NORTH STAR EXTENSION FLORA AND VEGETATION SURVEY

Iron Bridge

ecoscape

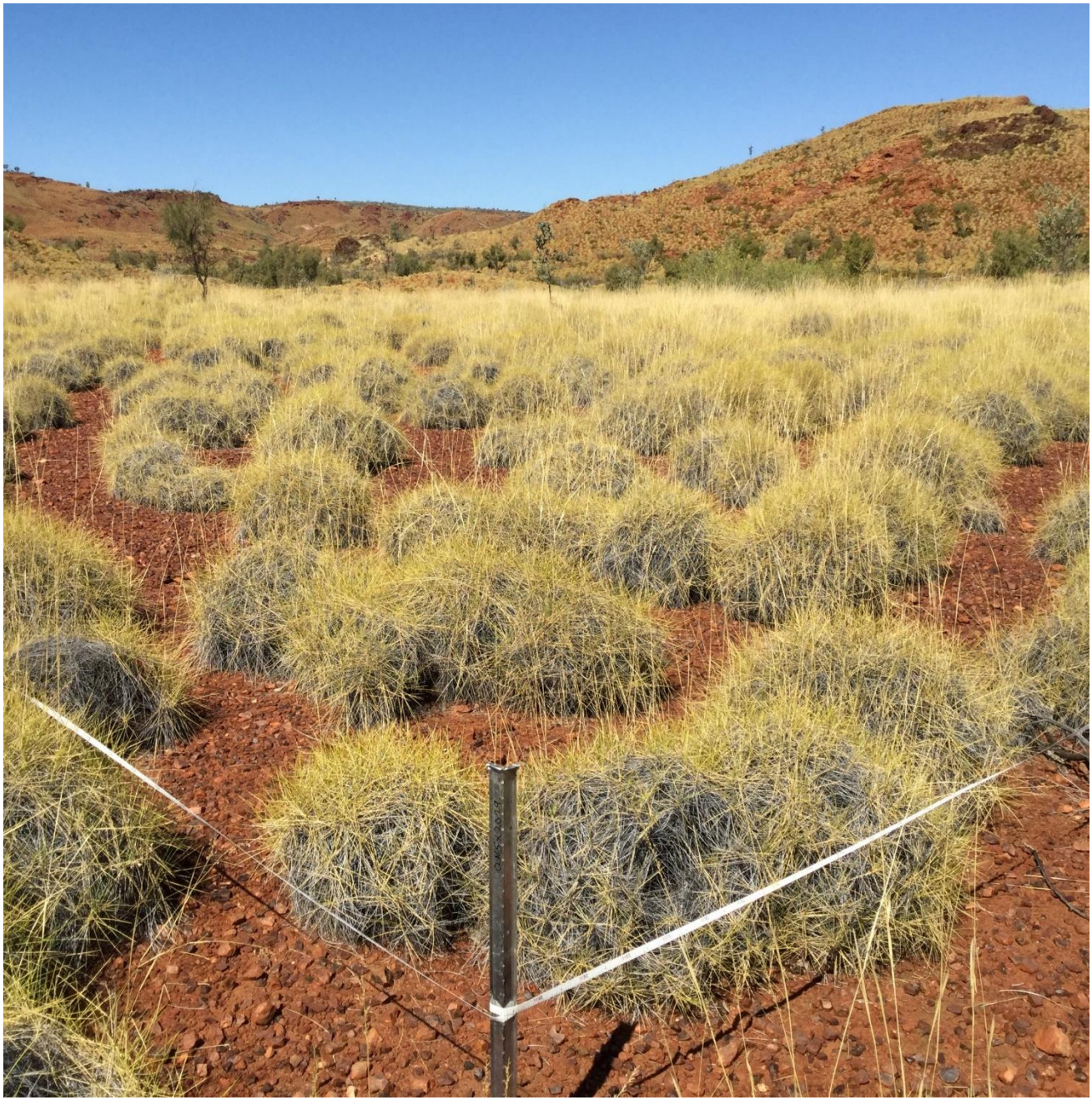

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TABLE OF CONTENTS

FIGURES

TABLES

MAPS

IMAGES

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SUMMARY

Fortescue Metals Group Iron Bridge Ltd (FMG IB) subsidiary FMG Magnetite Pty Ltd and joint venture partner Formosa Steel IB Pty Ltd (Formosa) are developing the North Star Magnetite Project (North Star). North Star is located approximately 100 km south-south-east of Port Hedland and approximately 20 km to the east of the Fortescue rail line.

FMG IB is seeking to extend North Star through the development of additional deposit immediately to the south (North Star Extension). Ecoscape was commissioned by FMG IB to undertake a flora and vegetation assessment consolidation and supplementary survey of the North Star Extension survey area that occupies 1,551 ha within the Pilbara bioregion of Western Australia, in the Shire of East Pilbara.

The desktop assessment identified:

- numerous flora and vegetation surveys have been conducted within the region and the survey area has been entirely mapped by two previous surveys.
- There are no Threatened or Priority Ecological Communities known within a 50 km radius of the survey area
- 25 conservation-listed flora species were identified from combined database searches, including three that have been previously recorded within the survey area. A likelihood assessment identified that four additional flora taxa have a 'Possible' likelihood of occurring within the survey area.

Ecoscape conducted a supplementary flora and vegetation field survey during August 2020. Ecoscape established 30 floristic quadrats to supplement the 21 existing quadrats within the survey area (total of 51).

A total of 201 vascular flora species were identified within the survey area, based on previous surveys as well as 2020 records, including:

- three conservation significant flora species: *Quoya zonalis* (TF), *Triodia basitricha* (P3) and *Ptilotus mollis* (P4)
- one species of taxonomic significance and considered to represent an undescribed species of *Themeda*.
- three introduced flora species (weeds): **Aerva javanica*, **Cenchrus ciliaris* and **Flaveria trinervia*.

Twelve vegetation types were recorded from landform types including hill, slopes, foothills, drainage lines and gullies. The vegetation types considered of potential significant were:

- vegetation type **EvApTl**, dominated by *Eucalyptus victrix*, is associated with drainage lines and considered potential Groundwater Dependant Vegetation
- five vegetation types have small extents within the survey area of less than one percent. Of these, **CfAtCa** and **TcAtTw** appear to be poorly represented within the surrounding areas based on previous mapping.

The vegetation condition ranged from Excellent to Very Good, with the majority (96.49%) in Excellent condition.

ADDENDUM SUMMARY

In 2023 FMG IB requested a report addendum outlining the recorded conservation significant flora species' responses to changes to groundwater and surface hydrology. Ecoscape's understanding of each species are that:

- *Quoya zonalis* (TF) does not grow in a habitat that indicates it could access groundwater (it grows on hills in massive rocky substrate) thus is highly unlikely to be groundwater dependent, therefore changes in groundwater level would be highly unlikely to affect it. Nor is it likely to be affected by changes to surface

hydrology (increases or decreases in stream or overland flows) as it does not inhabit areas that would be affected.

- *Themeda* sp. Panorama (J. Nelson *et al*. NS 102) (P1) is unlikely to be groundwater dependent as it is likely to be shallow-rooted. However, at North Star it grows in and adjacent to drainage lines thus changes to surface water hydrology are likely to affect it, particularly as it is unlikely to be tolerant of waterlogging which would likely lead to plant death. Note that as an undescribed species the assumption that *Themeda* sp. Panorama is a savanna and grassland species may be incorrect; if it is a wetland species it is likely to be more tolerant of waterlogging and less affected by changed surface hydrology.
- *Triodia basitricha* (P3) grows on hills and slopes and is unlikely to access groundwater, thus would be unlikely to be groundwater dependent. Changes to groundwater levels would be unlikely to affect it. Nor does it grow in drainage lines or riparian areas thus changes to surface water hydrology are unlikely to affect it.
- *Ptilotus mollis* (P4) grows in similar habitat to *Quoya zonalis* and is similarly unlikely to be able to access groundwater, thus would not be groundwater dependent and changes to groundwater would be unlikely to affect it. Nor does it grow in drainage lines or riparian areas thus surface hydrology changes are also unlikely to affect it.

ACRONYMS AND ABBREVIATIONS

Table 1: Acronyms and abbreviations

Acronyms and abbreviations	
BAM Act	Western Australian *Biosecurity and Agriculture Management Act 2007*
BC Act	Western Australian *Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
CALM	Western Australian Department of Conservation and Land Management (1985-2006, now DBCA)
CR	Critically Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
DAFWA	Department of Agriculture and Food, Western Australia (2006-2017, now DPIRD)
DAWE	Commonwealth Department of Agriculture, Water and Environment (2020-)
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DEC	Western Australian Department of Environment and Conservation (2006-2013, now DBCA)
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts (2007-2010, now DAWE)
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety
DPaW	Western Australian Department of Parks and Wildlife (2013-2017, now DBCA)
DoE	Commonwealth Department of the Environment (2013-2016, now DAWE)
DotEE	Commonwealth Department of the Environment and Energy (2016-2020)
DPIRD	Western Australian Department of Primary Industries and Rural Development
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (2010-2013, now DAWE)
DWER	Western Australian Department of Water and Environmental Regulation
EN	Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
EP Act	Western Australian *Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater Dependent Ecosystem
GDV	Groundwater Dependent Vegetation
ha	hectare/hectares
IBRA	Interim Biogeographic Regionalisation for Australia
NVIS	National Vegetation Inventory System
P; P1, P2, P3, P4, P5	Priority Flora species rankings (P1-P4) or Priority Ecological Communities (P1-P5)
PEC	Priority Ecological Community
PF	Priority Flora
PGDV	Potential Groundwater Dependent Vegetation
PMST	Protected Matters Search Tool (hosted by DAWE, used to search for MNES)
SFDV	Sheet Flow Dependent Vegetation
sp.	Species (generally referring to an unidentified taxon or when a phrase name has been applied)
subsp.	Subspecies (infrataxon)
TEC	Threatened Ecological Community
TF	Threatened Flora (formerly termed Declared Rare Flora, DRF, in Western Australia)
var.	Variety (infrataxon)
VU	Vulnerable (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
WAH	Western Australian Herbarium
WONS	Weeds of National Significance
*****	Introduced flora species (i.e. weed)

1 INTRODUCTION

1.1 BACKGROUND

Fortescue Metals Group Iron Bridge Ltd (FMG IB) subsidiary FMG Magnetite Pty Ltd and joint venture partner Formosa Steel IB Pty Ltd (Formosa) are developing the North Star Magnetite Project (North Star). North Star is located approximately 100 km south-south-east of Port Hedland and approximately 20 km to the east of the Fortescue rail line.

FMG IB is seeking to extend North Star through the development of additional deposit immediately to the south (North Star Extension). To support primary environmental approvals FMG IB requires the consolidation of two existing detailed flora and vegetation surveys plus a supplementary (dry season) to ensure the North Star Extension area meets the requirements for a detailed flora and vegetation survey as per EPA (2016) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*,.

Ecoscape was commissioned by FMG IB to undertake the flora and vegetation assessment consolidation and supplementary survey.

1.2 SURVEY AREA

The North Star Extension area, known as the 'survey area' in this report, is located within Shire of East Pilbara in the Pilbara Region of Western Australia. The survey area comprises a total area of 1,551 ha and is located approximately 100 km south-south-east of Port Hedland (**Figure 1**).

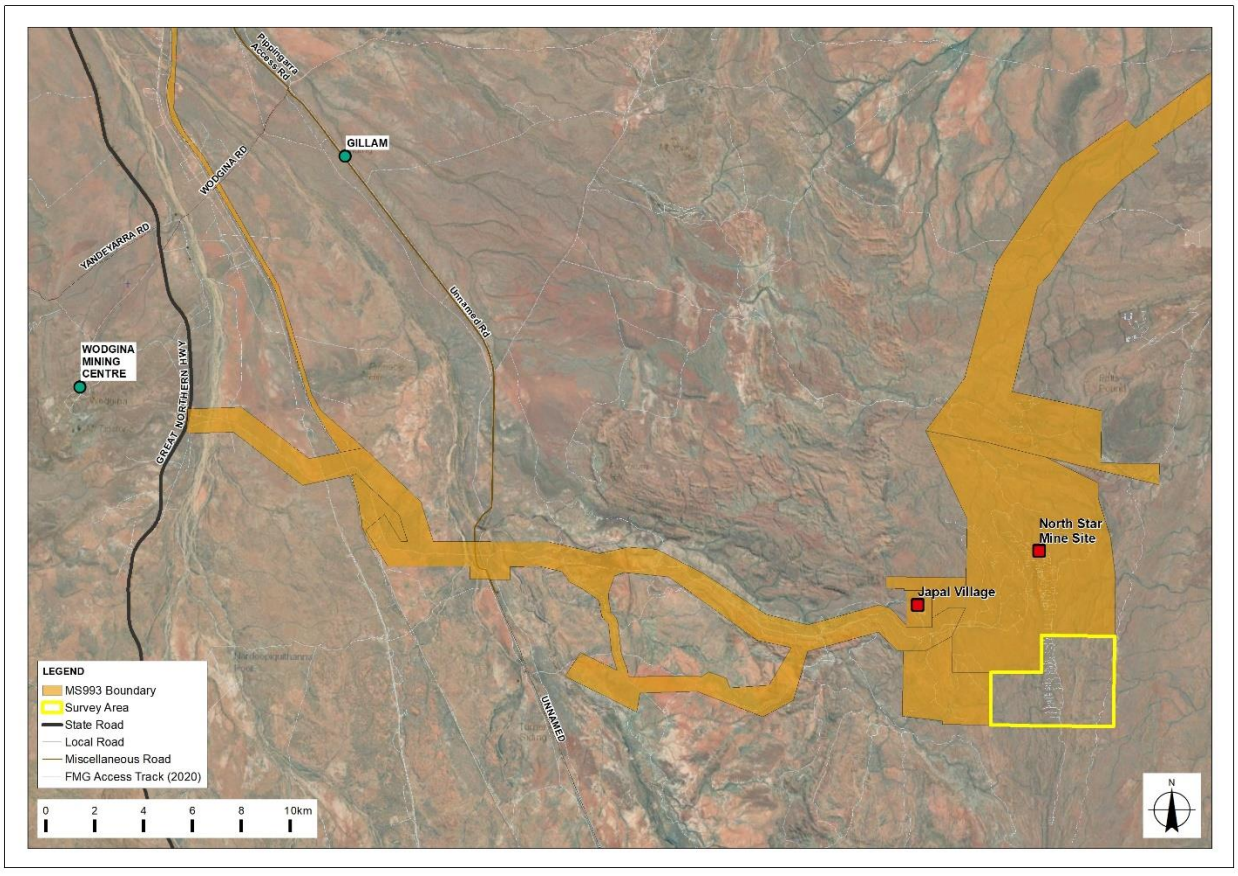


Figure 1: Survey area location

1.3 SURVEY REQUIREMENTS

The scope of works was to conduct a consolidated detailed flora and vegetation survey that includes:

- a desktop assessment including a literature review and demonstrating that the survey meets the relevant guidelines
- consolidation of existing information
- a supplementary flora and vegetation field survey that includes:
  - establishment and sampling of new floristic quadrats ('quadrats') to supplement existing
  - describing and mapping of vegetation types, particularly where they may represent a conservation-listed ecological community, Groundwater Dependant Vegetation (GDV) or Sheet Flow Dependent Vegetation (SFDV)
  - describing and mapping vegetation condition, including identifying and recording the abundance of significant weeds
  - targeted conservation significant flora searches
- a comprehensive flora and vegetation assessment report that includes:
  - desktop and field survey methods, results and discussion
  - regional statistical assessment of floristic data to demonstrate wider occurrence of vegetation types found to be of limited spatial distribution
- preparation of digital data to Fortescue's standards.

1.4 COMPLIANCE

This environmental assessment was conducted in accordance with Commonwealth and State legislation and guidelines:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Western Australian *Environmental Protection Act 1986* (EP Act)
- Western Australian *Biodiversity Conservation Act 2016* (BC Act)
- Western Australian *Biodiversity Conservation Regulations 2018*.

As well as those listed above, the assessment complied with Environmental Protection Authority (EPA) requirements for environmental survey and reporting in Western Australia, as outlined in:

- EPA (2016) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, known herein as the Flora and Vegetation Technical Guidance
- EPA (2020) *Statement of Environmental Principles, Factors and Objectives*.

Fortescue's internal management Guidelines and Procedures were also complied with, primarily *Flora and Vegetation Assessment Guidelines* (100-GU-EN-0005) (Fortescue 2014).

1.4.1 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The EPBC Act is a legal framework to protect and manage matters of national environmental significance (MNES) including important flora, fauna, ecological communities and heritage areas listed under the Act. Threatened taxa (flora and fauna) are protected under the EPBC Act, which lists species and ecological communities that have been assessed as meeting the criteria to be listed as Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild, as detailed in **Table 13** in **Appendix One**.

Threatened Ecological Communities are categorised as Critically Endangered, Endangered or Vulnerable, also detailed in this table.

1.4.2 WESTERN AUSTRALIAN ENVIRONMENTAL PROTECTION ACT 1986

The Western Australian EP Act was created to provide for an Environmental Protection Authority (the EPA) that has the responsibility for:

- prevention, control and abatement of pollution and environmental harm
- conservation, preservation, protection, enhancement and management of the environment
- matters incidental to or connected with the above.

The EPA is responsible for providing the guidance and policy under which environmental assessments are conducted. It conducts environmental impact assessments (based on the information provided by the proponent), initiates measures to protect the environment and provides advice to the Minister responsible for environmental matters.

1.4.3 WESTERN AUSTRALIAN BIODIVERSITY CONSERVATION ACT 2016

The Western Australian BC Act provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia.

Threatened species (both flora and fauna) and ecological communities that meet the categories listed within the BC Act are protected under this legislation and require authorisation by the Minister to take or disturb. These are known as Threatened Flora, Threatened Fauna and Threatened Ecological Communities. The conservation categories of Critically Endangered, Endangered and Vulnerable are detailed in **Table 14** in **Appendix One**; these categories align with those of the EPBC Act.

Flora and fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. Migratory species and those subject to international agreement are also listed under the Act. These are known as specially protected species in the BC Act.

The most recent flora and fauna listings were published in the *Government Gazette* on 11 September 2018 (Government of Western Australia 2018a).

1.5 FLORA

1.5.1 THREATENED AND PRIORITY FLORA

Conservation significant flora species are those that are listed as TF (Threatened Flora) and (within Western Australia) as PF (Priority Flora). TF species are listed as Threatened by the Western Australian DBCA and protected under the provisions of the BC Act. Some State-listed TF are provided with additional protection as they are also listed under the Commonwealth EPBC Act (see **Table 13** in **Appendix One** for conservation status category descriptions).

Flora are listed as PF where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to TF categories. Whilst PF are not specifically listed in the BC Act, some may qualify as being of special conservation interest and thereby have a greater level of protection than unlisted species.

There are seven categories covering Western Australian-listed TF and PF species which are outlined in **Table 14** in **Appendix One**. PF for Western Australia are regularly reviewed by the DBCA whenever new information becomes available, with species status altered or removed from the list when data indicates that they no longer meet the requirements outlined in **Table 14**.

1.5.2 OTHER SIGNIFICANT FLORA

According to the Flora and Vegetation Technical Guidance (EPA 2016) other than being listed as Threatened or Priority Flora, a species can be considered as significant if it is considered to be:

- locally endemic or association with a restricted habitat type (e.g. Groundwater Dependent Ecosystems, Sheet Flow Dependent Vegetation)
- a new species or has anomalous features that indicate a potential new species
- at the extremes of range, recently discovered range extensions (generally considered greater than 100 km or in a different bioregion), or isolated outliers of the main range)
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

1.5.3 INTRODUCED FLORA

Introduced plant species, known as weeds, are plants that are not indigenous to an area and have been introduced either directly or indirectly (unintentionally) through human activity. Species are regarded as introduced if they are listed as 'alien' on *FloraBase* (Western Australian Herbarium [WAH] 1998-2020) and are designated with an asterisk (*) in this document.

1.5.3.1 Weeds of National Significance

At a national level there are 36 weed species listed as Weeds of National Significance (WoNS) (Weeds Australia & Centre for Invasive Species Solutions 2020). The Commonwealth *Australian Weeds Strategy 2017-2027* (Invasive Plants and Animals Committee 2016) describes broad goals and objectives to manage these species.

1.5.3.2 Declared Pest Plants

The Western Australian Organism List (WAOL) details organisms listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Under the BAM Act, Declared Pests are listed as one of the three categories, or exempt:

- C1 (exclusion), that applies to pests not established in Western Australia; control measures are to be taken to prevent their entry and establishment
- C2 (eradication), that applies to pests that are present in Western Australia but in low numbers or in limited areas where eradication is still a possibility
- C3 (management), that applies to established pests where it is not feasible or desirable to manage them in order to limit their damage
- exempt (no category).

1.6 ECOLOGICAL COMMUNITIES/VEGETATION

Most, although not all, conservation-listed ecological communities are defined by vegetation, usually within the context of a defined landform or unique habitat. Although 'vegetation' and 'ecological communities' are not interchangeable terms, this assessment describes the vegetation of the survey area with conservation status

taking into consideration the interactions of the vegetation with the biological and physical environment within which it occurs (i.e. the ecological community as a whole).

1.6.1 EPBC-LISTED THREATENED ECOLOGICAL COMMUNITIES

Ecological communities are naturally occurring biological assemblages associated with a particular type of habitat (DBCA 2020). At Commonwealth level, Threatened Ecological Communities (TECs) are protected under the Commonwealth EPBC Act. Ecological communities are categorised as Critically Endangered, Endangered and Vulnerable as described in **Table 13** in **Appendix One**.

1.6.2 WESTERN AUSTRALIAN THREATENED ECOLOGICAL COMMUNITIES

Western Australian TECs are protected under the BC Act. TECs are categorised much like those of the EPBC Act, shown in **Table 15** in **Appendix One**.

Currently described TECs are listed on the DBCA website, with the most recent list endorsed by the Minister for Environment in June in June 2018 (DBCA 2018).

1.6.3 WESTERN AUSTRALIAN PRIORITY ECOLOGICAL COMMUNITIES

DBCA maintains a list of Priority Ecological Communities (PECs). PECs include potential TECs that do not meet survey criteria, or that are not adequately defined. They are not protected under legislation but are taken into consideration as part of the environmental approvals process.

Currently described PECs are listed on the DBCA website, with the most recent list dated 5 May 2020 (Species and Communities Program; DBCA 2020).

1.6.4 OTHER SIGNIFICANT VEGETATION

1.6.4.1 Groundwater Dependent Ecosystems

Groundwater Definition

Groundwater is water that is found in the saturated zone of the soil, where all soil pores are filled with water. The water table is the upper surface of the saturated zone in an unconfined aquifer. Groundwater may also occur as a perched aquifer located above unsaturated rock formations as a result of a discontinuous permeable layer or held under pressure in a confined aquifer (Goulburn-Murray Water 2010).

Groundwater Dependent Ecosystems Definition

Groundwater Dependent Ecosystems (GDEs) have been defined as ecosystems that are dependent on groundwater for their survival at some stage or stages of their lifecycle, however groundwater use cannot be equated with groundwater dependence (Eamus 2009). In some contexts, GDEs are also known as Groundwater Dependent Vegetation.

Hatton and Evans (1998) identified four types of GDEs based on their geographic setting: terrestrial vegetation (vegetation communities and dependent fauna that have seasonal or episodic dependence on groundwater), river base flow systems (aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow), aquifer and cave ecosystems, and wetlands.

Eamus *et al.* (2006) identified three primary classes based on type of groundwater reliance:

1. Aquifer and cave ecosystems.
2. All ecosystems dependent on the surface expression of groundwater:
    a) river base flows

b) wetlands, swamplands
c) seagrass beds in estuaries
d) floodplains
e) mound springs
f) riparian vegetation
g) saline discharge to lakes
h) low lying forests.

3. All ecosystems dependent on the subsurface presence of groundwater, often accessed via the capillary fringe (non-saturated zone above the water table) when roots penetrate this zone:
   a) River Red Gum (*Eucalyptus camaldulensis*) forests
   b) Banksia woodlands
   c) Riparian vegetation in the wet/dry tropics.

GDEs in the Pilbara are generally determined to be vegetation associated with riparian areas. GDEs dependent on the surface expression of groundwater (Eamus *et al.* 2006 class 2) includes vegetation associated with wetlands (permanent or semi-permanent pools) within riparian areas, and generally includes *Melaleuca argentea* in association with other species described below. GDEs associated with the subsurface presence of groundwater (Eamus *et al.* 2006 class 3) includes riparian vegetation characterised by the phreatophytic species described below.

Direct impacts on GDEs i.e. clearing, and indirect impacts, including from dewatering and reinjection, frequently feature as being a significant environmental impact in mining approvals documents e.g. (Office of the Appeals Convenor 2016a, 2016b; Rio Tinto 2016).

Phreatophytic Species

Phreatophytic species rely on groundwater sources for water intake (Maunsell Australia Pty Ltd 2006) essentially the water requirements of phreatophytes are greater than can be provided from the surface soil profile (e.g. riparian vegetation) or they are dependent on free water availability (e.g. wetland species). They frequently show low tolerance to extended water stress due to a lack of physiological and/or morphological adaptation to drought, and respond to significant water deficit by a decline in health and eventual death (*ibid.*).

Obligate phreatophytes are dependent on free access to water (i.e. they are wetland species) whereas facultative phreatophytes can switch their water source between the soil surface profile in times of rain, to groundwater in times of drought when the soil surface profile (vadosphere) is depleted (Grierson 2010).

Phreatophytic species likely to occur in the Pilbara include:

- *Eucalyptus camaldulensis* subsp. *refulgens*, which is regarded as a facultative phreatophyte that is dependent on groundwater for part of its lifecycle and/or in times of drought. This species has been reported to be tolerant of groundwater falls of up to 4 m per year (Maunsell Australia Pty Ltd 2006), has both lateral and sinker roots and is tolerant of waterlogging (Grierson 2010).
- *Eucalyptus victrix*, which may be regarded as a facultative phreatophyte. It is considered to be relatively drought tolerant and likely to be tolerant of gradual declines to the water table (to a degree) (Maunsell Australia Pty Ltd 2006). *Eucalyptus victrix* has lateral and sinker roots (i.e. a dimorphic root system) but is not tolerant of waterlogging (Grierson 2010). There is some conjecture that this species is actually a vadophyte (i.e. relies on water from within the soil surface profile, and is independent of groundwater) or, at best, weakly phreatophytic (Resource and Environmental Management Pty Ltd 2007). Depth to

groundwater is likely to be an important indicator of groundwater dependence (Equinox Environmental 2017).

- wetland species such as *Melaleuca argentea*
- *Melaleuca xerophila* may be groundwater dependent in some areas (Markey 2016).

Vegetation containing *Eucalyptus camaldulensis sens. lat*. and *Melaleuca argentea* is generally considered to represent a GDE. However, there is supporting evidence that, in some circumstances, *Eucalyptus victrix* does not always depend on groundwater (Batini 2009; Eamus 2009; Environmental Protection Authority & Hamersley Iron Pty Ltd 2010; Resource and Environmental Management Pty Ltd 2007) and therefore vegetation characterised by this species is considered to be potentially representative of a GDE.

Groundwater Dependent Vegetation

As this assessment took into consideration only the vegetation (including individual component flora species) aspect of GDEs, GDEs within this document are referred to as Groundwater Dependent Vegetation (GDV)

Atlas of Groundwater Dependent Ecosystems

The Groundwater Dependent Ecosystems Atlas (BoM 2020a) indicates the presence of known GDEs and Inflow Dependent Ecosystems (IDEs) in Australia.

An Inflow Dependent Ecosystem is one in which the vegetation within the landscape is likely to be accessing water in addition to rainfall, from soil or surface water or groundwater, assessed using remotely sensed data. The likelihood of a landscape using additional water is rated from one to 10 (low to high), with a rating above six indicating that a landscape is likely to be inflow dependent (BoM 2020a).

1.6.4.2 Other Significant Vegetation

According to the Flora and Vegetation Technical Guidance (EPA 2016), other than being listed as a TEC or PEC, vegetation can be considered as significant if it is considered to have:

- restricted distribution
- a degree of historical impact from threatening processes
- a role as a refuge
- provides an important function required to maintain ecological integrity of a significant ecosystem.

2 EXISTING ENVIRONMENT (DESKTOP ASSESSMENT)

2.1 PHYSICAL ENVIRONMENT

2.1.1 CLIMATE

The survey area is located within the Pilbara region, which includes two broad climatic zones. Coastal areas, as well as some higher rainfall inland areas, have a semi-desert tropical climate which experience 9-11 months of dry weather, with hot humid summers and warm winters. The remaining inland areas have a dry desert climate, typically with higher temperatures and lower rainfall, and often experience up to 12 months of dry weather, with hot dry summers and mild winters (Leighton 2004). The survey area is within the dry inland area.

According to the Köppen-Geiger climate classification, the survey areas have a hot arid desert (Class BWh) (Peel, Finlayson & McMahon 2007). This classification is considered to represent a desert climate where annual rainfall is generally less than 200 mm or the region loses more water via evapotranspiration than it receives as rain, generally a result of hot, sunny weather without significant cloud. The mean average temperature exceeds 18°C, and summer temperatures are frequently over 40°C.

Annual rainfall in the Pilbara has substantial yearly variation, but generally follows an inland to coastal and southern to northern increasing trend (Leighton 2004). 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 winter rainfall is highly variable, generally decreasing from the coast through to inland areas (Leighton 2004).

The closest Bureau of Meteorology (BoM) station with long term records for rainfall is Wallareenya (BoM 2020b station no 4038, operating since 1908) located approximately 60 km from the survey area. The mean annual rainfall is 318.9 mm, 66% of which falls in summer from January to March.

The closest BoM station with long term records for temperature is Marble Bar (station no 4106, operating since 2000) located approximately 70 km from the survey area. December is the hottest month with a mean maximum temperature of 42° and minimum of 26.2°. June is the coldest month with a mean maximum of 27.1° and minimum of 13.2°.

Figure 2 shows the average rainfall and temperatures of the survey area.

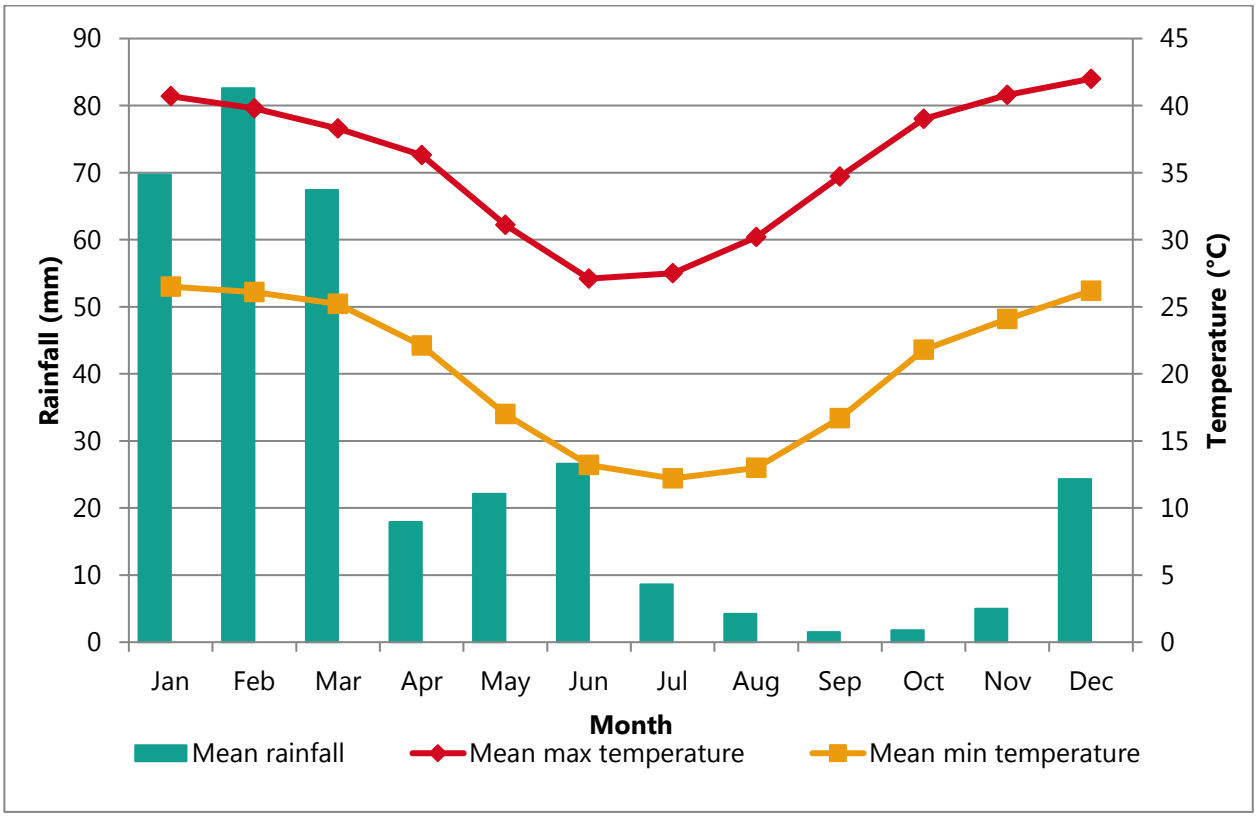


Figure 2: Rainfall and temperature data for the survey area (BoM stations Wallareenya and Marble Bar

2.1.2 LAND SYSTEMS

According to Department of Primary Industries and Rural Development (DPIRD 2020) soil landscape mapping, the following land systems intersect the survey area (**Table 2** and **Map 1**).

Table 2: Land systems (DPIRD 2020)

Mapping unit	Land system	Description	Extent (ha)	%
280Cp	Capricorn	Rugged sandstone hills, ridges, stony footslopes and interfluves supporting low acacia shrublands or hard spinifex grasslands with scattered shrubs.	1198.12	77.25
280Rk	Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	323.13	20.84
280Ti	Talga	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.	29.63	1.91

2.1.3 GEOLOGY

Regional geological mapping covering the survey area is associated with the Marble Bar map sheet (SF50-08) of the 1:250,000 Geological Series of Western Australia (Hickman 2010). Six geological units intersect the survey area as outlined (**Table 3** and **Map 2**).

Table 3: Geological units that intersect the survey area

Code	Unit Name	Description	Extent (ha)	%
A-DA-xo-a	Dalton Suite	Mafic and ultramafic intrusive rocks; metamorphosed	190.54	12.29
A-SOc-s	Corby Formation	Siliciclastic sedimentary rocks; metamorphosed	139.49	8.99
A-SScp-ci	Pincunah Banded-Iron Member	Banded iron-formation; jaspilitic; minor layered chert and shale; metamorphosed	336.57	21.70
A-SSc-xf-s	Kangaroo Caves Formation	Felsic and mafic volcanic rocks, and siliciclastic sedimentary rocks; metamorphosed	571.68	36.86
A-SSk-b	Kunagunarrina Formation	Basaltic volcanic rocks, with minor komatiite, siliciclastic sedimentary rocks, and chert; metamorphosed	270.65	17.45
A-SSl-s	Leilira Formation	Siliciclastic sedimentary rocks, minor felsic volcanic rocks, and chert; metamorphosed	41.97	2.71

2.1.4 WETLANDS AND DRAINAGE

The survey area is at the intersection of three catchments: the Turner River, Strelley River and Shaw River catchments, in the river regions of Port Hedland Coast and De Grey River (Landgate 2020). The survey area is intersected by numerous minor to mid-sized drainage lines (unnamed).

2.1.5 GROUNDWATER DEPENDENT ECOSYSTEMS

The Groundwater Dependent Ecosystems Atlas (Australian Government & BoM 2020) indicates that the survey area is considered as low and moderate potential for terrestrial GDEs to occur, with an IDE likelihood of 7.

2.1.6 ENVIRONMENTALLY SENSITIVE AREAS

There are a number of areas around Western Australia identified as being of environmental significance within which the exemptions to the Native Vegetation Clearing Regulations do not apply. These are referred to as Environmentally Sensitive Areas (ESAs), and are declared under section 51B of the EP Act and described in the *Environmental Protection (Environmentally Sensitive Areas) Notice*.

The survey are does not correspond with any ESAs.

2.1.7 CONSERVATION ESTATE

The National Reserve System is a network of protected areas managed for conservation under international guidelines. The objective of placing areas of bushland into the Conservation Estate is to achieve and maintain a comprehensive, adequate and representative reserve system for Western Australia. The Conservation and Parks Commission is the vesting body for conservation lands, forest and marine reserves that are managed by DBCA (Government of Western Australia 2018b).

