	<0.05	3.1	0.061	1.21	<0.005	2.24	<1	<1	<1	8	3	<1	9	<1	<1
DQMW3	27/11/2019	0.01	0.005	0.05	0.008	0.14	3.27	0.073	1.37	0.007	2.95	<1	<1	<1	9	5	<1	10	<1	<1
DQMW3	13/05/2020	0.02	0.004	0.036	0.013	<0.05	2.15	0.057	1.2	0.017	2.31	<1	<1	<1	8	3	<1	10	<1	<1
DQMW4	8/12/2016	0.06	<0.001	0.04	0.01	0.07	1.39	0.01	0.18	0.02	1.24	<1	1	<1	14	4	<1	-	<1	-
DQMW4	17/05/2017	0.02	<0.001	0.05	<0.005	0.1	3.36	0.02	0.23	0.01	2.92	<1	<1	<1	12	4	<1	-	<1	<1
DQMW4	29/11/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DQMW4	30/11/2017	0.06	<0.001	0.03	0.01	<0.05	3.87	0.02	0.19	0.02	2.6	<1	1	<1	12	9	<1	-	<1	4
DQMW4	23/05/2018	0.02	<0.001	0.03	0.02	<0.05	0.41	0	0.05	0.02	0.41	<1	1	<1	13	3	<1	-	<1	4
DQMW4	20/11/2018	0.02	0.006	0.02	0.007	<0.05	0.85	0.011	0.191	0.008	0.76	<1	1	<1	13	4	<1	19	<1	-
DQMW4	26/06/2019	0.05	0.003	0.028	<0.005	<0.05	1.24	0.008	0.086	<0.005	0.87	<1	1	<1	12	3	<1	16	<1	4
DQMW4	13/05/2020	0.01	0.002	0.019	0.016	<0.05	0.32	0.003	0.026	0.018	0.16	<1	<1	<1	12	6	<1	18	<1	<1
FCMW1B	8/12/2016	0.03	<0.001	0.14	0.02	0.06	0.93	0.03	1.9	0.03	1.06	<1	<1	<1	16	6	<1	-	<1	-
FCMW1B	17/05/2017	<0.01	<0.001	0.13	0.01	<0.05	1.27	0.03	1.95	0.01	1.33	<1	<1	<1	14	3	<1	-	<1	<1
FCMW1B	30/11/2017	<0.01	<0.001	0.11	0.01	<0.05	1.61	0.04	1.98	0.02	1.43	<1	<1	<1	14	12	<1	-	<1	<1
FCMW1B	22/05/2018	<0.01	<0.001	0.13	<0.005	<0.05	1.14	0.03	1.88	0.01	1.13	<1	<1	<1	13	8	<1	-	<1	<1
FCMW1B	20/11/2018	0.02	0.009	0.105	0.008	<0.05	1.91	0.057	3.14	0.021	2.26	<1	<1	<1	14	4	<1	18	<1	-
FCMW1B	26/06/2019	<0.01	<0.001	0.122	<0.005	<0.05	1.4	0.038	2.14	0.01	1.58	<1	<1	<1	14	5	<1	15	<1	<1

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)				Total Metals (mg/L)						Cations (mg/L)				Anions (mg/L)				
		Al	Ba	Mn	Zn	Fe	Al	Ba	Mn	Zn	Fe	Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		**0.055**	**-**	**1.9**	**0.008**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
FCMW1B	27/11/2019	0.01	<0.001	0.092	0.005	<0.05	0.71	0.02	1.1	0.006	0.81	<1	<1	<1	13	7	<1	18	<1	<1
FCMW1B	14/05/2020	<0.01	<0.001	0.127	0.015	<0.05	1.16	0.037	2.25	0.028	1.47	<1	<1	<1	13	6	<1	17	<1	<1
FCMW4	8/12/2016	0.04	0.01	0.13	0.02	0.08	2.84	0.04	0.99	0.03	7.48	<1	<1	<1	8	2	<1	-	<1	-
FCMW4	17/05/2017	0.05	<0.001	0.15	0.01	<0.05	8.65	0.1	2.7	0.02	20.3	<1	<1	<1	8	4	<1	-	<1	<1
FCMW4	30/11/2017	0.02	<0.001	0.1	<0.005	<0.05	5.24	0.08	1.84	0.01	14.4	<1	<1	<1	7	2	<1	-	<1	<1
FCMW4	22/05/2018	0.01	<0.001	0.06	<0.005	<0.05	4.93	0.06	1.56	0.02	13.4	<1	<1	<1	8	4	<1	-	<1	<1
FCMW4	20/11/2018	0.01	0.009	0.109	0.008	<0.05	0.48	0.013	0.202	0.008	1.43	<1	<1	<1	8	2	<1	12	<1	-
FCMW4	26/06/2019	0.02	0.004	0.079	<0.005	<0.05	1.99	0.016	0.322	<0.005	3.6	<1	<1	<1	8	3	<1	10	<1	<1
FCMW4	27/11/2019	0.01	0.005	0.068	<0.005	<0.05	0.96	0.011	0.225	0.008	2.26	<1	<1	<1	9	4	<1	12	<1	<1
FCMW4	18/05/2020	0.03	0.004	0.068	0.021	<0.05	0.44	0.007	0.118	0.026	0.4	<1	<1	<1	8	2	<1	11	<1	<1
FCMW5B	17/05/2017	0.07	0.01	0.1	0.01	0.06	0.66	0.02	0.27	0.01	0.32	<1	<1	<1	8	3	<1	-	<1	<1
FCMW6	17/05/2017	<0.01	0.01	0.02	0.01	<0.05	2.56	0.09	1.16	0.01	2.14	<1	<1	<1	5	3	<1	-	<1	<1
FCMW6	22/05/2018	0.02	0.01	0.03	0.01	<0.05	1.12	0.03	0.27	0.01	0.65	<1	<1	<1	6	4	<1	-	1	<1
FCMW6	26/06/2019	0.02	0.011	0.063	<0.005	<0.05	3	0.04	0.432	0.01	1.71	<1	<1	<1	7	1	<1	8	1	<1
MW8567	8/12/2016	<0.01	<0.001	0.03	0.02	<0.05	1.36	0.09	1.25	0.02	1.6	<1	<1	<1	8	4	<1	-	<1	-
MW8567	17/05/2017	<0.01	<0.001	0.03	0.01	<0.05	0.89	0.04	0.68	0.01	1.4	<1	<1	<1	6	4	<1	-	<1	<1
MW8567	30/11/2017	<0.01	<0.001	0.04	0.01	<0.05	3.07	0.19	2.2	0.02	3.12	<1	<1	<1	6	4	<1	-	<1	<1
MW8567	22/05/2018	<0.01	<0.001	0.03	<0.005	<0.05	0.99	0.05	0.74	0.01	0.92	<1	<1	<1	6	5	<1	-	<1	<1
MW8567	20/11/2018	<0.01	0.002	0.04	0.013	<0.05	0.29	0.013	0.2	0.013	0.3	<1	<1	<1	6	2	<1	8	<1	-
MW8567	26/06/2019	<0.01	0.002	0.032	<0.005	<0.05	1.24	0.044	0.704	0.01	1.05	<1	<1	<1	7	4	<1	9	<1	<1
MW8567	27/11/2019	0.01	0.003	0.035	0.006	0.08	3.54	0.175	2.28	0.01	5.9	<1	<1	<1	8	5	<1	8	<1	<1
MW8567	14/05/2020	<0.01	0.002	0.037	0.019	<0.05	1	0.025	0.431	0.019	0.94	<1	<1	<1	7	7	<1	10	<1	<1
MW8569	8/12/2016	0.06	0.07	1.2	0.04	0.09	0.17	0.12	1.99	0.03	0.28	<1	<1	<1	7	5	<1	-	<1	-
MW8569	17/05/2017	0.02	0.04	0.36	0.01	<0.05	0.1	0.1	1.03	0.01	0.11	<1	<1	<1	6	3	<1	-	<1	<1

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)				Total Metals (mg/L)					Cations (mg/L)				Anions (mg/L)				
		Al	Ba	Mn	Zn	Fe	Al	Ba	Mn	Zn	Fe	Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		**0.055**	**-**	**1.9**	**0.008**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
MW8569	30/11/2017	<0.01	0.05	2.27	0.01	<0.05	0.28	0.13	3.17	0.01	0.21	<1	<1	<1	5	13	<1	-	<1	<1
MW8569	22/05/2018	0.03	0.16	1.37	0.01	<0.05	0.14	0.21	1.82	0.02	0.12	<1	1	<1	5	9	<1	-	<1	4
MW8569	20/11/2018	0.01	0.101	1.1	0.011	<0.05	0.13	0.132	1.37	0.028	0.18	<1	<1	<1	7	4	<1	9	<1	-
MW8569	26/06/2019	0.03	0.068	0.427	<0.005	<0.05	0.67	0.157	1.4	0.019	0.57	<1	<1	<1	6	3	<1	7	<1	<1
MW8569	28/11/2019	0.03	0.088	1.01	0.009	<0.05	0.06	0.099	1.13	0.007	0.07	<1	<1	<1	6	8	<1	9	<1	<1
MW8569	14/05/2020	0.01	0.082	0.918	0.012	<0.05	0.16	0.102	1.1	0.018	0.16	<1	<1	<1	6	10	<1	8	<1	<1
MW8570	8/12/2016	<0.01	<0.001	0.04	0.03	<0.05	3.11	0.02	0.82	0.04	1.67	<1	<1	<1	8	4	<1	-	<1	-
MW8570	17/05/2017	<0.01	<0.001	0.05	0.01	<0.05	1.78	0.01	0.4	0.01	0.95	<1	<1	<1	7	3	<1	-	<1	<1
MW8570	30/11/2017	<0.01	<0.001	0.07	0.01	<0.05	1.58	0.02	0.47	0.02	0.83	<1	<1	<1	7	5	<1	-	<1	<1
MW8570	22/05/2018	<0.01	<0.001	0.06	0.01	<0.05	2.64	0.01	0.52	0.01	1.22	<1	<1	<1	7	5	<1	-	<1	<1
MW8570	20/11/2018	<0.01	0.003	0.055	0.012	<0.05	9.72	0.034	1.36	0.028	4.91	<1	<1	<1	8	3	<1	10	<1	-
MW8570	26/06/2019	<0.01	0.003	0.058	0.006	<0.05	4.79	0.024	0.886	0.013	2.4	<1	<1	<1	8	2	<1	9	<1	<1
MW8570	27/11/2019	<0.01	0.002	0.043	0.008	<0.05	0.58	0.006	0.184	0.007	0.24	<1	<1	<1	8	5	<1	10	<1	<1
MW8570	14/05/2020	<0.01	0.004	0.062	0.016	<0.05	6.83	0.032	1.08	0.026	3.85	<1	<1	<1	7	6	<1	10	<1	<1
MW8584	8/12/2016	0.07	0.01	0.09	0.04	<0.05	0.61	0.01	0.19	0.04	0.9	4	12	4	110	<1	<1	-	28	-
MW8584	30/11/2017	<0.01	0.01	0.07	0.01	<0.05	1.17	0.02	0.33	0.15	1.6	2	5	1	40	5	<1	-	8	26
MW8584	22/05/2018	<0.01	<0.001	0.04	0.01	0.06	0.42	0.01	0.14	0.18	0.69	<1	2	<1	22	5	<1	-	3	8
MW8584	20/11/2018	0.05	0.007	0.099	0.008	<0.05	0.11	0.009	0.125	0.015	0.12	4	11	3	97	<1	<1	162	22	-
MW8584	26/06/2019	0.02	0.005	0.073	<0.005	<0.05	0.66	0.013	0.186	0.021	1.03	2	5	1	46	2	<1	75	10	26
MW8584	27/11/2019	0.05	0.006	0.065	0.005	<0.05	0.08	0.007	0.111	0.007	0.08	3	9	3	85	3	<1	164	20	44
MW8584	14/05/2020	0.02	0.004	0.043	0.011	<0.05	0.09	0.004	0.042	0.012	<0.05	1	4	1	38	2	<1	62	7	19

Table 9-4 Groundwater Quality Results – Sand Blasting

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)				Total Metals (mg/L)						Cations (mg/L)				Anions (mg/L)				
		Al	Ba	Mn	Zn	Fe	Al	Ba	Mn	Zn	Fe	Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		**0.055**	-	**1.9**	**0.008**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SBMW1	17/05/2017	0.11	<0.001	0.02	0.01	<0.05	3.27	0.02	0.18	0.03	4.66	<1	<1	<1	14	4	<1	12	11	<1
	22/05/2018	0.03	0.01	0.03	0.01	<0.05	0.42	0.01	0.04	0.01	0.28	<1	1	<1	16	5	<1	21	2	4
SBMW2	17/05/2017	0.06	0.02	0.13	0.02	1.31	2.13	0.05	0.25	0.04	12.6	<1	4	<1	13	17	<1	4	24	16
	22/05/2018	0.09	0.02	0.28	0.01	6.49	1.05	0.02	0.3	0.01	9.32	<1	5	<1	11	26	<1	6	15	20
SBMM3	17/05/2017	0.06	<0.001	0.03	0.01	<0.05	0.9	0.01	0.1	0.01	1.21	<1	<1	<1	11	13	<1	8	7	<1
	22/05/2018	0.24	0.03	0.63	0.01	3.74	1.1	0.04	0.67	0.02	5.33	<1	3	<1	24	17	<1	28	6	12

Table 9-5: Groundwater Quality Results – Sewage Pond

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)					Total Metals (mg/L)					Cations (mg/L)				Anions (mg/L)							
		Al	Ba	Mn	Zn	Fe	Al	Ba	Mn	Zn	Fe	Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)	E.Coli	Ammonia	Nitrate
ANZG (2018) Guidelines		**0.055**	**-**	**1.9**	**0.008**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
SPMW1	All	Dry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPMW2	01/12/2016	Dry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPMW2	18/05/2017	0.05	0.1	6.49	0.01	3.16	1.8	0.15	8.49	0.02	6.15	3	10	8	41	80	<1	39	5	49	<100	0.09	0.42
SPMW2	01/12/2017	Dry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPMW2	22/05/2018	0.07	0.03	0.11	<0.005	0.08	1.14	0.05	0.36	0.01	7.34	8	7	17	37	32	<1	26	6	49	<140	<0.01	18.6
SPMW2	01/12/2018	Dry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPMW2	27/06/2019	0.12	0.01	0.18	<0.005	0.11	0.77	0.01	0.20	0.01	2.52	<1	4	6	28	-	-	22	12	14	-	-	-
SPMW2	28/11/2019	Dry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPMW2	18/05/2020	Dry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPMW3	All	Dry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9-6: Groundwater Quality Results - Fuel Tank and Refuelling Station

Monitoring Bore	Sampling Date	BTEXN (µg/L)								TRH (µg/L)						
		Benzene	Ethylbenzene	M-&P-Xylene	Naphalene	Ortho-xylene	Toluene	Total Xylene	Sum of BTEXN	C_6-C_{10}	C_{10}-C_{16}	C_{16}-C_{34}	C_{34}-C_{40}	C_{10}-C_{40} (Sum)	F1	F2
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	**600**	-	-
FP11	19/02/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP11	24/05/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP11	4/03/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP11	30/05/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP11	20/08/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP11	11/05/2020	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	110	110	220	<20	<100
FP6	29/08/2016	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP6	7/11/2016	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP6	24/02/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP6	31/05/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP6	30/08/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<280	<280	<280	<280	<20	<280
FP6	9/11/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP6	19/02/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP6	24/05/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP6	28/02/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP6	30/05/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP6	20/08/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP6	19/11/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP6	26/02/2020	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	120	<100	120	<20	<100
FP6	11/05/2020	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP8	9/11/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP8	19/02/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100

Monitoring Bore	Sampling Date	BTEXN (µg/L)								TRH (µg/L)						
		Benzene	Ethylbenzene	M-&P-Xylene	Naphalene	Ortho-xylene	Toluene	Total Xylene	Sum of BTEXN	C_6-C_{10}	C_{10}-C_{16}	C_{16}-C_{34}	C_{34}-C_{40}	C_{10}-C_{40} (Sum)	F1	F2
ANZG (2018) Guidelines		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**600**	**-**	**-**
FP8	24/05/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
FP8	28/02/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP8	30/05/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP8	20/08/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP8	19/11/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP8	26/02/2020	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
FP8	11/05/2020	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
NFMW1	24/02/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
NFMW1	31/05/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	150	<100	150	<20	<100
NFMW1	19/02/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	110	<100	110	<20	<100
NFMW1	24/05/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	340	450	790	<20	<100
NFMW1	28/02/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	140	<100	140	<20	<100
NFMW1	30/05/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	110	<100	110	<20	<100
NFMW1	11/05/2020	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
NFMW2	24/02/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
NFMW2	31/05/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
NFMW2	19/02/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
NFMW2	30/05/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	410	220	630	<20	<100
NFMW2	11/05/2020	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	120	<100	120	<20	<100
NFMW3	29/08/2016	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	120	<100	120	<20	<100
NFMW3	7/11/2016	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	130	<100	130	<20	<100
NFMW3	24/02/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
NFMW3	31/05/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	620	230	850	<20	<100
NFMW3	30/08/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<290	<290	<290	<290	<20	<290

Monitoring Bore	Sampling Date	BTEXN (µg/L)								TRH (µg/L)						
		Benzene	Ethylbenzene	M-&P-Xylene	Naphalene	Ortho-xylene	Toluene	Total Xylene	Sum of BTEXN	C_6-C_{10}	C_{10}-C_{16}	C_{16}-C_{34}	C_{34}-C_{40}	C_{10}-C_{40} (Sum)	F1	F2
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	**600**	-	-
NFMW3	19/02/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
NFMW3	24/05/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	480	<100	480	<20	<100
NFMW3	28/02/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	140	<100	140	<20	<100
NFMW3	30/05/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
NFMW3	20/08/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	120	<100	120	<20	<100
NFMW3	26/02/2020	<1	<2	<2	<5	<2	<2	<2	<1	<20	580	2130	980	3690	<20	580
NFMW3	11/05/2020	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
NFMW4	24/02/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
NFMW4	31/05/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	300	150	450	<20	<100
NFMW4	19/02/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	<100	<100	<100	<20	<100
NFMW4	24/05/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	<100	510	<100	510	<20	<100
NFMW4	28/02/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	100	<100	100	<20	<100
NFMW4	30/05/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
NFMW4	11/05/2020	<1	<2	<2	<5	<2	<2	<2	<1	<20	<100	<100	<100	<100	<20	<100
NFMW5	24/02/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	560	1880	<100	2440	<20	560
NFMW5	31/05/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	5790	22700	200	28700	<20	5790
NFMW5	30/08/2017	<1	<2	<2	<5	<2	<2	4	<1	<20	53800	211000	1600	266000	<20	53800
NFMW5	19/02/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	300	3480	<100	3780	<20	300
NFMW5	24/05/2018	<1	<2	<2	<5	<2	<2	4	<1	<20	5110	24600	200	29900	<20	5110
NFMW5	4/03/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	1370	7390	130	8890	<20	1370
NFMW5	30/05/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	300	1080	<100	1380	<20	300
NFMW5	20/08/2019	<1	<2	<2	<5	<2	<2	<2	<1	<20	4480	22100	790	27400	<20	4480
NFMW5	11/05/2020	<1	<2	<2	<5	<2	<2	<2	<1	180	54000	117000	820	172000	180	54000

