Metro Mining Ltd

Bauxite Hills Project

Initial Advice Statement

October 2015

Table of Contents

List of Figures

List of Tables

Section 1 Introduction

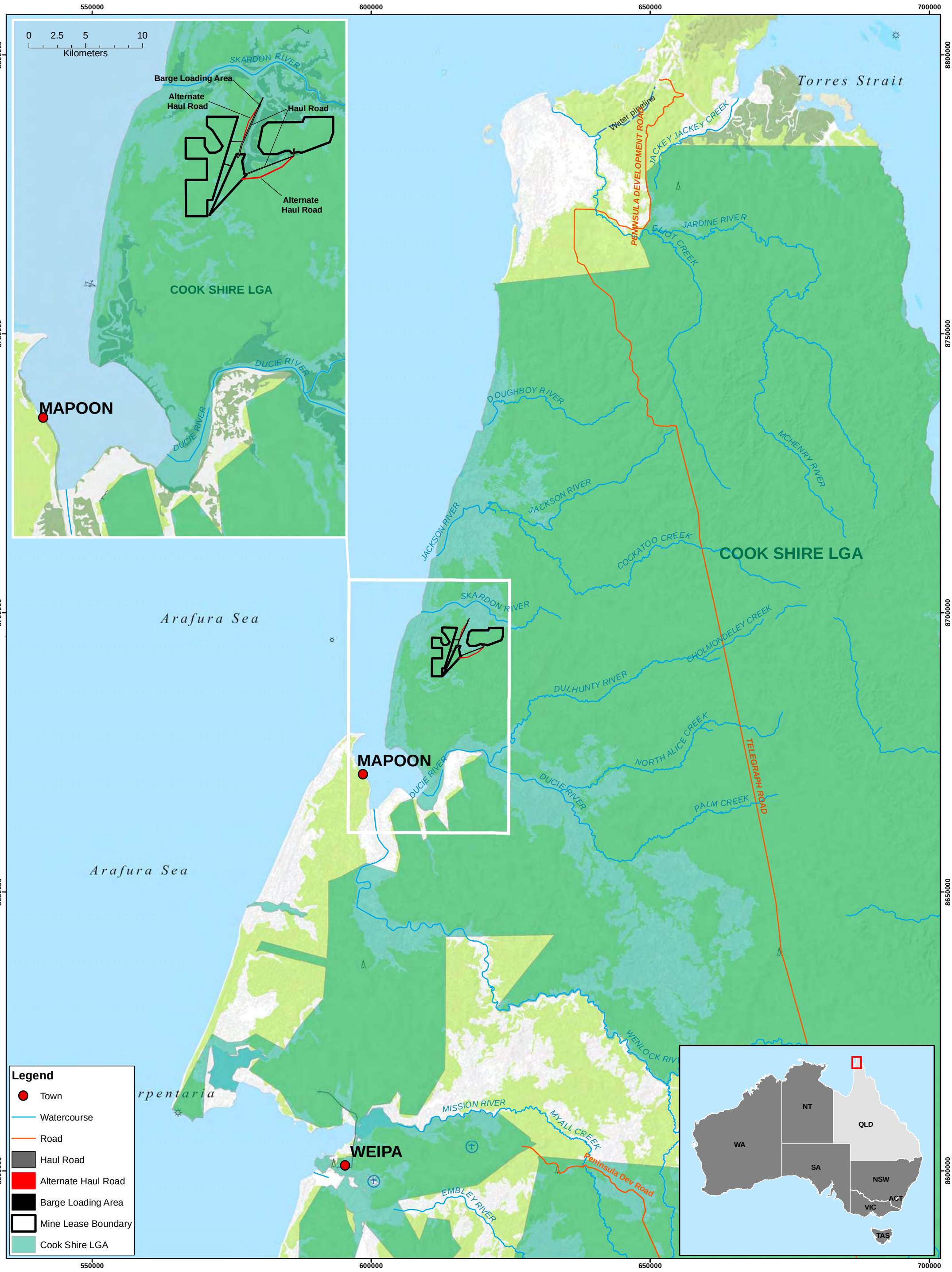
1.1 Background

Metro Mining Limited (Metro Mining) is proposing to develop the Bauxite Hills Project (the Project) located on the western coastline of Cape York, Queensland (**Figure 1-1**), approximately 35 kilometres (km) northeast of Mapoon. The proposed Project includes an open cut operation, haul roads and barge loading facility. The Project will produce and transport up to 5 million tonnes per annum (Mtpa) of ore over 12 years. The bauxite from the Project is suitable as a Direct Shipping Ore (DSO) product (i.e. ore is extracted and loaded directly to ships with no beneficiation (washing) or tailings dams required) and hence, minimal overburden is generated which in turn minimises impacts to the surrounding environmental values (EVs). Bauxite will be transported by barge via the Skardon River to the transshipment site, approximately 12 km offshore, where it will be loaded into ocean going vessels (OGVs) and shipped to customers

The Project is characterised by several shallow open cut pits that will be connected via internal haul roads, which in turn, will be connected to a main north-south haul road that will link with the Mine Infrastructure Area (MIA) and barge loading facility located to the north of the pits on the Skardon River (**Figure 1-2**). Bauxite will be hauled to the run-of-mine (ROM) stockpile using road train trucks. Overburden material will be initially stored ex-pit with in-pit overburden storage to commence within the first six months of production. The overburden volume is low for this deposit and as such, does not represent an issue in terms of overburden storage or required capacity of mining equipment.

Key components of the Project include:

- Shallow open cut pits;
- Internal haul roads and access roads;
- Barge loading facility on the Skardon River;
- MIA including the ROM stockpile, bauxite stockpiles, barge loading conveyor load point, earthmoving equipment hard park, administration offices, workshops and fuelling facilities;
- Accommodation camp;
- Raw and potable water supply; and
- Sewage treatment plant.



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DESIGNED	MD	CHECKED	-
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APPROVED	-	DATE	15/07/15

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Scale @ A3 - 1:600,000
GCS GDA 1994 Zone 54

DISCLAIMER
CDM Smith has endeavoured to ensure accuracy and completeness of the data. CDM Smith assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
MEC Mining 2015;
QLD Government Open Data Source;
Australian Government Bureau of Meteorology.

DESIGNER
CDM Smith
cdmsmith.com

CLIENT
METRO MINING LIMITED

FIGURE 1-1
REGIONAL CONTEXT

DRG Ref: **BES150115-001-R1_REGLOC**

F:\1_PROJECTS\BES150115_Bauxite_Hill\GIS\DATA\MXD\FINAL\ERA\BES150115-001-R1_REGLOC.mxd

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SKARDON RIVER

Existing Jetty Site

Barge Loading Area

Alternate Haul Road

BH1 MLA boundary
(ML 20676)

BH6 West
MLA boundary
(ML 20689)

Haul Road

Alternate Haul Road

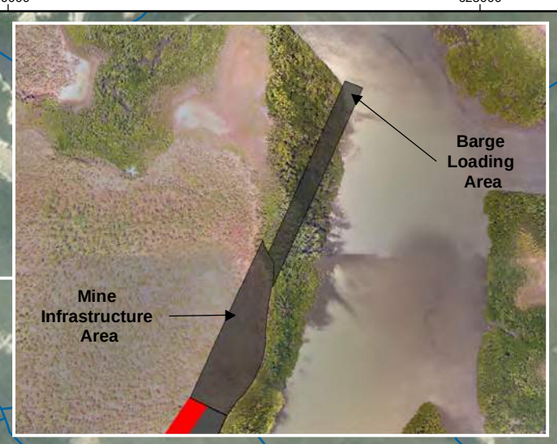
BH6 East
MLA boundary
(ML 20688)

Camp Site

Airport Strip

NAMALETA CREEK

NAMALETA CREEK



Legend

- Watercourse
- Barge Loading Area
- Haul Road
- Alternate Haul Road
- Pit Extents
- Mine Lease Area
- Camp Site

605000 610000 615000 620000 625000

R	Details	Date
1	For Approval	15/07/15
2	Updated Pit Extents	21/10/15
-	-	
-	-	
-	-	
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DESIGNED	MD	CHECKED	-
DRAWN	MD	CHECKED	-
APPROVED	-	DATE	21/10/15

Notes:

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GCS GDA 1994 MGA Zone 54

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DATA SOURCE
MEC Mining 2015;
QLD Government Open Source Data;
Australian Hydrological Geospatial Fabric (Geofabric) PRODUCT SUITE V2.1.1

DESIGNER

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CLIENT

METRO MINING LIMITED

FIGURE 1-2

PROJECT INFRASTRUCTURE

DRG Ref: **BES150115-002-R1_PROJ_INFRA**

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1.2 Purpose of this Initial Advice Statement

Metro Mining lodged an application for an environmental authority (EA) (EPML 03398515) through its wholly owned subsidiaries Aldoga Minerals Proprietary Limited (Aldoga) and Cape Alumina Proprietary Limited (Cape Alumina) on 17 August 2015. The Department of Environment and Heritage (EHP) as the administering authority considered the application and determined that the Project will be assessed by an Environmental Impact Statement (EIS) process pursuant Chapter 3 of the *Environmental Protection Act 1994* (EP Act).

The purpose of this Initial Advice Statement (IAS) is to present information to:

- Enable stakeholders (including the general community) to determine the nature and level of their interest in the proposal; and
- Assist EHP with the finalisation of Terms of Reference (ToR) for an EIS for the proposed Project.

The IAS provides a preliminary overview of the nature and extent of the potential social, economic and environmental impacts that may be associated with the construction and operation of the proposed Project as far as they can be foreseen at the concept stage of Project planning. The IAS also identifies the key statutory approvals that may be required for the Project to proceed and identifies environmental studies that may be required to support Project development.

1.3 The Proponent

Metro Mining is the proponent and ultimate holding company of 100% of the Project. The Bauxite Hills Mining Lease Applications (MLAs) are held in Metro Mining subsidiaries (which are owned 100% by Metro Mining), with 99% of the tenements held by Aldoga and 1% of the tenements held by Cape Alumina.

Metro Mining is headquartered in Brisbane and holds approximately 1,400 square kilometres (km^2) of bauxite exploration tenements, which makes Metro Mining one of the largest holders in Cape York. Metro Mining also holds over 4 billion tonnes of coal tenements in Queensland.

Metro Mining was formed after MetroCoal Limited undertook a takeover of Cape Alumina, which was completed in mid-December 2014. Both companies were listed on the ASX in 2009 and have been focussed on developing projects in Queensland over the past six or more years. Metro Mining's major shareholders are Dadi Engineering and Development Group (16.4%), Balance Property Group (14.4%) and China Xinfa Group Corporation Limited (7.8%).

The relevant details regarding the proponent, including website and contact details, are summarised in **Table 1-1.**

Table 1-1 Proponent and consultant details

	Proponent – Project Director	Proponent – Manager Environment and Communities	Consultant
Entity	Metro Mining Ltd	Metro Mining Ltd	CDM Smith
Contact	Mike O'Brien	Colleen Fish	Mark Imber
Address	PO Box 10955 Adelaide Street, Brisbane 4000	PO Box 10955 Adelaide Street, Brisbane 4000	PO Box 359 Fortitude Valley, QLD, 4163
Phone	P: (07) 3009 8000	P: (07) 3009 8000	P: (07) 3828 6900
Website	http://www.metromining.com.au/	http://www.metromining.com.au/	http://www.cdmsmith.com
Email	mobrien@metromining.coom.au	Cfish@metromining.com.au	imberms@cdmsmith.com

1.4 Project Needs and Benefits

Bauxite is the primary ore of aluminium with approximately 5 tonnes (t) of bauxite needed to produce 1 tonne of aluminium. Approximately 70% - 80% of the world's dry bauxite production is processed first into alumina and then into aluminium by electrolysis.

Australia is one of the top producers of bauxite with almost one-third of the world's production, followed by China, Brazil, India, and Guinea.

Structural change in the aluminium industry resulting in increased separation of bauxite mining, alumina refining and aluminium smelting has resulted in the transformation in the global third party traded bauxite market.

China has seen a massive expansion of aluminium production driven by the ongoing urbanisation of the country. At the same time China's domestic bauxite reserve base is depleting. Around two thirds of the country's bauxite refining capacity has been domestically sourced and the impact of depleting reserves and falling grades is predicted to be severe.

Previously Indonesia supplied around 80% of China's import needs. In 2014 the Indonesian Government banned the export of unprocessed mineral products, which forced Chinese refiners to secure product elsewhere. Initially this pushed bauxite prices up; however, the emergence of low-cost Malaysian bauxite saw prices come off 2014 peaks. Now many analysts predict Malaysian supply may be unsustainable, meaning short pricing is beginning to strengthen.

China's major merchant refiners, including Xinfa, the Nanshan Group and Weiqiao have been working to develop new global bauxite sources. The strategy has been to avoid the potential for a replication of the concentrated supply base experienced in the global iron ore industry.

Australia, Fiji, Guinea, Ghana, Jamaica, Dominican Republic, Brazil and other counties have become supply contenders. Australian bauxite deposits are considered to be the main source of continued reliable supply and consistent quality of bauxite into China. Internal unrest in India, civil conflicts in Guinea, limited infrastructure and remote locations in developing countries support this view.

Australia, particularly the Cape York region, is a globally significant and dominant supplier of bauxite to China. Chinese refineries have gained familiarity with the region's ore qualities and processing requirements. Australia is also recognised as the most stable jurisdiction in developing mines to provide Chinese imports in the near and mid-term.

Aluminium production growth in China is forecast to remain strong, with much of the industry forecasting around 8% to 10% growth over the decade ahead. The CM Group estimates China's bauxite import requirements to rise to 60 Mtpa by 2020, up from 36 Mtpa in 2014, then rise further to 100-110 Mtpa by 2025, as domestic reserves become more seriously depleted.

As at 2014 China produced 50% of the world's aluminium production and initiatives to reduce smelting costs indicate China is poised to become even more competitive globally underpinning demand growth for bauxite.

Australia is the world's largest producer of bauxite, accounting for about one-third of global output. Bauxite production in Australia is estimated to reach 82.0 million tonnes (Mt) in 2014-15, up from 67.8 Mt in 2009-10. Demand for Queensland bauxite remains strong, with exports from the state reaching a record new high of approximately 15.146 Mt valued at $546 million in 2013–14 up from 12.567 Mt valued at $382 million in 2012–13. Using the 10% royalty rate for export this equates to approximately $38 million in royalties to the Queensland Government. Additionally domestic usage

of bauxite has continued to increase and is demonstrated through alumina exports increasing from 18.914 Mt valued at $5,342 million in 2012–13 to 18.614 Mt valued at $5,711 million in 2013–14. Similarly Aluminium (ingot metal) exports increased from 1.569 Mt valued at $3,276 million in 2012–13 to 1.576 Mt valued at $3,477 million in 2013–14.

Throughout the construction and operation phases of the Project, Metro Mining will provide potential employment opportunities in local and regional areas. Development of the Project will add a further 75 and 160 staff during construction and operations respectively will provide a further boost to Queensland's and Australia's economy, particularly at a time of global financial uncertainty and economic uncertainty in Australia driven by the downturn in the retail sector. In addition to the permanent workforce, it is expected the Project will result in the employment of additional workers locally and regionally through businesses supporting the construction and operation of the mine. Initial estimates anticipate a capital cost of approximately $35 million will be required to bring the Project to full production. Operational expenditure is estimated to be $15 million per annum for the life of the Project.

A significant proportion of this investment will flow directly into the regional economy from the goods and services required during the construction and operation phases. For example, goods and services expected to be sourced locally and from the region include:

- Consumables for the camp (food, beverages etc.);
- Fuel supply and transport;
- Housing;
- Light engineering and engineering support services;
- Professional and technical services;
- Shipping transport services for consumables, equipment and supplies;
- Tools and equipment;
- Training and personnel management services; and
- Vehicle hire or purchasing.

1.5 Project Timing and Workforce

The construction of the mine is due to commence in 2016 and is expected to take seven months to complete. The first shipment of bauxite is planned for Q1 2017.

The Project workforce is estimated to be 75 employees during construction and approximately 160 employees at the peak of operations.

1.6 Legislative Approvals

1.6.1 Commonwealth Legislation

1.6.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important aspects of the Australian environment including its biodiversity and heritage places.

The Act has been established to:

- Provide for the protection of the environment, especially Matters of National Environmental Significance (MNES);
- Promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources;
- Promote the conservation of biodiversity;
- Provide for the protection and conservation of heritage;
- Promote a cooperative approach to the protection and management of the environment involving governments, the community, landholders and Indigenous peoples;
- Assist in the cooperative implementation of Australia's international environmental responsibilities;
- Recognise the role of Indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity; and
- To promote the use of Indigenous peoples' knowledge of biodiversity with the involvement of, and in cooperation with, the owners of the knowledge.

Cape Alumina (now Metro Mining) submitted a referral to the Department of the Environment (DotE) for a similar project on 10 January 2012 (2012/6246). That project was declared a controlled action under the EPBC Act by the Commonwealth Minister for the Environment on 10 February 2012. Controlling provisions applicable to the Project were:

- Sections 18 and 18A (listed threatened species and communities);
- Sections 20 and 20A (listed migratory species); and
- Sections 23 and 24A (Commonwealth marine areas).

Due to material changes in the Project scope, Metro Mining had the referral withdrawn 17 August 2015. A new referral based on the revised Project scope was submitted 11 August 2015 (2015/7538) and was declared a controlled action on 18 September 2015, with the same controlling provisions.

No decision has been taken as yet as to the assessment process by the Commonwealth Government. It is expected; however, that the Project will be assessed under the Bilateral Agreement between the Commonwealth and Queensland governments.

1.6.2 State Legislation

1.6.2.1 Mineral Resources Act 1989

The *Mineral Resources Act 1989 (*MR Act) provides for the assessment, development and utilisation of mineral resources. The MR Act establishes a framework to facilitate mining-related activities, through the leasing of prospecting, exploration, mineral development and mining tenure. The MR act is administered through the Department of Natural Resources and Mines (DNRM).

Metro Mining through its wholly owned subsidiaries Aldoga and Cape Alumina, holds Exploration Permit for Minerals (EPM) 15376 and EPM 16899. To facilitate mining of the resource, Aldoga lodged three initial MLAs (MLA 20676, MLA 20688 and MLA 20689) with the DNRM on 19 October 2012. Aldoga lodged a further three MLAs, MLA 100051, MLA 100047 and MLA 100048, with DNRM on 10 July 2015 for infrastructure associated with the Project.

A mining lease provides entitlements to:

- Enter and be on the mining lease area for mining purposes or transportation through land to access the mining area;
- Use any sand, gravel and rock within lease area for mining activities;
- Prospecting, exploring or mining;
- Processing a mineral won or extracted by the mining;
- An activity that is directly associated with, or facilitates or supports, the mining or processing of the mineral; and
- Rehabilitating or remediating environmental harm because of a mining activity.

The MR Act also sets royalty payments, rents, landholder compensation and notification requirements which Metro Mining must comply.

Section 4A of the MR Act precludes the application of the *Sustainable Planning Act 2009* (SP Act) to activities undertaken for purposes of the mining tenure, with the exception provisions in relation to the *Queensland Heritage Act 1992*. It also makes building work controlled under the *Building Act 1975* self-assessable development within the lease.

Pursuant to the Mineral Resources Regulation 2003, various restricted areas have been declared across parts of Queensland that limit exploration and mining activities. It is noted there are no unavailable or restricted areas within the proposed ML boundaries.

1.6.2.2 Environmental Protection Act 1994

The EP Act provides the key legislative framework for environmental management and protection in Queensland. The objective of the EP Act is to: *"Protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains ecological processes on which life depends"* (Section 3). Under the EP Act, Metro Mining must comply with the general environmental duty not to undertake an: *"Activity that causes, or is likely to cause, environmental harm unless…all reasonable and practicable measures to prevent or minimise the harm are taken"* (Section 319).

The process for obtaining an EA for mining activities is established in Chapter 5 of the EP Act. According to the Act, the Project requires a site–specific application for ineligible Environmentally

Relevant Activities (ERA) (Section 124) that is for which eligibility criteria are not in effect. The EA imposes environmental management conditions on mining activities undertaken on the ML that Metro Mining must comply with. EHP is the regulatory authority that has responsibility for administration of EAs, oversight of compliance and retaining financial assurance bonds to ensure the area is suitably rehabilitated.

Under changes from *Environmental Protection (Greentape Reduction) and Other Legislation Amendment Act 2012* which commenced on the 31 March 2013, the EIS prepared by Metro Mining for this Project will satisfy the Information and Notification stages. Upon lodgement of the EA application the application will only require the decision stage to be completed, thus reducing the duplication of information submission and public notification which previously existed.

Environmentally Relevant Activities

Pursuant to the EP Act, activities that will, or have the potential to, release contaminants into the environment and which may cause environmental harm are defined as ERAs. In accordance with the Environmental Protection Regulation 2008 (EP Regulation) (Schedule 6, Item 5), the development will be a site-specific EA mining project for the mining of bauxite (ERA 11).

The activities associated with the Project will require a number of ERAs (as prescribed in Schedule 2, EP Regulation). The EA is an integrated authority that allows for the carrying out of multiple ERAs that are part of a project, as such all ERAs must be listed and described in the EIS for inclusion in the EA. The EA is expected to provide approval conditions for each of the required ERAs.

Additional ERAs potentially triggered by the Project are:

- ERA 8 – Chemical Storage - storing more than 500 m^3 of chemicals of class C1 or C2 combustible liquids under AS 1940 or dangerous goods class 3;
- ERA 17 - Abrasive Blasting – cleaning equipment or structures on a commercial basis using a stream of abrasives in either a wet or dry pressure stream. This includes spraying a coating on equipment or a structure that has been subject to abrasive blasting;
- ERA 33 – Crushing, milling, grinding or screening more than 5,000 t in a year; and
- ERA 63 – Sewage treatment for 100 to 1,500 equivalent persons with treated effluent discharges to an infiltration trench or irrigated.

Notifiable Activities

Land contamination and activities that have been identified as likely to cause land contamination are listed as notifiable activities in Schedule 3 of the EP Act. Any person undertaking these notifiable activities must notify EHP and the land is recorded on the Environmental Management Register (EMR). Potentially notifiable activities associated with the Project are listed in **Table 1-2.**

Table 1-2 Anticipated notifiable activities for the Project

Item number (Schedule 3 EP Act)	Description of activity
1	Abrasive blasting—carrying out abrasive blast cleaning (other than cleaning carried out in fully enclosed booths) or disposing of abrasive blasting material.
7	Chemical storage of more than 10 tonne of chemicals that are dangerous goods under the dangerous goods code.
23	Metal treatment or coating - treating or coating metal including, for example, anodising, galvanising, pickling, electroplating, heat treatment using cyanide compounds and spray painting using more than 5 litres (l) of paint per week.
24	Mine wastes – (a) Storing hazardous mine or exploration wastes, including, for example, tailings dams, overburden or waste rock dumps containing hazardous contaminants; and (b) Mining or processing, minerals in a way that exposes faces, or releases groundwater, containing hazardous contaminants.
29	Petroleum product or oil storage in above ground tanks.
37	Waste storage, treatment or disposal – storing, treating, reprocessing or disposing regulated waste including operating a sewage treatment facility with on-site disposal facilities.