The survey area does not correspond with any conservation lands (i.e. National Parks, Nature Reserves and other areas vested for conservation). The nearest conservation estate is Mungaroona Range Nature Reserve, located approximately 70 km south west of the survey area.

2.2 BIOLOGICAL ENVIRONMENT

2.2.1 BIOGEOGRAPHIC REGION

Biogeographic regions are delineated on the basis of similar climate, geology, landforms, vegetation and fauna and are defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Department of Agriculture Water and the Environment 2020).

The survey area is located in the Pilbara IBRA region in the Chichester subregion (PIL1), described as:

> *The Chichester subregion (PIL 1) comprises the northern section of the Pilbara Craton. Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by Acacia inaequilatera over Triodia wiseana (formerly Triodia pungens) hummock grasslands, while Eucalyptus leucophloia tree steppes occur on ranges. The climate is Semi-desert-tropical and receives 300mm of rainfall annually. Drainage occurs to the north via numerous rivers (e.g. De Grey, Oakover, Nullagine, Shaw, Yule, Sherlock). Subregional area is 9,044,560ha.*

2.2.2 PRE-EUROPEAN VEGETATION

During the 1970s, John Beard and associates conducted a systematic survey of native vegetation, describing the vegetation systems in Western Australia at a scale of 1:250 000 in the south-west and at a scale of 1:1 000 000 in less developed areas.

Beard's vegetation maps attempted to depict the native vegetation as it was presumed to be at the time of settlement and is known as the pre-European vegetation type and extent. Beard's vegetation maps have since been developed in digital form by Shepherd, Beeston & Hopkins (2002) and updated by DPIRD (2019). Extents are updated every two years by DBCA (2019a). This mapping indicates that the survey areas intersects one pre-European vegetation unit:

- George Ranges (82): Hummock grassland with scattered bloodwoods & snappy gum, *Triodia* spp., *Corymbia dichromophloia*, *Eucalyptus leucophloia*.

The pre-European vegetation association identified from the survey area (DPIRD 2019) and its pre-European and current extents are listed in **Table 4** (DBCA 2019a). This association has greater than 99% extent remaining at all scales.

Table 4: Pre-European vegetation association representation (DBCA 2019a)

Region	Original extent (ha)	Current extent (ha)	% Remaining
Western Australia	2,565,901.28	2,553,206.19	99.51
IBRA biographic region (Pilbara)	2,563,583.23	2,550,888.14	99.50
IBRA biographic sub-region (Chichester)	360,666.90	360,322.69	99.90
LGA (Shire of East Pilbara)	927,709.76	919,072.17	99.07

2.2.3 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

The Protected Matters Search Tool (PMST) search (Australian Government & DAWE 2020; search reference PMST_URT236) using a 50 km buffer around a point approximating the centre of the survey area identified no EPBC-listed TECs or suitable habitat for such occur or are likely to occur within the search area buffer.

The DBCA database search (search reference 23-0820EC using a 50 km buffer) identified no known TECs or PECs within the search area.

2.2.4 EXISTING VEGETATION MAPPING

The survey area corresponds with two previous flora and vegetation surveys (Ecologia Environment 2012a; Ecoscape 2018), shown in **Map 3**. The previous vegetation mapping indicates the presence of up to 20 vegetation types. **Table 5** summarises the vegetation types that have been recorded from previous surveys, with vegetation types aligned that appear to extend across survey areas. An objective of the supplementary surveys was to further reconcile the existing vegetation types following field survey.

Table 5: Vegetation types recorded from previous assessments within the survey area

Vegetation Code		Description (NVIS Level V)	
Ecologia (2012a)	**Ecoscape (2018)**	**Ecoscape (2018)**	**Ecologia (2012a)**
AaTw2	**AaTw1**	*Acacia acradenia*, *Acacia inaequilatera* and *Grevillea wickhamii* tall sparse shrubland over *Triodia wiseana* and *Triodia brizoides* low hummock grassland	*Acacia acradenia* open mid shrubland over *Triodia wiseana* hummock grassland
AaTw3	**AaTw2**	*Acacia acradenia*, *Acacia inaequilatera* and *Acacia bivenosa* tall open shrubland over *Triodia wiseana* and *Triodia epactia* mid hummock grassland with *Corymbia hamersleyana* scattered low trees	*Acacia acradenia*, *Acacia tumida* and *Grevillea wickhamii* open shrubland over *Triodia wiseana* hummock grassland
AiTb	**AiTw**	*Acacia inaequilatera* mid sparse shrubland over *Triodia wiseana* low hummock grassland	*Acacia inaequilatera*, *Acacia acradenia* and *Grevillea wickhamii* sparse shrubland over *Triodia basedowii* and *Triodia wiseana* hummock grassland
AoTw	**AoTw**	*Acacia orthocarpa* and *Grevillea wickhamii* mid open shrubland over *Triodia wiseana* and *Triodia basitricha* mid hummock grassland	*Acacia orthocarpa* open tall shrubland over *Triodia wiseana* open hummock grassland
ApTp	**ChAaTl**	*Acacia acradenia, Grevillea wickhamii* and *Petalostylis labicheoides* tall open shrubland over *Triodia longiceps* mid open hummock grassland with *Corymbia hamersleyana* low scattered trees	*Acacia pyrifolia*, *Acacia acradenia* and *Tephrosia rosea* mid shrubland over *Triodia pungens* open hummock grassland
At			*Acacia tumida*, *Grevillea wickhamii* and *Indigofera monophylla* shrubland
AtEm			*Acacia tumida*, *Acacia orthocarpa* and *Grevillea wickhamii* open shrubland over *Eriachne mucronata* isolated tussock grasses
AtTw			*Acacia tumida* and *Grevillea wickhamii* open tall shrubland over *Triodia wiseana* open hummock grassland
ElApEm	**ElTw**	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Triodia wiseana* and *Triodia brizoides* low open hummock grassland	*Eucalyptus leucophloia* isolated low trees over *Acacia ptychophylla* and *Grevillea wickhamii* shrubland over *Eriachne mucronata* isolated tussock grasses
ElApTw			*Eucalyptus leucophloia* isolated trees over *Acacia ptychophylla* sparse shrubland over *Triodia wiseana* open hummock grassland

Vegetation Code		Description (NVIS Level V)	
Ecologia (2012a)	**Ecoscape (2018)**	**Ecoscape (2018)**	**Ecologia (2012a)**
Tl			*Triodia lanigera* open hummock grassland
Tw2			*Triodia wiseana* open hummock grassland
	AbTw	*Acacia bivenosa* and *Acacia inaequilatera* mid sparse shrubland over *Triodia wiseana* and *Triodia brizoides* mid hummock grassland	
	AeTb	*Acacia eriopoda* and *Grevillea wickhamii* subsp. *aprica* tall sparse shrubland over *Triodia basitricha* and *Triodia wiseana* mid hummock grassland	
	CfAtEm	*Corymbia ferriticola, Terminalia circumalata* and *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia tumida* var. *pilbarensis*, *Acacia pruinocarpa* and *Ehretia saligna* var. *saligna* tall open shrubland over *Eriachne mucronata* and *Triodia wiseana* mid open tussock grassland/hummock grassland	
	ChAiTa	*Corymbia hamersleyana* open woodland over *Acacia inaequilatera* tall sparse shrubland over *Triodia angusta* and *Triodia wiseana* low hummock grassland	
	EvAtCc	*Eucalyptus victrix* mid woodland over *Acacia tumida* var. *pilbarensis*, *Melaleuca glomerata* and *Acacia ampliceps* tall open shrubland over **Cenchrus ciliaris* and *Triodia longiceps* low open tussock grassland/hummock grassland/sedgeland	

2.2.5 THREATENED AND PRIORITY FLORA

The PMST search (as above) identified one EPBC-listed TF within the 50 km search buffer area, *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)[1] (Endangered) as 'species or habitat known to occur within area'

A search of DBCA's databases was conducted (search reference 07-0820FL) using a 50 km buffer around the supplied shapefiles (TPFL List, taken from Threatened and Priority Flora Report Forms and DBCA surveys, and WA Herb, taken from vouchered specimens held in the Western Australian Herbarium).

Fortescue maintains a database of conservation-listed flora and other flora of conservation interest associated with its operational and exploration tenements. This database consists of DBCA database search results requested for flora and vegetation assessments and the results of field surveys it has commissioned. The resultant list, and associated location data, provides a comprehensive understanding of the conservation significant flora and other flora of conservation interest (e.g. significant range extensions, unusual forms) within

[1] *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) has since been formally described as *Quoya zonalis* (Shepherd & Hislop 2020). It is hereafter referred to by its published name.

and close to Fortescue's areas of interest. Fortescue's significant flora database identified numerous additional records of conservation-listed flora including one additional taxon not included in the DBCA database searches.

The combined database searches identified the species listed in **Table 19** in **Appendix Two**, consisting of one TF, three P1, one P2, 17 P3 and three P4. Three of these conservation-listed flora taxa have been previously recorded within the survey area including *Quoya zonalis* (TF), *Triodia basitricha* (P3) and *Ptilotus mollis* (P4). **Map 3** shows the locations of conservation-listed flora identified by the combined database searches.

2.2.5.1 Threatened and Priority Flora Likelihood Assessment

Ecoscape conducted a likelihood assessment to identify TF and PF species that have potential to occur within the survey area. The likelihood of a species occurring is based on the following attributes, as listed on *FloraBase* (WAH 1998-2020, 2020, including specimen collection information), incorporating an assessment of habitats likely to be present in the survey area. The attributes taken into consideration were:

- broad soil type usually associated with the species
- broad landform usually associated with the species
- usual vegetation (characteristic species) with which the species is usually associated
- species having previously been recorded from within approximately 20 km of the survey area (considered as 'nearby') taking locational accuracy into account
- time since recorded (i.e. within the previous 25 years), taking into consideration land use changes since collection.

The likelihood rating is assigned using the categories listed in **Table 6**.

Table 6: Categories for likelihood of occurrence of TF and PF

Likelihood	Category
Recorded	Species recorded within the survey area.
Possible	May occur within the survey area (but has not been recorded); broadly, 2-4 of the required attributes (but always including records from nearby) are present in the survey area.

Unlikely	Could occur but is not expected; 1-3 of the required attributes are present in the survey area but:
	• it is not known from nearby, or
	• it is known from nearby but has no other required attributes, or
	• it is known from nearby but has at least one well-defined attribute that does not occur in the survey area (e.g. it is associated with a specific landform or soil type that does not occur in the survey area), or
	• it is known from nearby but:
	  ○ the record is old (>25 years), or
	  ○ the locational data is highly likely to be inaccurate, or
	  ○ the area has been significantly cleared at and around the location of the record and survey area and as such the habitat almost certainly no longer occurs within the survey area.

Highly unlikely	The species characteristics include only one or none of the required attributes of soil, landform, associated vegetation and having previously been recorded nearby, or a critical element (often landform) is not within the survey area and as such it almost certainly does not occur.

The likelihood assessment is available in **Table 19** in **Appendix Two**. Three conservation-listed flora are known to occur within the survey area based on reliable previous records including *Quoya zonalis* (TF), *Triodia basitricha* (P3) and *Ptilotus mollis* (P4). There were three P3 and one P4 identified as having a Possible

likelihood of occurring based on the information available during the desktop assessment. These were considered the most likely to occur and were prioritised for field survey.

Following the field survey when actual survey area characteristics (vegetation types, vegetation condition, visibility for individual species) are better understood, and the level of survey effort was considered, the likelihood of occurrence was re-evaluated.

2.3 LITERATURE REVIEW

The survey area has been subject to previous flora and vegetation assessments including:

- Ecologia Environment (2012a) *North Star Vegetation and Flora Assessment*, unpublished report for Fortescue Metals Group Ltd.
- Ecoscape (Australia) Pty Ltd (2018) *Glacier Valley Extension Flora and Vegetation Survey, North Star Project*, unpublished report prepared for IB Operations Pty Ltd.

The surrounding region has also been subject to numerous flora and vegetation assessments and the following documents were also reviewed for relevance to the survey area:

- Woodman Environmental Consulting (2017) *Corunna Downs Intersection Works Flora and Vegetation Assessment*, prepared for Atlas Iron Ltd
- Ecologia Environment (2016) *Iron Bridge North Star Stage 2 Pityrodia sp. Marble Bar Regional Survey 2015*, unpublished report for FMG Iron Bridge (Aust) Pty Ltd
- Ecologia Environment (2015a) *North Star Slurry and Infrastructure Corridors Conservation Significant Flora and Vegetation Assessment,* unpublished report for Iron Bridge and Fortescue Metals Group
- Ecologia Environment (2015b) *North Star Aerodrome Flora Level 2 and Fauna Level 1 Assessment*, unpublished report for Iron Bridge and Fortescue Metals Group
- Ecologia Environment (2014), *North Star Filtration Plant Relocation Flora and Fauna Desktop Assessmen*t, unpublished report for Fortescue Metals Group
- Coffey Environments (2014a) *Significant Species Management Plan Abydos DSO Project*, unpublished report for Atlas Iron Limited
- Coffey Environments (2014b) *North Star Alternate Access Road Flora and Vegetation Assessment*, unpublished report for Fortescue Metals Group
- Onshore Environmental Consultants (2013) *Flora and vegetation survey and fauna assessment: Cundaline Northern Ridge*, report for BHP Billiton Iron Ore Pty Ltd
- Woodman Environmental Consulting (2013) A*bydos Direct Shipping Ore Project Stage 2 Flora and Vegetation Impact Assessment*, unpublished report for Atlas Iron Limited
- Ecologia Environment (2012b) *North Star Access Corridor Flora, Vegetation, Vertebrate Fauna and Fauna Habitat Assessment*, unpublished report for Fortescue Metals Group Ltd
- Ecologia Environment (2012a) *North Star Vegetation and Flora Assessment*, unpublished report for Fortescue Metals Group Ltd
- Ecologia Environment (2012c) *Pityrodia sp. Marble Bar Targeted Flora Survey*, unpublished report for Fortescue Metals Group Ltd
- Woodman Environmental Consulting (2011) *Mount Dove Direct Shipping Ore Project Flora and Vegetation Studies*, unpublished report for Atlas Iron Limited
- Mattiske Consulting Pty Ltd (2010a) *Assessment of flora and vegetation on the Airstrip Expansion Area*, prepared for Millenium Minerals Limited

- Mattiske Consulting Pty Ltd (2010b) *Assessment of flora and vegetation on the All Nations Lease Area*, prepared for Millenium Minerals Limited
- Mattiske Consulting Pty Ltd (2010c) *Assessment of flora and vegetation on the Barton Lease Area*, prepared for Millenium Minerals Limited
- Mattiske Consulting Pty Ltd (2010d) *Assessment of flora and vegetation on the Golden Gate and associated Lease Areas*, prepared for Millenium Minerals Limited
- Mattiske Consulting Pty Ltd (2010e) *Assessment of flora and vegetation on the Little Wonder Lease Area*, prepared for Millenium Minerals Limited
- Mattiske Consulting Pty Ltd (2010f) *Assessment of flora and vegetation on the Otways Lease Area*, prepared for Millenium Minerals Limited
- Mattiske Consulting Pty Ltd (2010g) *Assessment of flora and vegetation on the Shearers Lease Area*, prepared for Millenium Minerals Limited
- Coffey Environments (2007) *Supplementary Vegetation and Flora Survey of the Port Hedland to Cloudbreak Rail Corridor and Associated Borrow Pits and Infrastructure*, prepared for Fortescue Metals Group Ltd, August 2007, Report No. 2007/186: Version 1
- Tinley, K.L. (1991) *Ecological Survey of Abydos-Woodstock Reserve, Pilbara Region, Western Australia: vegetation, habitats and biogeographic context.* Records of the Western Australian Museum Supplement No. 37, pp. 30-77.

3 METHODS

3.1 GUIDING PRINCIPLES

The flora and vegetation survey was conducted as a detailed survey according to the Flora and Vegetation Technical Guidance (EPA 2016). This included the consolidation of previous survey data plus a supplementary survey to ensure the requirements for a detailed survey of the survey area were satisfied. The EPA considers that a detailed survey requires:

- a comprehensive survey design, including giving consideration to the survey timing that should be conducted during the primary season of survey for the bioregion and disturbance events, and the potential requirement for supplementary surveys
- a minimum of three quadrats (in proportion to the extent of the vegetation unit), located throughout each preliminary vegetation types sampled throughout its geographic range, with additional quadrats and rescoring during supplementary surveys to clarify vegetation unit boundaries
- regional surveys if there is insufficient information available (identified during the desktop assessment) to provide local and regional context
- the survey may include a number of sampling techniques including quadrats, relevés, transects and traverses, as well as opportunistic observations
- the flora inventory should be comprised of data collected from quadrats and relevés, supplemented by opportunistic observations, systematic surveys and targeted inspections of various habitat areas
- it may be appropriate to increase survey effort in areas of unusual habitat
- sampling sites that are placed at representative locations throughout the survey area considering landform, geology, elevation, slope, aspect, surface or groundwater expression and soil type, as well as vegetation structure, composition and condition.

Targeted searches were also conducted in areas of habitat suitable for TF and PF identified during the desktop assessment and previous surveys as having potential to occur.

3.2 FIELD SURVEY METHODS

The methods utilised during the field survey followed those outlined in the Flora and Vegetation Technical Guidance (EPA 2016), conducted as a supplementary survey with consolidation of previous survey data.

Conservation criteria used in this assessment are included in **Table 13**, **Table 14** and **Table 15** in **Appendix One**.

Survey method details are outlined below.

3.2.1 FLORISTIC QUADRATS

Floristic quadrat ('quadrat') locations were selected using aerial photography, environmental values and field observations to best represent the vegetation values existing at the site. The quadrats were 50 m x 50 m in dimension, as required according to the Flora and Vegetation Technical Guidance. They were marked on the northwest corner with a steel fence dropper. Where the vegetation consisted of a narrow linear corridor, quadrats were linear but of the same overall size i.e. 2,500 m^2.

The following information was collected from within each quadrat:

- observer

- date
- quadrat/site number
- GPS location (GDA94) of the northwest corner
- digital photograph (spatially referenced with a reference number), taken from the northwest corner, looking diagonally across the quadrat
- broad soil type and colour
- topography
- list of flora species recorded with the average height and total cover within the quadrat for each species
- vegetation description (as per below)
- vegetation condition.

Inclusive of previous survey data, at least three quadrats per vegetation type were recorded for the detailed survey where there was sufficient extent. All quadrat locations are displayed on **Map 4**.

3.2.1.1 Data Reconciliation

Previously established floristic quadrats were incorporated into the consolidated dataset. There have been several taxonomic changes or updates that required reconciliation of data for consistency including:

- previous *Acacia adoxa* records have been changed to A. *adoxa* var. *adoxa*
- previous *Acacia pyrifolia* records have been changed to *A. pyrifolia* var *pyrifolia*
- *Acacia tumida* var. *tumida* is more typical of the Kimberley region, considered more likely to be *A. tumida* var. *pilbarensis* at North Star
- a taxon previously recorded as *Bonamia media* is considered to be *B. pilbarensis*
- previous *Eriachne pulchella* records have been changed to *E. pulchella* subsp. *dominii*
- *Mollugo molluginea* is now referred to as *Trigastratheca molluginea*
- *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) has been formally described as *Quoya zonalis*
- a taxon previously recorded as *Polygala isingii* is now considered to be *P. glaucophylla*
- previous *Tephrosia rosea* var. *rosea* records are considered most likely to be *T. rosea* var. *clementii*
- *Tephrosia spechtii* is now considered to be *Tephrosia virens*
- a taxon previously identified as *Triodia bitextura* is considered to be *T. basitricha*
- *Triodia pungens* is largely now considered restricted to the Newman region in the Pilbara. North Star records are considered more likely to be *Triodia epactia.*

3.2.2 TARGETED SEARCHES

Threatened and Priority Flora identified during the desktop analysis and previous surveys as known or having potential to occur were targeted for searches in areas of potential habitat. Due to the large extent of the survey area searches were conducted in potentially suitable habitat of target species, with the remainder of the site opportunistically searched during site traverses.

The locations of all targeted taxa collected were recorded using a handheld GPS with the following data recorded:

- observer, date and time
- reproductive status and other features such as health of plants, percentage flowering and fruiting
- local abundance/population size and/or population boundary
- landform

- brief vegetation community description
- representative photos of each species and habitat
- collection of representative specimens.

3.2.3 INTRODUCED SPECIES

Introduced species (weeds) were recorded during the collection of the overall flora inventory.

The field survey included searches for WONS, Declared Pest plants and 'Priority Weeds' as outlined on a list maintained by Fortescue for its management purposes. Their locations and numbers/extents were recorded where noted during the field survey, and each such introduced plant species photographed.

3.2.4 VEGETATION DESCRIPTION AND CLASSIFICATION

Vegetation was described from each of the quadrats using the height and estimated cover of dominant and characteristic species of each stratum based on the National Vegetation Information System, recorded at Level V (NVIS Technical Working Group & DotEE 2017) (**Table 16** and **Table 17** in **Appendix One**). Up to three species per stratum from each stratum (upper, mid and ground) were used to formulate vegetation descriptions for each quadrat and each vegetation type.

Vegetation type descriptions were created as per Fortescue standards by combining quadrat descriptions and modifying, where necessary, based on the wider vegetation. Vegetation codes were formulated using the first letter of genus and species names of the dominant species of each stratum e.g. **ElAaTw** refers to ***E****ucalyptus* ***l****eucophloia* subsp. *leucophloia* low isolated trees over ***A****cacia* ***a****cradenia*, *Grevillea wickhamii* and *Acacia ptychophylla* mid sparse shrubland over ***T****riodia* ***w****iseana* low hummock grassland. Where the dominant species make up more than one version of the same code they are distinguished by a superscripted number at the end of the code (e.g. **ElAiTw^{2}**).

3.2.5 VEGETATION CONDITION ASSESSMENT

Vegetation condition was assessed broadly and continuously throughout the survey area and at each quadrat using the Vegetation Condition Scale for the Eremaean Botanical Province (EPA 2016) (**Table 18** in **Appendix One**). As quadrats are located in the best condition parts of a vegetation type, the condition rating of the quadrat may not match that of the broader vegetation type due to the scale of mapping.

3.2.6 FIELD SURVEY TIMING

The supplementary survey was undertaken by Andrew Fry (Senior Botanist, Flora Taking (Biological Assessment) Licence FB62000002), and Terri Jones (Senior Ecologist, FB62000191) during 7-14 August 2020.

Previous flora and vegetation assessments have been completed within the survey area over the following timeframes, noting that these surveys included broader areas extending beyond the boundary of the current North Star Extension survey area:

- North Star Mine (Ecologia Environment 2012a)
  - 1-7 April 2011 (phase one)
  - 17-22 August 2011 (phase two)
- Glacier Valley (Ecoscape 2018)
  - 7-17 May 2018 (phase one)
  - 8-14 August 2018 (phase two

3.3 STATISTICAL ANALYSIS

3.3.1 FLORISTIC ANALYSIS

PATN© software (Belbin & Collins 2006) was used to undertake statistical analysis to generate floristic groups using the data collected from the quadrats, in order to better understand local significance of floristic units. PATN analysis has been used for several local floristic analyses including Gibson *et al.* (1994) for the Swan Coastal Plain.

PATN is a multivariate analysis tool that generates estimates of association (resemblance, affinity, distance) between sets of objects described by a suite of variables (attributes), and classifies the objects into groups and condenses the information and displays the patterns in the data graphically. It offers a choice of data transformations prior to multivariate analysis.

Floristic groups, identified using a dendrogram output of the analysis, are used as a tool to inform vegetation type groups at various levels and scales.

For this project the Bray Curtis similarity coefficient for rows (species) and columns (sites) was used as this provides a good estimation of association for ecological applications (Belbin & Collins 2006). For this analysis presence/absence data was considered the most appropriate due to the multiple surveys that were incorporated (and associated potential inconsistencies that may arise from using cover weighted values).

Interpretation of these purely floristic groups into recognisable and mappable on-ground units is a tool used to identify broad vegetation types. Generally, quadrats that are closely floristically related on the dendrogram form identifiable vegetation units, however, interpretation is frequently required for imperfect results (due to variables such as disturbance and ecotones). Vegetation types are therefore determined as a combination of floristic analysis and on-ground interpretation using dominant and characteristic species.

A floristic analysis was undertaken using all quadrat data from the North Star Extension survey area (51 quadrats) to confirm the floristic groupings of the survey area.

A regional floristic analysis was undertaken using quadrat data supplied by FMG IB that incorporated 294 floristic quadrats from nearby surveys (Ecologia Environment 2012a, mine area, 2012b, access corridor, 2014, filtration area, 2015b, aerodrome; Ecoscape 2018; Glacier Valley) in addition to the 51 quadrats from the survey area (345 total). The purpose of the regional floristic analysis was to determine the wider regional representativeness of the quadrats/vegetation types of the North Star Extension survey area.

A revision of previous regional datasets was undertaken and species names were updated where applicable. Additionally, species that were not identified to species level were excluded as were singleton records.

The specific objectives of the floristic analyses were conducted in order to determine if:

- the floristics correlated with the structural vegetation types as determined during the field survey, identifying discrete groups that were not apparent using purely structural vegetation types
- the floristics identified discrete geographic groupings of vegetation types
- there were sufficient quadrats recorded from within each combined structural/floristic vegetation type
- for regional data, if the vegetation of the survey area is floristically representative of a wider area
- for regional data, consolidation of vegetation units between different surveys.

3.3.2 ADEQUACY OF SAMPLING

In order to demonstrate adequacy of sampling, a species accumulation curve was generated by the software Species Diversity and Richness IV (Pisces Conservation Ltd 2010) using five random selections of sample order, using quadrat data only.

3.3.3 POST-SURVEY LIKELIHOOD ASSESSMENT

Following the field survey, a post-survey likelihood assessment was conducted to identify conservation-listed species that have potential to occur on site. This assessment was based on survey effort and habitat known to occur in the survey area, and updated the desktop likelihood assessment.

4 CONSOLIDATED SURVEY RESULTS

4.1 FLORA

4.1.1 FLORA INVENTORY

Thirty floristic quadrats were recorded from within the survey area during the 2020 supplementary field survey. An additional 21 quadrats have been recorded within the survey area by previous assessments (Ecologia Environment 2012a; Ecoscape 2018) have been incorporated into the results.

A total of 201 vascular flora were recorded from 92 genera and 40 families from the quadrats, opportunistic observations and searches for conservation-listed flora. Of these, three were introduced (1.49%) and four (1.99%) could not be identified to species level due to insufficient diagnostic reproductive material. Three of the taxa that could not be identified to species level arise from previous surveys.

The most commonly represented families were Fabaceae (39 taxa, including one introduced), Malvaceae (26) and Poaceae (25, including one introduced). The most commonly represented genera were *Acacia* with 16 taxa, *Sida* (nine), *Ptilotus* (eight) and *Triodia* (eight).

The number of species per quadrat ranged from six in quadrat NSX2029 to 60 in quadrat NSX2027, with an average species diversity per quadrat of 26.4. The most commonly recorded species were *Triodia wiseana* recorded from 46 quadrats, *Solanum phlomoides* (35 quadrats), *Acacia acradenia*, *Acacia inaequilatera*, *Indigofera monophylla* and *Corchorus parviflorus* (30 quadrats each).

The combined flora inventory is presented in **Table 20** in **Appendix Three**. Quadrat data is presented in **Appendix Four**.

4.1.2 CONSERVATION-LISTED FLORA

4.1.2.1 Threatened Flora

Quoya zonalis is listed under the Commonwealth EPBC Act as Endangered, and as Schedule 2 (Flora that are considered likely to become extinct or rare, as endangered flora)[2] under the Western Australian BC Act.

Locations of *Quoya zonalis* are indicated on **Map 4** and described in more detail in **Table 7**.

4.1.2.2 Priority Flora

Two Priority-listed flora were recorded during the field survey:

- *Triodia basitricha* (P3)
- *Ptilotus mollis* (P4).

Locations of these PF are indicated on **Map 4** and described in more detail in **Table 7**.

[2] *Quoya zonalis* is listed as Threatened Flora under the previous name, *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) under the 2018 Rare Flora Notice, EPBC Conservation Advice, until publication of the next Threatened Flora – Rare Flora Notice.

Table 7: Conservation-listed flora recorded during the field survey

***Quoya zonalis* (TF)**	
Description: An erect woody shrub to 1.5 m high with densely tomentose leaves and pink tubular flowers (WAH 2020). Within the survey area this species was observed as low, woody shrubs to 1 m high, with foliage appearing particularly pruinose. Plants observed in 2020 were in flower at the time of survey. 	**Habitat:** Rocky upper slopes and cliffed hilltops/mesas within vegetation units **AiTb, ElAaTw** and **ElAtTw2**. **Location:** Elevated topography of the central and eastern survey area. **Survey results**: A total of 17 plants from 8 locations have been recorded from the survey area. Of these, 11 plants (3 locations) were recorded during the 2020 survey. **Populations:** The recorded plants represent three discrete populations. **Known records and distribution**: According to *NatureMap* (DBCA 2007-2020) there are 91 records of this species from a highly restricted distribution (approximately 40 km east-west). This species has been the subject of several targeted surveys (Ecologia Environment 2012c, 2016) and ongoing monitoring programs at North Star (Iron Bridge 2017).
***Triodia basitricha* (P3)**	
Description: A perennial hummock grass to approximately 40 cm high. The old leaf bases are curly (WAH 2020)**.** Several previous collections of this taxon from the surrounding region that are held at the WA Herbarium were previously identified as *Triodia bitextura* prior to the formal description of *T. basitricha*. Within the survey area this species was observed as a medium sized hummock grass in clumps to 40 cm high, with loosely twisting/curved phyllodes more evident at the skirts of larger clumps or in young plants after fire. 	**Habitat:** Flat or gently sloping hilltops and plains within vegetation units **ElAaTw, ElAtTw^2** and **ElAiTw^2**. **Location:** Broad hilltops/mesas of the central survey area, and undulating plains of the eastern survey area. **Survey results**: An estimated 21,300 plants from 44 locations have been recorded from the survey area. Of these, 17,800 plants (37 locations) were recorded during the 2020 survey. **Populations:** The recorded plants represent 2-3 discrete populations. **Known records and distribution**: According to *NatureMap* (DBCA 2007-2020) there are 24 records of this species, mostly from the Pilbara bioregion, with an east-west distribution of approximately 450 km.

***Ptilotus mollis* (P4)**	
Description: A compact woolly erect or sprawling shrub to 0.9 m high, with pink flowers (WAH 2020). Within the survey area this species was observed as a low, spreading to domed shrub with tomentose appearance. 	**Habitat:** Rocky hilltops and sheer-sided gorges within vegetation units **AiTb** and **ElAaTw.** **Location:** Elevated topography or gorges of the central and northern survey area. **Survey results**: A total of 820 plants from 20 locations have been recorded from the survey area. Of these, 188 plants (11 locations) were recorded during the 2020 survey. **Populations:** The recorded plants represent two discrete populations within the survey area. **Known records and distribution**: According to *NatureMap* (DBCA 2007-2020) there are 39 records of this species, almost entirely from the Pilbara bioregion, with an overall distribution of approximately 650 km (east-west).

4.1.3 OTHER SIGNIFICANT FLORA

A large, distinctive species of *Themeda* was recorded from drainage lines at the western and northern boundaries of the survey area, listed as *Themeda* sp. in the flora inventory. Plants were observed both within and beyond the survey area perimeter, and are likely to represent two discrete populations, with the larger of several thousand individuals at the northern boundary near NSX2019 (**Map 4**). The species forms large tussocks (**Image 1** and **Image 2**) and has been previously recorded from several locations in the vicinity of North Star and from the broader region including within the Glacier Valley survey area (Ecoscape 2018) where it was tentatively identified as *Themeda avenacea*, though noted as of potential taxonomic significance. This taxon has been the subject of recent taxonomic and genetic investigations and is considered to represent a new species of *Themeda* (P. Jayasekara *pers comm*). It is understood to have been recommended for listing on the WA plant census under the phrase name '*Themeda* sp. Panorama' and a formal description is in preparation.

Image 1: *Themeda* sp. habit

Image 2: *Themeda* sp. abundant across a creek

Eremophila platycalyx subsp. *platycalyx* has been recorded during a previous survey (Ecologia Environment 2012a), with data incorporated into the consolidated dataset. The closest known records (vouchered specimens) of this taxon are from over 700 km south of the survey area. However, it was not recorded during the 2020 field survey and cannot be verified. It is considered that this record may be erroneous.

4.1.4 INTRODUCED FLORA

Three introduced flora species (weeds) were recorded during the 2020 field survey, representing 1.49% of the overall flora inventory. Species descriptions are provided in **Table 8** and locations presented in **Map 5**. All were recorded at relatively low densities within the survey area and no single taxon was considered as a major contributor to vegetation condition assessment. None of the introduced flora have any specific significance i.e. none are Declared Pest plants or WoNS species.

One additional weed species, **Indigofera oblongifolia*, was recorded during a previous survey from two quadrats occurring within the North Star Extension survey area (Ecologia Environment 2012a). The typical distribution of this species is coastal and there are no existing inland records in the vicinity of North Star (WAH 1998-2020). One of the quadrats (150) was visited to investigate this record. Despite an extensive search of this location, **Indigofera oblongifolia* was not observed. However, *Indigofera monophylla* was observed to be common at this location, a species that was not included on the previous flora inventory of quadrat 150. It is therefore concluded that previous records of **Indigofera oblongifolia* are likely erroneous and have been excluded from the flora inventory of the supplementary survey.

Table 8: Introduced flora (weed) descriptions

Description and notes	Survey results	Photo
***Aerva javanica* (Kapok Bush)** Perennial herb to 1.6 m high (but usually less) with greyish white flowers throughout much of the year (WAH 1998-2020). Usually associated with disturbed areas and drainage lines, and is found throughout much of northern Western Australia.	Records: three including two from quadrats and one opportunistic record, all small infestations. Impact: not significant.	

Description and notes	Survey results	Photo
***Cenchrus ciliaris* (Buffel Grass)** **Cenchrus ciliaris* is a perennial tussock-forming grass to 1 m high (WAH 1998-2020). It is generally associated with drainage lines and floodplains, and is more common in grazed areas. **Cenchrus ciliaris* was either deliberately planted for pasture or accidently introduced (Van Vreeswyk et al. 2004), and has been known from the Pilbara bioregion since the early 1900s (Keighery 2010).	Records: one record from a quadrat located within the **EvApTl** vegetation type characteristic of drainage lines Impact: not significant.	
***Flaveria trinervia* (Speedy Weed)** **Flaveria trinervia* is an annual herb with distinctive red stems and three-veined leaves and is found throughout much of northern Western Australia. It is listed on *FloraBase* (WAH 1998-2020) as 'alien' (introduced), however Hussey *et al.* (Hussey et al. 2007) does not list this species, indicating there is debate in relation to **Flaveria trinervia* being native or introduced.	Records: one record from a quadrat located within the **EvApTl** vegetation type characteristic of drainage lines Impact: not significant.	

4.2 VEGETATION

4.2.1 VEGETATION TYPES

Twelve vegetation types were recorded from within the survey area (**Table 9**, **Map 4**) based on a combination of structural vegetation type as identified in the field, floristic analysis (see **Section 4.2.2**) and subsequent desktop review.

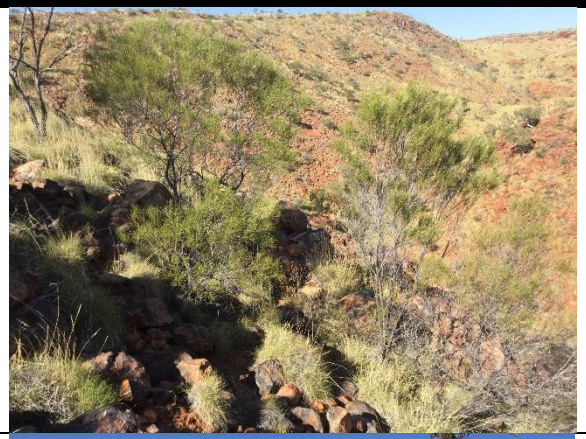
The vegetation types within the survey area, grouped broadly based on landform types, were:

- hills and slopes: **AeTb**, **AoTb**, **ElAaTw**, **ElAiTw^{1}**, **ElApTw**, **ElAtTw^{2}**, **TcAtTw**
- low hills and footslopes: **AiTb**, **ElAiTw^{2}**
- drainage lines/gullies: **CfAtCa**, **ElAtTw^{1}**, **EvApTl**.