Table 9-7: Groundwater Quality Results - Wet and Dry Tip

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)							Total Metals (mg/L)							Cations (mg/L)				Anions (mg/L)				Other		
		Al	Ba	Mn	Ni	Zn	Fe	Pb	Al	Ba	Mn	Ni	Zn	Fe	Pb	Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Enterococci	E.Coli	Ammonia
ANZG (2018) Guidelines		**0.055**	**-**	**1.9**	**-**	**0.008**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
DTMW2	15/05/2017	0.03	0.02	4.34	-	0.01	0.07	-	**0.2**	**0.03**	4.91	-	0.01	0.32	-	<1	1	<1	9	12	<1	-	<1	-	<1	-
DTMW3B	15/05/2017	0.08	<0.001	0.61	-	0.01	0.06	-	**3.08**	**0.06**	14.2	-	0.03	2	-	<1	1	<1	13	<1	<1	-	<1	-	<1	-
DTMW3B	26/06/2019	0.06	0.005	1.48	-	0.006	0.26	-	**1.58**	**0.016**	2.48	-	0.013	**1.16**	-	<1	1	<1	12	7	<1	17	<1	-	<1	0.1
WT007	28/02/2017	-	-	0.04	<0.001	0.01	0.06	<0.001	-	-	-	-	-	-	-	88	6	3	6	176	<1	-	54	<10	<1	<0.01
WT007	15/05/2017	-	-	0.01	<0.001	0.01	<0.05	<0.001	-	-	-	-	-	-	-	117	8	3	8	234	<1	-	70	<10	<1	0.05
WT007	28/08/2017	-	-	0.01	0.01	<0.005	<0.05	<0.001	-	-	-	-	-	-	-	100	6	3	5	228	<1	-	47	<1	<1	0.04
WT007	19/02/2018	-	-	0.01	<0.001	<0.005	<0.05	<0.001	-	-	-	-	-	-	-	77	4	2	4	-	-	-	40	<1	-	0.07
WT007	22/05/2018	-	-	0.01	0.02	0.01	<0.05	<0.001	-	-	-	-	-	-	-	87	5	3	10	202	<1	-	41	190	<1	0.04
WT007	28/05/2019	-	-	0.048	0.004	0.007	<0.05	<0.001	-	-	-	-	-	-	-	78	4	2	4	172	<1	-	29	<1	<1	0.01
WT009	28/02/2017	-	-	0.03	<0.001	0.02	<0.05	<0.001	-	-	-	-	-	-	-	<1	8	1	4	<1	<1	-	42	<10	<1	0.03
WT009	15/05/2017	-	-	0.01	0.01	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	8	1	6	4	<1	-	26	<1	<1	0.06
WT009	28/08/2017	-	-	0.03	<0.001	0.01	<0.05	0.01	-	-	-	-	-	-	-	<1	6	1	4	3	<1	-	26	<1	<1	0.01
WT009	19/02/2018	-	-	0.02	0.01	0.03	<0.05	<0.001	-	-	-	-	-	-	-	<1	8	1	4	3	<1	-	25	<1	<1	0.16
WT009	22/05/2018	-	-	0.02	0.01	0.02	<0.05	<0.001	-	-	-	-	-	-	-	<1	6	1	7	8	<1	-	25	<1	<1	0.04
WT009	28/05/2019	-	-	0.014	0.003	0.018	<0.05	<0.001	-	-	-	-	-	-	-	<1	6	1	4	3	<1	-	26	<1	<1	0.04
WT011A	28/02/2017	-	-	0.02	<0.001	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	10	<1	<1	-	4	<100	<1	0.09
WT011A	15/05/2017	-	-	0.02	<0.001	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	10	2	<1	-	3	<1	<1	0.06
WT011A	28/08/2017	-	-	0.02	0.01	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	8	4	<1	-	3	<1	<1	0.04
WT011A	19/02/2018	-	-	0.15	0.01	0.03	2.65	<0.001	-	-	-	-	-	-	-	<1	1	<1	6	3	<1	-	9	<1	<1	0.14
WT011A	22/05/2018	-	-	0.03	0.01	0.02	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	9	3	<1	-	4	<10	<1	0.02

		Dissolved Metals (mg/L)							Total Metals (mg/L)							Cations (mg/L)				Anions (mg/L)				Other		
Monitoring Bore	Sampling Date	Al	Ba	Mn	Ni	Zn	Fe	Pb	Al	Ba	Mn	Ni	Zn	Fe	Pb	Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Enterococci	E.Coli	Ammonia
ANZG (2018) Guidelines		**0.055**	**-**	**1.9**	**-**	**0.008**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
WT012	28/02/2017	-	-	0.04	<0.001	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	4	4	<1	-	4	<10	<1	0.03
WT012	15/05/2017	-	-	0.04	<0.001	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	3	2	<1	-	2	<1	<1	0.1
WT012	28/08/2017	-	-	0.03	<0.001	<0.005	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	6	4	<1	-	4	<1	<1	0.06
WT012	30/11/2017	-	-	0.02	<0.001	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	5	6	<1	-	5	<2	<1	0.27
WT012	19/02/2018	-	-	0.04	<0.001	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	5	3	<1	-	4	<10	<1	0.36
WT012	22/05/2018	-	-	0.05	<0.001	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	6	4	<1	-	3	<1	<1	0.07
WT012	30/08/2018	-	-	0.021	0.001	0.014	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	5	4	<1	-	4	<1	<1	0.06
WT012	28/05/2019	-	-	0.019	0.002	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	6	2	<1	-	5	<10	<1	<0.01
WT015	28/02/2017	-	-	0.03	<0.001	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	18	1	<1	-	2	<10	<1	0.21
WT015	15/05/2017	-	-	0.01	<0.001	0.02	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	16	2	<1	-	1	<1	<1	0.05
WT015	28/08/2017	-	-	0.02	0.01	<0.005	0.31	<0.001	-	-	-	-	-	-	-	<1	<1	<1	15	4	<1	-	<1	<1	<1	0.04
WT015	19/02/2018	-	-	0.06	0.01	0.02	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	14	4	<1	-	<1	<1	<1	0.04
WT015	22/05/2018	-	-	0.01	<0.001	0.02	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	15	4	<1	-	1	<1	<1	0.04
WT025	16/08/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WT025	7/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WT025	28/02/2017	-	-	0.01	0.01	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	1	<1	17	1	<1	-	2	<2	<1	0.14
WT025	15/05/2017	-	-	0.01	<0.001	0.01	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	16	2	<1	-	<1	<1	<1	0.05
WT025	28/08/2017	-	-	0.01	0.01	<0.005	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	16	4	<1	-	<1	<1	<1	0.08
WT025	30/11/2017	-	-	0.02	<0.001	0.01	0.06	<0.001	-	-	-	-	-	-	-	<1	<1	<1	15	4	<1	-	<1	<2	<1	0.12
WT025	19/02/2018	-	-	0.01	<0.001	0.02	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	16	<1	<1	-	5	<1	<1	0.16
WT025	22/05/2018	-	-	0.01	<0.001	0.02	<0.05	<0.001	-	-	-	-	-	-	-	<1	<1	<1	16	3	<1	-	<1	3	<1	0.01
WT025	30/08/2018	-	-	0.019	0.001	0.019	<0.05	<0.001	-	-	-	-	-	-	-	<1	1	<1	16	4	<1	-	<1	<1	<1	0.02
WT025	19/11/2018	-	-	0.044	0.002	0.03	<0.05	<0.001	-	-	-	-	-	-	-	<1	1	<1	16	5	<1	-	<1	<1	<1	0.03

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)							Total Metals (mg/L)							Cations (mg/L)				Anions (mg/L)				Other		
		Al	Ba	Mn	Ni	Zn	Fe	Pb	Al	Ba	Mn	Ni	Zn	Fe	Pb	Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Enterococci	E.Coli	Ammonia
ANZG (2018) Guidelines		**0.055**	**-**	**1.9**	**-**	**0.008**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
WT025	14/02/2019	-	-	0.035	0.012	0.031	0.14	0.002	-	-	-	-	-	-	-	1	2	<1	16	4	<1	-	<1	1	<1	2.69
WT025	28/05/2019	-	-	0.017	0.003	0.016	<0.05	0.006	-	-	-	-	-	-	-	<1	<1	<1	15	1	<1	-	<1	<1	<1	0.06

Table 9-8: Groundwater Quality Results (Dissolved Metals) - Tailings Storage Facilities

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8582	11/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8582	15/11/2016	<0.01	-	0.17	-	-	-	-	-	-	13	-	0.43	-	-	-	-	-	0.44
MW8582	16/06/2017	<0.01	-	0.28	-	-	-	-	-	-	10.3	-	1.13	-	-	-	-	-	1.11
MW8582	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8582	11/05/2018	0.04	0.01	0.15	-	<0.05	<0.0001	<0.001	0	<0.001	10.8	<0.001	0.73	<0.0001	0.02	<0.01	<0.001	<0.01	0.65
MW8582	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8582	17/06/2019	0.08	-	0.172	-	-	-	-	-	-	7.15	-	0.747	-	-	-	-	-	0.739
MW8593	16/08/2016	0.02	<0.001	0.07	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.07	-	0.01	-	<0.001	<0.01	0.02
MW8593	3/11/2016	<0.01	<0.001	0.07	<0.001	-	<0.0001	<0.001	0	0.01	<0.05	<0.001	0.07	-	0	-	<0.001	<0.01	0.01
MW8593	24/04/2017	0.02	<0.001	0.07	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.09	-	0.04	<0.01	<0.001	<0.01	<0.005
MW8593	16/10/2017	0.01	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.09	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8593	10/05/2018	<0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	<0.0001	0.02	<0.01	<0.001	<0.01	<0.005
MW8593	17/06/2019	0.01	-	0.025	-	-	-	-	-	-	<0.05	-	0.061	-	-	-	-	-	0.018
MW8593	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8593	7/11/2019	0.01	<0.001	0.029	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	<0.001	0.066	-	0.022	<0.01	<0.001	<0.01	-
MW8594	24/04/2017	0.05	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8594	10/05/2018	0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.05	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8594	11/06/2019	0.02	<0.001	0.007	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.09	<0.001	0.059	<0.0001	<0.001	<0.01	<0.001	<0.01	0.009
MW8594	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8594	7/11/2019	0.02	<0.001	0.007	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.034	-	0.008	<0.01	<0.001	<0.01	-
MW8595	16/08/2016	<0.01	<0.001	0.06	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.06	-	0.01	-	<0.001	<0.01	0.02
MW8595	3/11/2016	<0.01	<0.001	0.06	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.05	-	0	-	<0.001	<0.01	0.01

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L) Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8595	24/04/2017	<0.01	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8595	16/10/2017	0.01	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.07	-	0.01	<0.01	<0.001	<0.01	0.01
MW8595	10/05/2018	0.02	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.06	<0.0001	0.04	<0.01	<0.001	<0.01	0.01
MW8595	11/06/2019	<0.01	<0.001	0.033	-	<0.05	<0.0001	<0.001	<0.001	0.002	<0.05	<0.001	0.052	<0.0001	0.011	<0.01	<0.001	<0.01	0.014
MW8595	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8595	7/11/2019	<0.01	<0.001	0.037	-	<0.05	<0.0001	<0.001	<0.001	0.002	<0.05	<0.001	0.048	-	0.026	<0.01	<0.001	<0.01	-
MW8596	16/08/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.02	-	0	-	<0.001	<0.01	0.03
MW8596	3/11/2016	0.02	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.02	-	<0.001	-	<0.001	<0.01	0.01
MW8596	24/04/2017	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8596	10/05/2018	<0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	<0.0001	0	<0.01	<0.001	<0.01	<0.005
MW8596	11/06/2019	<0.01	<0.001	0.008	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.01	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8596	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8596	7/11/2019	<0.01	<0.001	0.008	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.1	0.002	0.029	-	0.005	<0.01	<0.001	<0.01	-
MW8597	16/08/2016	0.03	<0.001	0.03	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.05	-	0.01	-	<0.001	<0.01	0.03
MW8597	3/11/2016	0.02	<0.001	0.03	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.05	-	0	-	<0.001	<0.01	0.01
MW8597	24/04/2017	0.03	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.05	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8597	16/10/2017	0.02	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.1	<0.001	0.04	-	0	<0.01	<0.001	<0.01	<0.005
MW8597	10/05/2018	0.04	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	0.01	<0.05	0	0.05	<0.0001	0.02	<0.01	<0.001	<0.01	0.02
MW8597	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8597	7/11/2019	0.04	<0.001	0.023	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.042	-	0.019	<0.01	<0.001	<0.01	-
MW8598	16/08/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.03	-	0	-	<0.001	<0.01	0.02
MW8598	3/11/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.03	-	<0.001	-	<0.001	<0.01	0.01
MW8598	24/04/2017	0.04	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	0	0.05	-	0	<0.01	<0.001	<0.01	<0.005
MW8598	16/10/2017	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	-	0	<0.01	<0.001	<0.01	<0.005

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8598	10/05/2018	<0.01	<0.001	0	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	<0.0001	0	<0.01	<0.001	<0.01	<0.005
MW8598	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8598	7/11/2019	0.03	<0.001	0.003	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.025	-	0.004	<0.01	<0.001	<0.01	-
MW8599	16/08/2016	0.02	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.05	-	0.01	-	<0.001	<0.01	0.01
MW8599	3/11/2016	0.01	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.05	-	0	-	<0.001	<0.01	0.01
MW8599	24/04/2017	0.02	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8599	16/10/2017	0.02	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.05	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8599	10/05/2018	0.02	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0.01	<0.05	0	0.05	<0.0001	0.05	<0.01	<0.001	<0.01	0.03
MW8599	11/06/2019	0.02	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0.003	<0.05	<0.001	0.044	<0.0001	0.007	<0.01	<0.001	<0.01	0.008
MW8599	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8599	7/11/2019	0.02	<0.001	0.014	-	<0.05	<0.0001	<0.001	<0.001	0.002	<0.05	<0.001	0.049	-	0.024	<0.01	<0.001	<0.01	-
MW8600	16/08/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	0	-	<0.001	<0.01	0.01
MW8600	3/11/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	<0.001	-	<0.001	<0.01	0.01
MW8600	24/04/2017	<0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8600	16/10/2017	0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0	<0.01	<0.001	<0.01	<0.005
MW8600	10/05/2018	<0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	<0.0001	0	<0.01	<0.001	<0.01	<0.005
MW8600	11/06/2019	0.14	<0.001	0.006	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.012	<0.0001	0.001	<0.01	<0.001	<0.01	<0.005
MW8600	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8600	7/11/2019	<0.01	<0.001	0.005	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0.022	<0.01	<0.001	<0.01	-
MW8601	16/08/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.04	-	0.01	-	<0.001	<0.01	0.01
MW8601	3/11/2016	0.01	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.03	-	<0.001	-	<0.001	<0.01	0.01
MW8601	24/04/2017	0.02	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8601	16/10/2017	0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.04	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8601	10/05/2018	0.01	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	<0.0001	0	<0.01	<0.001	<0.01	0.01

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8601	11/06/2019	<0.01	<0.001	0.012	-	<0.05	<0.0001	<0.001	<0.001	0.002	<0.05	<0.001	0.028	<0.0001	0.005	<0.01	<0.001	<0.01	<0.005
MW8601	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8601	7/11/2019	<0.01	<0.001	0.017	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.042	-	0.021	<0.01	<0.001	<0.01	-
MW8602	16/08/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	0	-	<0.001	<0.01	0.01
MW8602	3/11/2016	0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	<0.001	-	<0.001	<0.01	<0.005
MW8602	24/04/2017	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	-	0	<0.01	<0.001	<0.01	<0.005
MW8602	16/10/2017	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	-	0	<0.01	<0.001	<0.01	<0.005
MW8602	10/05/2018	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.04	<0.0001	0	<0.01	<0.001	<0.01	<0.005
MW8602	11/06/2019	0.03	<0.001	0.007	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.019	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8602	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8602	7/11/2019	0.01	<0.001	0.006	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.037	-	0.01	<0.01	<0.001	<0.01	-
MW8603	16/08/2016	<0.01	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.04	-	0.01	-	<0.001	<0.01	0.01
MW8603	3/11/2016	<0.01	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.04	-	<0.001	-	<0.001	<0.01	0.01
MW8603	24/04/2017	<0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.04	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8603	16/10/2017	<0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.04	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8603	10/05/2018	<0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.05	<0.0001	0.02	<0.01	<0.001	<0.01	0.01
MW8603	11/06/2019	<0.01	<0.001	0.019	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	<0.001	0.036	<0.0001	0.006	<0.01	<0.001	<0.01	<0.005
MW8603	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8603	7/11/2019	<0.01	<0.001	0.018	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.041	-	0.015	<0.01	<0.001	<0.01	-
MW8604	16/08/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	0	-	<0.001	<0.01	0.01
MW8604	3/11/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	<0.001	-	<0.001	<0.01	0.01
MW8604	24/04/2017	0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8604	16/10/2017	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0	<0.01	<0.001	<0.01	<0.005
MW8604	10/05/2018	0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	<0.0001	0	<0.01	<0.001	<0.01	<0.005

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8604	11/06/2019	<0.01	<0.001	0.006	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.018	<0.0001	0.001	<0.01	<0.001	<0.01	<0.005
MW8604	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8604	7/11/2019	0.01	<0.001	0.005	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.023	-	0.012	<0.01	<0.001	<0.01	-
MW8605	16/08/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	0	-	<0.001	<0.01	0.01
MW8605	3/11/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	<0.001	-	<0.001	<0.01	0.01
MW8605	24/04/2017	<0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.04	-	0	<0.01	<0.001	<0.01	<0.005
MW8605	16/10/2017	<0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0	<0.01	<0.001	<0.01	<0.005
MW8605	10/05/2018	<0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	<0.0001	0	<0.01	<0.001	<0.01	0.01
MW8605	11/06/2019	<0.01	<0.001	0.012	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.016	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8605	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8605	7/11/2019	<0.01	<0.001	0.007	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.013	-	0.006	<0.01	<0.001	<0.01	-
MW8606	16/08/2016	<0.01	<0.001	0.03	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.06	-	<0.001	-	<0.001	<0.01	0.01
MW8606	3/11/2016	0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.03	-	<0.001	-	<0.001	<0.01	0.01
MW8606	24/04/2017	0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	0	<0.01	<0.001	<0.01	<0.005
MW8606	16/10/2017	0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.1	-	0	<0.01	<0.001	<0.01	<0.005
MW8606	10/05/2018	<0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.07	<0.0001	0	<0.01	<0.001	<0.01	0.01
MW8606	11/06/2019	0.01	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.135	<0.0001	0.001	<0.01	<0.001	<0.01	<0.005
MW8606	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8606	7/11/2019	0.02	<0.001	0.018	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.162	-	0.008	<0.01	<0.001	<0.01	-
MW8607	16/08/2016	<0.01	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.05	-	0	-	<0.001	<0.01	0.01
MW8607	3/11/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.04	-	<0.001	-	<0.001	<0.01	<0.005
MW8607	24/04/2017	0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	0	<0.01	<0.001	<0.01	<0.005
MW8607	16/10/2017	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.05	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8607	10/05/2018	0.09	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.11	<0.001	0.05	<0.0001	0	<0.01	<0.001	<0.01	0.01

