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1. INTRODUCTION

Fortescue Metals Group Limited (Fortescue) proposes to clear up to 17.7 ha of native vegetation for groundwater investigations. The groundwater investigations are located approximately 90 km west-north-west of Tom Price in the Pilbara region of Western Australia (Figure 1).

This report and its appendices provide all of the relevant information required under Part V, Section 51E of the Environmental Protection Act 1986 (EP Act), to assess the proposed clearing. This includes baseline environmental data, survey reports, a digital project envelope (shapefile) and assessment against the 10 Clearing Principles.

1.1 Summary of Proposal

The key details of the proposed clearing are represented in Table 1.

Table 1: Key Details of the Proposed Clearing

Site Details			
Project Name	Eliwana Groundwater Investigations		
Description of Operation	Tracks and pads for groundwater investigation		
Total Clearing Proposed	17.7 ha of native vegetation (within purpose permit envelope of 1,374 ha)		
Project Commencement Date	January 2018		
Tenement Details	**Tenement**	**Holder**	**Status**
	Section 182 Ministerial Authority	The Pilbara Infrastructure Pty Ltd	Granted
Clearing Method	Clearing will be conducted mechanically using earth moving equipment with the blade down.		
Purpose of Clearing	The clearing is to allow for groundwater investigations		
Proponent Details			
Company Name	Fortescue Metals Group Ltd		
ACN	57 002 594 872		
Postal Address	PO Box 6915 EAST PERTH WA 6985		
Key Contact	Name	Sean McGunnigle	
	Position	Manager, Environment Approvals	
	Phone	6218 8888	
	Email	smcgunnigle@fmgl.com.au	

1.2 Proposed Clearing Activities

Fortescue is applying to clear 35.5 ha of native vegetation within a purpose permit envelope of 1,374 ha (Figure 2). A breakdown of the clearing requirements is provided in Table 2 to give an indicative representation of the proposed works.

Table 2: Proposed Clearing by Activity

Item	Disturbance (ha)
Tracks 6m wide 19km length	11.4
Drill pads x 25 (50m x 50m)	6.3
TOTAL	17.7

1.3 Relevant Approvals and Background

Key legislation that may affect the environmental management of the project and a list of all relevant environmental approvals that have been sought or are required before the proposal may be implemented is provided in Table 3.

The groundwater investigation activities are general in nature and the investigations are not related specifically to any of Fortescue major projects or approvals.

Table 3: Relevant Approvals

Activity	Legislation	Approval Required
Land Clearing	EP Act (Part V)	A Native Vegetation Clearing Permit is required for all land clearing activities to be undertaken.
Construction of wells and abstraction of groundwater	*Rights in Water and Irrigation Act 1914*	Approval to construct a well for the purpose of groundwater production (26D Licence) and approval to abstract groundwater (5C Licence) may be required

1.4 Social Surrounds

Heritage and Native Title

The permit envelope is located within the Eastern Guruma (EAS) Native Title Determination area. Fortescue Metals Group LTD, The Pilbara Infrastructure PTY LTD, and FMG Pilbara PTY LTD entered into Land Access Agreements (LAA) with the Wintawari Guruma Aboriginal Corporation which is the Prescribed Body Corporate for the determined Eastern Guruma native title claim (WD6208/98), on 15 December 2009.

This agreement requires the establishment of an FMG Working Group and relevant Sub-Committee's such as Heritage Sub-Committee (HSC) which deals specifically with Heritage related matters. In addition, the agreements facilitate Fortescue's exploration, mining and development activities within the Native Title Determination areas. Fortescue meets and consults with traditional owners over all aspects related to identification, protection and management of their cultural heritage, constant with the relevant legislation (Aboriginal Heritage Act 1972 WA (AHA)) and its contractual obligations as prescribed by the LAA.

In accordance with the LAA, Fortescue engages nominated traditional owners and their professional heritage consultants to conduct comprehensive ethnographic and archaeological cultural heritage surveys. These surveys are completed to ensure compliance with the Aboriginal Heritage Act 1972 WA (AHA) and contractual obligations set out in the LAA's. 30 archaeological heritage survey areas and 12 ethnographic heritage surveys areas have been completed, resulting in 56 archaeological places and 4 ethnographic places being identified to date. There is a high likelihood places may be identified during ongoing cultural heritage surveys. These places will be managed in accordance with Fortescues legislative and contractual obligations and where practicable, disturbance will be avoided.

Fortescue undertakes all works in accordance with statutory and contractual obligations, in accordance with the appropriate approvals and Fortescue's own Land Management System (LMS) and Land Use Certificates (LUC's).

Pastoral and Other Lands

Fortescue has protocols and notification arrangements with pastoralists that may be affected by the works associated with this proposal. The Proposal intersects the Hamersley pastoral station and Unallocated Crown Land. Due to the low impact nature of the proposed activities, it is unlikely to result in impacts to the operations at the Hamersley pastoral station.

2. BASELINE ENVIRONMENTAL DATA

The Eliwana Project area (the broader project area encompassing the permit envelope) has been subject to baseline environmental investigations. This section outlines the environmental data relevant to this clearing permit application. The data has been used to define the environmental risks and potential impacts that have been used to inform the risk assessment and risk management measures.

2.1 Climate

The permit envelope experiences a dry desert climate, with hot dry summers and mild winters (van Vreeswyk, Payne, Leighton, & Hennig, 2004).

The monthly rainfall and temperature averages for the Tom Price (BoM, 2017a) and Paraburdoo (BoM, 2017b) Bureau of Meteorology (BoM) stations, located 60 km east and 80 km south-east of the Proposal area, respectively are shown in Figure 3.

Monthly maximum temperatures range from an average of 23°C in July to 41°C in January, whereas minimum temperatures range between 7°C in July and 26°C in January (BoM 2017a; 2017b).

Annual rainfall in the Pilbara has a substantial yearly variation. Tropical cyclones, many of which originate in the Timor Sea, along with local thunderstorms, produce much of the summer and early autumn rainfall. The driest months are in spring (September to October), and the wettest in summer (January to March) (BoM 2017a; 2017b).

2.2 Landscape

The permit envelope lies in the Pilbara biogeographic region of the Interim Biogeographic Regionalisation for Australia (IBRA). The Pilbara biogeographic region incorporates 17,928,700 ha and includes four subregions: Chichester, Roebourne, Hamersley, and Fortescue Plains. The permit envelope is located entirely within the Hamersley sub-bioregion of the Pilbara bioregion.

The Hamersley sub-bioregion, described by Kendrick (2002), consists of a mountainous area of Proterozoic sedimentary ranges and plateaus dissected by gorges. Surface drainage flows into either the Fortescue River to the north, the Ashburton River to the south or the Robe River to the west. Environmental features of conservation value in the sub-bioregion include the gorges of the Hamersley Range (particularly in Karijini National Park), Palm Springs and Duck Creek, the Themeda grasslands of the Pilbara, and isolated areas of Mulga on Red Hill Station. Land

use in the region is dominated by pastoral grazing and mining. The areal extent of the Hamersley sub-bioregion is 6,215,092 ha.

2.2.1 Geology

The Project occurs within the Hamersley Province which covers an approximate area of 80,000 km^2. The Hamersley Province contains late Archaean to Lower Proterozoic age sediments of the Mount Bruce Supergroup (SoilWater, 2017). This Supergroup contains the Fortescue, Hamersley and Turee Creek Groups, which are overlain by remnants of the Wyloo Group. The Fortescue Group is a sequence of basalts, inter-bedded clastic sediment, minor chemical sediment and doleritic intrusions. This Group contains the following Formations: the Mount Roe Basalt, the Hardley Formation, the Kylena, Boongal, Tumbiana and Maddina Formations, and the Jeerinah Formation.

The Hamersley Group overlies the Fortescue Group, and is approximately 2,500 m thick containing a sequence of banded iron formations (BIF), dolomites, pyroclastic/hemipelagic shale, and acid volcanics. The Hamersley Group contain the two dominant iron ore bearing formations of the region; these being the Brockman Iron Formation and the Marra Mamba Iron Formation. The Turee Creek Group is the youngest geologic unit of the Mount Bruce Supergroup, and is not considered to contain significant quantities of iron ore (SoilWater, 2017).

2.2.2 Land Systems and Soils

Three land systems, as described by van Vreeswyk et al. (2004), occur within the permit envelope. The Boolgeeda land system makes up the majority of the area with smaller representation of the Newman land system and Hooley Land System. These extents are described in Table 6.

Table 4: Land Systems within the permit envelope

Land System	Description	WA Soil Group	% of Permit Envelope
Boolgeeda System	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	Red loamy earth soils (544) Red/brown non-cracking clay (622)	84.9
Newman System	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	Stony soils (203) Red shallow loam soils (522)	9.9
Hooley System	Broad alluvial plains with clay soils and a mosaic of stony nongilgaied and less stony gilgaied surfaces	Deep red/brown noncracking clays (622) Red loamy earths (544)	4.3

Land System	Description	WA Soil Group	% of Permit Envelope
		Self-mulching cracking clays (602)	
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	Calcareous shallow loam soils (521) Red shallow loam soils (522)	0.8

Western Australian Soil Classification

Soils in Western Australia have been classified into 60 broad categories in the technical guide, 'Soil Groups of Western Australia', published by the Department of Agriculture and Food, Western Australia. These broad soil groups are a useful guide to the relationship between the project area and the regional landscape. Five soil groups, as classified by the Western Australia Soil Groups, occur within the disturbance envelope and are discussed below.

Stony soils (203)

Stony soils are often shallow (<0.25 – 0.5 m) and skeletal or poorly developed, with basalt as the dominant parent material. Stony soils have lighter textures ranging from loamy coarse sand to sandy loam, and are mostly dark red to red/brown, with a stony mantle protecting the soil surface. The topsoil is prone to slaking and dispersion, and the soil profile is non saline. Soil pH is typically in the acidic to weakly acidic range (pH 6 – 7). Soil water storage is low due to sandy/gravelly texture, and permeability varies from moderate to rapid. Most soils are not water repellent, and soil fertility varies from low to moderate.

Calcareous shallow loam soils (521)

Calcerous shallow loam soils are calcerous throughout, usually over limestone or calcrete with an alkaline pH. They are loamy throughout, although may grade to clay above the hard layer. They have moderate permeability with moderately low water storage. Water repellence is nil and fertility is high.

Red shallow loam (522)

Red shallow loam exhibit uniform texture throughout the soil profile, and are often underlain by weathered basalt. These soils are found on hillslopes, lower foot slope and on the stony plains, and can have a stony mantle on the soil surface. These red/brown loam soils can exhibit slaking and dispersion, and are often very shallow (<0.25 m) to shallow (0.25 – 0.5 m) in depth. These soils are of moderate fertility with slightly acid topsoil overlying a mostly neutral to alkaline subsoil. Plant rooting depth can be moderate (≈0.5 m) but soil water storage is low to

moderately low. Soil organic carbon levels are low, and the soil does not display water repellence.

Red loamy earth soils (544)

Red loamy earths soils exhibit thin to medium (10-30 cm) loam to clay loam topsoils overlying thick (30-60 cm) clay loam to light clay subsoils. The soils are deep but occasionally have substrates of red-brown hardpan, granite or banded ironstone at moderate depth (80-100 cm). The soils are dark reddish brown in colour, non-calcareous, non-saline with neutral to slightly alkaline soil reaction trends. The soils have either common to abundant (10->50%) cryptogam crusts or common to abundant (10->50%) stony mantles. Many soils occurring on footslopes, hillslopes, stony plains and laterite plains, are deep with common to abundant (10- >50%) stones or gravels through all or most of the soil profile. Red loamy earth soils occurring in broad drainage zones, groves or open plains tend to be stone free apart from occasional surface mantles

Self-mulching cracking clay (602)

Self-mulching cracking clay soils are deep (>100 cm) with thin to medium (10-30 cm) light, silty or medium clay topsoils. Occasionally the topsoils may include a thin (1-10 cm) layer of clay loam. The thick to very thick (>60 cm) subsoils have textures of medium to heavy clay or, less frequently, light clay. The uppermost layers of these soils exhibit large surface cracks or have crumbly (self-mulching) surfaces when dry and often show rough mounded (gilgai) surfaces. Large areas of cracking clays tend to show zonations of varying amounts of surface cracking. Soil colour is mainly dark reddish brown to red, soil reaction is alkaline and many soils contain some carbonates within at least part of the profile. Surface mantles of fine ironstone pebbles are common to abundant. The soil surfaces are generally non-saline with deep sub soils being partially saline. On upland areas large boulders of basalt occur on the soil surface and throughout the soil profile. Cracking clay soils often occur with or adjacent to, deep red/brown noncracking clay soils (Soil Group 622).