Table 9: Vegetation types

Bold indicates represented by photograph

Italicisation denote representative quadrats occurring outside of study area from previous surveys

Landform	Mapping unit	Vegetation type	Floristic quadrats*	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Hills	**AeTb**	*Acacia eriopoda* tall sparse shrubland over *Triodia basitricha, Eriachne mucronata* and *Triodia wiseana* mid hummock/tussock grassland	**GV18056** *GV18057*		*Cymbopogon ambiguus, Eucalyptus leucophloia* subsp. *leucophloia, Goodenia stobbsiana, Trigastrotheca molluginea, Triumfetta maconochieana, Triumfetta propinqua*	1.06 ha 0.07 %
Low hills	**AiTb**	*Acacia inaequilatera* mid sparse shrubland over *Triodia brizoides*, *T. wiseana* and *Acacia ptychophylla* low hummock grassland/shrubland	GV18055 NSX2002 NSX2004 **NSX2005** NSX2010		*Acacia acradenia, Acacia adoxa* var. *adoxa, Corchorus parviflorus, Corymbia hamersleyana, Dodonaea coriacea, Eriachne ciliate, Fimbristylis simulans, Goodenia stobbsiana, Grevillea wickhamii* subsp. *hispidula, Indigofera monophylla, Polycarpaea holtzei, Senna glutinosa* subsp. *glutinosa, Sida* sp. Pilbara (A.A. Mitchell PRP 1543), *Solanum phlomoides, Trigastrotheca molluginea, Triumfetta maconochieana*	461.55 ha 29.77 %

Landform	Mapping unit	Vegetation type	Floristic quadrats*	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Hill crest, plateaux	**AoTb**	*Acacia orthocarpa* mid open shrubland over *Triodia basitricha* and *T. wiseana* low hummock grassland	NSM159 NSX2006 NSX2024 **NSX2025**		*Acacia tumida* var. *pilbarensis, Corchorus parviflorus, Grevillea wickhamii* subsp. *hispidula, Goodenia stobbsiana, Indigofera monophylla, Ptilotus calostachyus, Senna glutinosa* subsp. *glutinosa, Sida* sp. Articulation below (A.A. Mitchell PRP 1605), *Sida* sp. Pilbara (A.A. Mitchell PRP 1543), *Solanum phlomoides, Trigastrotheca molluginea*	7.10 ha 0.46 %
Rocky gullies	**CfAtCa**	*Corymbia ferriticola* low open woodland over *Acacia tumida* var. *pilbarensis* and *A. pruinocarpa* tall open shrubland over *Cymbopogon ambiguus, Triodia wiseana* and *Eriachne mucronata* mid tussock/hummock grassland	NSX2012 NSX2013 **NSX2014** NSX2015		*Bulbostylis barbata, Cajanus cinereus, Cleome viscosa, Cucumis variabilis, Cyperus hesperius, Ehretia saligna* var. *saligna, Euphorbia biconvexa, Ficus brachypoda, Grevillea wickhamii* subsp. *hispidula, Indigofera monophylla, Jasminum didymum* subsp. *lineare, Pluchea dentex, Pterocaulon sphacelatum, Senna glutinosa* subsp. *glutinosa, Senna notabilis, Sida* sp. Articulation below (A.A. Mitchell PRP 1605), *Sida* sp. L (A.M. Ashby 4202), *Solanum horridum, Solanum phlomoides, Tephrosia virens, Triumfetta maconochieana*	12.23 ha 0.79 %

Landform	Mapping unit	Vegetation type	Floristic quadrats*	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Hillcrests, plateaus	**ElAaTw**	*Eucalyptus leucophloia* subsp. *leucophloia* low isolated trees over *Acacia acradenia*, *Grevillea wickhamii* and *Acacia ptychophylla* mid sparse shrubland over *Triodia wiseana* low hummock grassland	NSM158 NSM160 NSM166 NSX2017 **NSX2030**		*Acacia adoxa* var. *adoxa, Acacia inaequilatera, Dampiera candicans, Eriachne mucronata, Eriachne pulchella* subsp. *dominii, Fimbristylis simulans, Goodenia stobbsiana, Polycarpaea holtzei, Ptilotus calostachyus, Solanum phlomoides, Trigastrotheca molluginea*	297.05 ha 19.16 %
Hill slopes	**ElAiTw**[1]	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia inaequilatera, A. tumida* var. *pilbarensis* and *A. acradenia* mid sparse shrubland over *Triodia wiseana* and *T. brizoides* low hummock grassland	GV18026 NSX2003 **NSX2011** NSX2021 NSX2029		*Bulbostylis barbata, Cleome viscosa, Corchorus parviflorus, Cymbopogon ambiguous, Dampiera candicans, Eriachne ciliata, Eriachne pulchella* subsp. *dominii, Gomphrena cunninghamii, Goodenia stobbsiana, Grevillea wickhamii* subsp. *hispidula, Indigofera monophylla, Oldenlandia crouchiana, Polycarpaea holtzei, Ptilotus calostachyus, Senna glutinosa* subsp. *glutinosa, Solanum phlomoides, Tribulus suberosus, Triumfetta maconochieana, Triumfetta propinqua*	67.77 ha 4.37 %

Landform	Mapping unit	Vegetation type	Floristic quadrats*	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Low hills, foothills	**ElAiTw²**	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia inaequilatera, A. acradenia* and *A. bivenosa* mid sparse shrubland over *Triodia wiseana* and *T. angusta* low hummock grassland	GV18015 GV18017 GV18024 GV18058 NSM152 NSX2001 NSX2018 NSX2020 **NSX2023** NSX2026		*Bonamia pilbarensis, Cassytha capillaris, Corchorus parviflorus, Eriachne pulchella subsp. dominii, Euphorbia boophthona, Euphorbia tannensis* subsp. *eremophila, Goodenia microptera, Goodenia stobbsiana, Grevillea wickhamii* subsp. *hispidula, Hakea lorea* subsp. *lorea, Indigofera monophylla, Oldenlandia crouchiana, Ptilotus astrolasius, Ptilotus calostachyus, Solanum phlomoides, Trigastrotheca molluginea*	540.93 ha 34.89 %
Hillslopes	**ElApTw**	*Eucalyptus leucophloia* subsp. *leucophloia* isolated trees over *Acacia ptychophylla* mid sparse shrubland over *Triodia wiseana* open hummock grassland	**NSM153** NSM157 NSM165	 From Ecologia (2012a)	*Acacia orthocarpa, Acacia tumida* var. *pilbarensis, Bulbostylis barbata, Cajanus cinereus, Cleome viscosa, Cyperus hesperius, Dampiera candicans, Ehretia saligna* var. *saligna, Eriachne mucronata, Gossypium robinsonii, Grevillea wickhamii, Hybanthus aurantiacus, Solanum phlomoides, Tephrosia rosea* var. *clementii*	3.52 ha 0.23 %

Landform	Mapping unit	Vegetation type	Floristic quadrats*	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Minor drainage	**ElAtTw[1]**	*Eucalyptus leucophloia* subsp. *leucophloia* low isolated trees over *Acacia tumida* var. *pilbarensis* and *Grevillea wickhamii* mid open shrubland over *Triodia wiseana* mid hummock grassland	NSM150 **NSX2009** *NSM144* *NSM200* *NSM201* *NSM210* *NSM213* *NSM262* *NSM265* *NSM271* *NSM272*		*Acacia acradenia, Acacia bivenosa, Bonamia pilbarensis, Corymbia hamersleyana, Senna glutinosa* subsp. *glutinosa, Tephrosia rosea* var. *clementii*	35.53 ha 2.29 %
Hill slopes	**ElAtTw[2]**	*Eucalyptus leucophloia* subsp. *leucophloia* low isolated trees over *Acacia tumida* var. *pilbarensis* mid sparse shrubland over *Triodia wiseana* and *T. brizoides* low hummock grassland	GV18025 NSM164 NSX2016 **NSX2022**		*Acacia acradenia, Acacia inaequilatera, Bonamia pilbarensis, Bulbostylis barbata, Cleome viscosa, Eriachne ciliata, Eriachne mucronata, Gomphrena cunninghamii, Goodenia stobbsiana, Oldenlandia crouchiana, Polycarpaea holtzei, Ptilotus astrolasius, Senna glutinosa* subsp. *glutinosa*	66.23 ha 4.27 %

Landform	Mapping unit	Vegetation type	Floristic quadrats*	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Drainage lines	**EvApTl**	*Eucalyptus victrix* and *Corymbia hamersleyana* low open woodland over *Acacia pyrifolia* var. *pyrifolia, A. tumida* var. *pilbarensis* and *Petalostylis labicheoides* mid sparse shrubland over *Triodia longiceps, Cymbopogon ambiguus* and *Stemodia grossa* low open hummock/tussock grassland/forbland	GV18053 GV18054 **NSX2007** NSX2008 NSX2027 NSX2028		*Acacia bivenosa, Amaranthus undulatus, Atalaya hemiglauca, Cajanus cinereus, Cleome viscosa, Corchorus parviflorus, Cucumis variabilis, Enneapogon lindleyanus, Eriachne tenuiculmis, Gossypium robinsonii, Indigofera monophylla, Phyllanthus maderaspatensis, Pterocaulon sphacelatum, Solanum diversiflorum, Tephrosia rosea* var. *clementii, Trichodesma zeylanicum* var. *zeylanicum, Triodia wiseana*	54.40 ha 3.51 %
Steep slopes, gorges	**TcAtTw**	*Terminalia canescens* and *Corymbia ferriticola* low open woodland over *Acacia tumida* var. *pilbarensis* mid sparse shrubland over *Triodia wiseana* and *Eriachne mucronata* low open hummock/tussock grassland	GV18027 **NSX2019**		*Acacia pruinocarpa, Bulbostylis barbata, Cajanus cinereus, Cleome viscosa, Corchorus incanus, Cymbopogon ambiguus, Hibiscus goldsworthii, Oldenlandia crouchiana, Senna glutinosa* subsp. *glutinosa, Sida* sp. Articulation below (A.A. Mitchell PRP 1605), *Solanum phlomoides*	3.24 ha 0.21 %
		TOTAL EXTENT				**1,550.60 ha** **100%**

*quadrat codes are as follows: GV=Glacier Valley (Ecoscape 2018), NSM=North Star Mine (Ecologia Environment 2012a), NSX=North Star Extension (2020 survey)

4.2.2 VEGETATION SIGNIFICANCE

4.2.2.1 TECs and PECs

No vegetation recorded from the survey area was assessed as being representative of any currently described TEC or PEC.

4.2.2.2 Groundwater Dependent Vegetation

Eucalyptus camaldulensis subsp. *refulgens* (a facultative phreatophyte known to be dependent on groundwater at various times) was recorded opportunistically from within the survey area. It was not a dominant or characteristic component of any vegetation type and occurred as isolated individual plants or small populations. Locations where *Eucalyptus camaldulensis* subsp. *refulgens* was observed are presented in **Map 4**.

Vegetation type **EvApTl** occupies 54.40 ha (3.51% of the survey area), and corresponds with mid-sized drainage lines throughout the survey area. This vegetation type represents a potential GDV as it is characterised by *Eucalyptus victrix* which is regarded as a facultative phreatophyte although, in some circumstances, it appears not to access or be dependent on groundwater (see **Section 1.6.4.1**).

4.2.2.3 Sheet Flow Dependent Vegetation

Sheet Flow Dependent Vegetation (SFDV) is characterised by grove-intergrove formation of Mulga species. A species of Mulga (*Acacia aptaneura*) was recorded from a single quadrat where it was not a dominant or characteristic component of the vegetation. Therefore, none of the vegetation types recorded within the survey area are considered sheet flow dependant vegetation.

4.2.2.4 Other Significant Vegetation

Vegetation having a restricted distribution is also considered as significant according to the Flora and Vegetation Technical Guidance (EPA 2016). The following five vegetation types were represented by a small extent of less than one percent of the survey area:

- **AeTb** (1.06 ha, 0.07%)
- **AoTb** (7.10 ha, 0.46%)
- **CfAtCa** (12.23 ha, 0.79%)
- **ElApTw** (3.52 ha, 0.23%)
- **TcAtTw** (3.24 ha, 0.21%).

No other vegetation is considered to have significance according to the criteria defined in the Flora and Vegetation Technical Guidance (EPA 2016).

4.2.3 FLORISTIC ANALYSIS

4.2.3.1 Survey Area Floristic Analysis

The floristic dendrogram for the North Star Extension survey area (**Figure 5** in **Appendix Six**), conducted using the combined floristic quadrat datasets from previous surveys and the current surveys, indicates that the defined vegetation types are well supported by the floristic analysis. The only quadrat that appears to be a floristic outlier is NSX2029 (vegetation type **ElAiTw[1]**). This quadrat was species poor (six species recorded) in comparison with other quadrats of this vegetation type (average species diversity of 37 species). However, based on vegetation structure and landform, NSX2029 is considered best placed in **ElAiTw[1]**.

Four floristic supergroups can be defined from the floristic analysis (**Figure 5** in **Appendix Six**):

- **Supergroup 1**: consisting of four vegetation types including **AiTb**, **AoTb**, **ElAaTw** and **ElAiTw^{2}**. All for of these vegetation types were recorded and mapped from hill slopes or summits.
- **Supergroup 2**: consisting of two vegetation types including **ElAiTw^{1}**, **ElAtTw^{1}** and **ElAtTw^{2}**. Two of these vegetation types were recorded and mapped from hill slopes whilst the third (**ElAtTw^{1}**) was recorded from minor drainage lines.
- **Supergroup 3**: consisting of four vegetation types including **AeTb**, **CfAtCa**, **ElApTw** and **TcAtTw**. These vegetation types correspond with steep rocky slopes or gullies of restricted spatial extent.
  Supergroup 4: consisting of a single vegetation type, **EvApTl**, representative of drainage lines of the survey area.

4.2.3.2 Regional Floristic Analysis

Floristic analysis, conducted using quadrat data supplied by Fortescue for adjacent and nearby surveys (Ecologia Environment 2012a, mine area, 2012b, access corridor, 2014, filtration area, 2015b, aerodrome; Ecoscape 2018; Glacier Valley) was also conducted to determine wider regional representativeness of the quadrats recorded during this survey.

The regional floristic analysis identified:

- vegetation types assigned by previous surveys did not floristically group together using the analysis conducted by Ecoscape, nor group with ostensibly similar vegetation as described by Ecoscape.
- The North Star Extension survey area quadrats tended to be spread through the dendrogram matrix, rather than being grouped together.

These findings indicate that the North Star Extension survey area is broadly floristically similar to vegetation types occurring within the surrounding area

The regional floristic dendrogram is included in (**Figure 6** in **Appendix Six**).

4.2.4 VEGETATION CONDITION

The vegetation condition within the survey area ranged from Very Good to Excellent condition, with the majority in Excellent condition (**Table 10**, **Map 5**). The areas in lesser condition (Very Good) corresponded with drainage lines where the presence of introduced species was the main factor. At the scale of the vegetation condition mapping, existing cleared areas such as tracks and drill pads are considered too small to map.

Table 10: Vegetation condition

Vegetation condition	Extent (ha)	Proportion (%)
Excellent	1496.21	96.49
Very Good	54.40	3.51
Good	-	-
Poor	-	-
Degraded	-	-
Completely Degraded	-	-

4.2.5 ADEQUACY OF SURVEY

Adequacy of survey can be demonstrated using a species accumulation curve; if the curve has reached (or almost reached) an asymptote it is considered that most species are likely to have been recorded from the survey area.

A species accumulation curve was generated using quadrat data (**Figure 3**). Opportunistic observations, which increase the number of species recorded, are not included in the analysis. The species accumulation curve suggests that the majority of species likely present have been recorded. Based on the quadrat data, the Michaelis-Menten estimate of species richness is 193.1 which, when taking opportunistic records into account, is lower than the total taxa recorded (201), indicating the intensity of survey was adequate to record the majority of species likely to be present within the survey area.

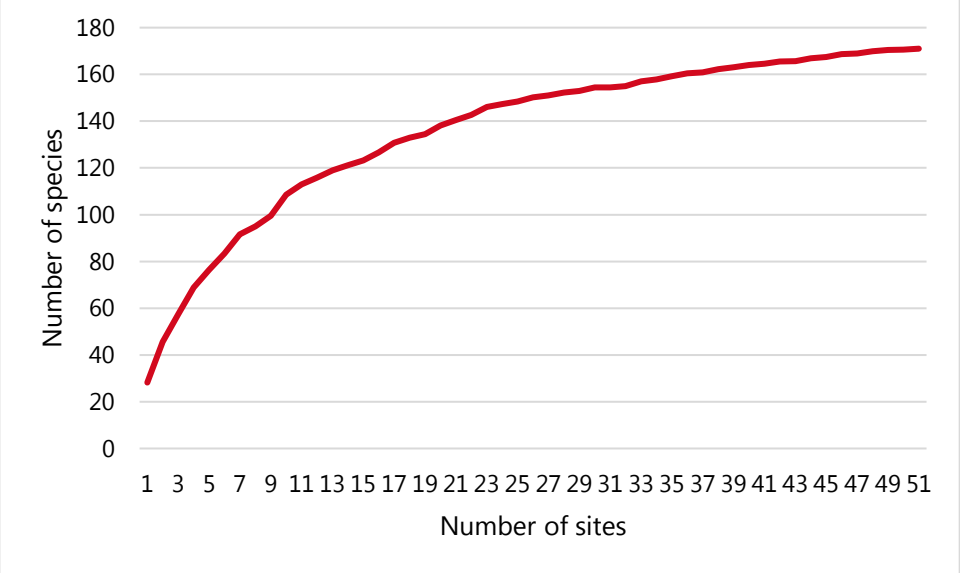


Figure 3: Species accumulation curve

4.3 BOTANICAL LIMITATIONS

4.3.1 SURVEY TIMING

The supplementary field survey was conducted during August 2020, which is outside the optimal period for flora survey within the Pilbara. However, the previous flora and vegetation assessments have included multiple phases of survey within the optimal period (March to June).

The rainfall prior to the supplementary field survey was below average with 80.1% of the mean rainfall in the six months previous (**Figure 4**). The survey of North Star Mine (Ecologia Environment 2012a) was undertaken following a period of above average rainfall whilst the Glacier Valley survey (Ecoscape 2018) followed a period of below average rainfall.

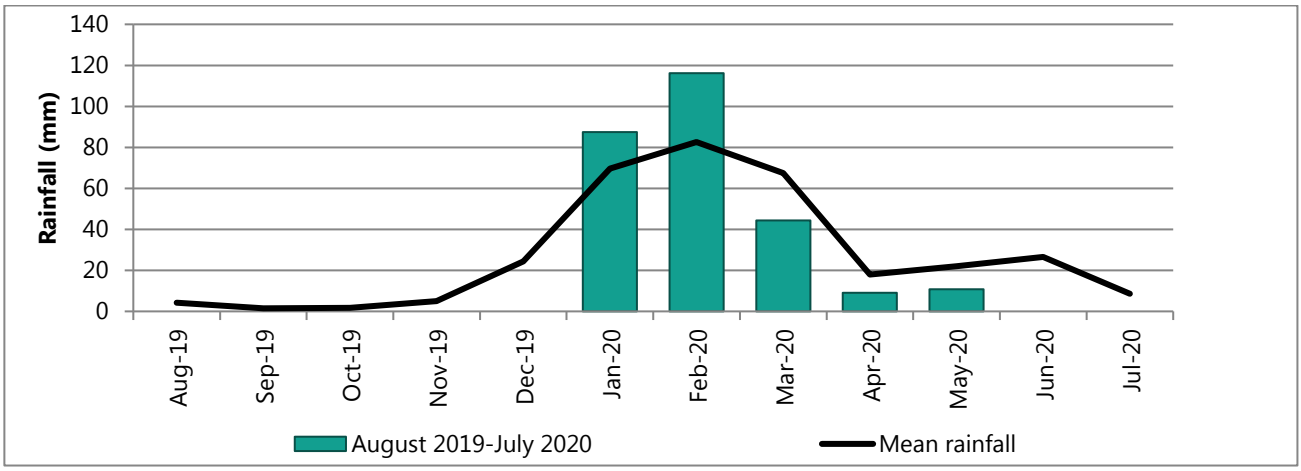


Figure 4: Mean rainfall and rainfall prior to the field survey (Wallareenya, 1923-2020) (BoM 2020b)

Survey design: Consolidated survey based on multiple phases of survey. Quadrat-based flora and vegetation survey with extensive traverses searching for conservation significant flora.

Survey type: Detailed flora and vegetation survey with extensive searches for significant flora searches conducted over a multiple phases. All areas were adequately surveyed through the use of floristic quadrats to sample vegetation types, and targeted searches for conservation significant flora.

Type of vegetation classification system: Vegetation classified at NVIS Level V (NVIS Technical Working Group & DotEE 2017) using largely structural vegetation types defined using dominant and characteristic species and vegetation structure as recorded during the field surveys. Floristic analysis was used to identify major floristic groups and outlier groups of floristic interest.

A full summary of botanical limitations is presented in **Table 11**.

Table 11: Botanical limitations

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Availability of contextual information at a regional and local scale	No	The entire survey area has been subject to previous flora and vegetation assessments and there are numerous other survey reports available from nearby areas.
Competence/experience of the team conducting the survey, including experience in the bioregion surveyed	No	Multiple phases of survey have been undertaken by highly experienced botanists. The lead botanist of the 2020 supplementary survey has nine years' experience with flora and vegetation surveys in the Pilbara bioregion including numerous surveys at North Star.
Proportion of the flora recorded and/or collected, and any identification issues	No	201 vascular flora taxa were recorded during the field survey of which 1.99% could not be identified with certainty to species level due to the lack of diagnostic reproductive material. The majority of these taxa were recorded during surveys prior to 2020. None of the unidentified taxa are considered likely to represent any conservation-listed flora from the region.

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Was the appropriate area fully surveyed (effort and extent)	No	The survey area has been subject to two previous flora surveys. The survey area contains mountainous terrain that can be difficult to access. However, the available tracks and traverses on foot enabled all points of interest to be accessed. There were three vegetation types that were represented by less than three quadrats, including **AeTb** (one quadrat, plus one additional in Glacier Valley survey area), **ElAtTw[1]** (two quadrats plus at least nine within the North Star Mine area) and **TcAtTw** (two quadrats). Each of these vegetation types is spatially restricted within the survey area, limiting the potential for adequate replication.
Access restrictions within the survey area	No	The survey area contains mountainous terrain that can be difficult to access. However, the available tracks and traverses on foot enabled all points of interest to be accessed. The previous Glacier Valley flora and vegetation survey included helicopter surveys to access remote areas and conduct extensive aerial targeted searches for *Quoya zonalis*.
Survey timing, rainfall, season of survey	No	The field survey was conducted during August 2020. This is outside of the optimal season for botanical survey in the Pilbara bioregion. However, two previous flora and vegetation assessments have been undertaken during the optimal timeframe of April and May. The rainfall in the six months prior to the supplementary field survey was below the mean for this period (**Figure 4**). However, earlier surveys have been undertaken following above average periods of rainfall (Ecologia Environment 2012a).
Disturbance that may have affected the results of the survey e.g. fire, flood, clearing	Negligible	The majority of the surveyed vegetation had not been burnt in five years or longer, however a number of areas had been affected by fire within the last 2-5 years, with some sections of the central and western survey area appearing more recently burnt at low intensity. Despite increased presence of some fire ephemerals, impacts of fire did not appear to have been sufficient to alter vegetation structure and did not preclude identification of flora taxa present. There were no other recent disturbances that would have affected the results of the survey.

5 DISCUSSION

5.1 FLORA SIGNIFICANCE

There have been 201 vascular flora taxa recorded from the survey area from the combined 51 floristic quadrats, targeted searches and opportunistic records. Three species (1.49%) were introduced indicating that weeds make up only a very small portion of the flora inventory within the survey area. Four taxa (1.99%) could not be identified to species level due to lack of adequate reproductive material. None of the unidentified taxa bear any similarity to conservation-listed flora identified by the database searches. Three of these taxa that could not be identified to species level arise from previous surveys.

Previous surveys that have incorporated portions of the survey area have recorded the following species diversity:

- Ecologia (2012a) – 473 flora taxa recorded from an area of 34,860 ha including 33 vegetation types with 272 quadrats sampled during above average seasonal conditions
- Ecoscape (2018) – 218 flora taxa recorded from an area of 4,820 ha including 11 vegetation with 60 quadrats sampled during below average seasonal conditions.

In comparison with these previous surveys the 201 flora taxa recorded from 1,551 ha with 51 quadrats sampled (inclusive of previous results) is considered a good representation of the flora of the North Star Extension survey area, which is much smaller in size. The species accumulation curve also indicates that the majority of species are likely to have been recorded from the survey area. This indicates that the survey intensity and effort was adequate for the survey area.

5.1.1 THREATENED AND PRIORITY FLORA

5.1.1.1 Threatened Flora

Quoya zonalis is listed under the Commonwealth EPBC Act as Endangered, and as Schedule 2 (Flora that are considered likely to become extinct or rare, as endangered flora) under the Western Australian BC Act.

Quoya zonalis has been recorded from three discrete populations within the survey area, inclusive of current and previous surveys, comprising a total of 17 plants. One of these populations had not been previously documented prior to the 2020 survey.

This species has been the subject of intensive survey effort and targeted searches (Ecologia Environment 2012a, 2012c, 2015a, 2016; Ecoscape (Australia) Pty Ltd 2018). According to Fortescue's *Pityrodia sp. Marble Bar Research and Conservation Plan* (Iron Bridge 2017) there were a total of 9,848 plants of this taxon. With the addition to the 267 plants subsequently recorded from Glacier Valley (Ecoscape 2018) and 11 new plants from the 2020 survey area, the total number of known plants is calculated to be 10,126 plants. Therefore, based on available data, the 17 total plants that have been recorded from the North Star Extension survey area represent 0.17% of the known total individuals of *Quoya zonalis*.

Quoya zonalis was recorded from the **AiTb**, **ElAaTw** and **ElAtTw²** vegetation types. These vegetation types comprise 53.19% of the survey area indicating there are large areas of potentially suitable habitat for this species. Mature plants are distinctive and can often be spotted from several hundred metres if unobscured by landscape features or other vegetation. Despite its conspicuous appearance and the number of past and

present surveys that have targeted this species, there remains some possibility that additional undetected plants/populations may occur within the survey area.

5.1.1.2 Priority Flora

Two PF were recorded from within the survey area:

- *Triodia basitricha* (P3); there are 24 records on *NatureMap* (DBCA 2007-2020) of this species, mostly from the Pilbara bioregion, with an east-west distribution of approximately 450 km. This species was recorded from an estimated 21,300 plants from 44 locations within the survey area. Based on the FMG IB significant flora database, there have been at least 2,611 plants of *Triodia basitricha* recorded from the broader North Star area. However, this is almost certainly an underestimate largely only on the 2018 Glacier Valley survey (Ecoscape 2018). This species was only formally described in 2015 (Barrett & Barrett 2015), prior to this publication it was identified as *T. bitextura* from the North Star mine surveys (Ecologia Environment 2012a). Since this species is not conservation-listed, population numbers were not documented.
- *Ptilotus mollis* (P4); there are 39 records on *NatureMap* (DBCA 2007-2020) of this species, almost entirely from the Pilbara bioregion, with an overall distribution of approximately 650 km (east-west). This species was recorded from an estimated 188 plants from 11 locations within the survey area. Based on the FMG IB significant flora database, there have been at least 1,668 plants of *Ptilotus mollis* recorded from the broader North Star area.

As both of the above PF are relatively widely distributed within the Pilbara bioregion, it is not expected that potential impacts on these species from any development within the North Star Extension survey area will be significant.

5.1.1.3 Post-survey Likelihood Assessment

The likelihood of conservation significant flora occurring in the survey area was revised following the field survey. This revised likelihood, that took into account vegetation condition, grazing and other disturbances, actual habitat availability and search effort (past and present), is included in **Table 19** in **Appendix Two**. The only species that was not recorded that is considered to have a 'Possible' likelihood of occurrence is *Goodenia nuda* (P4). This taxon is widespread throughout the Pilbara and is commonly encountered from drainage lines and valley floors. It is considered a possibility of occurring within the **EvApTl** vegetation type that is typical of mid-sized drainage lines of the survey area.

5.1.1.4 Other Significant Flora

The *Themeda* sp. recorded is of potential significance as a likely new species that is understood to be awaiting listing on the WA plant name census under the phrase name *Themeda* sp. Panorama'. This putative new taxon was identified as of potential taxonomic significance by Ecoscape (2018) where it was tentatively identified as *Themeda avenacea*. It is also known from other populations extending up to 80 km east of the survey area.

5.1.1.5 Introduced Flora

Three introduced flora species were recorded (**Aerva javanica*, **Cenchrus ciliaris* and **Flaveria trinervia*), representing 1.49% of the overall flora inventory. None of the introduced flora have any specific significance i.e. none are Declared Pest plants or WoNS species. However, two of the species are identified as 'Priority' weeds according to a list maintained by Fortescue for management purposes including **Aerva javanica* (Kapok Bush) and **Cenchrus ciliaris* (Buffel Grass, subject to pastoral exclusion areas).

One additional weed species, **Indigofera oblongifolia*, was recorded during a previous survey from two quadrats occurring within the North Star Extension survey area (Ecologia Environment 2012a). This was investigated and ruled likely to be erroneous.

There is no formal requirement for FMG IB to control of any of the weed species recorded.

5.2 VEGETATION SIGNIFICANCE

Twelve vegetation types were recorded from the survey area from landforms including hills/slopes, foothills, drainage lines and gullies. The floristic analysis confirmed these vegetation types represent distinct floristic units.

5.2.1 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

No TEC's or PEC's are known to occur within the vicinity of the survey area and none of the vegetation types recorded area considered similar to any currently described TEC or PEC.

5.2.2 OTHER SIGNIFICANT VEGETATION

Based on the criteria provided in the Flora and Vegetation Technical Guidance, a number of vegetation types may be considered as significant. These are discussed below.

5.2.2.1 Groundwater Dependent Vegetation

The Groundwater Dependent Ecosystems Atlas (Australian Government & BoM 2020) indicates that the survey area is considered as low and moderate potential for terrestrial GDEs to occur. Vegetation type **EvApTl** represents a potential GDV as it is characterised by *Eucalyptus victrix* which is regarded as a facultative phreatophyte. This vegetation type occupies 54.40 ha (3.51% of the survey area) and corresponds with mid-sized drainage lines. Any changes to groundwater may have the potential to affect this vegetation type.

5.2.3 LOCAL AND REGIONAL VEGETATION SIGNIFICANCE

Five vegetation types within the study area had small extents relative to other vegetation types, indicating that they may be locally significant. These were:

- **AeTb** (1.06 ha 0.07%)
- **AoTb** (7.10 ha 0.46%)
- **CfAtCa** (12.23 ha 0.79%)
- **ElApTw** (3.52 ha 0.23%)
- **TcAtTw** (3.24 ha 0.21%).

Aside from their small extent, they are not considered as significant for any other reason other than their size.

The vegetation types mapped within the survey area typically correspond with vegetation types from the previous surveys (Ecologia Environment 2012a; Ecoscape 2018) that incorporate the survey area and surrounds, summarised in **Table 12** and presented in **Map 6**. This indicates that the majority of vegetation types are well represented outside of the North Star Extension survey area, at least within the areas covered by the previous surveys. There are two vegetation types that have minimal representation mapped outside the survey area (**CfAtCa** and **TcAtTw**). Both of these vegetation types are highly restricted in extent within the survey areas and occupy niche landforms. However, they are considered likely to be more widespread than the existing mapping indicates as they occupy areas that may be deemed too small to map. Neither of these vegetation

types contain assemblages of species considered unusual for the area and other than restricted mapped extent, Ecoscape does not consider them of particular significance.

Table 12: Vegetation type summary

2020 Vegetation Code	Ecologia (2012a)		Ecoscape (2018)		North Star Extension	
	Code	Area (ha)	Code	Area (ha)	Area (ha)	% total area
AeTb			AeTb	21.28	1.06	4.74
AiTb	ElApEm	871	ElTw	793.58	459.6	21.64
AoTb	AoTw	588			7.1	1.19
CfAtCa			CfAtEm	3.17	12.23	**79.42**
ElAaTw	ElApTw	582	AoTw	157.94	299	28.78
ElAiTw[1]	AaTw3	2770	AiTw	1323.03	67.77	1.63
ElAiTw[2]	AaTw2	2206	AaTw1	691.75	540.93	12.95
			AaTw2	739.56		
ElApTw	AtTw	80			3.52	4.21
ElAtTw[1]	ApTp	1011			35.53	3.40
ElAtTw[2]	AaTw2	2206	AbTw	452.27	66.23	2.43
EvApTl	Ap	316	ChAaTl	170.04	54.4	8.77
			EvAtCc	133.84		
TcAtTw					3.24	**100.00**

5.2.4 VEGETATION CONDITION

The vegetation condition within the survey area ranged from Very Good to Excellent condition, the majority (96.49%) in Excellent condition with minimal evidence of disturbance. Areas of Very Good vegetation condition corresponded with drainage lines where there were occasional weeds observed and slight impacts of grazing by cattle or other hoofed animals.

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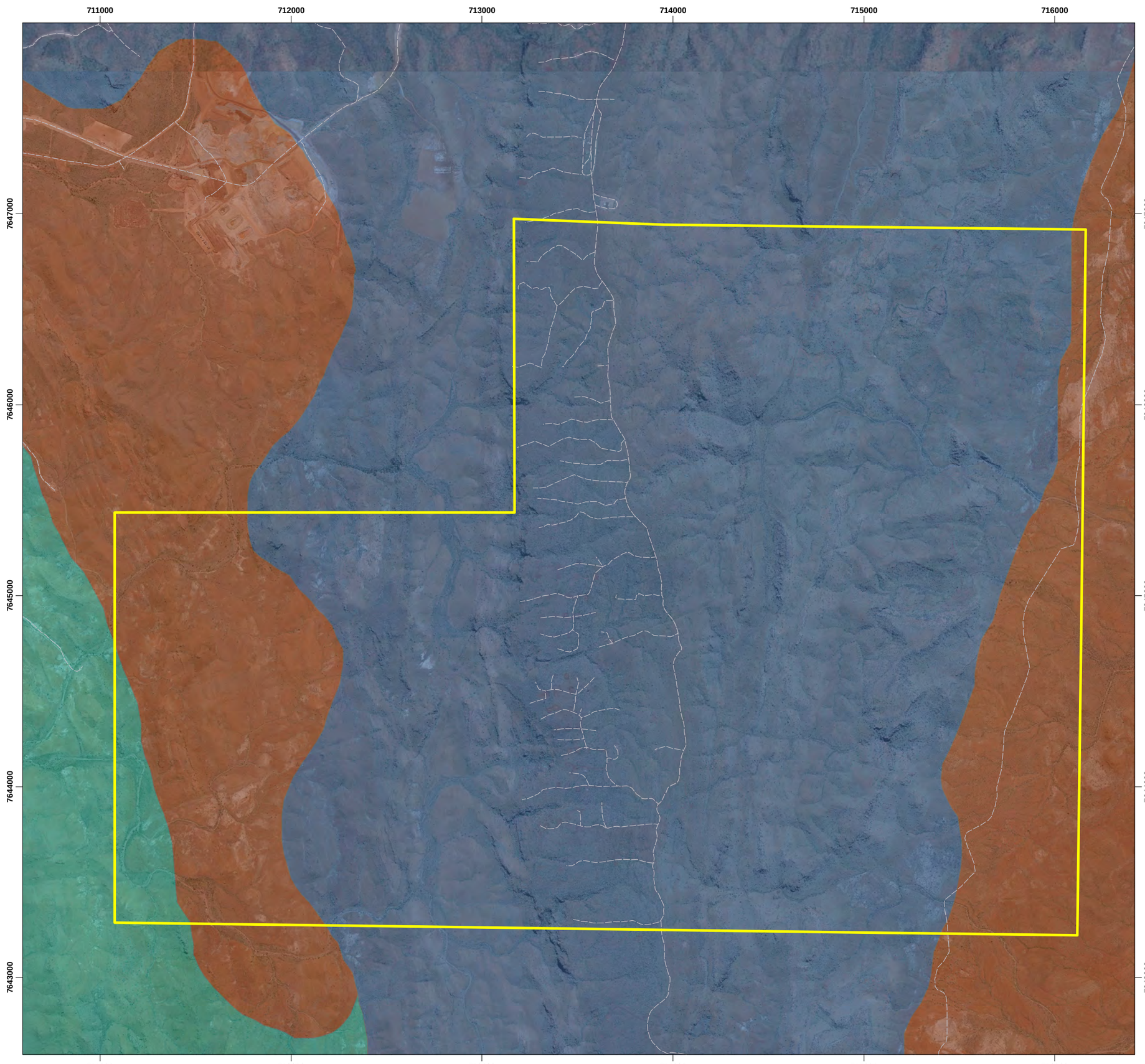
MAPS



LEGEND

- Survey Area
- FMG Access Track (2020)

Soil Land Systems (DPIRD 2018)

- 280Cp:Rugged sandstone hills, ridges, stony footslopes and interfluves supporting low acacia shrublands or hard spinifex grasslands with scattered shrubs.
- 280Rk:Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.
- 280Tl:Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.