Section 2 Proposed Development

2.1 Project Location

Metro Mining is proposing to develop the Project located on the western coastline of Cape York, Queensland (**Figure 1-1),** approximately 35 km northeast of Mapoon.

The Project area is located within the Cook Shire Local Government Area which covers 106,000km^2 of the Cape York Peninsula. The tenements lie within the Aboriginal Freehold Land (Lot 11 on SP204113 and Lot 13 on SP204113) held by the Old Mapoon Aboriginal Corporation (OMAC).

2.1.1 Land Use

The land use within the Project area is currently limited to exploration activities associated with mining, cultural activities and recreational uses. Areas of cultural and recreational importance that have been identified by the Traditional Owners include Bigfoot Swamp, Lunette Swamp and middens identified near the existing Port of Skardon River. In addition to this Project, Gulf Alumina are proposing to develop a separate mine and associated infrastructure within the immediate Project area.

Previously the dominant use of the lands within the Project area were for cultural purposes and the mining and processing of Kaolin (i.e. the Skardon Kaolin Project). Whilst there are currently no rural properties within the immediate vicinity of the Project there may have been limited cattle grazing and associated activities within the broader area up the early to mid-1900s.

Exploration activities, including drilling and associated access track development, have taken place throughout the Project area and activities such as drilling, ore sampling and other exploration activities are continuing.

Recreational activities within the Project area are generally associated with traversing the Project area to access camping areas at the mouth of the Skardon River. Existing vehicle tracks are used infrequently for recreational 4WD activities and hunting. The branch of the Skardon River that dissects the Project area is used for recreational fishing and boating activities.

2.2 Tenure

2.2.1 Existing Tenure

Nearby tenure and tenements are identified in the **Table 2-1**, including those comprising the Bauxite Hills tenements held by Metro Mining subsidiaries. The Mining Lease tenements in the vicinity of the Project are shown at **Figure 2-1**. There are no overlapping petroleum tenure.

Table 2-1 Nearby tenure and tenements

ML Granted					
Permit Number	**Permit Name**	**Permit Status**	**Authorised Holder Name**	**Minerals**	**Shape Area Hectares**
ML 6025	SKARDON RIVER NO. 1	Granted	GULF ALUMINA LIMITED	BX,CY,KAO	1,922
ML 7024	WEIPA	Granted	RTA WEIPA PTY LTD	BX,KAO	246,182.67
ML 7031	ALCAN WEIPA	Granted	ALCAN SOUTH PACIFIC PTY LTD	BX	138,900
ML 40069	SKARDON PIPELINE	Granted	GULF ALUMINA LIMITED	BX,KAO,SI	260
ML 40082	SKARDON BUFFER	Granted	GULF ALUMINA LIMITED	BX,KAO,SI	1,742.8863
ML in Application					
Permit Number	**Permit Name**	**Permit Status**	**Authorised Holder Name**	**Minerals**	**Shape Area Hectares**
MLA 20676	BAUXITE HILLS 1	Application	ALDOGA MINERALS PTY LIMITED	BX	2,317.9124
MLA 20688	BAUXITE HILLS 6 EAST (BH6 EAST)	Application	ALDOGA MINERALS PTY LIMITED	BX	530.8866
MLA 20689	BAUXITE HILLS 6 WEST (BH6 WEST)	Application	ALDOGA MINERALS PTY LIMITED	BX	2,052.3816
MLA 100047	Port Haul Road	Application	ALDOGA MINERALS PTY LIMITED	Infrastructure	45.23
MLA 100048	BH1 Haul Road	Application	ALDOGA MINERALS PTY LIMITED	Infrastructure	34.1
MLA 100051	Bauxite Hills Port	Application	ALDOGA MINERALS PTY LIMITED	Infrastructure	51.3
EPM Granted					
Permit Number	**Shape**	**Permit Status**	**Authorised Holder Name**	**Minerals**	**Subblock Count**
EPM 4068	Polygon	Granted	GULF ALUMINA LIMITED	AMOC	9
EPM 15370	Polygon	Granted	ORESOME AUSTRALIA PTY. LTD.	AMOC	3
EPM 15376	Polygon	Granted	CAPE ALUMINA PTY LTD	AMOC	29
EPM 16899	Polygon	Granted	CAPE ALUMINA PTY LTD	AMOC	14
EPM 18384	Polygon	Granted	GULF ALUMINA LIMITED	AMOC	13
EPM 19001	Polygon	Granted	ORESOME AUSTRALIA PTY. LTD.	AMOC	28
EPM 19047	Polygon	Granted	ORESOME AUSTRALIA PTY. LTD.	AMOC	20
EPM 25147	Polygon	Granted	SUNRISE MINERALS PTY LTD	AMOC	61

Note: BX = Bauxite, KAO = Kaolin, SI = Silica, CY = Clay, AMOC = All Minerals Other than Coal

610000 615000 620000 625000

8700000 8695000 8690000

SKARDON RIVER

ML 40082

ML 40069

Port Haul Road
MLA 100047

Port Area
MLA 100051

BH1 MLA boundary
(ML 20676)

BH1 Haul Road
MLA 100048

ML 7031

ML 7024

BH6 West
MLA boundary
(ML 20689)

BH6 East
MLA boundary
(ML 20688)

ML 6025

Airport Strip

Legend

- Watercourse
- Haul Road
- Haul Road (s.316 Application)
- Pit Extents
- Mine Infrastructure MLA Boundary
- Metro Mining Mine Lease Area
- Mine Lease Area (Gulf Alumina)
- Mine Lease Area

610000 615000 620000 625000

R	Details	Date
1	For Information	05/08/15
2	Updated Pit Extents	21/10/15
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-	-	
-	-	
-	-	

DESIGNED	MD	CHECKED	-
DRAWN	MD	CHECKED	-
APPROVED	-	DATE	21/10/15

Notes:

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DATA SOURCE
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QLD Government Open Source Data;
Australian Hydrological Geospatial Fabric (Geofabric) PRODUCT SUITE V2.1.1

DESIGNER
CDM Smith
cdmsmith.com

CLIENT
METRO MINING LIMITED

FIGURE 2-1

MINING LEASE TENEMENTS

DRG Ref: **BES150115-003-R2_MINE_TEN**

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2.2.2 Native Title

The Ankamuthi People (QUD6158/98) and the Northern Cape York Group #1 (QUD157/11) have been identified as being the relevant Aboriginal parties associated with the Project area. The Right to Negotiate process is well advanced with both Aboriginal parties.

2.3 Bauxite Resource

The current Australian Code for Reporting of Mineral Resources and Ore Reserves (JORC) estimated resource is 41.8 Mt of Proved and 6.4 Mt of Probable Marketable Ore Reserves. On average, the Proved Reserves contains 50.73% of total Al_2O_3 and 6.29% of reactive silica while the Probable Reserves on average contains 49.26% of total Al_20_3 and 6.92% of reactive silica; all qualities are reported on a dry basis. A breakdown of the reserves is shown in **Table 2-2**. The stated reserves represent the marketable product tonnes as this is a DSO, with no beneficiation and is saleable at ROM moistures.

Table 2-2 Mineral and ore reserve estimates

Area	Category	DSO[2] Tonnes (Mt)[1]	DSO Bauxite Qualities (Dry Basis)			
			Total Al_2O_3 (%)	THA[3] (%)	Total SiO_2 (%)	Rx Si[4] (%)
BH1 and BH6	Measured Resource (Dry *In-situ*)	41.8	51.0	39.2	11.0	6.1
BH1 and BH6	Indicated Resource (Dry *In-situ*)	8.3	49.3	37.1	14.0	6.8
BH1 and BH6	Inferred Resource (Dry *In-situ*)	3.4	48.4	35.9	14.8	7.2
Total resource		53.6	50.6	38.6	11.7	6.3
BH1 and BH6	Proved Reserve[5] (ROM @10% Moisture)	41.8	50.7	38.6	10.9	6.3
BH1 and BH6	Probable Reserve[6] (ROM @10% Moisture)	6.4	49.3	36.8	13.4	6.9
Total Marketable Ore Reserves		48.2	50.2	38.4	11.2	6.4

1 For BH1 and BH6 the tonnages are calculated using the following default bulk densities determined from a program of sonic drilling; 1.6g/cm3 for BH1 and 2g/cm3 for BH6. Actual values are used where measurements have been taken
2 DSO is defined as bauxite that can be exported directly with minimal processing and beneficiation.
3 THA is trihydrate available alumina (gibbsite alumina + kaolinite alumina – low temperature desilication product (DSP) alumina) at 1500C.
4 RxSi is reactive silica at 150 degrees C.
5 Proved Reserve - the proved reserve is included in the BH1 and BH6 Measured resource
6 Probable Reserve - the probable reserve is included in the BH1 and BH6 Indicated resource

Exploration by Metro Mining is ongoing within the Project area and will continue to be undertaken by Metro Mining throughout the mine life. The aim of the exploration program will be to better define the measured resource estimate for ongoing operational requirements of the mine. Exploration activities will be carried out according to the Project Environmental Management Plan (EMP) and in consultation with key stakeholders, as appropriate.

2.4 Proposed Operations

The mining method for the Project will be open cut mining utilising front end loaders and trucks for hauling. The material does not need any drilling and blasting; however, some ripping by dozers is likely to be required. Front end loaders will be used for loading bauxite to road trains.

Bauxite will be hauled to the ROM stockpile using road train trucks. Overburden material will be initially stored ex-pit. In-pit overburden storage is expected to commence within the first six months

of production. The overburden volume is low for this deposit and all overburden material will ultimately be returned in-pit. This is not expected to represent an issue in terms of waste storage or required capacity of mining equipment.

Construction is planned to commence in 2016, following the receipt of all necessary environmental approvals. The first shipment of bauxite is planned for Q1 2017.

Detailed design and construction is estimated to take seven months. The following works will be undertaken in the first year of construction and operation.

2.4.1 Initial Works

Vegetation will be progressively removed ahead of operations to ensure that the disturbed areas are minimised prior to each wet season. Prior to clearing, any trees that are suitable for selective felling, to be reused as nesting or tree-hollow sites, will be marked and individually felled and stored. Once cleared, vegetation will be inspected by environmental staff to identify vegetation suitable to be placed directly onto rehabilitated areas to provide initial habitat and assist with soil erosion control purposes. Some vegetation may also be wood-chipped to provide base organic material for a trial composting process. Vegetation that is not used in the rehabilitation or waste management processes will be windrowed and burned, with the burnt material incorporated into topsoil stockpiles.

Following clearing, topsoil will be collected where available and either used directly for rehabilitation purposes or placed into clearly marked topsoil stockpiles. This material will then be progressively replaced onto the post-mining rehabilitation landform. The mine plan is designed to maximise the amount of topsoil that can be placed directly, without stockpiling.

2.4.2 Open Cut Operations

For the initial operation, overburden material will be removed and stored in temporary stockpiles, before being pushed back into the post-mined area. All overburden that is removed before mining will then be progressively deposited in the mined out areas. Overburden thickness varies between 0.2 to 0.6 metres (m) over the majority of the deposit. Select areas of BH1 have overburden thickness of between 0.8 to 1.5 m and in some areas in BH6, the thickness varies between 0.6 to 1.0 m. The overburden is generally low in nitrogen, phosphorus and total organic carbon. Total iron concentrations were considered high which was evident on site due to the rich red soil colour. Soil salinity was considered low and pH was generally within the neutral range. The soils were typically not dispersive as the exchangeable sodium percentage (ESP) was below the limit of reporting (LOR) (<0.1%).

Excavation of the bauxite is expected to utilise CAT992K front end loaders with 12 m^3 bucket capacity. The excavated ore is hauled using "Pit Hauler" trucks having three trailers with a total capacity of 200 tonnes (t). Final equipment details will be determined by the contract mine operator. No drilling or blasting is required and most of the ore will be free dug. Some ripping may be required in areas of cemented bauxite.

Sediment control requirements will be ongoing and integrated into mine planning. Sediment control will include measures to keep surface water flow out of the mining areas as well as control runoff from the areas. With mining operations carried out only in the dry season, the risk of significant water flow into or around the mining operations is minimised. Pits will be designed to ensure that suitable containment measures are in place at the start of the wet season.

Mined areas will be progressively rehabilitated to meet agreed final land use criteria. Overburden material will be placed and shaped, before being covered with topsoil and any available composted material. Selected cleared vegetation may be placed back onto the topsoiled area to provide initial habitat and assist with soil erosion controls. It may also provide some direct seed placement. Where possible, locally sourced seed will then be spread across the rehabilitation area at rates that will be determined based on similar mining operations.

The final land form will be dictated by the bauxite floor and the amount of overburden replaced in the pit. In most areas this is expected to be stable with good drainage. Where necessary additional excavation / earth works will be carried out to achieve a suitable land profile or drainage outcome. These additional works will be minor and easily achieved using existing mining equipment.

Dust control will be maintained using water trucks to minimise dust on the haul roads and in pit. Water trucks and sprays will be deployed in the stockpiling, conveying and industrial area as required.

The mine plan will be reviewed from time to time and may be subject to change. Changes may require progressive approval and will be identified in the existing Plan of Operations process.

2.4.3 Product Handling

Bauxite will be delivered ex pit to the ROM stockpile area by side tipping trucks and dumped on the stockpile pad. The bauxite is of direct shipping quality and as such no beneficiation is required. From the ROM, stockpile ore will be picked up by front end loaders and dumped into hoppers feeding the screening, crushing and stacking circuit.

The screens will be designed to remove organic matter (tree roots etc.) and separate larger lumps of cemented bauxite. Ore will be passed through a crusher to reduce the top size to minus 100 millimetre (mm). The crushed ore will then be stacked by stacking conveyors to one of three proposed stockpiles. Stockpile height will not exceed 18 m. Organic material will be transported back to the mining area and either burned with the stripped vegetation or turned into the rehabilitated areas.

Screens, crusher and conveyors will be mobile with power provided by direct drive diesel engines or using electric motors powered by diesel generators. Dust control will involve road tankers to dampen the stockpile pad and MIA and low volume water sprays at dust generating points and over the product stockpiles. Bulldozers and front end loaders will be used to push bauxite from the ROM stockpile to the barge loading conveyor.

The Project will operate a small fleet of barges and tugs to carry the bauxite from the river berth to an OGV lying offshore. The fleet is anticipated to comprise of approximately six barges, three ocean going tugs and two assist tugs and one crew boat. When loading barges will be moored to piles in the river and loaded via a conveyor. The conveyor gantry from the barge to shore will be supported by piles. The total length of the conveyor will be approximately 550 m of which 150 m is over water.

Barges will be towed by tugs from the loading point to the transshipment location, approximately 12 km from the mouth of the Skardon River. Several temporary mooring buoys will be located in the river, near the mouth, and in the ocean, close to shore, immediately to the north of the mouth to assist barges in transit.

OGVs of a 50,000 t (Handymax) or 70,000 t (Panamax) class will anchor between 12 km offshore from the Skardon River mouth in designated areas. These areas have been surveyed and are located away from any significant benthic habitats. Transshipment from barge to OGV will be carried out

by bringing the barges alongside the OGV and using the ships' grabs to pick up the ore and dump into the ships holds. Negligible amounts of dust and spillage will be generated during the transshipment process and, as bauxite is completely inert and the negligible amounts of material resulting from this process it is anticipated that impacts to the environment will be low.

The vessels will all comply with applicable Australian Standards and will be registered as such. Refuelling of the tugs will take place either at the barge loading facility with fuel piped from the shore installation, in which case the mine's fuel loading and unloading protocols will be followed, or the tugs will refuel at a commercial installation in Weipa.

2.5 Mine Infrastructure

The following sections describe the infrastructure necessary to support the operation of the mine. Where possible, Metro Mining will seek to develop and utilise shared infrastructure with Gulf Alumina in order to minimise potential construction and operational impacts. Discussions in this regard are continuing; however, due to the uncertainty of sharing infrastructure, Metro Mining is seeking approval for a standalone Project.

2.5.1 Mine Infrastructure Area

The MIA will comprise a level site of approximately 5.5 ha and will include:

- ROM dump site;
- Screening and crushing;
- Bauxite stockpiles;
- Load point for the barge loading conveyor;
- Earthmoving equipment hard stand;
- Administration offices;
- Workshops; and
- Fuel storage.

The MIA will include cut-off drains to prevent stormwater entering the site from the surrounding catchment and sediment control measures to control runoff water. The site will also include an isolated runoff control system around the workshops incorporating oil separators. As the mine will not be operating during the wet season sediment build up will be limited during this time and sediment control measures will be designed to manage all runoff without maintenance for the duration of the wet season.

2.5.2 Fuel Delivery and Storage

Fuel (diesel) consumption is estimated at approximately 50 kilolitres per day for the mining equipment, power generation and tugs. Onshore storage for up to 1,000,000 litres will be provided via a tank farm. Fuel will be delivered via marine tankers and piped from the barge jetty.

All fuel tanks, bunding and transfer pipes will meet *AS1940-2004: The Storage and Handling of Flammable and Combustible Liquids* and *AS1692-2006: Steel tanks for flammable and combustible*

liquids. Spill control measures will be in place according to *AS1940-2004: The Storage and Handling of Flammable and Combustible Liquids.*

2.5.3 Haul Roads

Haul road routes are generally within Metro Mining's tenements. Haul roads outside Metro Mining's tenements are also considered, where practicable, to decrease and avoid potential environmental impacts and construction and engineering costs. Haul roads will be constructed from BH6 to the MIA and barge loading facility, and from BH6 to BH1. Haul roads will be constructed using local materials taken from within the proposed haul road corridor or from the mining pits.

The haul road design will be based on acceptable road design standards such as the *Austroads Guide to Rural Road Design* and the *Queensland Road Planning and Design Manual*. The basic design criteria adopted for the indicative design process is presented in **Table 2-3** (see **Figure 2-2** for indicative haul road design). Haul road design will includes suitable culverts and over flow structures to allow the free flow of water during the wet season, when the mine is not operating.

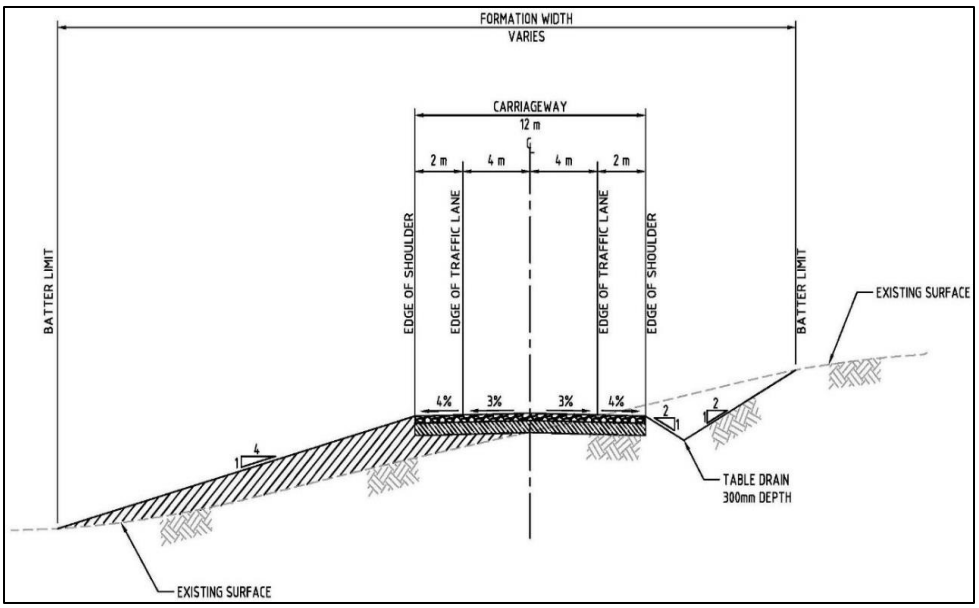

Figure 2-2 Indicative haul road cross section

Table 2-3 Indicative haul road design criteria

Design Element	Criteria
Typical Cross Section	
Design vehicle	Multi-Train Haul Truck
Number of traffic lanes	2 lanes (one lane each travel direction) except across culverts where one way traffic is designated to minimise area of disturbance
Traffic lane width	4 m
Traffic lane crossfall	3%
Shoulder width	2 m
Shoulder crossfall	4%
Cut batter slope	2H:1V
Fill batter slope	4H:1V
Design Speed	90 kph
Minimum Curve Radius	250 m
Maximum Longitudinal Gradient	8%

2.5.4 Barges and Barge Loading Facility

2.5.4.1 Barge Loading Facility Infrastructure

The bauxite stockpiles are located within the MIA, approximately 550 m from the barge loading jetty. A single overland belt conveyor, will transfer product bauxite at a rate of between 1,000 t/hr and 1,500 t/hr from the stockpiles to the barges.

The overland conveyor will be contained in a gantry supported by pairs of vertical tubular steel piles generally spaced at 20 m centres and driven into the river bank and river floor progressively from the stockpiles to the barge loading berth. The gantry will be prefabricated in spans approximately 20 m long.

Discharge into the barges will be via a chute mounted at the end of the conveyor.

The barge loading berth requires three berthing dolphins with three additional dolphins provided for the barge waiting berth. It is envisaged that each dolphin will have a maximum of four tubular steel piles. Total length of the barge mooring including the second berth will be approximately 160 m.

To maintain safe barge berthing, loading and un-berthing processes, a minimum water depth of 4 m is being planned at the loading point.

The maximum drop height of the bauxite is 6 m.

The barge loading facility, including jetty and dolphins, will be located within the same Mining Lease for Infrastructure Purposes that contains the MIA (see **Figure 2-3**).