Red/brown non-cracking clays (622)

Red/brown non-cracking clays (622) largely occur on the stony plains and narrow drainage zones. These soils are either dark reddish brown to yellowish brown in colour, and are often clay loam in texture. The depth of the soil profile is mostly deep (>1 m), and can have a stony mantle. These soils can exhibit slaking and dispersion, particularly in the subsoil, and are often non saline. Surface and sub soil pH is slightly acid to alkaline (pH 6.5 – 9.5), and of moderate to high fertility. The soil profile contains less gravels and stones than Stony Soils, and the permeability is slow due to the clay content and lack of gravels. Soil organic carbon can be high, but these soils do not exhibit water repellence.

When complemented with other studies, the following general comments can be made about the soils found in the area:

- Other studies undertaken for Fortescue operations have shown that nutrient levels are dependent on Organic Carbon content of the soil. It is suspected to be the same for the soils of the Eliwana Railway Corridor.
- Most soils could be considered to be apedal or massive.
- Most soils (except for gilgai soils and some granite based soils and river sands) were considered to be suitable for different fill types for the rail embankment, which suggests that although the soil can be used for geotechnically stable landforms.
- Most soils can be considered to be at risk of hardsetting and dispersive, common in the Pilbara, which suggests most topsoils could be erodible depending the landscape setting they are used in.

2.3 Flora and Vegetation

The flora and vegetation of the permit envelope has been analysed through desktop literature reviews and through follow up ground surveys. The results of this are provided in this section.

2.3.1 Regional Vegetation Units

Vegetation units have been described on a regional scale by Beard (1975) and updated by DAFWA (2012). These vegetation units are broad scale descriptors and attempt to depict the native vegetation as it was presumed to be at the time of European settlement. Four Beard vegetation units occur within the permit envelope and are listed in Table 7 with their total estimated Pre-European and current extent (DAFWA 2012).

Table 5: Beard vegetation units present within permit envelope

Association	Description	Pre-European Extent	Current State-wide Remaining (ha)
18	*Acacia* open shrubland. Low woodland, mulga (*Acacia aneura*)	581,246	577,123
29	Mulga (‘*Acacia aneura*’) sparse low woodland, discontinuous in scattered groups	172,083	171,975
82	Snappy Gum (*Eucalyptus leucophloia*) low woodland over *Triodia wiseana* hummock grassland	2,158,862	2,165,235
175	Short bunch grassland – savanna/grass plain (Pilbara)	92,900	92,751

2.3.2 Flora and Vegetation Studies

The permit envelope and surrounds has been subject to extensive flora and vegetation survey effort. The most relevant previous surveys relating to flora and vegetation include:

- Eliwana and Flying Fish Level 2 Flora and Vegetation Survey (Ecoscape, 2015);
- Western Hub Rail Link Level 2 Flora and Vegetation Survey (Ecoscape, 2014); and
- Eliwana Consolidated Detailed Flora and Vegetation Survey (Biota, 2017).

These surveys have been used to assess the flora and vegetation of the permit envelope for this clearing permit. The flora and vegetation surveys were conducted over a broad region surrounding and including the permit envelope.

2.3.3 Vegetation Communities

A total of 16 vegetation communities have been mapped within the permit envelope as depicted in Table 8 and Figure 4.

Table 6: Vegetation Communities within the Permit Envelope

Vegetation Community	Description	Extent in permit envelope (ha)	Area of disturbance (ha)
AanAprAatTwTe	*Acacia 'aneura'*, *A. pruinocarpa* low open woodland over *Acacia atkinsiana* tall sparse shrubland over *Triodia wiseana*, *T. epactia* mid hummock grassland	27.43	0.12
AanCHf*	*Acacia 'aneura'* low open woodland over *Chrysopogon fallax* mid sparse tussock grassland	367.44	5.46
AanEgAbTe	*Acacia 'aneura'* isolated trees over *Eucalyptus gamophylla* isolated mallee trees over *A. bivenosa* isolated tall shrubs over *Triodia epactia, T. wiseana* mid closed hummock grassland	702.99	7.42
AanExAatAbCHfTe	*Acacia 'aneura', Eucalyptus xerothermica* mid open woodland over *Acacia atkinsiana, A. bivenosa* mid sparse shrubland over *Chrysopogon fallax* mid sparse tussock grassland over *Triodia epactia* mid hummock grassland	7.30	0
AcAanVfBTe	*Acacia citrinoviridis*, *Acacia 'aneura'* mid isolated trees over **Vachellia farnesiana* mid sparse shrubland over *Bothriochloa ewartiana*, *Themeda sp. Hamersley Station* (M.E. Trudgen 11431), *Eriachne benthamii* tall closed hummock grassland	1.45	0.07

Vegetation Community	Description	Extent in permit envelope (ha)	Area of disturbance (ha)
AcBTe**	*Acacia citrinoviridis, Eucalyptus victrix* mid open woodland over *Bothriochloa ewartiana* and *Chrysopogon fallax* mid sparse tussock grassland	15.89	0.38
Ax	*Acacia xiphophylla* open shrubland over mixed *Poaceae spp.* sparse tussock grassland	7.28	0.69
ChApyTHtTe	*Corymbia hamersleyana* low open woodland over *Acacia pyrifolia* and/or *A. tumida var. pilbarensis* mid sparse shrubland occasionally over *Gossypium australe* low sparse shrubland over *Themeda triandra* open tussock grassland over *Triodia epactia* mid open hummock	7.01	0.32
ElAanAprAbTwTe	*Eucalyptus leucophloia subsp. leucophloia* isolated mid trees over *Acacia 'aneura'*, *A. pruinocarpa*, *A. bivenosa* tall open shrubland over *Triodia wiseana, T. epactia* mid hummock grassland	2.58	0
ElAanTbr	*Eucalyptus leucophloia subsp. leucophloia, Corymbia hamersleyana* scattered tree low sparse woodland over *Acacia 'aneura' A. pruinocarpa, A. bivenosa* tall open shrubland over *Triodia brizoides, T. epactia* mid hummock grassland	9.95	0
ElAaTw	*Eucalyptus leucophloia subsp. leucophloia* low isolated trees over *Acacia ancistrocarpa*, *A, bivenosa, A. inaequilatera* mid sparse shrubland over *Triodia wiseana* or *T. brizoides* open hummock grassland	174.12	1.22
ElAbTw	*Eucalyptus leucophloia subsp. leucophloia* and/ or *Corymbia hamersleyana* mid open woodland over Acacia maitlandii mid sparse shrubland over *Triodia wiseana* low hummock grassland	0.96	1.03
ElChAeTw	*Eucalyptus leucophloia subsp. leucophloia* and/ or *Corymbia hamersleyana* low open woodland over *Acacia exigua, A. bivenosa, A. synchronicia* mid open shrubland over *Triodia wiseana* mid hummock grassland	12.46	0
ElEgAatTw	*Eucalyptus leucophloia subsp. leucophloia*, *Acacia pruinocarpa* isolated low trees over *E. gamophylla* isolated low mallee trees over *Acacia atkinsiana*, *A. bivenosa, Senna glutinosa subsp. glutinosa, S.*	5.44	0.11

Vegetation Community	Description	Extent in permit envelope (ha)	Area of disturbance (ha)
	glutinosa subsp. pruinosa tall sparse shrubland over T		
ElHcAhTw	*Eucalyptus leucophloia subsp. leucophloia*, *Corymbia hamersleyana* low open woodland over *Hakea chordophylla* mid sparse shrubland occasionally over *Acacia hilliana*, *Acacia adoxa var. adoxa* low sparse shrubland over *Triodia wiseana* mid hummock grassland	13.50	0.19
VfARl	*Vachellia farnesiana mid sparse shrubland over Aristida latifolia, *Chrysopogon fallax*, *Dichanthium sericeum, Eriachne benthamii* mid tussock grassland	18.22	0.15

*** Denote Banded Mulga**

**** Denotes Potential Groundwater Dependent Vegetation**

2.3.4 Vegetation Condition

The vegetation condition of the permit envelope has been assessed using the adapted Keighery (1994) Vegetation Condition Scale for the Eremaean and Northern Botanical Provinces. Within the permit envelope, 66.8%, is considered to be in 'Excellent' condition, 29.4% is in 'Very Good' condition and 3.7% is in 'Good' condition.

2.3.5 Conservation Significant Vegetation Communities

Vegetation communities in Western Australia are described as Threatened Ecological Communities (TEC) if they have been endorsed by the Western Australian Minister for Environment following recommendations made by the Threatened Species Scientific Committee. TECs that are listed to be of State conservation significance in Western Australia are considered to be Environmentally Sensitive Areas (ESA) under Part V of the EP Act.

Possible threatened ecological communities that do not meet survey criteria are added to the Priority Ecological Community (PEC) list under Priority 1, 2 or 3. Ecological communities that are adequately known, are rare but not threatened, or meet criteria for "Near Threatened", or that have been recently removed from the threatened list, are placed in Priority 4. Conservation dependent ecological communities are placed in Priority 5.

The mapped extent of two conservation significant vegetation communities occur outside, yet immediately adjacent to the north-east extent of the permit envelope. These communities are:

- Themeda Grasslands on Cracking Clays TEC; and
- Brockman iron cracking clay communities of the Hamersley Range (Priority 1 - PEC).

The Themeda Grasslands on Cracking Clays occur within 15m of the eastern edge of the permit envelope. The eastern edge of the permit envelop has an existing track that is proposed to be used to gain access to the proposed water drilling location. The mapped extent of the TEC occurs on the opposite side of the existing road to where the proposed water drilling will take place (Figure 5). Therefore, no impact to the TEC is anticipated as a result of this proposal.

The Brockman iron cracking clay communities of the Hamersley Range (Priority 1 - PEC) occurs to the south-west and south-east of the permit envelope. No impact to this community is anticipated.

Due to the small amount and temporary nature of the proposed clearing there is not anticipated to be an impact to the aforementioned TECs or PECs.

2.3.6 Sheetflow Dependent Vegetation

The term 'sheet flow dependent vegetation' is intended to refer to vegetation communities that are dependent on overland sheet flow of water, which occurs on broad plains with a very gradual slope. The main communities that are considered to be reliant on this process in the Pilbara are typically recognised as grove-intergrove vegetation (often referred to as 'Banded Mulga', as the communities are dominated by various taxa in the *Acacia 'aneura'* complex) (Biota, 2017).

The term 'sheet-flow dependent vegetation' is increasingly used, primarily with reference to Banded Mulga, however evidence-based assessments are lacking and sheet flow alone does not provide the required dynamics to maintain Mulga groves (Biota, 2017).

Considerable Mulga-dominated vegetation was recorded from Biota's 2017 study area, but most of this occurred on hills, stony undulating plains or in drainage lines, rather than on the broad plains that could potentially be subject to sheet flow (if such a process was indeed occurring) (Biota, 2017).

The vegetation unit AanCHf was considered Banded Mulga when they were mapped as part of the consolidated survey (Biota, 2017).

The extent of this vegetation type proposed to be cleared in the permit envelope is 6 ha within a mapped extent of 2,497 ha, of which 367.4 ha occurs within the permit envelope. Given the limited clearing extent, linear nature of the proposed drill lines, and the fact that the vegetation type is well represented outside of the indicative clearing disturbance area, there is unlikely to be any significant impacts on this type of vegetation.

2.3.7 Groundwater Dependent and Potentially Groundwater Dependent Vegetation

Groundwater Dependant Vegetation (GDV) is defined as terrestrial vegetation that is dependent on the presence of groundwater to meet some or all of its ecological water requirement (Astron, 2016).

GDE vegetation is often characterised by the presence of key indicator species such as Coolibah (*Melaleuca argentea*) or River Red Gum (*Eucalyptus camaldulensis*). These species obtain the majority of their water requirements from groundwater.

Other vegetation communities may potentially be dependent on groundwater depending on the depth to groundwater. In particular, the presence of *Eucalyptus victrix* as dominant overstorey species may indicate that a vegetation community may potentially be dependent on groundwater. A discussion on *E. victrix* follows.

From an assessment of water level ranges of Pilbara riparian species, it was found that the mean minimum groundwater level depth of *E. victrix* was greater than that for *E. camaldulensis*, providing support for the view that *E. victrix* is found in slightly drier areas than *E. camaldulensis* and may not be as responsive to water table fluctuations (Loomes, 2010).

This is supported by a number of studies which find that *E. victrix* is considered to be a facultative phreatophyte (Batini, 2009) (Froend, 2009). That is, *E. victrix* uses soil water derived from surface water drainage into the unsaturated zone but may obtain some of their water requirements from groundwater where it is available, particularly large mature trees.

