Pilgangoora Lithium Project

Support Information for Native Vegetation Clearing (Purpose) Permit Application

M45/1260 and L45/485

Shire of East Pilbara

Rev O

30 August 2023

Tenements: M45/1260, L45/485

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ACRONYMS AND DEFINITIONS

ACRONYM	MEANING
AHD	Australian Height Datum
AER	Annual Environmental Report
BoM	Bureau of Meteorology
DMIRS	Department of Mines, Industry Regulation and Safety
EP Act	Environmental Protection Act 1986
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESA	Environmentally Sensitive Area
GDE	Groundwater-Dependent Ecosystem
GDV	Groundwater Dependent Vegetation
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometres
LoM	Life of Mine
m	Metres
mm	Millimetres
Mt	Million tonnes
Mtpa	Million tonnes per annum
PEC	Priority Ecological Community
P	Priority flora
PLS	Pilbara Minerals Ltd
POPL	Pilgangoora Operations Proprietary Limited
PMST	Protected Matters Search Tool
t	Tonnes
TEC	Threatened Ecological Community
TSF	Tailings Storage Facility

1. PERMIT APPLICATION DETAILS

1.1 BACKGROUND

Pilgangoora Operations Pty Ltd, a 100% subsidiary of Pilbara Minerals Limited (PLS), owns and operates the Pilgangoora Lithium Project (the Project). The Project is located approximately 80 km south-southeast of the town of Port Hedland and 30 km north-east of the Wodgina mine, in the Shire of East Pilbara (Figure 1).

The Project is located within Wallareenya Station pastoral lease, an active cattle grazing property, through which unsealed roads provide access from the Great Northern Highway.

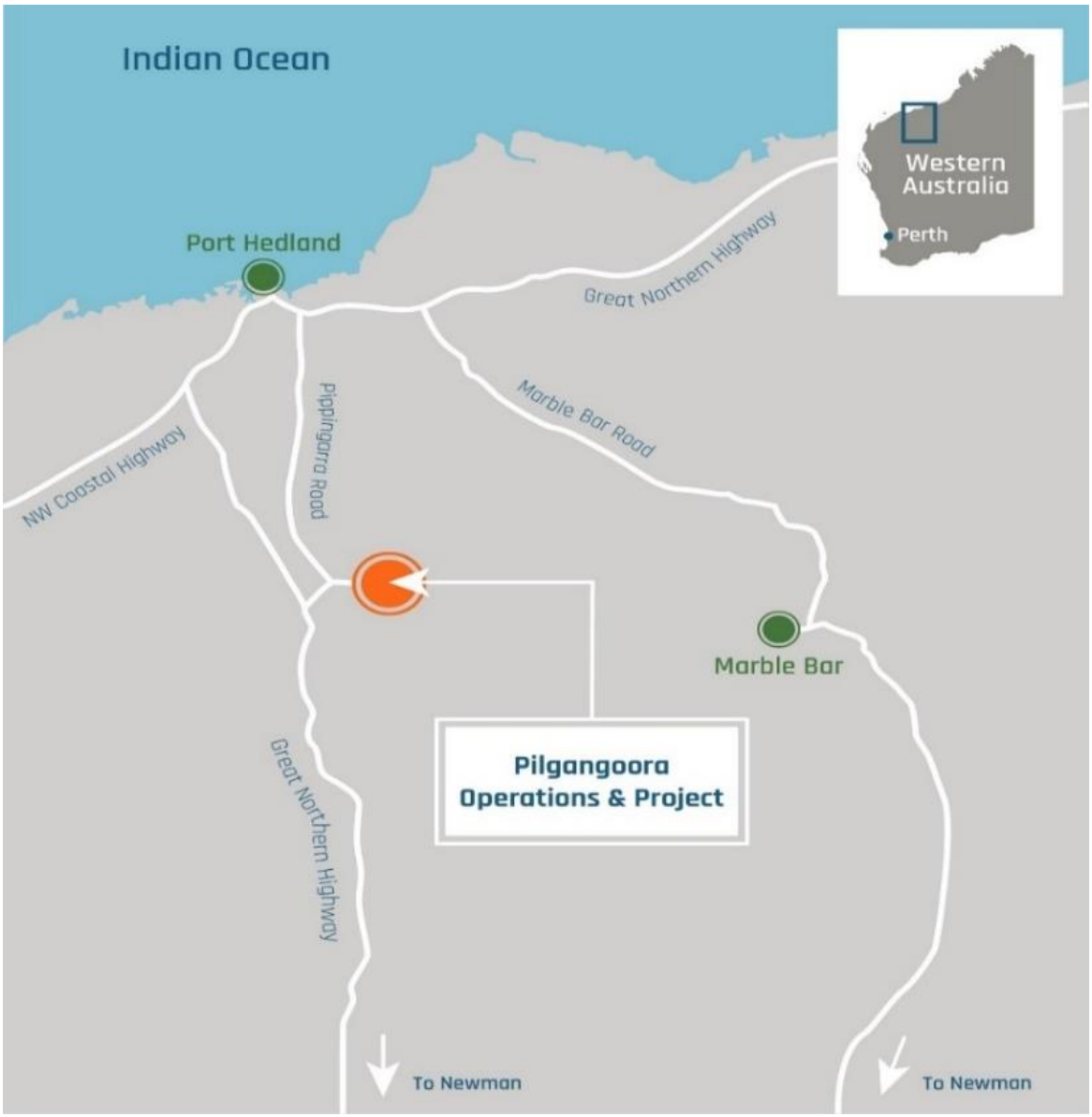

Figure 1: Regional location of the Pilgangoora Lithium Project

In July 2018 Pilbara Minerals Ltd established the subsidiary company Pilgangoora Operations Pty Ltd (POPL), to separate the Pilgangoora mining and processing operations from the company's other interests.

1.2 PROPOSAL DETAILS AND OWNERSHIP

Pilbara Minerals propose the construction of a 280-hectare (ha), 100 million tonne (Mt) Tailings Storage Facility (TSF 3) to support continued operations from the Ngungaju process plant and increased production from the Pilgangoora process plant which is currently under expansion (P1000 expansion project). The revised Life of Mine (LoM) is anticipated to be 25 years.

This Native Vegetation Clearing Permit (NVCP) application is being made for clearing to support the development of TSF 3, and associated infrastructure (pipelines, monitoring bores, topsoil stockpiles, access roads, drainage diversion, flood bunding and associated activities).

Ownership details of the tenements (Mining Lease M45/1260 and Miscellaneous Licence L45/485) associated with the proposed clearing envelope are presented below in Figure 2 and Figure 3.

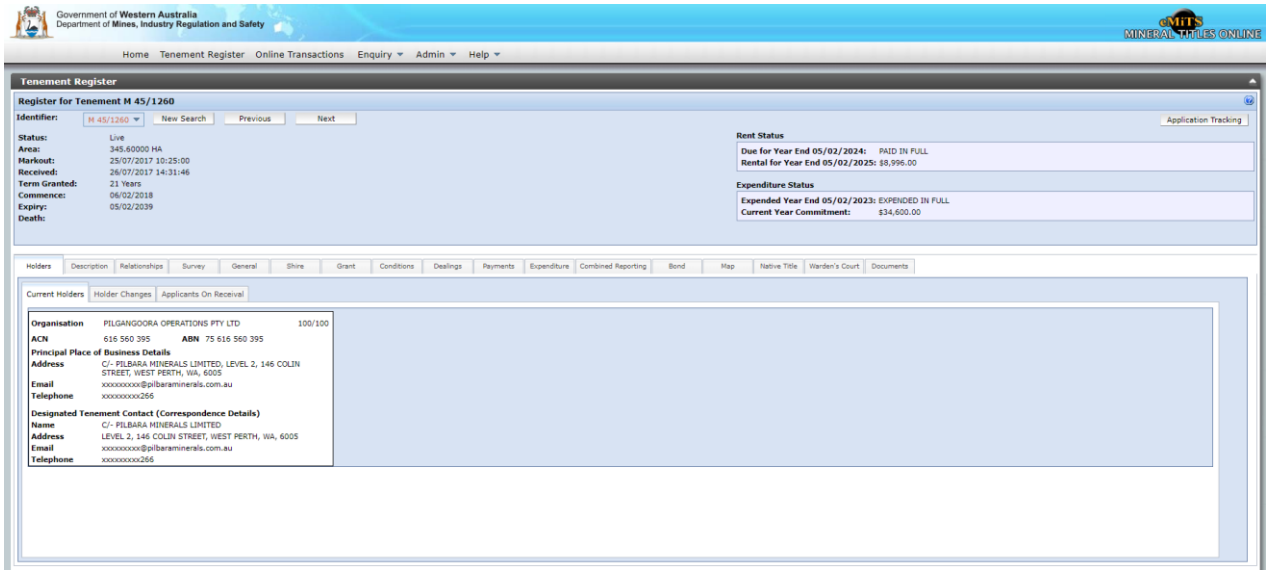

Figure 2: Mineral Titles Online Ownership Details for Mining Lease M45/1260

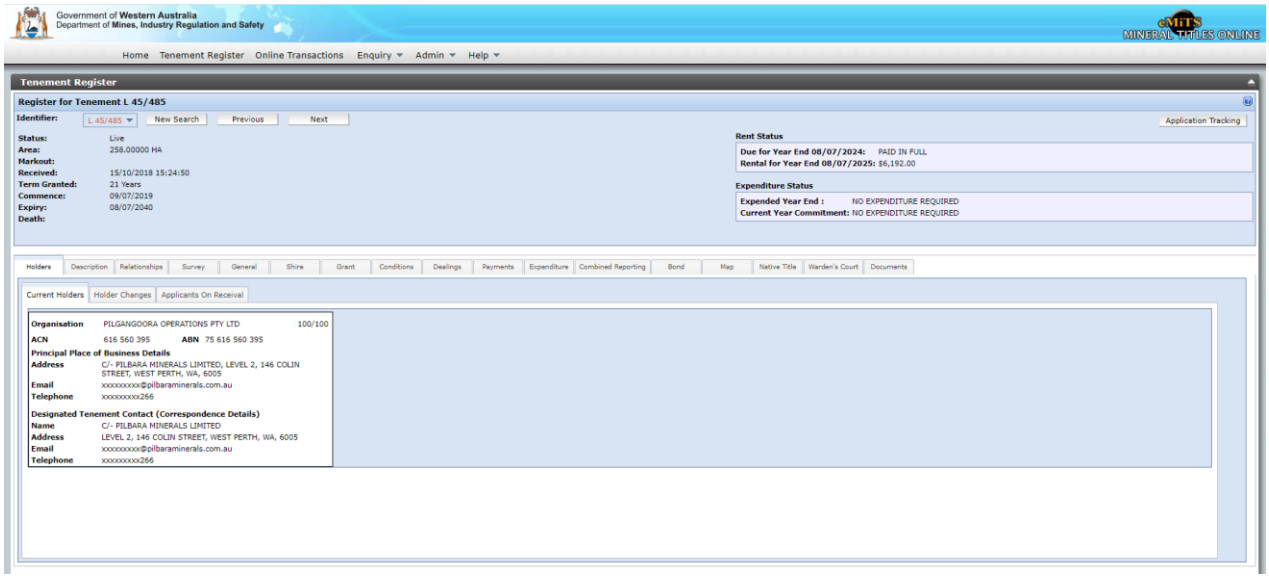

Figure 3: Mineral Titles Online Ownership Details for Miscellaneous Licence L45/485

1.3 PROPOSED CLEARING EXTENT

The proposed clearing envelope for the purpose permit measures 361.54 ha. Within the proposed envelope, up to 345 ha of vegetation is proposed for clearing. The clearing will support the establishment of TSF 3, pipelines, monitoring bores, topsoil stockpiles, access roads, drainage diversion, flood bunding and associated activities.

The location of the proposed clearing envelope on M45/1260 and L45/485 appears as Figure 4.