617000 617500 618000

8699000 8698500 8698000

INSET

BARGE 75m LENGTH X 25m BEAM NOM.
CONVEYOR DISCHARGE CHUTE
ELEVATED CONVEYOR GANTRY SUPPORTED ON CENTRE BERTHING DOLPHIN
SECOND BARGE AWAITING LOADING
CONVEYOR GANTRY WITH WALKWAYS TYP.
BERTHING DOLPHINS (8 OFF) 25m SPACING TYP.
QUAYLINE

INSET

BARGE OFFLOADING AREA

SKARDON RIVER

ORE OFFLOADING CONVEYOR JETTY

FUEL FARM
LOAD POINT FOR CONVEYOR
PRODUCT AREA 2
PRODUCT AREA 1
ROAD
SED TRAP
ROM2
ROM1
ADMIN & WORKSHOP
LAYDOWN
SED TRAP
MINE INFRASTRUCTURE MLA BOUNDARY
HAUL ROAD

Legend

Mine Infrastructure MLA Boundary

R	Details	Date
1	Details	23/02/15
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNED	MD	CHECKED	-
DRAWN	MD	CHECKED	-
APPROVED	-	DATE	05/08/15

Notes:

N W E S

0 25 50 100
Metres

Scale @ A3 - 1:4,500

GCS GDA 1994 Zone 54

DISCLAIMER
CDM Smith has endeavoured to ensure accuracy and completeness of the data. CDM Smith assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
MEC Mining 2015;
QLD Government Open Data Source;
Australian Government Bureau of Meteorology.

DESIGNER
CDM Smith
cdmsmith.com

CLIENT
METRO MINING LIMITED

FIGURE 2-3

MINE INFRASTRUCTURE AREA

DRG Ref: **BES150115-033-R2_MIA**

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2.5.4.2 Barge Operations

Bauxite transportation will be via barge through the Skardon River. Each barge will carry between 3,500 t and 6,500 t depending on the tide at the time of loading. It is expected that transit at the river mouth will be limited for approximately seven hours a day during low tide. The Project feasibility has taken into consideration these restrictions and has designed the barge system such that bed-levelling or dredging is not necessary.

Sufficient numbers of barges will be placed in service to provide for the maximum requirement during the expected operating year. Tugboats will standby with the barges during loading. Barges will then be delivered to the transshipment location where they will be discharged to the awaiting carrier. The tug boats will pick up empty barges and return to the barge loading facility.

Metro Mining will monitor river depth and tidal stages at its loading location and at all critical locations between the loading facility and downstream to through the mouth of the Skardon River. Barges will be loaded to drafts that will adequately clear the shallowest areas of the Skardon River. The tugboats will be of suitable design to clear the critical areas within the Skardon River at their lowest operating draft. As volume increases barges and tug boats will be added to the fleet to accommodate the increased tonnage. One or more mooring areas will be identified within the Skardon River to hold barges in between loading and during the wet season when the mine is not operational.

Vessels of between 60,000 to 80,000 t each (Panamax class) will be self-loaded at the transshipment anchorage site. Vessels will be loaded in approximately four to six days, requiring 15 - 20 loaded barges to complete each cargo. Each barge will typically have a capacity of 3,500 t and 6,500 t and be towed by a tug of 2,000 horsepower (HP).

2.5.4.3 Barge Mooring

When not in use the barges will be moored in the Skardon River clear of other river traffic. Moorings will consist of a concrete block weighing between 5 t to 10 t placed on the river floor with a chain connected to a float.

The moorings will be designed to withstand cyclones (cyclone rated) and barges will be secured to these moorings during the wet season. Tugs will be redeployed during the wet season at sites outside the Skardon River.

2.5.5 Site Power and Water

2.5.5.1 Site Power Generation

Power requirements will be sourced from onsite generators located within the MIA and the accommodation camp. The likely generator configuration is:

- Three generators (e.g. CAT generator) to provide 1 Megawatt (MW) for the operation of the MIA which will operate at 75% load; and
- One 500 (Kilowatt) kW CAT generator for the operation of the village, which will operate at 50% load.

Metro Mining is committed to minimising energy use throughout the Project life. A range of energy minimisation and energy efficiency strategies will be developed for both the construction and operational phases of the Project. These will be incorporated into detailed design and will be

pursuant to the relevant legislation and policies such as the *Clean Energy Act 2011* (Cwlth) and the ClimateQ: Towards a Greener Queensland strategy.

2.5.5.2 Site Water Supply

A schematic of the proposed water management network for the Project is shown in **Figure 2-4**. The proposed water supply is via Great Artesian Basin (GAB) bores to meet a total annual demand of 420 megalitre(ML), with potable water sourced from the local shallow groundwater aquifer. Assuming 275 days of operation per year and 20 hours of daily pumping time, a total yield of 22 litres per second (L/s) is required from the combined bores. Polyethylene storage tanks are proposed to buffer between supply from the bores and operational demand. The polyethylene tanks will include a peaking factor to accommodate temporary increases in water demand and to protect against irregularities in supply from the bores. A peaking factor of between one day and one week will equate to polyethylene tanks with a total storage of between 2 ML and 10 ML. The number of tanks required will be based on balancing the need to locate water storage near the water use versus trucking water to where it is used.

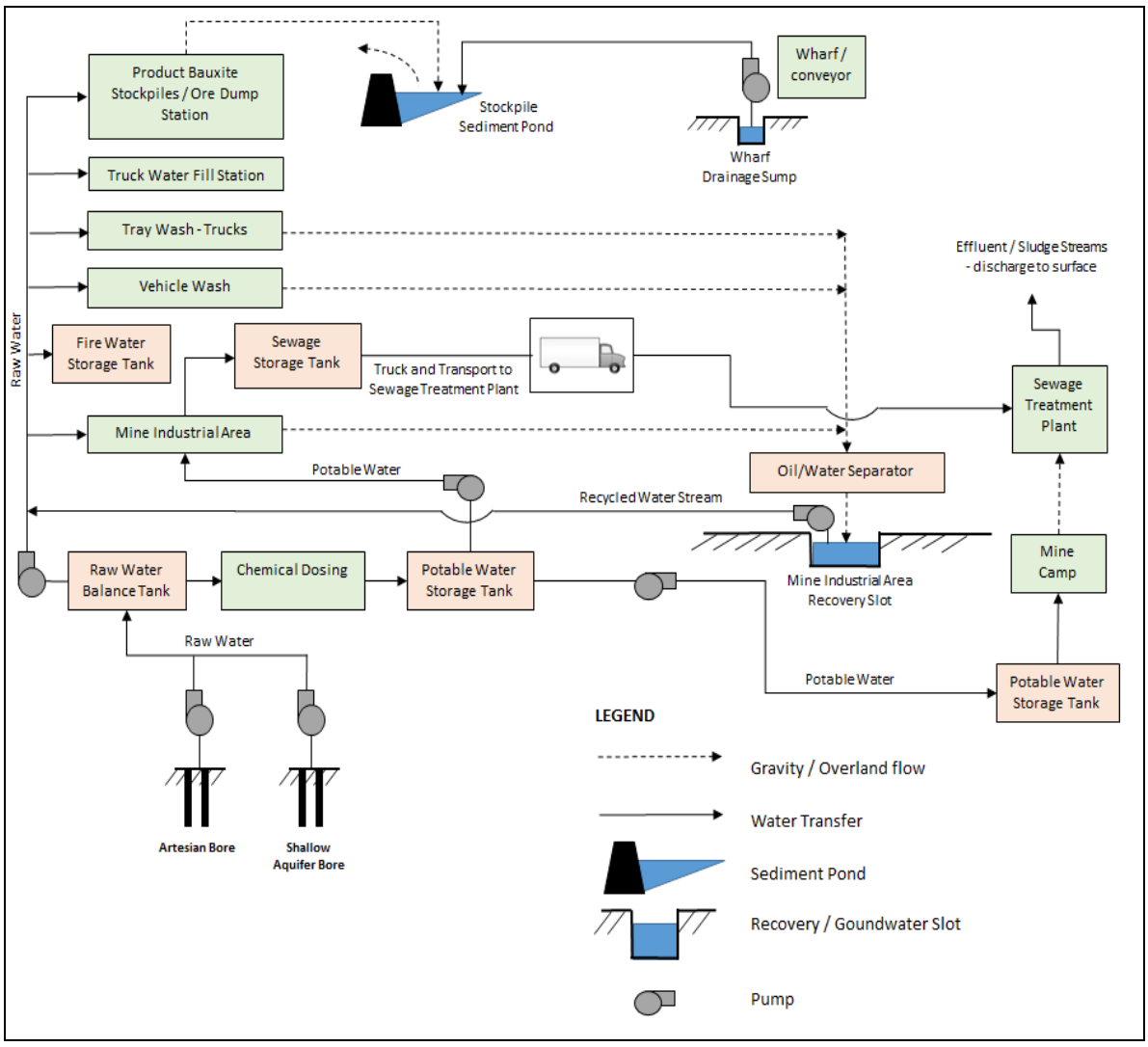


Figure 2-4 Proposed water management network

An approximate summary of the potential mine water demand which the water supply system must satisfy is shown in **Table 2-4**. The majority of water use (300 ML/yr) is raw water for dust suppression of the dump station, haul roads and stockpiles, as well as for washdown of the crusher plant and conveyor system.

Table 2-4 Mine water demands

Description	Annual Demand (ML)	Water Type
Operations (crusher; truck fill for dust suppression)	300	Raw
Mine personnel (200 persons)	45	Potable
Fire Fighting (poly tank spare capacity)	5	Raw
Mine Infrastructure Area (Workshop / Washdown)	70	Raw / Potable*
Total	**420**	-

*2 ML/yr potable supply to the MIA assuming 40 L/person/day

A potable water supply to the camp and MIA of approximately 45 ML/yr is required to meet the standard outlined in the National Health and Medical Research Council and Natural Resource Management Ministerial Council (NHMRC and NRMMC) (2011) National Water Quality Management Strategy, Australian Drinking Water Guidelines (ADWG). Field investigations and laboratory testing conducted indicate that the shallow aquifer water quality is suitable for potable use. Chemical dosing may be required to control pH levels and provide disinfection. Two potable water tanks will be required; one at the mine camp and the other at the MIA. The main potable use tank will be located near the mine camp, as this is the main source of potable demand. A potable water pipeline or truck transport will be required to transport potable water to the storage tank located at the MIA.

A sewage treatment plant is proposed to be located near the accommodation camp. Wastewater produced from the MIA will be stored and periodically trucked and transported to the sewage treatment plant. Effluent and sludge waste streams will be appropriately treated and irrigated to surface or used as mulching media, respectively.

The water management network allows for potential reuse of water collected in sumps, ponds and slots. Allowance for reuse of water has not been incorporated into the demand analysis; however, such an allowance will reduce the amount of water abstracted from bores. The main function of the sumps, ponds and slots is to capture sediment laden runoff for sediment removal prior to release to the existing environment. Oil / water separators are proposed for vehicle wash and workshop areas prior to release or reuse of water.

Fire water supply will be provided through storage in polyethylene tanks at suitable locations around the mine lease. A total of 10 ML has provisionally been included for the purpose of this water resources assessment. It is anticipated that these stores be replenished post use and that the total volume is available for firefighting activities during operations.

2.5.6 Site Communications

The communications systems for the Project will comprise both voice and data systems that will be implemented in stages associated with early works, construction and operation. Prior to construction, adequate communications systems must be operational to support the health and safety for all personnel involved in the Project. Metro Mining proposes to utilise a combination of the existing commercial Telstra mobile Next G network together with the use of the public ultra-high frequency radio network and satellite phones.

Radio procedures for emergency declaration will be in accordance with the standard operating procedures as instructed during generic and site specific induction processes. Once the MIA and accommodation camp are in place, a permanent site radio very high frequency repeater station may be setup which will enhance voice communications over the Project area to meet the needs of both the construction and operational phases. Alternatively talks will continue with the relevant parties in regards to upgrading the existing services located in Mapoon.

2.5.7 Lighting

Artificial lighting will be designed, installed, operated and maintained in accordance with AS4282:1997 Control of the Obtrusive Effects of Outdoor Lighting, to minimise the amount of light spill associated with the Project. Controls stipulated in this standard include consideration of the location and orientation of lighting as well as the selection and maintenance of luminaries. Any further mitigation (e.g. shielding, further restricting the use of lighting) will be implemented on an as needed basis, through consultation with adjoining property users and statutory agencies.

2.5.8 Site Waste Management

Metro Mining is committed to implementing waste minimisation and efficiency strategies. Metro Mining will ensure that construction and operation activities are in line with the waste management hierarchy outlined within the Environmental Protection (Waste Management) Policy 2000 which provides preferred principles of waste management based on:

- Avoid waste by optimising methods used within the construction, operation and decommissioning phases (most preferred);
- Reuse waste by identification of secondary sources that can utilise waste;
- Recycle waste by identification of facilities that can recycle the particular waste stream;
- Energy recovery from waste, e.g. creating energy from incineration; and
- Disposal of waste at an appropriate facility (least preferred).

The principles outlined above will form the basis of Metro Mining's waste management strategy and be applicable to all waste streams which may be generated throughout the life of the Project.

2.5.8.1 Excavated Waste

Waste material associated with the pit development and mining (including sub-soils and weathered rock) will be used for construction of the MIA and other infrastructure, where practicable. Topsoil will be retained nearby to the mine pits and reused as part of site rehabilitation. These materials are relatively geochemically inert (i.e. testing showing relatively neutral pH) and have low acid forming potential. Intercepted product during the construction will be stockpiled if suitable at the MIA for future export.

Whilst referred to as waste, the excavated waste materials will be returned to the pit void as part of the Projects rehabilitation program. It is therefore not expected that there will be any waste material stockpiles retained out-of-pit at the cessation of mining.

2.5.8.2 Solid and Liquid Waste

The generation, recycling and disposal of wastes will be reduced through effective management and implementation of site specific recycling practices. As part of the waste management strategy, Metro

Mining will develop and implement a Waste Management Plan that will provide the framework to implement good practice waste management practices in accordance with the Environmental Protection (Waste Management) Policy 2000.

Mining activities will result in the generation of domestic, commercial and industrial type wastes.

Waste streams generated by the Project include:

- General waste suitable for disposal to offsite landfill;
- Putrescible wastes suitable for onsite composting;
- Reusable or recyclable materials such as wood, scrap metal, paper, cardboard, aluminium cans, glass and plastic bottles paper, wood;
- Inert construction material suitable for disposal onsite to the waste trench; and
- Regulated waste such as tyres, solvents, lubricants, redundant chemicals and engine coolant.

Where possible waste will be recycled or reused and will be separated out into various skips according to its waste stream. In instances where the waste cannot be recycled, or disposed of in the inert waste trench, it will be removed offsite by appropriately licenced contractors and taken to landfill. For any regulated waste, an appropriately licensed waste contractor will be used to remove the waste from the Project site.

2.5.9 Workforce Accommodation

The accommodation camp will have up to 180 rooms with 75% occupancy at any one time. The camp will provide accommodation needs for the workforce, any contractors required from time to time and any other visitors to the site (such as Metro Mining staff). Personnel will be shuttled between the accommodation camp and site at shift commencement and completion.

The construction of the accommodation camp is anticipated to occur over one month. The construction workforce is presently estimated at 75 people for the first month which will be maintained into the start of operations. During construction, it is anticipated that the workforce will reside within the limited existing camp facilities until the Project's accommodation camp is operational. This method will reduce any demand on existing accommodation requirements within Weipa.

The accommodation camp will utilise diesel generators for power supply and will have its own sewage treatment plant. Waste water from the sewage treatment plant will be treated to a class suitable for irrigation and / or composting. The reuse of water is expected to minimise the need for disposal.

The accommodation camp will offer a high level of amenity, which will contribute to a healthy workforce. Ensuring adequate access to exercise and other recreational facilities, along with modern communication facilities, will also contribute to the health and social wellbeing of workers. The accommodation camp has been located well away from the workings and MIA, in order to minimise vehicle and operational noise.

Section 3 Environmental Values

3.1 Climate

The Project lies within the Australian Monsoon Zone and has a Climate Classification of Equatorial – Tropical Savannah using the Bureau of Meteorology's (BoM) modified Koppen classification system.

Meteorological data for the Project has been acquired from two long-term BoM weather stations, a temporary weather station located at Pisolite Hills (approximately 23 km south from the Project) and a recently installed weather station for the Project located at the Skardon River airstrip.

The location of all meteorological data collection points are shown in **Table 3-1**.

Table 3-1 Relevant weather station data

Weather Station	Commenced Operation	Status of Operation	Comments
Old Mapoon	1893	Closed in 2000	Nearest BoM long-term weather station. No longer in Operation
Weipa Eastern Ave and Weipa Airport	1914	In operation	Weipa Airport data has been added to Weipa Eastern Ave data, where Weipa Eastern Ave data is unavailable
Pisolite Hills	2008	Removed in 2014	Nearest privately owned weather station
Bauxite Hills	2014	In operation	Onsite weather station

The data obtained from these weather stations has been used collectively to describe the historical climatic patterns within the vicinity of the Project. Historical data is presented as an indicative guide to future climatic trends, cycles and extremes.

3.1.1 Temperature

Temperature data for Old Mapoon, Weipa and the Pisolite Hills project area are presented in (**Table 3-2**). The local monthly mean minimum and maximum temperatures indicate that the hottest months of the year for the Project are typically October, November and December, ranging from 34 to 36.1 degrees Celsius (°C). The coolest months of the year across all weather stations are July and August, with monthly mean minimum temperatures ranging from 17.5°C to 18.9°C.

Table 3-2 Monthly mean maximum and minimum temperatures

Month	Old Mapoon		Weipa Eastern Ave		Pisolite Hills	
	Mean Minimum Temperature (°C)	Mean Maximum Temperature (°C)	Mean Minimum Temperature (°C)	Mean Maximum Temperature (°C)	Mean Minimum Temperature (°C)	Mean Maximum Temperature (°C)
January	22.5	32.7	24	31.9	23.4	32.4
February	22.5	33	24	31.4	23.6	33.1
March	22.2	33	23.6	31.7	23.3	33.1
April	21.9	32.8	22.5	32	22.8	33.1
May	20.5	31.4	21.3	31.6	19.9	32.1
June	18.8	30.4	19.5	30.6	18.7	31.5
July	18.1	30.3	18.9	30.4	18.4	30.9
August	18.1	30.6	18.8	31.6	17.5	32.3
September	19.2	32.4	20	33.3	19.6	33.6
October	20.7	34	21.4	34.8	21.6	35.6
November	21.7	35	23.2	34.7	22.2	36.1
December	22.5	34.7	23.9	33.3	23.2	35

Note: data for Pisolite Hills were obtained via the Project weather station between December 2008 and January 2013

3.1.2 Rainfall

Rainfall data for Old Mapoon, Weipa and the Pisolite Hills project area are presented in **Table 3-3**. The mean annual rainfall at the broader Project area ranges between 1,640 mm at Old Mapoon to 1,768.8 mm at Weipa. December to March is generally accepted as the monsoon period, with rainfall during this time accounting for over 80% of the Project's total yearly rainfall. The Project area can typically experience 90 days of precipitation per annum. The driest period is between June and August where mean rainfall is less than 2 mm for these months.

Table 3-3 Monthly mean rainfall

Month	Mean Rainfall (mm)		
	Old Mapoon	Weipa Eastern Ave	Pisolite Hills
January	421.1	448.8	425.3
February	411.2	444.9	361.8
March	308.4	347.4	337.8
April	94.8	108.1	136.6
May	18.7	16.8	9.2
June	4.2	4.3	1.5
July	2.7	1.7	3.7
August	1.1	2.8	23.3
September	4.0	5.6	8.3
October	11.1	25.2	40.2
November	63.8	103.0	106.5
December	228.9	259.6	286.1
Total	1,640.0	1,768.8	1,740.1

Note: data for Pisolite Hills were obtained via the Project weather station between December 2008 and January 2013

3.1.3 Relative Humidity

Relative humidity data for Weipa and the Pisolite Hills project area are presented in **Table 3-4**. Relative humidity at the broader Project area typically peaks in February before reducing each month until September / October. Relative humidity at 9 am is consistently reported higher than that at 3pm. No humidity data is available for the Old Mapoon weather station.

Table 3-4 Monthly mean relative humidity

Month	Weipa Eastern Ave		Pisolite Hills	
	Relative Humidity at 9am (%)	Relative Humidity at 3pm (%)	Relative Humidity (Minimum)	Relative Humidity (Maximum)
January	85	75	63.7	98.8
February	87	78	61.5	99.0
March	84	73	60.0	98.9
April	80	62	54.7	97.4
May	78	57	52.1	97.6
June	77	53	50.0	96.7
July	76	51	52.0	95.8
August	73	46	41.6	96.0
September	68	44	40.5	94.1
October	60	46	37.2	94.8
November	70	53	38.0	95.6
December	78	65	48.6	97.8
Annual	77	59	50.01	96.85

Note: data for Pisolite Hills were obtained via the Project weather station between December 2008 and January 2013 and recorded only minimum and maximum values.

3.1.4 Wind

Wind data for the Weipa Eastern Ave weather station is presented at **Table 3-5.**

Table 3-5 Monthly mean wind speed

Month	Weipa Eastern Ave	
	Mean Wind Speed at 9 am (km/h)	Mean Wind Speed at 3 pm (km/h)
January	4.4	8.4
February	3.9	8.6
March	5.2	7.9
April	7.6	8.7
May	8.6	10.1
June	8.3	10.1
July	8.1	11
August	8.4	11.3
September	9.8	11.8
October	9.1	11.1
November	6.4	10
December	4.5	8.3
Annual	7	9.8

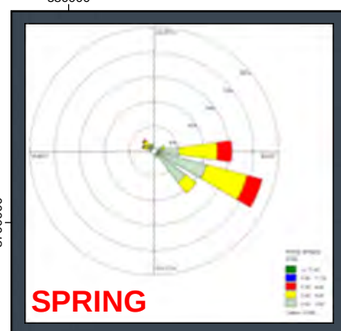
Weipa recorded its windiest month in September. The calmest month has been recorded as January at 9 am. Measured monthly mean wind speeds range from 4.4 to 11.8 km per hour (km/h). No wind data are available for Old Mapoon or Pisolite Hills.

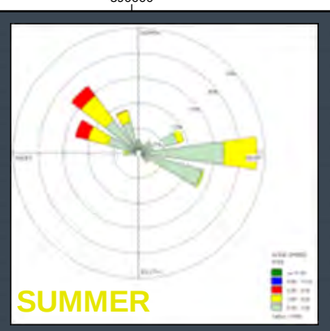
Wind roses demonstrate the annual mean wind direction at Weipa Eastern Ave weather station is predominantly from the southeast **(Figure 3-1)**. Seasonally, winds tend from northwest to southeast and rarely blow from the north or south direction.

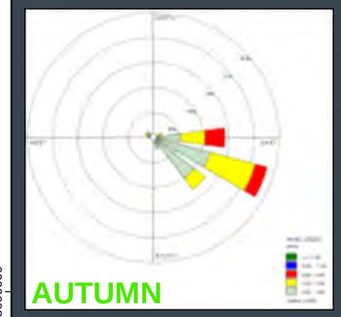
High winds occurring as a result of cyclones can cause structural damage and present a safety risk from flying debris. Rehabilitation is at risk of damage from high winds, including defoliation and windthrow of trees. Species adapted to the local climate will be utilised in rehabilitation to maximise the ability of revegetated areas to withstand these types of storms and regenerate quickly.