Water inputs from flooding appears to be important for sustaining *E. victrix* communities in most environments, regardless of the groundwater level. Regular flood events are required to recharge soil moisture in the vadose zone and provide enough soil water to sustain *E. victrix* during lengthy periods of drought that can last many months to years (Astron, 2016).

Therefore, based on available literature Fortescue considers that the presence of *E. victrix* as a dominant overstorey species is indicative of a potential use of groundwater, depending on site-based conditions, including depth to groundwater and the surface hydrological regime.

One vegetation unit has been identified within the permit envelope that is potentially GDV:

- AcBTe - *Acacia citrinoviridis*, *Eucalyptus victrix* mid open woodland over *Bothriochloa ewartiana* and *Chrysopogon fallax* mid sparse tussock grassland

A maximum of 0.38 ha of the potentially GDV unit AcBTe is proposed to be cleared under this application for road and drill pad construction. This community is well represented outside of the indicative footprint with 45.3 ha mapped more widely of which 15.9 ha occurs within the permit

envelope. Given the low impact and linear nature of clearing for the proposed infrastructure, and the relatively small area of clearing, there will not be a significant impact on this vegetation communities.

2.3.8 Flora Taxa

As discussed earlier, the permit envelope and surrounding areas have been subject to extensive flora and vegetation survey effort.

These found 651 flora taxa from 204 genera. The results tend to indicate a higher level of species richness for the survey area when compared to other study areas in the local area. These higher than expected species richness values are considered to be a result of the broad extent of the study area (spanning 160km), which encompasses a wide range of habitats and vegetation units. The long linear nature of the proposed disturbance over such a large distance would be the main contributor to the observed higher species richness.

2.3.9 Flora of Conservation Significance

No Threatened Flora listed under the *Environment Protection and Biodiversity Conservation Act 1999* or the *Biodiversity Conservation Act 2016* has been mapped within 200 km of the permit envelope.

All priority flora recorded within 1 km of the permit envelope are listed in Table 9 and represented on Figure 6.

Table 7: Priority Flora within 1 km of the permit envelope

Species	Conservation Status
Helichrysum oligochaetum	Priority 1
Vittadinia sp Coondewanna Flats	Priority 1
Astrebla lappacea	Priority 3
Goodenia sp. East Pilbara	Priority 3
Glycine falcata	Priority 3
Indigofera sp. Bungaroo Creek	Priority 3
Iotasperma sessilifolium	Priority 3
Rhagodia sp. Hamersley	Priority 3
Themed asp. Hamersley Station	Priority 3

Three of the above listed species have been recorded within the permit envelope. These include: *Vittadinia sp Coondewanna Flats*; *Goodenia sp. East Pilbara*; and *Rhagodia sp. Hamersley*. All known locations of Priority flora will be avoided during ground disturbance activities.

2.3.10 Weeds

A total of 7 species of introduced flora have been recorded from within a 5 km radius of the permit envelope (Figure 7). No weeds of National Significance (WONS) or Declared Plants under the *Agriculture and Related Resources Protection Act 1978* were identified in the Project area or surrounds. Introduced flora species recorded within the permit envelope are:

- *Bidens bipinnata* (Beggartick)
- *Chloris virgata (Feathertop Rhodes Grass)*
- *Echinochloa colona (Awnless Barnyard Grass)*
- *Flaveria trinervia (Speedy Weed)*
- *Malvastrum americanum* (Spiked Malvastrum)
- *Rumex vesicarius* (Ruby Dock)
- *Vachellia farnesiana* (Mimosa Bush)

Buffel Grass (*Cenchrus cilliaris*) was not recorded within the permit envelope but is almost certainly present, particularly in drainage areas.

2.4 Vertebrate Fauna

Fortescue engaged Ecoscape (Australia) Pty Ltd (Ecoscape) to conduct a consolidated Level 2 terrestrial fauna assessment of the Eliwana Iron Ore Railway Project (encompasses and surrounds the permit envelope). A total of 41 previous fauna survey reports were consulted to develop the *Eliwana Project: Consolidated Vertebrate Fauna Survey* (Ecoscape, 2017).

The results of the Ecoscape (2017) report have been used to provide the baseline data for the clearing permit application.

2.4.1 Fauna Habitat

Four broad fauna habitat types, as mapped by Ecoscape (2017), occur within the permit envelope (Figure 8). Details regarding these habitat types are listed in Table 11, including whether they support conservation significant fauna.

Fauna habitat is affected to some extent by grazing and trampling by cattle and feral donkeys in localised areas, but generally is considered to be in good condition (Ecoscape, 2017).

Despite targeted searches, no significant roost caves supporting the Pilbara Leaf-nosed Bat or Ghost Bat are known from within the broader Eliwana Rail Project survey area that encompasses the permit envelope.

Table 8: Fauna Habitats within the permit envelope

Habitat Type	Description	Significant Fauna reliant on habitat	Area within permit envelope (ha)
Lower Slopes/Hillslopes	Rolling hills, footslopes of hills with a hard rocky substrate. Tree strata of *Eucalyptus leucophloia*, *Acacia*, over a shrub layer of *Senna* and a spinifex hummock grassland.	Western Pebble-mound Mouse	166.8
Plain (Shrubland)	Mixed *Acacia* (mulga) woodland over spinifex hummock grassland.	Nil.	319.0
Plain (Stony/Gibber)	Relatively flat, slightly undulating plain with open shrubland of Acacia's and *Senna* over a spinifex hummock grassland. Substrate of bedrock with scattered pebbles and stones.	Western Pebble-mound Mouse Peregrine Falcon (foraging) Grey Falcon (foraging)	879.8
Plain (Cracking Clay)	This is a unique habitat type that contains little to no overstorey and is often dominated by one or two tussock grass species. The vegetation is described as isolated shrubs of *Sida spinosa* and/or *Vachellia farnesiana* located amongst dense tussock grassland dominated by *Chrysopogon fallax*, *Themeda* sp. Hamersley Station (P3) and/or *Astrebla pectinata* grass species	Peregrine Falcon (foraging) Grey Falcon (foraging) Short-tailed Mouse	8.3

2.4.2 Conservation Significant Fauna

The Western Pebble-mound Mouse (Priority 4) is likely to use some of the permit envelope for breeding purposes. In addition, the Gane's Blind Snake (Priority 1) may occur in some of the Lower Slopes/Hillslopes habitat area within the permit envelope. The Whistling Kite has been recorded within 1 km of the permit envelope.

Four conservation significant species are likely to use the habitat types that occur within the permit envelope for foraging and dispersal:

- Peregrine Falcon (Specially Protected)
- Grey Falcon (Vulnerable)
- Pilbara Leaf-nosed Bat (Vulnerable)
- Ghost Bat (Vulnerable)

The small areas of clearing within the permit envelope is unlikely to impact on the conservation of any fauna. Records of conservation significant fauna within the permit envelope are shown in Figure 9.

2.4.3 Short Range Endemic Invertebrates

Short-range endemic (SRE) fauna are defined as animals that display restricted geographic distributions, nominally less than 10,000 km^2, that may also be disjunct and highly localised (Harvey, 2002).

Surveys for SRE invertebrates have been undertaken over the permit envelope and surrounding areas (Phoenix , 2018).

The following potential SRE invertebrates have been recorded in close proximity to the permit envelope:

- Pseudoscoprion: *Austrochthonius* 'pilbara'
- Pseudoscoprion: *Beierolpium sp*. '8/4'
- Pseudoscoprion *Olpiidae sp*
- Isopod: *Buddelundia* 'EE1340'
- Isopod: *Buddelundia* '75'
- Isopod: *Buddelundia* '76'
- Isopod: *Buddelundia* '77'
- Isopod: *Cubaris* 'EE1515'
- Gastropod: *Succinea* Genus
- Gastropod: *Succinea* sp.

None of these potential SRE species have been located within the disturbance footprint. Given the low impact nature of the clearing, there is unlikely to be any significant impact to SRE invertebrates or their habitat.

2.4.4 Feral Animals

Five introduced mammal species have been recorded in the Eliwana Fauna survey area which encompasses the permit envelope including (Ecoscape 2017):

- House mouse

- Dingo/dog
- Cat
- Donkey
- Cattle

2.5 Hydrology

2.5.1 Surface Water Flow

The permit envelope occurs within the Duck Creek sub catchment (Figure 10), a tributary of the Ashburton River. The Duck Creek catchment area is approximately 6,800km^2 at the confluence with the Ashburton River. There are no permanent surface water features within the permit envelope. Several ephemeral water courses that flow only after heavy rainfall occur throughout the catchment, however, significant disturbance to the natural drainage of water from the landscape is not anticipated.

Surface water flows are most likely to occur in the summer months during localised storm events or from cyclonic activity. Clearing for tracks across drainage lines will be at grade and therefore, there will not be any impact on surface water flow.

2.5.2 Surface Water Quality

The streamflow in the ephemeral creeks in the Duck Creek catchment (and wider Pilbara) are typically fresh, but highly turbid due to the rapid rise of creek levels in response to rainfall, when flooding occurs. The highly variable nature of rainfall and flooding across the Pilbara also results in significant variation in the physical parameters across samples within the same basin. To illustrate this variation, water samples from the Ashburton River basin from the DoW's *Water Information Reporting* database have been analysed and compared against available Pilbara wide surface water quality data. Available water quality data from the DoW dataset has been presented in Table 11 and includes the range across all Pilbara watercourses as well as the range within the Ashburton River basins.

Clearing within minor drainage lines will not significantly impact on surface water quality.

Table 9: Surface Water Quality Data

	Pilbara Wide (DoW)		Ashburton	
	Minimum	Maximum	Minimum	Maximum
pH	5.2	9.4	6.7	8.8
EC (µS/cm)	3	6,090	83	6,090

	Pilbara Wide (DoW)		Ashburton	
Turbidity (NTU)	0.1	3,200	0.5	3,200
Alkalinity (mg/L	3.6	420	35	274
TDS (mg/L)	22	3,932	70	2,618
Nitrate as N (mg/L)	0.05	32	1	3
Hardness (mg/L)	3.6	1,538	48.9	1,539
Dissolved Silica (mg/L)	1	68	7.7	22

2.5.3 Groundwater

Groundwater within the broader Eliwana area occurs within both deep, fractured rock aquifers and near the surface along dissected creeks and within gorges. The main aquifers relevant to the permit envelope are likely to be fractured rock aquifers or minor alluvial aquifers in surface creeks. Clearing of small amounts of vegetation of a wide range will have no impact on groundwater levels or quality.

3. ENVIRONMENTAL IMPACTS AND MANAGEMENT

The environmental impacts of the proposed vegetation clearing have been considered in the following section.

3.1 Potential Impacts to Flora and Vegetation

Potential impacts to flora and vegetation resulting from the implementation of this proposal include:

- Direct loss of vegetation at a local level
- Direct loss of potentially GDV
- Degradation of vegetation due to indirect impacts such as:
  - Fragmentation, leading to edge effects
  - Dust deposition
  - Chemical and hydrocarbon spills and leaks

3.1.1 Direct Loss of Vegetation

The groundwater investigations will result in the disturbance of approximately 17.7 ha of native vegetation. The disturbance by vegetation unit together with the area of each vegetation unit to be cleared in relation to the currently mapped extent was provided in Table 6.

The loss of 17.7 ha of vegetation over such a large area that remains mostly uncleared will not significantly impact on the biodiversity values of the vegetation within the permit envelope or the wider area. None of the vegetation types within the permit envelope are restricted in areal extent or otherwise conservations significant.

3.1.2 Direct Loss of Flora of Conservation Significance

No Threatened Flora listed under the *Environment Protection and Biodiversity Conservation Act 1999* or the *Biodiversity Conservation Act 2016* has been mapped within 200 km of the permit envelope.

No flora species of conservation significance have been recorded within the disturbance footprint. However, it is possible that some priority flora species may occur within the footprint based on the proximity of the disturbance to known locations of Priority flora. However, the proposed clearing will not impact the conservation significance of the any flora species.

3.1.3 Direct Loss of Potentially Groundwater Dependent Vegetation

Approximately 0.64 ha of the potential GDV unit AcBTe is proposed to be cleared under this application (Table 8). Given the low impact nature of clearing for the proposed infrastructure, and the relatively small area of clearing, there will not be a significant impact on these vegetation communities.