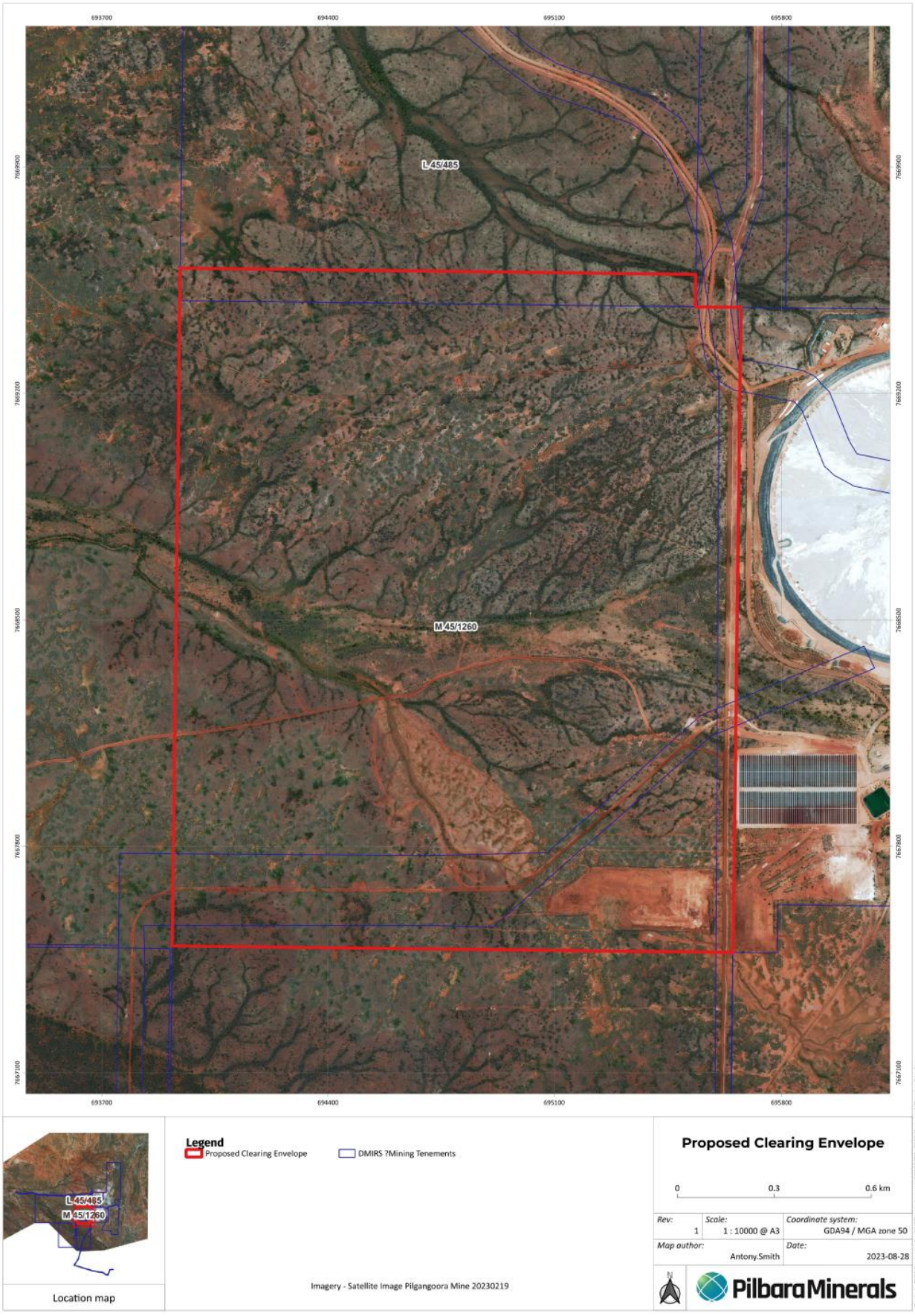

Figure 4: Proposed Clearing Envelope

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1.4 ALTERNATIVES CONSIDERED / ACTIONS TO MINIMISE CLEARING AND IMPACTS

1.4.1 ALTERNATIVES

Consideration was given to raising existing tailings storage facilities to minimise potential clearing. A lift is proposed for the existing Ngungaju Lithium Operation (NLO) tailings management facility and applications for necessary approvals are underway. The other existing tailings management facilities were deemed not suitable for further expansion at this time.

A range of locations were investigated to ascertain the optimum location for the TSF 3 and associated infrastructure. Five options were investigated at a preliminary stage and a further two options (option 2 and option 5) investigated more rigorously with considerations to heritage, flora, vegetation and fauna, hydrology and soil conditions – see Figure 5.

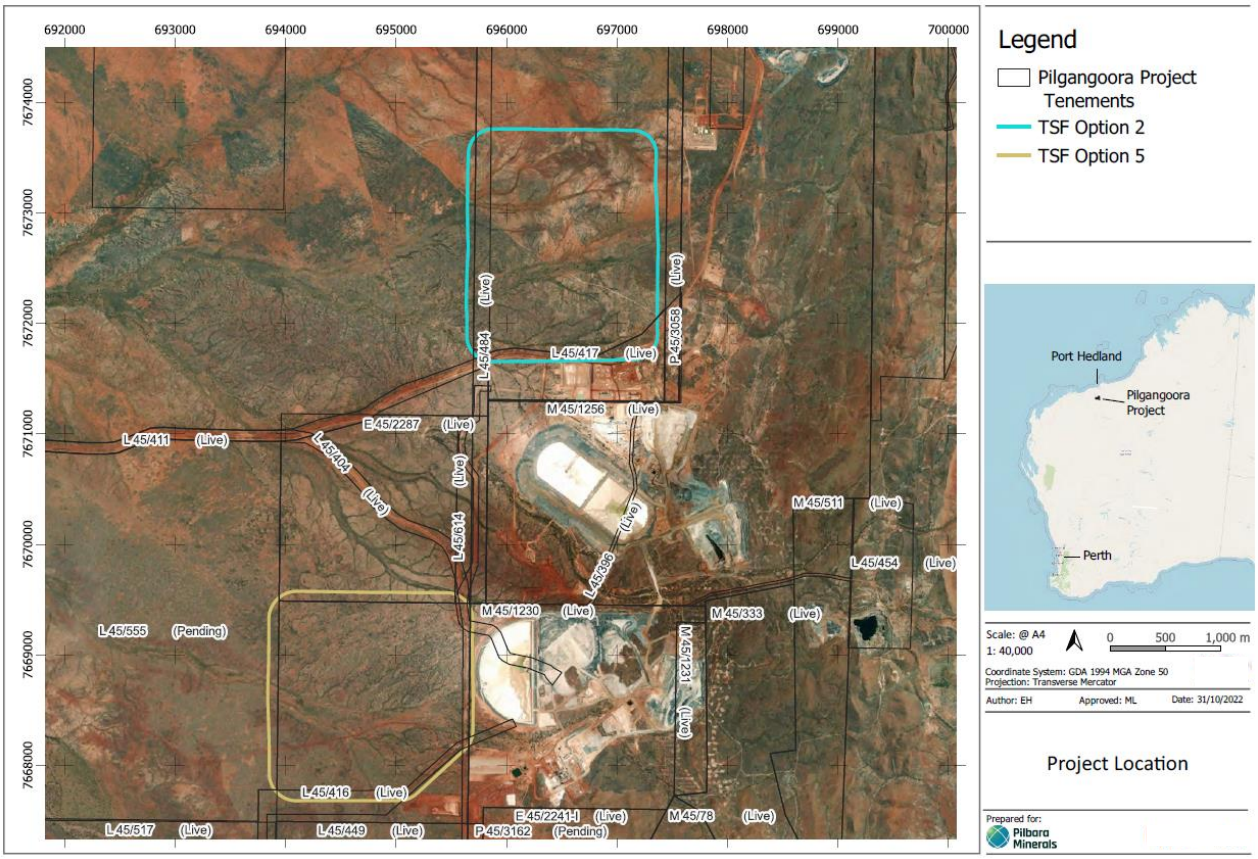


Figure 5: Options investigated for siting TSF 3

Option 5 was ultimately deemed to be a more suitable site for locating TSF 3 due to underlying geology and soil conditions.

1.4.2 ACTIONS TO MINIMISE CLEARING

The design of TSF 3 has been developed to have a life of mine of 25 years and be able to contain up to 100 Mt of tailings. This will avoid the requirement for development of another tailings storage facility in the medium to long term. The design of the TSF 3 involves 13 lifts (raises of the tailings wall) thereby optimising available space by developing vertically.

The sub-soils from the proposed clearing envelope provide a suitable resource for use during construction of TSF 3 embankments and raises. This reduces the requirement to clear other areas to win construction materials.

1.4.3 ACTION TO MINIMISE IMPACTS

Actions to minimise impacts are outlined below.

- Vegetation clearing protocols and the potential impacts of unauthorised clearing are included in the site induction.
- A Land Use Certificate system is in place and requires sign off by the Environmental Advisor prior to clearing being undertaken.
- Survey control will be utilised to set out the limits of areas to be cleared using survey pegs and flagging tape.
- All site personnel will be made aware of the vegetation clearing procedure and permitting requirements.
- All topsoil stripped will be retained for use in rehabilitation activities.
- Collect and correctly stockpile vegetative material and available growth medium for later use at selected sites.
- Progressively rehabilitate areas no longer required as soon as practicable.
- Where seed is required, only native plant species of local provenance will be used.
- To assist with ongoing review of the rehabilitation and impact assessment and environmental management at the site, the proponent will submit an annual environmental report to DMIRS as required by tenement conditions.

2. EXISTING ENVIRONMENT

2.1 REGIONAL SETTING

The topography of the Project site is related to the range of hills that are located to the east of the mine site. These hills provide in the order of 90 m local relief with ground elevations rising from about 170 metres Australian Height Datum (mAHD) on the plains to the west, to about 260 mAHD in the vicinity of the mining areas. The Project area has the Turner River 20 km to the west and immediately to the east by a range of north-south trending hills that form the local watershed with the Strelley/De Grey River system.

One primary drainage line dissects the proposed clearing envelope, with Sothern Creek flowing from east to west through the middle of M45/1260. Southern Creek reports to Chinnamon Creek about 8.5 km west of the proposed clearing envelope before discharging into the Turner River, some 13 km to the northwest. The rivers and creeks in the immediate vicinity of the Project site are ephemeral, only carrying runoff following significant rainfall events (GRM 2018).

2.2 CLIMATE

The Pilbara has very hot summers, mild winters and low and variable rainfall. It is classified as hot desert in northern and inland areas and hot grasslands in the north-west. The climate of the Chichester subregion of the Pilbara is described as semi-desert-tropical, receiving 300 millimetres (mm) of rainfall annually (Kendrick and McKenzie, 2001).

The nearest Bureau of Meteorology (BoM) weather station with a long historical record is at Port Hedland Airport (BoM Site Number: 004032), approximately 75 km northeast of the Study Areas. Port Hedland Airport has recorded rainfall from 1942 – 2022 (80 years), and temperature from 1948 – 2022 (74 years). The climate data recorded for the region over these periods is shown in Figure 2-1. Monthly mean maximum temperature ranges from 36.8°C in March to 27.4°C in July. Monthly mean rainfall ranges from 90.2 mm in February to 0.9 mm in October, with a mean annual rainfall of 317.7 mm (BoM 2022).

The evaporation rate in the Pilbara is considerably higher than the average rainfall and can exceed 3000 mm per year.