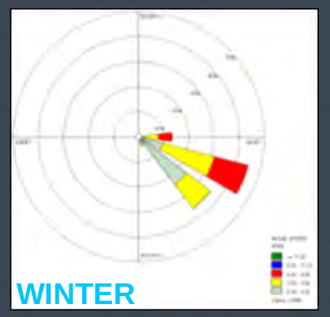
All plant and infrastructure facilities will be designed and constructed to the relevant Australian Standards to reduce the risk of structural damage caused by high wind speeds.

Potential impacts and risks associated with natural hazards such as flooding, bushfires, tropical storms, climate change and coastal inundation will be assessed as part of the EIS.









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SKARDON RIVER

Barge Loading Area

Haul Road

Alternate Haul Road

SUMMER

WINTER

SPRING

AUTUMN

Haul Road

Alternate Haul Road

Camp Site

NAMALETA CREEK

NAMALETA CREEK

DULHUNTY RIVER

MAPOON

DUCIE RIVER

PARGOM CREEK

Legend

- Town
- Watercourse
- Camp Site
- Haul Road
- Alternate Haul Road
- Barge Loading Area
- Pit Extents
- Mine Lease Area

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GCS GDA 1994 MGA Zone 54

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DATA SOURCE
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FIGURE 3-1

SEASONAL WIND DIRECTIONS

DRG Ref: **BES150115-035-R1_WIND**

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3.2 Land

3.2.1 Geology

The Project bauxite deposits are located within the Carpentaria Basin, a sub-basin of the GAB. The bauxite occurs on plateaus as the upper part of a Quaternary / Tertiary loose, pisolitic, laterite profile that is up to about 15 m thick. Quaternary alluvial deposits of silt, clay and minor sand occur in the valleys associated with the rivers. The alluvial deposits are derived from Palaeozoic basement rocks that sub crop in the Eastern Highlands.

The bauxite is formed from weathering and leaching of shales and siltstones of the underlying Tertiary / Cretaceous Bulimba Formation and Lower Cretaceous Rolling Downs Group. This has resulted in a "classic" lateritic profile; an upper bauxite layer which is up to 5 m thick, grades over a narrow interval into ferricretes which in turn grade into mottled and silty clays, including kaolinite, with some sandy clay layers. The clays in turn grade into the parent rock at depth, being generally dark grey Cretaceous shales and siltstones. Refer to **Table 3-6** for a description of the stratigraphy present within the study area.

Table 3-6 Stratigraphy of study area

Period	Sub-Group/Formation	Dominant Lithology
Quaternary	Surficial Beach Sand Deposits	Sands.
	Valley Cut and Fill Deposits	Silts and sands of alluvium channel deposits (creek estuarine areas). Alluvium can be very kaolinitic as a result of re-working of source material from the pallid zone of the Rolling Downs Group or Bulimba Formation.
Tertiary	Bulimba Formation (Wyaaba Beds)	Variable lithology, ranging from claystone (often kaolinitic) to coarse grained unconsolidated sands, or cemented cobble conglomerate. Bauxite laterite develops at the top of the formation. Comprises localised sandy, permeable deposits of ancient stream channels.
Mesozoic	Rolling Downs Formation	Marine clays, fine grained clastics, mudstones and some sandstone lenses.
	Gilbert River Formation	Sandstone interbedded with siltstone and conglomerate units.

Exploration holes were drilled to a maximum depth of 30 m with most holes being around 5 m depth. The lithological logs indicate that the general stratigraphic profile beneath the Project can be summarized as:

- Topsoil of 0 to 0.6 m;
- Bauxite 0.6 to 5 m;
- Ferricrete 5 to 6 m;
- Mottled silty clay (kaolin) 6 to 30 m; and
- Grey siltstone or sandstone > 30 m.

The underlying sequence consists of about 800 m of shales, siltstones and sandstones overlying granite and metamorphic basement rocks which form the ancient, stable rock platform of the continent. A typical stratigraphic profile of the Western Cape region is shown at **Figure 3-2.** At the Project site, the kaolinite clay locally reaches a thickness of up to 12 m (AGE, 2011).

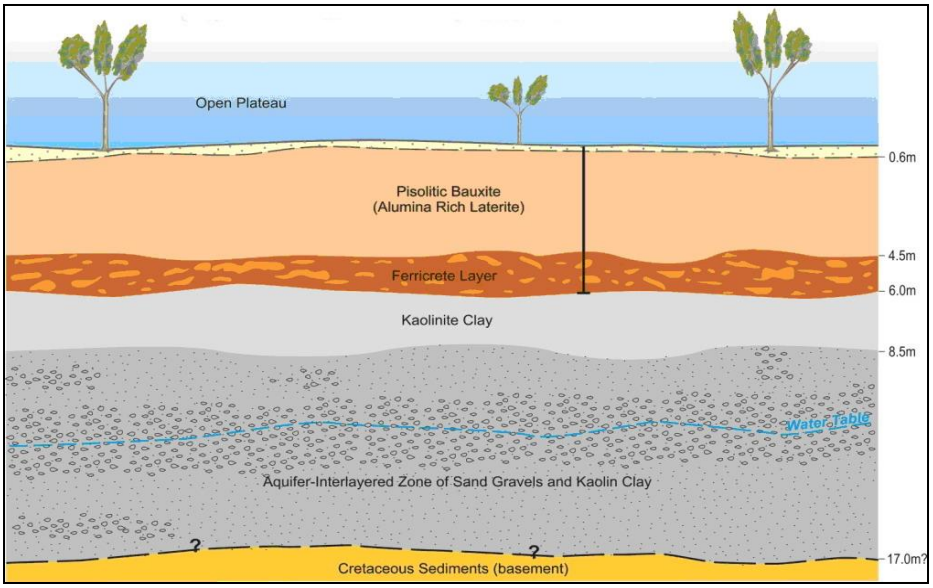

Figure 3-2 Typical stratigraphic profile of Western Cape region (after AGE 2011)

3.2.2 Topography

The Project mining is located on bauxite plateaus that surround the Skardon River. Mine pit areas are proposed across an elevation range of approximately 6 metres Australian Height Datum (mAHD) to 16 mAHD. The plateaus are non-undulating and exhibit moderate slopes of approximately 0.6% (BH1 MLA) and 0.3% (BH6 West MLA). Steeper slopes are encountered along the fringes of the Skardon River.

The BH1 MLA boundary is surrounded to the north and south by tidal zones of the Skardon River and main tributary, respectively. To the east, a ridge rises between these major drainage lines and is characterised by tributary gully formations that feed the main channels.

The BH6 West MLA is divided by a ridgeline running parallel to the main tributary of the Skardon River. The western boundary is characterised by a series of swamps, coastal dunes and low lying coastal zones that are tidally influenced. The eastern boundary rises up a ridge that forms the divide between the Skardon River and Namaleta Creek catchments**. Figure 3-3** is a visual representation of the topography of the study area.

Vegetation types in the study area include medium to tall Eucalypt woodland, grassland, mangrove communities surrounding the Skardon River estuary and open Melaleuca wetlands around creeks.

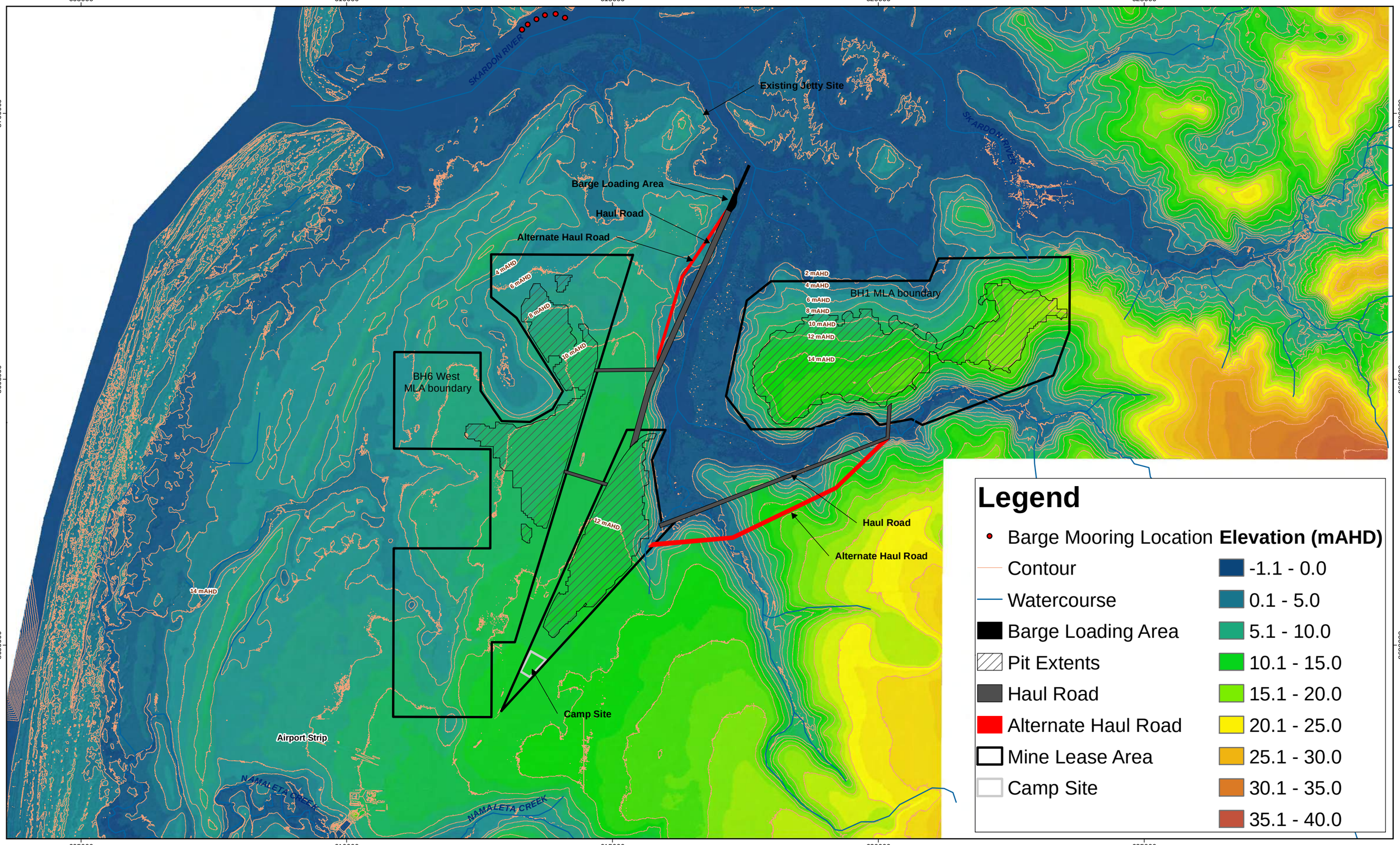

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FIGURE 3-3

TOPOGRAPHY

DRG Ref: **BES150115-007-R1_TOPO**

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3.2.3 Soils

Broad scale soil mapping on Cape York Peninsula was first undertaken as a part of the compilation of the Atlas of Australian Soils (Isbell *et al.*, 1968). In 1992, the Cape York Peninsula Land Use Strategy (CYPLUS) was developed to assist government make sustainable land use and planning decisions regarding Cape York Peninsula. CYPLUS included a soil survey and agricultural land suitability assessment (Biggs and Philip, 1995). This assessment used site and chemical analysis data from previous soil surveys as well as profile descriptions and chemical analyses from a new field survey to produce detailed soil descriptions and a soil map at a scale of 1:500,000.

Biggs and Philip (1995) also identified and described seven soil landscapes on the Cape York Peninsula based on distinctions in physiography and geology as well as elements of vegetation and current land use. These soil landscapes are useful for providing an overview of the soils and explaining their position in the landscape. The soil types mapped for the Project area are listed in **Table 3-7**and shown in **Figure 3-4**.

Table 3-7 Soil types mapped in the Project area

Legend	Dominant Soil	Concept	Great Soil Group[1]	Aust. Soil Class[2]	Landform	Assoc. Soils
Soils of the Rolling Downs Group and Laterised Bulimba Formation						
Wp	Weipa	Deep gradational or uniform red massive soils with aluminous concretions	Red Earth	Red Kandosol	Plains	Ad, Mp
Bv	Batavia	Deep Gradational mottled yellow soils with nodules (F,N,M)	Yellow Podzolic	Yellow Dermosol	Hillslopes, plains	Ml Ld Pn Sp Br Hk
Soils on the Coastal Margin – Estuarine and near coastal plains						
Sd	Skardon	Recent estuarine deposits under mangrove	No suitable group	Intertidal Hydrosol	Tidal flats, estuarine	Go, Mn
Soils on the Coastal Margin – Beach ridge and dune deposits						
Cv	Caravan	Deep to very deep coloured uniform sands formed in beach ridges on chenier and beach ridge plains	Siliceous sands	Othic Tenosol	Coastal margin associated with younger sand dune deposits and beach ridges. Very minor distribution	Mn
Soils the Drainage Lines and Swamps						
Mp	Mapoon	Deep duplex or Gradational soils with dark loamy surface over mottled grey clay	Humic gley	Redoxic Hydrosol	Swamps, drainage depressions	Wp Ad Kd Ab

1. Australian Soil Classification (Isbell, 2002).
2. Great Soil Group (Stace *et al.*, 1968).

600000 605000 610000 615000 620000 625000

8705000 8700000 8695000 8690000

Legend

- Soil Sampling Location
- Watercourse
- Pit Extents
- Barge Loading Area
- Haul Road
- Alternate Haul Road
- Camp Site
- Metro Mining Mine Lease Area

Mapped soils of the Cape York Peninsula (1995)

- Bt-Deep Gradational or Uniform red massive soil with ferruginous nodules formed on remnant surfaces.
- Bv-Deep Gradational mottled yellow soil formed on siltstone, mudstone or claystone
- Cv-Deep to very deep coloured Uniform sands formed in beach ridges on chernier and beach ridge plains.
- Cx-Deep Uniform or Gradational red massive soils on alluvial plains within the Rolling Downs Group.
- Gv-Deep uniform bleached sand over coffee rock formed on drainage depressions and footslopes on northern sandstone
- Hm-Deep gradational bleached yellow massive soils formed on sandstones
- Mn-Very deep uniform frequently cracking saline grey clays formed on marine plains
- Mp-Deep duplex or gradational soils with a dark loamy surface over a mottled grey clay formed in swamps
- Sd-Recent estuarine deposits under mangroves
- Ss-Very deep uniform coastal sands deposited on laterite and other surfaces
- Wp-Deep gradational or uniform red massive soil with aluminous concretions

SKARDON RIVER

NAMALETA CREEK

SS01 SS02 SS03 SS04 SS05

Barge Loading Area

Haul Road

Alternate Haul Road

BH1 MLA boundary (ML 20676)

BH6 West MLA boundary (ML 20689)

BH6 East MLA boundary (ML 20688)

Haul Road

Alternate Haul Road

Camp Site

600000 605000 610000 615000 620000 625000

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Notes:

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Scale @ A3 - 1:85,000

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FIGURE 3-4

SOIL TYPES AND SAMPLE LOCATIONS

DRG Ref: **BES150115-006-R1_SOIL**

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3.2.3.1 Soil Chemical and Physical Properties

The soils in the mining areas are considered to be chemically and physically poor, typical of those associated with the woodlands of the bauxite plateau. Results from sampling at the site indicate the sites soils a generally low in nitrogen, phosphorus and total organic carbon. Total iron concentrations were considered high which was evident on site due to the rich red soil colour. Soil salinity was considered low and pH was generally within the neutral range. The soils were typically not dispersive as the ESP was below the LOR (<0.1%) and the Emerson crumb test confirmed the structure of the soil.

Laboratory Electrical Conductivity (EC) analysis on the Weipa soil type indicate this soil type has low salinity (EC < 0.5 deciSiemens). Low chloride levels throughout the soil profiles for these soil types indicate good drainage. Soil profiles sampled and analysed ranged between non-sodic (ESP<6) and slightly sodic (ESP=6), and exchangeable sodium and cation exchange capacity (CEC) concentrations are very low. The low CEC concentrations make ESP results less meaningful in these soils.

The Weipa soil type is extremely infertile with low levels of Colwell extractable phosphorus (<1mg/kg) and very low exchangeable potassium (<0.35mg/kg). The average calcium / magnesium (Ca/Mg) ratio in the top 30cm is 1.6, and at 50-60cm depth the average Ca/Mg ratio is 0.95. These ratios are within the range considered desirable for good plant growth. At depths below 70cm the Ca/Mg ratio is on average 0.8, indicating an imbalance that could result in calcium deficiency and poor root growth if that layer was exposed at the surface during rehabilitation. Nutrients such as nitrogen, calcium and potassium are concentrated in the surface 10cm of soil, due to nutrient recycling in the litter layer. This layer represents the main nutrient storage capacity for tropical soils, and therefore would need to be preserved to facilitate rehabilitation following mining.

Soils in the lower lying areas of the Project, that will not be mined, are of marine origin and contain iron sulphides that on exposure to air and water react to produce acid i.e. Acid Sulfate Soils (ASS).

The Australian Soil Resource Information System (ASRIS), developed by CSIRO, provides predictive ASS mapping across Australia. From the ASRIS mapping, the mangrove and riparian habitats are identified as areas with the greatest potential to generate ASS. The potential to generate ASS decreases away from the Skardon River and associated tributaries, with low potential within the woodlands and grasslands. Preliminary ASS indicated the presence of Actual ASS (Titratable Actual Acidity >0.02% sulfur) in a number of samples from surface level to 0.5 metres below surface level within the Project area.

3.2.4 Land Use Suitability

The suitability of the soils of Cape York Peninsula were assessed by Biggs and Philip (1995) for a number of land uses using the methods described by the former Department of Primary Industries (DPI) (1990). Interpreting land suitability using these methods was used previously in the Planning Guidelines: The Identification of Good Quality Agricultural Land (DPI and DHLGP 1993). The following five land uses were directly assessed by Biggs and Philip (1995):

- Peanut cropping;
- Sorghum and maize cropping;
- High input pastures;
- Medium input pastures; and

- Low input pastures.

These land uses were chosen because they are currently practiced at certain locations on the Cape York Peninsula.

The suitability of each of the soil types present on the Cape York Peninsula was assessed for each of the above land uses by Biggs and Philip (1995). Land suitability of the Cape York Peninsula was mapped at a scale of 1:700,000 and was based on the suitability of the dominant soil type of each map unit, and the dominant soil types were based on soil survey data from air photo interpretation and ground observations. Biggs and Philip (1995) mapped most of the Cape York Peninsula north of Aurukun as "land suitable for low intensity grazing of native pastures."

A land suitability assessment for a range of soil types was also undertaken by Rio Tinto Alcan, including for the Weipa soil type that is dominant across the Project area. The outcome of the land suitability assessment found that the Weipa soil type is not considered to be good quality agricultural land or suitable for improved pasture land uses. The Weipa soil type does; however, have some potential for low intensity grazing of native pasture uses. Land suitable for low intensity grazing of native pastures represents native pasture grazing land with a very low fertility status; however, it is often associated with areas suitable for pastoral development and is a useful component of the total grazing system. Soils associated with estuarine areas (Skardon soil type), near coastal plains (Caravan) and soils associated with drainage lines (Batavia) and swamps (Mapoon) within the Project area are not suitable for any improved pasture or native pasture grazing land uses. The finding of the Rio Tinto Alcan South of Embley EIS – land suitability assessment (located in Weipa) was consistent with the Biggs and Philips (1995) assessment.

3.2.4.1 Contaminated Land

A search of the EHP EMR and CLR was undertaken to determine whether a notifiable activity had been undertaken within the Project area. Land that has been used for a notifiable activity, of which the EHP has been advised, is recorded on the EMR. The EMR provides information on historic and current land uses, including whether the land has been, or is currently used for a notifiable activity, or has been contaminated by hazardous material.

The CLR includes land that has been proven (through investigation) to be contaminated, and is causing or has the potential to cause serious environmental harm. Therefore, land will only be recorded on the CLR when an investigation shows it is contaminated and action must be undertaken to remediate or manage the land. There are no land parcels within the Project area that are listed on the CLR.

The search of the register indicated Lot 11 of SP 204113, Lot 12 of SP 204113 and Lot 13 of SP 204113 are listed on the EMR for Chemical Storage, Landfill, Petroleum Product or Oil Storage. The EMR listing is likely to be associated with the historical mining activities undertaken by others in the broader area.

3.2.5 Potential Impacts

Construction works and mining will involve clearing and earthworks for mining pit development, internal access roads / haul roads, equipment and materials laydown areas, excavation for water management systems, site preparatory works and establishment of buildings and workshops, and construction of the barge loading facility. The construction activities will include earthworks for excavation, re-profiling, regrading, stockpiling, and drainage and water storage structures.

During operation, major activities will relate to the extraction of bauxite, the management of erosion and sedimentation, including diverting clean water away from work areas, and collection of dirty water in sediment ponds and the implementation of progressive rehabilitation.

3.3 Landscape and Visual Amenity

There are limited sensitive receptors within a 40 km radius of the Project (refer to **Figure 3-5**). The town of Mapoon is the most populated sensitive receptor and is located approximately 35 km from the MIA and 16 km from the mining lease boundary. Given the distance, and the intervening forests and mangroves, infrastructure from the Project is not expected to be visible from Mapoon.

The most significant vantage point for visual amenity impacts will be from the Skardon River itself, given the location of the product stockpiles beside the river and the construction of the barge loading facility and its extension part-way into the river. As there is limited vehicle access into the area, any access to the Skardon River is most likely achieved by boat from Mapoon, Weipa and/or possibly Bamaga, by Traditional Owners and for recreational fishing.

3.3.1 Potential Impacts

The visual amenity values and potential impacts associated with the Project are relatively low, given that the dense and / or tall woodlands and mangroves within the vicinity of the mine tend to limit the local viewshed. Given the limited access, distance from the closest sensitive receptors, it is unlikely that daytime activities onshore or at sea will be observable from Mapoon or the Skardon River mouth. There may be some lighting visible from ships at mooring or underway at night; however, this will be managed by limiting lighting to the minimum required under current shipping laws.