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8607	11/06/2019	<0.01	<0.001	0.009	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.034	<0.0001	0.001	<0.01	<0.001	<0.01	<0.005
MW8607	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8607	7/11/2019	0.01	<0.001	0.005	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.031	-	0.009	<0.01	<0.001	<0.01	-
MW8608	16/08/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	0	-	<0.001	<0.01	0.01
MW8608	3/11/2016	0.04	<0.001	0	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	<0.001	-	<0.001	<0.01	<0.005
MW8608	24/04/2017	0.02	<0.001	0	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0	<0.01	<0.001	<0.01	<0.005
MW8608	16/10/2017	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	-	0	<0.01	<0.001	<0.01	<0.005
MW8608	10/05/2018	0.01	<0.001	0	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	<0.0001	0	<0.01	<0.001	<0.01	<0.005
MW8608	11/06/2019	0.05	<0.001	0.006	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.08	<0.001	0.042	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8608	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8608	7/11/2019	<0.01	<0.001	0.004	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.019	-	0.003	<0.01	<0.001	<0.01	-
MW8609	16/08/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	0.01	-	<0.001	<0.01	0.01
MW8609	3/11/2016	<0.01	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.03	-	<0.001	-	<0.001	<0.01	0.01
MW8609	16/10/2017	0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0	<0.01	<0.001	<0.01	<0.005
MW8609	10/05/2018	<0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	<0.0001	0.01	<0.01	<0.001	<0.01	0.01
MW8609	12/06/2019	<0.01	<0.001	0.013	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	0.001	0.016	<0.0001	0.002	<0.01	<0.001	<0.01	<0.005
MW8609	7/11/2019	<0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.019	-	0.005	<0.01	<0.001	<0.01	-
MW8610	16/08/2016	0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	0	-	<0.001	<0.01	0.01
MW8610	3/11/2016	0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.02	-	<0.001	-	<0.001	<0.01	<0.005
MW8610	16/10/2017	0.02	<0.001	0	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0	<0.01	<0.001	<0.01	<0.005
MW8610	10/05/2018	0.04	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	<0.0001	0	<0.01	<0.001	<0.01	0.01
MW8610	12/06/2019	<0.01	<0.001	0.006	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	0.003	0.019	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8610	7/11/2019	0.01	<0.001	0.005	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.023	-	0.005	<0.01	<0.001	<0.01	-
MW8612	27/04/2017	<0.01	<0.001	0.09	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.05	-	0.02	<0.01	<0.001	<0.01	<0.005

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8612	9/05/2018	<0.01	<0.001	0.07	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.65	<0.0001	0	<0.01	<0.001	<0.01	0.01
MW8612	19/06/2019	<0.01	<0.001	0.039	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.025	<0.0001	0.005	<0.01	<0.001	<0.01	0.007
MW8613	27/04/2017	0.01	<0.001	0.06	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8614	23/08/2016	0.02	<0.001	0.06	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.15	-	0.01	-	<0.001	<0.01	0.01
MW8614	2/11/2016	<0.01	<0.001	0.09	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.07	-	<0.001	-	<0.001	<0.01	0.02
MW8614	27/04/2017	0.02	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8614	17/10/2017	0.01	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.07	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8614	9/05/2018	0.02	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	<0.0001	0.01	<0.01	<0.001	<0.01	0.01
MW8614	19/06/2019	0.02	<0.001	0.11	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.058	<0.0001	0.004	<0.01	<0.001	<0.01	0.006
MW8614	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8614	7/11/2019	0.02	<0.001	0.056	-	<0.05	<0.0001	<0.001	<0.001	0.002	<0.05	<0.001	0.06	-	0.017	<0.01	<0.001	<0.01	-
MW8615	23/08/2016	<0.01	<0.001	0.02	<0.001	-	<0.0001	0	<0.001	0.01	<0.05	<0.001	0.04	-	0.01	-	<0.001	<0.01	0.03
MW8615	2/11/2016	<0.01	<0.001	0.02	<0.001	-	<0.0001	0	<0.001	0	<0.05	<0.001	0.04	-	0.01	-	<0.001	<0.01	0.01
MW8615	27/04/2017	<0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8615	17/10/2017	<0.01	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.1	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8615	9/05/2018	<0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.07	<0.0001	0.01	<0.01	<0.001	<0.01	0.01
MW8615	19/06/2019	0.02	<0.001	0.008	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.061	<0.0001	0.007	<0.01	<0.001	<0.01	0.007
MW8616D	31/08/2016	<0.01	0	0.07	<0.001	-	0	<0.001	0.01	0.01	<0.05	<0.001	1.9	-	0.06	-	<0.001	<0.01	0.04
MW8616D	2/11/2016	<0.01	0	0.09	<0.001	-	0	<0.001	0.01	0.01	<0.05	<0.001	2.28	-	0.06	-	<0.001	<0.01	0.03
MW8616D	27/04/2017	<0.01	0	0.08	-	0.61	0	<0.001	0.01	0	<0.05	<0.001	1.41	-	0.05	<0.01	<0.001	<0.01	0.03
MW8616D	17/10/2017	<0.01	<0.001	0.08	-	0.56	0	<0.001	0.01	0	<0.05	<0.001	1.32	-	0.06	<0.01	<0.001	<0.01	0.03
MW8616D	9/05/2018	<0.01	<0.001	0.09	-	0.61	0	<0.001	0.01	0	<0.05	<0.001	2.88	<0.0001	0.09	<0.01	<0.001	<0.01	0.04
MW8616D	24/06/2019	0.03	<0.001	0.102	-	0.58	<0.0001	<0.001	0.016	0.009	<0.05	<0.001	2.72	<0.0001	0.079	<0.01	<0.001	<0.01	0.048
MW8616D	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8616D	7/11/2019	0.01	<0.001	0.103	-	0.67	0.0002	<0.001	0.015	0.003	<0.05	<0.001	2.86	-	0.085	<0.01	<0.001	<0.01	-
MW8616S	31/08/2016	0.31	<0.001	0.02	<0.001	-	<0.0001	0.01	<0.001	<0.001	0.08	<0.001	0.34	-	0	-	<0.001	<0.01	<0.005
MW8616S	2/11/2016	0.1	<0.001	0.03	<0.001	-	<0.0001	0.01	<0.001	<0.001	<0.05	<0.001	0.53	-	0	-	<0.001	<0.01	<0.005
MW8616S	27/04/2017	0.19	0	0.03	-	0.08	<0.0001	0.02	<0.001	<0.001	0.11	<0.001	0.05	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8616S	17/10/2017	0.11	<0.001	0.01	-	<0.05	<0.0001	0.01	<0.001	<0.001	<0.05	<0.001	0.3	-	0	<0.01	<0.001	<0.01	<0.005
MW8616S	9/05/2018	0.06	<0.001	0.01	-	0.05	<0.0001	0	<0.001	<0.001	<0.05	<0.001	0.36	<0.0001	0.01	<0.01	<0.001	<0.01	<0.005
MW8616S	24/06/2019	0.13	<0.001	0.021	-	<0.05	<0.0001	0.004	<0.001	<0.001	<0.05	<0.001	0.382	<0.0001	0.01	<0.01	<0.001	<0.01	<0.005
MW8616S	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8616S	7/11/2019	0.18	<0.001	0.019	-	<0.05	<0.0001	0.009	<0.001	<0.001	0.05	<0.001	0.255	-	0.009	<0.01	<0.001	<0.01	-
MW8617D	31/08/2016	<0.01	<0.001	0.03	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.04	-	0.01	-	<0.001	<0.01	<0.005
MW8617D	2/11/2016	<0.01	<0.001	0.03	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.05	-	0.01	-	<0.001	<0.01	<0.005
MW8617D	27/04/2017	<0.01	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.09	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8617D	17/10/2017	0.01	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.36	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8617D	11/05/2018	0.02	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.35	<0.0001	0.01	<0.01	<0.001	<0.01	0.01
MW8617D	24/06/2019	0.01	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.11	<0.0001	0.008	<0.01	<0.001	<0.01	0.009
MW8617D	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8617D	7/11/2019	0.01	<0.001	0.034	-	<0.05	<0.0001	<0.001	<0.001	0.003	<0.05	<0.001	0.075	-	0.026	<0.01	<0.001	<0.01	-
MW8617S	31/08/2016	0.02	<0.001	0.03	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.07	-	<0.001	-	<0.001	<0.01	<0.005
MW8617S	2/11/2016	0.04	<0.001	0.04	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.13	-	<0.001	-	<0.001	<0.01	<0.005
MW8617S	27/04/2017	0.02	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.2	-	0	<0.01	<0.001	<0.01	<0.005
MW8617S	17/10/2017	0.05	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	<0.001	<0.01	<0.001	<0.01	<0.005
MW8617S	11/05/2018	0.03	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.1	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8617S	24/06/2019	0.06	<0.001	<0.001	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.005	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8617S	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8617S	7/11/2019	0.53	<0.001	0.005	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.16	<0.001	0.017	-	0.001	<0.01	<0.001	<0.01	-
MW8618D	31/08/2016	<0.01	<0.001	0	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	-	0	-	<0.001	<0.01	<0.005
MW8618D	2/11/2016	<0.01	<0.001	0	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.03	-	0	-	<0.001	<0.01	0.01
MW8618D	17/10/2017	<0.01	<0.001	0	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8618D	11/05/2018	<0.01	<0.001	0	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.04	<0.0001	0	<0.01	<0.001	<0.01	0.01
MW8618D	24/06/2019	<0.01	<0.001	0.003	-	<0.05	<0.0001	0.001	<0.001	<0.001	<0.05	<0.001	0.016	<0.0001	0.005	<0.01	<0.001	<0.01	0.007
MW8618D	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8618D	7/11/2019	<0.01	<0.001	0.003	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.028	-	0.011	<0.01	<0.001	<0.01	-
MW8618S	2/11/2016	0.29	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.04	-	<0.001	-	<0.001	<0.01	0.01
MW8618S	17/10/2017	0.27	<0.001	0.04	-	<0.05	<0.0001	0	<0.001	<0.001	0.07	<0.001	0.11	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8618S	11/05/2018	0.04	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.16	<0.0001	0	<0.01	<0.001	<0.01	<0.005
MW8618S	24/06/2019	0.04	<0.001	0.024	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.2	<0.001	0.192	<0.0001	0.003	<0.01	<0.001	<0.01	0.006
MW8618S	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8618S	7/11/2019	0.13	<0.001	0.035	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.18	<0.001	0.385	-	0.012	<0.01	<0.001	<0.01	-
MW8619	23/08/2016	0.06	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.05	-	0.01	-	<0.001	<0.01	0.01
MW8619	2/11/2016	0.02	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.04	-	0.01	-	<0.001	<0.01	0.01
MW8621	23/08/2016	0.01	<0.001	0.06	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.17	-	0.01	-	0	<0.01	0.01
MW8621	2/11/2016	<0.01	<0.001	0.06	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.16	-	0	-	<0.001	<0.01	<0.005
MW8621	27/04/2017	0.02	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.12	-	0	<0.01	<0.001	<0.01	<0.005
MW8621	17/10/2017	0.02	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.11	-	0	<0.01	<0.001	<0.01	0.01
MW8621	9/05/2018	<0.01	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.11	<0.0001	0	<0.01	<0.001	<0.01	<0.005
MW8621	19/06/2019	0.01	<0.001	0.025	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.164	<0.0001	0.008	<0.01	<0.001	<0.01	0.006
MW8621	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8621	7/11/2019	0.01	<0.001	0.022	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.15	-	0.012	<0.01	<0.001	<0.01	-

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8622	23/08/2016	0.02	<0.001	0	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.06	-	0	-	<0.001	<0.01	0.02
MW8622	2/11/2016	<0.01	<0.001	0	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.05	-	0.01	-	<0.001	<0.01	0.01
MW8622	27/04/2017	0.02	<0.001	0	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8622	17/10/2017	0.02	<0.001	0	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.06	-	0.01	<0.01	<0.001	<0.01	0.01
MW8622	9/05/2018	0.02	<0.001	0	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.05	<0.0001	0.02	<0.01	<0.001	<0.01	0.01
MW8622	19/06/2019	0.02	<0.001	0.003	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	<0.001	0.068	<0.0001	0.016	<0.01	<0.001	<0.01	0.01
MW8622	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8622	7/11/2019	0.02	<0.001	0.002	-	<0.05	<0.0001	<0.001	<0.001	0.004	<0.05	<0.001	0.063	-	0.023	<0.01	<0.001	<0.01	-
MW8623	27/04/2017	0.04	<0.001	0.09	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.01	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8623	17/10/2017	0.02	<0.001	0.09	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.01	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8624	23/08/2016	<0.01	<0.001	0.09	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.19	-	0.01	-	<0.001	<0.01	<0.005
MW8624	2/11/2016	<0.01	<0.001	0.07	<0.001	-	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.17	-	<0.001	-	<0.001	<0.01	<0.005
MW8624	27/04/2017	<0.01	<0.001	0.08	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.2	-	0	<0.01	<0.001	<0.01	<0.005
MW8624	17/10/2017	<0.01	<0.001	0.09	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.23	-	0	<0.01	<0.001	<0.01	<0.005
MW8627	23/08/2016	<0.01	<0.001	0.07	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.1	-	0	-	<0.001	<0.01	0.02
MW8627	2/11/2016	<0.01	<0.001	0.07	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.09	-	0	-	<0.001	<0.01	0.01
MW8627	27/04/2017	<0.01	<0.001	0.08	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.06	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8627	17/10/2017	<0.01	<0.001	0.08	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0	<0.01	<0.001	<0.01	<0.005
MW8627	9/05/2018	<0.01	<0.001	0.07	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.04	<0.0001	0	<0.01	<0.001	<0.01	0.02
MW8627	19/06/2019	<0.01	<0.001	0.009	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.015	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8628	23/08/2016	0.03	<0.001	0.06	<0.001	-	<0.0001	<0.001	0	0	<0.05	<0.001	0.54	-	0	-	<0.001	<0.01	0.02
MW8628	2/11/2016	0.01	<0.001	0.05	<0.001	-	<0.0001	<0.001	0	<0.001	<0.05	<0.001	0.39	-	0	-	<0.001	<0.01	0.01
MW8628	27/04/2017	0.02	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.36	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8628	17/10/2017	0.02	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.3	-	0	<0.01	<0.001	<0.01	0.01

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8628	9/05/2018	0.01	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.24	<0.0001	0.01	<0.01	<0.001	<0.01	0.01
MW8628	19/06/2019	0.06	<0.001	0.059	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.369	<0.0001	0.005	<0.01	<0.001	<0.01	<0.005
MW8630	31/08/2016	0.01	<0.001	0.05	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.12	-	0.02	-	<0.001	<0.01	0.01
MW8630	2/11/2016	<0.01	<0.001	0.05	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.12	-	0.01	-	<0.001	<0.01	0.02
MW8630	27/04/2017	0.01	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.1	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8630	18/10/2017	0.01	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.08	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8630	11/05/2018	0.01	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.09	<0.0001	0.01	<0.01	<0.001	<0.01	0.01
MW8630	26/11/2018	0.03	<0.001	0.035	-	<0.05	<0.0001	<0.001	<0.001	0.003	<0.05	0.003	0.072	<0.0001	0.004	<0.01	<0.001	<0.01	0.019
MW8630	19/06/2019	0.02	<0.001	0.027	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	<0.001	0.064	<0.0001	0.006	<0.01	<0.001	<0.01	0.026
MW8630	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8630	7/11/2019	0.01	<0.001	0.021	-	<0.05	<0.0001	<0.001	<0.001	0.002	<0.05	<0.001	0.074	-	0.013	<0.01	<0.001	<0.01	-
MW8634D	31/08/2016	0.17	0.02	0.01	0	-	<0.0001	0.01	<0.001	0	0.07	<0.001	0.27	-	0.01	-	<0.001	0.01	<0.005
MW8634D	2/11/2016	0.11	0.01	0.01	<0.001	-	<0.0001	0.01	<0.001	0	<0.05	<0.001	0.16	-	0.01	-	<0.001	0.01	<0.005
MW8634D	17/10/2017	0.11	0.02	0.02	-	<0.05	<0.0001	0	<0.001	<0.001	<0.05	<0.001	0.14	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8634D	9/05/2018	0.06	0.02	0.04	-	0.05	<0.0001	0	<0.001	<0.001	<0.05	<0.001	0.3	<0.0001	0.01	<0.01	<0.001	0.01	<0.005
MW8634S	9/05/2018	0.11	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.04	<0.0001	0.01	<0.01	<0.001	<0.01	<0.005
MW8635D	31/08/2016	0.9	0.01	0.01	0	-	<0.0001	0.04	<0.001	0	0.12	<0.001	0.33	-	0	-	<0.001	<0.01	<0.005
MW8635D	2/11/2016	0.17	0	0.01	<0.001	-	<0.0001	0.05	<0.001	<0.001	<0.05	<0.001	0.3	-	<0.001	-	<0.001	<0.01	<0.005
MW8635D	27/04/2017	0.06	0	0.01	-	0.12	<0.0001	0.05	<0.001	<0.001	<0.05	<0.001	0.21	-	0	<0.01	<0.001	<0.01	<0.005
MW8635D	17/10/2017	0.18	<0.001	0.01	-	0.12	<0.0001	0.03	<0.001	<0.001	0.07	<0.001	0.14	-	0	<0.01	<0.001	<0.01	<0.005
MW8635D	9/05/2018	0.02	<0.001	0.01	-	0.14	<0.0001	0.03	<0.001	<0.001	<0.05	<0.001	0.18	<0.0001	0	<0.01	<0.001	<0.01	<0.005
MW8635D	24/06/2019	0.09	<0.001	0.029	-	0.14	<0.0001	0.015	<0.001	<0.001	<0.05	<0.001	0.235	<0.0001	0.002	<0.01	<0.001	<0.01	0.01
MW8635D	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8635D	7/11/2019	0.04	<0.001	0.021	-	0.15	<0.0001	0.016	<0.001	0.002	<0.05	<0.001	0.22	-	0.018	<0.01	<0.001	<0.01	-