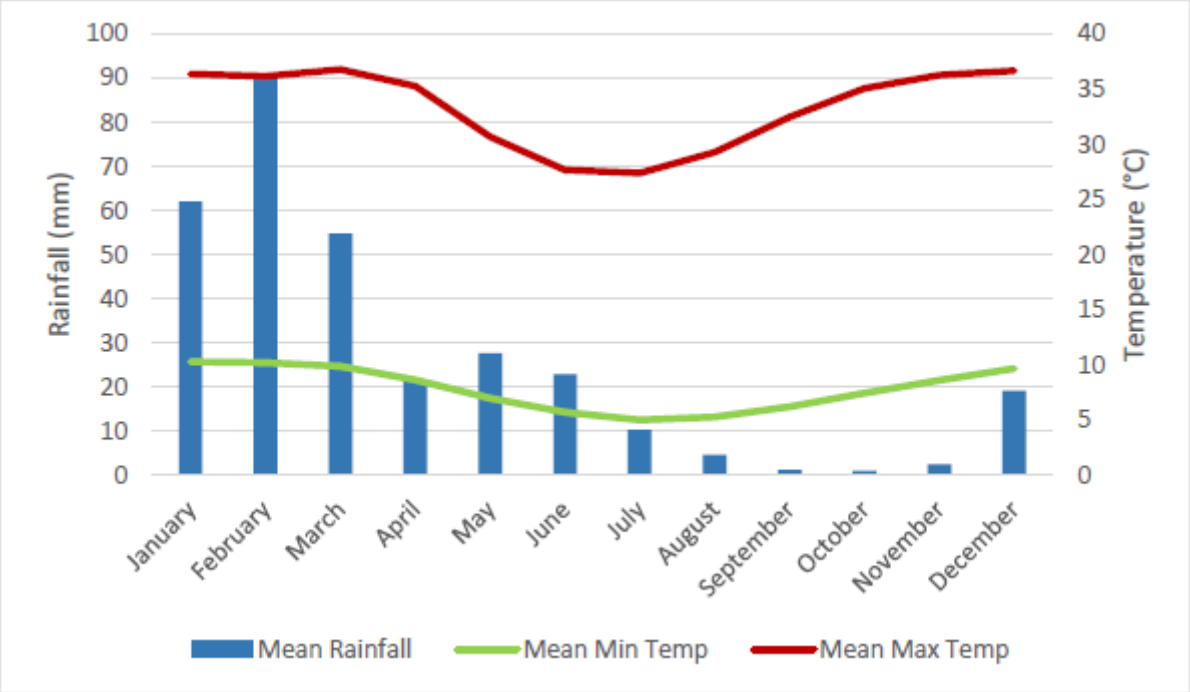


Figure 6: Climate data - Port Hedland Airport weather station (Station No. 004032) (BoM 2022)

2.3 BIOGEOGRAPHIC REGIONALISATION

The Interim Biogeographic Regionalisation for Australia (IBRA, version 7) classifies the Australian

continent into regions (bioregions) of similar geology, landform, vegetation, fauna and climate characteristics (Thackway and Cresswell 1995). The mapping completed by Beard (1975) provides thebasis for the IBRA bioregions. IBRA mapping (Version 7), places the Project within the Pilbara Bioregion.

The Pilbara Bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges. Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses.

The Pilbara Bioregion is further subdivided into the Chichester (PIL1), Fortescue (PIL2), Hamersley (PIL3) and Roebourne (PIL4) Sub-regions. The Project lies entirely within the Chichester Sub-region.

The Chichester Sub-region comprises the northern section of the Pilbara Craton and is comprised of undulating Archaean granite and basalt plains and includes significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges (Kendrick and McKenzie, 2001).

2.4 LAND SYSTEMS

Land system mapping classifies the Pilbara into 106 land systems (Van Vreeswyk *et al*. 2004). The proposed clearing envelope occurs within the Satirist land system. This land system is described in

Table 1 and shown on Figure 7.

Table 1: Land Systems of the Project area

LAND SYSTEM	DESCRIPTION	LAND SYSTEM WITHIN PILBARA BIOREGION		LAND SYSTEM WITHIN PROJECT AREA	
		Area (km^2)	% of Pilbara Bioregion	Area (km^2)	% of Pilbara Bioregion
Satirist	Stony plains and low rises supporting hard spinifex grasslands and gilgai plains supporting tussock grasslands.	377	0.2	7.7	0.004

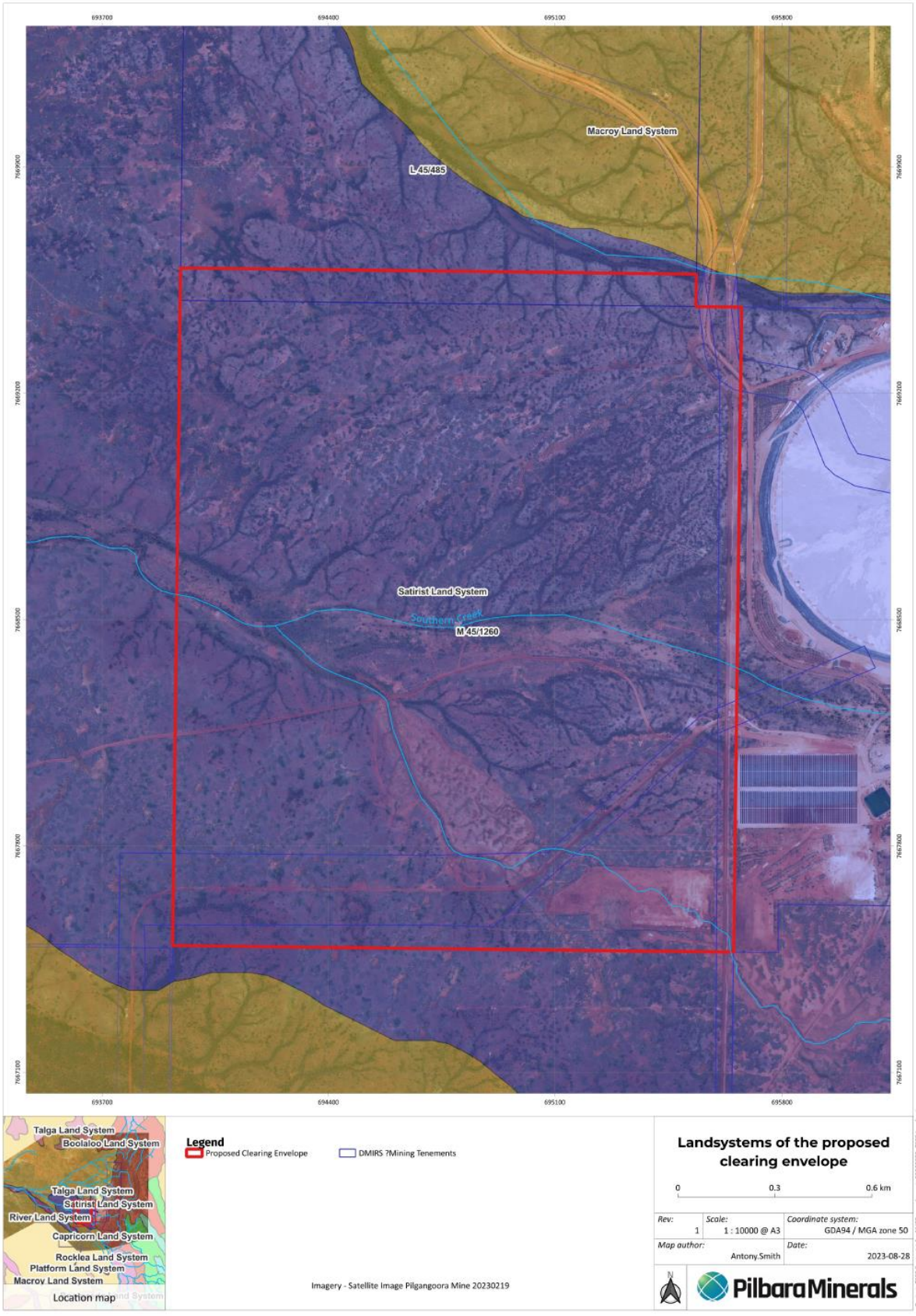


Figure 7: Land systems of the proposed clearing envelope

2.5 GEOLOGY

2.5.1 REGIONAL GEOLOGY

The description of the geological conditions associated with the Project are derived from the 1:100,000 sheet (Wodgina) and explanatory notes provided by the Geological Survey of Western Australia (2014).

The Project area lies within the East Strelley Greenstone Belt of the Archean North Pilbara Craton, in the western part of the well exposed East Pilbara Granite Greenstone Terrane. Apart from a thin Cenozoic regolith cover, the region is entirely underlain by Archean rocks, comprising volcanic, sedimentary, mafic and ultramafic rocks of the Pilbara and De Grey Supergroups.

The East Strelley Greenstone Belt is characterised by a series of steeply dipping mafic meta-volcanics and amphibolites.

2.5.2 SITE GEOLOGY

The proposed clearing envelope contains the following geological formations:

- A-CLmo-xmgm-mgg; Motherin Monzogranite; Interleaved metamonzogranite, metagranodiorite, gneiss, and pegmatite; moderately to strongly foliated; intruded by abundant sheets of massive to weakly foliated muscovite-bearing metamonzogranite and pegmatite;
- C1 ; Colluvial unit; Colluvial sand, silt, and gravel in outwash fans; scree and talus; proximal mass-wasting deposits; unconsolidated;
- A2-d-k; Alluvial unit; Partly consolidated alluvial gravel, sand, and silt; local carbonate cement; dissected by present-day drainage;
- A1i ; Alluvial unit; Mixed floodplain deposits; sand, silt, and clay adjacent to main drainage channels; numerous small claypans; unconsolidated;
- A1f-cb-vb; Alluvial unit; Clay, silt, sand, and basaltic or doleritic gravel on floodplains; gilgai surface in areas of expansive clay; derived from ferromagnesian parent rock; unconsolidated; and
- A1c; Alluvial unit; Sand, silt, and gravel in active drainage channels; includes clay, silt, and sand in poorly defined drainage courses on floodplains; unconsolidated.

The surface geology is reported to be alluvial cover sediments including unconsolidated and partly consolidated alluvial gravel, sand, and silt. A modern drainage channel also runs east-west with a tributary to the Houston Creek. The underlying geology of this area is mapped as Sisters Suite Monzogranite.

No regional faults are mapped under the area.

Drill logs in the vicinity of the area show 4 m of calcrete/colluvium over layers of granite and schist. Fresh rock is generally logged from between 14 metres below ground level (mbgl) to 20 mbgl.

2.6 SURFACE WATER

2.6.1 HYDROLOGICAL SETTING

The Project site is located entirely within the Turner River catchment immediately to the west of the regional watershed divide with the Strelley River (Figure 8). The Turner River is a regionally significant river system, draining a catchment area of some 4800 km^2. The Turner River catchment forms the eastern-most part of the Department of Water's designated Port Hedland Coast Basin (No. 709).

There are several relatively minor watercourses in the vicinity of the proposed clearing envelope including Pilgangoora Creek and an unnamed watercourse to the south of Pilgangoora Creek (referred to as Southern Creek. The catchment areas for these creeks are shown on Figure 8.

The headwaters of the Turner River East rise at the northernmost part of the broader Pilgangoora Project site and drain in a northerly direction before forming the river proper about 15 km to the north of the site. The Turner River East joins with the Turner River about 55 km northwest of the Project site and continues in a northerly direction for a further 35 km before discharging into the Indian Ocean via marshlands located 10 km west of Port Hedland.

Pilgangoora and Southern Creeks drain in a roughly east to west direction across the Project site. The smaller Pilgangoora and Houston Creeks discharge into Northern Creek which in turn reports to Southern Creek before emptying into Chinnamon Creek about 8 km west of the Project site.

All creeks and drainages in the vicinity of the Project site are typical of watercourses in the Pilbara in that they are ephemeral and highly variable with flows that can increase from zero to hundreds of cubic metres per second in a matter of hours as a result of precipitation from tropical cyclones and low-pressure weather systems. Although none of the on-site creeks are gauged, it is understood that the majority of annual stream flow occurs during January, February and March, after which they usually recede and dry up by June or July.