3.1.4 Degradation of vegetation

Degradation of vegetation may occur as a result of:

- uncontrolled vehicle access leading to physical damage of vegetation and/or the introduction or spread of weeds
- dust deposition on vegetation resulting from land clearing and construction activities
- introduction or spread of weed species
- leaks of containment structures, pipes, vehicles or equipment leading to contamination of soils, surface water or groundwater
- spills of chemicals or hydrocarbons leading to contamination of soils, surface water or groundwater
- inappropriate disposal of domestic waste, waste hydrocarbons and chemicals, construction waste or treated sewerage leading to contamination of soils, surface water or groundwater.

These indirect impacts can be managed as discussed later in this section to ensure there are no significant impacts.

Dust Deposition

Dust deposition on foliage can impact on a plants ability to photosynthesise, or control water loss through transpiration. One published study indicates that vegetation health is not impacted by dust deposition until relatively high levels of dust are experienced, that is, greater than 7g/m^2/month (Doley, 2006). Dust deposition can occur through movement of vehicles and earth moving. The impact from dust deposition from this proposal is low due to short construction timeframe and Fortescue's dust management measures.

Chemical Spills, Leaks and Leachate

Contamination of soil by chemical and hydrocarbon spills can impede plant growth or kill vegetation. Drainage from infrastructure may contain higher levels of sediments which may cause a decline in vegetation health. Fortescue consider the risk of impacts to vegetation from contamination and pollution to be low.

Altered Surface Hydrology

The proposed roads and drill pads are located in upper catchments of tributaries which flow into Duck Creek. The construction of exploration tracks (6m wide) across minor ephemeral drainage lines is unlikely to result in significant alterations to surface hydrology.

3.1.5 Management Measures for Flora and Vegetation

Fortescue manages clearing of native vegetation though a Land Use Certificate System (LUC), previously known as a Ground Disturbance Permit (GDP). A LUC identifies the area to be disturbed and considers multiple factors, such as environmental (significant values and approvals), heritage, *Mining Act 1978* tenure, pastoral leases and water, before disturbance is permitted. Each LUC application is reviewed for each factor by technical leads with Fortescue before approval. Conditions are placed on each LUC with regards to the identified factors to ensure clearing is undertaken in accordance with legal obligations and with regards to environmental or heritage values. The LUC process allows applicants to modify their application to avoid significant or sensitive values in consultation with the technical leads prior to approval of the LUC.

Conditions of the LUC may include ground inspections for conservation significant flora or fauna depending on the receiving environment and the conditions of any environmental approval applicable to the area. No LUC would be approved without the area having been subject to heritage survey.

Table 10: Management Measures for Flora and Vegetation

Impact	Management Actions
Direct Loss of Vegetation and Flora	• Review the proposed project design against the vegetation survey data to avoid/minimise clearing of significant flora and vegetation. • All Threatened and Priority Flora are to be identified on the ground by appropriate signage, fencing and/or flagging prior to clearing. • Minimise clearing and vegetation disturbance to ensure significant flora and vegetation are protected. Conduct vegetation clearing in accordance with a permit issued under the *Land Use Certificate Procedure 100-PR-TA-0001* • Ensure staff and contractors are aware of the location of significant flora and vegetation on site and their responsibility to ensure they are protected.

Impact	Management Actions
Fragmentation	• Weed hygiene requirements are implemented for plant and equipment in identified weed risk areas and/or in areas where weed populations have been identified and high risk activities are proposed to be undertaken in accordance with the *Weed Management Plan 100-PL-EN-1017*.
Altered fire regimes	• Site induction will inform about fire risk and potential sources.
Dust	• Vehicle speeds restricted according to Traffic Management Plan 100-PR-SA-0049
Chemical and Hydrocarbon Spills	• Ensure relevant personnel and contractors involved in chemical and hydrocarbon handling and storage activities are provided with the appropriate training and equipment as outlined in the *Chemical and Hydrocarbon Spills Procedures 100-PR-EN-0014* and *the Hazardous Materials Management Procedure 100-PR-SA-1059*. • Chemicals and hydrocarbons should be stored in accordance with AS 1940, AS 3833 or AS 3780 to minimise the potential for environmental harm. Storage should only be in designated areas and within the limits specified in applicable Licence conditions under the EP Act. • Store chemicals and hydrocarbons in accordance with Licence conditions under the EP Act. • Where a chemical or hydrocarbon spill has occurred, manage the spill including any contaminated material, in accordance with the *Chemical and Hydrocarbon Spills Procedure 100-PR-EN-0014* and investigate and report the incident in accordance with the *Incident Event Management Procedure 100-PR-SA-0011*. • Contain and appropriately manage potentially contaminated stormwater prior to release to the environment. • Remediate any area declared contaminated as defined under the *Contaminated Sites Act 2003* in accordance with the DER's Contaminated Sites Management Series – Assessment Levels for Soil, Sediment and Water (2011)
Altered surface hydrology	• Conduct a risk assessment to determine the likelihood of a change to the surface water regime that may lead to unacceptable environmental impacts. • Drainage infrastructure location, design, construction and operation to design specifications which reflect risk assessment outcomes in minimising interference and disruption of natural surface water flows and quality where practicable in accordance with the *Standard Engineering Specification for Drainage and Flood Protection 100-SP-CI-0004* and the *Standard Engineering Specification for Road Design for Projects 100-SP-CL-0002*. • Protect natural drainage lines from construction impacts where possible to minimise impacts to water quality.

3.1.6 Conclusion – Impacts to Flora

Taking into account the existing environment, proposed activities and management strategies, Fortescue believes the impacts to flora and vegetation of the proposed clearing are not significant.

3.2 Potential Impacts to Fauna

Potential impacts to terrestrial fauna, including the conservation significant fauna and SRE invertebrates include:

- Habitat loss from direct clearing of fauna habitat, including habitat for SRE invertebrates;
- Habitat fragmentation, resulting in:
  - Restriction or removal of access to breeding habitat, foraging habitat or water sources through the construction of roads and drill pads
  - Increased feral animal species
  - Increased weed species
- Increased vehicle strike;

These impacts are discussed further below.

3.2.1 Fragmentation of Habitat

Fragmentation occurs when a large expanse of habitat is transformed into a number of smaller patches of smaller total area due to clearing, isolating these smaller fragments from each other by cleared areas (Wilcove, McLellan, & Dobson, 1986). Where the landscape surrounding the fragments is inhospitable to species of the original habitat and when dispersal is low, remnant patches can be considered true habitat islands and local communities will be isolates. Small habitat fragments are likely to be low in heterogeneity, that is, the habitat may not present the range of habitat variety required by some species (e.g. both foraging and breeding habitat) (Wilcove, McLellan, & Dobson, 1986).

It is possible that clearing for the construction of access tracks and drill pads may cause disruption to some species movement within their home ranges, particularly small reptiles and mammals. However, large areas of undisturbed habitat will remain post-disturbance and populations in these areas will not be impacted. Significant impacts to fauna resulting from habitat fragmentation is not anticipated.

3.2.2 Increased Vehicle Strike

Vehicles may strike fauna species on roads, particularly slow moving animals or species that are easily startled. Vehicles travelling at night are more likely to strike native fauna when visibility is reduced and more animals are on the move. Species such as birds of prey are also likely to feed off dead carcases on roads and may also become victim to vehicle strike.

Fortescue keeps a record of all vehicle related fauna incidents. The species with the highest number of vehicle strikes at Fortescue's operating sites is the kangaroo, usually at dawn and dusk. There have been relatively few vehicle strikes involving significant fauna at Fortescue sites.

3.2.3 Increased Weed Species

Increased movement of vehicles, including earth moving machinery may result in the establishment of new populations of weed species. Increased numbers of weeds can significantly increase the risk of fire, which can impact on fauna habitat value (see further discussion later in this section). Areas of dense weed infestation can also reduce the ability of fauna to move through their habitat and impact on their ability to forage. Weed species palatable to feral herbivores may attract these animals to the area causing potential land degradation and further spreading weed species either by movement of soil or in the animal's dung.

3.2.4 Mitigation

Fortescue has applied the mitigation hierarchy to the Project in relation to terrestrial fauna. Mitigation measures to address potential impacts are detailed in Table 11.

Table 11: Management Measures for Fauna

Impact	Management Actions
Loss of habitat	• Record conservation significant fauna and habitat identified during a targeted fauna survey in the Corporate GIS and PIMS in accordance with the *Environmental Datasets – Data Governance Guidelines 100-GU-EN-0020*. • Conduct a risk assessment to identify high risk areas, including areas where conservation significant fauna species and habitat have been identified and potential impacts are likely. • Land use certification (LUC) procedure. Must be adhered to before any: ground disturbance, rehabilitation or land access. This ensures all proposed disturbance is checked for: purpose; cultural heritage; and environmental significance. No ground disturbance can take place without a valid land use certificate. • Ensure infrastructure location, design, construction and operation reflects risk assessment outcomes in minimising impacts on conservation significant fauna and associated habitat. • Ensure staff and contractors are provided with appropriate training to ensure conservation significant fauna and associated habitat are protected.

Impact	Management Actions
	• Prior to conducting ground disturbance activities, ensure known locations of environmentally sensitive areas to be retained and protected from disturbance are identified on the ground by appropriate signage, fencing or flagging.
Fragmentation of habitat	• Land use certification (LUC) procedure must be adhered to before any: ground disturbance, rehabilitation or land access. This ensures all proposed disturbance is checked for: purpose; cultural heritage; and environmental significance. No ground disturbance can take place without a valid land use certificate. • Conduct progressive rehabilitation of disturbed areas, particularly those areas with known conservation significant fauna and associated habitat.
Increased Feral Animals	• Domestic waste stored in appropriate bins inaccessible to animals. • All domestic waste will be transported off site • No domestic animals permitted on site
Vehicle Strike	To minimise the potential for fauna injuries or deaths on haul and access roads, implement appropriate mitigation measures such as speed limit restrictions, right of way for fauna and the prohibition of off-road driving.
Weeds	Weed hygiene requirements are implemented for plant and equipment in identified weed risk areas and/or in areas where weed populations have been identified and high risk activities are proposed to be undertaken in accordance with the *Weed Management Plan 100-PL-EN-1017.*
Changes to surface water	• Conduct a risk assessment to determine the likelihood of a change to the surface water regime that may lead to unacceptable environmental impacts. • Drainage infrastructure location, design, construction and operation to design specifications which reflect risk assessment outcomes in minimising interference and disruption of natural surface water flows and quality in accordance with the *Standard Engineering Specification for Drainage and Flood Protection 100-SP-CI-0004* and the *Standard Engineering Specification for Road Design for Projects 100-SP-CL-0002*. • Protect natural drainage lines from construction impacts where possible to minimise impacts to water quality.

3.2.5 Conclusion – Impacts to Fauna

Taking into account the existing environment, proposed activities and management strategies, Fortescue believes the impacts to fauna and fauna habitat of the proposed clearing are not significant.

4. ASSESSMENT AGAINST THE 10 CLEARING PRINCIPLES

The *Environmental Protection Act 1986* includes 10 principles that provide decision makers with a guide on whether native vegetation should be cleared. The principles, outlined in 'Schedule 5 – Principles for Clearing Native Vegetation', are used as a comparative tool by DEWIR and DMIRS in determining whether clearing activities are environmentally acceptable and capable of being appropriately managed. Table 14 assesses the proposed clearing against these Principles.

Table 12: 10 Clearing Principles

Proponent Assessment of the Clearing Principles
(a) Native Vegetation should not be cleared if it comprises a high level of biological diversity

Proposed clearing is not likely to be at variance to this Principle

Fortescue has conducted Flora surveys across 134,177 ha for the Eliwana Mine and Railway Projects. The Eliwana Rail Survey study area comprised 61,797ha as part of the recent consolidated survey (Biota, 2017). The consolidated survey data from the rail survey area found 651 flora taxa from 204 genera. During the design of the drilling programme, specific attention was given to avoiding flora and vegetation communities of environmental significance.

Under the clearing permit direct disturbance footprint, up to 17.7 ha of native vegetation will be cleared from up to 16 vegetation communities. The impact to the extent of all of the vegetation communities within the clearing disturbance footprint is low.

The consolidated survey area results tends to indicate a higher level of species richness for the survey area when compared to other study areas in the local area. These higher than expected species richness values are considered to be a result of the broad extent of the study area (spanning 160km), which encompasses a wide range of habitats and vegetation units.

The vegetation condition of the permit envelope, assessed using the adapted Keighery (1994) Vegetation Condition Scale for the Eremaean and Northern Botanical Provinces. The majority of vegetation within the permit envelope is in good to excellent condition.

The vascular flora total from the permit area includes 7 known introduced species and is also certain to include Buffel Grass (8 species in total). No introduced species from the study area is listed under the BAM Act 2007 as a Declared Pest in the Shire of Ashburton. None are Weeds of National Significance.