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8635S	31/08/2016	0.26	0	0.02	<0.001	-	<0.0001	<0.001	<0.001	<0.001	0.06	<0.001	0.16	-	0	-	<0.001	<0.01	<0.005
MW8635S	2/11/2016	0.76	<0.001	0.03	<0.001	-	<0.0001	0	<0.001	0	0.18	<0.001	0.3	-	<0.001	-	<0.001	<0.01	<0.005
MW8635S	27/04/2017	0.06	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	1.22	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8635S	17/10/2017	0.15	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.14	-	0	<0.01	<0.001	<0.01	<0.005
MW8635S	9/05/2018	0.02	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.55	<0.0001	0.01	<0.01	<0.001	<0.01	<0.005
MW8635S	24/06/2019	0.13	<0.001	0.023	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.052	<0.0001	0.001	<0.01	<0.001	<0.01	0.022
MW8635S	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8635S	7/11/2019	0.32	<0.001	0.022	-	<0.05	<0.0001	<0.001	<0.001	0.001	0.1	<0.001	0.112	-	0.004	<0.01	<0.001	<0.01	-
MW8636D	31/08/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	0	<0.001	<0.001	<0.05	<0.001	0.08	-	0	-	<0.001	<0.01	<0.005
MW8636D	2/11/2016	<0.01	<0.001	0	<0.001	-	<0.0001	0	<0.001	<0.001	<0.05	<0.001	0.03	-	<0.001	-	<0.001	<0.01	<0.005
MW8636D	27/04/2017	<0.01	<0.001	0	-	<0.05	<0.0001	0	<0.001	<0.001	<0.05	<0.001	0.02	-	0	<0.01	<0.001	<0.01	<0.005
MW8636D	17/10/2017	0.02	<0.001	0	-	<0.05	<0.0001	0	<0.001	<0.001	<0.05	<0.001	0.02	-	0	<0.01	<0.001	<0.01	<0.005
MW8636D	11/05/2018	0.02	<0.001	0.01	-	<0.05	<0.0001	0	<0.001	<0.001	<0.05	<0.001	0.04	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8636D	24/06/2019	0.07	<0.001	0.008	-	<0.05	<0.0001	0.003	<0.001	<0.001	<0.05	<0.001	0.028	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8636D	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8636D	7/11/2019	0.08	<0.001	0.007	-	<0.05	<0.0001	0.003	<0.001	<0.001	<0.05	<0.001	0.012	-	0.003	<0.01	<0.001	<0.01	-
MW8636S	27/04/2017	0.04	<0.001	0.04	-	0.06	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.1	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8636S	17/10/2017	0.17	<0.001	0.13	-	0.06	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.77	-	0.05	<0.01	<0.001	<0.01	0.01
MW8636S	11/05/2018	0.08	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.38	<0.0001	0	<0.01	<0.001	<0.01	0.01
MW8636S	24/06/2019	0.11	<0.001	0.051	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.229	<0.0001	0.005	<0.01	<0.001	<0.01	0.011
MW8636S	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8636S	7/11/2019	0.14	<0.001	0.077	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	<0.001	0.504	-	0.014	<0.01	<0.001	<0.01	-
MW8640	17/08/2016	<0.01	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.12	-	0	-	<0.001	<0.01	0.01
MW8640	3/11/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	0.01	0.01	<0.05	<0.001	0.28	-	<0.001	-	<0.001	<0.01	0.02

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8640	24/04/2017	<0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	0.01	<0.001	<0.05	<0.001	0.27	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8640	16/10/2017	<0.01	<0.001	0	-	<0.05	<0.0001	<0.001	0	<0.001	<0.05	<0.001	0.11	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8640	10/05/2018	<0.01	<0.001	0	-	<0.05	<0.0001	<0.001	0	0	<0.05	<0.001	0.05	<0.0001	0	<0.01	<0.001	<0.01	0.01
MW8641	26/04/2017	0.18	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.06	<0.001	0.03	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8641	10/05/2018	0.08	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8642	17/08/2016	0.03	<0.001	0.01	<0.001	-	<0.0001	0	<0.001	0	<0.05	<0.001	0.02	-	0	-	<0.001	<0.01	0.01
MW8642	3/11/2016	<0.01	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.05	-	0	-	<0.001	<0.01	0.01
MW8642	24/04/2017	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.07	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8642	16/10/2017	0.03	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.08	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8642	10/05/2018	0.02	<0.001	0	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.08	<0.0001	0	<0.01	<0.001	<0.01	0.01
MW8642	11/06/2019	0.02	<0.001	0.004	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	<0.001	0.01	<0.0001	0.003	<0.01	<0.001	<0.01	0.016
MW8642	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8642	7/11/2019	0.02	<0.001	0.007	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.024	-	0.007	<0.01	<0.001	<0.01	-
MW8643	17/08/2016	0.38	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	0.06	<0.001	0.03	-	0	-	<0.001	<0.01	0.01
MW8643	3/11/2016	0.13	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.15	-	0	-	<0.001	<0.01	0.01
MW8643	24/04/2017	0.68	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.19	<0.001	0.25	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8643	16/10/2017	0.11	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	-	0	<0.01	<0.001	<0.01	<0.005
MW8643	10/05/2018	0.08	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8643	26/11/2018	0.11	<0.001	0.006	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.017	<0.0001	<0.001	<0.01	<0.001	<0.01	0.009
MW8643	11/06/2019	0.04	<0.001	0.006	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.005	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8643	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8643	7/11/2019	0.1	<0.001	0.009	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.024	-	0.002	<0.01	<0.001	<0.01	-
MW8644	17/08/2016	2.85	0	0.01	<0.001	-	<0.0001	0.03	<0.001	<0.001	0.66	<0.001	0.03	-	0	-	<0.001	<0.01	<0.005
MW8644	4/11/2016	1.71	<0.001	0.02	<0.001	-	<0.0001	0	<0.001	<0.001	0.4	<0.001	0.05	-	<0.001	-	<0.001	<0.01	<0.005

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8644	26/04/2017	0.06	<0.001	0.03	-	<0.05	<0.0001	0	<0.001	<0.001	<0.05	<0.001	0.01	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8644	16/10/2017	0.11	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8644	10/05/2018	0.06	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.08	<0.0001	0.01	<0.01	<0.001	<0.01	<0.005
MW8644	26/11/2018	0.18	<0.001	0.014	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.022	<0.0001	0.002	<0.01	<0.001	<0.01	0.005
MW8645	17/08/2016	7.75	0	0.03	<0.001	-	<0.0001	0.02	<0.001	0	2.35	<0.001	0.05	-	0	-	<0.001	<0.01	<0.005
MW8645	3/11/2016	3.89	<0.001	0.02	<0.001	-	<0.0001	0	<0.001	0	1.27	<0.001	0.08	-	<0.001	-	<0.001	<0.01	<0.005
MW8645	26/04/2017	0.38	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.08	<0.001	0.07	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8645	16/10/2017	0.17	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.12	-	0	<0.01	<0.001	<0.01	<0.005
MW8645	10/05/2018	0.08	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	<0.0001	0	<0.01	<0.001	<0.01	<0.005
MW8645	26/11/2018	0.1	<0.001	0.018	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.036	<0.0001	<0.001	<0.01	<0.001	<0.01	0.006
MW8646	17/08/2016	1.66	0	0.01	<0.001	-	<0.0001	0.05	<0.001	0	0.68	<0.001	0.05	-	<0.001	-	0	<0.01	<0.005
MW8646	4/11/2016	0.47	0	0	<0.001	-	<0.0001	0.02	<0.001	<0.001	0.33	<0.001	0.06	-	<0.001	-	<0.001	<0.01	<0.005
MW8646	26/04/2017	0.35	<0.001	0.01	-	<0.05	<0.0001	0	<0.001	<0.001	0.09	<0.001	0.04	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8646	16/10/2017	0.48	<0.001	0.01	-	<0.05	<0.0001	0	<0.001	<0.001	0.1	<0.001	0.22	-	0	<0.01	<0.001	<0.01	<0.005
MW8647	17/08/2016	10.7	0	0.09	<0.001	-	0	0.04	<0.001	0.01	2.75	0	0.3	-	0.01	-	0	<0.01	<0.005
MW8647	4/11/2016	6.34	0	0.05	<0.001	-	<0.0001	0.01	<0.001	0	2.26	0	0.33	-	<0.001	-	<0.001	<0.01	<0.005
MW8647	26/04/2017	1.62	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.47	<0.001	0.17	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8647	16/10/2017	0.2	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.05	<0.001	0.06	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8648	17/08/2016	0.09	<0.001	0.06	<0.001	-	<0.0001	<0.001	0	<0.001	0.45	<0.001	2.53	-	0.01	-	<0.001	<0.01	<0.005
MW8648	4/11/2016	0.02	<0.001	0.08	<0.001	-	<0.0001	<0.001	0	<0.001	0.4	<0.001	1.82	-	0	-	<0.001	<0.01	<0.005
MW8648	26/04/2017	0.05	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.53	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8648	16/10/2017	0.04	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.18	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8649	26/04/2017	0.05	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8650	24/06/2019	0.05	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.015	<0.0001	0.009	<0.01	<0.001	<0.01	<0.005

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
MW8650	7/11/2019	0.04	<0.001	0.022	-	<0.05	<0.0001	<0.001	<0.001	0.002	<0.05	<0.001	0.031	-	0.018	<0.01	<0.001	<0.01	-
MW8651	24/06/2019	0.06	<0.001	0.021	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.03	<0.0001	0.001	<0.01	<0.001	<0.01	<0.005
MW8651	7/11/2019	0.03	<0.001	0.031	-	<0.05	<0.0001	0.002	<0.001	<0.001	<0.05	<0.001	0.051	-	0.006	<0.01	<0.001	<0.01	-
MW8654	24/06/2019	<0.01	<0.001	0.026	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.435	<0.0001	0.004	<0.01	<0.001	<0.01	<0.005
MW8654	7/11/2019	0.01	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	<0.001	0.254	-	0.006	<0.01	<0.001	<0.01	-
MW8655	7/11/2019	0.01	<0.001	0.033	-	<0.05	<0.0001	<0.001	<0.001	0.002	<0.05	<0.001	0.987	-	0.027	<0.01	<0.001	<0.01	-
TDMW1	11/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW1	15/11/2016	<0.01	-	0.05	-	-	-	-	-	-	3.69	-	0.62	-	-	-	-	-	0.01
TDMW1	16/06/2017	0.18	-	0.06	-	-	-	-	-	-	3.45	-	1.44	-	-	-	-	-	0.02
TDMW1	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW1	11/05/2018	0.01	0	0.28	-	<0.05	<0.0001	<0.001	0.01	<0.001	15.8	<0.001	5.24	<0.0001	0.01	<0.01	<0.001	<0.01	0.01
TDMW1	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW1	17/06/2019	0.12	-	0.066	-	-	-	-	-	-	2.44	-	1.77	-	-	-	-	-	<0.005
TDMW10	11/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW10	15/11/2016	<0.05	-	0.09	-	-	-	-	-	-	17.2	-	2.84	-	-	-	-	-	0.03
TDMW10	16/06/2017	<0.01	-	0.1	-	-	-	-	-	-	2.42	-	4.52	-	-	-	-	-	0.01
TDMW10	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW10	11/05/2018	0.02	0	0.05	-	0.29	<0.0001	<0.001	0	0	2.86	<0.001	2.26	<0.0001	0.03	<0.01	<0.001	<0.01	0.01
TDMW10	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW10	17/06/2019	0.06	-	0.032	-	-	-	-	-	-	0.43	-	1.07	-	-	-	-	-	<0.005
TDMW2	11/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW2	15/11/2016	0.01	-	0.02	-	-	-	-	-	-	0.05	-	0.1	-	-	-	-	-	0.01
TDMW2	16/06/2017	0.02	-	0.02	-	-	-	-	-	-	<0.05	-	0.21	-	-	-	-	-	<0.005
TDMW2	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Monitoring Bore	Sampling Date	Dissolved Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		**0.055**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.9**	**-**	**-**	**-**	**-**	**-**	**0.008**
TDMW2	11/05/2018	0.03	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.31	<0.001	0.36	<0.0001	0.01	<0.01	<0.001	<0.01	0.01
TDMW2	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW2	17/06/2019	0.06	-	0.019	-	-	-	-	-	-	0.17	-	0.232	-	-	-	-	-	<0.005
TDMW7	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW7	17/06/2019	0.03	-	0.053	-	-	-	-	-	-	2.2	-	1.63	-	-	-	-	-	<0.005
TDMW8	16/06/2017	0.12	-	0.05	-	-	-	-	-	-	5.15	-	1.42	-	-	-	-	-	<0.005
TDMW8	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW8	11/05/2018	0.02	0	0.08	-	<0.05	<0.0001	<0.001	0.02	<0.001	6.74	<0.001	3.48	<0.0001	0.02	<0.01	<0.001	<0.01	0.01
TDMW8	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW8	17/06/2019	0.22	-	0.063	-	-	-	-	-	-	2.13	-	1.8	-	-	-	-	-	<0.005
TDMW9	16/06/2017	<0.01	-	0.02	-	-	-	-	-	-	2.29	-	1.43	-	-	-	-	-	0.02
TDMW9	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW9	11/05/2018	0.03	0	0.03	-	<0.05	<0.0001	<0.001	0	<0.001	8.7	<0.001	1	<0.0001	0.03	<0.01	<0.001	<0.01	0.02
TDMW9	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW9	17/06/2019	0.08	-	0.032	-	-	-	-	-	-	6.05	-	1.21	-	-	-	-	-	0.008

Table 9-9: Groundwater Quality Results Total Metals) - Tailings storage facilities

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW85820	11/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8582	15/11/2016	2.35	-	0.18	-	-	-	-	-	16	-	0.46	-	-	-	-	-	1.06	-
MW8582	16/06/2017	2.94	-	0.32	-	-	-	-	-	15.5	-	1.15	-	-	-	-	-	3.77	-
MW8582	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8582	11/05/2018	0.04	0.01	0.17	-	0.06	<0.0001	<0.001	0	<0.001	11.9	<0.001	0.7	-	0.02	<0.01	<0.001	<0.01	0.63
MW8582	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8582	17/06/2019	4.44	-	0.196	-	-	-	-	-	-	19.5	-	0.891	-	-	-	-	-	1.37
MW8593	16/08/2016	0.06	<0.001	0.07	<0.001	-	<0.0001	<0.001	<0.001	0.01	0.09	<0.001	0.12	-	0.01	-	<0.001	<0.01	0.02
MW8593	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8593	24/04/2017	0.05	<0.001	0.07	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.14	-	0.04	<0.01	<0.001	<0.01	<0.005
MW8593	16/10/2017	0.04	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.18	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8593	10/05/2018	0.11	<0.001	0.03	-	<0.05	<0.0001	<0.001	0	0	0.16	0	0.28	-	0.02	<0.01	<0.001	<0.01	0.01
MW8593	17/06/2019	0.05	-	0.027	-	-	-	-	-	-	0.06	-	0.134	-	-	-	-	-	0.021
MW8593	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8593	7/11/2019	0.04	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	<0.001	0.1	-	0.023	<0.01	<0.001	<0.01	<0.005
MW8594	24/04/2017	0.67	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	0	0.6	0	0.12	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8594	10/05/2018	0.22	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.15	<0.001	0.06	-	0	<0.01	<0.001	<0.01	<0.005
MW8594	11/06/2019	0.16	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	0.001	0.21	<0.001	0.094	<0.0001	<0.001	<0.01	<0.001	<0.01	0.014
MW8594	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8594	7/11/2019	0.25	<0.001	0.009	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.24	<0.001	0.042	-	0.007	<0.01	<0.001	<0.01	0.01
MW8595	16/08/2016	0.11	<0.001	0.06	<0.001	-	<0.0001	<0.001	<0.001	0.01	0.26	<0.001	0.14	-	0.01	-	<0.001	<0.01	0.02
MW8595	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8595	24/04/2017	0.09	<0.001	0.06	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.17	<0.001	0.13	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8595	16/10/2017	0.14	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	0	0.18	<0.001	0.12	-	0.01	<0.01	<0.001	<0.01	0.01
MW8595	10/05/2018	0.27	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	0.01	0.41	0	0.13	-	0.04	<0.01	<0.001	<0.01	0.02
MW8595	11/06/2019	0.05	<0.001	0.033	-	<0.05	<0.0001	<0.001	<0.001	0.002	0.08	<0.001	0.066	<0.0001	0.009	<0.01	<0.001	<0.01	0.021
MW8595	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8595	7/11/2019	0.12	<0.001	0.041	-	<0.05	<0.0001	<0.001	<0.001	0.002	0.15	<0.001	0.172	-	0.028	<0.01	<0.001	<0.01	<0.005
MW8596	16/08/2016	0.02	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.03	-	0.01	-	<0.001	<0.01	0.04
MW8596	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8596	24/04/2017	0.36	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.55	0	0.12	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8596	10/05/2018	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.3	<0.001	0.03	-	0	<0.01	<0.001	<0.01	<0.005
MW8596	11/06/2019	0.02	<0.001	0.007	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.018	<0.0001	<0.001	<0.01	<0.001	<0.01	0.007
MW8596	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8596	7/11/2019	0.36	<0.001	0.009	-	<0.05	<0.0001	<0.001	<0.001	0.002	0.57	0.006	0.042	-	0.005	<0.01	<0.001	<0.01	0.005
MW8597	16/08/2016	0.09	<0.001	0.03	<0.001	-	<0.0001	<0.001	<0.001	0.01	0.1	0	0.15	-	0.01	-	<0.001	<0.01	0.02
MW8597	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8597	24/04/2017	0.06	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.12	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8597	16/10/2017	0.09	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	0	0.1	<0.001	0.18	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8597	10/05/2018	0.07	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	0.01	0.07	0	0.13	-	0.02	<0.01	<0.001	<0.01	0.02
MW8597	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8597	7/11/2019	0.12	<0.001	0.027	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.12	<0.001	0.172	-	0.021	<0.01	<0.001	<0.01	<0.005
MW8598	16/08/2016	0.08	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0.01	0.06	<0.001	0.05	-	0	-	<0.001	<0.01	0.02
MW8598	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8598	24/04/2017	1.42	<0.001	0.03	-	<0.05	<0.0001	0	<0.001	0	1.56	0.01	0.16	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8598	16/10/2017	0.8	<0.001	0.01	-	<0.05	<0.0001	0	<0.001	0	2.83	0	0.08	-	0	<0.01	<0.001	<0.01	<0.005