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Mouth Of Skardon River
Barge Loading Area
Haul Road
Alternate Haul Road
SKARDON RIVER
ML 20689
BAUXITE HILLS 6 WEST
(BH6 WEST)
ML 20676
BAUXITE HILLS 1
ML 20688
BAUXITE HILLS
6 EAST
(BH6 EAST)
Haul Road
Alternate Haul Road
Accomodation Village
Airport
Camp Site
NAMALETA CREEK
NAMALETA CREEK
Mapoon
Residential
Houses
JANIE CREEK
DUCIE RIVER
PARGON CREEK
DULHUNTY RIVER

Legend

- Sensitive receptor
- Watercourse
- Camp Site
- Barge Loading Area
- Haul Road
- Alternate Haul Road
- Pit Extents
- Mine Lease Area

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FIGURE 3-5

SENSITIVE RECEPTORS

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3.4 Marine Ecology

The Gulf of Carpentaria is a large and relatively shallow body of water which is enclosed on three sides by the Australian mainland and bounded on the north by the Arafura Sea. The Gulf of Carpentaria can be subject to seasonal fluctuations in sea level (up to 0.5 m) as a result of trade winds (e.g. during the monsoon) and forcing from the Arafura Sea (Wolanski, 1993). These seasonal sea level fluctuations can result in large areas only being inundated by tides in the summer months (during the monsoon), as a result these areas cannot support mangrove or freshwater vegetation and therefore form salt flats.

The Skardon River and adjacent inshore and off-shore areas encompass several marine habitats, including; saltmarsh, mangroves, seagrass, rocky reef, oyster reef, coral reef and broad areas of intertidal and sub tidal soft substrates that are either bare or variably colonized by macroinvertebrates and macroalgal communities.

The majority of sub tidal benthic habitats within the Skardon River estuary are dominated by open bare substrates of silt, silty/sand, sand and rock. Only a very limited live benthic cover has been recorded within the Skardon River. Of the live cover recorded, macroalgae was dominant. Macroinvertebrates were greatest within rocky shoals and rubble fields which provide stable substrate for colonisation. These habitats include a range of macroinvertebrates dominated by sponges and ascidians, and brown macroalgae. Several intertidal areas of oyster rock/reef have been identified adjacent to mangrove banks.

Intertidal habitats surrounding the entrance to the Skardon River are dominated by sand beaches, exposed to prevailing wind and waves from the Gulf of Carpentaria. As the shoreline progresses into the estuary and river system, silty sands and muds begin to dominate the intertidal substrate. This is accompanied by an increasing mangrove habitat, and decline in exposed sandy shores, ironstone banks and Casuarina sp. habitat. The distribution of intertidal mud and sand banks at the entrance and inner estuary system is quite extensive; however, as the river progresses upstream the width of the primary waterway narrows. The edge of the banks become steeper, particularly on the outer bank curves, favoring the establishment of mangroves such as the *Rhizophroa* sp. Further upstream within the small tributaries, the channels may dry completely or almost completely at low tide. These intertidal habitats are predominately bare mud and silty/sand with the presence of some isolated patches of filamentous algae and oyster beds having been recorded (Roleof *et al*., 2002 and PaCE, 2015)

Nearshore rocky reef habitat containing significant coral and soft coral cover has been identified approximately 5 to 7 km southwest of the entrance to the Skardon River. Given the shallow depths and risk of grounding, operational activities are not proposed within this near shore zone.

Surveys of the Skardon River have identified areas of seagrass are various locations within the river system. Surveys undertaken in 2014 identified areas of seagrass within the vicinity of the existing barge loading facility and extending beyond the location of the barge facility proposed for the Project. Seagrass species that were present include Narrowleaf Seagrass (*Halodule uninervis*) and Paddle Grass (*Halophila dicepiens)*.

3.4.1 Conservation Significant Species

Several marine fauna species of State and / or Commonwealth importance have the potential to occur in and around the Project area including turtles, cetaceans, sharks, sawfishes, crocodile, dugong, sea snakes and migratory birds. The marine species that are known to occur or have potential to occur within the broader Project area are listed at **Table 3-8**. The listing status under

the EPBC Act, the *Nature Conservation Act 1992* (NC Act) and the International Union for Conservation of Nature (IUCN) are included.

Table 3-8 Conservation status listed species that are known to occur or highly likely to occur

Species	EPBC Act Listing	NC Act Listing	IUCN Status
Marine Reptiles			
Flatback turtle ***Natator depressus***	Vulnerable, migratory marine species, listed marine species	Vulnerable	Not assessed
Loggerhead turtle ***Caretta caretta***	Endangered, migratory marine species, listed marine species	Endangered	Endangered
Green turtle ***Chelonia mydas***	Vulnerable, migratory marine species, listed marine species	Vulnerable	Endangered
Olive Ridley turtle ***Lepidochelys olivacea***	Endangered, migratory marine species, listed marine species	Endangered	Vulnerable
Hawksbill turtle ***Eretmochelys imbricate***	Vulnerable, migratory marine species, listed marine species	Vulnerable	Endangered
Estuarine crocodile ***Crocodylus porosus***	Migratory marine species, listed marine species	Not listed	Least concern
Sea snakes (19 species)	Listed marine species	Not listed	Not assessed, Least Concern or data deficient
Mammals			
Dugong ***Dugong dugon***	Migratory marine species, listed marine species	Vulnerable	Vulnerable
Indo Pacific humpback dolphin ***Sousa sahulensis***	Migratory marine species, whales and other cetaceans	Near threatened	Near threatened
Australian snubfin dolphin ***Orcaella heinsohni***	Migratory marine species, whales and other cetaceans	Near threatened	Near threatened
Bryde's whale ***Balaenoptera edeni***	Migratory marine species, whales and other cetaceans	Not listed	Data deficient
Spotted dolphin ***Stenella attenuate***	Whales and other cetaceans	Not listed	Least concern
Bottlenose dolphin ***Tursiops* sp.**	Whales and other cetaceans	Not listed	Least concern
Fish and Sharks			
Speartooth shark ***Glyphis glyphis***	Critically endangered	Not listed	Endangered
Dwarf sawfish ***Pristis clavata***	Vulnerable	Not listed	Endangered
Largetooth sawfish ***Pristis pristis***	Vulnerable	Not listed	Critically endangered
Green sawfish ***Pristis zijsron***	Vulnerable	Not listed	Critically endangered
Pipefishes (33 species)	Listed marine species	Not listed	Not assessed, Least Concern or data deficient

3.4.1.1 Marine Turtles

Four turtle species, the Loggerhead Turtle (*Caretta caretta*), Hawksbill Turtle (*Eretmochelys imbricate*), Olive Ridley turtle (*Lepidochelys olivacea*) and Flatback Turtle (*Natator depressus*) have been identified as having potential to occur within the Project area. Marine turtles nest on beaches throughout the western Cape York region. The barge loading facility is situated within a mangrove fringed estuary environment within the Skardon River, with no suitable nesting habitat. As such it is not anticipated that the Project will impact upon turtle nesting habitat.

3.4.1.2 Estuarine Crocodiles

The Estuarine Crocodile (*Crocodylus porosus)* inhabits coastal and inland waterways from Gladstone to Cape York and through the Gulf of Carpentaria to the Queensland/ Northern Territory boarder (Read *et al.,* 2004) with the majority of the population occurring in tidally influenced areas (Fukuda *et al.,* 2007). The habitat of the Estuarine Crocodile includes marine habitats such as mangroves, but they also commonly occur in freshwater habitats such as rivers, lakes and swamps.

The Port Musgrave area, and in particular, the Wenlock River, is recognised as containing significant habitat for the Estuarine Crocodiles with one of the largest breeding populations in Queensland (Abrahams *et al.,* 1995; Read *et al.,* 2004; EHP, 2013). Crocodile have been recorded within the vicinity of the Project area.

3.4.1.3 Sea Snakes

The sea snake fauna has been assessed in detail in the Weipa area, and the dominant sea snake species is the Spine-bellied Sea Snake *(Lapemis hardwicki)* comprising approximately 90% of the sea snake fauna (Redfield *et al.,* 1978). Other species recorded in the Weipa area include:

- Peron's sea snake (*Acalyptophis peronii);*
- Reef shallows sea snake (*Aipysurus duboisii);*
- Olive sea snake (*Aipysurus laevis);*
- Stokes' sea snake (*Astrotia stokesii);*
- Common sea snake (*Enhydrina schistose);*
- Elegant sea snake (*Hydrophis elegans)*; and
- Reef sea snake (*Hydrophis ornatus)*.

Whilst the aforementioned species have been recorded from multiple locations elsewhere in the Gulf of Carpentaria (Redfield *et al*., 1978) there are no specific studies that have examined the sea snake fauna specifically at the sites of the proposed development.

3.4.1.4 Dugong

Dugong (*Dugong dugon)* are abundant at many locations in the Gulf of Carpentaria and are usually associated with seagrass beds. A major proportion of dugongs in the Gulf of Carpentaria occur in the region of the Wellesley Islands, the Sir Edward Pellew Group, and Blue Mud Bay (Saalfield and Marsh, 2004). Of the estimated 27,602 (± 3,110) Dugong in the Gulf of Carpentaria, only 15% occurred in the waters of the Queensland coast, reflecting the much greater area of seagrass along the Northern Territory coast (Saalfield and Marsh, 2004).

A single sighting for Dugong has been recorded upstream within the Skardon River adjacent to the now decommissioned kaolin facility and barge ramp (Roelofs *et al.,* 2002). The Project is not at or adjacent to seagrass habitat that constitutes important dugong habitat. The main feeding locations for dugong in the Gulf of Carpentaria are known and are remote from the Project location.

3.4.1.5 Whales and Dolphins

No whales or dolphins (cetaceans), that are listed by the state or Commonwealth as threatened species are likely to occur at or adjacent to the proposed Project location. All cetacean species are; however, given specific protection under the EPBC Act as listed "whales and other cetaceans" and in a number of instances, migratory/marine species. Five species have been identified as having potential to occur at, or adjacent to, the Project location: Indo-Pacific Humpback Dolphin (*Sousa sahulensis*), Australian Snubfin Dolphin (*Orcaaella heinshoni*), Bottlenose Dolphin (*Tursiops* sp.), Spotted Dolphin (*Stenella attenuate*) and Bryde's Whale (*Balaentoptera edeni*).

3.4.1.6 Fish and Sharks

The Speartooth or Bizant River Shark (*Glyphis glyphis*) have been recorded from the lower reaches of the Wenlock and Ducie Rivers and Port Musgrave as well as the Bizant River, and a number of river systems in the Northern Territory (Peverell *et al*., 2006). From a limited amount of tagging work, Speartooth Sharks are considered to move up and down an estuary system with the tide and repeatedly use the same available habitat (Pillans *et al.,* 2010). Given the habitat preference of the species it possibly occurs in the Skardon River.

The Dwarf Sawfish (*Pristis clavata*) occurs on sand and mudflats and upstream estuarine habitats, including in inundated mangrove habitats that the species access at high tides (Peverell, 2005; Stevens *et al.,* 2008). Given the habitat preference of the species it has potential to occur in the Skardon River and may also occur at, and adjacent to, the proposed barge loading facility.

The Largetooth Sawfish (*Pristis pristis*) utilises both marine and freshwater habitats, but does not generally extend into coastal habitat such as the flats at the mouth of rivers, and appears to have a preference for waters of low salinity (Thorburn *et al.,* 2004). Given the habitat preference of the species it has potential to occur in the Skardon River and may occur at and adjacent to the barge loading facility. Given the salinity during the dry season is ambient seawater and the species appears to have a preference for lower salinity water, the area around the barge loading facility is unlikely to constitute as a critical habitat, at least during the dry season.

The Green Sawfish (*Pristis zijsron*) is considered to be widely distributed throughout the Gulf of Carpentaria; however, it has a preference for sand and mud flats outside of river mouths (Peverell, 2005). It frequently utilises very shallow water (< 1 m) and an individual animal commonly uses the same small patch of habitat repeatedly (Peverell and Pillans, 2004 and Stevens *et al.,* 2008). Given the current information on the habitat preference of the Green Sawfish, it is unlikely to be present at, or adjacent to, the barge loading facility. Individuals may occur at the Skardon River entrance shoals and at the transshipping location on the basis that adults are known to extend into deeper waters in the vicinity of river mouths.

3.4.1.7 Pipefishes

The Gulf of Carpentaria also supports rich pipefish populations. The distribution and abundance of pipefishes in the Gulf of Carpentaria is poorly known, but it is known that the species group forms a component of by-catch in the Northern Prawn Fishery. The Project is unlikely to result in any significant impacts to pipefishes.

3.4.2 Potential Impacts

Construction of the proposed barge loading infrastructure will require the disturbance of fringing mangrove and potential minor saltmarsh vegetation communities adjoining the adjacent melaleuca and eucalyptus woodlands of the plateau.

Nearshore rocky reef habitat containing significant coral and soft coral cover has been identified approximately 5-7km south west of the entrance to the Skardon River. These habitats provide substantial resources for turtles and other marine species of conservation significance. Operational activities are not proposed within this nearshore zone given its shallow depths and risk of grounding. The interaction between other benthic habitats such as coral reef, rocky reef and macrophytes and macroinvertebrate communities is limited to the proposed barge route and transhipment anchorages. Some impact on low density mixed benthic communities and bare substrates will also be experienced at the proposed cyclone moorings. The barge route includes predominantly bare sediment substrates, with minor live benthic cover. Potential propwash effects may be experienced along this route where water depths are shallowest; however, impacts are thought to be of negligible consequence.

The proposed options for transhipment contain low density benthic communities. Surveys have concluded a dominance of bare substrates, with live cover being in the order of 1-3%. Localised physical disturbance from anchoring can be expected. The process of selecting the proposed locations has considered avoidance of potentially significant habitats and adjacent environmental management areas. The surveyed areas are also considered representative of the adjacent coastal benthos and habitats within the anchorage zones are likely to be expressed widely.

Impacts on marine plants, seagrass and seagrass meadows associated with the Project activities are not anticipated to be significant. The positioning of infrastructure, the methods of construction (i.e. pile driving) and the absence of dredging or bed levelling will all contribute to reducing the risk of potential significant impacts to marine plants.

The potential impacts of offshore construction on marine turtles include disturbance from vessels and underwater noise from construction and indirect impacts associated with the loss of habitat and onshore lighting. Marine turtles are mobile and can generally avoid impacted areas for the duration of offshore construction activities. The direct and indirect impacts on habitat from construction activities are considered to be negligible and are not likely to impact on the ability of the region to support existing turtle populations. Potential impacts associated with lighting during construction and operation are able to be effectively managed to reduce any potential impacts to the turtle population, particularly in regard to nesting activities.

Given the single record of a Dugong within the Skardon River system it is unlikely that the Project will present a significant impact to the species.

The primary potential impact of the offshore construction on marine mammals is considered to be the generation of underwater noise and vibration. The potential for impacts associated with the transshipment activities will be undertaken as part of the EIS.

3.5 Freshwater Ecology

The Project area is located in the Skardon River catchment, or drainage sub-basin, which covers approximately 439 km^2. While the Skardon River is perennial, many associated watercourses within the Project area are ephemeral and flow only after sustained or intense rainfall. Stream flows are highly variable, with flows typically occurring during the wetter months (November to April), with low to no flow the rest of the year. The Skardon River catchment is part of the broader Skardon River-Cotterell River wetland aggregation, which is listed under the directory of important wetlands (DIWA).

Wetlands associated with the Skardon River-Cotterell River aggregation do occur within the Project area and MLAs, and overlap some of the infrastructure footprint; however, the wetlands do not

occur within the mining footprints. In the western section of the Project area, there are several palustrine wetlands, coastal and sub-coastal floodplains. To the east there are estuarine wetlands. A drainage channel of the Skardon River and estuarine wetland system occurs in the central part of the Project area, while estuarine and palustrine wetlands also occur in the north and south (refer to **Figure 3-6**).

Initial baseline aquatic ecology assessments have been undertaken within the Project area. The Project area supports a relatively low diversity of aquatic flora and fauna species, largely due to the ephemeral nature of the watercourses within the Project area. No threatened aquatic species were recorded during the surveys. Of the species listed with a conservation status, the Largetooth Sawfish is the only one that may be present in the broader Skardon River aquatic environment; however, there is insufficient freshwater habitat across or adjacent the Project area to support juveniles of the species (Peverell, 2005). No other threatened species are predicted as likely to occur within the Project area.

The Estuarine Crocodile and Freshwater Crocodile (*Crocodylus johnsonii*) were the only fauna species of state significance likely to occur within or adjacent the Project area. Suitable habitat for these species is present throughout the estuarine and marine habitats within and adjacent the Project area and also within the ephemeral freshwater streams and swamps within and adjacent the Project area.

The only true freshwater species listed in Back on Track was Waterhole Yabby (*Cherax cartalacoolah*). The Waterhole Yabbie has been recorded on the east coast of Cape York; however, is unlikely to be present within the Project area due to lack of suitable year-long habitat.

The surveys identified 24 families / taxa of macro invertebrates across within the proposed Project area. Greater abundances of Hydrophilidae, Lestidae and Libellulidae larvae were recorded within the Project area. Specimens from one taxa of crab (Parathelphusidae) and crayfish (Parastacidae) were recorded as were three families/taxa of microcrustacean (cladocera, copepod and ostracoda).

Specimens of Empire Gudgeon (*Hypseleotris compressa*) and Checkered Rainbowfish (*Melanotaenia splendida* subsp. *inornata*) were recorded during the surveys. No turtle species or large macroinvertebrates were captured or observed during the surveys.

Melaleuca forest was the dominant vegetation at the wetlands within the Project area. Aquatic/semi aquatic plant species recorded in the understory during the surveys were Native Couch (*Paspalum* sp.), Water Chestnut (*Eleocharis dulcis*) and Water Ribbons (*Triglochin dubia*). The aquatic plant diversity is likely to be higher in the late wet season once species such as *Paspalum* spp. and Water Chestnut re-colonise. One flora species, *Lycopodiella limosa*, listed as near threatened under the NC Act, has previously been recorded 50 km to the east of BH1 (Worley Parsons, 2011a). The species has not; however, been previously recorded within the Project area.

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SKARDON RIVER

Barge Loading Area

Haul Road

Alternate Haul Road

BH1 MLA boundary
(ML 20676)

BH6 West
MLA boundary
(ML 20689)

BH6 East
MLA boundary
(ML 20688)

Haul Road

Alternate Haul Road

Camp Site

Legend

- Watercourse
- Barge Loading Area
- Pit Extents
- Haul Road
- Alternate Haul Road
- Camp Site

Skardon River Wetland Categorisation

- Artificial/ highly modified wetlands (dams, ring tanks, irrigation channel
- Coastal/ Sub-Coastal non-floodplain tree swamps (Melaleuca and Eucalypt)
- Coastal/ Sub-coastal floodplain grass, sedge and herb swamps
- Coastal/ Sub-coastal floodplain tree swamps (Melaleuca and Eucalypt)
- Coastal/ Sub-coastal non-floodplain grass, sedge and herb swamps
- Estuarine - Mangroves and related tree communities
- Estuarine - salt flats and saltmarshes
- Estuarine - water
- Marine
- Riverine
- Metro Mining Mine Lease Area

605000 610000 615000 620000 625000

R	Details	Date
1	For Information Purposes	15/07/15
2	Updated Pit Extents	21/10/15
-	-	
-	-	
-	-	
-	-	
-	-	

DESIGNED	MD	CHECKED	-
DRAWN	MD	CHECKED	-
APPROVED	-	DATE	21/10/15

Notes:

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Metres

Scale @ A3 - 1:65,000
GCS GDA 1994 MGA Zone 54

DISCLAIMER
CDM Smith has endeavoured to ensure accuracy and completeness of the data. CDM Smith assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
MEC Mining;
QLD Government Open Source Data;
Australian Hydrological Geospatial Fabric (Geofabric) PRODUCT SUITE V2.1.1

DESIGNER
CDM Smith
cdmsmith.com

CLIENT
METRO MINING LIMITED

FIGURE 3-6

SKARDON RIVER WETLAND CLASSIFICATION

DRG Ref: **BES150115-005-R1_WETL**

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3.5.1 Potential Impacts

Alterations to water quality and surface water inflows to the swamps and wetland associated with the Skardon River have the potential to impact aquatic ecology values. During mining, minor drainage channels supplying water to the Skardon River and associated swamps and wetlands may be disrupted, potentially altering flows to these watercourses. Surface water flows from areas associated with the Project may carry pollutants including, sediments, hydrocarbons and other chemicals. These would negatively impact water quality of aquatic environs, and lead to potential impacts of aquatic values. Similarly any contamination of groundwater due to Project activities may impact surface waters through groundwater baseflows to these environments.

Land clearing will occur during the construction and operation phases may impact aquatic values. The effects of land clearing relevant to the aquatic ecological values of the Project area may include:

- Increased erosion of soils and runoff to adjacent environs;
- Loss of land stabilisation and riparian filtration functions; and
- Loss of habitat, loss of connectivity between habitat areas and associated diminished fauna movement.

Dust has the potential to enter aquatic habitats, impacting water quality, and reducing photosynthesis of aquatic plants and riparian vegetation. Project activities likely to generate dust include mining, overburden stockpiling, vehicle movements, stockpiling (e.g. topsoil, spoil and product bauxite) and bauxite transport.

As with most ecosystems associated with variable and perennial inundation, aquatic ecology values are likely to be tolerant of significant changes in abiotic conditions. Species colonising these areas can generally tolerate a range of conditions. It is therefore unlikely that the relatively small and temporary increase of baseflow to Bigfoot Swamp that is predicted to occur during mining activities (refer to Section 3.8.1) will significantly alter overall aquatic flora diversity. The area of standing water at Bigfoot Swamp may increase during mining operations; however, at the cessation of mining and following a return to current hydrological conditions, it is likely that Melaleuca trees will recolonise these areas.

Aquatic fauna diversity may increase over time if the size and depth of standing water increases during the dry season and could lead to a temporary shift in aquatic fauna to species that require permanent water to persist. Given the ecologically short mining-life timeframe, it is unlikely that significant changes will occur in this time. Post mining, it is predicted that hydrological conditions would largely return to existing conditions and therefore a return to baseline aquatic flora and fauna assemblages over time.

3.6 Terrestrial Ecology

3.6.1 Threatened Ecological Communities / Regional Ecosystems

Threatened Ecological community (TEC) mapping accessed as part of the EPBC Protected Matters search did not identify any TEC as potentially occurring within the Project area. Field assessments undertaken as part of the baseline surveys confirmed the absence of TECs from within the Project area.

Current RE mapping identified 16 REs as occurring within the Project area. Field assessment undertaken as part of the baseline surveys confirmed the presence of eight of the mapped REs. Five REs not previously mapped for the Project area were also recorded. The REs confirmed by field surveys as occurring within the Project area are listed at **Table 3-9**. Of these, RE 3.3.12 is listed as Of Concern under the *Vegetation Management Act 1999* (VM Act).