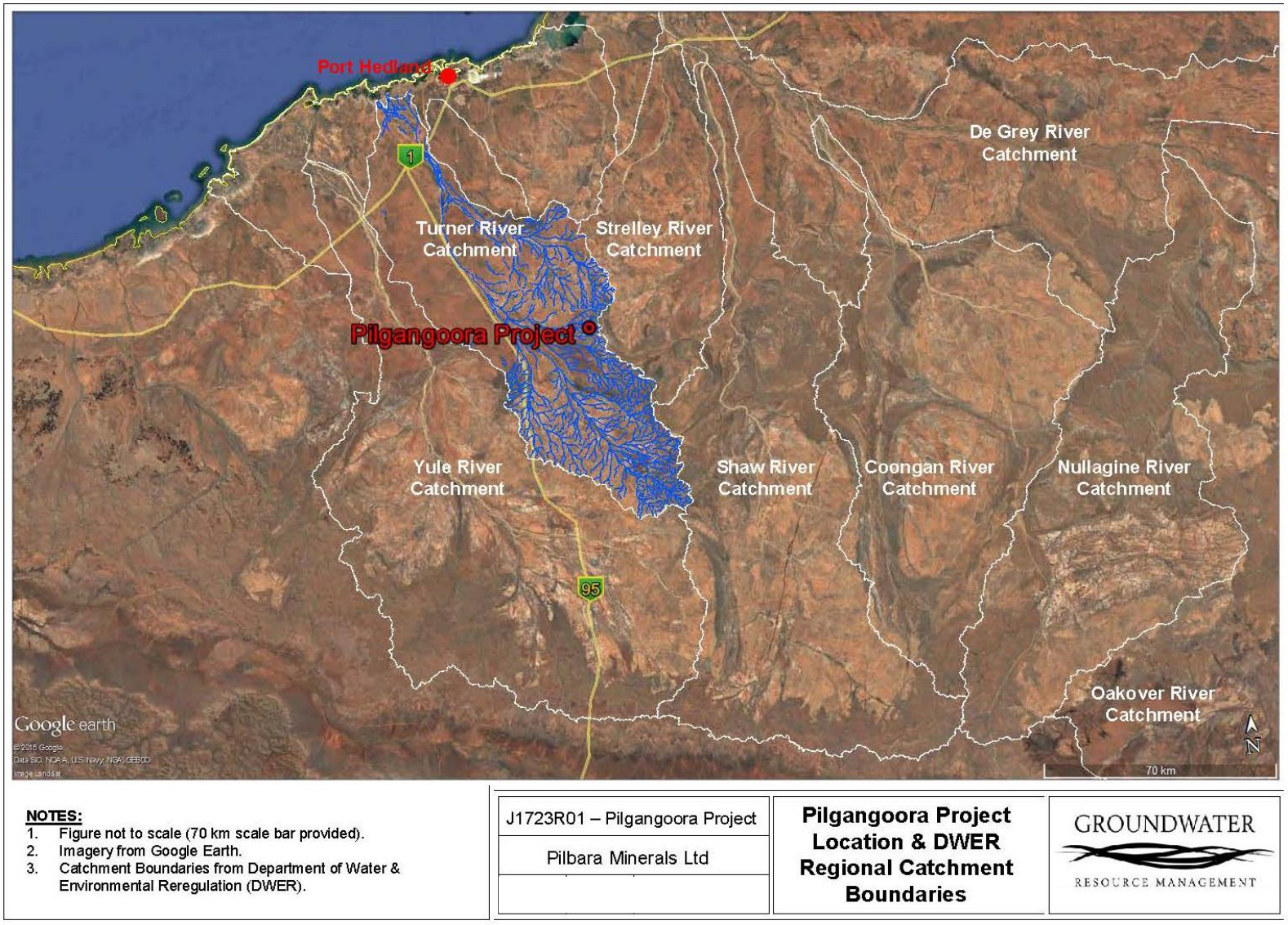


Figure 8: Regional surface water catchment boundaries

2.6.2 LOCAL SURFACE WATER CATCHMENTS

The proposed clearing envelope intersects with the Southern Creek and Pilgangoora Creek catchments identified by Groundwater Resource Management (GRM) (2018) – see catchments 4 and 5 in Table 2, and appearing on Figure 9. The surface water assessment appears attached as Appendix 1.

Table 2: Existing pre-mining catchment areas

NO	CATCHMENT NAME	AREA (KM^2)
1	Turner River East Creek see note 1	28.463
2	Northern Creek (exc. Houston and Pilgangoora Creeks) see note 2	26.403
3	Houston Creek see note 2	17.553
4	Pilgangoora Creek see note 2	18.126
5	Southern Creek	18.844
6	Chinnamon Creek see note 3	287.544
	Total Combined Catchment Area	**396.933**

Notes:

1. Turner River East Creek catchment area measured to confluence with eastern headwaters.

2. Northern Creek catchment area measured to confluence with Chinnamon Creek and excluding Houston Creek (17.553 km^2) and Pilgangoora Creek (18.126 km^2). Both Houston and Pilgangoora Creeks report to Northern Creek, giving it a combined catchment area of 62.082 km^2.

3. All of the above creeks, excluding Turner River East Creek, report to Chinnamon Creek catchment which has a combined area of 368.470 km^2 upstream of its confluence with the Turner River.

All of these catchments ultimately report to the Turner River downstream (west) of the Project site.

It is expected that the catchments with ephemeral creeks that intersect the proposed clearing envelope will change over time, with portions of the catchment being lost upstream of the proposed clearing envelope due to mining activities.

Within the proposed clearing envelope, it is expected that the Southern Creek catchment and the Pilgangoora Creek catchments will be subject to changes in surface water hydrology associated with construction of infrastructure. These will be assessed under a *Rights in Water and Irrigation Act 1914*, section 11/17/21A permit to interfere with bed and banks.

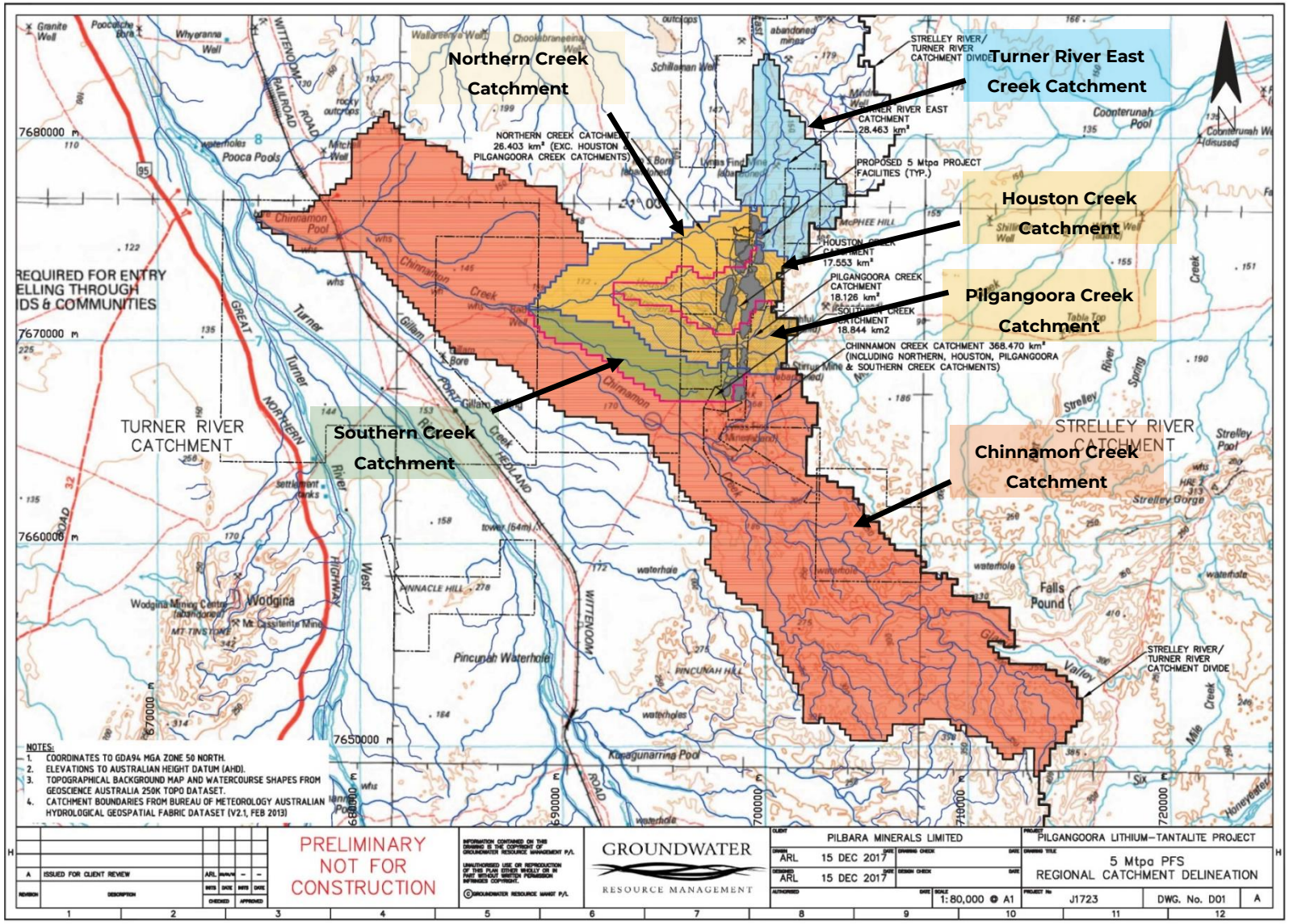


Figure 9: Surface water catchments at the Pilgangoora Project

2.7 GROUNDWATER

2.7.1 REGIONAL HYDROGEOLOGY

The Pilgangoora project lies within the East Pilbara Granite Greenstone Terrane. There are no highly productive aquifers in this province although fractured rock aquifers are associated with the greenstones and occasional quartz veining.

Data from the broader Pilgangoora project indicates that there is an east to west hydraulic gradient across the site, with a typical depth to groundwater of between 23 mgbl and 53 mbgl. Mining activity has locally altered the groundwater table in the area, with drawdown around pits and supply bores and some mounding around the existing tailings facilities.

Previous field investigations have found relatively low permeability in bedrock. Regions of higher permeability occur in alluvium and in some fracture zones in the bedrock, which tend to underly some of the alluvial waterways, such as Pilgangoora Creek.

Groundwater is recharged by direct rainfall or by stream flow during episodic rainfall events. Recharge is predominantly from surface water runoff and flooding events along the upper reaches of Pilgangoora Creek and Houston Creek (a tributary of Chinnamon Creek). Recharge occurs mainly on or adjacent to the groundwater divide and along drainage lines.

The hydrogeology of the Pilgangoora project area is characterised by an east to west draining system, with the groundwater divide coincident with the catchment divide (GRM, 2018). Throughflow is therefore considered to be limited given the setting at the top of the groundwater catchment. In the proposed clearing envelope there are westerly trending creeklines, these likely feature a greater depth of weathering into the underlying basement, and are anticipated to act as preferential pathways for groundwater flow.

2.8 FLORA AND VEGETATION

2.8.1 SURVEYS

Flora and vegetation surveys conducted over areas of the proposed clearing envelope appear in Table 3. The survey reports are attached as Appendix 3 and Appendix 3.

Table 3: Flora, vegetation and fauna surveys

AUTHOR	REPORT	YEAR	SURVEY AREA	STATUS
ecologia Environment (*ecologia)*	Altura Mining Ltd: Pilgangoora Lithium Project – M45/1260.	2018	M45/1260	Reconnaissance flora and vegetation survey and a Level 1 fauna and fauna habitat assessment
Animal Plant Mineral Pty Ltd (APM)	Pilbara Minerals: TSF Options 2 and 5, Pilgangoora Project Biological Survey, Pilbara, Western Australia	2022	Option 5 includes area of: M45/1260 L45/485	Detailed flora and vegetation survey and Targeted terrestrial vertebrate fauna survey

ecologia undertook their survey between 14-16 May 2018, following a significantly higher than average rainfall period in January of that year and a slightly lower period in February, March and April.

APM undertook their survey between 4-8 October 2022. The rainfall in Winter/Spring preceding the survey was approximately double the average for the period. The higher-than-average winter rainfall is a result of a high total monthly rainfall in May of 123.8 millimetres (mm), which is almost 4.5 times higher than the long-term average of 52.3 mm for the same period.

The details from the flora, vegetation and fauna assessment is provided below in the following sections.

2.8.2 FLORA

ecologia (2018) found a total of 122 sub-generic vascular plant taxa from 71 genera and 27 families were recorded within M45/1260. Of these, two were State listed Priority Flora (Priority 3) species (*Euphorbia clementii* and *Triodia chichesterensis*) and three were introduced.

APM (2022) recorded a total of 123 species within the Study Areas, comprising 117 native species and six introduced species. APM found no conservation significant flora within the survey area.

2.8.3 VEGETATION TYPES

ecologia (2018) described and mapped six vegetation units within the study area and appear below summarised in Table 4 below.