All areas that that have significant environmental values have been avoided. Therefore, the permit envelope is composed of vegetation and fauna habitat that are typical in the landscape.

Based on the above, the proposed clearing is not likely to be at variance to this Principle.

(b) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

Proposed clearing is not likely to be at variance to this Principle

The permit envelope has been designed to avoid or minimise impacts to fauna habitat of conservation significance. Fauna habitat mapping was conducted by Ecoscape (2017). Using this data all significant habitat for conservation significant fauna species has been avoided through project design.

Four broad fauna habitat types occur within the permit envelope. Conservation significant fauna likely to utilise these habitat types for breeding purposes include the Western Pebble-Mound mouse and the Short Tailed Mouse. It is likely that individuals Western Pebble-mound Mouse and Short Tailed mouse should be able to move away from the areas being disturbed. Some impact may occur where disturbance occurs over nesting sites. Given the small area and sporadic nature of the proposed clearing, the proposal is unlikely to have a significant impact on either of these species.

Both the Pilbara Leaf Nosed Bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*) have been recorded within 5 km of the permit envelope. These species are generally encountered in rocky areas that provide

Proponent Assessment of the Clearing Principles

opportunity for roosting in caves or disused underground mines (Armstrong, 2001). Results of the targeted conservation significant bat (Pilbara Leaf-nosed Bat and Ghost Bat) assessment did not confirm the locations of any diurnal roost sites within the Survey Area (Ecoscape, 2017). The Gorge/Gully habitat type is potential suitable roosting habitat for the Pilbara Leaf Nosed Bat and Ghost Bat (Biota, 2017). This habitat type is not found within the permit envelope and therefore will not be impacted by this activity. Although these species of bat may forage within the permit envelope, the proposed disturbance is not expected to impact on any bat species.

Species such as the Grey Falcon, Peregrine Falcon, Whistling Kite and Rainbow Bee-eater are unlikely to be significantly impacted by a loss of foraging habitat due to their high mobility across the landscape.

Based on the above, the proposed clearing is not at variance to this Principle.

(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

Proposed clearing is not at variance to this Principle

According to available databases and flora surveys there are no threatened flora, or habitat considered significant within the permit envelope. One species of priority flora has been recorded from within the permit envelope and are in close proximity to the proposed disturbance. Despite this, the proposed disturbance will not significantly impact on the conservation significance of any priority flora species.

Based on the above, the proposed clearing is not at variance to this Principle.

(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

Proposed clearing is not likely to be at variance to this Principle

According to available databases and flora surveys, there are no Threatened Ecological Community (TEC) within permit envelope. The closest recorded TEC is the Themada Grasslands on cracking clays which is located adjacent to the eastern edge of the permit envelope. There is an existing track that allows access to the proposed work site adjacent to the TEC and given the low impact nature of the proposal there will not be any impact to the TEC.

No TECs listed under the Commonwealth EPBC Act have been recorded from the study area or within 20km (Department of Biodiversity, Conservation and Attractions, 2017)

Based on the above, the proposed clearing is not likely to be at variance to this Principle.

(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

Proposed clearing is not at variance to this Principle

The permit envelope occurs within the Hamersley subregion of the Pilbara Interim Biogeographic Regionalisation of Australia. The Hamersley subregion has not been extensively cleared and there are no vegetation communities within the permit envelope that would be considered a remnant.

The three largest Beard (1975) vegetation communities within the permit envelope comprise:

- 175; Short bunch grassland – savanna / grass plain (Pilbara)
- 82; Snappy Gum (*Eucalyptus leucophloia*) low woodland over *Triodia wiseana* hummock grassland

Proponent Assessment of the Clearing Principles

- 29; Mulga ('*Acacia aneura*') sparse low woodland, discontinuous in scattered groups
- 18; *Acacia* open shrubland. Low woodland, mulga (*Acacia aneura*)

All of these vegetation communities are considered widespread across the Pilbara, with over 95 percent of their pre-European extent remaining.

Based on the above, the proposed clearing is not at variance to this Principle.

(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

Proposed clearing is not likely to be at variance to this Principle

There are no permanent surface water features within the permit envelope. Several ephemeral water courses that flow only after heavy rainfall occur throughout both catchment areas. Disturbance to the natural drainage of water within drainage lines is not anticipated under the proposed clearing.

The permit envelope has been designed to avoid and minimise any impacts to vegetation that is associated with watercourses, however, there will be some minor instances of disturbance to riparian vegetation. The riparian vegetation that is proposed to be cleared have been surveyed and mapped and are considered typical of the region.

Based on the above, the proposed clearing is not likely to be at variance to this Principle.

(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

Proposed clearing is not likely to be at variance to this Principle

Using land system mapping, six broad soil groups, as classified by the Western Australia Soil Groups, have been identified within the permit envelope. These are:

- Stony Soils (203);
- Calcareous shallow loam soils (521)
- Red shallow loam (522);
- Red loamy earth (544);
- Self-mulching cracking clays (602);
- Red/brown non-cracking clay (622).

Stony Soils are typically associated with the hilly terrain of the Pilbara region, while Red shallow loams and Red/brown non-cracking clays are found on the stony footslopes and plains beneath basaltic hills.

The management measures detailed in previous sections will assist in reducing the likelihood of land degradation occurring as a result of clearing for the Project. These management measures include surface water and weed management measures and progressive rehabilitation to reduce the amount of cleared land potentially at risk of erosion. In addition, all of the proposed clearing is for the placement of infrastructure which will be maintained and used to ensure erosion does not take place in any significance.

Based on the above, the proposed clearing is not likely to be at variance to this Principle.

Proponent Assessment of the Clearing Principles
(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

Proposed clearing is not at variance to this Principle

There are no nearby conservation areas within 90 km of the proposed disturbance and hence will not have an impact on their values.

Based on the above, the proposed clearing is not at variance to this Principle.

(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

Proposed clearing is not at variance to this Principle

The depth to groundwater and it nearest point is approximately 30-40 m. It is unlikely that the proposed clearing will impact on groundwater quality at this depth.

There are no permanent surface water features within the permit envelope. Surface water is only present following significant rainfall events. The proposed clearing is unlikely to have a significant impact on surface water quality during these sporadic events. Appropriate stormwater, vegetation clearing and materials handling management measures will be put in place to minimise the potential impact on water quality.

Based on the above, the proposed clearing is not at variance to this Principle.

(j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

Proposed clearing is not at variance to this Principle

The permit envelope is located within the Duck Creek catchment, a tributary of the Ashburton River. A small portion of the permit envelope in the north east is located within the Weelumurra Creek Catchment, a tributary of the Fortescue River. The Duck Creek catchment area covers approximately 6,800km^2 at the confluence with the Ashburton River. The Ashburton River basin has a total area of 78,777 km^2 (Fortescue, 2017a).

There are no permanent surface water features within the permit envelope. Several ephemeral water courses that flow only after heavy rainfall occur throughout both catchment areas, however, significant disturbance to the natural drainage of water from the landscape is not anticipated as a result of the proposed clearing.

Flood events are most likely to occur in the summer months when the remnants of tropical cyclones can pass inland and continue to precipitate large volumes of water onto the landscape. The natural drainage features of the landscape will be unaffected by the proposed disturbance and hence impacts to the landscape associated with this aspect are not anticipated.

Based on the above, the proposed clearing is not at variance to this Principle.

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Figure 1: Proposal Location

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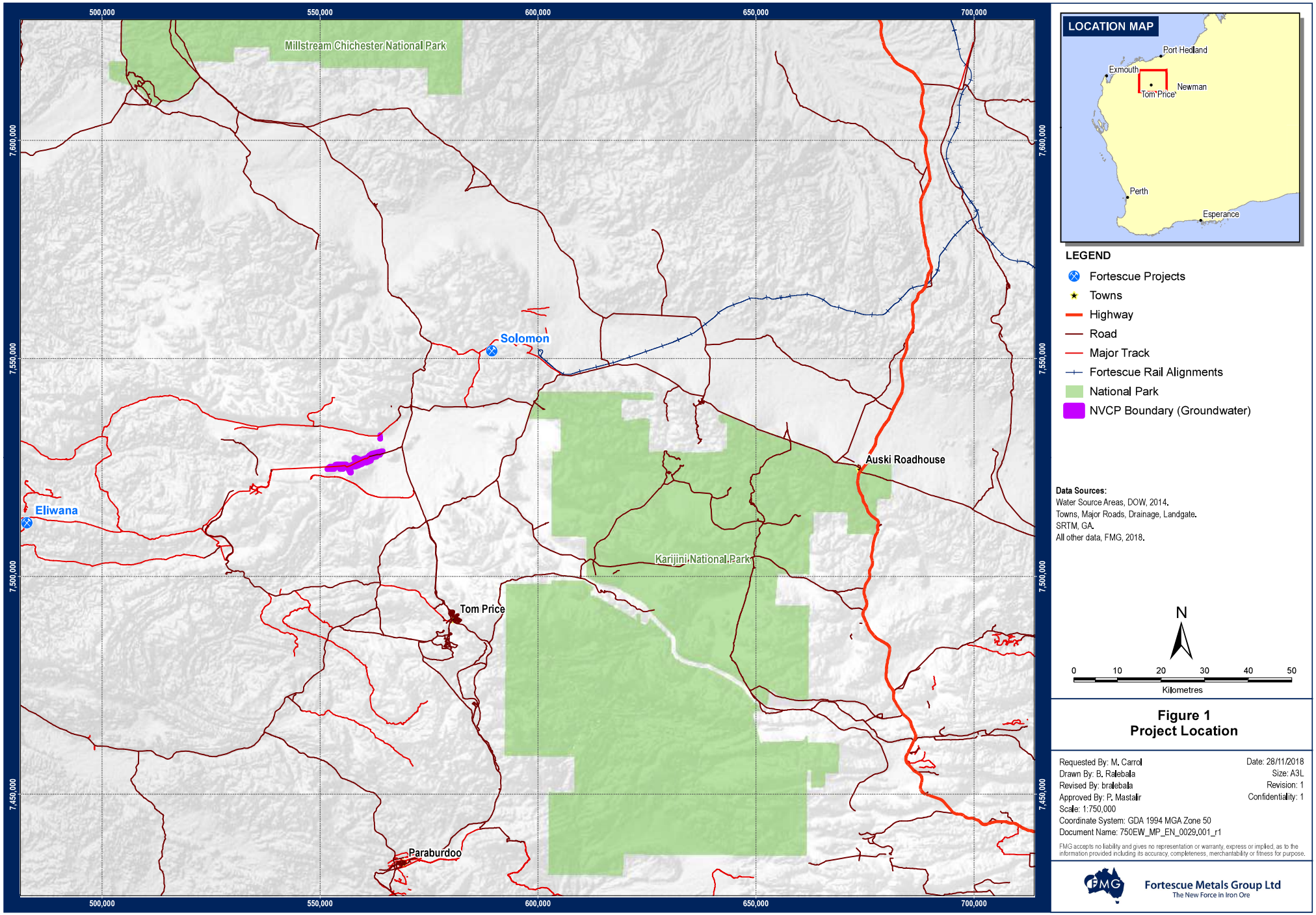

Figure 1
Project Location

Requested By: M. Carrol
Drawn By: B. Ralebala
Revised By: bralebala
Approved By: P. Mastalir
Scale: 1:750,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 750EW_MP_EN_0029,001_r1