Table 3-9 REs occurring within the Project area

Regional Ecosystem		Status		
RE Number	Description	EPBC Act	VM Class	BD Status
3.1.1	Closed forest of *Rhizophora stylosa* ± *Bruguiera gymnorhiza.* Occurs as outer mangroves	-	LC	NOC
3.1.3	*Ceriops tagal* ± *Avicennia marina* low closed forest. Extensive on intertidal areas	-	LC	NOC
3.1.6	Sparse herbland or bare saltpans. Associated with salt plains and saline flats	-	LC	NOC
3.3.12	*Melaleuca quinquenervia* open forest. Associated with scattered coastal swamps	-	OC	OC
3.3.14a	*Melaleuca saligna* ± *M. viridiflora, Lophostemon suaveolens* woodland on drainage swamps	-	LC	NOC
3.3.22a	*Corymbia clarksoniana* or *C. novoguineensis* woodland on alluvial plains	-	LC	NOC
3.3.32	*Melaleuca viridiflora* +/- *M. saligna* woodland in sinkholes and drainage depressions	-	LC	NOC
3.3.42	Low woodland of *Melaleuca viridiflora* +/- emergent *Corymbia clarksoniana* (Clarkson's bloodwood)	-	LC	NOC
3.3.49	*Melaleuca viridiflora* low open woodland on low plains	-	LC	NOC
3.3.51	*Melaleuca acacioides* +/- *Hakea pedunculata* tall shrubland on marine plains	-	OC	OC
3.3.65	Ephemeral lakes and lagoons on alluvial plains and depressions	-	LC	NOC
3.5.2	*Eucalyptus tetrodonta, Corymbia nesophila* tall woodland on deeply weathered plateaus and remnants	-	LC	NOC
3.5.22c	*Corymbia clarksoniana* and *Erythrophleum chlorostachys* and *Corymbia* spp. and *Eucalyptus* spp. woodland on plains	-	LC	NOC

BD = Biodiversity status; LC = Least Concern; NOC = no concern at present;

The field surveys confirmed that the predominant vegetation of the bauxite plateau surfaces comprises LC RE 3.5.2 with characteristic tall grassy woodland of Darwin Stringybark (*Eucalyptus tetrodonta*) and Melville Island Bloodwood (*Corymbia nesophila*) with Cooktown Ironwood (*Erythrophleum chlorostachys*). Woodlands of Tropical Bloodwood (*C. novoguineensis*) and Nonda (*Parinari nonda*), typically occur on plateau margins.

Broad swampy drainage systems occupy the western parts of the Project area, and the margins of the estuaries feature seasonal wetlands and forested swamps consistent with REs 3.3.12, 3.3.14a, 3.3.22a and 3.3.42. Vegetation of these areas includes woodlands and low open forests of a number of paperbark species (Broad-leaved Paperbark (*Melaleuca viridiflora*), *M. saligna*, Coastal Paperbark (*M. quinquenervia*) and Weeping Paperbark (*M. leucadendra*)) in association with Swamp Box

(*Lophostemon suaveolens*) and *C. novoguineensis*. Limited areas of sedgeland and grassland occur on the margins of swamps which hold water to the end of the dry season (RE 3.3.65). Estuarine sediments associated with the Skardon River system occupy the peripheries of the leases. These support mangrove shrublands and forests (RE 3.1.1 and 3.1.3) as well as extensive salt pans (RE 3.3.6) with fringing grasslands of Saltwater Couch (*Sporobolus virginicus*). Mangrove habitats are generally adjoined by paperbark woodlands on narrow alluvial flats.

Two Of Concern REs were confirmed being; open forests of Coastal Paperbark (RE 3.3.12) that occurs in a narrow band running north to south on MLA 20676 and MLA 20689. This RE is likely to be impacted as a result of proposed haul road options. Tall shrubland of the Of Concern' RE 3.3.51 comprising Saltwater Paperbark (*Melaleuca acacioides*) and Hakea (*Hakea pedunculata)*, occur along the landward margins of mangrove shrublands and forests in MLA 20676, but not within the mining or infrastructure footprint. The ground-truthed Of Concern and of Least Concern REs are shown in **Figure 3-7**.

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Existing Gulf Alumina Jetty Site

Barge Loading Area

Haul Road

Alternate Haul Road

BH1 MLA boundary (ML 20676)

BH6 West MLA boundary (ML 20689)

BH6 East MLA boundary (ML 20688)

Camp Site

Haul Road

Alternate Haul Road

Legend

- Watercourse
- Barge Loading Area
- Haul Road
- Alternate Haul Road
- Pit Extents
- Camp Site
- Metro Mining Mine Lease Area
- Vegetation Survey Site (Dry Season)
- Vegetation Survey Site (Wet Season)

Ground-truthed RE

- Of Concern
- Of Least Concern
- Water

R	Details	Date
1	For Information Purposes	16/07/15
2	Updated Pit Extents	21/10/15
-	-	
-	-	
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-	-	

DESIGNED	MD	CHECKED	-
DRAWN	MD	CHECKED	-
APPROVED	-	DATE	21/10/15

Notes:

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0 500 1,000 2,000 Metres

Scale @ A3 - 1:60,000

GCS GDA 1994 MGA Zone 54

DISCLAIMER
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DATA SOURCE
MEC Mining; AMEC, 2015;
QLD Government Open Source Data;
Australian Hydrological Geospatial Fabric (Geofabric) PRODUCT SUITE V2.1.1

DESIGNER

CDM Smith
cdmsmith.com

CLIENT

METRO MINING LIMITED

FIGURE 3-7

GROUND-TRUTHED REs

DRG Ref: **BES150115-031-R2_GROUND_REs**

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3.6.2 Flora

Desktop assessments identified two MNES and four Endangered, Vulnerable or Near Threatened flora species as likely to occur in the broader Project area. Field assessments undertaken as part of the baseline dry and wet season surveys recorded 227 flora species as occurring in the Project area. No threatened flora species or flora species of scientific or bioregional significance were recorded during the surveys.

3.6.3 Fauna

The limited diversity of flora species and vegetation communities, and relatively uniform landform topography and substrate in the Project area supports a low diversity of fauna species. During the surveys, 98 vertebrate species were recorded comprising 8 amphibian species, 18 reptile species, 64 bird species and 8 mammal species.

Analysis of recorded bat calls revealed two species present (Northern Freetail Bat (*Chaerephon jobensis*) and Hoary Wattled Bat (*Chalinolobus nigrogriseus*)). A further 15 species were considered likely to be present, 4 species possibly present and 6 species unlikely to be present within the broader Project area. A further 11 species were identified through desktop assessments as having potential to occur within the Project area but were not detected in the call analysis.

No bird species listed as critically endangered, endangered or vulnerable under the EPBC Act were identified during the field survey. Three species listed as migratory marine, four listed as marine, and three listed as migratory were recorded. These being:

- Migratory marine:
  - Common Sandpiper *(Actitis hypoleucos*);
  - Cattle Egret *(Adrea idris*); and
  - Eastern Great Egret *(Adrea modesta*).
- Marine:
  - Little Egret (*Egretta garzetta*);
  - Dollarbird (*Eurystomus orientalis*);
  - Brahminy Kite (*Haliastur indus*); and
  - Whistling Kite (*Haliastur sphenurus*).
- Migratory:
  - Radjah shelduck (*Tadorna radjah*);
  - Whimbrel (*Numenius phaeopus*); and
  - Little Tern (*Sternula albifrons*).

Both the Cattle Egret and Great Egret were recorded in low abundance on a semi-ephemeral swamp, in groups of six and two respectively. Ephemeral swamps of the survey area provide the most suitable habitat for these species, and it is anticipated that the eastern great egret may also frequent this area. The Whimbrel is a migratory wader, typically associated with estuarine mudflat and

sandbank habitats. On this occasion, the species was only recorded on the Skardon River. Two Radjah Shelducks were recorded on a semi-permanent swamp located in the northwest of MLA20688/20689. There was also a sighting of a Little Tern within the project area.

The Palm Cockatoo (*Probosciger aterrimus*), listed as Near Threatened under the NC Act was recorded infrequently during the surveys. A further two threatened fauna species are considered likely to occur in the Project area, being Black-necked Stork (*Ephipprorhynchus asiaticus)* and Beach Stone-curlew (*Esacus magnirostris)*.

Four bird species listed as being of bioregional significance under the Biodiversity Planning Assessment (BPA) for Cape York were recorded during the surveys, including:

- Black-backed Butcherbird (*Cracticus mentalis*);
- Palm Cockatoo;
- Radjah Shelduck; and
- Whimbrel.

The Agile Wallaby (*Macropus agilis*) was the only macropod recorded in the project area during the surveys.

Three terrestrial mammal species were recorded in the project area during the surveys; Dingo (*Canus lupus/dingo*), Feral Cat (*Felis catus*) and Feral Pig (*Sus scrofa*). It is likely Wild Dog (*Canus lupus familiaris*) are also present within the region.

Four arboreal mammals were recorded during the surveys, all during the late dry season surveys. These being, Sugar Glider (*Petaurus breviceps*), Black Flying-fox (*Pteropus Alecto*), Little Red Flying-fox (*Pteropus scapulatus*) and Common Brushtail Possum (*Trichosurus vulpecula*).

Eighteen reptile species were recorded during the surveys, 17 during late dry season surveys and nine (eight previously recorded) during early wet season surveys. Of those recorded during the early wet season, only one species was not detected in the late dry season surveys – Sand Goanna (*Varanus gouldii*). One species, Eborac Island Gecko (*Nactus eboracensis*) is listed as a priority species under the BPA for Cape York.

Nine amphibian species were recorded during the surveys, four during the late dry and five during the early wet season. Only one species was recorded during both surveys, Cane Toad (*Rhinella marinus*). One species, Six-toothed Rainbow-skink (*Carlia sexdentata*) is listed of bioregional significance under the BPA for Cape York.

3.6.4 Potential Impacts

3.6.4.1 Direct Impacts

Approximately 1,637 ha of remnant vegetation will be cleared across both the mining and infrastructure footprints. Of the REs to be cleared, one is listed Of Concern (RE 3.3.12), while the remainder are listed as Least Concern. The area to be cleared does not include any TECs. Clearing of vegetation would occur in stages as mining progresses, followed by progressive rehabilitation.

Clearing of vegetation would result in the temporary loss of habitat for terrestrial flora and fauna species. Habitat loss has been limited to the mine and minor infrastructure areas.

Connectivity across the broader Project area has been considered in terms of habitat connections and broader corridors with regional linkages beyond the boundaries of the Project area. Within the Project area connectivity is linked to riparian corridors associated with the Skardon River and contiguous areas of terrestrial vegetation.

The primary areas of impact on connectivity within the Project area as a result of the Project, include:

- Loss of connectivity within the band of terrestrial vegetation in MLA 20676 associated with the establishment of the BH1 mine area. This would result in areas to the west of the pit footprint becoming isolated from large, contiguous tracts of vegetation to the east of the Project area;
- Loss of connectivity between riparian corridors and wetland areas in the south of MLA 20676, and between MLA 20676 and riparian and wetland habitats to the west; and
- Reduced connectivity of riparian corridors along the lower Skardon River associated with the construction mine areas and haul roads. Fauna movement along this corridor and access for less mobile species to aquatic habitats would be restricted. The haul road also increases the potential for interaction between vehicles and fauna, which would be mitigated by imposing slower speed limits at the crossing point.

A key impact associated with the clearing of vegetation and construction of infrastructure and mine area is the creation of smaller patches of vegetation, with a greater edge-to-surface-area ratio. The impacts of edge effects are difficult to quantify as these effects occur gradually over time. Therefore, direct impacts such as vegetation loss and fragmentation are used to determine impacts.

Dust generation has the potential to smother plants, reducing photosynthesis and resulting in decreased vegetation condition or the death of vegetation. Project activities likely to generate dust include mining, overburden stockpiling, vehicle movements, stockpiling (e.g. topsoil, spoil, product bauxite), and bauxite transport (e.g. haul trucks, etc.). A deposition rate of 500 mg/m^2/day is considered sufficient to have a detrimental effect on plant health.

Dust impacts are typically assessed for sensitive receptors (e.g. places of residence) within close proximity to dust generating activities. While not directly linked to terrestrial flora and fauna values, the results of dust deposition assessments would be reviewed to assess the likely extent of impact of dust generating activities within the Project area.

Increased noise from operation of machinery and vehicle traffic has the potential to disturb terrestrial fauna species and impact on feeding and breeding behaviour. In general, increased activity levels are likely to result in reduced fauna activity around work areas.

Key sources of light generation in the Project area will be the mine areas and associated infrastructure areas, and haul roads. Headlights and flashing lights associated with vehicle movements will also contribute. Combined, these sources would also be expected to result in 'sky glow' or the general lightening of the night sky.

Light spill has the potential to impact on nocturnal terrestrial fauna species by disrupting feeding behaviour and reducing effective ranges. It can also impact on the breeding behaviour of some species. Conversely, increased light will attract insects which may be beneficial for some species.

The traffic generation associated with the Project has the potential to impact terrestrial flora and fauna in the following ways:

- Mortality resulting from vehicle collision;
- Dust generation, which has the potential to smother roadside plants thereby affecting vegetation condition and reducing available habitat and food resources; and
- Noise disturbance which can disrupt fauna behaviour.

Direct fauna mortality associated with vehicle movement on haul roads and access roads has the potential to impact on a number of fauna species. Reptile species which may use road verges as habitat are susceptible to collision as they are less mobile than other species.

The Project has the potential to increase fire risk associated with the operation of vehicles, and activities undertaken by site personnel (e.g. welding, cigarette butts). Uncontrolled fires have the potential to alter ecosystem characteristics and directly and indirectly impact on ecological values in the Project area.

The Project area lies in close proximity to extensive disturbance associated with the abandoned Skardon Kaolin Project. There are; however, extensive areas of woodland that are free from disturbance, with the exception of riparian zones and swamps which have impacts associated with Feral Pig and potentially Wild Cattle (*Bos Taurus)*. Although existing weed issues are subsequently minor, there is considerable potential that presently intact habitats will be degraded by exotic species.

Impacts of potentially associated with the presence of pest species include:

- Predation on native species;
- Competition for food resources, which may decrease abundance of prey for native predator species;
- Habitat changes due to destruction of plants; changed floristic composition; reduced regeneration of plants; alteration of soil structure; increased invasion and spread of weeds;
- Increased access for non-native predator species;
- Toxicity to native species;
- Reduced water quality and availability; and
- Spread of exotic invertebrates and creation of habitats suitable for disease.

3.6.4.2 Indirect Impacts

This section identifies the impacts that are associated with changes in surface water and groundwater levels as a result of clearing. The response of the terrestrial ecosystem to predicted changes in the size and depth of inundation is difficult to predict. As with most ecosystems associated with variable and perennial inundation, terrestrial ecology values are likely to be tolerant of significant changes in available habitats. Species utilising these areas can generally tolerate a range of conditions; however, there will be a variable reduction in available habitats due to longer and higher inundation levels within the surrounding areas of Big Foot Swamp. This may potentially alter vegetation communities and their extent subject to toleration of longer period of and deeper levels of inundation. It is; however, unlikely that changes to hydrology of the swamp that are

predicted to occur during mining activities will significantly alter overall terrestrial flora diversity. If the size of standing water during the dry season significantly increases in area, and does not dry out over a period of years, it is possible that there will be mortality of Melaleuca trees as a result of anaerobic soil conditions. Currently Bigfoot Swamp has an area absent of any tree species directly surrounding the area of standing water during the dry season. The size of this area may increase over time during mining operations; however, following a return to current hydrological conditions, it is likely that Melaleuca trees will recolonise these areas.

3.6.4.3 Impacts on Threatened Terrestrial Flora Values

No endangered REs were recorded in the Project area and therefore impacts to these are not considered. Two Of Concern REs were recorded in the Project area (e.g. mining lease areas and infrastructure footprints). Of these, RE 3.3.51 does not overlap the mine or infrastructure footprints, and therefore significant impacts to this RE are not anticipated. However, RE 3.3.12 overlaps the infrastructure footprint of some haul roads and extraction pits, with less than 1 ha expected to be cleared. The area of disturbance would be minimised to the greatest extent possible through reducing the haul road width if possible or adjustments to their location where possible. Additional impacts to remaining vegetation communities would be minimised where practicable.

No nationally significant EPBC Act listed flora species were recorded within the disturbance footprints of the mine areas during the surveys. No state significant flora species were recorded in the surveys. It is considered the near threatened grass species *Heterachne baileyi* has potential to occur within the broader Project area and has been historically identified by other studies in the region. This species is likely to be restricted to riparian and wetland areas and unlikely to be impacted the proposed mining activities.

Riparian and watercourse vegetation occurs within the Project area but not within the mine footprint. Two watercourses (stream order 2) will be crossed by development of internal roads and haul roads resulting in an estimated maximum of 10 ha of remnant vegetation being impacted.

3.6.4.4 Impacts on Threatened Terrestrial Fauna Values

Impacts to threatened terrestrial fauna would result from land clearing, habitat loss and fragmentation. Essential habitat for most of the migratory and marine avian species known to occur, or likely to occur within the Project area includes coastal, wetland, riverine and riparian habitats. It is predicted that less than 30 ha of these moister habitats will be impacted by the proposed development layout through clearing for infrastructure. Impacts to these species will be considered in the EIS.

The Project will result in minor impacts to suitable habitat for a number of migratory species, mainly associated with jetty and haul road components which intersect riparian and mangrove habitats. These habitats are highly common and extensive throughout the region and the Project is unlikely to substantially modify, destroy or isolate areas of important habitat for migratory species. The area of disturbance would be minimised to the greatest extent possible.

Impacts to migratory avifauna which utilise drier habitats such as the Rainbow Bee-eater or Dollar Bird were not considered significant either given the extent and quality of habitat supported within the wider region and their ability to adapt to impacts (e.g. persist in urban and cleared environments).

It is likely the pest mammal species are in some capacity impacting the densities of native fauna and flora species present within the project area and broader region. Pigs are likely to have impacts to native fauna through competition for herbivorous resources, the spreading of weeds and also

creating erosional and water quality issues, particularly within habitats such as Big Foot Swamp and mangrove habitats. Feral cats cause direct predation pressure on small native fauna within the region, and can respond in large numbers to fluctuations in prey abundance placing pressure on native faunal assemblages. Although considered a pest under the *Land Protection (Pest and Stock Route. Management) Act 2002*, the presence of dingo and wild dogs has been shown to reduce the levels of mesopredators (such as feral cats and foxes) and as such retaining these higher level predators within the systems can keep mesopredator populations in check.

The observation of cane toads in the area is of importance given that this region is also potential habitat for Northern Quoll (*Dasyurus hallucatus*) which feed on the cane toad. Despite no quolls being found within the study area, it is relevant to note that ingestion of a cane toad by animals can result in death and as a result the cane toad is recognised as a key threatening process for species in the area.

Potential Offset Requirements

Biodiversity offsets would be required for the Project to compensate for any significant, residual impacts to MNES and biodiversity values listed as matter of state environmental significance (MSES). Offsets for the Project are required to be assessed and delivered under the EPBC Offsets Policy and *Environmental Offsets Act 2014*. To fully address the Project's offset requirements a Biodiversity Offsets Strategy Report has been prepared to evaluate both MNES and MSES offset requirements, including a Significant Impact Assessment for MNES and MSES under the applicable guidelines to determine the extent of offsets required. This report will be reviewed as required and incorporated into the EIS. Offset delivery options will also be considered (e.g. direct offsets, financial contributions, in-direct offsets) as applicable under relevant policies and timing of offset delivery.

3.7 Surface Water

The majority of the Project area is located within the Skardon River catchment, which forms approximately 350 km^2 of the Ducie drainage basin and is bounded by the Ducie River and Namaleta Creek catchments to the South and the McDonald River catchment to the north (**Figure 3-8**). The Project is located on the southern end of the Mapoon Plain, which extends along the western coastal fringe of Cape York, from the mouth of Ducie River in the south, to Jardine Swamp to the north.

The Skardon River is a perennial system whilst the Namaleta Creek and freshwater reaches of the Ducie River are ephemeral, generally only flowing after rainfall events of sufficient size to generate runoff (SRK, 2014). Stream flow in rivers tends to show a lagged response to rainfall, with wet-season rainfall commencing in November and reaching its peak in January, whilst an appreciable increase in surface water flow is not noted until January, reaching peak flow in March. This coincides with the timing of rainfall-derived recharge and suggests that annual or prolonged stream flow in rivers and creeks are maintained to some extent by baseflow. The overall surface water quality in the area is considered high and it appears that there has been minimal impact to existing EVs pertaining to surface water.

The area is surrounded by low lying swamps which are seasonally inundated. There are no known Wetlands of International Importance within or surrounding the Project area; however, the Project is partially located in the Skardon River- Cotterell River Aggregation which is a nationally important wetland area (EHP, 2009). Bigfoot Swamp, a freshwater swamp located near the northwest boundary of BH6 is registered in the Queensland Directory of Important Wetlands.

The Project proposed pit locations are situated either side of the Skardon River on elevated bauxite plateaus. Minor partial pit areas (BH6) and the camp facilities are proposed within the adjoining Namaleta Creek catchment to the south. The barge loading facility is proposed on the bank of the southern Skardon River branch.

580100 600100 620100 640100 660100 680100

8749970 8699970 8649970

Gulf of Carpentaria

JACKEY JACKEY CREEK

JARDINE RIVER

ELLIOT CREEK

McDonald River
272,255 ha

JACKSON RIVER

COCKATOO CREEK

Skardon River
43,898 ha

SKARDON RIVER

CHOLMONDELEY CREEK

NAMALETA CREEK

DULHUNTY RIVER

NORTH ALICE CREEK

MCHENRY RIVER

MAPOON

DUCIE RIVER

Ducie River
358,192 ha

PALM CREEK

WENLOCK RIVER

Legend

- Town
- Watercourse
- Mainland
- Mine Lease Area
- Ducie Drainage Basin

Ducie Basin Sub-catchment Area

- Ducie River
- McDonald River
- Skardon River

R	Details	Date
1	Details	22/01/15
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNED	MD	CHECKED	-
DRAWN	MD	CHECKED	-
APPROVED	-	DATE	14/07/15

Notes:

N W E S

0 2,500 5,000 10,000
Metres

Scale @ A3 - 1:450,000

GCS GDA 1994 Zone 54

DISCLAIMER
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DATA SOURCE
QLD Government Open Data Source
Australian Government Bureau of Meteorology

DESIGNER
CDM Smith
cdmsmith.com

CLIENT
METRO MINING LIMITED

FIGURE 3-8

DUCIE BASIN CATCHMENT

DRG Ref: **BES150115-008-R1_DUCI_BAS**

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3.7.1 Potential Impacts

The components of the Project with the most potential to impact on surface water quality and surface water flow regimes include the open cut mining pits, the haul roads and the mine infrastructure area. The process of clearing, excavation and stockpiling associated with extracting ore and the creation of hardstand areas results in changes to the catchment hydrology and the partitioning of rainfall into evaporative losses, runoff and baseflow. Changes to catchment hydrology may have adverse impacts on the ecosystems which are reliant on the natural and existing surface water flow regime.