Table 4: Vegetation units mapped by *ecologia* (2018)

CODE	LANDFORM	VEGETATION DESCRIPTION	M45/1260	
			ha	%
S1	Stony plains, undulating plains	*Acacia inaequilatera* and *Acacia ancistrocarpa* mid open shrubland over *Triodia longiceps* (±*T. lanigera*, *T. brizoides*, *T. epactia*) open hummock grassland.	289.88 (mosaic)	83.9
S2	Gilgai, claypans	*Neptunia dimorphantha* and *Sida fibulifera* low open shrubland over *Eriachne benthamii* and *Cynodon convergens* open grassland.		
S3	Drainage lines, floodplains	*Acacia acradenia*, *A. ancistrocarpa*, *A. tumida* var. *pilbarensis,* and *Petalostylis labicheoides* mid open shrubland over *Triodia epactia* (±*T. wiseana*) hummock grassland.	31.96	9.2
S4	Low stony quartzite rises	*Acacia inaequilatera* sparse mid shrubland over *Triodia chichesterensis* (P3) open hummock grassland.	3.37	1.0
W1	Minor creek	*Eucalyptus victrix* and *Corymbia hamersleyana* low open woodland over *Acacia colei* mid sparse shrubland over *Triodia epactia* sparse hummock grassland.	0.54	0.2
W2	Minor creek, drainage lines	*Corymbia hamersleyana* low open woodland over *Acacia acradenia* and *A. ancistrocarpa* mid sparse shrubland over *Triodia epactia* (±*T. wiseana*, *T. longiceps*) open hummock grassland.	19.77	5.7

APM (2022) mapped three vegetation types within the survey area summarised in Table 5 below. The vegetation mapping followed the broad methodology of MMWC 2016 that has undertaken extensive mapping of the broader Pilgangoora Project area.

Table 5: Vegetation Types of the APM 2022 survey areas

CODE	LANDFORM	VEGETATION DESCRIPTION	TSF OPTION 5	
			ha	%
12a	Undulating plains	Isolated low *Corymbia hammersleyana* over mid to tall, isolated shrubs of *Acacia tumida*, *Acacia adsurgens* and *Acacia inaequilatera* with hummock grassland of *Triodia angusta*, *Triodia wiseana* and *Triodia lanigera*	293.6	89.2
13a	Creeks	Low open woodland of *Eucalyptus camaldulensis* , *Corymbia hammersleyana* and *Eucalyptus victrix* ; sparse mid to tall shrubland of *Acacia tumida*, *Acacia stellaticeps* and *Acacia bivenosa* over *Triodia epactia*, **Cenchrus ciliaris* and **Cenchrus setiger* tussock/ hummock grassland.	20.8	6.3
14a	Drainage depression	*Corymbia hammersleyana* low open woodland over sparse forbland/low shrubland of *Streptoglossa odora*, *Goodenia lamprosperma* and *Solanum diversiflorum*.	2.0	0.6
D	Disturbed	Disturbed – clear of vegetation	12.8	3.9

None of the mapped vegetation types correspond to Commonwealth (*Environment Protection and Biodiversity Conservation Act* 1999) or State (*Biodiversity Conservation Act 2016*) listed Threatened Ecological Communities (TEC's) or Priority Ecological Communities (PECs). One Priority 3 Ecological Community is located approximately 30 km west of the Study Areas; the Gregory Land System.

The APM 2022 vegetation mapping with the inclusion of the S4 vegetation community mapped by *ecologia* (2018) containing *Triodia chichesterensis* (P3) appears below as Figure 10.

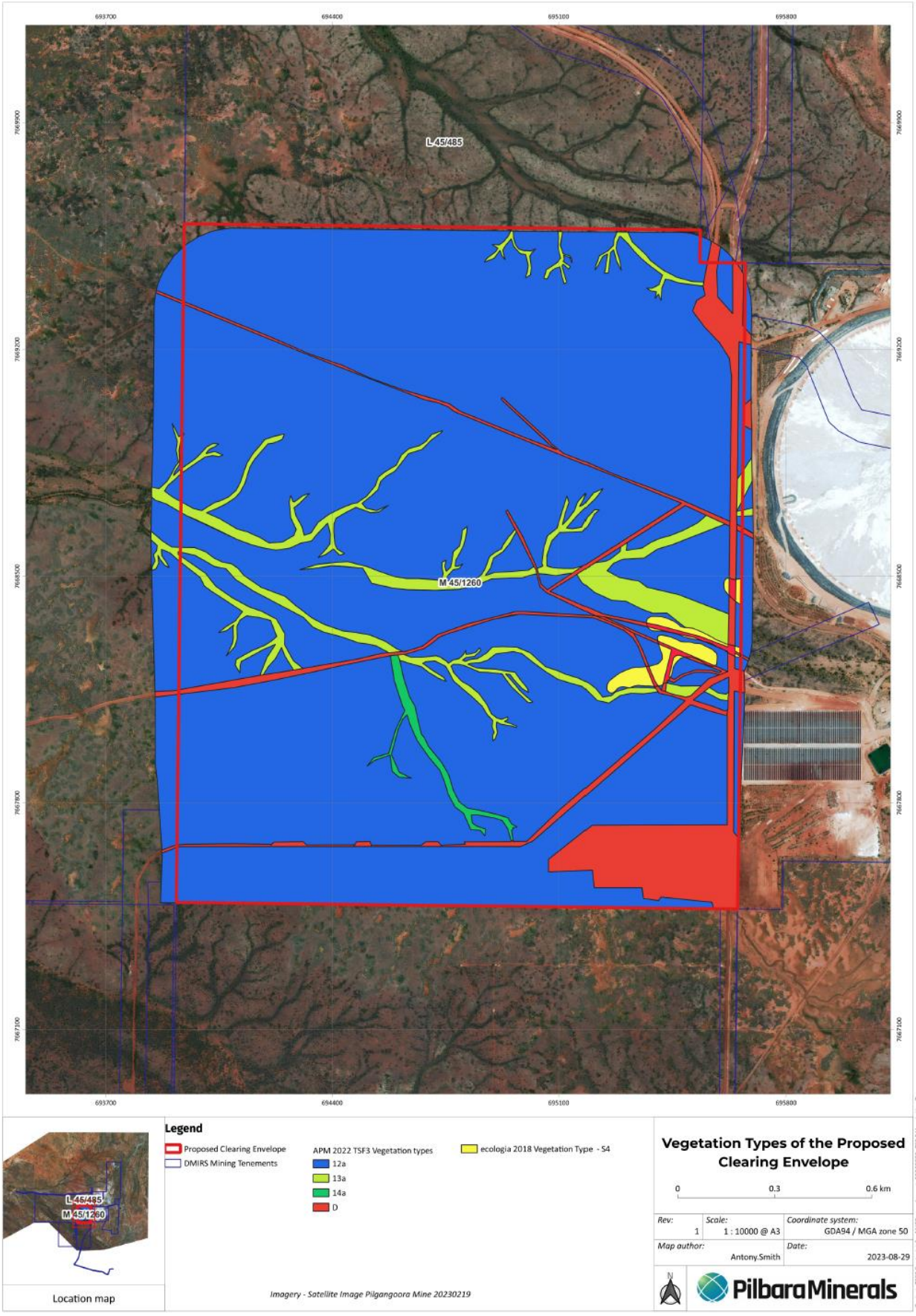


Figure 10: Vegetation types of the proposed clearing envelope

2.8.4 VEGETATION CONDITION

ecologia (2018) assessed vegetation condition across most of the study area as 'Very Good' to 'Excellent', with no or minimal weed invasion and insignificant grazing. Vegetation within the creek line and surrounding floodplain was rated as 'Good' due to more significant grazing and trampling by cattle and higher abundance of introduced species.

APM (2022) recorded vegetation condition with the TSF Option 5 study area as predominately *Very Good* (89.2%) and *Good* (6.3%), with remaining areas as *Poor* (0.6%) and *Completely Degraded* (3.9%). The primary sources of disturbance on site are moderate to high grazing impact from cattle and roads to support the pastoralism activities and mining activities. Several weed species occur primarily through the creek lines are grasses valued for pastoralism.

2.8.5 SIGNIFICANT FLORA

ecologia (2018) recorded Euphorbia clementii (Priority 3) from 27 locations (approx. 250 individuals) within M45/1260, where it was found almost exclusively on vehicle tracks and windrows. *Triodia chichesterensis* (Priority 3) was recorded from the eastern border of the study area where it formed a dominant component of the vegetation community present on stony quartzite plains (1000+ individuals). The number of *T. chichesterensis* is likely to have declined from the 2018 survey due to disturbance for access roads/tracks through M45/1260.

ecologia advises that no suitable habitat (or suitable land system) for the Endangered *Quoya zonalis* (formerly *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)) was identified within the study area.

APM (2022) did not record any priority flora however they do discuss the possibility of occurrence of *Triodia chichesterensis*, the known range of the species (study areas being in the middle of the known range) and the difficulty of distinguishing it from *Triodia lanigera*. APM discusses that where the two the co-occur, there is a subtle but consistent substrate change that marks the shift in species, with *T. lanigera* occurring on sandier soils and *T. chichesterensis* on rockier soils with quartzite pieces.

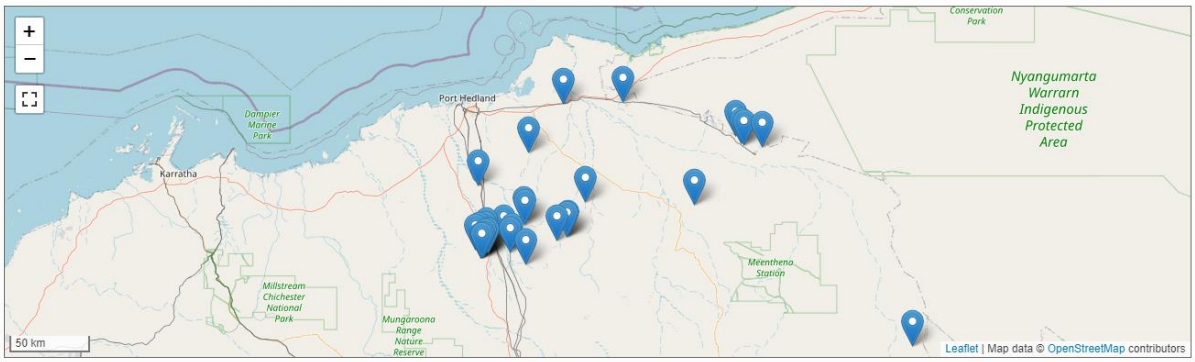
It is likely that the populations of *Euphorbia clementii* and *Triodia chichesterensis* recorded by *ecologia* (2018) will be removed by proposed clearing. Based on current Florabase records, both species are well represented outside of the proposed clearing envelope – see Figure 11 below.

Euphorbia clementii Domin

Reference	Biblioth.Bot. 89:308-309 (1927)
Conservation Code	Priority Three
Naturalised Status	Native to Western Australia
Name Status	Current

Erect herb, to 0.6 m high. Gravelly hillsides, stony grounds.

Grazyna Paczkowska, Descriptive Catalogue, 29 August 1996

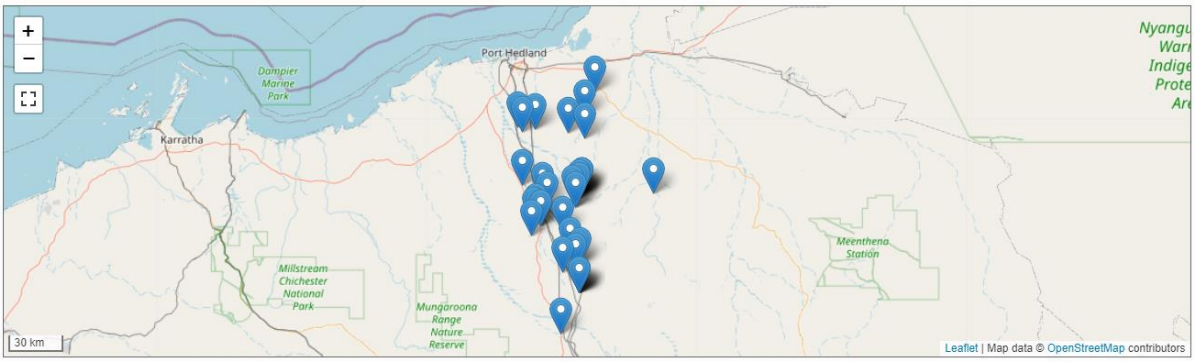


Distribution

IBRA Regions	Pilbara.
IBRA Subregions	Chichester, Roebourne.
Local Government Areas (LGAs)	East Pilbara, Port Hedland.