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8598	10/05/2018	0.02	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.06	<0.001	0.04	-	0	<0.01	<0.001	<0.01	<0.005
MW8598	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8598	7/11/2019	0.49	<0.001	0.005	-	<0.05	<0.0001	<0.001	<0.001	<0.001	1.66	<0.001	0.046	-	0.005	<0.01	<0.001	<0.01	<0.005
MW8599	16/08/2016	0.07	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0.01	0.12	<0.001	0.14	-	0.01	-	<0.001	<0.01	0.01
MW8599	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8599	24/04/2017	0.06	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.09	<0.001	0.21	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8599	16/10/2017	0.1	<0.001	0.02	-	<0.05	<0.0001	0	<0.001	0	0.24	<0.001	0.22	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8599	10/05/2018	0.14	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0.01	0.23	0	0.21	-	0.05	<0.01	<0.001	<0.01	0.02
MW8599	11/06/2019	0.07	<0.001	0.021	-	<0.05	<0.0001	<0.001	<0.001	0.004	0.12	<0.001	0.1	<0.0001	0.008	<0.01	<0.001	<0.01	0.013
MW8599	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8599	7/11/2019	0.11	<0.001	0.016	-	<0.05	<0.0001	<0.001	<0.001	0.002	0.16	<0.001	0.153	-	0.024	<0.01	<0.001	<0.01	0.005
MW8600	16/08/2016	0.04	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.04	-	0	-	<0.001	<0.01	0.01
MW8600	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8600	24/04/2017	0.13	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.14	<0.001	0.04	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8600	16/10/2017	0.06	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.06	<0.001	0.05	-	0	<0.01	<0.001	<0.01	<0.005
MW8600	10/05/2018	0.04	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.03	-	0	<0.01	<0.001	<0.01	<0.005
MW8600	11/06/2019	0.13	<0.001	0.007	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.06	<0.001	0.038	<0.0001	0.001	<0.01	<0.001	<0.01	0.009
MW8600	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8600	7/11/2019	0.04	<0.001	0.005	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.022	-	0.025	<0.01	<0.001	<0.01	<0.005
MW8601	16/08/2016	0.26	<0.001	0.02	<0.001	-	<0.0001	0	0	0.01	0.69	0	0.25	-	0.01	-	<0.001	<0.01	0.02
MW8601	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8601	24/04/2017	0.23	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.54	0	0.14	-	0.03	<0.01	<0.001	<0.01	<0.005
MW8601	16/10/2017	0.26	<0.001	0.01	-	<0.05	<0.0001	<0.001	0	0	0.75	0	0.16	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8601	10/05/2018	0.11	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	0	0.34	<0.001	0.06	-	0	<0.01	<0.001	<0.01	0.01

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8601	11/06/2019	0.1	<0.001	0.013	-	<0.05	<0.0001	<0.001	<0.001	0.002	0.27	<0.001	0.067	<0.0001	0.005	<0.01	<0.001	<0.01	0.006
MW8601	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8601	7/11/2019	0.06	<0.001	0.018	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.059	-	0.022	<0.01	<0.001	<0.01	<0.005
MW8602	16/08/2016	0.36	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	0.44	<0.001	0.07	-	0	-	<0.001	<0.01	0.01
MW8602	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8602	24/04/2017	1.47	<0.001	0.05	-	<0.05	<0.0001	0	<0.001	0	1.99	0	0.22	-	0.01	<0.01	<0.001	<0.01	0.01
MW8602	16/10/2017	1.99	<0.001	0.11	-	<0.05	<0.0001	<0.001	<0.001	0	1.82	0	0.12	-	0	<0.01	0	<0.01	0.01
MW8602	10/05/2018	3.54	<0.001	0.12	-	<0.05	<0.0001	0	<0.001	0.01	6.59	0.01	0.27	-	0.01	<0.01	0	<0.01	0.02
MW8602	11/06/2019	0.27	<0.001	0.015	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.22	<0.001	0.032	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8602	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8602	7/11/2019	0.7	<0.001	0.027	-	<0.05	<0.0001	<0.001	<0.001	<0.001	1.13	<0.001	0.087	-	0.013	<0.01	<0.001	<0.01	<0.005
MW8603	16/08/2016	0.3	<0.001	0.02	<0.001	-	<0.0001	<0.001	0	0	0.35	<0.001	0.1	-	0.01	-	<0.001	<0.01	0.01
MW8603	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8603	24/04/2017	0.44	<0.001	0.02	-	<0.05	<0.0001	<0.001	0	<0.001	0.56	<0.001	0.13	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8603	16/10/2017	0.32	<0.001	0.02	-	<0.05	<0.0001	<0.001	0	<0.001	0.31	<0.001	0.08	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8603	10/05/2018	0.46	<0.001	0.03	-	<0.05	<0.0001	<0.001	0	0	0.81	0	0.1	-	0.03	<0.01	<0.001	<0.01	0.01
MW8603	11/06/2019	0.35	<0.001	0.021	-	<0.05	<0.0001	<0.001	<0.001	0.001	0.54	<0.001	0.07	<0.0001	0.007	<0.01	<0.001	<0.01	0.009
MW8603	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8603	7/11/2019	0.92	<0.001	0.024	-	<0.05	<0.0001	0.001	0.003	0.001	1.13	0.001	0.122	-	0.019	<0.01	<0.001	<0.01	0.006
MW8604	16/08/2016	0.09	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0.01	0.08	<0.001	0.04	-	0	-	<0.001	<0.01	0.02
MW8604	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8604	24/04/2017	0.29	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.24	<0.001	0.04	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8604	16/10/2017	0.2	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.16	<0.001	0.04	-	0	<0.01	<0.001	<0.01	<0.005
MW8604	10/05/2018	0.1	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	0	0.07	<0.001	0.03	-	0	<0.01	<0.001	<0.01	0.01

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8604	11/06/2019	0.05	<0.001	0.007	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.026	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8604	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8604	7/11/2019	0.36	<0.001	0.007	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.26	<0.001	0.05	-	0.017	<0.01	<0.001	<0.01	0.02
MW8605	16/08/2016	0.2	<0.001	0.02	<0.001	-	0	<0.001	<0.001	0	0.1	<0.001	0.19	-	0.01	-	<0.001	<0.01	0.02
MW8605	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8605	24/04/2017	0.23	<0.001	0.02	-	<0.05	<0.0001	0	<0.001	0	0.15	<0.001	0.36	-	0	<0.01	<0.001	<0.01	<0.005
MW8605	16/10/2017	0.3	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.21	<0.001	0.42	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8605	10/05/2018	0.08	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	0	0.1	<0.001	0.2	-	0	<0.01	<0.001	<0.01	0.01
MW8605	11/06/2019	0.01	<0.001	0.012	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.014	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8605	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8605	7/11/2019	0.03	<0.001	0.008	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.075	-	0.008	<0.01	<0.001	<0.01	<0.005
MW8606	16/08/2016	0.05	<0.001	0.03	<0.001	-	<0.0001	<0.001	<0.001	0	0.05	<0.001	0.09	-	0	-	<0.001	<0.01	0.01
MW8606	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8606	24/04/2017	0.15	<0.001	0.02	-	<0.05	<0.0001	0	<0.001	<0.001	0.51	<0.001	0.1	-	0	<0.01	<0.001	<0.01	<0.005
MW8606	16/10/2017	0.22	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.31	<0.001	0.12	-	0	<0.01	<0.001	<0.01	<0.005
MW8606	10/05/2018	0.13	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	0	0.15	<0.001	0.1	-	0	<0.01	<0.001	<0.01	0.01
MW8606	11/06/2019	0.04	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.143	<0.0001	0.001	<0.01	<0.001	<0.01	<0.005
MW8606	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8606	7/11/2019	0.18	<0.001	0.018	-	<0.05	<0.0001	<0.001	<0.001	0.001	1.46	<0.001	0.191	-	0.008	<0.01	<0.001	<0.01	<0.005
MW8607	16/08/2016	0.04	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	0.07	<0.001	0.1	-	0	-	<0.001	<0.01	0.01
MW8607	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8607	24/04/2017	0.09	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0	0.15	<0.001	0.18	-	0	<0.01	<0.001	<0.01	0.01
MW8607	16/10/2017	0.11	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0	0.4	<0.001	0.3	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8607	10/05/2018	<0.01	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.25	-	0	<0.01	<0.001	<0.01	0.01

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8607	11/06/2019	0.04	<0.001	0.011	-	<0.05	<0.0001	<0.001	<0.001	0.001	0.05	<0.001	0.087	<0.0001	0.001	<0.01	<0.001	<0.01	<0.005
MW8607	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8607	7/11/2019	0.08	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.16	<0.001	0.155	-	0.012	<0.01	<0.001	<0.01	<0.005
MW8608	16/08/2016	0.18	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	0.09	<0.001	0.04	-	0	-	<0.001	<0.01	0.01
MW8608	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8608	24/04/2017	0.25	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.17	<0.001	0.08	-	0	<0.01	<0.001	<0.01	<0.005
MW8608	16/10/2017	0.42	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0	0.36	<0.001	0.34	-	0	<0.01	<0.001	<0.01	<0.005
MW8608	10/05/2018	0.32	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	0	0.59	<0.001	0.16	-	0	<0.01	<0.001	<0.01	0.01
MW8608	11/06/2019	0.35	<0.001	0.012	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.24	<0.001	0.084	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8608	6/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8608	7/11/2019	0.04	<0.001	0.004	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.02	-	0.003	<0.01	<0.001	<0.01	<0.005
MW8609	16/08/2016	0.1	<0.001	0.02	<0.001	-	<0.0001	<0.001	<0.001	0	0.2	<0.001	0.11	-	0.01	-	<0.001	<0.01	0.01
MW8609	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8609	16/10/2017	0.26	<0.001	0.03	-	<0.05	<0.0001	<0.001	<0.001	0	0.39	<0.001	0.29	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8609	10/05/2018	0.1	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0.01	0.22	<0.001	0.13	-	0.01	<0.01	<0.001	<0.01	0.01
MW8609	12/06/2019	0.01	<0.001	0.014	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	0.001	0.023	<0.0001	0.002	<0.01	<0.001	<0.01	<0.005
MW8609	7/11/2019	0.08	<0.001	0.012	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.14	<0.001	0.086	-	0.006	<0.01	<0.001	<0.01	0.008
MW8610	16/08/2016	0.14	<0.001	0.01	<0.001	-	<0.0001	<0.001	<0.001	0	0.26	<0.001	0.05	-	0	-	<0.001	<0.01	0.01
MW8610	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8610	16/10/2017	0.12	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.21	<0.001	0.04	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8610	10/05/2018	0.27	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	0	0.32	<0.001	0.05	-	0	<0.01	<0.001	<0.01	0.01
MW8610	12/06/2019	0.02	<0.001	0.006	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	0.003	0.026	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8610	7/11/2019	0.08	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.13	<0.001	0.048	-	0.005	<0.01	<0.001	<0.01	0.019
MW8612	27/04/2017	0.68	<0.001	0.14	-	<0.05	<0.0001	0	0	0	1.06	0.01	0.95	-	0.03	<0.01	<0.001	<0.01	0.01

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8612	9/05/2018	3.58	0	0.43	-	<0.05	<0.0001	0.01	0.01	0.01	5.88	0.14	2.28	-	0.01	<0.01	<0.001	0.03	0.03
MW8612	19/06/2019	0.91	<0.001	0.137	-	<0.05	<0.0001	0.004	0.001	0.006	0.72	0.019	0.864	<0.0001	0.008	<0.01	<0.001	<0.01	0.009
MW8613	27/04/2017	0.25	<0.001	0.13	-	<0.05	<0.0001	0	0	0.01	0.45	0	2.96	-	0.02	<0.01	<0.001	<0.01	0.01
MW8614	23/08/2016	0.52	<0.001	0.11	<0.001	-	<0.0001	0	0.01	0.01	0.89	0	1.89	-	0.02	-	<0.001	<0.01	0.01
MW8614	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8614	27/04/2017	0.81	<0.001	0.12	-	<0.05	<0.0001	0	0.01	0	1.54	0	2.84	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8614	17/10/2017	0.73	<0.001	0.11	-	<0.05	<0.0001	0	0.01	0	1.26	0	2.36	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8614	9/05/2018	0.82	<0.001	0.1	-	<0.05	<0.0001	0	0.01	0	1.32	0.01	2.21	-	0.02	<0.01	<0.001	<0.01	0.01
MW8614	19/06/2019	0.49	<0.001	0.141	-	<0.05	<0.0001	<0.001	0.002	0.002	0.52	0.002	0.899	<0.0001	0.005	<0.01	<0.001	<0.01	0.008
MW8614	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8614	7/11/2019	0.34	<0.001	0.085	-	<0.05	<0.0001	0.001	0.003	0.003	0.51	0.003	1.23	-	0.02	<0.01	<0.001	<0.01	0.009
MW8615	23/08/2016	1.13	<0.001	0.14	<0.001	-	<0.0001	0	0	0.01	1.37	0.01	2.16	-	0.02	-	<0.001	<0.01	0.04
MW8615	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8615	27/04/2017	2.68	0	0.21	-	<0.05	<0.0001	0.01	0.01	0.01	5.09	0.01	3.69	-	0.02	<0.01	<0.001	0.02	0.01
MW8615	17/10/2017	2.15	<0.001	0.22	-	<0.05	<0.0001	0.01	0.01	0	3.57	0.01	3.43	-	0.01	<0.01	<0.001	0.02	0.01
MW8615	9/05/2018	1.38	<0.001	0.13	-	<0.05	<0.0001	0	0	0	1.8	0.01	2.21	-	0.01	<0.01	<0.001	<0.01	0.01
MW8615	19/06/2019	0.89	<0.001	0.088	-	<0.05	<0.0001	0.002	0.001	0.003	0.98	0.004	1.36	<0.0001	0.009	<0.01	<0.001	<0.01	0.01
MW8616D	31/08/2016	0.76	0	0.11	<0.001	-	0	0	0.01	0.01	0.9	0	4.65	-	0.07	-	<0.001	<0.01	0.05
MW8616D	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8616D	27/04/2017	0.08	0	0.09	-	0.59	0	<0.001	0.01	0	0.11	<0.001	1.69	-	0.05	<0.01	<0.001	<0.01	0.03
MW8616D	17/10/2017	0.08	<0.001	0.13	-	0.55	0	<0.001	0.01	0	0.13	<0.001	2.16	-	0.06	<0.01	<0.001	<0.01	0.04
MW8616D	9/05/2018	0.09	<0.001	0.1	-	0.47	0	<0.001	0.01	0	0.11	<0.001	3.03	-	0.09	<0.01	<0.001	<0.01	0.04
MW8616D	24/06/2019	0.03	<0.001	0.096	-	0.55	0.0002	<0.001	0.015	0.011	<0.05	<0.001	3	<0.0001	0.072	<0.01	<0.001	<0.01	0.047
MW8616D	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8616D	7/11/2019	0.09	<0.001	0.1	-	0.59	0.0002	<0.001	0.016	0.002	0.12	<0.001	3.52	-	0.091	<0.01	<0.001	<0.01	0.039
MW8616S	31/08/2016	4.65	0	0.13	<0.001	-	<0.0001	0.01	0	0.01	3.33	0	1.76	-	0.01	-	<0.001	<0.01	0.03
MW8616S	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8616S	27/04/2017	3.16	0	0.15	-	0.08	<0.0001	0.03	0	0.01	2.99	0	1.57	-	0.02	<0.01	<0.001	<0.01	0.01
MW8616S	17/10/2017	1.52	<0.001	0.06	-	<0.05	<0.0001	0.01	0	0	1.43	0	1.07	-	0.01	<0.01	<0.001	<0.01	0.01
MW8616S	9/05/2018	1.09	<0.001	0.04	-	0.06	<0.0001	0.01	0	0	0.85	0	0.78	-	0.01	<0.01	<0.001	<0.01	0.01
MW8616S	24/06/2019	1.18	<0.001	0.048	-	<0.05	<0.0001	0.007	0.001	0.002	0.92	0.001	0.86	<0.0001	0.014	<0.01	<0.001	<0.01	0.009
MW8616S	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8616S	7/11/2019	3.27	0.001	0.103	-	<0.05	<0.0001	0.019	0.002	0.004	3.04	0.003	1.74	-	0.026	<0.01	<0.001	<0.01	0.015
MW8617D	31/08/2016	0.38	<0.001	0.05	<0.001	-	<0.0001	0	<0.001	0	0.39	<0.001	1.92	-	0.01	-	<0.001	<0.01	0.01
MW8617D	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8617D	27/04/2017	0.17	<0.001	0.04	-	<0.05	<0.0001	0	<0.001	0	0.23	<0.001	0.98	-	0.02	<0.01	<0.001	<0.01	0.01
MW8617D	17/10/2017	0.12	<0.001	0.06	-	<0.05	<0.0001	<0.001	<0.001	0	0.14	<0.001	0.48	-	0.01	<0.01	<0.001	<0.01	0.01
MW8617D	11/05/2018	1.07	<0.001	0.08	-	<0.05	<0.0001	0.01	0	0.01	1.83	0	3.01	-	0.01	<0.01	<0.001	0.01	0.03
MW8617D	24/06/2019	0.06	<0.001	0.036	-	<0.05	0.0001	<0.001	<0.001	0.001	0.05	<0.001	0.167	<0.0001	0.008	<0.01	<0.001	<0.01	0.009
MW8617D	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8617D	7/11/2019	0.12	<0.001	0.037	-	<0.05	<0.0001	0.001	<0.001	0.004	0.15	<0.001	0.412	-	0.03	<0.01	<0.001	<0.01	0.009
MW8617S	31/08/2016	8.77	0	0.66	0	-	<0.0001	0.01	0.01	0.01	7.26	0.01	1.52	-	0.02	-	<0.001	0.02	0.03
MW8617S	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8617S	27/04/2017	4.55	0	0.21	-	<0.05	<0.0001	0.01	0.01	0.01	6.7	0.01	2.15	-	0.01	<0.01	<0.001	0.02	0.01
MW8617S	17/10/2017	10.1	0	0.42	-	<0.05	<0.0001	0.01	0.01	0.01	12.9	0.01	2.22	-	0.02	<0.01	<0.001	0.03	0.03
MW8617S	11/05/2018	5.49	0	0.19	-	<0.05	<0.0001	0.01	0.01	0.01	7.78	0.01	2.47	-	0.01	<0.01	<0.001	0.02	0.02
MW8617S	24/06/2019	13.9	0.003	0.53	-	<0.05	<0.0001	0.013	0.01	0.016	15.5	0.013	3.52	<0.0001	0.029	<0.01	0.003	0.03	0.048
MW8617S	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8617S	7/11/2019	34.7	0.012	2.06	-	<0.05	0.0002	0.03	0.024	0.041	37.6	0.034	7.74	-	0.075	<0.01	0.006	0.07	0.095
MW8618D	31/08/2016	0.82	<0.001	0.02	<0.001	-	<0.0001	0	0	0	0.71	<0.001	1.69	-	0.01	-	<0.001	<0.01	0.01
MW8618D	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8618D	17/10/2017	0.53	<0.001	0.01	-	<0.05	<0.0001	0	<0.001	0	0.59	<0.001	1.63	-	0.01	<0.01	<0.001	<0.01	0.01
MW8618D	11/05/2018	0.17	<0.001	0.01	-	<0.05	<0.0001	0	<0.001	<0.001	0.17	<0.001	0.74	-	0	<0.01	<0.001	<0.01	0.01
MW8618D	24/06/2019	0.36	<0.001	0.006	-	<0.05	0.0004	0.002	<0.001	0.002	0.22	0.003	0.182	<0.0001	0.008	<0.01	<0.001	<0.01	0.012
MW8618D	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8618D	7/11/2019	0.18	<0.001	0.005	-	<0.05	<0.0001	<0.001	<0.001	0.004	0.12	<0.001	0.077	-	0.013	<0.01	<0.001	<0.01	<0.005
MW8618S	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8618S	17/10/2017	0.79	<0.001	0.07	-	<0.05	<0.0001	0	<0.001	0	0.46	0	0.32	-	0.01	<0.01	<0.001	<0.01	0.01
MW8618S	11/05/2018	0.65	<0.001	0.02	-	<0.05	<0.0001	0	<0.001	0	0.71	0	0.41	-	0	<0.01	<0.001	<0.01	0.01
MW8618S	24/06/2019	0.62	<0.001	0.039	-	<0.05	0.0003	0.001	0.001	0.002	0.72	0.001	0.316	<0.0001	0.004	<0.01	<0.001	<0.01	0.01
MW8618S	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8618S	7/11/2019	3.18	0.001	0.117	-	<0.05	<0.0001	0.005	0.003	0.003	5.3	0.003	1.58	-	0.023	<0.01	<0.001	0.01	0.009
MW8619	23/08/2016	6.76	0	0.17	<0.001	-	<0.0001	0.01	0	0.01	6.54	0.02	1.89	-	0.02	-	0	0.03	0.03
MW8619	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8621	23/08/2016	0.97	<0.001	0.09	<0.001	-	<0.0001	0	<0.001	0	1.28	0.01	0.45	-	0.01	-	0	<0.01	0.01
MW8621	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8621	27/04/2017	4.03	0	0.16	-	<0.05	<0.0001	0.01	0	0.01	6.46	0.04	1.72	-	0.01	<0.01	0.01	0.03	0.01
MW8621	17/10/2017	2.73	0	0.11	-	<0.05	<0.0001	0	0	0	4.08	0.02	0.96	-	0.01	<0.01	0.01	0.02	0.01
MW8621	9/05/2018	2.02	0	0.1	-	<0.05	<0.0001	0	<0.001	0	2.57	0.01	0.73	-	0.01	<0.01	0	0.02	0.01
MW8621	19/06/2019	0.79	<0.001	0.051	-	<0.05	<0.0001	0.001	<0.001	0.003	1.07	0.003	0.554	<0.0001	0.007	<0.01	<0.001	<0.01	0.007
MW8621	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8621	7/11/2019	3.12	0.001	0.094	-	<0.05	<0.0001	0.004	0.001	0.006	4.59	0.013	1.12	-	0.019	<0.01	0.003	0.02	0.011