Date: 28/11/2018
Size: A3L
Revision: 1
Confidentiality: 1

Fortescue Metals Group Ltd
The New Force in Iron Ore

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Figure 2: Permit Envelope

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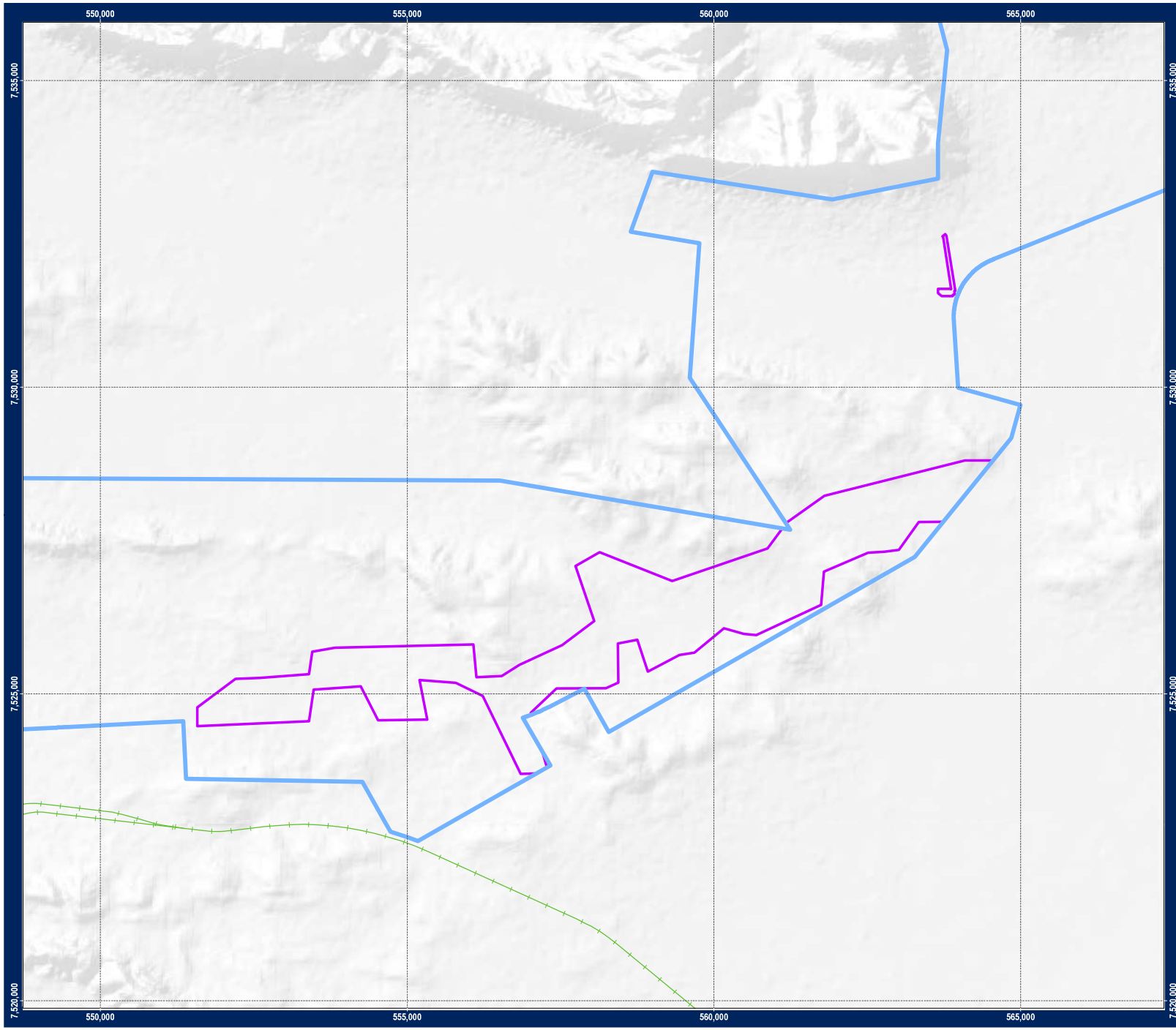

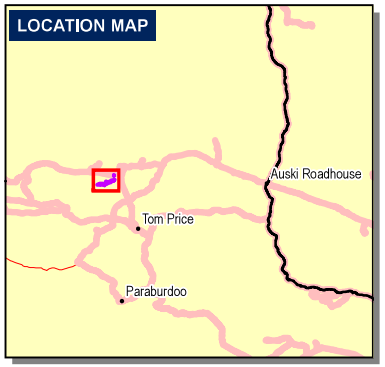

LEGEND

- Rio Tinto Rail
- NVCP Boundary (Groundwater)
- S182 Rail Investigation Corridor

Data Sources:
Water Source Areas, DOW, 2014.
Towns, Major Roads, Drainage, Landgate.
SRTM, GA.
All other data, FMG, 2018.

N

0 1 2 3
Kilometres

Figure 2
Permit Envelope

Requested By: M. Carrol
Drawn By: B. Ralebala
Revised By: bralebala
Approved By: P. Mastalir
Scale: 1:60,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 750EW_MP_EN_0029,002_r2

Date: 20/12/2018
Size: A3L
Revision: 2
Confidentiality: 1

Fortescue Metals Group Ltd
The New Force in Iron Ore

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Figure 3: Climate Averages

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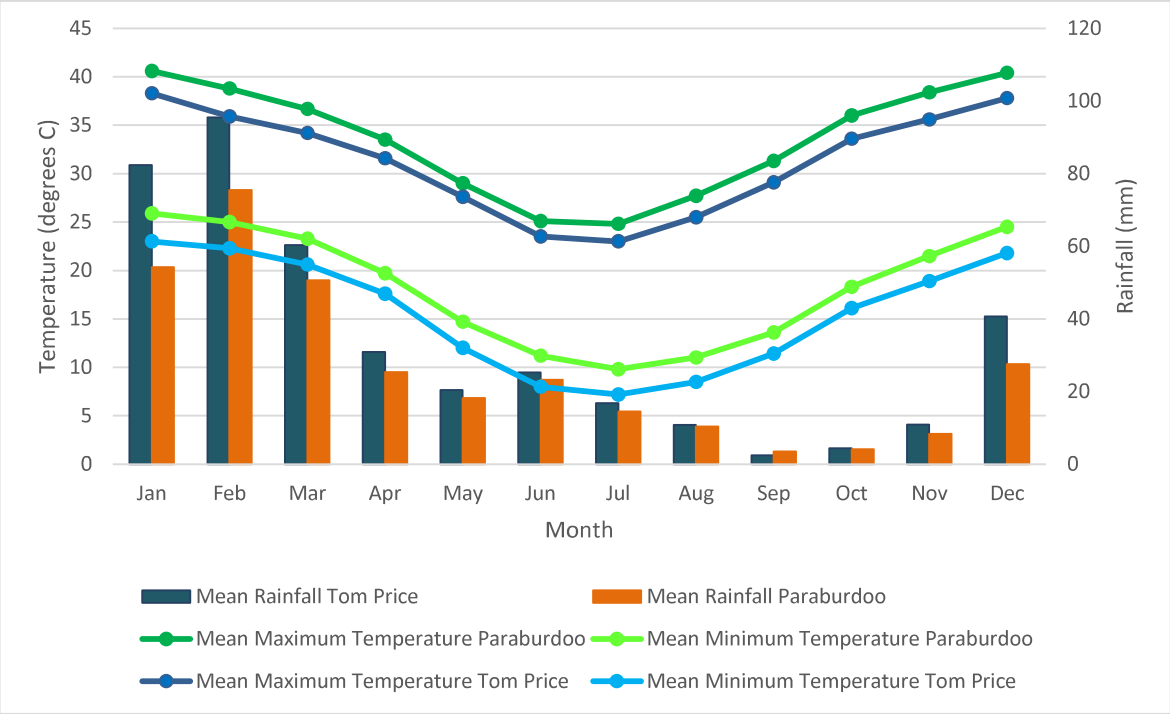
45
40
35
30
25
20
15
10
5
0
Temperature (degrees C)
120
100
80
60
40
20
0
Rainfall (mm)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Mean Rainfall Tom Price
Mean Rainfall Paraburdoo
Mean Maximum Temperature Paraburdoo
Mean Minimum Temperature Paraburdoo
Mean Maximum Temperature Tom Price
Mean Minimum Temperature Tom Price

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Figure 4: Vegetation Communities

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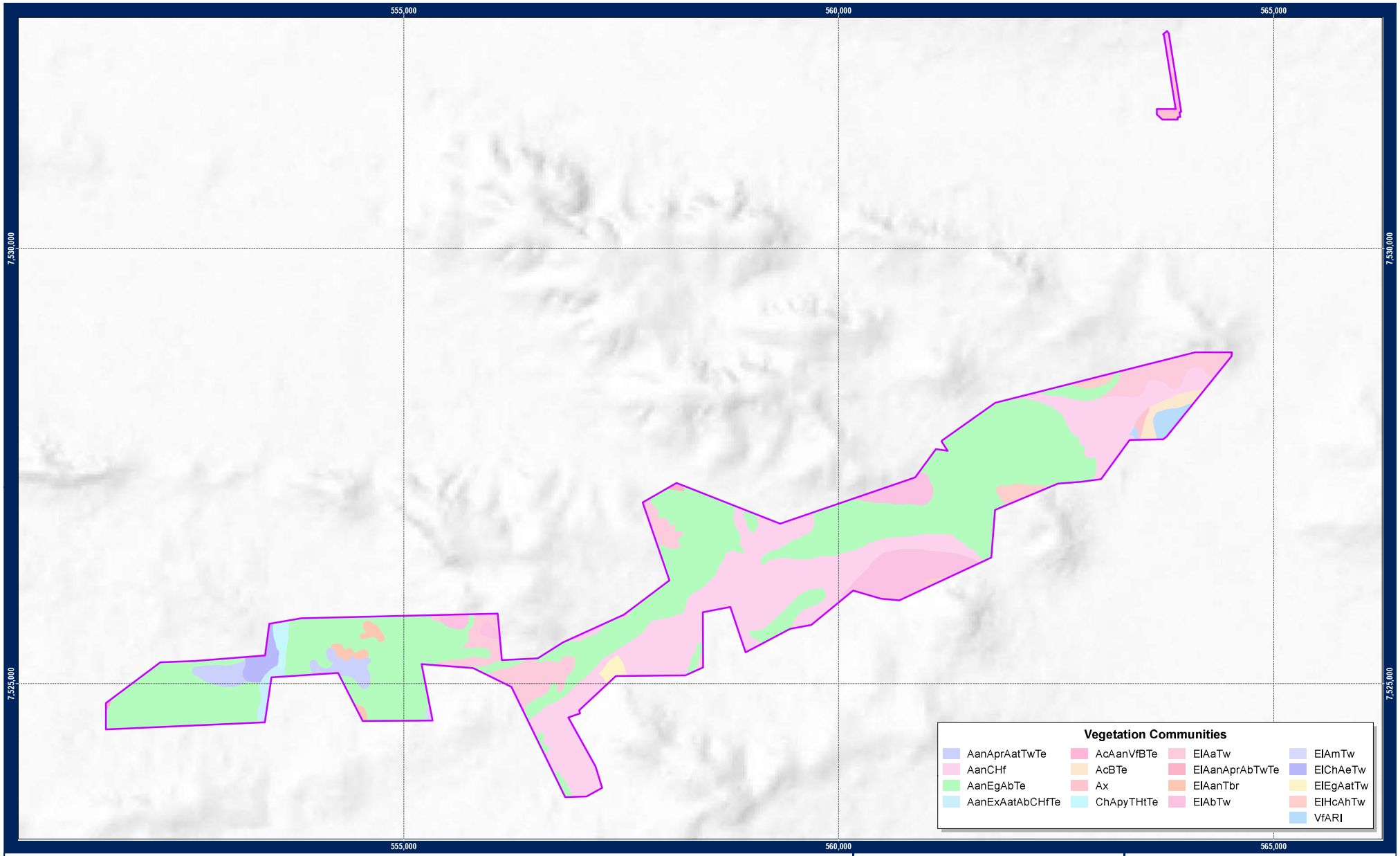

Data Sources:
SRTM, GA
All data, FMG, 2018

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Kilometres

Requested By: M. Carrol
Drawn By: B. Ralebala
Revised By: bralebala
Approved By: P. Mastalir
Scale: 1:40,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 750EW_MP_EN_0029.003_r1

Date: 30/11/2018
Size: A3L
Revision: 1
Confidentiality: 1

Figure 4
Vegetation Communities

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The New Force in Iron Ore

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Figure 5: Proximity to Themeda Grasslands Threatened Ecological Community