Triodia chichesterensis B.M.Anderson

Reference	Austral.Syst.Bot. 30:206-209, Fig. 8 (2017)
Conservation Code	Priority Three
Naturalised Status	Native to Western Australia
Name Status	Current



Distribution

IBRA Regions	Pilbara.
IBRA Subregions	Chichester.
Local Government Areas (LGAs)	East Pilbara, Port Hedland.

Figure 11: Distribution of *Euphorbia clementii* (P3) and *Triodia chichesterensis* (P3)

2.8.6 SIGNIFICANT VEGETATION

ecologia (2018) suggest that vegetation unit S4 (appearing on Figure 10) may be considered locally significant as it supports the Priority 3 species *Triodia chichesterensis*, which is restricted to the central Chichester IBRA subregion. The area of S4 has declined since 2018 through disturbance from access roads/tracks through M45/1260.

APM (2022) reports The Chichester Subregion includes seven Ecosystems at Risk which are subject to a range of threatening processes (Kendrick and McKenzie 2001). None of these ecosystems are relevant to the Study Areas.

Two species that have been associated with GDEs were recorded in the vegetation type 13a. The Bureau of Meteorology GDE Atlas indicates the Study Areas have a low likelihood of dependency. The red gum and coolabah within the 13a vegetation type are of low height and stem diameter, likely to be a consequence of intermittent water availability, supporting the assessment of a low likelihood of access to groundwater.

Regional Vegetation Associations within the Study Areas as described by Beard have over 99% pre-European Vegetation extent remaining. Conservation significance ranking of vegetation associations occurring within the Study Areas are of 'Least Concern'.

2.8.7 INTRODUCED FLORA

ecologia (2018) recorded three introduced flora in the M45/1260 study area (*Cenchrus ciliaris*, *C. setiger*, and *Echinochloa colona*). Two of the introduced species recorded (*C. ciliaris* and *C. setiger*) were primarily associated with a minor creek line and adjacent floodplains while *E. colona* was recorded in low abundance from small claypans (gilgai).

APM (2022) identified six introduced flora species in the study areas inclusive of *C. ciliaris* and *C. setiger*.

A compiled list from the surveys appears as Table 6. These species are listed as 'Permitted' on the Western Australian Organism List (DAFWA 2016) and are not Weeds of National Significance.

Table 6: Compiled list of introduced flora appearing in study areas

SPECIES	COMMON NAME	DESCRIPTION
		BAM Act S11 - Permitted
Aerva javanica	Kapok	Erect, much-branched perennial herb, 0.4-1.6 m high. Flowers white from January to October. Often found growing on sandy soils and along drainage lines.
Cenchrus ciliaris	Buffel grass	Tufted or sometimes stoloniferous perennial, grass-like or herb. 0.2 - 1.5 m high. Flowers purple from February to October. Grows on white, red, or brown sand, stony red loam, or black cracking clay.
Cenchrus setiger	Birdwood grass	Erect, tussocky, stoloniferous perennial, herb or grass-like. Grows to 0.5 m high. Flowers cream to purple from April to May.

SPECIES	COMMON NAME	DESCRIPTION
		Grows on brown sands, red loam, or pindan soils on sand dunes, plains, rangelands, stony hillsides, or floodplains.
Echinochloa colona	Awnless barnyard grass	Tufted annual, grass-like or herb, 0.2-0.6(-0.9) m high. Flowers green/purple, February to July. Grows on black sand, black clay. Near watercourses and swamps.
Flaveria trinervia	Speedy weed	An erect, annual herb preferring wet areas. Often in disturbed areas.
Malvastrum americanum	Spiked malvastrum	Erect perennial, herb or shrub, 0.5-1.3 m high. Fl. yellow-orange, Apr to Jul. Orange/red/yellow sands, gritty alluvial sand, black/brown clay, alluvial cracking clays, limestone, calcrete. Stony ridges and hillsides, floodplains, along drainage lines.
Triumfetta pentandra	-	Woody annual, herb or shrub, to 1.5 m high. Fl. yellow-green, Apr to May. Brown sand, black clayey sand, red-brown clay, sandstone. Sandbank above river flood plain, forest edges, coastal sites, disturbed areas.

2.9 FAUNA

2.9.1 FAUNA SURVEYS

Fauna desktop and field surveys were undertaken over the proposed clearing envelope by ecologia (2018) and APM (2022) and were reported as per Table 3 and appear as Appendix 2 and Appendix 3 . The APM (2022) study provides the most recent results for the area and is used as the basis for this application.

2.9.2 DESKTOP FAUNA STUDY RESULTS

The Department of Biodiversity Conservation and Attractions (DBCA) database search returned 16 species of significant fauna that have previously been recorded within 30 km of the Study Areas. Of these, four are listed as migratory bird species (MI) and one as Other Specifically Protected (OS). Record locations of threatened (T) and priority (P) fauna in relation to the Study Areas are shown in Figure 5-1 of Appendix 3.

No T or P fauna species have previously been recorded within the Study Areas.

The Protected Matters Search Tool (PMST) returned 11 additional species, six T and five MI. These are species that do not have records within 30 km but where modelling has identified that suitable habitat is known to occur or may occur.

The Literature review returned additional information about the locations and abundance of Pilbara leaf-nosed bat and Northern quoll records. Database search results of T, P and MI fauna within 30 km of the Study Areas are listed in Table 7, with the outcome of the likelihood of occurrence assessment.

Table 7: Significant fauna database records and likelihood of occurrence

Species	Common Name	Conservation Code		Assessment of Occurrence
		BC Act	EPBC Act	
Actitis hypoleucos	Common sandpiper	MI	MI	Possible. No saline or coastal habitats available. Freshwater habitats are likely to be seasonally present in the drainage lines, however there are no permanent or semi-permanent pools. The undulating plains habitat would receive run-on following significant rainfall. Clay in the lower areas suggests inundation occurs following significant rainfall. Wading habitat would be available at these times.
Calidris acuminata	Sharp-tailed sandpiper	MI	MI	
Calidris ferruginea	Curlew sandpiper	CR	CR, MI	
Calidris melanotos	Pectoral sandpiper	-	MI	
Numenius madagascariensis	Eastern curlew	CR	CR, MI	
Apus pacificus	Fork-tailed swift	MI	MI	Possible. Utilises a broad array of habitats.
Charadrius veredus	Oriental plover	MI	MI	Likely. Suitable habitat in the seasonally inundated areas.
Erythrotriorchis radiatus	Red goshawk	VU	VU	Unlikely. Not within the known range of the species distribution.
Falco hypoleucos	Grey falcon	VU	VU	Likely. All areas are suitable for foraging. No suitable nesting habitat.
Falco peregrinus	Peregrine falcon	OS	-	Likely. All areas are suitable for foraging. No suitable nesting habitat.
Glareola maldivarum	Oriental pranticole	MI	MI	Possible. Suitable habitat in the seasonally inundated areas.
Hirundo rustica	Barn swallow	MI	MI	Possible. Suitable habitat in the seasonally inundated areas.
Motacilla cinerea	Grey wagtail	MI	MI	Unlikely. No opportunities for fast flowing water.
Motacilla flava	Yellow wagtail	MI	MI	Possible. Suitable habitat in the seasonally inundated areas.
Pezoporus occidentalis	Night parrot	CR	EN	Possible. No local records. Habitat modelling includes the Study Areas at the extremity of the species potential extent. Foraging resources are limited.

Species	Common Name	Conservation Code		Assessment of Occurrence
		BC Act	EPBC Act	
Rostratula australis	Australian painted-Snipe	EN	EN	Unlikely. No habitat occurs in the Study Areas. Vegetation too open to provide well vegetated shallows.
Dasycercus blythi	Brush-tailed mulgara	P4	-	Possible. Sandy rises in the undulating plains habitat is suitable.
Dasyurus hallucatus	Northern quoll	EN	EN	Likely. Suitable foraging habitat in the creeks but of low quality. No suitable denning habitat available.
Hipposideros stenotis	Northern leaf-nosed bat	P2	-	Unlikely. Not within the known range of the species distribution.
Lagorchestes conspicillatus leichardti	Spectacled hare-wallaby	P4	-	Unlikely. Historic records nearby however habitat is too open to be suitable.
Macroderma gigas	Ghost bat	VU	VU	Likely. Foraging habitat available. No roosting habitat available.
Macrotis lagotis	Greater bilby	VU	VU	Possible. Suitable habitat includes the undulating plains habitats.
Pseudomys chapmani	Western pebble-mound mouse	P4	-	Present. Mounds located in the undulating plains where suitable pebbles occur.
Rhinonicteris aurantia	Pilbara leaf-nosed bat	VU	VU	Likely. No roosting habitat available, foraging quality of habitats is Low.
Sminthopsis longicaudata	Long-tailed dunnart	P4	-	Unlikely. No suitable habitat.
Anilios ganei	Gane's blind snake (Pilbara)	P1	-	Unlikely. No suitable habitat.
Liasis olivaceus subsp. *baronni*	Pilbara olive python	VU	VU	Unlikely. No suitable habitat.
Liopholis kintorei	Great desert skink	VU	VU	Unlikely. No records in the local area. May occur 10 km to the east.

NatureMap records for eight introduced fauna recorded within 30 km of the Study Areas were returned and are listed below:

- Camel (*Camelus dromedarius*);
- Cat (*Felis cattus*);
- Cattle (*Bos taurus*);
- Dog (*Canis lupus*);
- Donkey (*Equus asinus*)
- Fox (*Vulpes v*ulpes)
- Horse (*Equus caballus*); and
- House mouse (*Mus musculus*).

2.9.3 FAUNA FIELD SURVEY RESULTS

Fauna Habitat

The Study Areas are characterised by undulating plains dissected by ephemeral creeks. There are higher ranges to the east and water sheds from these into the Study Areas and continues through to the west.

The presence of water is ephemeral and no permanent or semi-permanent water is available. The undulating plains has stony surface on the highest areas, sand surface on the lower rises and clay soils in the depressions. This arrangement is often referred to as gilgai. The lower clay areas are likely to be inundated following significant rainfalls.

Fauna habitat assessments were performed at 25 locations. Descriptive data was recorded including soil type, landform, presence of microhabitats, disturbances and images were recorded. Two fauna habitats are described for the Study Areas and are summarised in Table 8 below. Whilst the inundated clay depressions offer a different set of microhabitats to the sandy and stony rises, the scale of the patterning is too fine to be described as separate habitats and they are grouped as undulating plains. The distribution of fauna habitats is shown in Figure 12.