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8622	23/08/2016	1.09	<0.001	0.02	<0.001	-	<0.0001	0	<0.001	0.01	1.66	0.02	0.41	-	0.01	-	0	<0.01	0.02
MW8622	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8622	27/04/2017	0.05	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	0	0.07	<0.001	0.15	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8622	17/10/2017	0.21	<0.001	0.01	-	<0.05	<0.0001	0	<0.001	0	0.33	0	0.27	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8622	9/05/2018	0.13	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0	0.18	0	0.46	-	0.02	<0.01	<0.001	<0.01	0.01
MW8622	19/06/2019	0.07	<0.001	0.009	-	<0.05	<0.0001	<0.001	<0.001	0.004	0.08	<0.001	0.221	<0.0001	0.017	<0.01	<0.001	<0.01	0.011
MW8622	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8622	7/11/2019	0.07	<0.001	0.008	-	<0.05	<0.0001	<0.001	<0.001	0.004	0.07	<0.001	0.283	-	0.025	<0.01	<0.001	<0.01	0.007
MW8623	27/04/2017	3.9	0	0.26	-	<0.05	<0.0001	0.01	0	0	6	0.01	3.38	-	0.01	<0.01	<0.001	0.03	0.01
MW8623	17/10/2017	0.86	<0.001	0.13	-	<0.05	<0.0001	0	<0.001	<0.001	0.94	0	0.82	-	0.01	<0.01	<0.001	<0.01	0.01
MW8624	23/08/2016	12.7	0	0.88	0	-	0	0.01	0.01	0.01	14.1	0.04	5.36	-	0.03	-	0.01	0.05	0.06
MW8624	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8624	27/04/2017	9.34	0	0.73	-	<0.05	0	0.01	0.01	0.01	10.4	0.04	4.08	-	0.02	<0.01	0.01	0.04	0.03
MW8624	17/10/2017	14.5	0	0.91	-	<0.05	0	0.02	0.01	0.01	17.6	0.05	5.58	-	0.02	<0.01	0.01	0.07	0.03
MW8627	23/08/2016	0.04	<0.001	0.07	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.11	-	0	-	<0.001	<0.01	0.03
MW8627	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8627	27/04/2017	0.02	<0.001	0.08	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.06	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8627	17/10/2017	0.03	<0.001	0.08	-	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.05	<0.001	0.04	-	0	<0.01	<0.001	<0.01	<0.005
MW8627	9/05/2018	0.09	<0.001	0.09	-	<0.05	<0.0001	<0.001	<0.001	0	0.15	<0.001	0.24	-	0	<0.01	<0.001	<0.01	0.02
MW8627	19/06/2019	0.06	<0.001	0.08	-	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	<0.001	0.178	<0.0001	0.004	<0.01	<0.001	<0.01	0.008
MW8628	23/08/2016	1.02	<0.001	0.11	<0.001	-	<0.0001	0	0.01	0	1.43	0	2.21	-	0	-	<0.001	<0.01	0.02
MW8628	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8628	27/04/2017	1.01	<0.001	0.12	-	<0.05	<0.0001	0	0	0	1.69	0.01	3.38	-	0.01	<0.01	<0.001	0.01	<0.005
MW8628	17/10/2017	1.04	<0.001	0.11	-	<0.05	<0.0001	0	0	0	1.46	0.01	2.34	-	0	<0.01	<0.001	<0.01	0.01

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8628	9/05/2018	1.48	<0.001	0.18	-	<0.05	<0.0001	0	0	0	2.48	0	3.09	-	0.01	<0.01	<0.001	0.01	0.01
MW8628	19/06/2019	7.84	0.002	0.434	-	<0.05	0.0002	0.012	0.01	0.011	8.23	0.016	5.8	<0.0001	0.022	<0.01	0.002	0.03	0.03
MW8630	31/08/2016	0.25	<0.001	0.06	<0.001	-	<0.0001	0	<0.001	0.01	0.3	<0.001	0.22	-	0.02	-	<0.001	<0.01	0.02
MW8630	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8630	27/04/2017	0.26	<0.001	0.06	-	<0.05	<0.0001	0	<0.001	0	0.42	<0.001	0.41	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8630	18/10/2017	0.66	<0.001	0.06	-	<0.05	<0.0001	0	<0.001	0	0.58	0	0.34	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8630	11/05/2018	0.89	<0.001	0.07	-	<0.05	0	0.01	<0.001	0	1.55	0	0.58	-	0.01	<0.01	<0.001	<0.01	0.02
MW8630	26/11/2018	0.35	0.001	0.043	-	<0.05	<0.0001	<0.001	<0.001	0.004	0.38	0.006	0.214	<0.0001	0.005	<0.01	<0.001	<0.01	0.017
MW8630	19/06/2019	0.03	<0.001	0.027	-	<0.05	<0.0001	<0.001	<0.001	0.004	<0.05	0.001	0.077	<0.0001	0.007	<0.01	<0.001	<0.01	0.026
MW8630	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8630	7/11/2019	0.37	<0.001	0.046	-	<0.05	<0.0001	0.002	<0.001	0.003	0.54	0.004	0.772	-	0.016	<0.01	<0.001	<0.01	<0.005
MW8634D	31/08/2016	7.32	0.02	0.1	0	-	<0.0001	0.02	0	0.01	6.27	0	1.74	-	0.03	-	<0.001	0.04	0.05
MW8634D	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8634D	17/10/2017	13.7	0.02	0.28	-	<0.05	<0.0001	0.03	0.01	0.01	11.5	0.01	3.05	-	0.06	<0.01	0	0.04	0.07
MW8634D	9/05/2018	6.7	0.02	0.18	-	0.06	<0.0001	0.01	0.01	0.01	7.03	0.01	3.58	-	0.03	<0.01	<0.001	0.03	0.04
MW8634S	9/05/2018	2.22	0	0.1	-	<0.05	<0.0001	0	0	0	2.87	0	1.6	-	0.02	<0.01	<0.001	<0.01	0.01
MW8635D	31/08/2016	6.6	0.01	0.14	0	-	<0.0001	0.05	0.01	0.01	5.04	0	3.99	-	0.02	-	<0.001	0.03	0.03
MW8635D	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8635D	27/04/2017	6.9	0	0.39	-	0.12	<0.0001	0.06	0.01	0.01	6.9	0.01	8.71	-	0.03	<0.01	<0.001	0.02	0.03
MW8635D	17/10/2017	3.92	0	0.21	-	0.11	<0.0001	0.04	0	0.01	3.72	0	5.12	-	0.01	<0.01	<0.001	0.02	0.02
MW8635D	9/05/2018	3.46	0	0.23	-	0.16	<0.0001	0.04	0	0.01	2.86	0	5.04	-	0.02	<0.01	<0.001	0.01	0.02
MW8635D	24/06/2019	1.23	0.002	0.098	-	0.12	0.0001	0.017	0.002	0.003	0.98	0.002	2.21	<0.0001	0.007	<0.01	<0.001	<0.01	0.024
MW8635D	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8635D	7/11/2019	0.7	<0.001	0.06	-	0.13	<0.0001	0.017	<0.001	0.004	0.68	<0.001	2.08	-	0.029	<0.01	<0.001	<0.01	0.006

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8635S	31/08/2016	10.3	0	0.51	<0.001	-	0	0.01	0.02	0.01	8.14	0.01	8.34	-	0.02	-	0	0.03	0.03
MW8635S	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8635S	27/04/2017	0.92	<0.001	0.09	-	<0.05	<0.0001	0	0	0	1.15	0	3.53	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8635S	17/10/2017	1.1	<0.001	0.09	-	<0.05	<0.0001	0	0	0	0.88	0	1.46	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8635S	9/05/2018	0.7	<0.001	0.05	-	<0.05	<0.0001	0	0	0	0.86	0	1.64	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8635S	24/06/2019	0.37	0.002	0.044	-	<0.05	0.0014	0.002	0.002	0.005	0.28	0.003	0.372	<0.0001	0.003	<0.01	<0.001	<0.01	0.034
MW8635S	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8635S	7/11/2019	3.14	0.001	0.18	-	<0.05	<0.0001	0.006	0.006	0.008	4.27	0.01	4.73	-	0.016	<0.01	<0.001	0.02	0.027
MW8636D	31/08/2016	6.64	0	0.12	<0.001	-	<0.0001	0.01	0.01	0.01	6.34	0	7.48	-	0.03	-	<0.001	0.02	0.04
MW8636D	2/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8636D	27/04/2017	3.11	<0.001	0.05	-	<0.05	<0.0001	0.01	0	0	3.25	0	4.83	-	0.03	<0.01	<0.001	0.01	0.02
MW8636D	17/10/2017	2.6	0	0.06	-	<0.05	<0.0001	0.01	0	0	2.55	0	4.7	-	0.02	<0.01	<0.001	0.01	0.02
MW8636D	11/05/2018	6.82	0	0.14	-	<0.05	<0.0001	0.01	0.01	0.01	5.31	0	7.33	-	0.02	<0.01	<0.001	0.02	0.05
MW8636D	24/06/2019	3.3	0.002	0.102	-	<0.05	<0.0001	0.006	0.005	0.004	3.61	0.002	5.14	<0.0001	0.016	<0.01	<0.001	0.02	0.029
MW8636D	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8636D	7/11/2019	2.89	0.001	0.095	-	<0.05	<0.0001	0.007	0.004	0.003	3.77	0.002	5.71	-	0.028	<0.01	<0.001	0.02	0.018
MW8636S	27/04/2017	3.45	0	0.24	-	0.06	<0.0001	0	0.01	0.01	5.09	0.01	8.6	-	0.03	<0.01	<0.001	0.02	0.02
MW8636S	17/10/2017	7.98	0	0.48	-	0.06	0	0.01	0.02	0.01	9.88	0.01	20.7	-	0.06	<0.01	0	0.04	0.06
MW8636S	11/05/2018	0.38	<0.001	0.05	-	<0.05	<0.0001	<0.001	<0.001	0	0.27	<0.001	0.83	-	0	<0.01	<0.001	<0.01	0.01
MW8636S	24/06/2019	0.31	<0.001	0.059	-	<0.05	<0.0001	<0.001	<0.001	0.002	0.2	<0.001	0.625	<0.0001	0.006	<0.01	<0.001	<0.01	0.013
MW8636S	4/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8636S	7/11/2019	0.45	<0.001	0.088	-	<0.05	<0.0001	0.001	<0.001	0.002	0.26	<0.001	0.897	-	0.028	<0.01	<0.001	<0.01	0.006
MW8640	17/08/2016	0.04	<0.001	0.03	<0.001	-	<0.0001	<0.001	<0.001	0	<0.05	<0.001	0.14	-	0	-	<0.001	<0.01	0.01
MW8640	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8640	24/04/2017	0.06	<0.001	0.01	-	<0.05	<0.0001	<0.001	0.01	<0.001	0.07	<0.001	0.33	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8640	16/10/2017	0.06	<0.001	0	-	<0.05	<0.0001	<0.001	0	0	0.08	<0.001	0.27	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8640	10/05/2018	0.05	<0.001	0.01	-	<0.05	<0.0001	<0.001	0	0	0.08	0	0.17	-	0.01	<0.01	<0.001	<0.01	0.01
MW8641	26/04/2017	0.33	<0.001	0.05	-	0.05	<0.0001	<0.001	<0.001	<0.001	0.32	<0.001	0.08	-	0.01	<0.01	<0.001	<0.01	0.01
MW8641	10/05/2018	0.11	<0.001	0.04	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.07	<0.001	0.03	-	0	<0.01	<0.001	<0.01	<0.005
MW8642	17/08/2016	0.95	<0.001	0.06	<0.001	-	<0.0001	0.01	0	0	0.95	0	1.77	-	0	-	<0.001	<0.01	0.01
MW8642	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8642	24/04/2017	0.66	<0.001	0.03	-	<0.05	<0.0001	0	<0.001	<0.001	0.74	0	0.66	-	0.02	<0.01	<0.001	<0.01	<0.005
MW8642	16/10/2017	0.32	<0.001	0.02	-	<0.05	<0.0001	0	<0.001	0	0.3	0	0.49	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8642	10/05/2018	0.35	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0	0.38	0	0.55	-	0	<0.01	<0.001	<0.01	0.01
MW8642	11/06/2019	0.26	<0.001	0.014	-	<0.05	<0.0001	<0.001	<0.001	0.002	0.29	0.002	0.41	<0.0001	0.004	<0.01	<0.001	<0.01	0.016
MW8642	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8642	7/11/2019	0.89	<0.001	0.042	-	<0.05	<0.0001	0.002	0.001	0.002	0.88	0.004	1.28	-	0.01	<0.01	<0.001	<0.01	0.011
MW8643	17/08/2016	0.66	<0.001	0.03	<0.001	-	<0.0001	0	<0.001	0	0.52	<0.001	0.12	-	0.01	-	<0.001	<0.01	0.01
MW8643	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8643	24/04/2017	0.03	<0.001	0.02	-	<0.05	<0.0001	<0.001	<0.001	0.01	<0.05	<0.001	0.15	-	0.01	<0.01	<0.001	<0.01	0.01
MW8643	16/10/2017	0.77	<0.001	0.02	-	<0.05	<0.0001	0	<0.001	0	1.05	0	0.33	-	0	<0.01	<0.001	<0.01	<0.005
MW8643	10/05/2018	0.46	<0.001	0.01	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.77	0	0.08	-	0	<0.01	<0.001	<0.01	0.01
MW8643	26/11/2018	0.24	<0.001	0.007	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.17	<0.001	0.03	<0.0001	<0.001	<0.01	<0.001	<0.01	<0.005
MW8643	11/06/2019	0.16	<0.001	0.009	-	<0.05	<0.0001	<0.001	<0.001	<0.001	0.2	<0.001	0.035	<0.0001	<0.001	<0.01	<0.001	<0.01	0.008
MW8643	5/11/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8643	7/11/2019	6.42	0.001	0.077	-	<0.05	<0.0001	0.01	0.004	0.004	8.22	0.009	1.32	-	0.006	<0.01	<0.001	0.02	0.013
MW8644	17/08/2016	6.37	0	0.18	<0.001	-	<0.0001	0.03	0	0.01	4.97	0.01	2.1	-	0.01	-	0	0.04	0.01
MW8644	4/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8644	26/04/2017	4.31	0	0.18	-	<0.05	<0.0001	0.02	0	0	4.61	0.01	1.72	-	0.02	<0.01	<0.001	0.02	0.01
MW8644	16/10/2017	3.32	0	0.16	-	<0.05	<0.0001	0.01	0	0	4.36	0.01	2.5	-	0.01	<0.01	<0.001	0.02	<0.005
MW8644	10/05/2018	2.12	<0.001	0.15	-	<0.05	<0.0001	0.01	0	0	2.83	0.01	2.98	-	0.01	<0.01	<0.001	0.02	0.01
MW8644	26/11/2018	1.07	<0.001	0.057	-	<0.05	<0.0001	0.002	0.002	0.003	0.88	0.004	0.983	<0.0001	0.002	<0.01	<0.001	<0.01	<0.005
MW8645	17/08/2016	16.2	0	0.25	<0.001	-	<0.0001	0.04	0.01	0.01	14.8	0.02	1.26	-	0.01	-	0	0.06	0.03
MW8645	3/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8645	26/04/2017	7.85	0	0.13	-	<0.05	<0.0001	0.01	0	0	6.97	0.02	1.17	-	0.02	<0.01	0	0.02	0.01
MW8645	16/10/2017	8.29	0	0.13	-	<0.05	<0.0001	0.01	0	0	7.84	0.02	1.34	-	0.01	<0.01	0	0.03	0.01
MW8645	10/05/2018	3.3	<0.001	0.07	-	<0.05	<0.0001	0.01	0	0	4.15	0.01	0.6	-	0	<0.01	<0.001	0.02	0.01
MW8645	26/11/2018	1.72	<0.001	0.041	-	<0.05	<0.0001	0.002	<0.001	0.002	1.77	0.004	0.326	<0.0001	0.001	<0.01	<0.001	<0.01	<0.005
MW8646	17/08/2016	19.5	0	0.16	0	-	<0.0001	0.06	0.01	0.02	8.58	0.02	2	-	0.01	-	0.01	0.06	0.04
MW8646	4/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8646	26/04/2017	3.93	0	0.11	-	<0.05	<0.0001	0.01	0.01	0	2.72	0.01	1.71	-	0.02	<0.01	0	0.02	0.01
MW8646	16/10/2017	4.83	0	0.16	-	<0.05	<0.0001	0.01	0.01	0.01	3.7	0.01	2.68	-	0.01	<0.01	0	0.02	0.01
MW8647	17/08/2016	10.8	0	0.32	<0.001	-	0	0.04	0	0.02	5.26	0.01	0.64	-	0.01	-	0	0.04	0.02
MW8647	4/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8647	26/04/2017	7.32	<0.001	0.1	-	<0.05	<0.0001	0.01	0	0	7.44	0.01	1.04	-	0.01	<0.01	<0.001	0.01	0.01
MW8647	16/10/2017	1.58	<0.001	0.06	-	<0.05	<0.0001	0	<0.001	0	1.84	0	0.25	-	0.01	<0.01	<0.001	<0.01	<0.005
MW8648	17/08/2016	1.05	0	0.09	<0.001	-	<0.0001	0	0	0	2.02	0	3.69	-	0.01	-	<0.001	0.02	0.01
MW8648	4/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW8648	26/04/2017	0.5	<0.001	0.06	-	<0.05	<0.0001	0	<0.001	0.01	0.75	0	0.82	-	0.01	<0.01	<0.001	<0.01	0.01
MW8648	16/10/2017	0.61	<0.001	0.07	-	<0.05	<0.0001	0	<0.001	0	1.11	0	1.05	-	0.01	<0.01	<0.001	<0.01	0.01
MW8649	26/04/2017	0.79	<0.001	0.07	-	<0.05	<0.0001	0	<0.001	0	1.28	0	0.4	-	0.02	<0.01	<0.001	<0.01	0.01
MW8650	24/06/2019	0.08	<0.001	0.041	-	<0.05	<0.0001	0.001	<0.001	<0.001	0.07	<0.001	0.025	<0.0001	0.009	<0.01	<0.001	<0.01	<0.005