DATASOURCES:
AERIAL: FMG 15CM ORTHOMOSAIC (2020)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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NORTH STAR EXTENSION LAND SYSTEMS

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

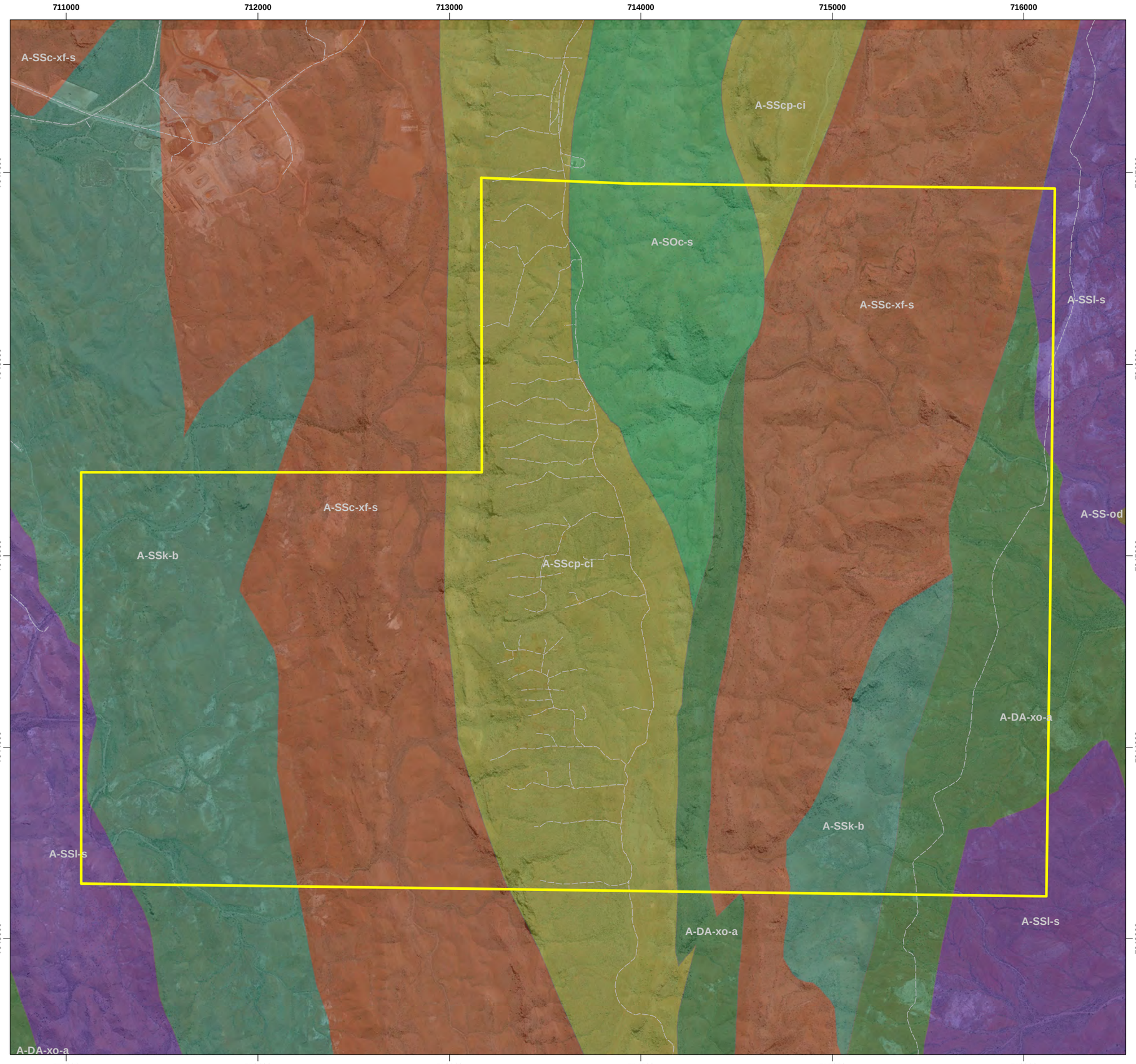
SCALE: 1:20,000 @ A3

0 0.2 0.4 0.6 km

PROJECT NO: 4549-20

REV	AUTHOR	APPROVED	DATE
00	TJ	SK	10/09/2020

MAP
01



LEGEND

- Survey Area
- FMG Access Track (2020)

Geology (DMIRS_016)

- A-DA-xo-a
- A-SOc-s
- A-SS-od
- A-SSc-xf-s
- A-SScp-ci
- A-SSk-b
- A-SSl-s

DATASOURCES:
AERIAL: FMG 15CM ORTHOMOSAIC (2020)
GEOLOGY: DMIRS (2018)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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NORTH STAR EXTENSION GEOLOGY

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

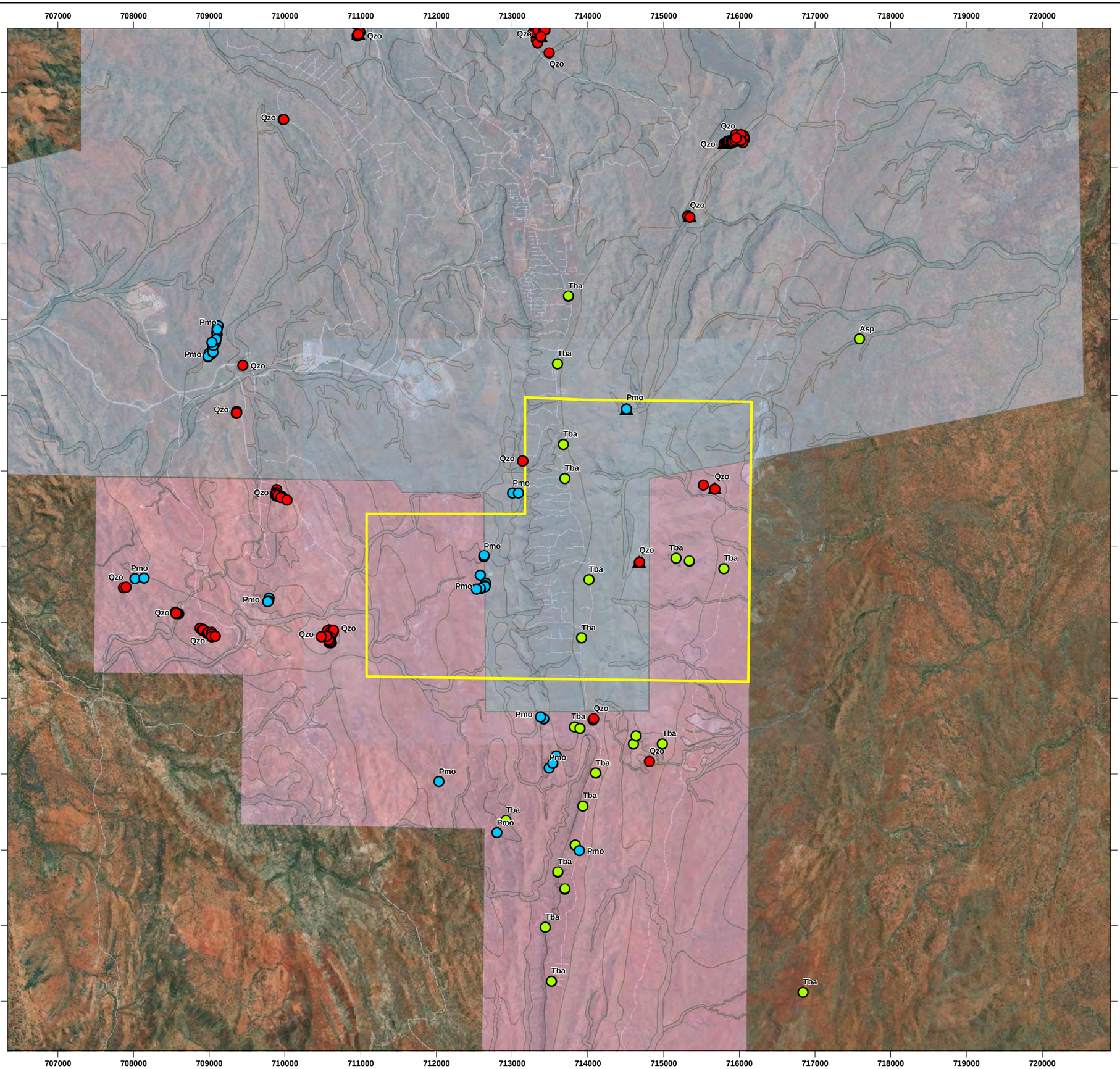
SCALE: 1:20,000 @ A3

0 0.2 0.4 0.6 km

PROJECT NO: 4549-20

REV	AUTHOR	APPROVED	DATE
00	TJ	SK	10/09/2020

MAP
02



LEGEND

- Survey Area
- FMG Access Track (2020)

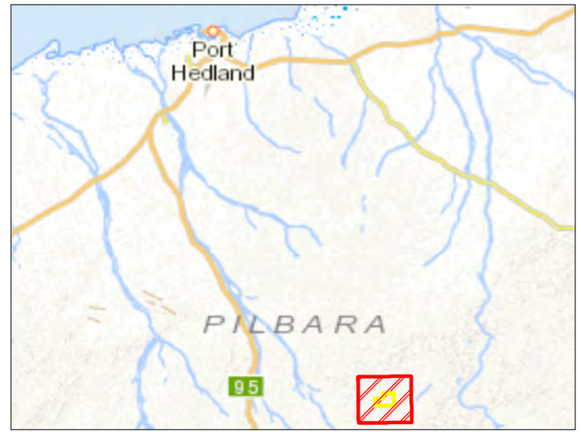
FMG Database Conservation Listed Flora

- Threatened
- Priority 3
- Priority 4

DBCA Search - Conservation Listed Flora

- Threatened
- Ecoscape 2018 Glacier Valley Survey Area
- Ecologia 2012 North Star Survey Area

DATASOURCES:
AERIAL: FMG 15CM ORTHOMOSAIC (2020)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY



ecoscape

NORTH STAR EXTENSION FLORA DATABASE SEARCH RESULTS

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

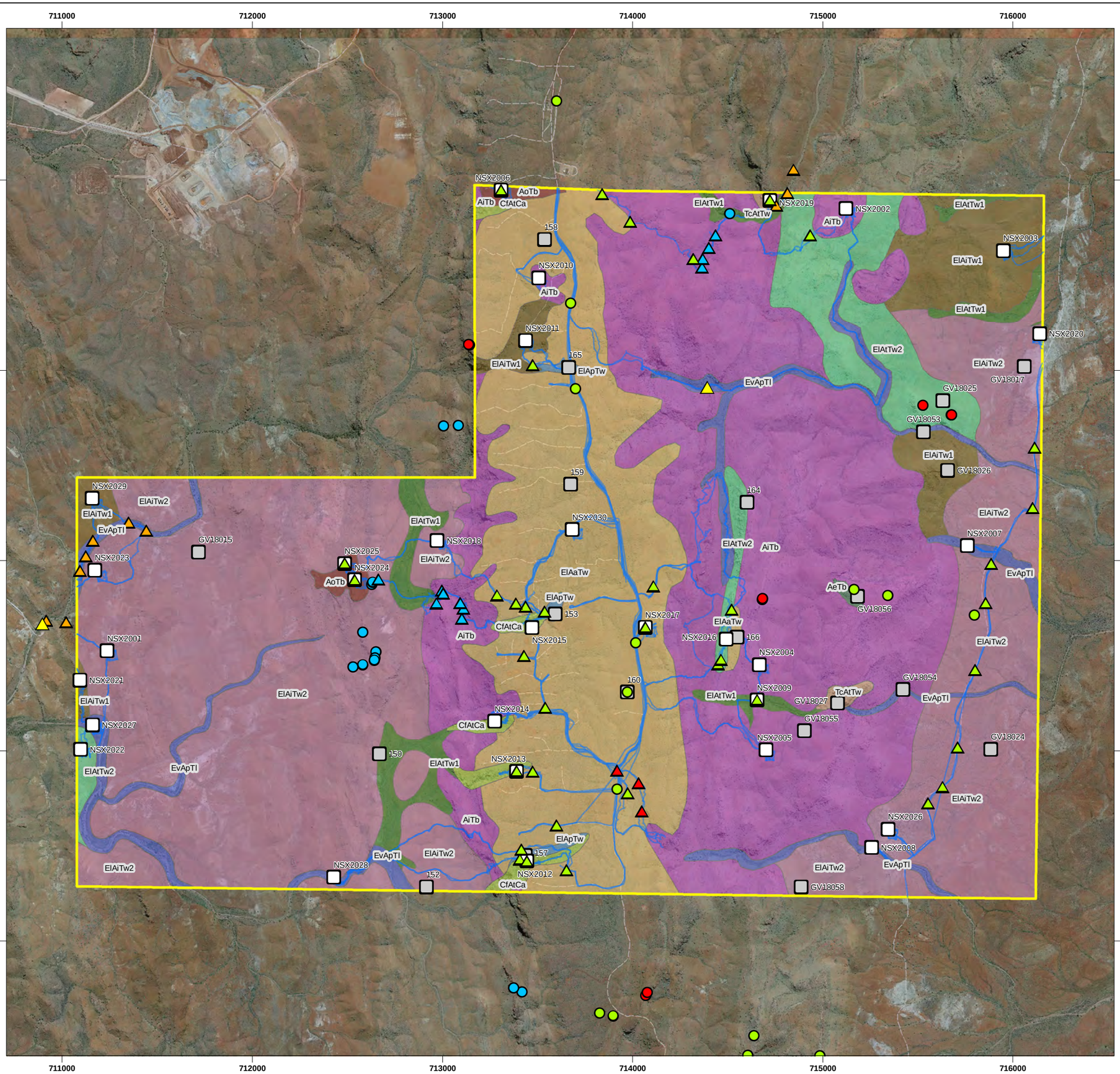
SCALE: 1:50,000 @ A3

0 0.4 0.8 1.2 1.6 km

PROJECT NO: 4549-20

REV	AUTHOR	APPROVED	DATE
00	TJ	SK	10/09/2020

MAP
03



LEGEND

- Survey Area
- FMG Access Track (2020)
- 2020 Survey Tracks

Other Flora

- *Eucalyptus camaldulensis*
- *Themeda* sp. (undescribed)

2020 Conservation Listed Flora

- *Quoya zonalis* (T)
- *Triodia basitricha* (P3)
- *Ptilotus mollis* (P4)

FMG Database Conservation Listed Flora

- *Quoya zonalis* (T)
- *Ptilotus mollis* (P4)
- *Triodia basitricha* (P3)

- 2020 Quadrats
- Previous Quadrats

2020 Vegetation Units

- AeTb
- AiTb
- AoTb
- CfAtCa
- ElAaTw
- ElAiTw1
- ElAiTw2
- ElApTw
- ElAtTw1
- ElAtTw2
- EvApTl
- TcAtTw

DATASOURCES :
AERIAL: FMG 15CM ORTHOMOSAIC (2020)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

ecoscape

NORTH STAR EXTENSION
FLORA, VEGETATION AND QUADRAT LOCATIONS

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:20,000 @ A3

0 0.2 0.4 0.6 km

PROJECT NO: 4549-20

REV	AUTHOR	APPROVED	DATE
00	TJ	SK	10/09/2020
01	SB	SK	06/11/2020

MAP
04

711000 712000 713000 714000 715000 716000

7647000 7646000 7645000 7644000 7643000

NSX2006 NSX2019 NSX2002 NSX2003 NSX2010 NSX2011 Aerva javanica NSX2020 Flaveria trinervia NSX2029 NSX2018 NSX2030 NSX2007 NSX2023 NSX2025 NSX2024 NSX2015 NSX2017 NSX2016 NSX2001 NSX2004 NSX2021 NSX2009 Aerva javanica NSX2027 NSX2014 NSX2022 Aerva javanica NSX2005 NSX2013 NSX2026 NSX2008 Cenchrus ciliaris NSX2028 NSX2012

LEGEND

- Survey Area
- FMG Access Track (2020)
- Weed Locations

Vegetation Condition
- Excellent
- Very Good

2020 Quadrats
- Excellent
- Very Good

Previous Quadrats
- Excellent
- Very Good
- Not available

DATASOURCES :
AERIAL: FMG 15CM ORTHOMOSAIC (2020)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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NORTH STAR EXTENSION VEGETATION CONDITION AND WEED LOCATIONS

FMG Fortescue The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

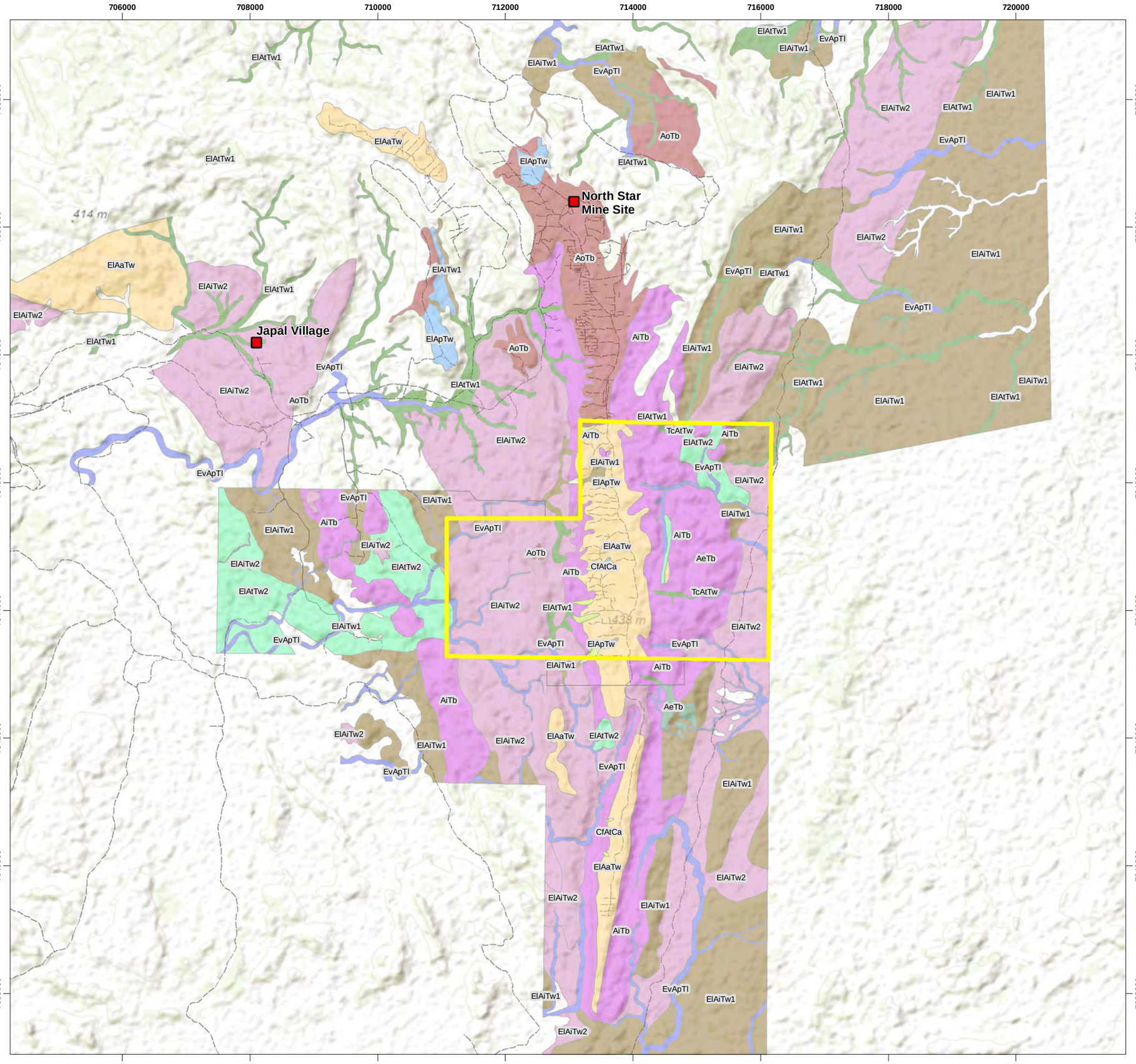
SCALE: 1:20,000 @ A3

0 0.2 0.4 0.6 km

PROJECT NO: 4549-20

REV	AUTHOR	APPROVED	DATE
00	TJ	SK	10/09/2020
01	SB	SK	06/11/2020

MAP 05



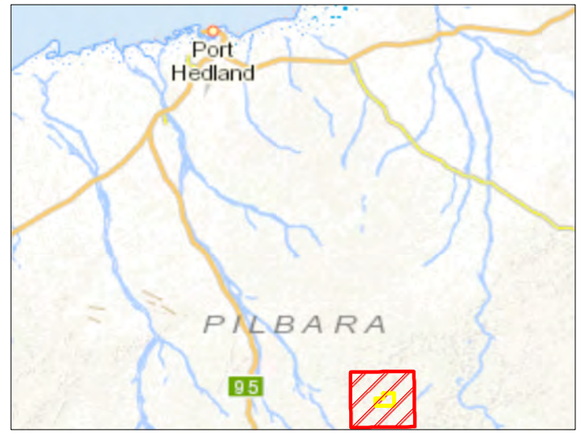
LEGEND

- Survey Area
- FMG Access Track

2020 Vegetation Units

- AeTb
- AiTb
- AoTb
- CfAtCa
- ElAaTw
- ElAiTw1
- ElAiTw2
- ElApTw
- ElAtTw1
- ElAtTw2
- EvApTl
- TcAtTw

DATASOURCES :
AERIAL: FMG 15CM ORTHOMOSAIC (2020)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA



ecoscape

NORTH STAR EXTENSION REGIONAL VEGETATION REPRESENTATION

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:60,000 @ A3

0 0.5 1 1.5 2 km

PROJECT NO: 4549-20

REV	AUTHOR	APPROVED	DATE
00	SB	SK	06/11/2020

MAP
06

APPENDIX ONE DEFINITIONS AND CRITERIA

Table 13: EPBC Act categories for flora, fauna and ecological communities

Category	Threatened species	Threatened Ecological Communities
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.	n/a
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.	n/a
Critically Endangered (CE)	A native species is eligible to be included in the *critically endangered* category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *critically endangered* category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria
Endangered (EN)	A native species is eligible to be included in the *endangered* category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *endangered* category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the *vulnerable* category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *vulnerable* category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.	n/a

Table 14: Conservation codes for Western Australian flora and fauna (DBCA 2019b)

Conservation Codes for Western Australian Flora and Fauna	
Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. **The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.** **Categories of Threatened, Extinct and Specially Protected fauna and flora are:**	
T	**Threatened species** Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	**Critically endangered species** Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as critically endangered undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.
EN	**Endangered species** Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.
VU	**Vulnerable species** Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as vulnerable undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.
Extinct species **Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.**	
EX	**Extinct species** Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.
EW	Extinct in the wild species Species that "*is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species **Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.** **Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.**	

Conservation Codes for Western Australian Flora and Fauna	
MI	**Migratory species** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
CD	**Species of special conservation interest (conservation dependent fauna)** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14of the BC Act). Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18of the BC Act). Published as other specially protected fauna under schedule 7of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
P	**Priority species** Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**Priority 1: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	**Priority 2: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	**Priority 3: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Conservation Codes for Western Australian Flora and Fauna	
4	**Priority 4: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
[1] The definition of flora includes algae, fungi and lichens. **[2] Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).**	

Table 15: DBCA definitions and criteria for TECs and PECs (DEC 2013)

Criteria	Definition
Threatened Ecological Communities	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A. Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B. All occurrences recorded within the last 50 years have since been destroyed
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i. geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii. modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Criteria	Definition
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): A. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii. modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): A. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority ecological communities	
Priority One	*Poorly known ecological communities* Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	*Poorly known ecological communities* Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, state forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities, but do not meet adequacy of survey requirements, and / or are not well defined, and appear to be under threat from known threatening processes.

Criteria	Definition
Priority Three	*Poorly known ecological communities* i. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or; ii. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; iii. Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities, but do not meet adequacy of survey requirements and / or are not well defined, and known threatening processes exist that could affect them.
Priority Four	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. i. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change These communities are usually represented on conservation lands. ii. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. iii. Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five	*Conservation Dependent Ecological Communities* Ecological Communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Table 16: NVIS structural formation terminology, terrestrial vegetation (NVIS Technical Working Group; DotEE 2017)

	Cover characteristics							
	Foliage cover *	70-100	30-70	10-30	<10	» 0 (scattered)	0-5 (clumped)	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	**Height Ranges (m)**	**Structural Formation Classes**						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	tree, palm
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	tree mallee
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrub, cycad, grass-tree, tree-fern
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrub
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrub
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrub
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrub
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grass
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grass
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grass
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedge
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rush
herb	<0.5,>0.5	closed herbland	herbland	open herbland	sparse herbland	isolated herbs	isolated clumps of herbs	herb
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	fern
bryophyte	<0.5	closed bryophyte-land	bryophyte-land	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophyte
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichen
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vine

Table 17: NVIS height classes (NVIS Technical Working Group; DotEE 2017)

Height		Growth form				
Height Class	**Height Range (m)**	**Tree, vine (M & U), palm (single-stemmed)**	**Shrub, heath shrub, chenopod shrub, ferns, samphire shrub, cycad, tree-fern, grass-tree, palm (multi-stemmed)**	**Tree mallee, mallee shrub**	**Tussock grass, hummock grass, other grass, sedge, rush, forbs, vine (G)**	**Bryophyte, lichen, seagrass, aquatic**
8	>30	tall	NA	NA	NA	NA
7	10-30	mid	NA	tall	NA	NA
6	<10	low	NA	mid	NA	NA
5	<3	NA	NA	low	NA	NA
4	>2	NA	tall	NA	tall	NA
3	1-2	NA	mid	NA	tall	NA
2	0.5-1	NA	low	NA	mid	tall
1	<0.5	NA	low	NA	low	low
Source: (based on Walker & Hopkins 1990)						

Table 18: Vegetation condition scale for the Eremaean and Northern Botanical Provinces (EPA 2016)

Condition rating	Description
Excellent	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX TWO DESKTOP ASSESSMENT RESULTS AND LIKELIHOOD ASSESSMENTS

Table 19: Flora database search results, habitat and likelihood assessment

Light blue shading indicates possible likelihood; darker blue indicates species is known (recorded) from the survey area

DBCA*	FMG	Species name	Habitat from *FloraBase* (WAH 1998-2020) or (for *Acacia* species) *World Wide Wattle* (WAH *et al.* 2019)	Flowers	Likelihood of occurrence	
					Desktop	Post-survey
Threatened Flora						
x	x	*Quoya zonalis (*formerly *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4))	Ironstone, sandstone. Steep slope, slopes. *Terminalia circumalata, Acacia tumida, Triodia longiceps*	Jul-Oct	Recorded	Recorded
DBCA Priority 1						
x		*Acacia leeuweniana*	Granite outcrop, skeletal sandy loam, gravelly sand. Rock outcrops. *Acacia retivenea, Terminalia circumalata, Triodia pungens, Acacia tumida*	May	Unlikely	Highly Unlikely
x		*Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 01.05)	Slopes, drainage lines, gullies and hill tops. Brown clay loam. Low woodland of *Eucalyptus* and *Melaleuca* over *Acacia* shrubland	May-Jun	Unlikely	Unlikely
x		*Josephinia* sp. Woodstock (A.A. Mitchell PRP 989)	Rocky plains.	May-Jun	Unlikely	Unlikely
DBCA Priority 2						
x		*Euphorbia inappendiculata* var *inappendiculata*	Plains and hill slopes. With cracking clays.		Highly Unlikely	Highly Unlikely
DBCA Priority 3						
	x	*Abutilon* sp. Pritzelianum (S. van Leeuwen 5095)	Plains, floodplains, sand dunes. Red-brown or orange-brown sandy or loamy soil. Open *Acacia* shrubland over *Triodia* grassland	Apr-Sep	Unlikely	Unlikely
x		*Acacia levata*	Granitic sand or sandy loam. Hillslopes, plain, granite outcrop. *Acacia stellaticeps*, *Triodia pungens, Triodia lanigera, Acacia translucens, Acacia hilliana*	May	Unlikely	Highly Unlikely
x		*Eragrostis crateriformis*	Clay loam, clay, granite outcrop, cracking clay. Creek banks, depressions, granite outcrop, clay pan. *Acacia pyrifolia, Acacia trachycarpa, Acacia tumida, Cenchrus ciliaris, Eucalyptus victrix, Corymbia hamersleyana, Acacia bivenosa, Acacia synchronicia, Triodia epactia, Triodia longiceps, Eucalyptus leucophloia, Chrysopogon fallax, Triodia wiseana, Flueggea virosa*	Jan-Jul	Unlikely	Unlikely
x	x	*Euphorbia clementii*	Red clay loam, colluvium, granitic. Sandplain, outwash fans, lower slope. *Triodia epactia, Acacia inaequilatera, Corymbia hamersleyana, Acacia tumida, Triodia basedowii, Triodia lanigera*		Unlikely	Unlikely
x		*Fimbristylis sieberiana*	Riparian areas (edges of rivers) and edges of pools in gorges. *Eucalyptus camaldulensis, E. victrix*, sedges	May-Jun	Possible	Unlikely
x	x	*Gomphrena leptophylla*	Sand, sandy clay, loam, granite, quartz, alluvium. Flats, creeks, salt pan edges, marshes, stony hills, floodplain. *Triodia lanigera*	Mar-Sep	Unlikely	Highly Unlikely

DBCA*	FMG	Species name	Habitat from *FloraBase* (WAH 1998-2020) or (for *Acacia* species) *World Wide Wattle* (WAH *et al.* 2019)	Flowers	Likelihood of occurrence	
					Desktop	Post-survey
x	x	*Gymnanthera cunninghamii*	Sand, alluvium, clayey sand, basalt, ironstone, clay loam, limestone. Creekline, scree, floodplain. *Eucalyptus victrix, Eucalyptus camaldulensis, Triodia pungens*	Jan-Dec	Possible	Unlikely
x		*Heliotropium murinum*	Sand, granitic sand. Plain. *Corymbia hamersleyana, Acacia inaequilatera, Triodia epactia, Triodia lanigera, Triodia pungens*		Unlikely	Highly Unlikely
x	x	*Heliotropium muticum*	Sand, sandy loam, granitic sand. Sandplain. *Acacia bivenosa, Acacia stellaticeps, Acacia inaequilatera, Triodia epactia, Corymbia hamersleyana, Corymbia flavescens, Acacia tumida, Triodia pungens, Acacia pyrifolia, Acacia trachycarpa*	May-Nov	Unlikely	Highly Unlikely
x	x	*Nicotiana umbratica*	Skeletal soils, ironstone, granite. Sheltered areas, creeklines, gorges, rocky outcrops, steep slopes, hills. *Eucalyptus victrix, Eucalyptus leucophloia,* Mulga, *Acacia arida*	Apr-Jun	Possible	Unlikely
x		*Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479)	Cracking clay, basalt. Gently undulating plain with large surface rocks, flat crabholed plain.		Unlikely	Highly Unlikely
x	x	*Phyllanthus hebecarpus*	Granite outcrop, alluvium. Granite outcrop, creek, outwash. *Terminalia circumalata, Acacia tumida, Acacia retivenea, Triodia epactia*		Unlikely	Highly Unlikely
x		*Rothia indica* subsp. *australis*	Sand, clay loam. Sandhills, flats, creekline. *Pluchea ferdinandi-muelleri, Corchorus lasiocarpus, Triodia longiceps, Triodia lanigera, Gyrocarpus americanus, Triodia epactia, Cenchrus ciliaris, Corymbia flavescens, Chrysopogon fallax, Eucalyptus victrix*	Apr-Aug	Unlikely	Highly Unlikely
x	x	*Stylidium weeliwolli*	Alluvium, clay, sand, wet soil. Watercourses, plains. *Eucalyptus victrix, Eucalyptus camaldulensis,* Mulga	Aug-Sep	Unlikely	Highly Unlikely
x	x	*Terminalia supranitifolia*	Sand, basalt, clay loam. Hilltop, basalt boulders, breakaway. *Triodia epactia, Triodia wiseana, Acacia acradenia, Acacia bivenosa, Grevillea wickhamii, Rhagodia eremaea*	May-Dec	Unlikely	Highly Unlikely
x	x	*Triodia basitricha*	Ironstone. Stony plain, stony crest, low hills. *Acacia* shrubland over *Triodia basitricha, Eucalyptus leucophloia* over *Triodia* (dominant)	May-Jul	Recorded	Recorded
x		*Triodia chichesterensis*	Quartz, granite, basalt. Ridges, flat plain, hills. *Triodia* grassland. *Acacia inaequilatera* woodland	Mar-May	Unlikely	Highly Unlikely
DBCA Priority 4						
x	x	*Bulbostylis burbidgeae*	Granite outcrop. Granite outcrop, cliff bases. *Triodia epactia*	Mar-Aug	Unlikely	Highly Unlikely
x	x	*Goodenia nuda*	Alluvium, clay. Drainage lines, floodplain. *Eucalyptus victrix, E. leucophloia,* Mulga, grasses.	Apr-Aug	Possible	Possible
x	x	*Ptilotus mollis*	Ironstone, clay loam. Stony hills, scree, crest. *Eucalyptus leucophloia, Corymbia hamersleyana, Eucalyptus kingsmillii, Acacia bivenosa, Acacia synchronicia, Triodia basedowii, Triodia pungens*	May or Sep	Recorded	Recorded