Table 8: Fauna habitat description of the survey area

Habitat Code	Name	Sites	Description	Photo	Extent in Study Area (ha)	
					Option 2	Option 5
FH1	Undulating plains	MSC06 MSC07 MSC10 MSC11 NP001 NP002 NP003 BM01 BM02 BM03 BM04 BM05 BM06 BM07 BM08 BM09 BM10 BM11	Undulating plains with clay soils in the lowest areas interspersed with higher ground of sandy and stony surface soils. Seasonal inundation likely to occur in the lower areas. Sandy rises suitable for burrowing species. Stony areas suitable for pebble mound mouse. Hummock grasses in some areas are large. The vegetation consists of Isolated low *Corymbia hammersleyana* over mid to tall, isolated shrubs of *Acacia tumida, Acacia adsurgens* and *Acacia inaequilatera* with hummock grassland of *Triodia angusta, Triodia wiseana* and *Triodia lanigera*		277.5 (78.2%)	293.6 (89.2%)

Habitat Code	Name	Sites	Description	Photo	Extent in Study Area (ha)	
					Option 2	Option 5
FH2	Ephemeral creeks	MSC04 MSC12 MSC14 MSC16 AS622904 AS642029 AS660630 AS660654 NP004 RV001	Ephemeral creeklines with rocky sandy loam soil. Riparian banks are often present with alluvial loamy soils. Creeks are all ephemeral with no permanent or semi-permanent pools present. Sandy soils is suitable for burrowing species. Occasional trees but generally of insufficient size to have hollows and no fallen hollow branches observed. This habitat may act as a wildlife corridor for birds, bats, mammals, and reptiles. The condition of the habitat is poor, the cover of weedy grasses is high, there is a low leaf litter or accumulation of dead wood to provided microhabitats, and a high grazing pressure. The vegetation consists of Low open woodland of *Eucalyptus camaldulensis, Corymbia hammersleyana* and *Eucalyptus victrix*; sparse mid to tall shrubland of *Acacia tumida, Acacia stellaticeps* and *Acacia bivenosa* over *Triodia epactia, *Cenchrus ciliaris* and **Cenchrus setiger* tussock/hummock grassland.		66.9 (18.9%)	22.8 (6.9%)
D	Disturbed				10.4 (2.9%)	12.8 (3.9%)

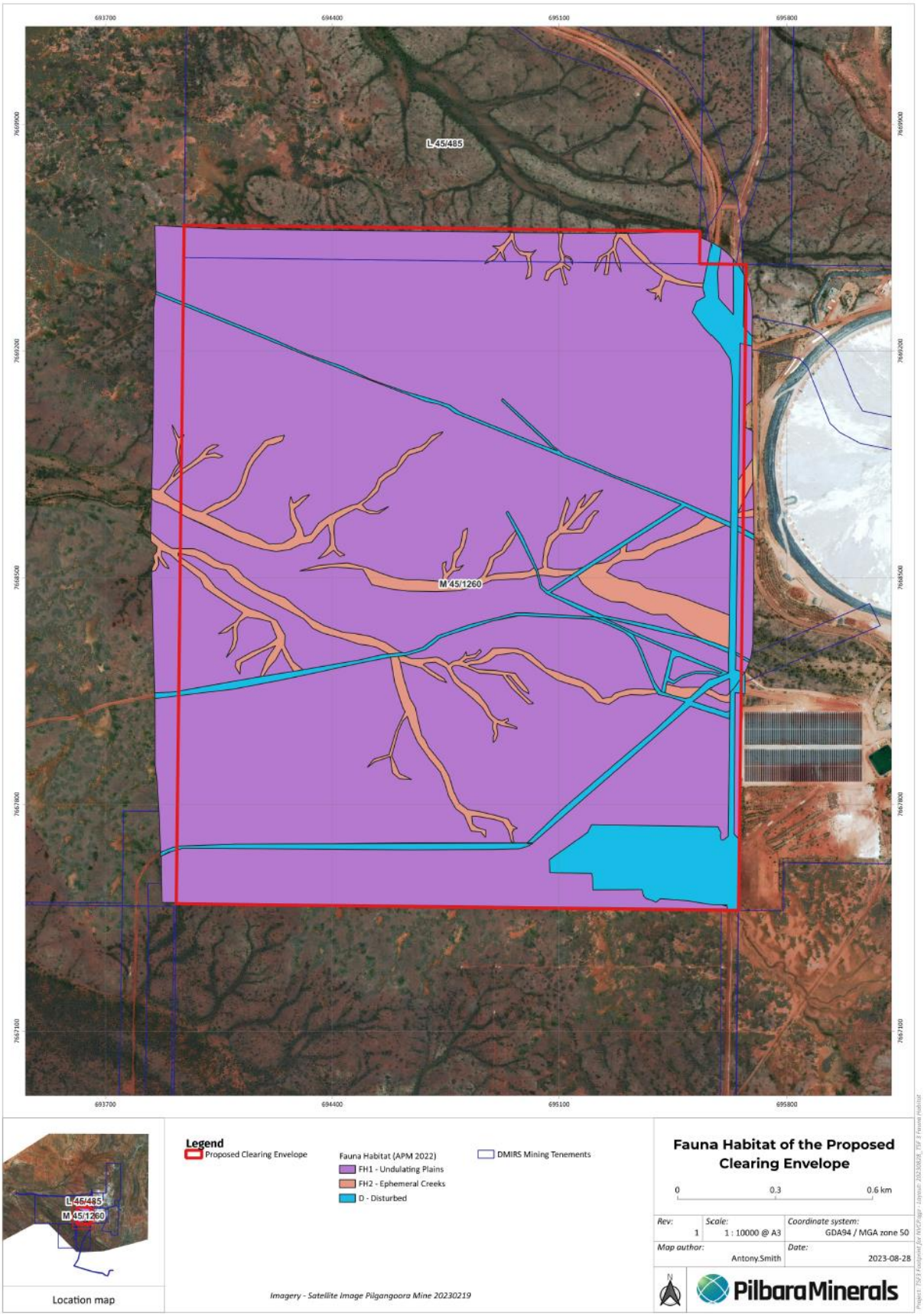


Figure 12: Fauna habitats of the proposed clearing envelope

Conservation Significant Fauna

The APM 2022 survey recorded multiple active Pebble mound mouse mounds. The Pebble mound mouse is known to occur in the area and its presence within the Study Areas is confirmed. The suitability of mound building habitat is confined by the availability of suitable size pebbles, which occur on the higher rises.

The Northern quoll is known to occur in the local area and critical habitat has been identified in the ridgeline to the east of the Study Areas. The Study Areas are more than 2 km from this critical habitat.

The Study Areas contain habitats that are of possible value to the Northern quoll for foraging and dispersal however, they are of low quality. No signs of the Northern quoll were recorded and no captures on cameras were obtained. It is possible the Northern quoll occasionally uses the Study Areas however, they do not constitute critical habitat.

The Pilbara leaf-nosed bat is known to occur in the local area and diurnal roosts occur within the range of the Study Areas. The quality of habitat for the Pilbara leaf-nosed bat is limited to low quality foraging – the species may occasionally use the site for foraging or in transit to other more productive areas.

The Ghost bat is known to occur in the local area and diurnal roosts are known to occur within range of the Study Areas. The Study Areas are suitable foraging habitat for the Ghost bat. The Ghost bat was not recorded during the acoustic survey however the method has limitation with detection of the species. The species is likely to occur within the Study Areas, for foraging purposes only.

The Grey falcon is known to occur in the local area and the Study Areas are within foraging range of the species. Grey falcon nesting in the Turner River area are likely to visit the Study Areas at some times for the purpose of foraging.

During periods of inundation, the Study Areas are likely to sustain habitat suitable for migratory shorebirds. The quality of the habitat is likely to be lower than those available in the near coastal areas, as reflected in the lack of records from the site and immediate surrounds. There are no nationally or internationally significant aggregations of migratory species known to occur within or near the Study Areas.

An abandoned burrow that may once have hosted Brush-tailed mulgara was recorded. The burrow was collapsed, however there were indications of a multi-entranced burrow system as used by the Brushtailed mulgara. Suitable habitat is limited to the sandy rises that occur sporadically throughout the undulating plains. No further signs were recorded. Whilst the Study Areas are likely to contain suitable habitat, there is no evidence of the species being currently present.

2.10 ENVIRONMENTALLY SIGNIFICANT AREAS

2.10.1 CONSERVATION ESTATE

No part of the proposed clearing envelope appears within the Western Australian conservation estate.

2.10.2 ENVIRONMENTALLY SENSITIVE AREAS

No sites within the proposed clearing envelope comprise *Environmentally Sensitive Areas* within the *Environmental Protection (Environmentally Sensitive Area) Notice 2005*, declared under Part V, Division 2 of the *EP Act 1986*.

3. ENVIRONMENTAL RISK MANAGEMENT

3.1 IDENTIFYING ENVIRONMENTAL THREATS

Threats related to clearing of native vegetation at the Pilgangoora Project are summarised in Table 9.

Table 9: Threats from native vegetation clearing

ENVIRONMENTAL THREAT	POTENTIAL RISK
Clearing of native vegetation	Clearing beyond approved boundaries and/or exceeding approved disturbance areas.
Dust	Impacts to native flora caused by dust emanating from the site.
Impacts to surface water flows	Clearing of vegetation leading to changes to runoff or mobilisation of sediment resulting in adverse impacts to natural surface water flows, potentially impacting creek lines and downstream riparian vegetation.
Native fauna and habitat	Clearing of vegetation and activity associated with the project has potential to directly (vehicle strikes, habitat removal) and indirectly impact native fauna (changes to foraging or dispersion dynamics).
Introduced flora	Weeds competing with native species and impacting the success of rehabilitation.

3.2 RISK ASSESSMENT

An Environmental Risk Assessment was undertaken for the threats identified above using the criteria adopted from the DMIRS Statutory Guidelines for Mining Proposals (2020) – see Table 10 below. The Site Environmental Risk Assessment process appears in Appendix 4.

Table 10: Environmental risk assessment

ENVIRONMENTAL THREAT	CAUSE	POTENTIAL IMPACT	BEFORE MANAGEMENT			MANAGEMENT PRACTICES TO BE IMPLEMENTED	AFTER MANAGEMENT		
			Consequence	Likelihood	Inherent Risk		Consequence	Likelihood	Residual risk
Clearing of vegetation	Clearing works undertaken for project development	Clearing of vegetation in unapproved areas and/or outside the tenement boundary. Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem	Moderate	Possible	Moderate (B3)	• Survey undertaken prior to clearing. • Induction training highlights the procedure for clearing and the consequences of unauthorised clearing. • Land Use Certificate permitting system and procedure is in place. • Survey control of areas to be cleared. • Post clearing checks to ensure clearing has been undertaken in accordance with approval.	Moderate	Unlikely	Moderate (C4)
		Clearing of vegetation resulting in loss of conservation significant species or habitat. Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem	Moderate	Likely	High(C2)	• Survey undertaken prior to clearing. • Induction training highlights the procedure for clearing and the consequences of unauthorised clearing. • Land Use Certificate permitting system and procedure is in place. • Survey control of areas to be cleared. • Understand and record Priority Flora locations. Maintain GIS records and record impacts to Priority Flora if they are subject to clearing.	Moderate	Possible	Moderate (B3)
Dust	Vehicle and machinery movement	Dust resulting from movement of vehicles and operation of machinery settles on adjacent vegetation and causes plant death. Environmental factor: Biodiversity/Flora/Fauna/ Ecosystem	Minor	Likely	Moderate (B2)	• Regular dust suppression of vehicle access roads, hardstand areas using water carts. • Stripping and movement of topsoil not to be undertaken in windy conditions where practical.	Minor	Unlikely	Low (B4)
	Wind	Dust generated by wind blowing across cleared areas and stockpiles settles on adjacent vegetation and causes plant death. Environmental factor: Biodiversity/Flora/Fauna/ Ecosystem	Minor	Likely	Moderate (B2)	• Regular dust suppression of vehicle access roads, hardstands using water carts. • Dust suppression of stockpiles as required. • Clearing of vegetation to be undertaken progressively.	Minor	Possible	Moderate (B3)
Surface water flows	Interruption of natural surface water flows	Surface water flows are captured or redirected away from the natural drainage channels resulting in impact to riparian vegetation. Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem • Water resources	Major	Possible	High (D3)	• Surface water flows to be redirected away from operational areas in an effort to minimise disruption of surface flow. • Surface Water Management Plan to implemented.	Major	Unlikely	Moderate (D4)

ENVIRONMENTAL THREAT	CAUSE	POTENTIAL IMPACT	BEFORE MANAGEMENT			MANAGEMENT PRACTICES TO BE IMPLEMENTED	AFTER MANAGEMENT		
			Consequence	Likelihood	Inherent Risk		Consequence	Likelihood	Residual risk
	Uncontrolled surface water movement	Surface water flows carry sediment into surrounding vegetation causing vegetation death. Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem • Water resources	Moderate	Likely	High (C2)	• Drainage and containment structures to direct flows to sediment traps for removal of sediment before discharge to the environment.	Moderate	Unlikely	Moderate (C4)
Native fauna and habitat	Clearing of Vegetation	Clearing results in loss of conservation-significant fauna or suitable habitat Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem	Moderate	Possible	Moderate (C3)	• Survey undertaken prior to clearing. • Clearing managed with the Land Use Certificate process.	Moderate	Unlikely	Moderate (C4)
	Interaction with fauna	Interaction with native fauna causes detriment to significant species. Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem	Moderate	Possible	Moderate (C3)	• Induction and site rules relating to avoiding interaction with fauna. • Appropriate management of waste. • Speed limits imposed on Project roads. • Management of site landfill in accordance with DWER licence conditions.	Moderate	Unlikely	Moderate (C4)
Introduced flora	New weed species introduced to site	Machinery and equipment brought to site carrying seeds of weed species not currently found in the project area. Environmental factor: • Biodiversity/Flora/Fauna/Ecosystem	Minor	Possible	Moderate (B3)	• Weed hygiene procedure. • Machinery and equipment to be cleaned prior to being mobilised to site. • Inspection of machinery on arrival, not permitted to work until appropriately cleaned. • Weed surveys to be undertaken.	Minor	Unlikely	Low (B4)

3.3 SPECIFIC MANAGEMENT ACTIONS TO ADDRESS IMPACTS FROM CLEARING

An assessment of the environmental risks related to development and operation of the Pilgangoora Project has been undertaken. The following sections summarise the management methods for each of the key risks identified in the risk assessment. Factors assessed as having a Low level of risk (refer to Table 10) are not considered further.