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
MW8650	7/11/2019	0.28	<0.001	0.028	-	<0.05	<0.0001	<0.001	<0.001	0.002	0.24	<0.001	0.116	-	0.023	<0.01	<0.001	<0.01	0.013
MW8651	24/06/2019	3.48	0.001	0.093	-	<0.05	<0.0001	0.008	0.002	0.004	4.7	0.006	0.77	<0.0001	0.004	<0.01	<0.001	0.03	0.007
MW8651	7/11/2019	1.13	<0.001	0.049	-	<0.05	<0.0001	0.004	<0.001	0.001	1.28	0.001	0.264	-	0.007	<0.01	<0.001	0.02	0.006
MW8654	24/06/2019	0.14	<0.001	0.033	-	<0.05	<0.0001	<0.001	<0.001	0.002	0.17	<0.001	0.475	<0.0001	0.004	<0.01	<0.001	<0.01	<0.005
MW8654	7/11/2019	0.26	<0.001	0.017	-	<0.05	<0.0001	<0.001	<0.001	0.001	0.39	<0.001	0.456	-	0.008	<0.01	<0.001	<0.01	0.018
MW8655	7/11/2019	0.22	<0.001	0.044	-	<0.05	<0.0001	<0.001	<0.001	0.003	0.24	<0.001	1.44	-	0.03	<0.01	<0.001	<0.01	0.009
TDMW1	11/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW1	15/11/2016	0.44	-	0.05	-	-	-	-	-	-	4.34	-	0.65	-	-	-	-	-	0.01
TDMW1	16/06/2017	2.04	-	0.09	-	-	-	-	-	-	5.07	-	1.62	-	-	-	-	-	0.01
TDMW1	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW1	11/05/2018	1.75	0	0.3	-	<0.05	<0.0001	0	0.01	0	19.2	0.01	4.92	-	0.02	<0.01	<0.001	0.01	0.01
TDMW1	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW1	17/06/2019	1.27	-	0.074	-	-	-	-	-	-	3.63	-	2.02	-	-	-	-	-	<0.005
TDMW10	11/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW10	15/11/2016	7.14	-	0.1	-	-	-	-	-	-	30.6	-	3.09	-	-	-	-	-	0.03
TDMW10	16/06/2017	6.02	-	0.14	-	-	-	-	-	-	19.2	-	4.89	-	-	-	-	-	0.01
TDMW10	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW10	11/05/2018	6.62	0.01	0.07	-	0.34	<0.0001	0.02	0	0.01	14.8	0.01	2.34	-	0.03	<0.01	0.01	0.05	0.01
TDMW10	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW10	17/06/2019	1.72	-	0.034	-	-	-	-	-	-	5.51	-	1.19	-	-	-	-	-	0.012
TDMW2	11/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW2	15/11/2016	4.39	-	0.04	-	-	-	-	-	-	30.2	-	0.65	-	-	-	-	-	0.02
TDMW2	16/06/2017	4.06	-	0.06	-	-	-	-	-	-	26.1	-	0.66	-	-	-	-	-	0.01
TDMW2	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Monitoring Bore	Sampling Date	Total Metals (mg/L)																	
		Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Hg	Ni	Se	U	V	Zn
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-
TDMW2	11/05/2018	2.86	0	0.04	-	<0.05	<0.0001	0.01	0	0.01	19.2	0.01	0.4	-	0.02	<0.01	0	0.06	0.01
TDMW2	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW2	17/06/2019	2.62	-	0.048	-	-	-	-	-	-	13.2	-	0.441	-	-	-	-	-	0.015
TDMW7	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW7	17/06/2019	0.2	-	0.054	-	-	-	-	-	-	4.88	-	1.91	-	-	-	-	-	0.01
TDMW8	16/06/2017	1.57	-	0.07	-	-	-	-	-	-	7.5	-	1.56	-	-	-	-	-	<0.005
TDMW8	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW8	11/05/2018	0.85	0	0.09	-	<0.05	<0.0001	0	0.02	0	7.99	0	3.27	-	0.02	<0.01	0	0.01	0.01
TDMW8	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW8	17/06/2019	1.44	-	0.07	-	-	-	-	-	-	2.82	-	2.18	-	-	-	-	-	0.008
TDMW9	16/06/2017	0.28	-	0.02	-	-	-	-	-	-	2.86	-	1.55	-	-	-	-	-	0.01
TDMW9	8/05/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW9	11/05/2018	2.01	0.01	0.03	-	<0.05	<0.0001	0.01	0	0.01	10.8	0	1.01	-	0.03	<0.01	<0.001	<0.01	0.02
TDMW9	12/06/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDMW9	17/06/2019	0.83	-	0.036	-	-	-	-	-	-	7.18	-	1.44	-	-	-	-	-	0.012

Table 9-10: Groundwater Quality Results (Cations and Anions) - Tailings storage facilities

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
MW85820	11/11/2016	-	-	-	-	-	-	-	-	-
MW8582	15/11/2016	2	8	64	2	8	<1	131	22	38
MW8582	16/06/2017	2	10	72	2	6	<1	138	35	46
MW8582	8/05/2018	-	-	-	-	-	-	-	-	-
MW8582	11/05/2018	1	8	69	2	1	<1	111	41	35
MW8582	12/06/2019	-	-	-	-	-	-	-	-	-
MW8582	17/06/2019	2	8	74	2	<1	<1	-	26	38
MW8593	16/08/2016	<1	<1	10	<1	8	<1	14	1	<1
MW8593	3/11/2016	<1	1	10	<1	4	<1	16	<1	4
MW8593	24/04/2017	<1	1	9	<1	6	<1	14	<1	4
MW8593	16/10/2017	<1	1	9	<1	8	<1	17	<1	4
MW8593	10/05/2018	<1	1	9	<1	5	<1	16	<1	4
MW8593	17/06/2019	<1	1	9	<1	4	<1	-	<1	4
MW8593	6/11/2019	-	-	-	-	-	-	-	-	-
MW8593	7/11/2019	<1	1	9	<1	7	<1	-	<1	4
MW8594	24/04/2017	<1	1	15	<1	4	<1	20	<1	4
MW8594	10/05/2018	<1	1	14	<1	3	<1	22	1	4
MW8594	11/06/2019	<1	1	15	<1	3	<1	-	1	4
MW8594	6/11/2019	-	-	-	-	-	-	-	-	-
MW8594	7/11/2019	<1	1	14	<1	8	<1	-	1	4
MW8595	16/08/2016	<1	1	8	<1	2	<1	12	<1	4
MW8595	3/11/2016	<1	1	8	<1	3	<1	14	<1	4
MW8595	24/04/2017	<1	1	8	<1	4	<1	13	<1	4
MW8595	16/10/2017	<1	1	8	<1	3	<1	15	<1	4

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8595	10/05/2018	<1	1	8	<1	5	<1	14	<1	4
MW8595	11/06/2019	<1	1	9	<1	3	<1	-	<1	4
MW8595	6/11/2019	-	-	-	-	-	-	-	-	-
MW8595	7/11/2019	<1	1	8	<1	2	<1	-	<1	4
MW8596	16/08/2016	<1	1	14	<1	3	<1	19	<1	4
MW8596	3/11/2016	<1	1	14	<1	3	<1	22	<1	4
MW8596	24/04/2017	<1	1	14	<1	3	<1	19	<1	4
MW8596	10/05/2018	<1	1	14	<1	3	<1	23	1	4
MW8596	11/06/2019	<1	1	15	<1	3	<1	-	<1	4
MW8596	6/11/2019	-	-	-	-	-	-	-	-	-
MW8596	7/11/2019	<1	1	14	<1	6	<1	-	<1	4
MW8597	16/08/2016	2	<1	7	<1	3	<1	12	<1	5
MW8597	3/11/2016	1	<1	7	<1	4	<1	13	<1	2
MW8597	24/04/2017	<1	<1	7	<1	<1	<1	12	<1	<1
MW8597	16/10/2017	2	<1	7	<1	6	<1	15	<1	5
MW8597	10/05/2018	<1	<1	7	<1	2	<1	14	<1	<1
MW8597	6/11/2019	-	-	-	-	-	-	-	-	-
MW8597	7/11/2019	2	<1	8	<1	3	<1	-	<1	5
MW8598	16/08/2016	<1	1	12	<1	3	<1	18	<1	4
MW8598	3/11/2016	<1	1	13	<1	2	<1	21	<1	4
MW8598	24/04/2017	<1	1	14	<1	3	<1	19	<1	4
MW8598	16/10/2017	<1	1	14	<1	4	<1	22	<1	4
MW8598	10/05/2018	<1	1	13	<1	3	<1	21	<1	4
MW8598	6/11/2019	-	-	-	-	-	-	-	-	-
MW8598	7/11/2019	<1	1	13	<1	3	<1	-	<1	4

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8599	16/08/2016	<1	<1	9	<1	2	<1	14	<1	<1
MW8599	3/11/2016	<1	<1	10	<1	1	<1	16	<1	<1
MW8599	24/04/2017	<1	<1	7	<1	<1	<1	13	<1	<1
MW8599	16/10/2017	<1	<1	10	<1	3	<1	18	<1	<1
MW8599	10/05/2018	<1	<1	8	<1	1	<1	14	<1	<1
MW8599	11/06/2019	<1	<1	10	<1	1	<1	-	<1	<1
MW8599	6/11/2019	-	-	-	-	-	-	-	-	-
MW8599	7/11/2019	<1	<1	10	<1	2	<1	-	<1	<1
MW8600	16/08/2016	<1	2	14	<1	4	<1	21	<1	8
MW8600	3/11/2016	<1	1	14	<1	2	<1	23	<1	4
MW8600	24/04/2017	<1	2	14	<1	2	<1	20	<1	8
MW8600	16/10/2017	<1	1	14	<1	4	<1	23	<1	4
MW8600	10/05/2018	<1	1	14	<1	3	<1	23	<1	4
MW8600	11/06/2019	<1	2	14	<1	2	<1	-	<1	8
MW8600	6/11/2019	-	-	-	-	-	-	-	-	-
MW8600	7/11/2019	<1	2	13	<1	3	<1	-	<1	8
MW8601	16/08/2016	<1	<1	8	<1	4	<1	11	<1	<1
MW8601	3/11/2016	<1	<1	8	<1	3	<1	13	<1	<1
MW8601	24/04/2017	<1	<1	8	<1	4	<1	12	<1	<1
MW8601	16/10/2017	<1	<1	8	<1	4	<1	14	<1	<1
MW8601	10/05/2018	<1	<1	8	<1	3	<1	13	<1	<1
MW8601	11/06/2019	<1	<1	8	<1	3	<1	-	<1	<1
MW8601	6/11/2019	-	-	-	-	-	-	-	-	-
MW8601	7/11/2019	<1	<1	9	<1	3	<1	-	<1	<1
MW8602	16/08/2016	<1	1	14	<1	4	<1	23	<1	4

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8602	3/11/2016	<1	1	14	<1	2	<1	24	<1	4
MW8602	24/04/2017	<1	1	14	<1	2	<1	22	<1	4
MW8602	16/10/2017	<1	1	15	<1	4	<1	25	<1	4
MW8602	10/05/2018	<1	1	14	<1	3	<1	26	<1	4
MW8602	11/06/2019	<1	1	16	<1	3	<1	-	<1	4
MW8602	6/11/2019	-	-	-	-	-	-	-	-	-
MW8602	7/11/2019	<1	1	14	<1	3	<1	-	<1	4
MW8603	16/08/2016	<1	1	14	<1	4	<1	22	<1	4
MW8603	3/11/2016	<1	1	14	<1	2	<1	24	4	4
MW8603	24/04/2017	<1	1	12	<1	3	<1	20	<1	4
MW8603	16/10/2017	<1	1	14	<1	4	<1	26	<1	4
MW8603	10/05/2018	<1	1	12	<1	3	<1	23	<1	4
MW8603	11/06/2019	<1	1	13	<1	3	<1	-	<1	4
MW8603	6/11/2019	-	-	-	-	-	-	-	-	-
MW8603	7/11/2019	<1	1	13	<1	3	<1	-	<1	4
MW8604	16/08/2016	<1	1	14	<1	4	<1	22	<1	4
MW8604	3/11/2016	<1	1	14	<1	3	<1	25	<1	4
MW8604	24/04/2017	<1	1	14	<1	2	<1	22	<1	4
MW8604	16/10/2017	<1	1	15	<1	4	<1	24	<1	4
MW8604	10/05/2018	<1	1	14	<1	3	<1	26	<1	4
MW8604	11/06/2019	<1	1	15	<1	3	<1	-	<1	4
MW8604	6/11/2019	-	-	-	-	-	-	-	-	-
MW8604	7/11/2019	<1	1	14	<1	4	<1	-	<1	4
MW8605	16/08/2016	1	1	13	<1	7	<1	20	<1	7
MW8605	3/11/2016	<1	1	14	<1	5	<1	21	<1	4

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8605	24/04/2017	1	1	14	<1	5	<1	20	1	7
MW8605	16/10/2017	1	1	14	<1	3	<1	24	<1	7
MW8605	10/05/2018	<1	1	13	<1	3	<1	24	<1	4
MW8605	11/06/2019	<1	1	14	<1	4	<1	-	<1	4
MW8605	6/11/2019	-	-	-	-	-	-	-	-	-
MW8605	7/11/2019	<1	1	14	<1	7	<1	-	<1	4
MW8606	16/08/2016	<1	1	14	<1	6	<1	20	<1	4
MW8606	3/11/2016	<1	1	14	<1	5	<1	21	<1	4
MW8606	24/04/2017	<1	1	14	<1	5	<1	20	<1	4
MW8606	16/10/2017	<1	1	14	<1	3	<1	24	<1	4
MW8606	10/05/2018	<1	1	14	<1	4	<1	24	<1	4
MW8606	11/06/2019	1	2	15	<1	7	<1	-	1	11
MW8606	6/11/2019	-	-	-	-	-	-	-	-	-
MW8606	7/11/2019	<1	2	16	<1	7	<1	-	1	8
MW8607	16/08/2016	1	2	14	<1	11	<1	22	<1	11
MW8607	3/11/2016	<1	2	14	<1	4	<1	22	<1	8
MW8607	24/04/2017	1	2	14	<1	5	<1	22	<1	11
MW8607	16/10/2017	<1	2	14	<1	3	<1	24	<1	8
MW8607	10/05/2018	1	2	14	<1	6	<1	26	<1	11
MW8607	11/06/2019	1	1	14	<1	4	<1	-	<1	7
MW8607	6/11/2019	-	-	-	-	-	-	-	-	-
MW8607	7/11/2019	<1	2	13	<1	6	<1	-	<1	8
MW8608	16/08/2016	<1	1	14	<1	6	<1	19	<1	4
MW8608	3/11/2016	<1	1	14	<1	3	<1	21	<1	4
MW8608	24/04/2017	<1	1	14	<1	4	<1	21	<1	4

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8608	16/10/2017	<1	1	14	<1	4	<1	25	<1	4
MW8608	10/05/2018	<1	1	14	<1	3	<1	25	<1	4
MW8608	11/06/2019	<1	1	15	<1	4	<1	-	<1	4
MW8608	6/11/2019	-	-	-	-	-	-	-	-	-
MW8608	7/11/2019	<1	1	14	<1	9	<1	-	<1	4
MW8609	16/08/2016	<1	1	13	<1	7	<1	19	<1	4
MW8609	3/11/2016	<1	1	13	<1	3	<1	20	<1	4
MW8609	16/10/2017	<1	1	15	<1	4	<1	26	<1	4
MW8609	10/05/2018	<1	2	16	<1	3	<1	26	<1	8
MW8609	12/06/2019	<1	2	18	<1	2	<1	-	<1	8
MW8609	7/11/2019	1	2	18	<1	3	<1	-	<1	11
MW8610	16/08/2016	<1	1	14	<1	5	<1	21	<1	4
MW8610	3/11/2016	<1	1	14	<1	3	<1	22	<1	4
MW8610	16/10/2017	<1	1	15	<1	4	<1	27	<1	4
MW8610	10/05/2018	<1	1	16	<1	3	<1	28	<1	4
MW8610	12/06/2019	1	2	17	<1	3	<1	-	<1	11
MW8610	7/11/2019	1	2	16	<1	3	<1	-	<1	11
MW8612	27/04/2017	4	7	5	<1	15	<1	5	2	39
MW8612	9/05/2018	6	3	4	<1	30	<1	4	2	27
MW8612	19/06/2019	5	3	6	<1	16	<1	-	2	25
MW8613	27/04/2017	2	2	3	<1	6	<1	7	<1	13
MW8614	23/08/2016	2	<1	5	<1	10	<1	4	3	5
MW8614	2/11/2016	2	1	5	<1	10	<1	4	1	9
MW8614	27/04/2017	<1	<1	3	<1	4	<1	5	<1	<1
MW8614	17/10/2017	<1	<1	4	<1	4	<1	6	<1	<1