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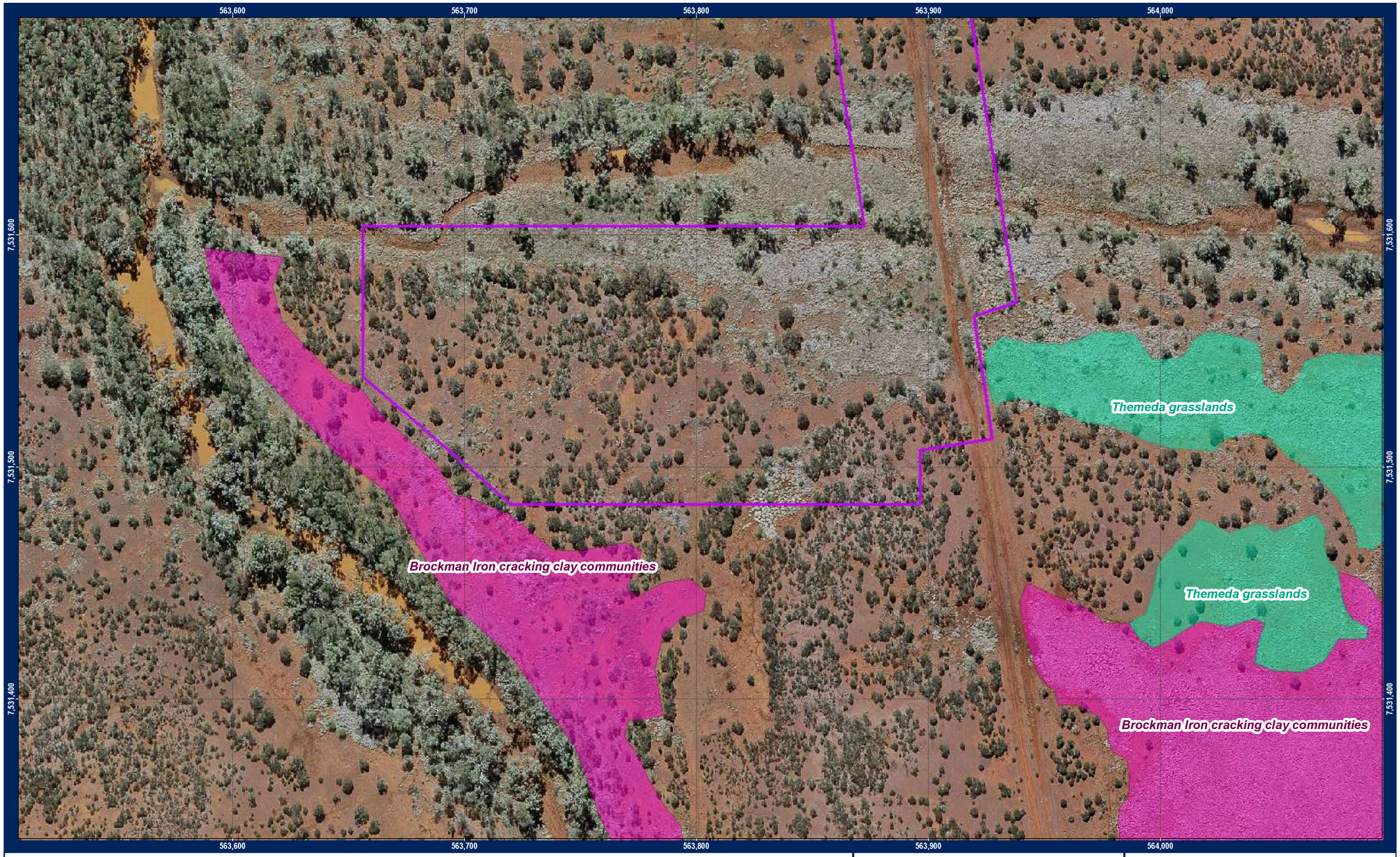

Legend

- GOV TEC Site
- GOV PEC Site
- NVCP Boundary (Groundwater)

Data Sources:
TEC and PEC, DPaW
All data, FMG, 2018

N

0 25 50 75 100
Meters

Requested By: M. Carrol
Drawn By: B. Ralebala
Revised By: bralebala
Approved By: P. Mastalir
Scale: 1:1,500
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 750EW_MP_EN_0029.012_r0

Date: 20/12/2018
Size: A3L
Revision: 0
Confidentiality: 1

Figure 5
Significant Vegetation Communities

Fortescue Metals Group Ltd
The New Force in Iron Ore

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Figure 6: Conservation Significant Flora

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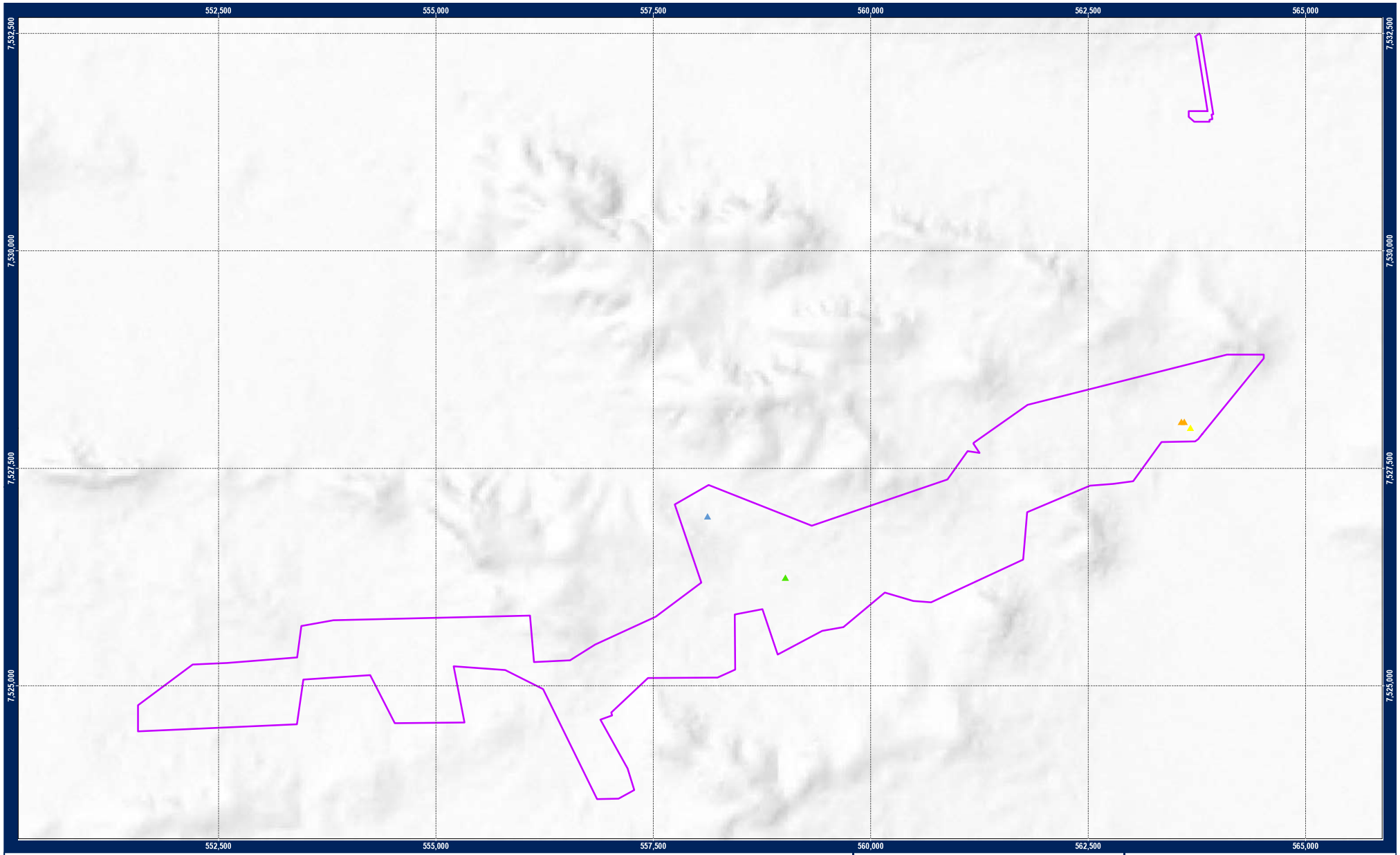

Significat Flora

- Glycine falcata
- Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)
- Rhagodia sp. Hamersley (M. Trudgen 17794)
- Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)

Data Sources:
SRTM, GA
All data, FMG, 2018

N

0 0.5 1 1.5 2
Kilometres

Requested By: M. Carrol
Drawn By: B. Ralebala
Revised By: bralebala
Approved By: P. Mastalir
Scale: 1:40,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 750EW_MP_EN_0029.004_r1

Date: 30/11/2018
Size: A3L
Revision: 1
Confidentiality: 1

Figure 6
Conservation Significant Flora

Fortescue Metals Group Ltd
The New Force in Iron Ore

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Figure 7: Weed Species

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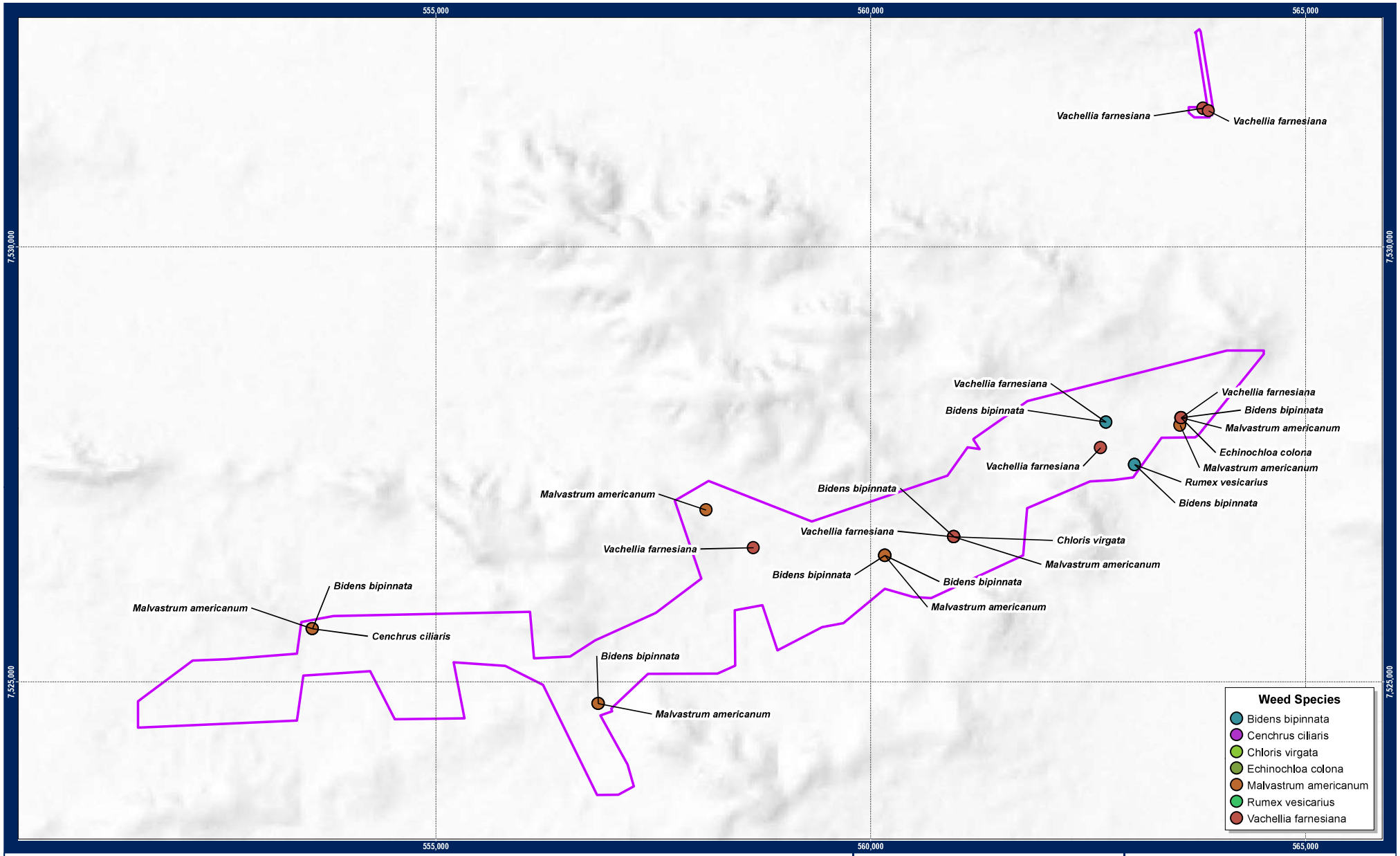

Data Sources:
SRTM, GA
All data, FMG, 2018

N

0 0.5 1 1.5 2
Kilometres

Requested By: M. Carrol
Drawn By: B. Ralebala
Revised By: bralebala
Approved By: P. Mastalir
Scale: 1:40,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 750EW_MP_EN_0029.005_r1