APPENDIX THREE FIELD SURVEY RESULTS

Table 20: Flora inventory (site x species), inclusive of previous results

Family	Species	NATURALISED	CONS. CODE	GV18015	GV18017	GV18024	GV18025	GV18026	GV18027	GV18053	GV18054	GV18055	GV18056	GV18058	NSM150	NSM152	NSM153	NSM157	NSM158	NSM159	NSM160	NSM164	NSM165	NSM166	NSX2001	NSX2002	NSX2003	NSX2004	NSX2005	NSX2006	NSX2007	NSX2008	NSX2009	NSX2010	NSX2011	NSX2012	NSX2013	NSX2014	NSX2015	NSX2016	NSX2017	NSX2018	NSX2019	NSX2020	NSX2021	NSX2022	NSX2023	NSX2024	NSX2025	NSX2026	NSX2027	NSX2028	NSX2029	NSX2030	Opp.
Amaranthaceae	*Aerva javanica*	*																					X																																X
	Amaranthus undulatus									X	X											X							X		X	X						X					X								X				
	Gomphrena cunninghamii						X	X	X	X			X									X					X													X					X	X									
	Ptilotus aervoides																															X																			X				X
	Ptilotus astrolasius				X	X	X							X											X										X			X		X		X	X	X		X	X	X	X	X		X			
	Ptilotus calostachyus					X		X						X	X				X	X	X			X		X				X				X	X					X	X	X	X	X	X	X		X	X	X	X			X	
	Ptilotus exaltatus																								X																														
	Ptilotus fusiformis																													X					X										X				X						
	Ptilotus incanus										X	X																																							X				
	Ptilotus mollis		4																																																				X
	Ptilotus obovatus					X																																																	
Apocynaceae	*Cynanchum viminale* subsp. *australe*																																				X																		
Araliaceae	*Trachymene oleracea* subsp. *oleracea*																					X															X	X																	
Asteraceae	*Flaveria trinervia*	*								X																																													
	Peripleura virgata							X																														X																	
	Pluchea dentex																																				X	X	X																
	Pluchea rubelliflora									X							X																						X													X			
	Pluchea sp.																							X																															
	Pluchea tetranthera					X											X							X				X	X																										
	Pterocaulon sphacelatum									X	X																					X					X	X	X												X	X			
	Rhodanthe margarethae																																																						X
	Streptoglossa decurrens																																											X			X		X			X				
Boraginaceae	*Ehretia saligna* var. *saligna*								X		X				X		X						X														X	X	X																
	Heliotropium cunninghamii																													X																				X					
	Heliotropium ovalifolium																																	X																					
	Heliotropium pachyphyllum																				X																																		
	Trichodesma zeylanicum var. *zeylanicum*									X																						X		X	X		X														X	X			
Caryophyllaceae	*Polycarpaea corymbosa* var. *corymbosa*					X																																																	
	Polycarpaea holtzei				X	X	X	X										X	X	X	X	X		X		X	X	X	X										X						X	X	X								
	Polycarpaea involucrata												X																																										
	Polycarpaea longiflora						X	X																														X							X										
Chenopodiaceae	*Dysphania rhadinostachya*					X																																																	
Cleomaceae	*Cleome viscosa*						X	X	X	X			X				X					X	X		X		X				X	X	X		X	X	X	X	X	X		X	X		X	X				X	X	X			
Combretaceae	*Terminalia circumalata*								X		X		X																								X															X			
Convolvulaceae	*Bonamia erecta*																																																	X					
	Bonamia pilbarensis			X		X	X	X						X	X		X					X		X	X	X				X			X	X										X	X	X	X	X		X					
	Evolvulus alsinoides var. *villosicalyx*																										X																								X				
	Polymeria ambigua																										X																	X							X				
Cucurbitaceae	*Cucumis variabilis*																X														X	X			X	X		X	X												X	X			
Cyperaceae	*Bulbostylis barbata*						X	X	X							X	X	X		X		X		X			X				X					X	X		X				X		X	X					X				
	Cyperus cunninghamii subsp. *cunninghamii*						X	X		X	X		X																																										
	Cyperus hesperius																	X				X	X								X					X	X	X	X				X		X										
	Cyperus vaginatus																																																			X			
	Fimbristylis dichotoma																									X			X																										
	Fimbristylis simulans							X											X		X				X	X		X	X	X				X	X						X					X	X								
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*																X																																		X				
	Euphorbia australis var. *subtomentosa*					X																																													X				
	Euphorbia biconvexa																						X				X										X	X	X	X			X	X							X				
	Euphorbia boophthona				X	X										X	X																			X				X								X			X				
	Euphorbia careyi							X		X																										X															X				
	Euphorbia coghlanii								X	X																																													
	Euphorbia tannensis subsp. *eremophila*			X						X				X											X																									X		X			X
Fabaceae	*Acacia acradenia*			X		X	X	X	X			X		X	X	X			X		X	X	X	X	X	X	X	X	X		X	X	X	X	X					X		X								X		X	X	X	
	Acacia adoxa var. *adoxa*													X					X	X	X	X		X		X		X	X	X			X	X	X						X		X											X	
	Acacia ampliceps																																																						X
	Acacia aptaneura																																			X																			
	Acacia bivenosa			X		X		X		X				X	X									X							X	X	X						X						X	X	X				X		X			
	Acacia eriopoda							X					X	X												X																													X
	Acacia inaequilatera			X	X	X	X	X				X		X		X				X	X	X		X	X	X	X	X	X					X	X					X	X	X	X	X	X	X	X			X			X	X	
	Acacia maitlandii																									X					X																				X				
	Acacia orthocarpa																X	X												X							X		X									X	X					X	
	Acacia pruinocarpa								X									X				X														X		X		X			X		X										
	Acacia ptychophylla								X											X	X					X			X	X			X								X													X	

Family	Species	NATURALISED	CONS. CODE	GV18015	GV18017	GV18024	GV18025	GV18026	GV18027	GV18053	GV18054	GV18055	GV18056	GV18058
	Acacia pyrifolia var. *pyrifolia*					X				X	X			
	Acacia spondylophylla			X										
	Acacia stellaticeps			X										
	Acacia trachycarpa													
	Acacia tumida var. *pilbarensis*								X	X	X			
	Cajanus cinereus								X	X	X			
	Cullen leucanthum													
	Indigofera monophylla			X		X	X	X	X		X	X		X
	Indigofera rugosa													
	Indigofera trita subsp. *trita*													
	Isotropis atropurpurea					X								
	Petalostylis labicheoides			X										
	Rhynchosia minima			X					X	X	X			
	Senna artemisioides subsp. *helmsii*													
	Senna artemisioides subsp. *oligophylla*													
	Senna glutinosa subsp. *glutinosa*					X	X	X	X	X		X		
	Senna glutinosa subsp. *pruinosa*													
	Senna notabilis							X						
	Senna symonii													
	Senna venusta												X	
	Swainsona formosa													
	Templetonia hookeri													
	Tephrosia rosea var. *clementii*							X	X	X		X		
	Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)								X				X	X
	Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)													X
	Tephrosia supina													
	Tephrosia virens												X	
Goodeniaceae	*Dampiera candicans*							X	X	X				X
	Goodenia cusackiana							X						
	Goodenia microptera				X	X								
	Goodenia muelleriana					X								
	Goodenia scaevolina													
	Goodenia stobbsiana				X	X	X	X				X	X	
	Scaevola amblyanthera var. *centralis*													
	Scaevola spinescens													
Lamiaceae	*Clerodendrum floribundum* var. *angustifolium*													X
	Quoya zonalis		T											
Lauraceae	*Cassytha capillaris*			X		X								X
	Cassytha filiformis													
Lythraceae	*Ammannia baccifera*													
Malvaceae	*Abutilon lepidum*								X					
	Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)									X	X			
	Corchorus incanus								X	X	X			
	Corchorus incanus subsp. *incanus*													
	Corchorus laniflorus													
	Corchorus parviflorus			X	X	X	X	X	X	X		X		X
	Corchorus sp.													
	Gossypium australe						X		X		X			X
	Gossypium robinsonii								X	X				
	Hibiscus coatesii							X						
	Hibiscus goldsworthii								X					
	Hibiscus leptocladus													
	Hibiscus sturtii													
	Hibiscus sturtii var. *campylochlamys*													
	Sida arsiniata													
	Sida clementii													
	Sida fibulifera													
	Sida sp.							X			X		X	
	Sida sp. ? B Kimberley Flora													
	Sida sp. Articulation below (A.A. Mitchell PRP 1605)								X					
	Sida sp. L (A.M. Ashby 4202)													

Species	NSM150	NSM152	NSM153	NSM157	NSM158	NSM159	NSM160	NSM164	NSM165	NSM166	NSX2001	NSX2002	NSX2003	NSX2004	NSX2005	NSX2006	NSX2007	NSX2008	NSX2009	NSX2010
Acacia pyrifolia var. *pyrifolia*	X								X								X	X		
Acacia spondylophylla											X									
Acacia stellaticeps																				
Acacia trachycarpa																				
Acacia tumida var. *pilbarensis*	X		X	X				X	X							X	X	X	X	
Cajanus cinereus			X	X					X				X				X	X	X	
Cullen leucanthum																				
Indigofera monophylla	X	X	X			X						X	X		X	X	X		X	X
Indigofera rugosa																				
Indigofera trita subsp. *trita*																				
Isotropis atropurpurea																	X	X		
Petalostylis labicheoides											X							X		
Rhynchosia minima													X							
Senna artemisioides subsp. *helmsii*																		X		
Senna artemisioides subsp. *oligophylla*													X							
Senna glutinosa subsp. *glutinosa*	X	X	X			X		X		X		X	X	X		X	X		X	
Senna glutinosa subsp. *pruinosa*						X														
Senna notabilis			X			X										X				
Senna symonii							X						X						X	X
Senna venusta																				
Swainsona formosa																				
Templetonia hookeri																				
Tephrosia rosea var. *clementii*	X		X	X		X		X									X	X	X	
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)																				
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)																				X
Tephrosia supina														X	X					
Tephrosia virens			X			X		X				X								
Dampiera candicans				X	X	X	X		X				X		X	X		X	X	X
Goodenia cusackiana														X						
Goodenia microptera		X														X				X
Goodenia muelleriana																				
Goodenia scaevolina			X																	
Goodenia stobbsiana					X	X	X	X			X	X	X	X		X		X		X
Scaevola amblyanthera var. *centralis*																				
Scaevola spinescens																		X		
Clerodendrum floribundum var. *angustifolium*																				
Quoya zonalis																				
Cassytha capillaris																		X		
Cassytha filiformis										X										
Ammannia baccifera																				
Abutilon lepidum									X											
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)																		X		
Corchorus incanus				X				X											X	
Corchorus incanus subsp. *incanus*									X											
Corchorus laniflorus	X	X																		
Corchorus parviflorus						X					X	X	X	X	X		X	X	X	X
Corchorus sp.																				
Gossypium australe													X				X			
Gossypium robinsonii	X		X			X			X									X		
Hibiscus coatesii																				
Hibiscus goldsworthii																				
Hibiscus leptocladus		X																	X	
Hibiscus sturtii	X		X																	
Hibiscus sturtii var. *campylochlamys*																		X		
Sida arsiniata			X																	
Sida clementii																	X			
Sida fibulifera				X																
Sida sp.																				
Sida sp. ? B Kimberley Flora								X												
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	X		X			X		X								X				X
Sida sp. L (A.M. Ashby 4202)																				

Species	NSX2011	NSX2012	NSX2013	NSX2014	NSX2015	NSX2016	NSX2017	NSX2018	NSX2019	NSX2020	NSX2021	NSX2022	NSX2023	NSX2024	NSX2025	NSX2026	NSX2027	NSX2028	NSX2029	NSX2030	Opp.
Acacia pyrifolia var. *pyrifolia*					X									X			X	X			
Acacia spondylophylla											X		X				X		X		
Acacia stellaticeps																					
Acacia trachycarpa										X											
Acacia tumida var. *pilbarensis*	X	X	X	X	X	X			X	X		X		X	X	X	X	X		X	
Cajanus cinereus	X	X	X	X	X				X								X	X			
Cullen leucanthum																	X				
Indigofera monophylla	X	X		X	X			X		X	X	X	X		X	X	X	X			
Indigofera rugosa																	X				X
Indigofera trita subsp. *trita*																	X				
Isotropis atropurpurea																X	X				
Petalostylis labicheoides												X					X	X			
Rhynchosia minima				X														X			X
Senna artemisioides subsp. *helmsii*																					
Senna artemisioides subsp. *oligophylla*																	X				
Senna glutinosa subsp. *glutinosa*	X	X		X	X	X			X	X	X	X		X	X						
Senna glutinosa subsp. *pruinosa*																					
Senna notabilis	X	X	X		X			X										X			
Senna symonii										X	X										
Senna venusta			X	X					X		X										
Swainsona formosa													X				X				
Templetonia hookeri																					X
Tephrosia rosea var. *clementii*			X							X						X	X	X			X
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)																					
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	X															X					
Tephrosia supina										X											
Tephrosia virens	X	X	X	X	X						X									X	
Dampiera candicans	X		X		X		X														
Goodenia cusackiana									X	X											
Goodenia microptera								X		X		X		X							
Goodenia muelleriana																	X				
Goodenia scaevolina																					
Goodenia stobbsiana	X		X			X	X			X		X	X	X	X	X	X			X	
Scaevola amblyanthera var. *centralis*										X							X				
Scaevola spinescens												X					X				
Clerodendrum floribundum var. *angustifolium*				X																	
Quoya zonalis																					X
Cassytha capillaris							X			X						X		X		X	
Cassytha filiformis																					
Ammannia baccifera																		X			
Abutilon lepidum				X	X													X			
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)																					
Corchorus incanus	X								X					X	X						
Corchorus incanus subsp. *incanus*																					
Corchorus laniflorus																					
Corchorus parviflorus			X					X		X	X	X	X	X	X	X	X	X			
Corchorus sp.																	X				
Gossypium australe						X					X										
Gossypium robinsonii	X		X		X												X	X			
Hibiscus coatesii	X											X									X
Hibiscus goldsworthii		X		X					X												X
Hibiscus leptocladus								X													
Hibiscus sturtii																					
Hibiscus sturtii var. *campylochlamys*	X																				
Sida arsiniata																					
Sida clementii																	X				
Sida fibulifera																					
Sida sp.																					
Sida sp. ? B Kimberley Flora																					
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	X	X	X		X				X			X		X			X			X	
Sida sp. L (A.M. Ashby 4202)		X	X	X	X	X			X												

Family	Species	NATURALISED	CONS. CODE	GV18015	GV18017	GV18024	GV18025	GV18026	GV18027	GV18053	GV18054	GV18055	GV18056	GV18058	NSM150	NSM152	NSM153	NSM157	NSM158	NSM159	NSM160	NSM164	NSM165	NSM166	NSX2001	NSX2002	NSX2003	NSX2004	NSX2005	NSX2006	NSX2007	NSX2008	NSX2009	NSX2010	NSX2011	NSX2012	NSX2013	NSX2014	NSX2015	NSX2016	NSX2017	NSX2018	NSX2019	NSX2020	NSX2021	NSX2022	NSX2023	NSX2024	NSX2025	NSX2026	NSX2027	NSX2028	NSX2029	NSX2030	Opp.
	Sida sp. Pilbara (A.A. Mitchell PRP 1543)				X			X				X			X			X	X	X		X						X	X	X				X										X		X		X	X		X				
	Sida sp. Pindan (B.G. Thomson 3398)								X																																														
	Triumfetta chaetocarpa																			X				X																																	
	Triumfetta maconochieana							X				X	X	X				X											X	X				X	X	X	X		X				X		X												
	Triumfetta propinqua							X		X			X															X									X		X	X		X			X		X					X	X			
Menispermaceae	*Tinospora smilacina*																																					X																			
Molluginaceae	*Trigastrotheca molluginea*					X	X	X				X	X					X	X				X	X		X	X	X													X			X		X			X	X	X				
Moraceae	*Ficus brachypoda*									X	X																									X	X	X						X		X										
Myrtaceae	*Corymbia candida*																	X																																						
	Corymbia ferriticola								X		X		X																								X	X	X	X						X		X										
	Corymbia hamersleyana			X						X	X	X			X					X	X		X			X			X	X		X	X								X	X	X							X						
	Eucalyptus camaldulensis subsp. *refulgens*																																																							X
	Eucalyptus leucophloia subsp. *leucophloia*							X	X				X	X					X	X	X	X	X	X		X		X				X	X		X	X		X		X	X	X		X	X	X		X						X	
	Eucalyptus victrix									X						X														X																							X	X			
	Melaleuca glomerata																																																				X			
	Melaleuca linophylla																	X																																						
Nyctaginaceae	*Boerhavia coccinea*						X	X				X																																												
	Boerhavia gardneri															X	X											X				X																									X	X				
Oleaceae	*Jasminum didymum* subsp. *lineare*			X																												X	X				X	X	X	X							X								X			X
Phyllanthaceae	*Flueggea virosa* subsp. *melanthesoides*																															X	X				X		X																	X			
	Notoleptopus decaisnei									X																																														
	Phyllanthus maderaspatensis								X	X														X								X	X																					X	X			
Plantaginaceae	*Stemodia grossa*									X	X						X																					X															X	X			
Poaceae	*Aristida burbidgeae*										X																									X	X																	X			
	Aristida contorta					X																																							X										
	Aristida holathera																																																			X				
	Cenchrus ciliaris	*																														X																								
	Cymbopogon ambiguus						X	X	X	X	X		X															X				X	X			X	X	X	X	X	X				X		X					X				
	Cymbopogon obtectus																			X		X	X	X																																
	Enneapogon lindleyanus									X																		X					X																					X	X			
	Eragrostis cumingii																																																			X				
	Eriachne ciliata						X	X					X					X		X		X				X	X	X	X	X					X			X		X	X	X		X		X	X											
	Eriachne mucronata					X		X	X	X	X		X			X	X			X	X		X				X		X			X			X	X	X	X	X	X		X		X	X									X	
	Eriachne pulchella subsp. *dominii*				X	X		X				X				X			X		X				X		X			X				X										X	X		X		X					X	
	Eriachne tenuiculmis									X	X											X								X	X	X																					X				
	Paspalidium clementii																					X																																		
	Sporobolus australasicus																																																			X				
	Themeda sp.																																																							X
	Themeda triandra									X						X																					X																		
	Triodia angusta				X																											X																				X					
	Triodia basedowii																							X																																
	Triodia basitricha		3										X								X									X			X			X	X				X		X					X	X						X
	Triodia brizoides						X	X				X		X													X	X	X														X		X													
	Triodia epactia					X		X									X													X									X														
	Triodia longiceps									X																					X	X																					X	X			
	Triodia sp.																						X																																	
	Triodia wiseana			X	X	X	X		X		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	Yakirra australiensis var. *australiensis*																													X																										
Polygalaceae	*Polygala glaucifolia*											X				X																																							
Portulacaceae	*Portulaca cyclophylla*																			X																																				
	Portulaca oleracea																																													X										
Proteaceae	*Grevillea pyramidalis* subsp. *leucadendron*																											X																												
	Grevillea wickhamii			X											X			X	X	X	X	X	X	X	X																														
	Grevillea wickhamii subsp. *aprica*				X	X			X	X											X																																		
	Grevillea wickhamii subsp. *hispidula*													X													X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X		X	X	
	Hakea lorea subsp. *lorea*				X																											X	X										X	X		X		X	X			X			X		
Pteridaceae	*Cheilanthes brownii*													X	X															X	X								X		X					X												
Rubiaceae	*Oldenlandia crouchiana*			X	X		X	X	X			X		X										X												X	X							X	X		X	X						X			
	Oldenlandia galioides																																																							X
	Pomax rupestris																																												X												
	Synaptantha tillaeacea var. *tillaeacea*					X																																																	
Santalaceae	*Santalum lanceolatum*																																					X														X				

Family	Species	NATURALISED	CONS. CODE	GV18015	GV18017	GV18024	GV18025	GV18026	GV18027	GV18053	GV18054	GV18055	GV18056	GV18058	NSM150	NSM152	NSM153	NSM157	NSM158	NSM159	NSM160	NSM164	NSM165	NSM166	NSX2001	NSX2002	NSX2003	NSX2004	NSX2005	NSX2006	NSX2007	NSX2008	NSX2009	NSX2010	NSX2011	NSX2012	NSX2013	NSX2014	NSX2015	NSX2016	NSX2017	NSX2018	NSX2019	NSX2020	NSX2021	NSX2022	NSX2023	NSX2024	NSX2025	NSX2026	NSX2027	NSX2028	NSX2029	NSX2030	Opp.
Sapindaceae	*Atalaya hemiglauca*									X	X						X												X					X															X	X				
	Dodonaea coriacea							X				X		X					X	X								X	X					X											X								
Scrophulariaceae	*Eremophila latrobei* subsp. *filiformis*																	X																																					
	Eremophila latrobei subsp. *glabra*																																		X	X											X							
	Eremophila platycalyx subsp. *platycalyx*																	X																																					
Solanaceae	*Nicotiana benthamiana*																																											X											
	Solanum cleistogamum																																											X											
	Solanum diversiflorum									X																					X							X										X	X		X	X		
	Solanum horridum																																	X	X	X		X		X	X		X			X	X			X			
	Solanum phlomoides			X	X	X	X	X	X			X		X		X	X	X	X	X	X			X		X	X		X	X		X	X	X	X		X	X	X	X	X	X	X			X	X	X				X		
Typhaceae	*Typha domingensis*																																																				X		
Violaceae	*Hybanthus aurantiacus*			X				X	X								X					X	X								X	X					X	X				X				X					X	X		X	
Zygophyllaceae	*Tribulus macrocarpus*																	X						X																															
	Tribulus platypterus																						X																																
	Tribulus suberosus							X	X								X							X		X	X										X	X			X				X	X								

APPENDIX FOUR 2020 FLORISTIC QUADRATS

NSX2001

Staff TCJ **Date** 11/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 711237 **mE** 7644527 **mN** **Lat.** -21.2888 **Long.** 119.0361

Habitat Mid-Slope

Aspect NW **Slope** Gentle

Soil Type Red brown sandy loam

Rock Type Weathered granite

Loose Rock 20-50 % cover; 20-60 mm in size **Litter** <1 % cover ; 1 cm in depth

Bare ground 60 % cover **Weeds** 0 % cover

Vegetation M+ ^*Acacia inaequilatera*\^shrub\3\bi;G ^*Triodia wiseana*,^*Acacia spondylophylla*\^tussock grass, shrub\2\c

Veg. Condition Excellent

Disturbance Tracks in area, cattle

Fire Age 2-5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		1	<1	
Acacia inaequilatera		2	1	
Acacia spondylophylla		.6	10	
Bonamia pilbarensis		.1	<1	
Cleome viscosa		.4	<1	

Corchorus parviflorus	.2	<1
Eriachne pulchella subsp. *dominii*	.1	<1
Euphorbia tannensis subsp. *eremophila*	.4	<1
Fimbristylis simulans	.1	<1
Goodenia stobbsiana	.3	<1
Grevillea wickhamii subsp. *hispidula*	.5	<1
Petalostylis labicheoides	2	<1
Ptilotus astrolasius	.4	<1
Ptilotus exaltatus	.3	<1
Trigastrotheca molluginea	.2	<1
Triodia wiseana	.6	30

NSX2002

Staff TCJ **Date** 13/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 715123 **mE** 7646851 **mN** **Lat.** -21.2674 **Long.** 119.0733

Habitat Rolling hills

Aspect N/A **Slope** Moderate

Soil Type Red brown sandy loam

Rock Type

Loose Rock >90 % cover; 20-60 mm in size **Litter** 1 % cover ; 1 cm in depth

Bare ground 40 % cover **Weeds** 0 % cover

Vegetation M+ ^*Acacia inaequilatera*,^*Acacia eriopoda*\^shrub\3\bi;G ^*Triodia brizoides*,^*Acacia ptychophylla*\^hummock grass,shrub\1\c

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		0.5	<1	
Acacia adoxa var. *adoxa*		0.2	<1	
Acacia eriopoda		1	6	
Acacia inaequilatera		2	1	
Acacia maitlandii		0.7	<1	

Acacia ptychophylla	0.6	5
Bonamia pilbarensis	0.1	<1
Corchorus parviflorus	0.4	<1
Corymbia hamersleyana	4.5	<1
Eriachne ciliata	0.1	<1
Eucalyptus leucophloia subsp. *leucophloia*	2.5	<1
Fimbristylis dichotoma	0.1	<1
Fimbristylis simulans	0.2	<1
Goodenia stobbsiana	0.3	<1
Grevillea wickhamii subsp. *hispidula*	1.5	<1
Indigofera monophylla	0.5	<1
Polycarpaea holtzei	0.1	<1
Ptilotus calostachyus	0.7	<1
Senna glutinosa subsp. *glutinosa*	1	<1
Solanum phlomoides	0.3	<1
Tephrosia virens	1	<1
Tribulus suberosus	0.7	<1
Triodia brizoides	0.5	58
Triodia wiseana	0.5	<1

NSX2003

Staff TCJ **Date** 10/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 715951 **mE** 7646630 **mN** **Lat.** -21.2693 **Long.** 119.0813

Habitat Upper-Slope

Aspect SE **Slope** Moderate

Soil Type Red brown sandy loam

Rock Type Ironstone

Loose Rock 20-50 % cover; 6-20 mm in size **Litter** 5 % cover ; 1 cm in depth

Bare ground 40 % cover **Weeds** 0 % cover

Vegetation M+ ^*Acacia inaequilatera*\^shrub\3\r;G ^*Triodia wiseana*\^hummock grass\2\c

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		1.2	<1	
Acacia inaequilatera		2	2	
Boerhavia gardneri		.2	<1	
Bulbostylis barbata		.1	<1	
Cajanus cinereus		1.3	<1	

Cheilanthes brownii	.1	<1
Cleome viscosa	.2	<1
Corchorus parviflorus	.4	<1
Cymbopogon ambiguus	.6	<1
Dampiera candicans	.3	<1
Enneapogon lindleyanus	.4	<1
Eriachne ciliata	.1	<1
Eriachne pulchella subsp. *dominii*	.3	<1
Euphorbia biconvexa	.1	<1
Evolvulus alsinoides var. *villosicalyx*	.1	<1
Gomphrena cunninghamii	.2	<1
Goodenia stobbsiana	.3	<1
Gossypium australe	.6	1
Grevillea pyramidalis subsp. *leucadendron*	1.5	<1
Grevillea wickhamii subsp. *hispidula*	1.3	<1
Indigofera monophylla	.3	<1
Polycarpaea holtzei	.1	<1
Polymeria ambigua	.1	<1
Rhynchosia minima	.3	<1
Senna artemisioides subsp. *oligophylla*	.8	<1
Senna glutinosa subsp. *glutinosa*	1	<1
Senna symonii	.4	<1
Solanum phlomoides	.4	<1
Tribulus suberosus	1	<1
Triodia brizoides	.4	<1
Triodia wiseana	.6	60
Triumfetta propinqua	1	<1

NSX2004

Staff TCJ **Date** 12/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 714668 **mE** 7644453 **mN** **Lat.** -21.2891 **Long.** 119.0692

Habitat Upper-Slope

Aspect S **Slope** Moderate

Soil Type Red brown sandy loam

Rock Type

Loose Rock 50-90 % cover; 20-60 mm in size **Litter** 1.5 % cover ; 1 cm in depth

Bare ground 30 % cover **Weeds** 0 % cover

Vegetation U+ ^*Eucalyptus leucophloia* subsp. *leucophloia*\^tree\6\r;M ^*Acacia acradenia*,^*Acacia inaequilatera*\^shrub\3\i;G ^*Triodia brizoides*,^*Triodia wiseana*\^hummock grass\1\c

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		1	12	
Acacia adoxa var. *adoxa*		0.5	<1	
Acacia inaequilatera		1.8	1	
Cheilanthes brownii		0.1	<1	
Corchorus parviflorus		0.5	<1	

Dodonaea coriacea	0.3	<1
Eriachne ciliata	0.1	<1
Eriachne mucronata	0.3	<1
Eucalyptus leucophloia subsp. *leucophloia*	5	1.5
Fimbristylis simulans	0.1	<1
Goodenia cusackiana	0.1	<1
Goodenia stobbsiana	0.3	<1
Grevillea wickhamii subsp. *hispidula*	1	<1
Hakea lorea subsp. *lorea*	0.5	<1
Pluchea tetranthera	0.5	<1
Polycarpaea holtzei	0.1	<1
Senna glutinosa subsp. *glutinosa*	0.2	<1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.3	<1
Tephrosia supina	0.1	<1
Trigastrotheca molluginea	0.1	<1
Triodia brizoides	0.5	56
Triodia wiseana	0.5	<1

NSX2005

Staff TCJ **Date** 12/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 714703 **mE** 7644005 **mN** **Lat.** -21.2931 **Long.** 119.0696

Habitat Upper-Slope

Aspect W **Slope** Moderate

Soil Type Brown sandy loam

Rock Type Granite

Loose Rock >90 % cover; 60-200 mm in size **Litter** 1 % cover ; 1 cm in depth

Bare ground 55 % cover **Weeds** 0 % cover

Vegetation U+ ^*Corymbia hamersleyana*\^tree\6\bi;M ^*Acacia inaequilatera*\^shrub\4\bi;G ^*Triodia wiseana*, *Acacia ptychophylla*\^hummock grass,shrub\1\c

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		1	<1	
Acacia adoxa var. *adoxa*		0.3	<1	
Acacia inaequilatera		3.5	1.5	
Acacia ptychophylla		0.5	10	
Amaranthus undulatus		0.4	<1	

Corchorus parviflorus	0.3	<1
Corymbia hamersleyana	3	1
Dampiera candicans	0.5	<1
Dodonaea coriacea	1.5	<1
Eriachne ciliata	0.1	<1
Fimbristylis dichotoma	0.2	<1
Fimbristylis simulans	0.1	<1
Grevillea wickhamii subsp. *hispidula*	1.5	<1
Hakea lorea subsp. *lorea*	0.5	<1
Indigofera monophylla	0.5	<1
Pluchea tetranthera	0.6	<1
Polycarpaea holtzei	0.1	<1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.3	<1
Solanum phlomoides	0.3	<1
Tephrosia supina	0.1	<1
Trigastrotheca molluginea	0.1	<1
Triodia wiseana	0.4	45
Triumfetta maconochieana	0.4	<1
Yakirra australiensis var. *australiensis*	0.1	<1

NSX2006

Staff TCJ **Date** 7/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 713308 **mE** 7646948 **mN** **Lat.** -21.2667 **Long.** 119.0558

Habitat Crest

Aspect N **Slope** Very Gentle

Soil Type Red brown loam

Rock Type Ironstone

Loose Rock 20-50 % cover; 6-20 mm in size **Litter** 2 % cover ; 1 cm in depth

Bare ground 60 % cover **Weeds** 0 % cover

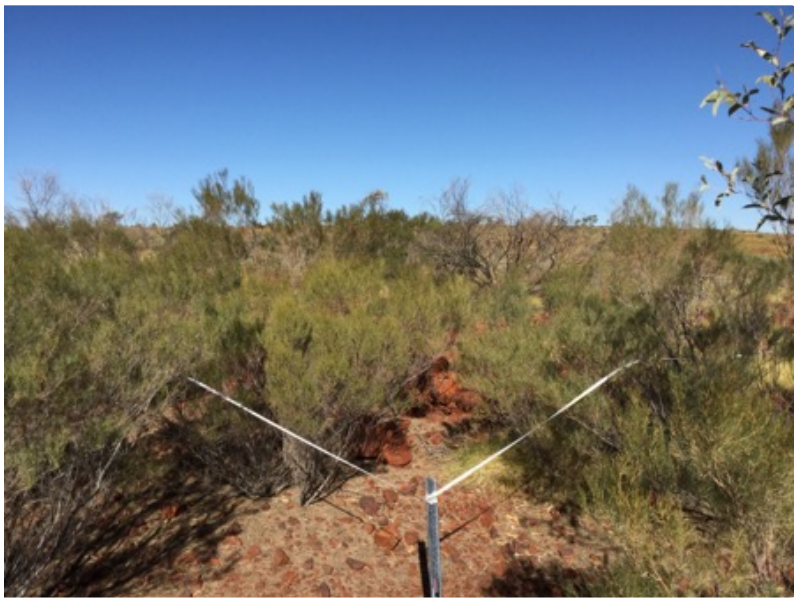
Vegetation M+ ^*Acacia orthocarpa*,^*Acacia tumida* var. *pilbarensis*,*Grevillea wickhamii* subsp. *hispidula*\^shrub,*temp*\4\i;G ^*Triodia wiseana*,^*Triodia basitricha*\^hummock grass\1\i

Veg. Condition Very Good

Disturbance Track clearing

Fire Age 2-5 years

Notes



Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia adoxa var. *adoxa*		.3	<1	
Acacia orthocarpa		1.8	10	
Acacia ptychophylla		.6	<1	
Acacia tumida var. *pilbarensis*		1.8	5	
Bonamia pilbarensis		.3	<1	

Corymbia hamersleyana		.3	<1
Dampiera candicans		.2	<1
Eriachne ciliata		.3	<1
Eriachne mucronata		.2	<1
Eriachne pulchella subsp. *dominii*		.1	<1
Fimbristylis simulans		.2	<1
Goodenia microptera		.2	<1
Goodenia stobbsiana		.3	<1
Grevillea wickhamii subsp. *hispidula*			<1
Heliotropium cunninghamii		.2	<1
Indigofera monophylla		.4	<1
Ptilotus calostachyus		.4	<1
Ptilotus fusiformis		.2	<1
Senna glutinosa subsp. *glutinosa*		1	<1
Senna notabilis		.3	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)		.5	<1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)		.2	<1
Solanum phlomoides		.5	<1
Trigastrotheca molluginea		.2	<1
Triodia basitricha	P 3	.3	10
Triodia wiseana		.4	15
Triumfetta maconochieana		.3	<1

NSX2007

Staff TCJ **Date** 10/08/2020 **Season** A

Revisit

Type Q 100 m x 25 m

Location North Star

MGA Zone 50 715761 **mE** 7645079 **mN** **Lat.** -21.2833 **Long.** 119.0797

Habitat Creek

Aspect N/A **Slope** N/A

Soil Type Brown sand

Rock Type Mixed alluvial

Loose Rock 20-50 % cover; 20-60 mm in size **Litter** 10 % cover ; 2 cm in depth

Bare ground 40 % cover **Weeds** 0 % cover

Vegetation U+ ^*Eucalyptus victrix*\^tree\6\r;M ^*Acacia pyrifolia* var. *pyrifolia*,^*Acacia acradenia*\^shrub\4\i;G ^^*Triodia longiceps*,*Triodia epactia*,*Cymbopogon ambiguus*\^hummock grass,tussock grass\2\c

Veg. Condition Excellent

Disturbance Tracks in area

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		2.4	8	
Acacia bivenosa		1.8	<1	
Acacia maitlandii		1.3	<1	
Acacia pyrifolia var. *pyrifolia*		2	10	
Acacia tumida var. *pilbarensis*		2	<1	

Amaranthus undulatus	,3	<1
Atalaya hemiglauca	2	<1
Boerhavia gardneri	.3	<1
Bulbostylis barbata	.2	<1
Cajanus cinereus	.5	<1
Cleome viscosa	.5	<1
Corchorus parviflorus	.5	<1
Cucumis variabilis	.5	<1
Cymbopogon ambiguus	.7	2
Cyperus hesperius	.4	<1
Eriachne tenuiculmis	.4	3
Eucalyptus victrix	8	3
Flueggea virosa subsp. *melanthesoides*	1.5	<1
Gossypium australe	1	<1
Grevillea wickhamii subsp. *hispidula*	,5	<1
Indigofera monophylla	.4	<1
Isotropis atropurpurea	.5	<1
Jasminum didymum subsp. *lineare*	.5	<1
Phyllanthus maderaspatensis	.3	<1
Senna glutinosa subsp. *glutinosa*	1	<1
Sida clementii	.4	<1
Tephrosia rosea var. *clementii*	1	<1
Triodia epactia	.6	10
Triodia longiceps	.6	25
Triodia wiseana	.6	2

NSX2008

Staff TCJ **Date** 10/08/2020 **Season** A

Revisit

Type Q 200 m x 12.5 m

Location North Star

MGA Zone 50 715257 **mE** 7643493 **mN** **Lat.** -21.2977 **Long.** 119.0750

Habitat Creek

Aspect E **Slope** Very Gentle

Soil Type Red brown loamy sand

Rock Type Mixed alluvial

Loose Rock 50-90 % cover; 60-200 mm in size **Litter** <1 % cover ; <1 cm in depth

Bare ground 70 % cover **Weeds** <1 % cover

Vegetation U+ ^*Corymbia hamersleyana*\^tree\6\r;M ^^*Petalostylis labicheoides*,*Acacia tumida* var. *pilbarensis*,*Acacia pyrifolia* var. *pyrifolia*\^shrub\3\r;G ^*Triodia wiseana*,^*Eriachne tenuiculmis*\^hummock grass,tussock grass\1\

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes No signs of recent fire but old dead Acacia stems.

Species	WA Cons.	Height (m)	Cover (%)	Count
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)		0.4	<1	
Acacia acradenia		1.5	1	
Acacia bivenosa		1.5	1	
Acacia pyrifolia var. *pyrifolia*		1.5	1	

Acacia tumida var. *pilbarensis*	2	3	
Amaranthus undulatus	0.3	<1	
Cajanus cinereus	0.5	<1	
Cassytha capillaris	0.5	<1	
**Cenchrus ciliaris*	0.7	<1	
Cleome viscosa	0.7	<1	
Corchorus parviflorus	1	<1	
Corymbia hamersleyana	5	2	
Cucumis variabilis	0.5	<1	
Cymbopogon ambiguus	1.1	1	
Dampiera candicans	0.4	<1	
Enneapogon lindleyanus	0.5	<1	
Eriachne tenuiculmis	0.4	3	
Eucalyptus leucophloia subsp. *leucophloia*	7	<1	
Flueggea virosa subsp. *melanthesoides*	.4	<1	
Goodenia stobbsiana	0.2	<1	
Gossypium robinsonii	2	<1	
Grevillea wickhamii subsp. *hispidula*	1.5	<1	
Hibiscus sturtii var. *campylochlamys*	0.4	<1	
Hybanthus aurantiacus	0.2	<1	
Isotropis atropurpurea	0.5	<1	
Jasminum didymum subsp. *lineare*	0.9	<1	
Petalostylis labicheoides	1.3	5	
Phyllanthus maderaspatensis	0.5	<1	
Pterocaulon sphacelatum	0.4	<1	
Ptilotus aervoides	0.2	<1	
Scaevola spinescens	0.6	<1	Cbh
Senna artemisioides subsp. *helmsii*	0.2	<1	
Solanum diversiflorum	0.2	<1	
Solanum phlomoides	0.4	<1	
Tephrosia rosea var. *clementii*	0.7	<1	
Trichodesma zeylanicum var. *zeylanicum*	0.7	<1	
Triodia angusta	0.3	<1	
Triodia longiceps	0.4	<1	
Triodia wiseana	0.4	8	

NSX2009

Staff TCJ **Date** 12/08/2020 **Season** A

Revisit

Type Q 100 m x 25 m

Location North Star

MGA Zone 50 714656 **mE** 7644267 **mN** **Lat.** -21.2907 **Long.** 119.0691

Habitat Creek

Aspect E **Slope** Very Gentle

Soil Type Creek sand and alluvial rocks

Rock Type Mixed alluvial

Loose Rock 20-50 % cover; 20-60 mm in size **Litter** 3 % cover ; 1 cm in depth

Bare ground 50 % cover **Weeds** 0 % cover

Vegetation U+ ^*Eucalyptus leucophloia* subsp. *leucophloia*\^tree\6\bi;M ^*Acacia tumida* var. *pilbarensis*, ^*Grevillea wickhamii* subsp. *hispidula*\^shrub\3\i;G ^*Triodia wiseana*,^*Eriachne mucronata*\^hummock grass,tussock grass\2\c

Veg. Condition Excellent

Disturbance Cattle in area

Fire Age >5 years

Notes Quadrat shaped to follow narrow drainage.