The activities with the most potential to impact water quality include:

- Clearing of vegetation, excavations and stockpiling of materials thus increasing erosion potential and sedimentation within watercourses;
- Disturbance and stockpiling of soils causing increased turbidity and / or suspended solids within the water column of streams / creeks;
- The use of potentially contaminated / low quality water for dust suppression and other site activities causing surface runoff and migration of contaminants to streams / creeks; and
- The storage of chemicals on site (e.g. hydrocarbons, detergents, degreasers, etc.) during construction and operations and the movement of these to streams / creeks.

The clearing of vegetation and construction of the open cut pits and haul roads has the potential to increase sediment deposition in nearby waterways. Stockpiled material has the highest potential to impact surrounding streams / creeks in the event of large storm events prior to construction of the facility. Potential impacts include:

- Siltation of watercourses and aquatic habitat;
- Irregular and unstable land forms due to erosion;
- Adverse ecological effects from de-silting streams;
- Reduced ecological and aesthetic values of streams and riparian vegetation;
- Increased turbidity in the streams; and
- Blocked drainage infrastructure and increased localised flooding.

Construction and operational activities will require substantial quantities of water for dust suppression, landscaping, and surface stabilisation and / or compaction purposes. Supply for construction purposes is likely to be sought from non-potable surface and groundwater sources. Water from non-potable sources may have variable water quality and if run-off from the construction site occurs at high volumes and / or velocities, it may contribute to lowering water quality in the catchment.

Construction of the haul roads will require the use of culverts, bridges, causeways or a combination thereof to minimise flood damage to infrastructure and maintain existing flow paths. These drainage structures if not designed, constructed and managed correctly may result in scour in the waterways and surrounds, scour at the entry and exit locations of constructed cross drainage features (i.e. culverts under the terminal itself), as well as possible changes to flood levels both upstream and downstream of the haul roads.

Inappropriately stored and handled chemicals and other hazardous substances have the potential to impact surface waters in and around the barge loading facility during construction and operations. Chemical spills or low-level exposure of the aquatic environment to chemicals (e.g. run-off from machinery, including potential vehicle accidents) would most likely involve hydrocarbon products such as fuels and lubricants. Fuels and chemicals will be stored, transported, handled and used in accordance with relevant legislation, regulations, standards and guidelines. As such, the risk of spillage would be low.

3.8 Groundwater

The Project is situated within the Jurassic–Cretaceous intracratonic Carpentaria Basin, which lies beneath the Gulf of Carpentaria in offshore northern Australia and extends onshore into Queensland and the Northern Territory. The Carpentaria, Eromanga and Surat basins together form the GAB (refer to **Figure 3-9**) (Smerdon *et al*., 2012). The Project lies within the Weipa sub-basin (Munson *et al*., 2013). In this region, the Carpentaria Basin is overlain by Cenozoic sediments of the Karumba Basin and Quaternary alluvial sediments.

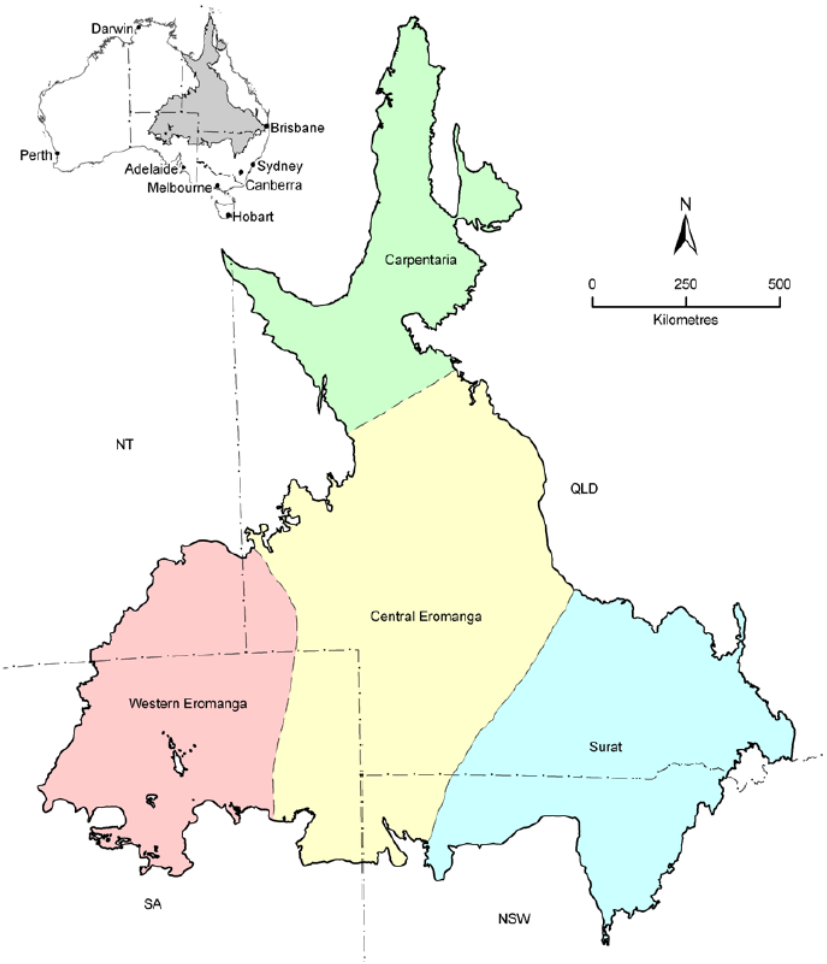

Figure 3-9 Depositional basins with Great Artesian Basin

Hydrostratigraphic units at the Project include 3 to 5 m thick bauxite which is underlain by Ironstone and Kaolinite Clay of the Bulimba Formation and weathered siltstone of the Rolling Downs Formation. These units are seasonally replenished by rainfall-derived recharge during the wet season and are drained during the dry season as groundwater laterally flows towards surrounding discharge zones (the Gulf, rivers, creeks, and wetlands). Bauxite and ironstone form

partial aquifers that are saturated during the wet season as the water table rises towards the ground surface.

During the dry season the water table occurs at the basal level of the kaolinite clay or within the upper (weathered) part of the siltstone. Stream flow in the Skardon River and its tributaries is maintained throughout the year by baseflow. Groundwater seasonally discharges to Bigfoot Swamp and other areas where the water table intersects the ground surface at the height of the wet season. Ecosystems associated with these discharge zones are likely to seasonally depend on groundwater and ecological values have been identified with shallow groundwater. Groundwater is currently extracted to supply water to the Skardon River Camp and there is no other extraction of groundwater at the Project for industrial, agricultural or stock and domestic use.

No perennial spring complexes have been identified within the study area; however, a number of potential groundwater dependent ecosystem (GDE) areas have been identified within the study area (refer to **Figure 3-10**). These being:

- Skardon River, including its tributaries, and the riparian zone;
- Bigfoot Swamp, a freshwater swamp, located near the northwest boundary of BH6;
- North to south trending drainage line (Lunette Creek), to the west of Bigfoot Swamp;
- Lunette Swamp, located adjacent to the southern boundary of BH6; and
- Namaleta Creek and the riparian zone, located to the south of Lunette Swamp and BH6.

605000 610000 615000 620000 625000

8700000 8695000 8690000

SKARDON RIVER

Barge Loading Area

Haul Road

Alternate Haul Road

BH1 MLA boundary
(ML 20676)

BH6 West
MLA boundary
(ML 20689)

Haul Road

Alternate Haul Road

BH6 East
MLA boundary
(ML 20688)

Camp Site

NAMALETA CREEK

NAMALETA CREEK

Legend

- Watercourse
- Barge Loading Area
- Haul Road
- Alternate Haul Road
- Pit Extents
- Camp Site
- Metro Mining Mine Lease Area

GDE Dependent On Surface Water

- High potential for GW interaction
- Moderate potential for GW interaction
- Low potential for GW interaction

R	Details	Date
1	For Information Purposes	15/07/15
2	Updated Pit Extents	22/10/15
-	-	
-	-	
-	-	
-	-	
-	-	

DESIGNED	MD	CHECKED	-
DRAWN	MD	CHECKED	-
APPROVED	-	DATE	22/10/15

Notes:

N W E S

0 500 1,000 2,000
Metres

Scale @ A3 - 1:70,000
GCS GDA 1994 MGA Zone 54

DISCLAIMER
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DATA SOURCE
MEC Mining;
QLD Government Open Source Data;
Australian Hydrological Geospatial Fabric (Geofabric) PRODUCT SUITE V2.1.1

DESIGNER
CDM Smith
cdmsmith.com

CLIENT
METRO MINING LIMITED

FIGURE 3-10

GROUNDWATER DEPENEDENT ECOSYSTEMS

DRG Ref: **BES150115-012-R1_GDE**

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Within the Project area the shallow groundwater salinity is fresh (<600 mg/L) and is regarded as possibly being good quality drinking water (ADWG, 2011), consistent with the shallow aquifers being readily replenished by annual recharge events. The groundwater salinity is within the range of salinity measured at the Pisolite Hills Project (75 to 1650 mg/L) (AGE, 2010). Groundwater is fresher during the wet season and the salinity is typically <60 mg/L. The salinity of groundwater from the nested pair of shallow and deeper bores is similar except at BH6 MB2D and BH6 MB2S, where groundwater sampled from the deeper bore is more saline (440 mg/L compared to 21 mg/L, based on March 2015 data). This difference could be due to less connectivity and mixing of water between the aquifers at that location or reduced potential for seasonal flushing of parts of aquifers occurring near sea level.

The pH of groundwater during the dry season ranges from 4.79 to 6.46 and 5.63 to 5.88 during the wet season (based on the laboratory analysis of pH). Rainwater unaffected by anthropogenic activities is weakly acidic due to the dissolution of carbon dioxide and its pH ranges from 5.5 to 6.5 (Hounslow, 1995). The pH of groundwater measured during the wet season is consistent with the typical pH of rainwater and has a narrow range of values reflecting the effects of rainfall-derived recharge replenishing the aquifers. The pH of shallow groundwater measured at the Pisolite Hills Project ranges from 5.32 to 6.75 (AGE, 2010) and is similar to the pH of shallow groundwater at the Project.

Groundwater sampled from monitoring bores within the study area exceeded the ANZECC and ARMCANZ guideline trigger values for fresh waters for aluminium, arsenic, cadmium, zinc, copper and nickel at a number of locations. These exceedances are considered to represent the naturally occurring background levels and are considered unlikely to negatively affect any ecological systems that interact with groundwater. The presence of several potential GDEs within the study area implies that exposure to these metals within the environment is likely to be within ecological tolerance limits.

3.8.1 Potential Impacts

Mining is predicted to cause a temporary increase in the volume of groundwater discharged to Bigfoot Swamp and the Skardon River tributaries and estuary area. Therefore, linkages between the effects of mining and ecosystems (receptors) associated with these features exist i.e. receptor exposure pathway exists via aquifers which possibly possess threats to some or all receptors.

The Skardon River receives baseflow and ecosystems (particularly the aquatic ecosystems) depend on this discharge. Additional volumes of groundwater introduced temporarily during mining are predicted to be relatively small (an increase of up to 3%), affecting only the peak discharge, and any changes are likely to be within natural ranges of ecosystem resilience and resistance. The quality of recharge water is also expected to be unaffected as the mined pits are backfilled with in-situ material. Therefore, potential small increases in groundwater discharge rates to the Skardon River are considered unlikely to adversely affect aquatic or riparian ecosystem function.

Numerical groundwater modelling conservatively assumes pool levels to be equal to the elevation of the post-mining pit floor and predicts a small reduction in post-mining groundwater discharge to Bigfoot Swamp as recharge returns to pre-mining levels. Despite this, the connectivity of the swamp to shallow groundwater is very likely to remain unaffected and a potential reduction in post-mining groundwater discharge is small albeit conservative i.e. approximately 3% reduction, resulting from a small reduction in the hydraulic gradient towards the swamp. Therefore, long term effects on ecosystems associated with Bigfoot Swamp is considered unlikely and specific mitigation measures to control potential changes in groundwater quantity are not considered necessary post-mining.

A possible threat to the degradation of EVs for groundwater is related to the accidental release of contaminants (e.g. spillage of fuel). If the contaminants are released, there is the potential for the contaminants to discharge to the Skardon River tributaries and Bigfoot Swamp via shallow aquifers (depending on the location of spills). Due; however, to high recharge rates the potential also exists for significant dilution of contaminant concentration within the aquifers. Given that accidental spillages will only result in localised release of contaminants and hazardous goods and chemical storage areas will be engineered and managed to prevent or mitigate uncontrolled releases, the threat of degradation of groundwater quality on sensitive receptors is considered moderate.

Groundwater discharging from open pits (vegetation cleared) has the potential to mobilise sediments, depending on whether this water is contained (allowed to pond) within the pits or diverted. Therefore, there is the potential for sediment loads to reach the Skardon River and estuary. There is also a very low risk that sediment will over top the pits in the BH 01 west mining area during extended periods of above average rainfall and enter the Bigfoot Swamp. This effect is expected to diminish as vegetation is established and mine pits are progressively rehabilitated over the life of Project.

Depending on the pool level within the mine pits and post-mining recharge rates, there is the potential for the volumes of groundwater discharge to Bigfoot Swamp to reduce post-mining. The discharge volumes are; however, predicted to reduce by relatively small amounts (<4%) and the connectivity of Bigfoot Swamp with groundwater will very likely remain unaffected. Therefore, long-term post-mining impacts on ecosystems associated with Bigfoot Swamp are considered unlikely.

3.9 Coastal Environment

3.9.1 Coastal Processes

The Gulf of Carpentaria is a large and relatively shallow body of water which is enclosed on three sides by the Australian mainland and bounded on the north by the Arafura Sea. The Gulf of Carpentaria can be subject to seasonal fluctuations in sea level (up to 0.5 m) as a result of trade winds (e.g. during the monsoon) and forcing from the Arafura Sea (Wolanski, 1993). These seasonal sea level fluctuations can result in large areas only being inundated by tides in the summer months (during the monsoon), as a result these areas cannot support mangrove or freshwater vegetation and therefore form salt flats.

Ryan *et al.,* (2003), describes Skardon River as a tidal creek as it has a low freshwater input with low-gradient and seaward-sloping coastal flats. These systems are primarily influenced by tidal currents and as a result they comprise of straight, sinuous or dendritic tidal channels that taper and shoal to landward. The mudflats which surround the creeks tend to be high relative to the tidal planes, with seawater being mainly confined to the tidal channels except during high tide on spring tides. Tidal creeks are usually highly turbid due to the strong tidal currents generated by the macro-tidal ranges allowing fine sediments to remain in suspension during spring tides. The tidal action results in the transport of sediment into the estuary, where the sheltered conditions eventually allow the coarser sediment fractions to settle. The currents within the river will be influenced by the channel depth and orientation along with the difference in tidal range through the river.

Due to the narrow entrance of the Skardon River (approximately 300 m) combined with the complex and relatively shallow bathymetry of the ebb tidal delta and the offshore channel, swell waves are not expected to propagate inside the Skardon River. The area upstream of the entrance will therefore only be influenced by locally generated wind waves. Due to the configuration of the Skardon River, with the channel width ranging from 1 km close to the entrance to 350 m at the

proposed barge loading facility and the dominant wind directions, not aligning with the estuaries main axis, the locally generated wind waves will be small and very short period. Based on this, along with the dominance of tidal currents within the river, wind generated waves in the estuary are not considered to be a significant process.

The highest tidal current speeds in an estuary tend to occur close to the entrance. Due to the configuration of the Skardon River, the peak speeds are expected to occur at the constriction of the entrance where a flatbed occurs. The flat bed indicates that the flow velocity exceeds the speed at which ripples and mega ripples form, with peak current speeds potentially exceeding one metre per second (m/s). Offshore of the entrance mega ripples and sand waves occur in the main channel where current speeds remain high due to the constrained channel focusing the flow.

The existing configuration of the shoreline to the north and south of the mouth of the Skardon River shows a depositional trend, with the shoreline showing signs of prograding and beach ridges being present. Studies of the shoreline at Cullen Point (located 25 km to the south-south-west and has a similar orientation and configuration to the study area and is therefore considered a good analogue) has been prograding at a rate of 1.5 to 2m/year since 1969, with most shoreline movement having occurred since 1989. An assessment of the longshore sediment transport along the shoreline to the north and south of the estuary mouth at Port Musgrave (Worley Parsons, 2011b) found:

- There is high variability in the net annual sediment transport;
- The dominant net longshore transport direction is to the south (rates approximately three times higher than the northerly transport); and
- Average net annual longshore transport for the area is approximately 10,000m3/year but the rate is strongly dependent on high energy events such as tropical cyclones or strong monsoon winds.

As the orientation, configuration and exposure of the shoreline adjacent to the mouth of Port Musgrave is similar to the shoreline adjacent to the mouth of the Skardon River it is expected that similar longshore sediment transport conditions would occur at both locations. As such, the longshore transport conditions from Port Musgrave are considered to provide a reasonable representation of the conditions at Skardon River. Sediment which is transported along the shoreline to the mouth of the Skardon River will be transported into the complex configuration of sand shoals and the ebb tidal delta and eventually bypass the river mouth. These shoals and the delta act as stores of sediment which allow sediment transported by longshore drift to bypass the river mouth during certain events.

Within the estuary and riverine system, fringing mangroves are present along the banks of the majority of the Skardon River. The mangrove vegetation acts to stabilise the sediment along the banks by attenuating both locally generated wind waves and tidal currents. The mangroves therefore help to create a depositional environment along the river banks. The presence of fringing mangroves throughout the estuary indicates that the banks of the river are currently stable.

3.9.2 Marine Water Quality

Marine water quality investigations at the Skardon River have been undertaken to provide baseline data for the assessment of potential impacts from proposed developments. Water quality behaviours associated with the Skardon River are reported to be highly site specific for a range of parameters (i.e. turbidity, total suspended solids, light availability and deposition) with variability likely to be influenced by tidal, wave and wind driven water movement (see PaCE, 2015).

The Skardon River presents a pH range of 7-8 within the entrance and lower estuary, reducing as sites progress up the estuary and beyond the existing barge facility (6.9-7.5). pH exhibits a strong spatial and temporal trend which is associated with tidal flushing and increases as the flooding tide push through the study area. As tides begin to ebb, reduced pH waters are extracted from the mangroves and creek systems to the primary Skardon River channel. The site specific median pH value was 7.7 and within the ANZECC and ARMCANZ range of 7-8.5.

Surface turbidity levels within the Skardon River were recorded from grab samples and ranged from 0 – 30.6 NTU with mean turbidity during the dry season of 4.2 NTU compared to 30.3 during the wet season. Increasing levels of turbidity are likely due to increased flows entering the estuarine/marine system in conjunction with natural tidal events where increased turbidity coincides with mid tidal runs when flow is approaching maximum velocities as water drains from the mangroves and mudflats.

Estuarine/marine nutrient levels reported median total phosphorous (0.04 mg/L) and median total nitrogen (0.30 mg/L) levels for the Project area exceeding the ANZECC and ARMCANZ trigger values of 0.02 mg/L and 0.2 – 0.3 mg/L respectively. Given the generally undeveloped nature of the region, the exceedance of phosphorous levels across different sites and across both fresh and marine samples would seem to indicate a slightly elevated natural phosphorous level in the region more so than from anthropogenic sources.

Water quality conditions of the Skardon River exhibit no problematic affects associated with historical or existing landuse, and the system is considered 'near pristine' with respect to water quality. In the absence of adjacent anthropogenic inputs, naturally occurring elevations in nutrients (nitrogen and phosphorous) and some metals (coper and zinc) are considered a feature of these biologically productive, turbid and tidally dominated tropical estuary systems. Spatially driven reductions in dissolved oxygen and variability in salinity, turbidity and oxidation reduction potential are considered representative of the naturally occurring processes of the study area.

3.9.3 Potential Impacts

3.9.3.1 Coastal Processes

The Project may provide a minor small scale impact on the system hydrodynamics at the proposed barge loading facility. Minor changes in current flow from pile construction and barge moorings could potentially result from a reduction in channel cross-sectional area, which in turn will result in localised increased tidal currents. The barges themselves may also induce altered current patterns and may lead to localised erosion of underlying soft sediments within the berth pocket, by way of increased current velocities during flood and ebb tidal flows and during manoeuvre of the barges and tugs via propwash.

Similar minor changes in current velocities may also be expected surrounding the mooring blocks for cyclone moorings. Localised mobilisation of soft sediments may be expected within the immediate vicinity of these features.

The land elevation where the proposed upstream facilities options are located are sufficiently high that sea level rise or storm tide inundation over the 12 year Project life are not considered to be an issue of concern.

The proposed development is not expected to have any impacts on the river flushing as there is no change to the tidal prism of the Skardon River.

No developments are proposed that would alter sediment transport processes within the Skardon River such that broad scale impacts would occur. The scale of changes via the development of the barge facility and operational processes of the bauxite barges are anticipated to remain within the natural scale of variability demonstrated within the Skardon River system. Potentially greater impact on sediment transport would originate from propwash by tugs and other service vessels. The use of pile construction is best suited to minimise impacts upon sediment transport.

The barging of the bauxite from the barge loading facility to the offshore transhipment location is likely to result in the generation of vessel wake waves within the Skardon River. As mangroves are present along the majority of the banks of the Skardon River any vessel wake waves are expected to be attenuated by the established mangrove vegetation and will therefore not result in significant erosion of the river bank.

3.9.3.2 Marine Water Quality

It is anticipated that the affects upon water quality during construction and operation of the proposed development will be minimal in terms of duration and spatial extent. Risks associated with the spillage of chemicals are considered low, with the handling of hydrocarbons at the wharf (via pipeline) and during vessel operations possibly the largest risk factor. However, given the standard practices applied to design and operation of such facilities, available response strategies and clean-up procedures would provide suitable management in the unlikely event of a release or spill.

The absence of any dedicated discharges, ongoing polluting processes from chemical release and demonstrated broad ambient fluctuations generally limits water quality threats from the Project. Of the ongoing operational processes propwash may be considered a source of potential plume generation and sediment mobilisation. Over time it is expected that the operational area will experience a level of scour and the potential for prop wash impacts may decrease.

3.10 Air Quality

Aside from localised and seasonal vegetation burning, the Project area is largely unaffected from processes affecting air quality. The main air emissions from mining operations are caused by wind-borne dust, haul road generated dust, materials handling, stockpiles and transfers.

A review of the National Pollutant Inventory emissions has determined that there are no existing air emissions or pollutants in a 90 km radius of the Project, except for an isolated power station, approximately 16 km from the nearest boundary of the Project but approximately 35 km south of the Project MIA. This facility is operated by Ergon Energy in Main Street, Mapoon. The reported emissions are a result of burning fuels for electricity generation. These emissions are unlikely to affect the Project area.