Date: 30/11/2018
Size: A3L
Revision: 1
Confidentiality: 1

Figure 7
Weed Species

Fortescue Metals Group Ltd
The New Force in Iron Ore

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Figure 8: Fauna Habitat

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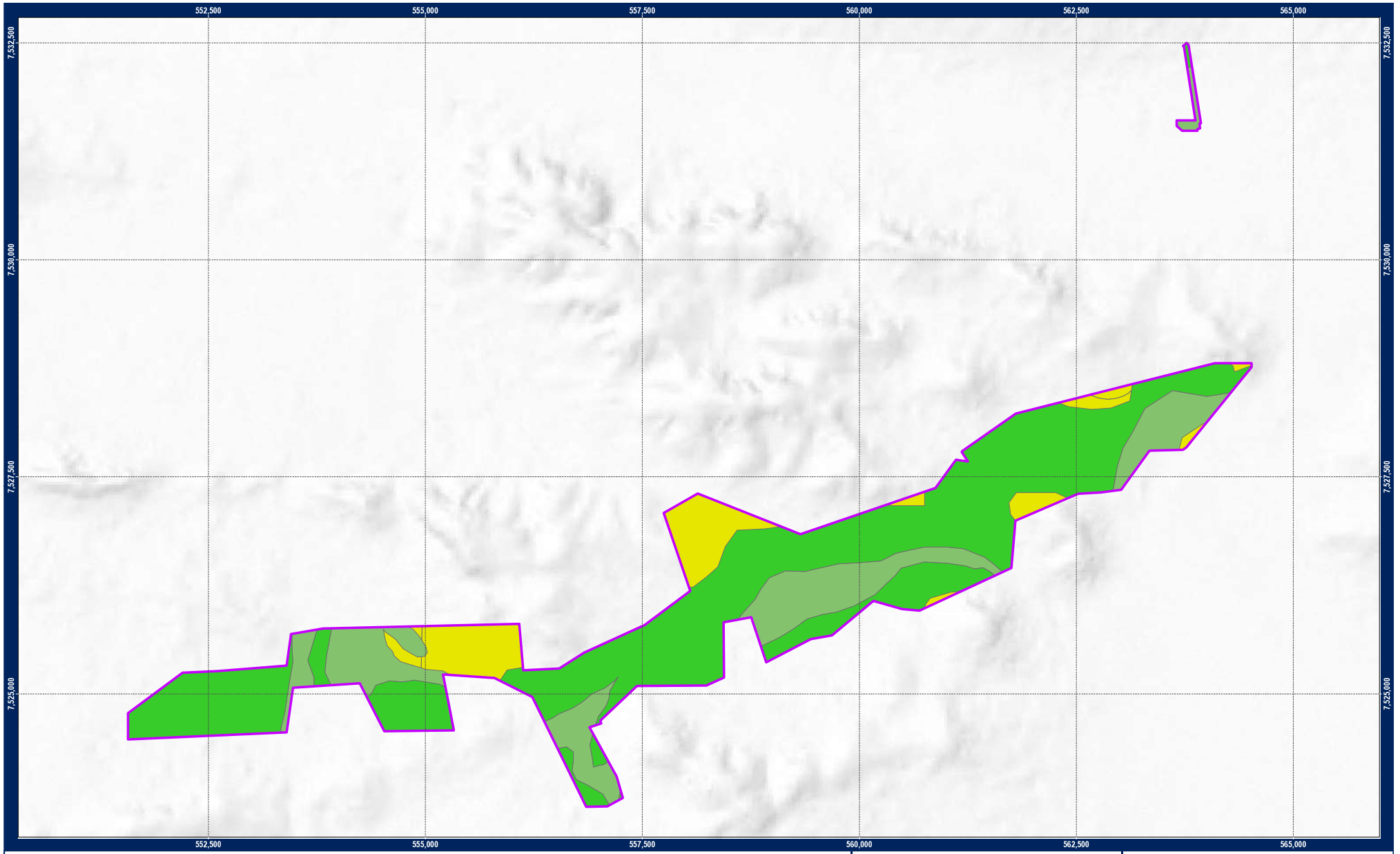

Fauna Mapping
- Plain (shrubland)
- Plain (stony/gibber)
- Fauna Mapping

Data Sources:
SRTM, GA
All data, FMG, 2018

N

0 0.5 1 1.5 2
Kilometres

Requested By: M. Carrol
Drawn By: B. Ralebala
Revised By: bralebala
Approved By: P. Mastalir
Scale: 1:40,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 750EW_MP_EN_0029.006_r1

Date: 30/11/2018
Size: A3L
Revision: 1
Confidentiality: 1

Figure 8
Fauna Habitat

Fortescue Metals Group Ltd
The New Force in Iron Ore

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Figure 9: Conservation Significant Fauna

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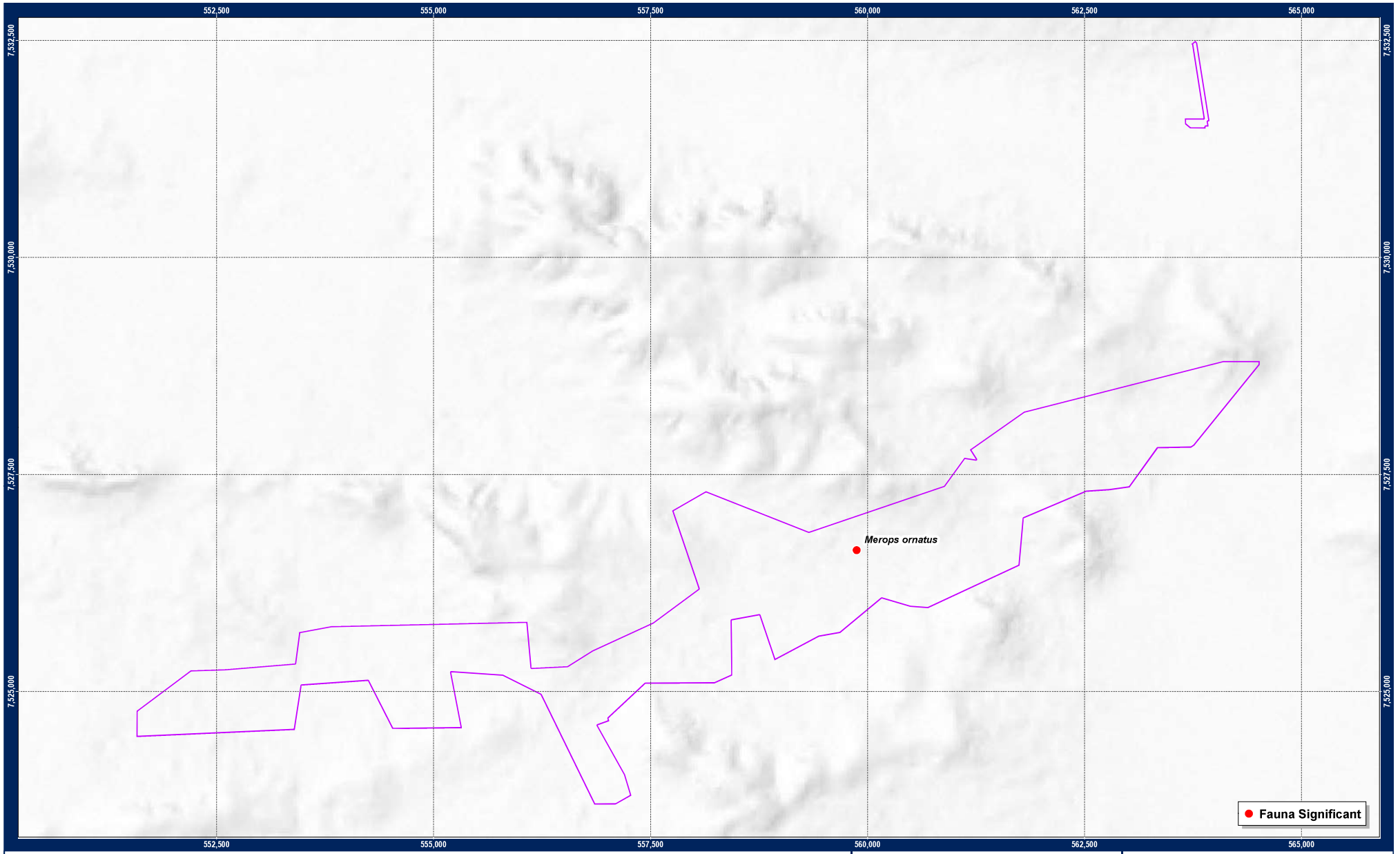

Data Sources:
SRTM, GA
All data, FMG, 2018

N

0 0.5 1 1.5 2
Kilometres

Requested By: M. Carrol
Drawn By: B. Ralebala
Revised By: bralebala
Approved By: P. Mastalir
Scale: 1:40,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 750EW_MP_EN_0029.007_r1

Date: 30/11/2018
Size: A3L
Revision: 1
Confidentiality: 1

Figure 9
Conservation Significant Fauna

Fortescue Metals Group Ltd
The New Force in Iron Ore

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Figure 10: Regional Catchments

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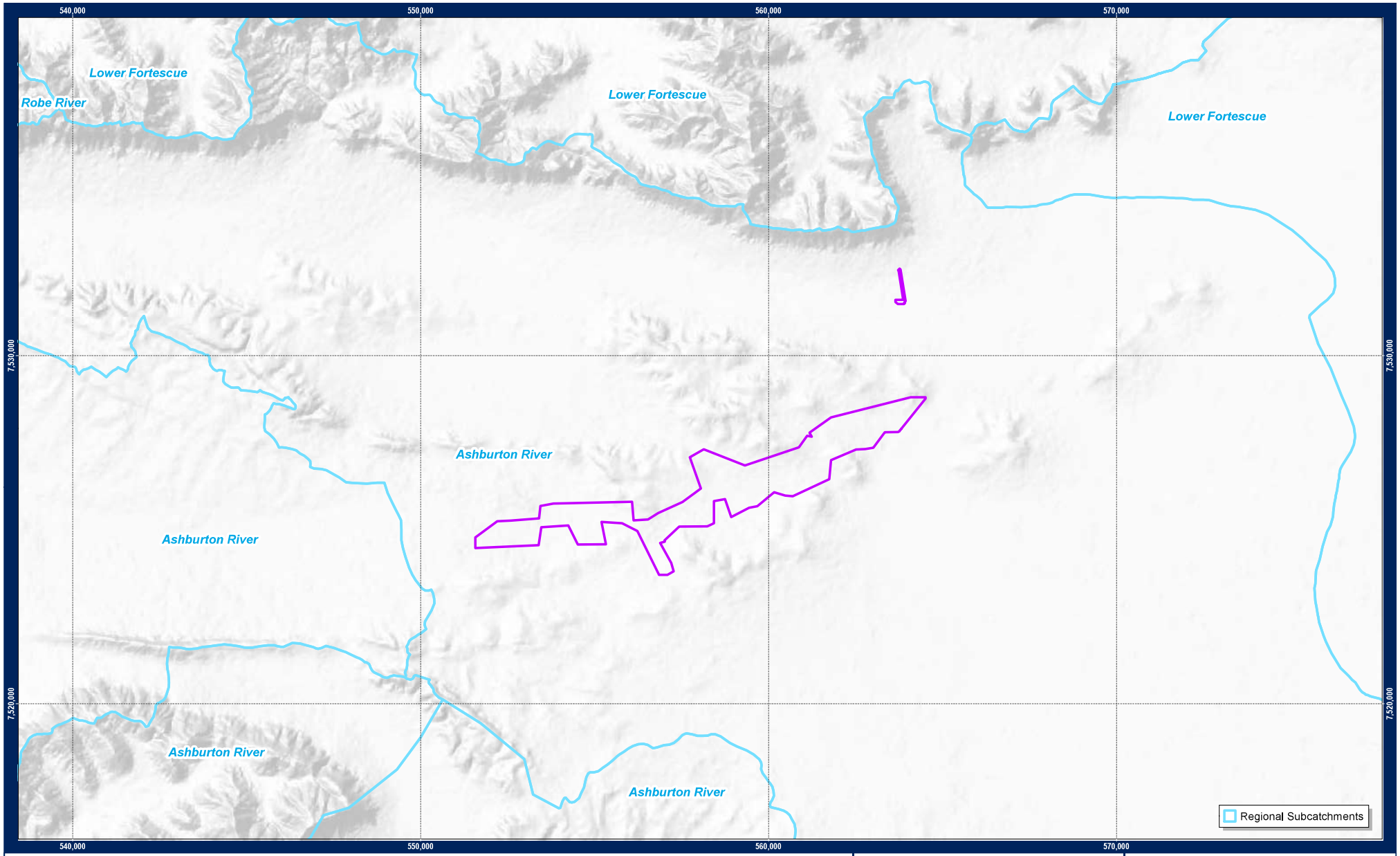

Data Sources:
SRTM, GA
Subcatchments, DoW
All data, FMG, 2018

N

0 1 2 3 4 5
Kilometres

Requested By: M. Carrol
Drawn By: B. Ralebala
Revised By: bralebala
Approved By: P. Mastalir
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Coordinate System: GDA 1994 MGA Zone 50
Document Name: 750EW_MP_EN_0029.009_r1

Date: 30/11/2018
Size: A3L
Revision: 1
Confidentiality: 1

Figure 10
Regional Catchments

Fortescue Metals Group Ltd
The New Force in Iron Ore

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