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		.6	1	
Acacia adoxa var. *adoxa*		.3	<1	
Acacia bivenosa		1.8	<1	
Acacia ptychophylla		.5	<1	

Acacia tumida var. *pilbarensis*		1.8	25
Acacia tumida var. *pilbarensis*		2	<1
Bonamia pilbarensis		.2	<1
Cajanus cinereus		1.2	<1
Cleome viscosa		.3	<1
Corchorus incanus		.4	1
Corchorus parviflorus		.4	<1
Corymbia hamersleyana		5	<1
Dampiera candicans		.3	<1
Eriachne mucronata		.5	5
Eriachne tenuiculmis		.3	<1
Eucalyptus leucophloia subsp. *leucophloia*		6	1
Grevillea wickhamii subsp. *hispidula*		1.6	2
Hibiscus leptocladus		.3	<1
Hybanthus aurantiacus		.1	<1
Indigofera monophylla		.4	<1
Senna glutinosa subsp. *glutinosa*		.8	<1
Senna symonii		1.5	<1
Solanum phlomoides		.3	<1
Tephrosia rosea var. *clementii*		.6	<1
Triodia basitricha	P 3	.5	<1
Triodia wiseana		.6	35

NSX2010

Staff TCJ **Date** 8/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 713507 **mE** 7646487 **mN** **Lat.** -21.2708 **Long.** 119.0578

Habitat Upper-Slope

Aspect NE **Slope** Steep

Soil Type Brown sandy loam

Rock Type Ironstone

Loose Rock >90 % cover; 20-60 mm in size **Litter** <1 % cover ; <1 cm in depth

Bare ground 65 % cover **Weeds** 0 % cover

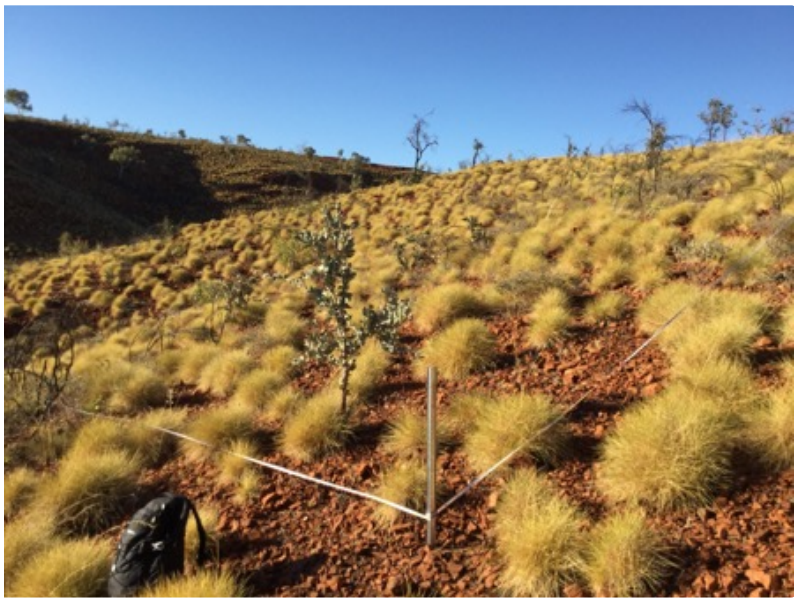
Vegetation M+ ^*Acacia inaequilatera*\^shrub\3\r;G ^*Triodia wiseana*,^*Indigofera monophylla*\^hummock grass, shrub\1\c

Veg. Condition Excellent

Disturbance Nil

Fire Age 2-5 years

Notes Drill tracks in area.



Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		0.9	<1	
Acacia adoxa var. *adoxa*		0.2	<1	
Acacia inaequilatera		1.3	4	
Bonamia pilbarensis		0.1	<1	
Corchorus parviflorus		0.4	<1	

Dampiera candicans	0.2	<1
Dodonaea coriacea	0.2	<1
Eriachne ciliata	0.1	<1
Eriachne pulchella subsp. *dominii*	0.1	<1
Fimbristylis simulans	0.1	<1
Goodenia microptera	0.2	<1
Goodenia stobbsiana	0.2	<1
Grevillea wickhamii subsp. *hispidula*	0.7	<1
Heliotropium ovalifolium	0.3	<1
Indigofera monophylla	0.3	5
Oldenlandia crouchiana	0.1	<1
Ptilotus calostachyus	0.6	<1
Senna symonii	0.9	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	0.6	<1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.3	<1
Solanum horridum	0.3	<1
Solanum phlomoides	0.4	<1
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	0.1	<1
Trichodesma zeylanicum var. *zeylanicum*	0.5	<1
Triodia wiseana	0.4	35
Triumfetta maconochieana	0.6	<1
Triumfetta maconochieana	0.3	<1

NSX2011

Staff TCJ **Date** 8/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 713437 **mE** 7646156 **mN** **Lat.** -21.2738 **Long.** 119.0571

Habitat Mid-Slope

Aspect N **Slope** Gentle

Soil Type Red brown sandy loam

Rock Type Ironstone

Loose Rock 50-90 % cover; 6-20 mm in size **Litter** 2 % cover ; 1 cm in depth

Bare ground 60 % cover **Weeds** 0 % cover

Vegetation U+ ^*Eucalyptus leucophloia* subsp. *leucophloia*\^tree\6\bi;M ^*Acacia tumida* var. *pilbarensis*, ^*Acacia inaequilatera*\^shrub\3\r;G ^*Triodia wiseana*,^*Indigofera monophylla*\^tussock grass, shrub\1\c

Veg. Condition Excellent

Disturbance Tracks in area

Fire Age 2-5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		1	<1	
Acacia adoxa var. *adoxa*		.4	<1	
Acacia inaequilatera		1.6	3	
Acacia tumida var. *pilbarensis*		1.8	5	

Cajanus cinereus	.6	<1
Cleome viscosa	.4	<1
Corchorus incanus	.5	<1
Cucumis variabilis	.3	<1
Cymbopogon ambiguus	.6	<1
Dampiera candicans	.3	<1
Dodonaea coriacea	.3	<1
Eucalyptus leucophloia subsp. *leucophloia*	5	1
Euphorbia boophthona	.3	<1
Euphorbia careyi	.4	<1
Fimbristylis simulans	.1	<1
Goodenia stobbsiana	.4	<1
Goodenia stobbsiana	.3	<1
Gossypium robinsonii	1.5	<1
Grevillea wickhamii subsp. *hispidula*	.8	<1
Hibiscus coatesii	.3	<1
Hibiscus sturtii var. *campylochlamys*	.3	<1
Indigofera monophylla	.5	5
Oldenlandia crouchiana	.3	<1
Ptilotus astrolasius	.2	<1
Ptilotus calostachyus	.5	<1
Ptilotus fusiformis	.3	<1
Senna glutinosa subsp. *glutinosa*	1	<1
Senna glutinosa subsp. *glutinosa*	1.2	<1
Senna notabilis	.4	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	.5	<1
Solanum horridum	.2	<1
Solanum phlomoides	.4	<1
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	.2	<1
Tephrosia virens	.4	<1
Trichodesma zeylanicum var. *zeylanicum*	.5	<1
Triodia wiseana	.5	30
Triumfetta maconochieana	.4	<1
Triumfetta propinqua	.4	<1

NSX2012

Staff TCJ **Date** 12/08/2020 **Season** A

Revisit

Type Q 100 m x 25 m

Location North Star

MGA Zone 50 713444 **mE** 7643420 **mN** **Lat.** -21.2985 **Long.** 119.0575

Habitat Upper-Slope

Aspect W **Slope** Gentle

Soil Type Brown sand

Rock Type Ironstone gorge

Loose Rock 20-50 % cover; 20-60 mm in size **Litter** 5 % cover ; 2 cm in depth

Bare ground 70 % cover **Weeds** 0 % cover

Vegetation U+ ^*Corymbia ferriticola*\^tree\6\r;M ^^*Acacia tumida* var. *pilbarensis*,*Acacia pruinocarpa*, *Eremophila latrobei* subsp. *glabra*\^shrub\4\i;G ^^*Triodia wiseana*,*Cymbopogon ambiguus*, *Eriachne mucronata*\^hummock grass,tussock grass\2\i

Veg. Condition Excellent

Disturbance Drill tracks in area

Fire Age >10 years

Notes Quadrat shaped to follow gorge feature.

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia aptaneura		4	<1	
Acacia pruinocarpa		4	5	
Acacia tumida var. *pilbarensis*		3	5	
Aristida burbidgeae		.2	<1	

Atalaya hemiglauca		3	<1
Bulbostylis barbata		.4	<1
Cajanus cinereus		1.2	<1
Cheilanthes brownii		.2	<1
Cleome viscosa		.3	<1
Corymbia ferriticola		5	2
Cucumis variabilis		.5	<1
Cymbopogon ambiguus		.7	3
Cyperus hesperius		.3	<1
Eremophila latrobei subsp. *glabra*		2	2
Eriachne mucronata		.5	2
Eucalyptus leucophloia subsp. *leucophloia*		1.5	<1
Euphorbia biconvexa		.3	<1
Ficus brachypoda		1	<1
Flueggea virosa subsp. *melanthesoides*		4	<1
Grevillea wickhamii subsp. *hispidula*		1.3	<1
Hibiscus goldsworthii		1	<1
Indigofera monophylla		.4	<1
Jasminum didymum subsp. *lineare*		.3	<1
Senna glutinosa subsp. *glutinosa*		1	<1
Senna notabilis		.3	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)		1.2	<1
Sida sp. L (A.M. Ashby 4202)		.2	<1
Solanum horridum		.1	<1
Tephrosia virens		.5	<1
Triodia basitricha	P 3	.2	<1
Triodia wiseana		.6	10
Triumfetta maconochieana		.3	<1

NSX2013

Staff TCJ **Date** 9/08/2020 **Season** A

Revisit

Type Q 100 m x 25 m

Location North Star

MGA Zone 50 713390 **mE** 7643892 **mN** **Lat.** -21.2943 **Long.** 119.0570

Habitat Gorge

Aspect W **Slope** Moderate

Soil Type Red brown sandy loam

Rock Type Ironstone

Loose Rock 50-90 % cover; 200 mm in size **Litter** 12 % cover ; <5 cm in depth

Bare ground 25 % cover **Weeds** 0 % cover

Vegetation U+ ^*Corymbia ferriticola*\^tree\6\i;M ^*Acacia tumida* var. *pilbarensis*\^shrub\4\r;G ^^*Eriachne mucronata*,*Cymbopogon ambiguus*\^tussock grass\1\i

Veg. Condition Excellent

Disturbance Nil

Fire Age 2-5 years

Notes No charting noted but patches of fire ephemeral.

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia orthocarpa		1.2	<1	
Acacia tumida var. *pilbarensis*		3	2	
Aristida burbidgeae		0.4	<1	
Bulbostylis barbata		0.1	<1	
Cajanus cinereus		0.5	<1	

Cleome viscosa		.5	<1
Corchorus parviflorus		1	<1
Corymbia ferriticola		7	12
Cymbopogon ambiguus		1.2	5
Cynanchum viminale subsp. *australe*		0.3	<1
Cyperus hesperius		0.2	<1
Dampiera candicans		0.5	<1
Ehretia saligna var. *saligna*		2	<1
Eremophila latrobei subsp. *glabra*		1.5	<1
Eriachne ciliata		0.2	<1
Eriachne mucronata		0.4	7
Euphorbia biconvexa		0.3	<1
Ficus brachypoda		4	<1
Goodenia stobbsiana		0.3	<1
Gossypium robinsonii		0.5	<1
Grevillea wickhamii subsp. *hispidula*		1	<1
Jasminum didymum subsp. *lineare*		0.2	<1
Pluchea dentex		0.3	<1
Pterocaulon sphacelatum		0.3	<1
Senna notabilis		0.3	<1
Senna venusta		1	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)		0.3	<1
Sida sp. L (A.M. Ashby 4202)		0.3	<1
Solanum horridum		0.1	<1
Solanum phlomoides		0.5	<1
Tephrosia rosea var. *clementii*		1.3	<1
Tephrosia virens		0.6	<1
Terminalia circumalata		4	<1
Trachymene oleracea subsp. *oleracea*		0.6	<1
Trichodesma zeylanicum var. *zeylanicum*		1.5	<1
Triodia basitricha	P 3	1	3
Triumfetta maconochieana		0.4	<1
Triumfetta propinqua		0.5	<1

NSX2014

Staff TCJ **Date** 9/08/2020 **Season** A

Revisit

Type Q 100 m x 25 m

Location North Star

MGA Zone 50 713275 **mE** 7644155 **mN** **Lat.** -21.2919 **Long.** 119.0558

Habitat Upper-Slope

Aspect W **Slope** Steep

Soil Type Red brown loam

Rock Type Ironstone

Loose Rock 20-50 % cover; 20-60 mm in size **Litter** 5 % cover ; 2 cm in depth

Bare ground 40 % cover **Weeds** 0 % cover

Vegetation U+ ^*Corymbia ferriticola*\^tree\6\r;M ^^*Acacia tumida* var. *pilbarensis*,*Acacia pruinocarpa*,*Acacia bivenosa*\^shrub\4\i;G ^^*Cymbopogon ambiguus*,*Triodia wiseana*,*Abutilon lepidum*\^tussock grass,hummock grass,shrub\2\c

Veg. Condition Excellent

Disturbance Track clearing in area

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Abutilon lepidum		.6	10	
Acacia bivenosa		3	2	
Acacia pruinocarpa		4	2	
Acacia tumida var. *pilbarensis*		3	20	

Amaranthus undulatus	.3	<1
Cajanus cinereus	2	<1
Cheilanthes brownii	.2	<1
Cleome viscosa	.6	<1
Clerodendrum floribundum var. *angustifolium*	3	<1
Corymbia ferriticola	6	2
Cucumis variabilis	.4	<1
Cymbopogon ambiguus	.7	25
Cyperus hesperius	.2	<1
Ehretia saligna var. *saligna*	3	1
Eriachne mucronata	.3	<1
Eucalyptus leucophloia subsp. *leucophloia*	5	<1
Euphorbia biconvexa	.3	<1
Ficus brachypoda	.2	<1
Flueggea virosa subsp. *melanthesoides*	3	<1
Hibiscus goldsworthii	.6	<1
Hybanthus aurantiacus	.2	<1
Indigofera monophylla	.3	<1
Jasminum didymum subsp. *lineare*	.3	<1
Peripleura virgata	.1	<1
Pluchea dentex	.3	<1
Pluchea dentex	.2	<1
Polycarpaea longiflora	.1	<1
Pterocaulon sphacelatum	.4	<1
Ptilotus astrolasius	.3	<1
Rhynchosia minima	.4	<1
Santalum lanceolatum	2	<1
Senna glutinosa subsp. *glutinosa*	1	<1
Senna venusta	.4	<1
Sida sp. L (A.M. Ashby 4202)	.3	<1
Solanum diversiflorum	.3	<1
Solanum horridum	.4	<1
Solanum phlomoides	.1	<1
Tephrosia virens	.6	<1
Tinospora smilacina	.3	<1
Trachymene oleracea subsp. *oleracea*	.3	<1
Tribulus suberosus	1	<1
Triodia wiseana	.6	10

Triumfetta propinqua	1.2	<1

NSX2015

Staff TCJ **Date** 8/08/2020 **Season** A

Revisit

Type Q 100 m x 25 m

Location North Star

MGA Zone 50 713472 **mE** 7644649 **mN** **Lat.** -21.2874 **Long.** 119.0577

Habitat Creek

Aspect NW **Slope** Gentle

Soil Type Red brown clay loam

Rock Type Ironstone

Loose Rock 50-90 % cover; 60-200 mm in size **Litter** 8 % cover ; <10 cm in depth

Bare ground 10 % cover **Weeds** 0 % cover

Vegetation M+ ^*Acacia tumida* var. *pilbarensis*,^*Gossypium robinsonii*\^shrub\4\i;G ^*Cymbopogon ambiguus*, ^*Triodia epactia*\^tussock grass,hummock grass\2\c

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Abutilon lepidum		1.5	<1	
Acacia orthocarpa		1.6	<1	
Acacia pyrifolia var. *pyrifolia*		2.5	<1	
Acacia tumida var. *pilbarensis*		4.2	16	
Atalaya hemiglauca		2.2	<1	

Bulbostylis barbata	0.1	<1
Cajanus cinereus	1.5	<1
Cleome viscosa	0.5	<1
Corymbia ferriticola	1	<1
Cucumis variabilis	0.5	<1
Cymbopogon ambiguus	1.2	18
Cyperus hesperius	0.5	<1
Dampiera candicans	0.4	<1
Ehretia saligna var. *saligna*	1.6	<1
Eriachne ciliata	0.2	<1
Eriachne mucronata	0.5	1
Euphorbia biconvexa	0.3	<1
Euphorbia boophthona	0.4	<1
Gossypium robinsonii	2.6	4
Grevillea wickhamii subsp. *hispidula*	1.8	<1
Hybanthus aurantiacus	0.3	<1
Indigofera monophylla	0.5	<1
Jasminum didymum subsp. *lineare*	0.4	<1
Pluchea dentex	0.6	<1
Pluchea rubelliflora	0.6	<1
Polycarpaea holtzei	0.1	<1
Pterocaulon sphacelatum	0.4	<1
Senna glutinosa subsp. *glutinosa*	1.8	<1
Senna notabilis	0.4	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	0.7	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	2	<1
Sida sp. L (A.M. Ashby 4202)	0.4	<1
Solanum phlomoides	0.5	<1
Stemodia grossa	0.5	<1
Tephrosia virens	0.6	<1
Themeda triandra	0.5	<1
Tribulus suberosus	0.8	<1
Triodia epactia	0.5	12
Triumfetta maconochieana	0.6	<1

NSX2016

Staff TCJ **Date** 14/08/2020 **Season** A

Revisit

Type Q 100 m x 25 m

Location North Star

MGA Zone 50 714492 **mE** 7644586 **mN** **Lat.** -21.2879 **Long.** 119.0675

Habitat Upper-Slope

Aspect W **Slope** Steep

Soil Type Red brown sandy loam

Rock Type Weathered granite, quartzite

Loose Rock 10-20 % cover; 200 mm in size **Litter** 1 % cover ; 3 cm in depth

Bare ground 50 % cover **Weeds** 0 % cover

Vegetation U+ ^*Eucalyptus leucophloia* subsp. *leucophloia*\^tree\6\bi;M ^*Acacia tumida* var. *pilbarensis*\^shrub\3\i;G ^^*Triodia brizoides*,*Triodia wiseana*,*Eriachne mucronata*\^hummock grass,tussock grass\2\c

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes Large hummocks but young Acacia tumida age class. Steep, precipitous area on ridge line, quadrat shaped.

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		0.6	<1	
Acacia inaequilatera		1	<1	
Acacia pruinocarpa		1.5	<1	

Acacia tumida var. *pilbarensis*	1.7	32
Cleome viscosa	0.3	<1
Cymbopogon ambiguus	0.4	<1
Eriachne ciliata	0.1	<1
Eriachne mucronata	0.4	1
Eucalyptus leucophloia subsp. *leucophloia*	3	1.5
Gomphrena cunninghamii	0.1	<1
Goodenia stobbsiana	0.3	<1
Gossypium australe	1.2	<1
Grevillea wickhamii subsp. *hispidula*	1.6	<1
Hakea lorea subsp. *lorea*	0.5	<1
Ptilotus astrolasius	0.3	<1
Ptilotus calostachyus	0.5	<1
Senna glutinosa subsp. *glutinosa*	1.5	<1
Sida sp. L (A.M. Ashby 4202)	0.2	<1
Solanum horridum	0.3	<1
Solanum phlomoides	0.6	<1
Triodia brizoides	0.5	25
Triodia wiseana	0.5	10
Triumfetta propinqua	0.9	<1

NSX2017

Staff TCJ **Date** 8/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 714068 **mE** 7644650 **mN** **Lat.** -21.2874 **Long.** 119.0634

Habitat Crest

Aspect W **Slope** Gentle

Soil Type Red brown clay loam

Rock Type Ironstone

Loose Rock >90 % cover; 20-60 mm in size **Litter** 1 % cover ; <2 cm in depth

Bare ground 20 % cover **Weeds** 0 % cover

Vegetation U+ ^*Eucalyptus leucophloia* subsp. *leucophloia*,^*Corymbia hamersleyana*\^tree\6\bi;M ^*Grevillea wickhamii* subsp. *hispidula*\^shrub\3\bi;G ^^*Triodia wiseana*,*Acacia ptychophylla*,*Triodia basitricha*\^hummock grass,shrub\1\d

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes Track to west.

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia adoxa var. *adoxa*		0.3	1	
Acacia inaequilatera		1.7	<1	
Acacia ptychophylla		0.6	12	
Cassytha capillaris		0.5	<1	

Corymbia hamersleyana		3	1
Dampiera candicans		0.3	<1
Eriachne ciliata		0.2	<1
Eriachne mucronata		0.3	<1
Eucalyptus leucophloia subsp. *leucophloia*		3.5	1
Fimbristylis simulans		0.1	<1
Goodenia stobbsiana		0.3	<1
Grevillea wickhamii subsp. *hispidula*		2	1
Hakea lorea subsp. *lorea*		1.9	<1
Ptilotus calostachyus		0.7	<1
Solanum phlomoides		0.3	<1
Trigastrotheca molluginea		0.2	<1
Triodia basitricha	P 3	0.4	8
Triodia wiseana		0.4	65

NSX2018

Staff TCJ **Date** 9/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 712972 **mE** 7645105 **mN** **Lat.** -21.2834 **Long.** 119.0528

Habitat Upper-Slope

Aspect NE **Slope** Steep

Soil Type Red brown clay loam

Rock Type Ironstone, chert

Loose Rock >90 % cover; 60-200 mm in size **Litter** 1 % cover ; <1 cm in depth

Bare ground 60 % cover **Weeds** 0 % cover

Vegetation U+ ^*Eucalyptus leucophloia* subsp. *leucophloia*,^*Corymbia hamersleyana*\^tree\6\r;M ^*Acacia inaequilatera*\^shrub\3\bi;G ^*Triodia wiseana*\^hummock grass\1\i

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes Very small patch burnt within 2 years, rest of quadrat no evidence.

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		1.5	<1	
Acacia inaequilatera		1.5	<1	
Cleome viscosa		0.5	<1	
Corchorus parviflorus		0.2	<1	
Corymbia hamersleyana		3	<1	

Eucalyptus leucophloia subsp. *leucophloia*	6	4
Euphorbia biconvexa	0.2	<1
Goodenia microptera	0.3	<1
Hibiscus leptocladus	0.5	<1
Hybanthus aurantiacus	0.1	<1
Indigofera monophylla	0.6	<1
Oldenlandia crouchiana	0.1	<1
Ptilotus astrolasius	0.3	<1
Ptilotus calostachyus	0.7	<1
Senna notabilis	0.2	<1
Solanum horridum	0.2	<1
Solanum phlomoides	0.1	<1
Tribulus suberosus	0.1	<1
Triodia brizoides	0.3	<1
Triodia wiseana	0.3	30

NSX2019

Staff TCJ **Date** 13/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 714722 **mE** 7646894 **mN** **Lat.** -21.2670 **Long.** 119.0694

Habitat Crest

Aspect S **Slope** Cliffed

Soil Type Brown sandy loam

Rock Type Granite and quartz

Loose Rock 20-50 % cover; 20-60 mm in size **Litter** 3 % cover ; 1 cm in depth

Bare ground 70 % cover **Weeds** 0 % cover

Vegetation U+ ^*Corymbia ferriticola*,^*Ficus brachypoda*\^tree\6\r;M ^*Acacia tumida* var. *pilbarensis*\^shrub\3\r; G ^^*Triodia wiseana*,*Cymbopogon ambiguus*,*Eriachne mucronata*\^hummock grass,tussock grass\1\i

Veg. Condition Excellent

Disturbance Cattle in area

Fire Age 2-5 years

Notes Quadrat not marked due to heritage area. Quadrat shaped to fit in cliff sections where safe to access.

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia adoxa var. *adoxa*		.3	<1	
Acacia inaequilatera		2	<1	
Acacia pruinocarpa		1.6	<1	

Acacia tumida var. *pilbarensis*		1.8	8
Amaranthus undulatus		.4	<1
Bulbostylis barbata		.3	<1
Cajanus cinereus		.8	<1
Cheilanthes brownii		.2	<1
Cleome viscosa		.1	<1
Corchorus incanus		.7	<1
Corymbia ferriticola		5	2
Corymbia hamersleyana		2	<1
Cymbopogon ambiguus		.5	5
Cyperus hesperius		.2	<1
Eriachne ciliata		.1	<1
Eriachne mucronata		.3	2
Euphorbia biconvexa		.2	<1
Ficus brachypoda		5	1
Goodenia cusackiana		.1	<1
Grevillea wickhamii subsp. *hispidula*		.4	<1
Hibiscus goldsworthii		.8	<1
Nicotiana benthamiana		.3	<1
Oldenlandia crouchiana		.3	<1
Polymeria ambigua		.1	<1
Pomax rupestris		,1	<1
Ptilotus astrolasius		.4	<1
Ptilotus calostachyus		.4	<1
Senna glutinosa subsp. *glutinosa*		1.4	<1
Senna venusta		.4	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)		.9	<1
Sida sp. L (A.M. Ashby 4202)		.4	<1
Solanum cleistogamum		.3	<1
Solanum horridum		.3	<1
Solanum phlomoides		.7	<1
Streptoglossa decurrens		.5	<1
Triodia basitricha	P 3	.2	<1
Triodia wiseana		.5	15
Triumfetta maconochieana		.4	<1
Triumfetta propinqua		.6	1

NSX2020

Staff TCJ **Date** 10/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 716142 **mE** 7646193 **mN** **Lat.** -21.2732 **Long.** 119.0832

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Red brown sandy loam

Rock Type Ironstone

Loose Rock 20-50 % cover; 6-20 mm in size **Litter** <1 % cover ; 1 cm in depth

Bare ground 60 % cover **Weeds** 0 % cover

Vegetation U+ ^*Eucalyptus leucophloia* subsp. *leucophloia*\^tree\6\bi;M ^*Acacia bivenosa*,^*Acacia inaequilatera*\^shrub\4\r;G ^*Triodia wiseana*\^hummock grass\2\c

Veg. Condition Excellent

Disturbance Tracks in area

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia bivenosa		2.2	2	
Acacia inaequilatera		3	1	
Acacia trachycarpa		1	<1	
Acacia tumida var. *pilbarensis*		2	<1	
Bonamia pilbarensis		.1	<1	

Cassytha capillaris	.3	<1
Corchorus parviflorus	.7	<1
Corchorus parviflorus	.4	<1
Eriachne pulchella subsp. *dominii*	.1	<1
Eucalyptus leucophloia subsp. *leucophloia*	6	1
Goodenia cusackiana	.4	<1
Goodenia microptera	.4	<1
Goodenia stobbsiana	.3	<1
Grevillea wickhamii subsp. *hispidula*	.7	<1
Hakea lorea subsp. *lorea*	.5	<1
Indigofera monophylla	.4	<1
Jasminum didymum subsp. *lineare*	.5	<1
Portulaca oleracea	.1	<1
Ptilotus astrolasius	.5	<1
Ptilotus calostachyus	.4	<1
Scaevola amblyanthera var. *centralis*	.3	<1
Senna glutinosa subsp. *glutinosa*	.9	<1
Senna symonii	1.3	<1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	.4	<1
Tephrosia rosea var. *clementii*	.6	<1
Tephrosia supina	.1	<1
Trigastrotheca molluginea	.2	<1
Triodia wiseana	.7	40

NSX2021

Staff TCJ **Date** 11/08/2020 **Season** A

Revisit

Type Q 100 m x 25 m

Location North Star

MGA Zone 50 711094 **mE** 7644372 **mN** **Lat.** -21.2902 **Long.** 119.0348

Habitat Ridgeline

Aspect W **Slope** Steep

Soil Type Brown sandy loam

Rock Type Granite

Loose Rock 50-90 % cover; 20-60 mm in size **Litter** 1 % cover ; <2 cm in depth

Bare ground 50 % cover **Weeds** 0 % cover

Vegetation M+ ^*Acacia inaequilatera*\^shrub\3\bi;G ^*Triodia wiseana*\^hummock grass\1\c

Veg. Condition Excellent

Disturbance Nil

Fire Age 2-5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia bivenosa		0.5	<1	
Acacia inaequilatera		1.2	1	
Acacia pruinocarpa		1	<1	
Acacia spondylophylla		0.3	<1	
Aristida contorta		0.1	<1	

Bonamia pilbarensis	0.1	<1
Bulbostylis barbata	0.2	<1
Cleome viscosa	0.15	<1
Corchorus parviflorus	0.5	<1
Corymbia ferriticola	2	<1
Cymbopogon ambiguus	0.4	<1
Cyperus hesperius	0.3	<1
Eriachne ciliata	0.1	<1
Eriachne mucronata	0.4	<1
Eriachne pulchella subsp. *dominii*	0.1	<1
Eucalyptus leucophloia subsp. *leucophloia*	5.5	<1
Ficus brachypoda	1	<1
Gomphrena cunninghamii	0.1	<1
Gossypium australe	1	<1
Indigofera monophylla	0.3	<1
Oldenlandia crouchiana	0.1	<1
Polycarpaea holtzei	0.1	<1
Polycarpaea longiflora	0.3	<1
Ptilotus calostachyus	0.5	<1
Ptilotus fusiformis	0.2	<1
Senna glutinosa subsp. *glutinosa*	0.7	<1
Senna symonii	0.4	<1
Senna venusta	0.9	<1
Solanum horridum	0.1	<1
Solanum phlomoides	0.3	<1
Tephrosia virens	0.7	<1
Tribulus suberosus	1	<1
Triodia wiseana	0.4	35
Triumfetta maconochieana	0.6	<1
Triumfetta propinqua	0.7	<1

NSX2022

Staff TCJ **Date** 11/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 711097 **mE** 7644008 **mN** **Lat.** -21.2935 **Long.** 119.0349

Habitat Upper-Slope

Aspect E **Slope** Steep

Soil Type Brown sandy clay loam

Rock Type Granite

Loose Rock 50-90 % cover; 60-200 mm in size **Litter** 2 % cover ; 2 cm in depth

Bare ground 30 % cover **Weeds** 0 % cover

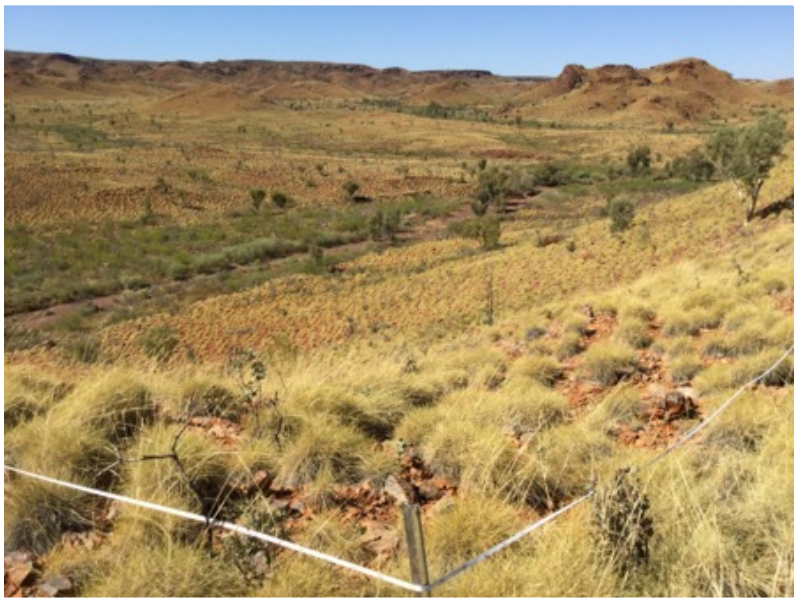
Vegetation U+ ^*Eucalyptus leucophloia* subsp. *leucophloia*\^tree\6\bi;M ^*Acacia inaequilatera*\^shrub\3\r;G ^*Triodia wiseana*\^hummock grass\1\c

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes



Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia bivenosa		1	<1	
Acacia inaequilatera		1.6	2	
Acacia tumida var. *pilbarensis*		1.5	<1	
Bonamia pilbarensis		0.1	<1	
Bulbostylis barbata		0.1	<1	

Cleome viscosa	0.2	<1
Corchorus parviflorus	0.6	<1
Eriachne ciliata	0.1	<1
Eriachne mucronata	0.3	<1
Eucalyptus leucophloia subsp. *leucophloia*	6	1.5
Fimbristylis simulans	0.1	<1
Gomphrena cunninghamii	0.1	<1
Goodenia microptera	0.2	<1
Goodenia stobbsiana	0.5	<1
Grevillea wickhamii subsp. *hispidula*	1	<1
Hakea lorea subsp. *lorea*	1.5	<1
Hibiscus coatesii	0.4	<1
Hybanthus aurantiacus	0.1	<1
Indigofera monophylla	0.5	<1
Oldenlandia crouchiana	0.1	<1
Petalostylis labicheoides	1.5	<1
Polycarpaea holtzei	0.1	<1
Ptilotus astrolasius	0.5	<1
Ptilotus calostachyus	0.5	<1
Scaevola spinescens	0.5	<1
Senna glutinosa subsp. *glutinosa*	1.5	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	1	<1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.5	<1
Streptoglossa decurrens	0.1	<1
Tribulus suberosus	0.3	<1
Trigastrotheca molluginea	0.1	<1
Triodia wiseana	0.5	60

NSX2023

Staff TCJ **Date** 11/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 711172 **mE** 7644950 **mN** **Lat.** -21.2850 **Long.** 119.0355

Habitat Lower-Slope

Aspect S **Slope** Gentle

Soil Type Red brown sandy loam

Rock Type Ironstone

Loose Rock 20-50 % cover; 20-60 mm in size **Litter** <1 % cover ; 1 cm in depth

Bare ground 60 % cover **Weeds** 0 % cover

Vegetation M+ ^*Acacia inaequilatera*\^shrub\4\bi;G ^*Triodia wiseana*,^*Acacia spondylophylla*\^hummock grass,shrub\2\c

Veg. Condition Excellent

Disturbance Cattle, tracks in area

Fire Age 2-5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia inaequilatera		2.2	1.5	
Acacia spondylophylla		.6	5	
Bonamia pilbarensis		.2	<1	
Corchorus parviflorus		.2	<1	
Eriachne pulchella subsp. *dominii*		.1	<1	

Euphorbia boophthona	.5	<1
Fimbristylis simulans	.1	<1
Goodenia stobbsiana	.5	<1
Grevillea wickhamii subsp. *hispidula*	1.5	<1
Hakea lorea subsp. *lorea*	1.2	<1
Indigofera monophylla	.5	<1
Polycarpaea holtzei	.1	<1
Ptilotus astrolasius	.3	<1
Swainsona formosa	.2	<1
Triodia wiseana	.6	40

NSX2024

Staff TCJ **Date** 9/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 712538 **mE** 7644899 **mN** **Lat.** -21.2853 **Long.** 119.0486

Habitat Crest

Aspect N/A **Slope** N/A

Soil Type Red brown sandy clay loam

Rock Type Ironstone

Loose Rock >90 % cover; 20-60 mm in size **Litter** 3 % cover ; 2 cm in depth

Bare ground 60 % cover **Weeds** 0 % cover

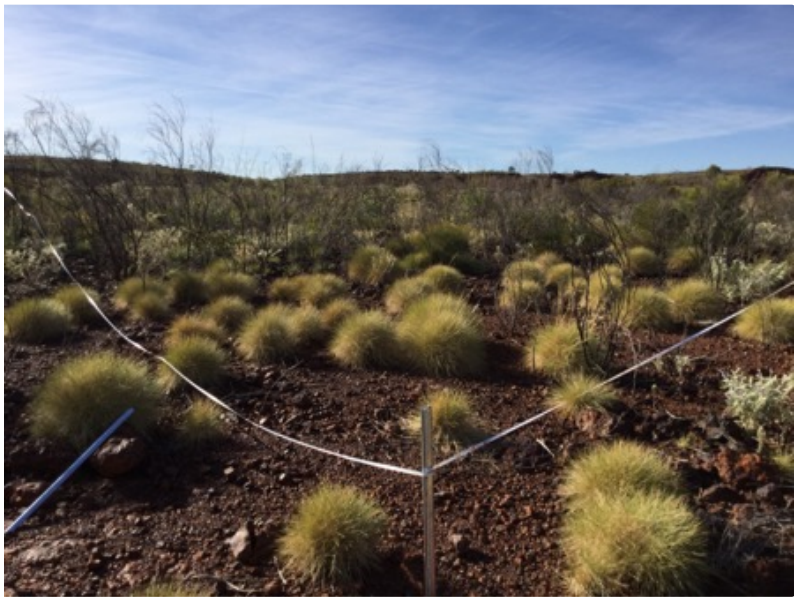
Vegetation M+ ^,^*Acacia orthocarpa*\^,shrub\3\;G ^*Triodia wiseana*,^*Triodia basitricha*\^hummock grass\1\i

Veg. Condition Excellent

Disturbance Nil

Fire Age 1-2 years

Notes Small Triodia and fire opportunists prominent, could be <1yr.



Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia orthocarpa		1.7	12	
Acacia pyrifolia var. *pyrifolia*		1.1	<1	
Acacia tumida var. *pilbarensis*		2	4	
Bonamia pilbarensis		0.1	<1	
Corchorus incanus		0.3	<1	

Corchorus parviflorus		0.5	<1
Dodonaea coriacea		0.6	<1
Eremophila latrobei subsp. *glabra*		1.5	<1
Eucalyptus leucophloia subsp. *leucophloia*		2	<1
Goodenia microptera		0.3	<1
Goodenia stobbsiana		0.4	1
Grevillea wickhamii subsp. *hispidula*		1	<1
Ptilotus astrolasius		0.3	<1
Ptilotus calostachyus		0.3	<1
Senna glutinosa subsp. *glutinosa*		1.2	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)		1.5	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)		0.3	<1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)		0.4	1
Solanum diversiflorum		0.3	<1
Solanum horridum		0.4	<1
Solanum phlomoides		0.3	1
Streptoglossa decurrens		0.7	<1
Triodia basitricha	P 3	0.4	3
Triodia wiseana		0.5	16

NSX2025

Staff TCJ **Date** 9/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 712485 **mE** 7644985 **mN** **Lat.** -21.2845 **Long.** 119.0481

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Red brown sandy clay

Rock Type Ironstone

Loose Rock >90 % cover; 20-60 mm in size **Litter** 4 % cover ; <2 cm in depth

Bare ground 25 % cover **Weeds** 0 % cover

Vegetation M+ ^*Acacia orthocarpa*\^shrub\3\i;G ^*Triodia wiseana*,^*Triodia basitricha*\^hummock grass\1\i

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes Most of quadrat long unburnt but corner recently burnt.

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia orthocarpa		1.7	12	
Acacia tumida var. *pilbarensis*		0.2	<1	
Corchorus incanus		0.6	1	
Corchorus parviflorus		0.6	<1	
Eriachne pulchella subsp. *dominii*		0.1	<1	

Goodenia stobbsiana		0.3	<1
Grevillea wickhamii subsp. *hispidula*		2	<1
Indigofera monophylla		0.6	<1
Ptilotus astrolasius		0.5	<1
Ptilotus calostachyus		0.5	<1
Ptilotus fusiformis		0.5	<1
Senna glutinosa subsp. *glutinosa*		1.5	<1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)		0.4	<1
Solanum diversiflorum		0.7	<1
Solanum horridum		0.2	<1
Solanum phlomoides		0.4	3
Trigastrotheca molluginea		0.1	<1
Triodia basitricha	P 3	0.3	2
Triodia wiseana		0.4	13

NSX2026

Staff TCJ **Date** 10/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 715344 **mE** 7643589 **mN** **Lat.** -21.2968 **Long.** 119.0758

Habitat Undulating plain

Aspect NW **Slope** Gentle

Soil Type Brown sandy loam

Rock Type Quartz, calcrete and ironstone

Loose Rock >90 % cover; 2-6 mm in size **Litter** 1 % cover ; <1 cm in depth

Bare ground 35 % cover **Weeds** 0 % cover

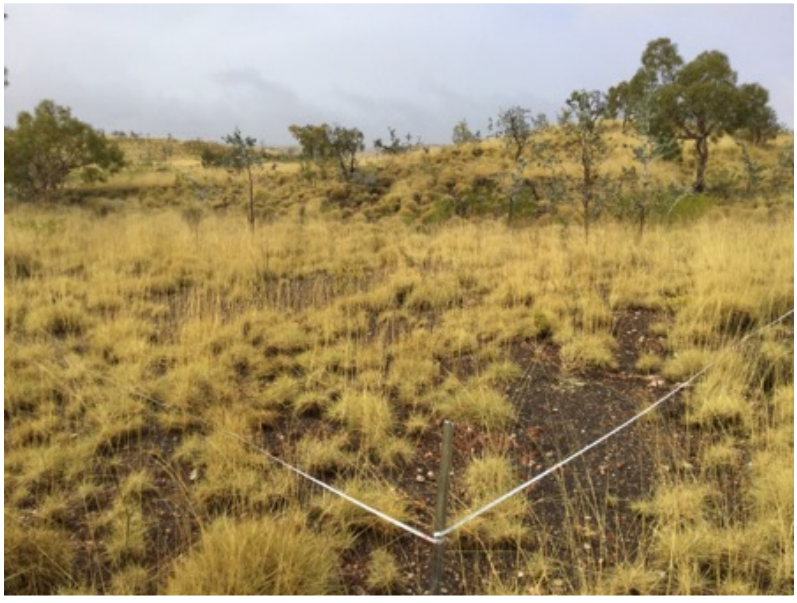
Vegetation U+ ^*Corymbia hamersleyana*\^tree\6\r;M ^*Acacia inaequilatera*\^shrub\4\r;G ^*Triodia angusta*, ^*Triodia wiseana*\^hummock grass\1\c

Veg. Condition Excellent

Disturbance Nil

Fire Age <5 years

Notes



Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		1.5	<1	
Acacia bivenosa		1.2	1	
Acacia inaequilatera		2.2	3	
Acacia tumida var. *pilbarensis*		1.8	<1	
Boerhavia gardneri		0.2	<1	

Bonamia erecta	0.2	<1
Bonamia pilbarensis	0.2	<1
Cassytha capillaris	0.4	<1
Cleome viscosa	0.5	<1
Corchorus parviflorus	0.5	<1
Corymbia hamersleyana	6	2
Euphorbia tannensis subsp. *eremophila*	1	<1
Goodenia stobbsiana	0.3	<1
Grevillea wickhamii subsp. *hispidula*	1.5	<1
Hakea lorea subsp. *lorea*	2	<1
Heliotropium cunninghamii	0.2	<1
Indigofera monophylla	0.7	<1
Isotropis atropurpurea	0.6	<1
Ptilotus astrolasius	0.4	<1
Ptilotus calostachyus	0.5	<1
Solanum phlomoides	0.3	<1
Solanum phlomoides	0.4	<1
Tephrosia rosea var. *clementii*	0.7	<1
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	0.1	<1
Trigastrotheca molluginea	0.1	<1
Triodia angusta	0.4	35
Triodia wiseana	0.5	30

NSX2027

Staff TCJ **Date** 11/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 711159 **mE** 7644137 **mN** **Lat.** -21.2923 **Long.** 119.0354

Habitat Floodplain

Aspect N/A **Slope** N/A

Soil Type Brown loamy sand

Rock Type Mixed alluvial

Loose Rock 20-50 % cover; 20-60 mm in size **Litter** 10 % cover ; 3 cm in depth

Bare ground 35 % cover **Weeds** <1 % cover

Vegetation U+ ^*Eucalyptus victrix*\^tree\6\bi;M ^^*Petalostylis labicheoides*,*Acacia pyrifolia* var. *pyrifolia*, *Acacia tumida* var. *pilbarensis*\^shrub\4\c;G ^*Triodia wiseana*\^hummock grass\1\i

Veg. Condition Very Good

Disturbance Some evidence of cattle

Fire Age 2-5 years

Notes Small number of Kapok plants (<5) near SE corner and centre.

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia maitlandii		0.3	<1	
Acacia pyrifolia var. *pyrifolia*		1.7	15	
Acacia spondylophylla		0.4	<1	
Acacia tumida var. *pilbarensis*		3.2	6	
Adriana tomentosa var. *tomentosa*		1.5	<1	

Amaranthus undulatus	0.4	<1
Aristida holathera	0.4	<1
Atalaya hemiglauca	2	<1
Boerhavia gardneri	0.3	<1
Bulbostylis barbata	0.1	<1
Cajanus cinereus	0.5	<1
Cleome viscosa	0.7	1
Corchorus parviflorus	0.4	2
Corchorus parviflorus	1.3	<1
Corchorus sp.	0.4	<1
Cucumis variabilis	0.3	<1
Cullen leucanthum	1.5	<1
Cymbopogon ambiguus	1	<1
Enneapogon lindleyanus	0.4	<1
Eragrostis cumingii	0.2	<1
Eriachne tenuiculmis	0.4	<1
Eucalyptus victrix	5	2
Euphorbia australis var. *subtomentosa*	0.3	<1
Euphorbia biconvexa	0.2	<1
Euphorbia boophthona	1	<1
Euphorbia careyi	0.2	<1
Evolvulus alsinoides var. *villosicalyx*	0.1	<1
Goodenia muelleriana	0.3	<1
Goodenia stobbsiana	0.3	<1
Gossypium robinsonii	1	<1
Grevillea wickhamii subsp. *hispidula*	1	<1
Hybanthus aurantiacus	0.4	<1
Indigofera monophylla	0.5	1
Indigofera rugosa	0.2	<1
Indigofera trita subsp. *trita*	0.5	<1
Isotropis atropurpurea	0.7	<1
Petalostylis labicheoides	2	22
Phyllanthus maderaspatensis	0.2	<1
Polymeria ambigua	0.1	<1
Pterocaulon sphacelatum	0.4	<1
Ptilotus aervoides	0.1	<1
Ptilotus calostachyus	0.5	<1
Ptilotus incanus	0.5	<1

Santalum lanceolatum	1.3	<1
Scaevola amblyanthera var. *centralis*	0.3	<1
Scaevola spinescens	1	<1
Senna artemisioides subsp. *oligophylla*	1	<1
Sida clementii	1.2	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	0.6	<1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.4	<1
Solanum diversiflorum	0.6	1
Sporobolus australasicus	0.1	<1
Stemodia grossa	0.4	<1
Streptoglossa decurrens	0.4	<1
Swainsona formosa	0.2	<1
Tephrosia rosea var. *clementii*	1	<1
Trichodesma zeylanicum var. *zeylanicum*	0.8	<1
Trigastrotheca molluginea	0.1	<1
Triodia longiceps	0.5	<1
Triodia wiseana	0.5	10
Triumfetta propinqua	0.6	<1

NSX2028

Staff TCJ **Date** 12/08/2020 **Season** A

Revisit

Type Q 100 m x 25 m

Location North Star

MGA Zone 50 712428 **mE** 7643336 **mN** **Lat.** -21.2994 **Long.** 119.0478

Habitat Creek

Aspect E **Slope** Very Gentle

Soil Type Red brown loamy sand

Rock Type Granite, ?marble, mixed alluvial

Loose Rock 20-50 % cover; 20-60 mm in size **Litter** 7 % cover ; <10 cm in depth

Bare ground 16 % cover **Weeds** 0 % cover

Vegetation U+ ^*Eucalyptus victrix*\^tree\6\r;M ^*Melaleuca glomerata*\^shrub\4\r;G ^^*Stemodia grossa*,*Triodia wiseana*,*Cyperus vaginatus*\^shrub,hummock grass,sedge\2\c

Veg. Condition Excellent

Disturbance Nil

Fire Age <5 years

Notes Majority of quadrat unburnt but some evidence of charred trunks and some post fire species.

Species	WA Cons.	Height (m)	Cover (%)	Count
Abutilon lepidum		1.5	<1	
Acacia acradenia		0.6	<1	
Acacia bivenosa		1	<1	
Acacia pyrifolia var. *pyrifolia*		1.2	1	
Acacia tumida var. *pilbarensis*		3.5	1	

Ammannia baccifera	0.4	<1
Aristida burbidgeae	0.5	<1
Atalaya hemiglauca	1.5	<1
Cajanus cinereus	0.7	<1
Cassytha capillaris	0.6	<1
Cleome viscosa	0.4	<1
Corchorus parviflorus	0.5	<1
Cucumis variabilis	0.5	<1
Cyperus vaginatus	1	5
Enneapogon lindleyanus	0.5	<1
Eucalyptus victrix	8	2
Euphorbia tannensis subsp. *eremophila*	1	<1
Flueggea virosa subsp. *melanthesoides*	2	<1
Gossypium robinsonii	1	<1
Hybanthus aurantiacus	0.2	<1
Indigofera monophylla	0.5	<1
Jasminum didymum subsp. *lineare*	0.6	<1
Melaleuca glomerata	5	8
Oldenlandia crouchiana	0.1	<1
Petalostylis labicheoides	1	<1
Phyllanthus maderaspatensis	0.4	<1
Pluchea rubelliflora	0.4	<1
Pterocaulon sphacelatum	0.3	<1
Ptilotus astrolasius	0.5	<1
Rhynchosia minima	0.3	<1
Senna notabilis	0.3	<1
Solanum diversiflorum	0.3	<1
Solanum horridum	0.15	<1
Stemodia grossa	0.6	22
Tephrosia rosea var. *clementii*	0.5	<1
Terminalia circumalata	4	<1
Trichodesma zeylanicum var. *zeylanicum*	0.5	<1
Triodia longiceps	0.7	1
Triodia wiseana	0.5	10
Triumfetta propinqua	0.7	<1
Typha domingensis	1.2	<1

NSX2029

Staff TCJ **Date** 11/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 711158 **mE** 7645327 **mN** **Lat.** -21.2816 **Long.** 119.0353

Habitat Undulating plain

Aspect SW **Slope** Very Gentle

Soil Type Red brown clay loam

Rock Type Ironstone

Loose Rock >90 % cover; 20-60 mm in size **Litter** 1 % cover ; 1 cm in depth

Bare ground 50 % cover **Weeds** 0 % cover

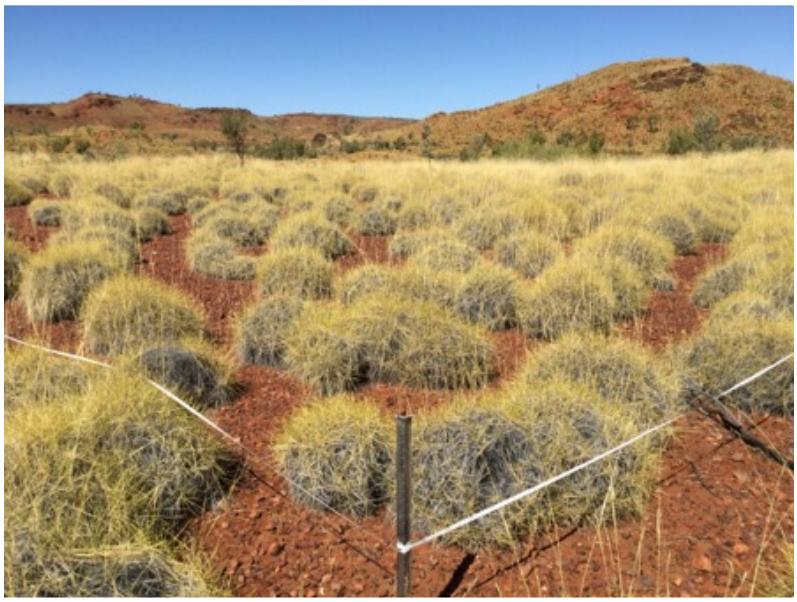
Vegetation M+ ^*Acacia inaequilatera*\^shrub\4\bi;G ^*Triodia wiseana*,^*Acacia spondylophylla*\^hummock grass,shrub\2\c

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes



Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		2	<1	
Acacia inaequilatera		2.2	1.5	
Acacia spondylophylla		0.6	2	
Grevillea wickhamii subsp. *hispidula*		2	<1	
Hakea lorea subsp. *lorea*		3	<1	

Triodia wiseana	0.5	55

NSX2030

Staff TCJ **Date** 8/08/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location North Star

MGA Zone 50 713683 **mE** 7645164 **mN** **Lat.** -21.2828 **Long.** 119.0596

Habitat Crest

Aspect SE **Slope** Very Gentle

Soil Type Red brown clay loam

Rock Type Ironstone

Loose Rock >90 % cover; 20-60 mm in size **Litter** 4 % cover ; <2 cm in depth

Bare ground 30 % cover **Weeds** 0 % cover

Vegetation M+ ^*Acacia acradenia*,^*Acacia orthocarpa*\^shrub\4\i;G ^*Triodia wiseana*\^hummock grass\1\c

Veg. Condition Excellent

Disturbance Nil

Fire Age >5 years

Notes Drill tracks nearby.

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia acradenia		1.8	12	
Acacia adoxa var. *adoxa*		1	<1	
Acacia inaequilatera		2.5	<1	
Acacia orthocarpa		2.2	2	
Acacia ptychophylla		1	<1	

Acacia tumida var. *pilbarensis*	2.5	<1
Cassytha capillaris	0.5	<1
Eriachne mucronata	0.2	<1
Eriachne pulchella subsp. *dominii*	0.1	<1
Eucalyptus leucophloia subsp. *leucophloia*	2.1	<1
Goodenia stobbsiana	0.3	<1
Grevillea wickhamii subsp. *hispidula*	2.3	<1
Hybanthus aurantiacus	0.3	<1
Ptilotus calostachyus	0.6	<1
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	1.2	<1
Solanum phlomoides	0.3	<1
Tephrosia virens	0.5	<1
Triodia wiseana	0.4	60

APPENDIX FIVE DBCA REPORT FORMS

Department of Biodiversity, Conservation and Attractions

Threatened and Priority Flora Report Form

Version 1.3a July 2020

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at http://dpaw.wa.gov.au/ under *Standard Report Forms*

TAXON: Ptilotus mollis **TPFL Pop. No:**

OBSERVATION DATE: 9/8/2020 **CONSERVATION STATUS:** P4 New population ☒

OBSERVER/S: Terri Jones, Andrew Fry **PHONE:** 08 9430 8955

ROLE: Botanists **ORGANISATION:** Ecoscape

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

South of North Star Mine site, approximately 110 km SSE of Port Hedland

Reserve No:

DBCA DISTRICT: Pilbara **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒

Lat / Northing: 7644693

Long / Easting: 713102

ZONE: 50

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐

No. satellites: ____ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☒ Extrapolation ☐ Estimate ☐ Count method: _____
(Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	107			
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ____ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: 50%

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Branch** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.3a July 2020

HABITAT INFORMATION:

LANDFORM:
- Crest ☐
- Hill ☒
- Ridge ☐
- Outcrop ☐
- Slope ☐
- Flat ☐
- Open depression ☐
- Drainage line ☐
- Closed depression ☐
- Wetland ☐

ROCK TYPE:
- Granite ☐
- Dolerite ☐
- Laterite ☐
- Ironstone ☒
- Limestone ☐
- Quartz ☐

Specify other: _____

LOOSE ROCK: (on soil surface; eg gravel, quartz fields)
- 0-10% ☐
- 10-30% ☐
- 30-50% ☐
- 50-100% ☒

SOIL TYPE:
- Sand ☐
- Sandy loam ☒
- Loam ☐
- Clay loam ☐
- Light clay ☐
- Peat ☐

Specify other: _____

SOIL COLOUR:
- Red ☒
- Brown ☒
- Yellow ☐
- White ☐
- Grey ☐
- Black ☐

Specify other: _____

DRAINAGE:
- Well drained ☒
- Seasonally inundated ☐
- Permanently inundated ☐
- Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☒ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1.** Banksia woodland (B. attenuata, B. ilicifolia); **2.** Open shrubland (Hibbertia sp., Acacia spp.) ; **3.** Isolated clumps of sedges (Mesomelaena tetragona)

1. Eucalyptus leucophloia subsp. leucophloia
2. Acacia acradenia
3. Triodia wiseana
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☒

FENCING: Not required ☒ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☒ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

DRF PERMIT/ LICENCE No: Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☒ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other:

Submitter of Record: Stephen Kern Role: Botanist Signed: Stephen Kern Date: 4/10/2020

Please return completed form to **Species And Communities Branch** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of Biodiversity, Conservation and Attractions

Threatened and Priority Flora Report Form

Version 1.3a July 2020

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at http://dpaw.wa.gov.au/ under *Standard Report Forms*

TAXON: Quoya zonalis **TPFL Pop. No:**

OBSERVATION DATE: 13/8/2020 **CONSERVATION STATUS:** TF New population ☒

OBSERVER/S: Terri Jones, Andrew Fry **PHONE:** 08 9430 8955

ROLE: Botanists **ORGANISATION:** Ecoscape

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

South of North Star Mine site, approximately 110 km SSE of Port Hedland

Reserve No:

DBCA DISTRICT: Pilbara **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒
Lat / Northing: 7643830
Long / Easting: 714031
ZONE: 50

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐
No. satellites: ____ Map used: _____
Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☒ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☒ Extrapolation ☐ Estimate ☐ Count method: _____
(Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	11			
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ____ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☒
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: 50%

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Branch** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.3a July 2020

HABITAT INFORMATION:

LANDFORM:
- Crest ☐
- Hill ☒
- Ridge ☐
- Outcrop ☐
- Slope ☐
- Flat ☐
- Open depression ☐
- Drainage line ☐
- Closed depression ☐
- Wetland ☐

ROCK TYPE:
- Granite ☐
- Dolerite ☐
- Laterite ☐
- Ironstone ☒
- Limestone ☐
- Quartz ☐

Specify other: _____

LOOSE ROCK: (on soil surface; eg gravel, quartz fields)
- 0-10% ☐
- 10-30% ☐
- 30-50% ☒
- 50-100% ☐

SOIL TYPE:
- Sand ☐
- Sandy loam ☒
- Loam ☐
- Clay loam ☐
- Light clay ☐
- Peat ☐

Specify other: _____

SOIL COLOUR:
- Red ☒
- Brown ☒
- Yellow ☐
- White ☐
- Grey ☐
- Black ☐

Specify other: _____

DRAINAGE:
- Well drained ☒
- Seasonally inundated ☐
- Permanently inundated ☐
- Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☒ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1.** Banksia woodland (B. attenuata, B. ilicifolia); **2.** Open shrubland (Hibbertia sp., Acacia spp.) ; **3.** Isolated clumps of sedges (Mesomelaena tetragona)

1. Eucalyptus leucophloia subsp. leucophloia
2. Acacia acradenia
3. Triodia wiseana
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☒

FENCING: Not required ☒ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☒ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

DRF PERMIT/ LICENCE No: Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☒ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other:

Submitter of Record: Stephen Kern Role: Botanist Signed: Stephen Kern Date: 4/10/2020

Please return completed form to **Species And Communities Branch** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

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TAXON: Triodia basitricha **TPFL Pop. No:**

OBSERVATION DATE: 8/8/2020 **CONSERVATION STATUS:** P3 New population ☒

OBSERVER/S: Terri Jones, Andrew Fry **PHONE:** 08 9430 8955

ROLE: Botanists **ORGANISATION:** Ecoscape

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

South of North Star Mine site, approximately 110 km SSE of Port Hedland

Reserve No:

DBCA DISTRICT: Pilbara **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒

Lat / Northing: 7646028

Long / Easting: 713474

ZONE: 50

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐

No. satellites: ____ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☒ Count method: _____
(Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1500			
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ____ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: 50%

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

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GOVERNMENT OF WESTERN AUSTRALIA

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Version 1.3a July 2020

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- Slope ☐
- Flat ☐
- Open depression ☐
- Drainage line ☐
- Closed depression ☐
- Wetland ☐

ROCK TYPE:
- Granite ☐
- Dolerite ☐
- Laterite ☐
- Ironstone ☒
- Limestone ☐
- Quartz ☐

Specify other: _____

LOOSE ROCK: (on soil surface; eg gravel, quartz fields)
- 0-10% ☐
- 10-30% ☐
- 30-50% ☐
- 50-100% ☒

SOIL TYPE:
- Sand ☐
- Sandy loam ☒
- Loam ☐
- Clay loam ☐
- Light clay ☐
- Peat ☐

Specify other: _____

SOIL COLOUR:
- Red ☒
- Brown ☒
- Yellow ☐
- White ☐
- Grey ☐
- Black ☐

Specify other: _____

DRAINAGE:
- Well drained ☒
- Seasonally inundated ☐
- Permanently inundated ☐
- Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☒ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1.** Banksia woodland (B. attenuata, B. ilicifolia); **2.** Open shrubland (Hibbertia sp., Acacia spp.) ; **3.** Isolated clumps of sedges (Mesomelaena tetragona)

1. Eucalyptus leucophloia subsp. leucophloia
2. Acacia acradenia
3. Triodia wiseana
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☒

FENCING: Not required ☒ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☒ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

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ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☒ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other:

Submitter of Record: Stephen Kern Role: Botanist Signed: Stephen Kern Date: 4/10/2020

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RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

APPENDIX SIX FLORISTIC ANALYSIS DENDROGRAMS

Figure 5: Survey area floristic analysis dendrogram

Fusion Type: Flexible UPGMA Beta = -0.10
Co-Step (Columns) Created on: 20:51:42, September 22, 2020

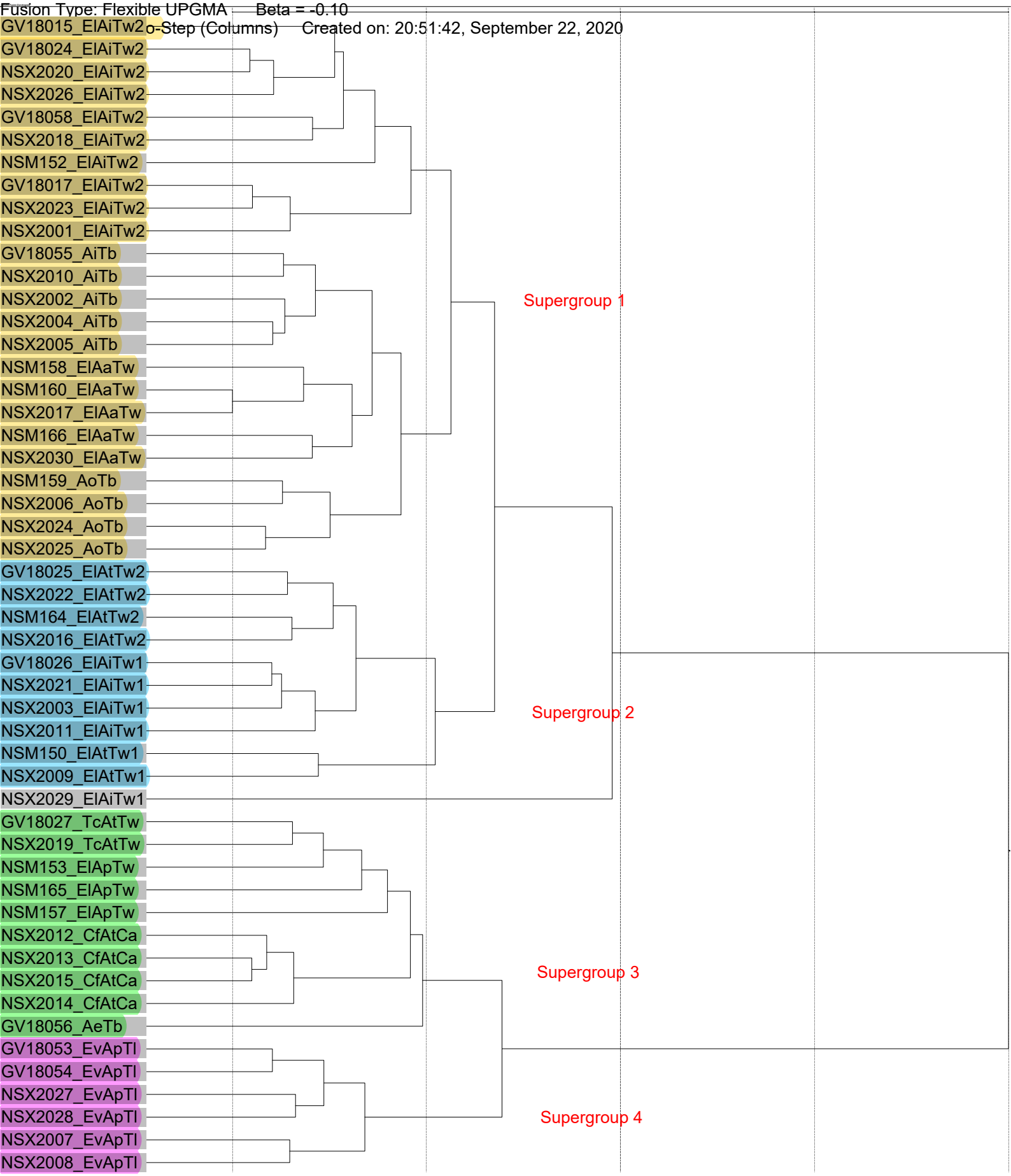
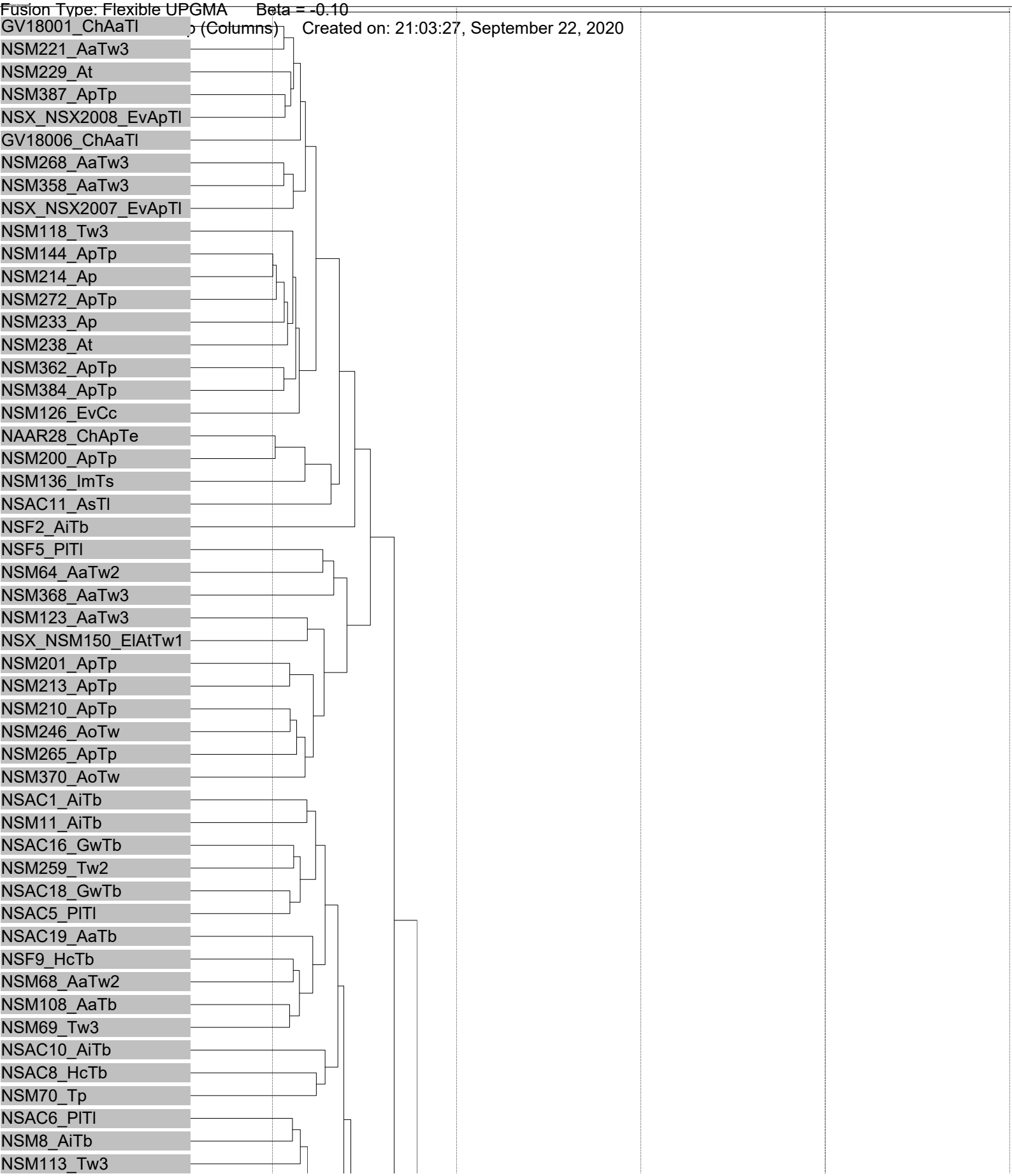