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8614	9/05/2018	<1	<1	4	<1	2	<1	5	1	<1
MW8614	19/06/2019	2	<1	4	<1	4	<1	-	<1	5
MW8614	5/11/2019	-	-	-	-	-	-	-	-	-
MW8614	7/11/2019	1	<1	4	<1	3	<1	-	1	2
MW8615	23/08/2016	<1	<1	8	<1	6	<1	7	<1	<1
MW8615	2/11/2016	<1	<1	8	<1	4	<1	8	<1	<1
MW8615	27/04/2017	<1	<1	7	<1	4	<1	7	1	<1
MW8615	17/10/2017	<1	1	11	<1	3	<1	12	<1	4
MW8615	9/05/2018	<1	1	8	<1	2	<1	11	1	4
MW8615	19/06/2019	<1	<1	8	<1	3	<1	-	1	<1
MW8616D	31/08/2016	246	237	892	5	31	<1	2550	126	1590
MW8616D	2/11/2016	258	240	922	4	27	<1	2650	127	1630
MW8616D	27/04/2017	233	240	971	4	24	<1	2500	132	1570
MW8616D	17/10/2017	230	228	851	5	21	<1	2260	126	1510
MW8616D	9/05/2018	233	223	848	4	26	<1	2610	128	1500
MW8616D	24/06/2019	238	220	859	4	22	<1	-	133	1500
MW8616D	5/11/2019	-	-	-	-	-	-	-	-	-
MW8616D	7/11/2019	206	207	804	4	26	<1	-	135	1370
MW8616S	31/08/2016	<1	2	19	2	15	<1	24	5	8
MW8616S	2/11/2016	3	4	26	<1	10	<1	45	6	24
MW8616S	27/04/2017	<1	1	22	1	7	<1	23	9	4
MW8616S	17/10/2017	<1	1	13	<1	12	<1	16	6	4
MW8616S	9/05/2018	<1	2	12	<1	14	<1	14	4	8
MW8616S	24/06/2019	1	2	15	<1	8	<1	-	6	11
MW8616S	5/11/2019	-	-	-	-	-	-	-	-	-

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8616S	7/11/2019	<1	1	14	<1	13	<1	-	6	4
MW8617D	31/08/2016	2	5	28	1	10	<1	49	4	26
MW8617D	2/11/2016	1	4	29	<1	9	<1	48	3	19
MW8617D	27/04/2017	<1	4	26	<1	7	<1	42	2	16
MW8617D	17/10/2017	1	3	27	<1	9	<1	36	6	15
MW8617D	11/05/2018	<1	3	42	<1	8	<1	47	22	12
MW8617D	24/06/2019	1	4	42	<1	4	<1	-	18	19
MW8617D	5/11/2019	-	-	-	-	-	-	-	-	-
MW8617D	7/11/2019	1	4	47	<1	8	<1	-	20	19
MW8617S	31/08/2016	<1	<1	24	1	11	<1	20	4	<1
MW8617S	2/11/2016	<1	<1	22	<1	7	<1	25	3	<1
MW8617S	27/04/2017	<1	1	19	<1	5	<1	23	2	4
MW8617S	17/10/2017	<1	<1	20	<1	3	<1	26	3	<1
MW8617S	11/05/2018	<1	<1	16	<1	3	<1	22	3	<1
MW8617S	24/06/2019	<1	<1	14	<1	3	<1	-	4	<1
MW8617S	5/11/2019	-	-	-	-	-	-	-	-	-
MW8617S	7/11/2019	<1	<1	15	<1	3	<1	-	4	<1
MW8618D	31/08/2016	<1	1	14	<1	9	<1	18	2	4
MW8618D	2/11/2016	<1	<1	11	<1	6	<1	13	1	<1
MW8618D	17/10/2017	<1	<1	9	<1	5	<1	12	<1	<1
MW8618D	11/05/2018	<1	<1	9	<1	6	<1	12	<1	<1
MW8618D	24/06/2019	<1	1	8	<1	6	<1	-	<1	4
MW8618D	4/11/2019	-	-	-	-	-	-	-	-	-
MW8618D	7/11/2019	<1	<1	8	<1	8	<1	-	<1	<1
MW8618S	2/11/2016	2	2	14	<1	20	<1	14	6	13

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8618S	17/10/2017	<1	<1	16	<1	8	<1	20	4	<1
MW8618S	11/05/2018	<1	<1	10	<1	6	<1	12	1	<1
MW8618S	24/06/2019	<1	<1	12	<1	8	<1	-	2	<1
MW8618S	4/11/2019	-	-	-	-	-	-	-	-	-
MW8618S	7/11/2019	<1	<1	16	<1	10	<1	-	2	<1
MW8619	23/08/2016	<1	1	8	<1	2	<1	10	<1	4
MW8619	2/11/2016	<1	2	8	<1	<1	<1	10	<1	8
MW8621	23/08/2016	4	2	17	<1	23	<1	15	4	18
MW8621	2/11/2016	5	2	25	<1	21	<1	17	4	21
MW8621	27/04/2017	3	2	10	<1	10	<1	12	1	16
MW8621	17/10/2017	3	1	11	<1	13	<1	13	1	12
MW8621	9/05/2018	5	2	25	<1	24	<1	12	4	21
MW8621	19/06/2019	4	3	14	<1	7	<1	-	1	22
MW8621	5/11/2019	-	-	-	-	-	-	-	-	-
MW8621	7/11/2019	3	2	14	<1	10	<1	-	2	16
MW8622	23/08/2016	<1	<1	7	<1	1	<1	10	2	<1
MW8622	2/11/2016	<1	<1	7	<1	3	<1	10	<1	<1
MW8622	27/04/2017	<1	<1	6	<1	2	<1	10	<1	<1
MW8622	17/10/2017	<1	<1	7	<1	4	<1	11	1	<1
MW8622	9/05/2018	<1	<1	7	<1	1	<1	10	1	<1
MW8622	19/06/2019	<1	<1	7	<1	2	<1	-	<1	<1
MW8622	5/11/2019	-	-	-	-	-	-	-	-	-
MW8622	7/11/2019	<1	<1	7	<1	6	<1	-	1	<1
MW8623	27/04/2017	9	4	20	1	68	<1	10	3	39
MW8623	17/10/2017	4	2	16	<1	34	<1	12	2	18

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8624	23/08/2016	3	2	13	<1	10	<1	17	<1	16
MW8624	2/11/2016	2	2	13	<1	7	<1	18	<1	13
MW8624	27/04/2017	2	2	12	<1	6	<1	18	<1	13
MW8624	17/10/2017	2	2	14	<1	10	<1	21	<1	13
MW8627	23/08/2016	3	1	9	<1	20	<1	11	<1	12
MW8627	2/11/2016	3	1	9	<1	15	<1	11	<1	12
MW8627	27/04/2017	6	2	10	<1	34	<1	10	2	23
MW8627	17/10/2017	3	1	9	<1	20	<1	12	1	12
MW8627	9/05/2018	3	1	8	<1	22	<1	10	1	12
MW8627	19/06/2019	2	1	9	<1	11	<1	-	<1	9
MW8628	23/08/2016	2	<1	12	<1	14	<1	9	4	5
MW8628	2/11/2016	2	<1	12	<1	10	<1	10	3	5
MW8628	27/04/2017	1	<1	10	<1	8	<1	9	2	2
MW8628	17/10/2017	1	<1	11	<1	8	<1	11	2	2
MW8628	9/05/2018	<1	<1	9	<1	7	<1	10	2	<1
MW8628	19/06/2019	1	<1	10	<1	6	<1	-	2	2
MW8630	31/08/2016	<1	<1	11	<1	6	<1	14	1	<1
MW8630	2/11/2016	<1	<1	11	<1	3	<1	14	1	<1
MW8630	27/04/2017	<1	<1	9	<1	2	<1	13	1	<1
MW8630	18/10/2017	<1	<1	10	<1	3	<1	16	1	<1
MW8630	11/05/2018	<1	<1	10	<1	2	<1	15	<1	<1
MW8630	26/11/2018	<1	<1	10	<1	4	<1	-	<1	<1
MW8630	19/06/2019	<1	<1	10	<1	2	<1	-	<1	<1
MW8630	5/11/2019	-	-	-	-	-	-	-	-	-
MW8630	7/11/2019	<1	<1	10	<1	2	<1	-	1	<1

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8634D	31/08/2016	12	15	66	3	100	<1	61	12	98
MW8634D	2/11/2016	7	8	37	2	61	<1	32	6	50
MW8634D	17/10/2017	4	8	38	3	50	<1	30	5	43
MW8634D	9/05/2018	3	5	30	2	37	<1	20	4	28
MW8634S	9/05/2018	<1	<1	13	<1	10	<1	16	2	<1
MW8635D	31/08/2016	<1	2	43	<1	21	<1	34	11	11
MW8635D	2/11/2016	<1	<1	23	<1	11	<1	18	8	<1
MW8635D	27/04/2017	<1	<1	20	<1	16	<1	14	6	<1
MW8635D	17/10/2017	<1	<1	26	<1	11	<1	29	6	<1
MW8635D	9/05/2018	<1	<1	23	<1	10	<1	21	5	<1
MW8635D	24/06/2019	<1	<1	34	<1	4	<1	-	6	<1
MW8635D	4/11/2019	-	-	-	-	-	-	-	-	-
MW8635D	7/11/2019	<1	<1	35	<1	9	<1	-	6	<1
MW8635S	31/08/2016	2	2	44	1	41	<1	41	9	13
MW8635S	2/11/2016	1	1	29	<1	15	<1	36	4	7
MW8635S	27/04/2017	<1	<1	13	<1	6	<1	12	1	<1
MW8635S	17/10/2017	<1	<1	17	<1	3	<1	22	2	<1
MW8635S	9/05/2018	<1	<1	15	<1	3	<1	14	1	<1
MW8635S	24/06/2019	<1	<1	13	<1	2	<1	-	2	<1
MW8635S	4/11/2019	-	-	-	-	-	-	-	-	-
MW8635S	7/11/2019	<1	<1	16	<1	7	<1	-	2	<1
MW8636D	31/08/2016	<1	2	27	1	31	<1	19	8	8
MW8636D	2/11/2016	<1	1	18	<1	24	<1	13	7	4
MW8636D	27/04/2017	<1	<1	14	<1	20	<1	10	3	<1
MW8636D	17/10/2017	<1	<1	17	<1	23	<1	13	4	<1

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8636D	11/05/2018	<1	<1	16	<1	23	<1	10	2	<1
MW8636D	24/06/2019	<1	<1	15	<1	18	<1	-	3	<1
MW8636D	4/11/2019	-	-	-	-	-	-	-	-	-
MW8636D	7/11/2019	<1	<1	14	<1	22	<1	-	2	<1
MW8636S	27/04/2017	2	4	29	<1	15	<1	31	15	21
MW8636S	17/10/2017	3	8	46	<1	5	<1	86	18	40
MW8636S	11/05/2018	<1	1	19	<1	14	<1	26	4	4
MW8636S	24/06/2019	<1	2	23	<1	2	<1	-	18	8
MW8636S	4/11/2019	-	-	-	-	-	-	-	-	-
MW8636S	7/11/2019	<1	2	25	<1	2	<1	-	12	8
MW8640	17/08/2016	2	2	13	<1	11	<1	15	5	13
MW8640	3/11/2016	<1	1	12	<1	7	<1	17	1	4
MW8640	24/04/2017	<1	1	11	<1	5	<1	16	<1	4
MW8640	16/10/2017	<1	<1	11	<1	4	<1	18	<1	<1
MW8640	10/05/2018	<1	<1	11	<1	3	<1	18	<1	<1
MW8641	26/04/2017	6	5	26	1	60	<1	16	10	36
MW8641	10/05/2018	1	1	13	<1	11	<1	17	2	7
MW8642	17/08/2016	<1	1	12	<1	10	<1	16	1	4
MW8642	3/11/2016	<1	1	14	<1	8	<1	18	<1	4
MW8642	24/04/2017	<1	1	11	<1	8	<1	16	<1	4
MW8642	16/10/2017	<1	1	11	<1	4	<1	17	<1	4
MW8642	10/05/2018	<1	1	11	<1	3	<1	17	<1	4
MW8642	11/06/2019	<1	1	14	<1	3	<1	-	<1	4
MW8642	5/11/2019	-	-	-	-	-	-	-	-	-
MW8642	7/11/2019	<1	1	12	<1	4	<1	-	<1	4

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8643	17/08/2016	2	2	16	<1	24	<1	20	3	13
MW8643	3/11/2016	1	2	15	<1	10	<1	18	1	11
MW8643	24/04/2017	1	2	12	<1	9	<1	16	1	11
MW8643	16/10/2017	<1	<1	12	<1	4	<1	18	<1	<1
MW8643	10/05/2018	<1	1	11	<1	3	<1	18	<1	4
MW8643	26/11/2018	<1	1	13	<1	<1	<1	-	<1	4
MW8643	11/06/2019	<1	1	13	<1	2	<1	-	<1	4
MW8643	5/11/2019	-	-	-	-	-	-	-	-	-
MW8643	7/11/2019	<1	1	12	<1	3	<1	-	<1	4
MW8644	17/08/2016	2	1	75	<1	81	<1	55	25	9
MW8644	4/11/2016	5	2	64	<1	66	<1	37	34	21
MW8644	26/04/2017	6	3	45	<1	36	<1	28	40	27
MW8644	16/10/2017	2	1	30	<1	13	<1	22	33	9
MW8644	10/05/2018	<1	<1	20	<1	13	<1	17	14	<1
MW8644	26/11/2018	<1	<1	13	<1	7	<1	-	4	<1
MW8645	17/08/2016	4	4	95	1	86	<1	99	23	26
MW8645	3/11/2016	1	1	36	<1	27	<1	27	8	7
MW8645	26/04/2017	<1	<1	12	<1	8	<1	13	1	<1
MW8645	16/10/2017	<1	<1	12	<1	4	<1	18	<1	<1
MW8645	10/05/2018	<1	<1	11	<1	3	<1	15	<1	<1
MW8645	26/11/2018	<1	<1	12	<1	<1	<1	-	<1	<1
MW8646	17/08/2016	2	2	130	<1	106	<1	117	32	13
MW8646	4/11/2016	<1	<1	108	<1	104	<1	81	23	<1
MW8646	26/04/2017	<1	<1	23	<1	17	<1	22	4	<1
MW8646	16/10/2017	<1	<1	18	<1	10	<1	17	5	<1

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
MW8647	17/08/2016	10	9	225	1	214	<1	211	60	62
MW8647	4/11/2016	3	2	113	1	90	<1	88	32	16
MW8647	26/04/2017	2	2	26	<1	33	<1	18	7	13
MW8647	16/10/2017	1	1	18	<1	16	<1	21	2	7
MW8648	17/08/2016	16	10	82	3	87	<1	100	35	81
MW8648	4/11/2016	8	6	51	2	60	<1	49	21	45
MW8648	26/04/2017	3	2	22	<1	31	<1	19	4	16
MW8648	16/10/2017	2	1	16	<1	22	<1	18	2	9
MW8649	26/04/2017	6	4	26	1	37	<1	31	4	31
MW8650	24/06/2019	3	1	8	<1	18	<1	-	3	12
MW8650	7/11/2019	<1	<1	7	<1	8	<1	-	1	<1
MW8651	24/06/2019	1	<1	12	<1	5	<1	-	4	2
MW8651	7/11/2019	2	<1	11	<1	12	<1	-	4	5
MW8654	24/06/2019	<1	<1	8	<1	2	<1	-	<1	<1
MW8654	7/11/2019	<1	<1	7	<1	3	<1	-	<1	<1
MW8655	7/11/2019	<1	1	12	<1	4	<1	-	2	4
TDMW1	11/11/2016	-	-	-	-	-	-	-	-	-
TDMW1	15/11/2016	2	7	42	2	10	<1	74	20	34
TDMW1	16/06/2017	3	8	40	3	14	<1	76	22	40
TDMW1	8/05/2018	-	-	-	-	-	-	-	-	-
TDMW1	11/05/2018	9	10	38	5	63	<1	59	16	64
TDMW1	12/06/2019	-	-	-	-	-	-	-	-	-
TDMW1	17/06/2019	4	8	46	3	14	<1	-	19	43
TDMW10	11/11/2016	-	-	-	-	-	-	-	-	-
TDMW10	15/11/2016	290	887	6990	233	10	<1	11200	1800	4380

Monitoring Bore	Sampling Date	Cations and Anions (mg/L)								
		Ca	Mg	K	Na	HCO_3	H_2CO_3	Cl	SO_4	Hardness ($CaCO_3$)
ANZG (2018) Guidelines		-	-	-	-	-	-	-	-	-
TDMW10	16/06/2017	27	91	762	27	33	<1	1180	200	442
TDMW10	8/05/2018	-	-	-	-	-	-	-	-	-
TDMW10	11/05/2018	28	89	694	26	29	<1	1320	162	436
TDMW10	12/06/2019	-	-	-	-	-	-	-	-	-
TDMW10	17/06/2019	16	54	538	21	26	<1	-	113	262
TDMW2	11/11/2016	-	-	-	-	-	-	-	-	-
TDMW2	15/11/2016	2	4	50	3	2	<1	68	36	21
TDMW2	16/06/2017	2	5	49	3	<1	<1	68	38	26
TDMW2	8/05/2018	-	-	-	-	-	-	-	-	-
TDMW2	11/05/2018	1	4	33	2	4	<1	40	24	19
TDMW2	12/06/2019	-	-	-	-	-	-	-	-	-
TDMW2	17/06/2019	2	4	42	3	1	<1	-	28	21
TDMW7	12/06/2019	-	-	-	-	-	-	-	-	-
TDMW7	17/06/2019	2	7	36	3	1	<1	-	13	34
TDMW8	16/06/2017	4	8	62	1	9	<1	104	39	43
TDMW8	8/05/2018	-	-	-	-	-	-	-	-	-
TDMW8	11/05/2018	6	12	85	2	6	<1	161	48	64
TDMW8	12/06/2019	-	-	-	-	-	-	-	-	-
TDMW8	17/06/2019	5	9	87	2	5	<1	-	48	50
TDMW9	16/06/2017	3	5	31	1	14	<1	58	17	28
TDMW9	8/05/2018	-	-	-	-	-	-	-	-	-
TDMW9	11/05/2018	2	4	20	2	25	<1	24	17	21
TDMW9	12/06/2019	-	-	-	-	-	-	-	-	-
TDMW9	17/06/2019	4	8	33	2	13	<1	-	5	43

9.9 GEMCO Standards

South32 Community Standard
South32 Environment Standard
(available on request)

9.10 References

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