3.10.1Potential Impacts

Impacts to air quality generated by the Project are expected to minimal. Regional air quality is typically influenced by localised vegetation burning and climatic conditions. The construction and operation of the mine will result in dust emissions. Mine site emissions typically occur from mobile open cut operations, equipment movements, materials handling and overburden stockpiles.

It is not expected that air quality in the region will be adversely affected by the construction and operation of the mine. A detailed air quality assessment will be conducted as part of the EIS. The results of the assessment will be used to develop air quality mitigation strategies in the EMP and to form conditions in the Project's EA.

3.11 Noise

The Project is located in a rural area and is current subjected to very little anthropogenic noise aside from exploration drilling activities and noise associated with vehicle and boat activity. Infrequent usage of the landing strip also generates periods of short-duration noise.

3.11.1Potential Impacts

Impacts from noise generated by the Project are expected to minimal. The nearest sensitive receptor to the Project is located at Mapoon, approximately 18 km from the MIA. Noise impacts would typically be associated with the open cut pit operations and hauling of bauxite.

Noise impacts associated with the Project would vary as a consequence of prevailing climatic conditions. It is not expected that noise from the construction or operational phases will adversely affect the Mapoon township. Notwithstanding, a detailed noise assessment will be conducted as part of the EIS. The results of the assessment will be used to develop noise mitigation strategies in the EM Plan and to form conditions in the Project's EA.

3.12 Cultural Heritage

3.12.1Indigenous Cultural Heritage

The Ankamuthi People (QUD6158/98) and the Northern Cape York Group #1 (QUD157/11) have been identified as being the relevant Aboriginal parties for the Project area, while the Old Mapoon Aboriginal Corporation (OMAC) are the Aboriginal trustee landowners. The conduct of the cultural heritage study and the implementation of site protection or remediation measures will be specified in the approved Cultural Heritage Management Plan (CHMP) that will be finalised as part of the Right to Negotiate process that is being undertaken will all relevant parties.

A search of the Australian Heritage Place Inventory and Aboriginal Cultural Heritage Database and Register did not identify any listed area within the immediate Project area. The Project area is located within the Cook Shire Regional Council and no cultural heritage overlays are available for the Skardon River area under the current Cook Shire Regional Council Planning Scheme.

Metro Mining has undertaken field surveys of specific areas required for exploration activities. Broader cultural heritage surveys of the Project area have not, as yet, been undertaken by Metro Mining as these will be undertaken as part of the CHMP implementation and prior to the commencement of construction.

Whilst the findings of the survey reports are confidential, field surveys have identified cultural heritage material within the Project area. The identified cultural heritage material has been managed in accordance with agreements between the Aboriginal parties for the area and Metro Mining. Metro Mining will attempt to avoid impacts to these sites. Where there are risks of potential impacts to these sites, Metro Mining will consult with the relevant Aboriginal parties to establish suitable mitigation measures to mitigate impacts to cultural heritage.

Metro Mining commits to engagement and negotiations with the relevant Aboriginal parties and to develop and implement an approved CHMP with these parties. The CHMP will include procedures developed by the Aboriginal parties covering the management of cultural heritage sites and values. Metro Mining aims to promote an understanding of Aboriginal cultural heritage in the workplace through employee induction programs and other specific training activities.

3.12.2Non-Indigenous Cultural Heritage

There are no listed non-Indigenous heritage sites in or within the vicinity of the Project area and previous studies of the broader Skardon River area undertaken by other have failed to identify potential non-Indigenous cultural heritage items. European activity in the area has been limited and studies of the area suggest that any remaining non-Indigenous items of cultural heritage significance are likely to be related to missions, pastoralist or mining activities. Despite, the lack of known non-Indigenous cultural heritage in the Project area, there is the potential to discover unknown sites during construction and operation. As such, management and mitigation measures will be implemented to identify any remaining items and, where necessary, appropriately deal with any discovery in accordance with the *Queensland Heritage Act 1992*.

3.12.3Potential Impacts

No listed Indigenous or non-Indigenous cultural heritage will be impacted by the Project. Items of unrecorded cultural heritage may occur within or near the Project development area and without appropriate site management initiatives, may be threatened by construction impacts. The conduct of the cultural heritage assessments and the implementation of site protection or remediation measures will be specified in approved CHMPs in regard to Indigenous cultural heritage and in the EMP for non-Indigenous cultural heritage.

3.13 Transport (Air and Land)

3.13.1Land Transport

There are no new or alterations to public road infrastructure proposed during the construction and operational phases of the Project. There will be very limited external council or state road network use to access the Project area. Use of the current road network in Weipa is expected to be extremely limited and is likely to be light vehicles only associated with personnel movements and obtaining supplies. Given the infrequent and minor nature of the use it is expected that the current level of service of the existing public road network will be maintained.

The Project site is remote and difficult to get to by the existing road network once off the Peninsula Development Road (PDR). Conservatively it is expected that it will take approximately a day to travel between Weipa and the Project area by light vehicle. The existing track leading off the PDR is unsealed, not maintained and only suitable for use by 4WD during the dry season. Furthermore, approval is required, from Rio Tinto Alcan, to use the sections of the track that cross their existing mining leases. No regular land access is being considered for the Project.

3.13.2Air Transport

It is currently proposed to use the Skardon River airstrip to support fly-in fly-out (FIFO) operations from Weipa, Cairns, Cooktown and/or Bamaga for staff transport to and from site. The airstrip is centrally located within the resource area and Metro Mining is seeking to reach a shared operating agreement with the existing airstrip operator to utilise the facilities throughout the life of the Project.

3.13.3Potential Impacts

The main modes of transport that will be used during all Project phases (construction, operation and decommissioning) will be by marine and air modes of travel. The use of any public roads will

be very infrequent as barge and air modes of transport will be the predominate mechanisms serving the development. As such the road service network is unlikely to be impacted and no road improvements will be required. It is expected that there will be traffic generated from the mining activity; however, this will be contained within the mining lease area. In relation to air activities and travel, there is not anticipated to be any reduction in the level of service at the Weipa, Cairns and Cooktown airports due to the anticipated low level of worker demands and that Metro Mining will charter private flights for FIFO employees. The Skardon River airport will experience increased usage; however, this will be addressed through upgrades to facilities as the Project develops.

3.14 Transport (Shipping)

Project activities associated with shipping will occur within Commonwealth waters (i.e. beyond 3 nautical miles (nm) from the territorial baseline); in addition to the Queensland state waters and internal waters (the Skardon River itself) within which the port exists. Metro Mining will abide by all relevant international, national and state laws associated with shipping activities (i.e. MARPOL and the Port of Skardon River Port Rules).

The barges will be moved by tug to the offshore anchorage approximately 12 km offshore from the river mouth in waters round 10 m deep or more. Here it is proposed that the ore will be transferred onto self-loading ships, expected to be of Panamax size (average cargo capacity of around 70,000 t). A small wheel loader (i.e. 'Bobcat' or similar) will operate on the barge to push up the product for the ships' grabs. At this juncture in the Project the number of barges (and tugs) required has not been determined.

The Project will have a planned production capacity, and hence ship loading throughput, of 5 Mtpa with a Project life of approximately 12 years. Each ship loading could be undertaken 24 hours per day, seven days a week with a loading rate up to 1,000 tonnes per hour (t/hr). It is expected that around four days to six days will normally be required for each ship load, and that approximately 75 ship visits will occur in any given year. This suggests approximately 1,250 (4,000 t loaded) to 2,500 (2,000 t loaded) barge movements per operational year at full production, and assumes between 12-15 tug/barge movements each day of ship loading operations. A detailed study of barge movement scenarios will occur in parallel to the EIS.

Operations will be seasonally-influenced to avoid any production during the wet season. This will limit operational activities at the mine site to nine months per year (nominally March to November). It is anticipated that ship loading will extend slightly longer than this period, although no activity is anticipated between December to February.

The development will involve the construction and fit-out of the barge loading jetty, and associated dolphins (i.e. mooring pylons) for the berthing of the barges. Although yet to be determined at the time of preparation of this report, it is anticipated a number of cyclone moorings will also be established at suitable sites both outside the mouth of and within the Skardon River. These moorings will be used when the barges are not in use (i.e. between ship loads), during the wet season hiatus in operations, and during cyclone warning periods. It is expected that the tugs will return to another nearby port during the wet season.

Ships will not refuel while loading at Skardon River, and as 'dumb' barges, the barges will have no need for fuel. Tugs will be refuelled via a pipeline along the conveyor structure to a storage farm from self-bunded containers. These will be retained at a small vessel maintenance facility to be established near the barge loading facility within the MIA. The maintenance facility would be centred upon two 20' ISO containers, or similar, in a small cleared area.

The West Cape York Marine Reserve is located to the west northwest of the Skardon River mouth. The Reserve extends from the boundary of Queensland waters adjacent to the northern end of the Cape York Peninsula and north-west to the edge of Australia's Exclusive Economic Zone. The reserve includes Special Purpose and Multiple Use Zones. Also included is a Marine National Park Zone; however, this is approximately 80 km from the mouth of the Skardon River (DotE, 2013). Barges moving to anchored bauxite carriers will transit through both State and Commonwealth waters. These activities will occur outside of the Marine Reserve. Passage of the bauxite carriers to and from the transshipment location may include transiting of the Marine National Park Zone. Vessel transit is a permitted activity for all three zones (Marine Reserve, Special Purpose and Multiple Use).

3.14.1Potential Impacts

A preliminary assessment of the potential impacts to the environment, and the control and mitigation measures, indicates that risk of potential adverse effects from the Project will be minimal. Some low level, persistent effects will exist, all of which are unavoidable results of shipping operations, none of which are considered likely to present any tangible or unacceptable risks to the environment.

Abnormal events, such as vessel grounding or collision, do pose a heightened risk, but in common with similar shipping activities around Australia and elsewhere, these risks will be controlled by a range of vessel design, equipment fit and operational measures. These measures sit within a comprehensive framework of international, national and Queensland regulations, and are applicable to both the international ships and coastal vessels to be engaged in the development and operation of the Project's shipping movements.

3.15 Waste

Construction and operation activities associated within the Project will increase the volume of waste materials from the Project area. Waste materials have the potential to impact the receiving environment through contaminating soil, habitat and water resources, in addition to having the potential to harm or injure neighbouring communities and fauna and flora species.

While waste produced during the construction phase will be of a relatively short duration (in comparison to the operational phase of the Project), waste will continue to be produced during the operation and decommissioning phases of the Project. Waste streams from construction and operation will be managed in accordance with the Waste Management Hierarchy. The strategy will identify controls, which target the reduction of generated wastes and ensure that onsite wastes do not enter the environment and minimise subsequent impacts.

To manage Project related waste in accordance with Government Policies, the following measures will be put in place:

- A waste management strategy will be developed along with processes and procedures that form a suitable environmental management framework allowing the incorporation of waste management into daily operations and will develop efficient practices throughout the lifecycle of the Project. These principles will ensure early identification of anticipated waste streams and quantities, and allow effective implementation of appropriate management and mitigation measures to reduce the potential for impacts to occur;
- No waste landfill is proposed on site. Generated waste will be managed and disposed of by licenced contractors in accordance with the waste's classification i.e. regulated wastes (e.g.

hydrocarbons, solvents, asbestos, contaminated soil) will be tracked and recorded prior to being removed from site;

- All waste water will be reused within the process; hence a wastewater stream will not be generated; and
- A proactive rather than reactive approach to waste generation and minimisation will assist in reducing the volume of waste generated due to the Project.

3.16 Socio - Economic

The resource sector is the main employer in the immediate area of the Project, with a number of mines already operating at Weipa. Employees are expected to come from the nearby towns of Weipa and Mapoon; however, the majority are expected to be FIFO through Cairns.

The Project will positively contribute to the local and regional areas with increased direct employment opportunities and indirect opportunities through the ongoing requirement for services and support. The Project is anticipated to result in a range of beneficial impacts including export revenue associated with the sale of bauxite, which in turn facilitate the payment of royalties to the Queensland Government in the order of $12 million per annum once the mine is fully operational;

The Project will require the hiring of 75 and 160 full time employees during construction and operations respectively. Given the small scale of the Project and considering the location of the Project relative to Weipa and Mapoon it is not expected that adverse social impacts will arise from the Project.

The area of the Project is primarily the traditional lands of the Ankamuthi People and the Northern Cape York Group #1 people. Metro Mining's existing operations are relatively small and are centred on exploration activities with little opportunity for either group. The Project would bring development activities much closer to the Traditional Owners and their country resulting in a broader range of employment and training related opportunities. Metro Mining would continue to work with Traditional Owners to facilitate access to these opportunities. Metro Mining would look to retaining existing employment, training and business development programs and tailor them to the needs of the Project and traditional owners and their communities.

3.17 Hazards and Safety

The probability of accidents associated with the development and implementation of the Project is as low as reasonably practicable, given that the design, operating and control measures adopted by Metro Mining will focus on their prevention. Similarly, natural events of sufficient magnitude (e.g. those that occur during the monsoon season), that could cause significant damage and pose serious safety risks, have a very low probability of occurring during operation of the Project, particularly noting that operations will not be undertaken during the wet season.

Project construction and operational Preliminary Hazard Analysis (PHA) results indicated that the baseline health and safety risk profile varied from low to high. Once mitigation measures and design treatments were applied to the assessed hazards, residual risk scores were reduced to 'low' or 'medium'.

Assessed hazards with 'medium' residual risks level include:

- Traffic collisions due to increased traffic as a result of the Project predominantly within the Project;

- Cumulative strain on emergency services. Metro Mining will work with emergency service agencies in the area to ensure that resources are sufficient to mitigate the increased risks associated with the Project;
- Human injury or death as a result of a construction or operational related accident. A Safety and Health Management System (SHMS) will be implemented and risks will be managed through detailed Standard Operating Procedures and Job Safety Analysis ;
- Human injury or death from tropical disease, infection or heat exposure. Metro Mining will have onsite first aid provisions and will undertake training in heat management and identification of tropical diseases; and
- Property damage, human injury or ecosystem damage from a marine incident, including collision, marine strike or grounding. Metro Mining will manage this risk by having a detailed shipping management plan, safety navigational aids, defined pilotage regimes and oil spill response equipment and training.

Importantly, the PHA did not identify any 'extreme' ranking risks outside the Project area.

Overall the risks to community receptors, environmental sensitive receptors and State and local government controlled roads can be considered acceptable. Metro Mining will implement a rigorous SHMS which will set out a framework and detailed safety procedures to manage the safety and health of its employees. A Project Risk Register and appropriate controls, including training, engineering, design, procedural and physical controls will be in place to manage any onsite hazards.

In the event of an emergency, Metro Mining will have detailed processes outlined in the Emergency Response Plan and prior implemented arrangements with emergency management departments to ensure emergencies are managed in a prompt, safe and efficient manner to protect the site property, environment and the community.

3.18 Stakeholder Engagement

Metro Mining and its subsidiary Cape Alumina have been active in the Cape York region since 2008 and have established communication processes with many of the stakeholders. Metro Mining is committed to continuing its consultation program as part of the Mining Lease application and Project approvals processes. In this regard, as defined under section 38 of the EP Act, Interested and Affected Person have been identified and their contact details will be provided to EHP. Affected persons have a high level of influence on, or potential to be affected by the Project and are likely to have a high level of interest in, or concern regarding the Project. Interested persons and other stakeholders include individuals or groups not directly affected by the Project, but who have a legitimate interest in it.

Regular engagement with affected and interested parties, provides the opportunity for active community involvement and education through an inclusive program. The public consultation process will continue to identify broad issues of concern to local community and interest groups at all stages including Project planning, construction, commissioning, operations and final decommissioning.

The public consultation program would include public meetings, interest group meetings, production of regular summary information and updates and other consultation mechanisms for encouraging and facilitating active public consultation. The existing list of affected persons and interested stakeholders would continue to be maintained as the Project passes through the approvals stage into construction and operations.

The key objectives of the consultation program during the approvals stage will be to:

- Explain the environmental impact assessment process and indicate how public input might influence the final recommendations for the Project;
- Seek an understanding of interest group concerns about the proposal;
- Provide an understanding of the regulatory approval process;
- Inform the different interest groups about the Project proposal;
- Seek local information and input into the Project; and
- Provide the community with a sense of ownership in the Project.

3.19 Environmental Management and Monitoring

An environmental management system (EMS) for both the construction and operational phases of the Project will be developed based on the principles of the AS/NZS ISO 14001:2004 Environmental Management Systems. The EMS will establish the framework for environmental management of Project activities, and will include the following:

- The Project's environmental policy statement;
- Roles and responsibilities;
- Identification of potential environmental impacts;
- Presentation of objectives and targets for the mitigation of potential environmental impacts;
- Implementation of plans and procedures to ensure objectives and targets are met;
- A reporting procedure – internal and external;
- Induction, training and awareness programs to ensure Project personnel are aware and capable of fulfilling the Project's environmental responsibilities;
- An emergency and incident procedure; and
- Management review process to search for opportunities for continuous improvement.

In preparing the EMS, Metro Mining will develop measures that will be undertaken to prevent or mitigate any potential adverse impacts on the environment. These measures will be documented in the Project's EMP which sits within the EMS framework. The EMP will be prepared using knowledge of potential impacts derived during the EIS process and will continue to be refined as part of ongoing discussions with administering agencies and in due consideration of conditions of licences and approvals gained by the Project. Each element within the EMP will include the following structure:

- Element - Aspect of construction or operation to be managed (as it affects environmental values);
- Operational Policy - The operational policy or management objective that applies to the element;
- Performance Criteria - Measurable performance criteria (outcomes) for each element of the operation;
- Implementation Strategy - The strategies, tasks or action program (to nominated operational design standards) that would be implemented to achieve the performance criteria;
- Monitoring - The monitoring requirements to measure actual performance (i.e. specified limits to pre-selected indicators of change);

- Auditing - The auditing requirements to demonstrate implementation of agreed construction and operation environmental management strategies and compliance with agreed performance criteria;
- Reporting - Format, timing and responsibility for reporting and auditing of monitoring results; and
- Corrective Action - The action (options) to be implemented in case a performance requirement is not reached and the person(s) responsible for action (including staff authority and responsibility management structure).

The environmental monitoring for the Project would include surface water and groundwater quality, groundwater levels, marine ecology, rehabilitation success, erosion, weeds, waste volume and type, sewage treatment plant water quality, community complaint records and cultural heritage assessments. The Project's EMP will outline the environmental monitoring program for each element and include specific details such as monitoring sites, parameters and their frequency of measurement as per the proposed EA conditions, in addition to detailing monitoring procedures and records.

Section 4 Acronyms, Abbreviations and Measurement Units

Acronyms and abbreviations used in this document are tabulated in **Table 4-1**.

Table 4-1 Acronyms and abbreviations

Acronym	Description
ADWG	Australian Drinking Water Guidelines
AHD	Australian Height Datum
ANZECC and ARMCANZ guidelines	Australian and New Zealand Environment and Conservation Council and Agriculture and Resources Management Council of Australia and New Zealand Guidelines for Fresh and Marine Water Quality 2000
AS/NZS	Australian Standard and New Zealand Standards
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soil
BH1	Bauxite Hills mining area 1
BH6	Bauxite Hills mining area 6
BoM	Bureau of Meteorology
BPA	Biodiversity Planning Assessment
CAMBA	China-Australia Migratory Birds Agreement
CAT	Caterpillar
CEC	Cation exchange capacity
CHMP	Cultural Heritage Management Plan
CLR	Contaminated Land Register
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cwlth	Commonwealth
DIWA	Directory of Important Wetlands in Australia
DNRM	Department of Natural Resources and Mines
DotE	Department of the Environment
DPI	Department of Primary Industries
DSO	Direct shipping of ore
EA	Environmental Authority
EHP	Department of Environment and Heritage Protection
EIS	Environmental Impact Statement
EMP	Environmental Management Program
EMR	Environmental Management Register
EMS	Environmental Management System
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
EPBC Offset Policy	*Environment Protect and Biodiversity Conservation Act 1999* Environmental Offsets Policy
EPM	Exploration Permit for Minerals
EP Regulation	Environmental Protection Regulation 2008
ERA	Environmentally Relevant Activity
ESP	Exchangeable Sodium Percentage
EV	Environmental value
FIFO	Fly-in Fly-out
GAB	Great Artesian Basin
GDE	Groundwater Dependant Ecosystem
HP	Horsepower

Acronym	Description
HSU	Hydrostratigraphic units
JAMBA	Japan-Australia Migratory Birds Agreement
LOR	Limit of reporting
MARPOL	International Convention for the Prevention of Pollution from Ships
Mg	Magnesium
MIA	Mining Infrastructure Area
MLA	Mining Lease Application(s)
MNES	Matters of National Environmental Significance
MR Act	*Mineral Resources Act 1989*
MSES	Matters of State Environmental Significance
NC Act	*Nature Conservation Act 1992*
NHMRC and NRMMC	National Health and Medical Research Council and National Resource Management Ministerial Council
NOC	Not of concern
OGV	Ocean going vessel
OMAC	Old Mapoon Aboriginal Corporation
PaCE	Ports and Coastal Environment
PDR	Peninsula Development Road
PHA	Preliminary Hazard Analysis
RE	Regional Ecosystem
ROKAMBA	Republic of Korea-Australia Migratory Birds Agreement
ROM	Run of Mine
SP Act	*Sustainable Planning Act 2009*
TEC	Threatened Ecological Community
TI Act	*Transport Infrastructure Act 1994*
TSS	Total Suspended Solids
VM Act	*Vegetation Management Act 1999*
VM Regulation	Vegetation Management Regulation 2012
VOCs	Volatile Organic Compound(s)
Waste Act	Waste Reduction and Recycling Act 2011
Water Act	*Water Act 2000*
WHS Act	*Work, Health and Safety Act 2011*
WHO	World Health Organisation
WQO	Water Quality Objectives

Measurement units used in this document are tabulated in **Table 4-2**.

Table 4-2 Units

Units	Description
°C	degrees Celsius
cm	centimetre(s)
EC	electrical conductivity
GL/yr	gigalitre(s) per year
ha	hectare(s)
km	kilometres
km/h	kilometre(s) per hour
km^2	square kilometre(s)
l	litre(s)
L/s	litre(s) per second
m/d	metre (s) per day

Units	Description
m/s	metre(s) per second
m^2/d	square metre(s) per day
m^3	cubic metre(s)
m^3/s	cubic metre(s) per second
mAHD	metre(s) above the Australian Height Datum
mg/L	milligram(s) per litre
$mg/m^2/day$	milligram(s) per square metre per day
ML/yr	megalitre(s) per year
ML/d	megalitre(s) per day
mm	millimetre(s)
Mt	million tonne(s)
Mtpa	millions tonne(s) per annum
MW	megawatt(s)
NTU	Nephelometric Turbidity Unit
tpa	tonnes per annum
t/hr	tonne(s) per hour

Section 5 References

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