Figure 6: Regional floristic analysis dendrogram

Fusion Type: Flexible UPGMA Beta = -0.10

(Columns) Created on: 21:03:27, September 22, 2020



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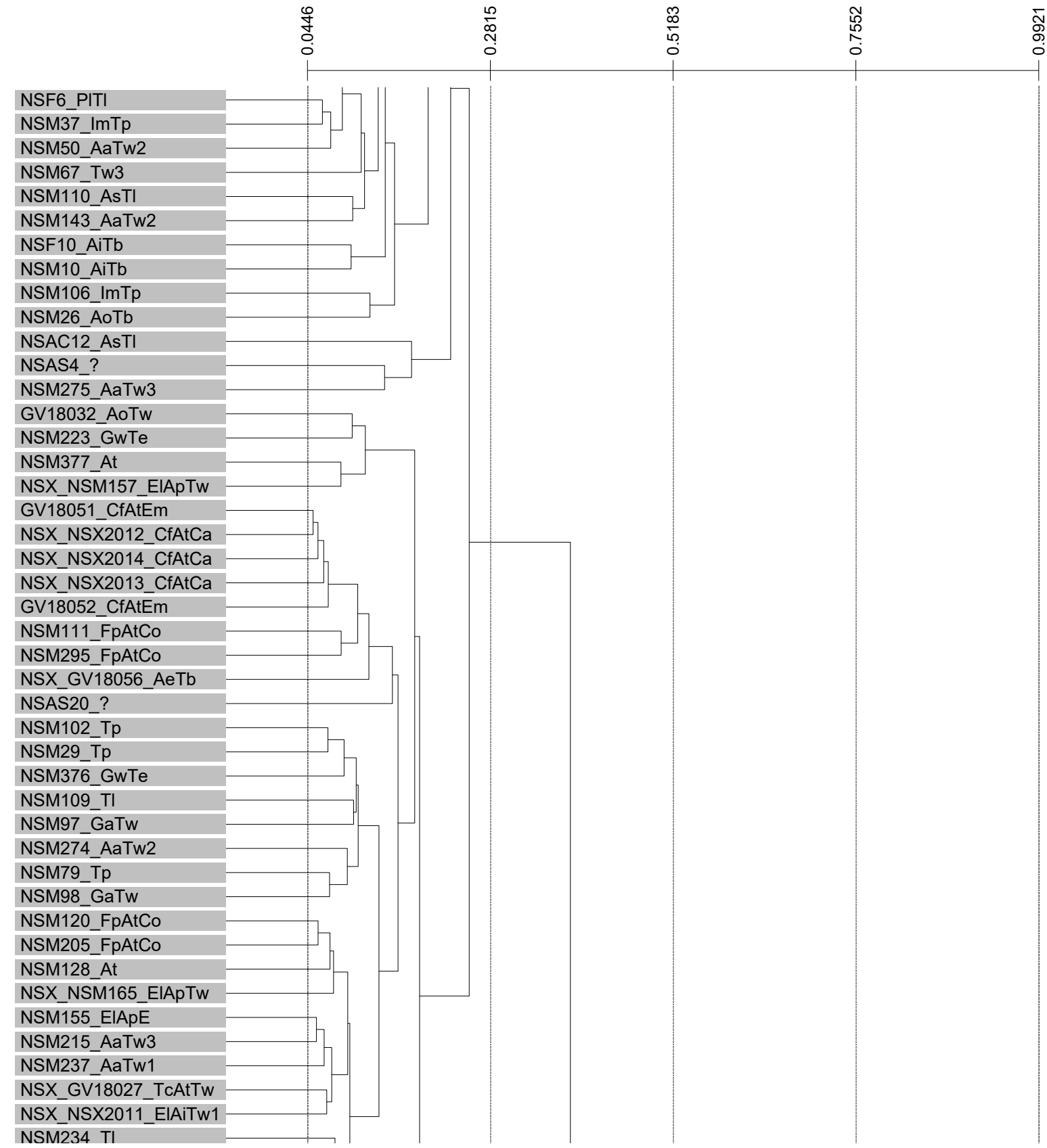
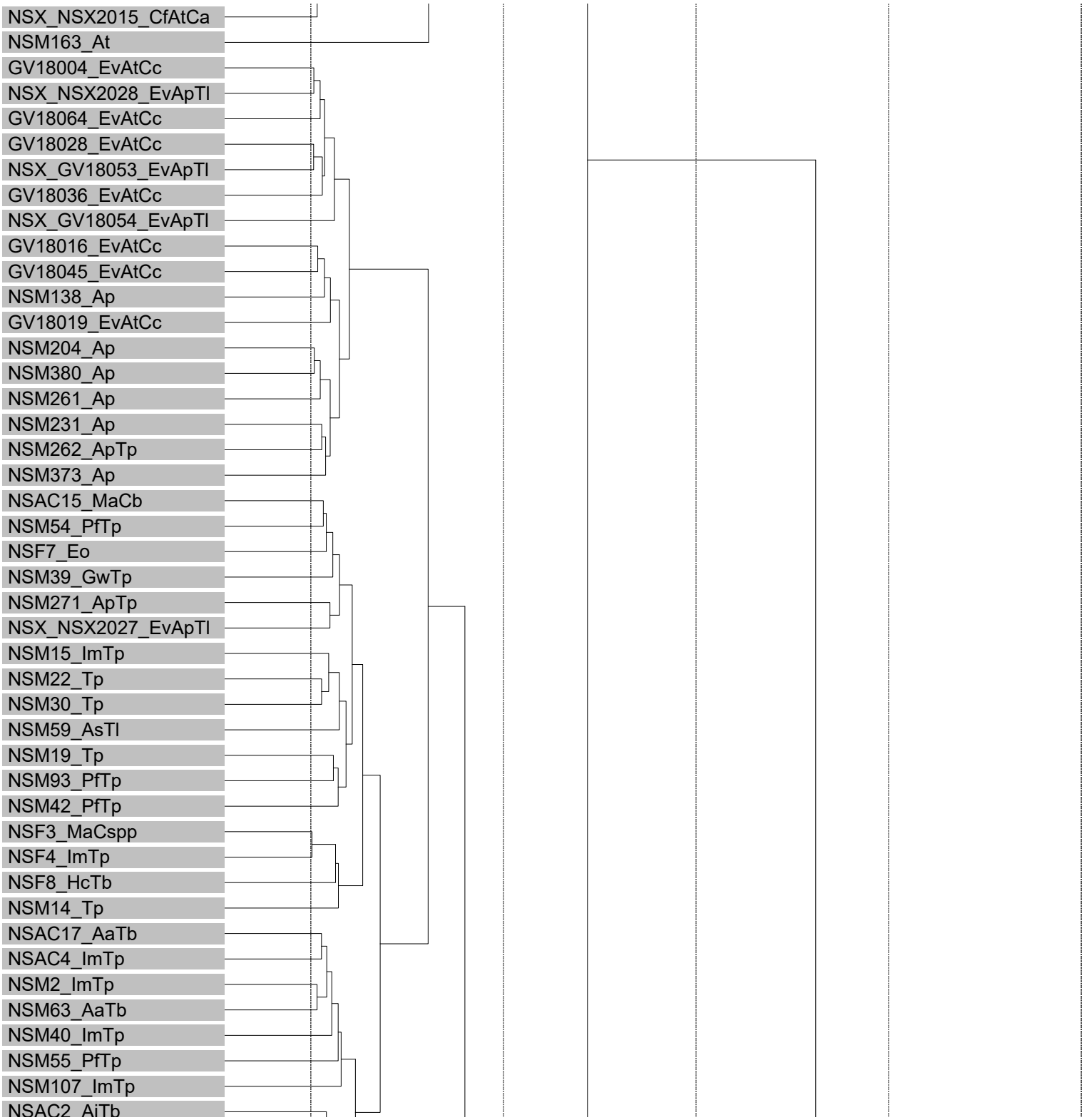
On Association: Two-Step (Columns) Created on: 21:03:27, September 22, 2020

Column Fusion Dendrogram

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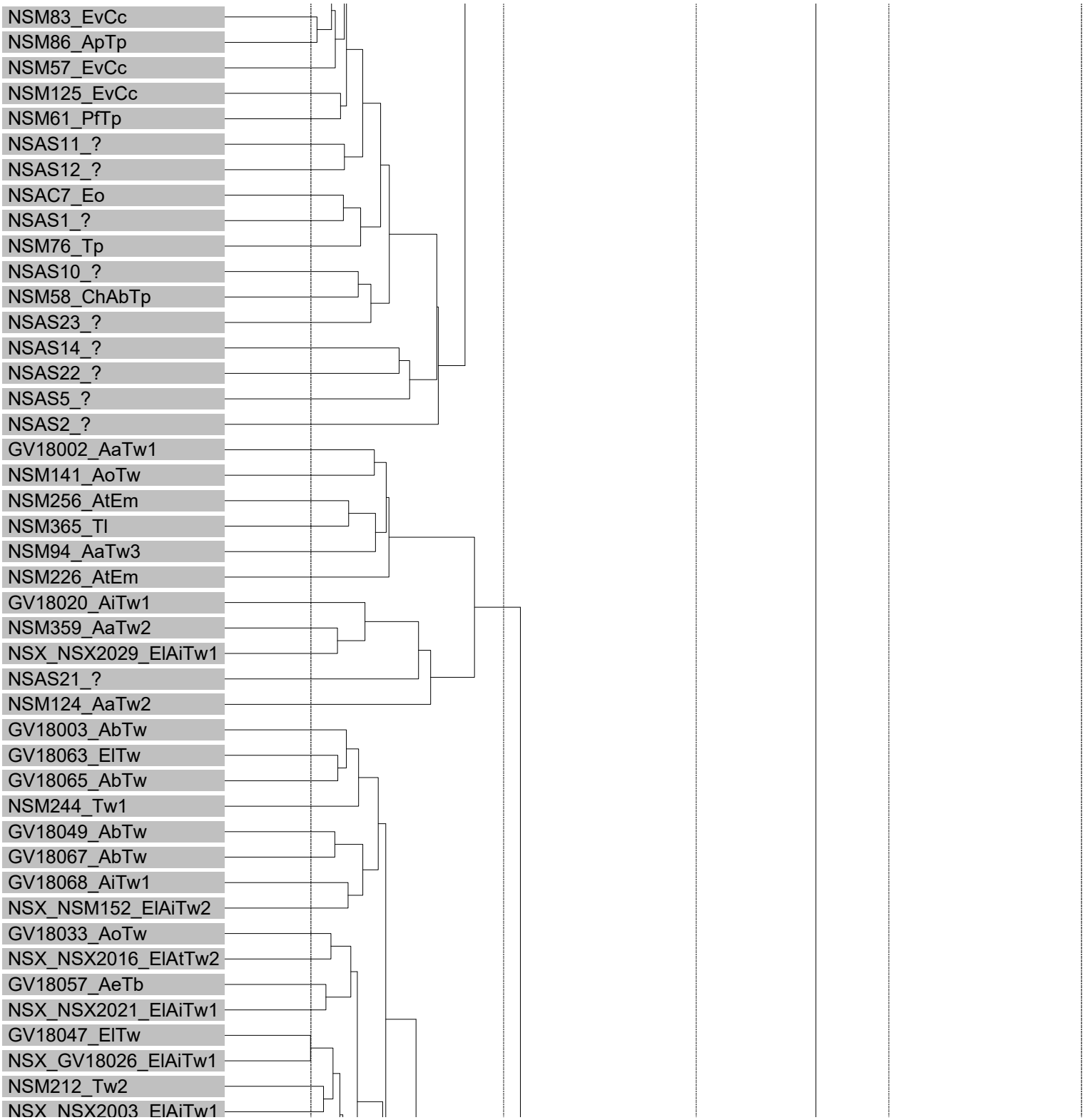
NSM163_At
GV18004_EvAtCc
NSX_NSX2028_EvApTl
GV18064_EvAtCc
GV18028_EvAtCc
NSX_GV18053_EvApTl
GV18036_EvAtCc
NSX_GV18054_EvApTl
GV18016_EvAtCc
GV18045_EvAtCc
NSM138_Ap
GV18019_EvAtCc
NSM204_Ap
NSM380_Ap
NSM261_Ap
NSM231_Ap
NSM262_ApTp
NSM373_Ap
NSAC15_MaCb
NSM54_PfTp
NSF7_Eo
NSM39_GwTp
NSM271_ApTp
NSX_NSX2027_EvApTl
NSM15_ImTp
NSM22_Tp
NSM30_Tp
NSM59_AsTl
NSM19_Tp
NSM93_PfTp
NSM42_PfTp
NSF3_MaCspp
NSF4_ImTp
NSF8_HcTb
NSM14_Tp
NSAC17_AaTb
NSAC4_ImTp
NSM2_ImTp
NSM63_AaTb
NSM40_ImTp
NSM55_PfTp
NSM107_ImTp
NSAC2_AiTb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NSM86_ApTp
NSM57_EvCc
NSM125_EvCc
NSM61_PfTp
NSAS11_?
NSAS12_?
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NSAS1_?
NSM76_Tp
NSAS10_?
NSM58_ChAbTp
NSAS23_?
NSAS14_?
NSAS22_?
NSAS5_?
NSAS2_?
GV18002_AaTw1
NSM141_AoTw
NSM256_AtEm
NSM365_Tl
NSM94_AaTw3
NSM226_AtEm
GV18020_AiTw1
NSM359_AaTw2
NSX_NSX2029_ElAiTw1
NSAS21_?
NSM124_AaTw2
GV18003_AbTw
GV18063_ElTw
GV18065_AbTw
NSM244_Tw1
GV18049_AbTw
GV18067_AbTw
GV18068_AiTw1
NSX_NSM152_ElAiTw2
GV18033_AoTw
NSX_NSX2016_ElAtTw2
GV18057_AeTb
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NSM212_Tw2
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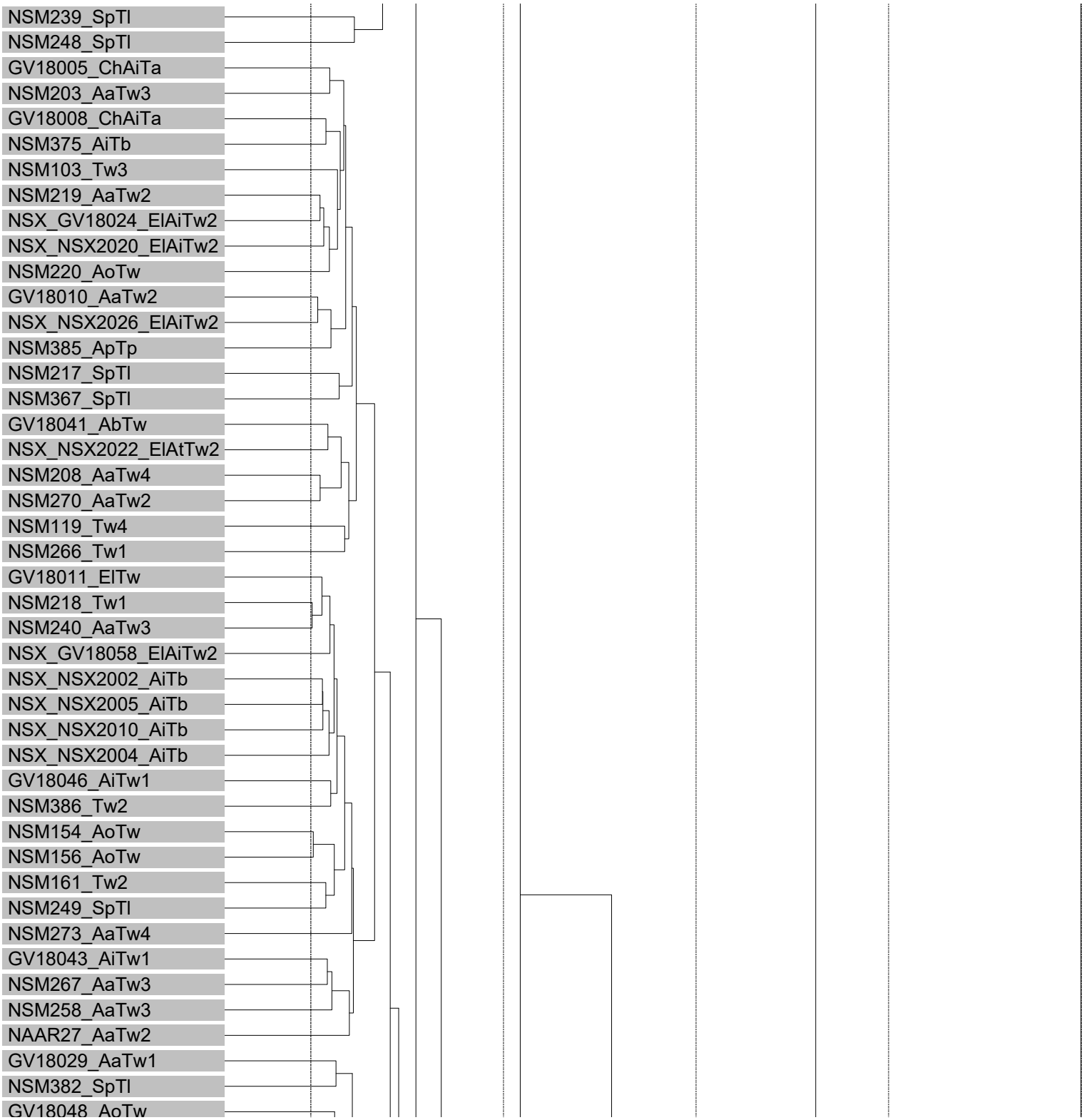
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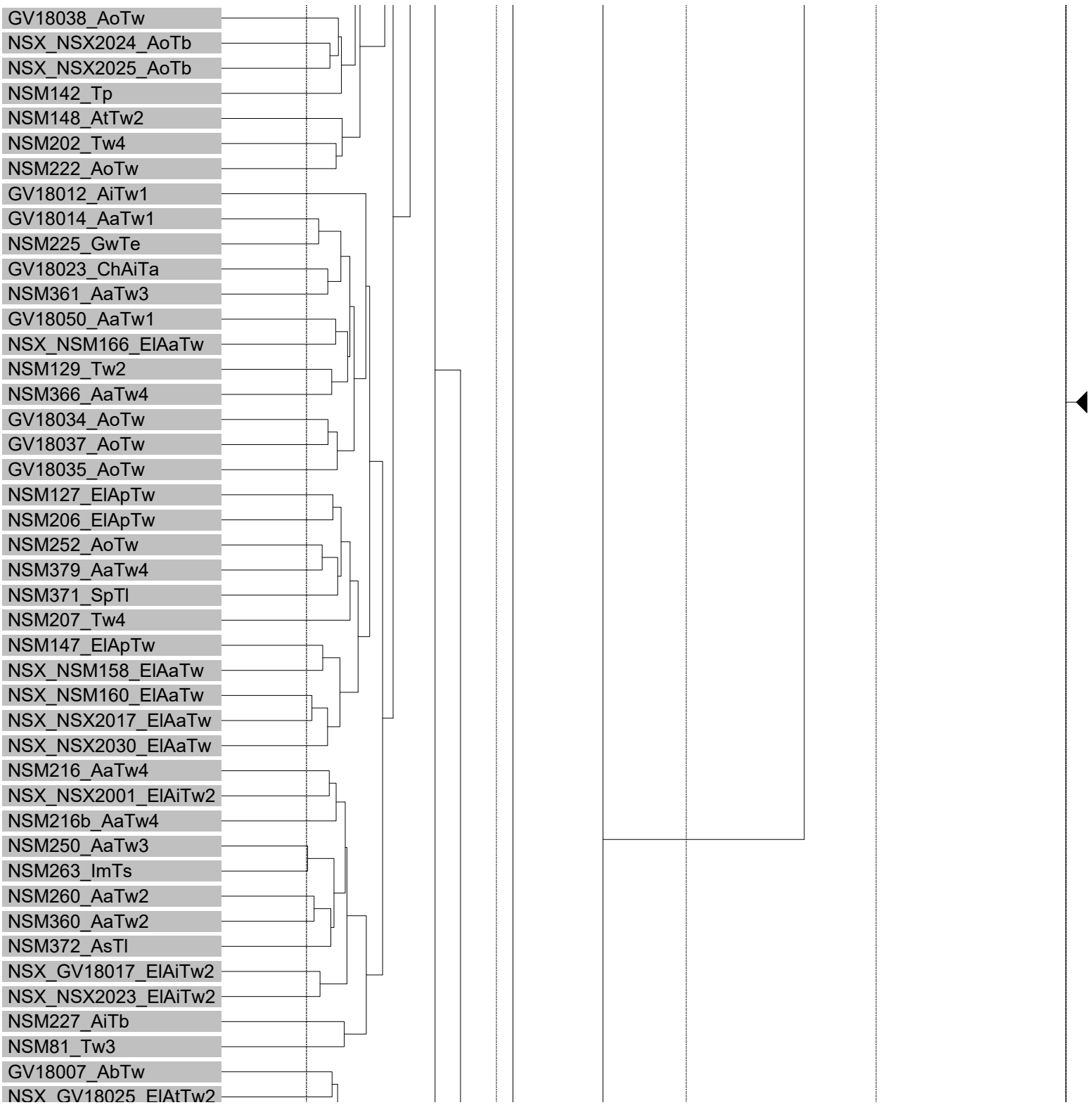
NSM248_SpTl
GV18005_ChAiTa
NSM203_AaTw3
GV18008_ChAiTa
NSM375_AiTb
NSM103_Tw3
NSM219_AaTw2
NSX_GV18024_ElAiTw2
NSX_NSX2020_ElAiTw2
NSM220_AoTw
GV18010_AaTw2
NSX_NSX2026_ElAiTw2
NSM385_ApTp
NSM217_SpTl
NSM367_SpTl
GV18041_AbTw
NSX_NSX2022_ElAtTw2
NSM208_AaTw4
NSM270_AaTw2
NSM119_Tw4
NSM266_Tw1
GV18011_ElTw
NSM218_Tw1
NSM240_AaTw3
NSX_GV18058_ElAiTw2
NSX_NSX2002_AiTb
NSX_NSX2005_AiTb
NSX_NSX2010_AiTb
NSX_NSX2004_AiTb
GV18046_AiTw1
NSM386_Tw2
NSM154_AoTw
NSM156_AoTw
NSM161_Tw2
NSM249_SpTl
NSM273_AaTw4
GV18043_AiTw1
NSM267_AaTw3
NSM258_AaTw3
NAAR27_AaTw2
GV18029_AaTw1
NSM382_SpTl
GV18048_AoTw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GV18023_ChAiTa
NSM361_AaTw3
GV18050_AaTw1
NSX_NSM166_ElAaTw
NSM129_Tw2
NSM366_AaTw4
GV18034_AoTw
GV18037_AoTw
GV18035_AoTw
NSM127_ElApTw
NSM206_ElApTw
NSM252_AoTw
NSM379_AaTw4
NSM371_SpTl
NSM207_Tw4
NSM147_ElApTw
NSX_NSM158_ElAaTw
NSX_NSM160_ElAaTw
NSX_NSX2017_ElAaTw
NSX_NSX2030_ElAaTw
NSM216_AaTw4
NSX_NSX2001_ElAiTw2
NSM216b_AaTw4
NSM250_AaTw3
NSM263_ImTs
NSM260_AaTw2
NSM360_AaTw2
NSM372_AsTl
NSX_GV18017_ElAiTw2
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NSM81_Tw3
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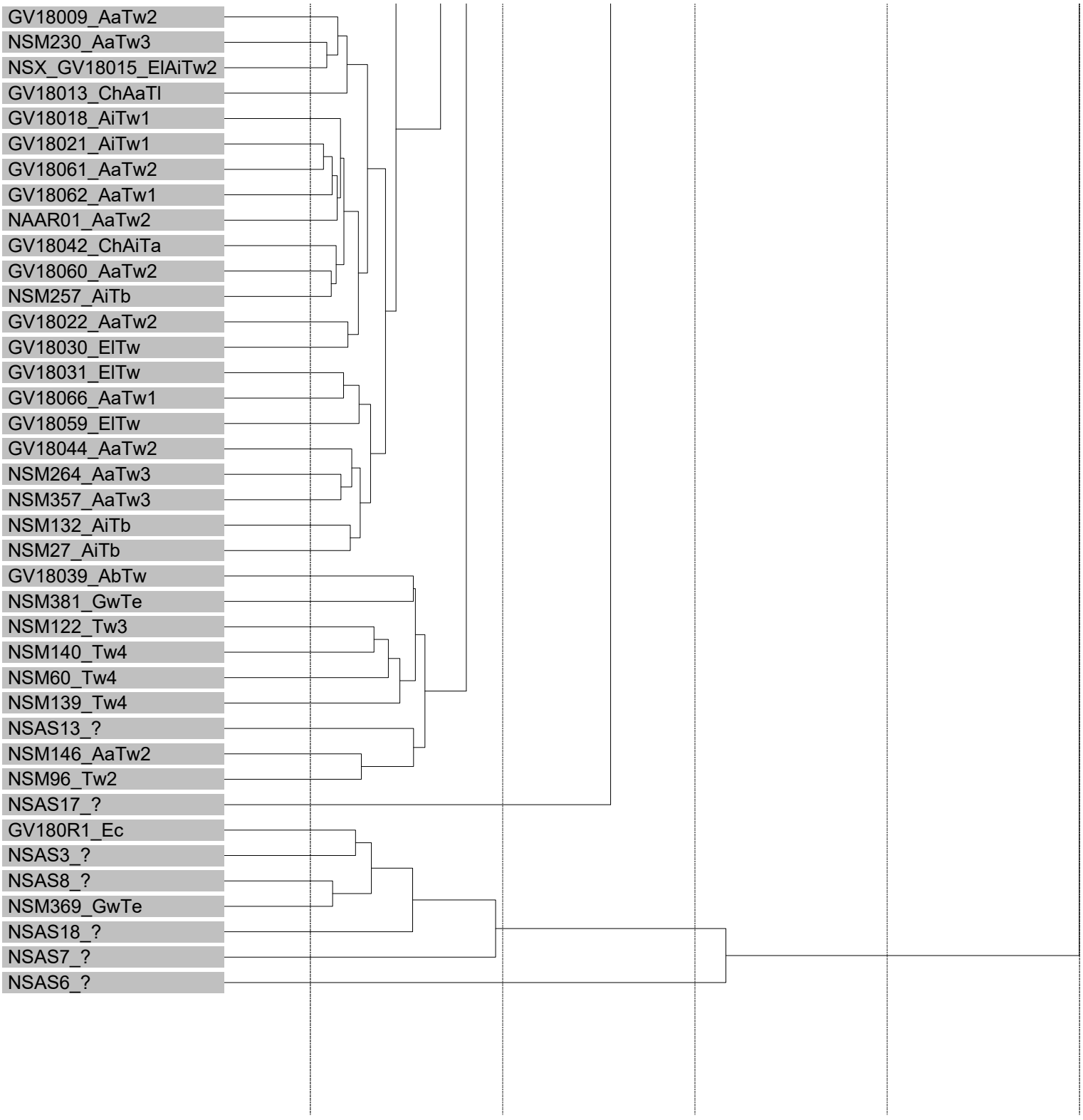
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NSX_GV18015_ElAiTw2
GV18013_ChAaTl
GV18018_AiTw1
GV18021_AiTw1
GV18061_AaTw2
GV18062_AaTw1
NAAR01_AaTw2
GV18042_ChAiTa
GV18060_AaTw2
NSM257_AiTb
GV18022_AaTw2
GV18030_ElTw
GV18031_ElTw
GV18066_AaTw1
GV18059_ElTw
GV18044_AaTw2
NSM264_AaTw3
NSM357_AaTw3
NSM132_AiTb
NSM27_AiTb
GV18039_AbTw
NSM381_GwTe
NSM122_Tw3
NSM140_Tw4
NSM60_Tw4
NSM139_Tw4
NSAS13_?
NSM146_AaTw2
NSM96_Tw2
NSAS17_?
GV180R1_Ec
NSAS3_?
NSAS8_?
NSM369_GwTe
NSAS18_?
NSAS7_?
NSAS6_?

ADDENDUM

In 2023 FMG IB requested an examination of the recorded conservation significant flora species' dependence on groundwater and responses to changes to groundwater and surface water flows, presented as a report addendum.

Three conservation significant flora species were recorded during the 2020 survey; a fourth species, noted that it was likely to be conservation-listed in the future (**Section 4.1.3**), has since been given a phrase name and is now listed as a P1 species (*Themeda* sp. Panorama (J. Nelson *et al.* NS 102)).

No specific references have been located outlining any of the species' hydrological requirements or responses. Consequently, the following assessments for each species have been based on references that identify any plant physiology or taxonomy, general biological principles, habitat assessment that indicates if groundwater or surface water flows are likely to be available, accessible or utilised, and field observations.

Quoya zonalis (TF)

Quoya zonalis was previously known as *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) prior to its description and publication as a new species (Shepherd & Hislop 2020). Shepherd and Hislop (*ibid.*) does not outline any hydrological requirements or responses, however, it describes this species' habitat as 'narrow lines along steep rocky slopes'. The Conservation Advice for this species (Threatened Species Scientific Committee 2018) confirms this habitat and also does not indicate any hydrological requirements or responses, including amongst the listed threats to this species.

Ecoscape's field observations confirm that *Quoya zonalis*' most common habitat is high in the landscape on rocky conglomerate sandstone, granite or ironstone with only skeletal soil (this document and Ecoscape 2018), confirmed by other biological survey or monitoring reports (Ecologia Environment 2012c, 2016; Woodman Environmental Consulting 2013). There are occasional records of this species occurring in other habitats including rocky creeklines (Woodman Environmental Consulting 2011, noting that this is the first documented recording of this species) and in Glacier Valley (Ecoscape 2018) in *Eucalyptus victrix*-dominated vegetation. This was not considered to be the usual habitat for this species, and even though it was associated with *Eucalyptus victrix* it was growing on steep rocky banks well above where it would be anticipated to access water. Ecoscape has also observed isolated individuals of *Quoya zonalis* along tracks, although not in riparian areas.

Groundwater Dependence

As *Quoya zonalis*' main habitat is high in the landscape in rocky soils it is highly unlikely to have developed a root system that would penetrate this substrate to sufficient depth to access groundwater. As such it is highly unlikely to be able to access ground water and is therefore not groundwater dependent. Any lowering of groundwater levels would therefore be highly unlikely to have any impact on *Quoya zonalis* at any stage in its life cycle. Rises in groundwater are unlikely to significantly occur in this species' habitat.

Surface Water Requirements and Response to Changes

Quoya zonalis' main habitat is not in creeklines or other riparian areas with surface water flows. Therefore, any changes to surface water flows are unlikely to affect the majority of individuals and populations of this species as they do not occur in landforms that are relevant to these changes.

Isolated individual *Quoya zonalis* plants may occur in rocky creeklines high in the landscape, however, given the slope within these landforms, water is unlikely to significantly pool and cause flooding and potential

waterlogging causing plant death. Reduced surface water flow is unlikely to significantly impact any of the individuals that may occur in riparian areas as the species on the whole is likely to be adapted to soils with low availability of free water.

However, it is anticipated that if significant changes to the landform occur causing water pooling in *Quoya zonalis*' habitat, this species is likely to be susceptible to waterlogging and would therefore be likely to die. We note that it is highly unlikely that any water pooling would be of sufficient extent and depth to impact the species.

Themeda sp. Panorama (J. Nelson *et al.* NS 102) (P1)

There is no formal taxonomic description of this species, herein abbreviated to *Themeda* sp. Panorama, nor is a summary of its usual habitat available on *FloraBase* (WAH 1998-2023).

The habitat of the 'type' specimen of this phrase name species (J. Nelson *et al.* NS 102), collected from North Star, is *Steep rocky S facing slope. Located in close proximity (50 m) to a permanent waterhole. Shallow soil amongst exposed bedrock and boulders*. Habitat descriptions for the other three specimens housed in the WAH (2023) are:

- *Shaded rocky gully of large ironstone ridge. High in the landscape. Skeletal rocky red clay loam.*
- *Proximal colluvial footslopes. Steep slope, aspect 115 degrees. Many coarse fragments to maximum size of 2 m. No bedrock exposed. Red brown loam, average depth 10 cm.*
- *Basalt hillslope with very large boulders.*

The four vouchered specimens of this species therefore occur in varying habitats including hills, gullies and slopes. Within this survey area, *Themeda* sp. Panorama was recorded from drainage lines, which is the most common habitat type of other *Themeda* species occurring in the Pilbara (*Themeda avenacea*, *Themeda triandra*) (1998-2023, WAH 2023). These (other) *Themeda* species are described as occurring in savanna and grassland, and are specifically not considered as wetland species (Arthan *et al.* 2022). *Themeda triandra* uses water when it is abundant and becomes semi-dormant when soil moisture is low; its root system is not well understood although its thickened roots are likely to contribute to energy storage that supports resprouting following fire or drought (Male *et al.* 2022). *Themeda triandra* does not tolerate poorly-drained soils with flooding described as 'having a negative impact on growth' (Snyman, Ingram & Kirkman 2013). *Themeda sens. lat.* is not considered to be deep-rooted, with most of the root growth being laterals located 100-150 mm below the surface and with the majority of deeper roots located in the top 200-300 mm of the soil, although they may be capable of going deeper (*ibid.*).

Whilst there is no detailed information available on *Themeda* sp. Panorama's physiology it is likely to be similar to the other savanna and grassland *Themeda* species based on the diverse habitats listed in the WAH specimens, and the following discussion is based on the information summarised above, taking into consideration its habitat at North Star that appears to be more mesic than the other collections.

It may be important to consider that, as an undescribed species with only a phrase name, *Themeda* sp. Panorama, when subject to taxonomic review and formal naming, may actually represent more than one taxa with the North Star population differing from others. If so, it is possible that the North Star population is representative of a wetland species and the assumption of it being a dryland species, and the assumptions that follow, may be inaccurate.

Groundwater Dependence

Based on an understanding of the genus' physiology (and assumption that this is representative of a savanna and grassland species), *Themeda* sp. Panorama is likely to be shallow-rooted and highly unlikely to be able to access groundwater, thus is unlikely to be groundwater dependent. Therefore, changes to groundwater depth (either lowering or rising) are unlikely to affect this species unless it rises to being at or near the soil surface, in which case plant death is likely as a result of waterlogging.

Surface Water Requirements and Response to Changes

Themeda sp. Panorama at North Star is generally associated with drainage lines thus changes to surface water flows have the potential to affect the species.

Themeda triandra is highly responsive to fluctuations in rainfall during the growing season, however, cannot take advantage of very high rainfall (Snyman, Ingram & Kirkman 2013). Based on this general physiological observation for the genus and the habitat of *Themeda* sp. Panorama, it is surmised that *Themeda* sp. Panorama is:

- likely to be susceptible to waterlogging that may occur when surface water flows are increased and either localised (or general) flooding occurs or the soil profile near the surface remains wet for extended periods, and potentially even for short periods
- less likely to be significantly affected by reduced surface water flows although, over a longer time period, plant vigour may decrease as energy stores in the root system are depleted.

It is not possible to estimate how *Themeda* sp. Panorama would respond to episodic increases in surface water flow if they do not cause waterlogging.

However, if this is a wetland species its physiological response would differ from the above, and it may be tolerant of waterlogging. Given that it grows close to permanent pools at North Star this possibility cannot be discounted.

Triodia basitricha (P3)

Triodia basitricha was formally described in 2015 (Barrett & Barrett 2015). Previously it was known by Ecoscape and other consultants as *Triodia* aff. *melvillei* (Ecoscape 2010, 2011, 2015, 2016, noting this later survey was to confirm synonomy with the formal name), which is an interim name suggested by Malcolm Trudgen, and by the phrase name *Triodia* sp. Millstream. It occurs through much of the Hamersley, Chichester and Fortescue IBRA subregions in the Pilbara (WAH 1998-2023), with these earlier Ecoscape references from the western Hamersley Range.

In all cases listed above and within the formal description of this species (Barrett & Barrett 2015), *Triodia basitricha* occurs on slopes and rocky hills; at North Star it is confined to hilltops and ridgelines. No references were located that indicate that this species is associated with low-lying or riparian areas.

Copious references indicate *Triodia* species' requirement for rainfall events for seed germination (e.g. Lewandrowski 2016; Lewandrowski *et al.* 2018). No references were located that suggest that any *Triodia* species access groundwater. However, *Triodia* species have been reported as having root systems extending to tens of metres deep in sedimentary soils (Reid, Hill & Lewis 2008) including specifically listing *T. pungens* as having roots to at least 30 m depth. *Triodia* species occurring on sand dunes were reported as having deeper root systems than *Triodia* species growing on rocky substrates (Grigg, Veneklaas & Lambers 2008). In general,

these last two references are in agreement that soft *Triodia* species (Barrett, Anderson & Thiele 2017), including *T. basitricha*, can be relatively deep-rooted.

Groundwater Dependence

Due to its habitat of rocky hills that are not significantly sedimentary and therefore unlikely to be suited to developing root systems of any great depth, it is highly unlikely that *Triodia basitricha* can access groundwater. Therefore, this species would not be groundwater dependent and changes to groundwater, either lowering or raising, are highly unlikely to affect it.

Surface Water Requirements and Response to Changes

Triodia basitricha occurs on rocky hills and has not been reported as occurring in association with significant riparian areas (creeks, rivers), although it does occur in the minor gullies that transport rainwater but do not hold water for any significant period.

Triodia species on the whole are not known to be tolerant of waterlogging, noting that waterlogging is unlikely to occur in the usual habitat of *Triodia basitricha*' at North Star. However, if there are significant changes to the landform that lead to water retention it is likely that *Triodia basitricha* would succumb to waterlogging and die.

***Ptilotus mollis* (P4)**

Ptilotus mollis grows on rocky hills, including scree slopes (Hammer, Davis & Theile 2020; WAH 1998-2023), usually in full sun on massive ironstone formations (Department of Parks and Wildlife and Rio Tinto 2015). Within this survey area, *Ptilotus mollis* was recorded from rocky hilltops and sheer-sided gorges (**Table 7** in **Section 4.1.2.2**). None of the specimen records of this species held by the WAH (2023) indicate that it occurs in low-lying habitat, although there are several records indicating the specimen's habitat as growing on the walls of gorges.

Groundwater Dependence

Due to its habitat that is generally high in the landscape (hills) and the soil profile upon which it occurs (massive ironstone), *Ptilotus mollis* is highly unlikely to be able to access groundwater and therefore would not be dependent on this resource. Any changes to groundwater would be highly unlikely to have any effect on this species.

Surface Water Requirements and Response to Changes

Ptilotus mollis' habitat does not include riparian areas or other areas where water would flow or pool, therefore it is unlikely to be subject to increases or decreases in surface water flow unless there are significant landscape changes.

Based on general physiological understanding, it is highly unlikely that decreases in surface water flow in nearby areas would significantly affect *Ptilotus mollis*, however, if deep water pooling occurred within its habitat it would be anticipated that this species could suffer from waterlogging causing subsequent death.

CONCLUSION

Ecoscape's assessment of each of the conservation significant flora species' responses to changed hydrology are:

- *Quoya zonalis* (TF), *Triodia basitricha* (P3) and *Ptilotus mollis* (P4) are unlikely to be groundwater dependent and are unlikely to be affected by to surface hydrology in their natural habitats. However, if there are significant landform changes they are unlikely to be tolerant of any waterlogging.
- *Themeda* sp. Panorama (J. Nelson *et al*. NS 102) (P1) is unlikely to be groundwater dependent due to being a shallow-rooted species, however, it grows in a habitat (drainage lines) where changes to surface water flow have the potential to result in significant impact. Based on the assumption that it is a savanna and grassland species, it is considered likely to readily suffer from waterlogging leading to plant death should soils become waterlogged, potentially even if only briefly, but less likely to suffer adverse effects from reduced surface water flow. However, if this assumption is incorrect and it is a wetland species it's response to hydrological change is likely to be different and it would be more tolerant of waterlogging.