3.3.1 CLEARING OF NATIVE VEGETATION

Mitigating factors

Vegetation in the Pilbara is resilient and typically recovers quickly following disturbance.

ecologia (2018) advises that no suitable habitat (or suitable land system) for the Endangered *Quoya zonalis* (formerly *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)) was identified within the study area. It will not be impacted by any proposed disturbance.

A population of *Triodia chichesterensis* (P3) was recorded within the proposed clearing envelope (*ecologia* 2018). Up to 1,000+ individuals are expected to be cleared for establishment of infrastructure at the Project.

Euphorbia clementii (P3) was found at 27 locations (approx. 250 individuals) within the proposed clearing envelope during surveys in 2018. It was found almost exclusively on vehicle tracks and windrows. The species is believed to be a disturbance opportunist and is therefore likely to respond positively to small areas of disturbance. This species was not found in the APM 2022 survey. If the species still occurs within the proposed survey area, they are expected to be cleared for establishment of infrastructure at the Project.

Management Actions

To ensure clearing is managed appropriately management actions will include:

- The locations of Priority 3 flora species *Triodia chichesterensis* and *Euphorbia clementii* have been documented and is included in the GIS database. Impacts will be recorded as areas are cleared. Periodic inspection of soil stockpiles will be undertaken to monitor germinants of these species.
- Vegetation clearing protocols and the potential impacts of unauthorised clearing are included in the site induction.
- A Land Use Certificate system is in place and requires sign off by the Environmental Advisor prior to clearing being undertaken.
- Survey control will be utilised to set out the limits of areas to be cleared using survey pegs and flagging tape.
- All site personnel will be made aware of the vegetation clearing procedure and permitting requirements.

3.3.2 DUST

The main environmental impact resulting from dust emission is vegetation death emanating from high levels of dust settling on plant leaves, preventing photosynthesis and respiration.

The main sources of dust are clearing of vegetation, vehicle movement, machinery operation and strong winds.

Freshly cleared ground, as well as open areas such as laydowns and soil stockpiles have potential to generate dust, particularly in windy conditions.

Mitigating Factors

There is no vegetation believed to be particularly sensitive to dust. Rainfall during the wet season will assist in settling dust as well as removing it from plants.

Management Actions

To minimise dust generation management actions will include:

- Land clearing will be undertaken progressively and only when required.
- Land clearing and handling of topsoil in windy conditions will be avoided as far as practical.

3.3.3 SURFACE WATER

The creeks and drainages within the proposed clearing envelope are ephemeral in nature and only convey flow following periods of significant rainfall. High intensity, short duration rainfall events occur during the summer months when the potential exposure to tropical cyclones and other low-pressure related events is greatest.

Within the proposed clearing envelope, the proposed tailings storage facility was found to be close to the catchment centroid and therefore impacted by external flows from approximately 50% of the total catchment area of Southern Creek.

Surface water management will be required to maintain the creek line function during mine development and operations in the proposed clearing envelope.

Potential Impacts

Potential impacts to surface water drainage include:

- interruption to natural surface water flow patterns
- reduction of surface water runoff volume to the downstream environment
- adverse impact to riparian vegetation downstream from the Project
- increased risk of erosion and sedimentation resulting from ground disturbance

Mitigating Factors

Flood protection will be constructed around the TSF where required. This will ensure a significant volume of surface runoff continues to make its way to the natural drainage channels.

Surface water flows and subsequent runoff into the creeks is very intermittent and highly variable. Riparian vegetation in the region is therefore adapted to intermittent and variable water availability.

Management Actions

Within the proposed clearing envelope, it is expected that the Southern Creek catchment and the Pilgangoora Creek catchments will be subject to changes in surface water hydrology associated with construction of infrastructure. These will be assessed under a *Rights in Water and Irrigation Act 1914*, section 11/17/21A permit to interfere with bed and banks.

3.3.4 NATIVE FAUNA AND HABITAT

Clearing within the proposed clearing envelope will result in up to 345 ha of land.

Potential Impacts

Clearing of vegetation has potential to destroy fauna habitat, including habitat specific to conservation-significant fauna species.

Increased vehicle and machinery movements have potential to result in animal impacts from vehicle strikes.

Mitigating Factors

There are no Environmentally Sensitive Areas (ESA) or Threatened Ecological Communities (TEC) within the Project area.

The conservation significant fauna species recorded in the Project area are considered to be relatively common across the Pilbara (rainbow bee-eater, western pebble-mound mouse) or only foraging within the P.roject area with no active roosts present (Pilbara leaf-nosed bat).

Management actions

The specific management measures to mitigate the potential impacts from land clearing on fauna habitat include:

- Clearing of vegetation will be kept to the minimum required for the Project
- Land clearing management actions will be implemented to ensure clearing is undertaken as per the conditions of any granted Native Vegetation Clearing Permit

Management measure related to direct impact or interaction between personnel and fauna include:

- All employees and contractors will be required to participate in the site induction which will cover general and site-specific fauna issues, including information about legal obligations to protect fauna.
- Employees and contractors who are nominated to handle fauna, for example, the removal of snakes from work areas, will require suitable training and permits
- Vehicle movements will be confined to defined haul roads and access roads, and all roads within the mining area will have a maximum speed limit of 60km/h
- Native fauna will not be captured or intentionally handled except by personnel or consultants qualified and required to do so
- Road kills to be removed from the road by a minimum distance of 10 m into the vegetation to avoid further impacts on fauna, such as birds of prey feeding on carcasses

3.3.5 INTRODUCED FLORA

Seven introduced flora species have been identified within the proposed clearing envelope. They are common throughout the Pilbara Region.

Potential Impacts

Introduced flora has potential to spread throughout the project area as a result of vehicle and soil movement. Many of these species thrive in disturbed ground and subsequently compete with native species in rehabilitated areas, potentially adversely impacting the success of rehabilitation.

Buffel grass is a preferred fodder crop for cattle in the region. The species is widespread in lower-lying and previously disturbed ground, as well as creek lines, throughout the project area.

Management actions

To minimise the potential for adverse impacts resulting from introduced flora, PLS have implemented, or are in the process of implementing the following management actions:

- Weed surveys commenced in 2018 to determine introduction and/or spread of weed species and are ongoing throughout the broader project area.
- An ongoing weed control program within the broader project area.
- A weed hygiene program is in place and includes a requirement for machinery to be thoroughly cleaned and inspected before entering the site.
- Vegetation monitoring sites are to be established when sufficient rehabilitation has been completed and will include a measure of weed abundance in rehabilitation areas. The intent is that weed abundance in rehabilitated areas post-mining will not exceed weed abundance in comparable non-mining areas.

4. ADDRESSING THE TEN CLEARING PRINCIPLES

Under section 51-O of the *EP Act*, the CEO must have regard to the clearing principles, outlined in Schedule 5 of the *EP Act*, when deciding to grant, or refuse, a permit. Table 11 below addresses the ten clearing principles in relation to the proposed clearing envelope.

Table 11: Addressing the Ten Clearing Principles

THE TEN PRINCIPLES OF CLEARING NATIVE VEGETATION	
Principle (a)	**Native vegetation should not be cleared if it comprises a high level of biological diversity**
No threatened flora species or threatened ecological communities have been recorded from or are considered likely to occur within the assessment area. Proposed clearing is contained within the Satirist landsystem which is mapped as 377 km^2 within the Pilbara bioregion. Proposed clearing represents 0.002% of the Pilbara bioregion and 0.91% of the Satirist landsystem. Vegetation unit S4 may be considered locally significant as it supports the Priority 3 species *Triodia chichesterensis*, which is restricted to the central Chichester IBRA subregion, however there are significant records of the species occurring outside the proposed clearing envelope in the broader subbioregion. Regional Vegetation Associations within the Study Areas as described by Beard have over 99% pre-European Vegetation extent remaining. Conservation significance ranking of vegetation associations occurring within the Study Areas are of 'Least Concern'. Thereby the proposed clearing is unlikely to have a significant impact on biological diversity and it is unlikely to be considered to be at variance with clearing principle (a).	
Principle (b)	**Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia**
While the assessment area contains habitat suitable for supporting fauna indigenous to Western Australia, the vegetation is not likely to comprise the whole or part of or be necessary for the maintenance of significant habitat and is therefore unlikely to be at variance with clearing principle (b).	
Principle (c)	**Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.**
No rare (Threatened) flora has been recorded from the proposed clearing envelope and the vegetation in the assessment area is unlikely to include, or be necessary for the continued existence of rare flora. Vegetation was determined as unsuitable habitat (or suitable land system) for the Endangered *Quoya zonalis* (formerly *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)). The proposed clearing is not likely to be at variance with clearing principle (c).	
Principle (d)	**Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.**
The vegetation of proposed clearing envelope is not consistent with the description of any threatened ecological community.	

The closest Priority Ecological Community to the proposed clearing envelope is the Gregory Landsystem, over 30 km away. Given the distance from the PEC the clearing will not impact the community. Therefore, the clearing is not likely to be at variance with clearing principle (d).	
Principle (e)	**Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.**
Regional Vegetation Associations within the proposed clearing envelope as described by Beard have over 99% pre-European Vegetation extent remaining. Conservation significance ranking of vegetation associations occurring within the proposed clearing envelope are of 'Least Concern'. The proposed clearing is not likely to be at variance with clearing principle (e).	
Principle (f)	**Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.**
The proposed clearing envelope intersects with ephemeral creeks that flow periodically during high rainfall events associated with cyclonic events and tropical lows. Being ephemeral creeks, the associated vegetation is adapted long periods with no stream-flows. Stream-flows are proposed to be diverted around cleared areas and directed back into the catchment downstream. While there will be direct clearing of areas within the proposed clearing envelope, the connectivity of streams outside of the proposed clearing envelope will be preserved and vegetation within those streams retained. Proposed clearing within the clearing envelope is not likely to be at variance with principle (f)	
Principle (g)	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.**
Clearing within the proposed clearing envelope is for the development of mining infrastructure. The infrastructure will be constructed in accordance with appropriate guidelines and standards to prevent appreciable land degradation. The clearing will be undertaken to minimise potential erosion, sediment movement, dust impacts and water contamination in accordance with management actions outlined in Section 3.3 above. Weed impacts will be managed by undertaking the activities outlined in Section 3.3.5. The proposed clearing is not likely to be at variance with clearing principle (g).	
Principle (h)	**Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.**
The nearest conservation area to the assessment is the DBCA-managed Mungaroona Range Nature Reserve, which is approximately 80 km south-west of the assessment area. Millstream-Chichester National Park is 120 km west-south-west while Karijini National Park is 140 km south. The proposed clearing is not likely to be at variance with clearing principle (h).	

Principle (i)	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.**
The proposed clearing is not likely to intersect groundwater resources of the area as the reported groundwater is >15 metres below ground level. The proposed clearing will be undertaken in accordance with a Land Use Certificate permitting system. Controls outlined in the Land Use Certificate permitting system reduce potential clearing during wet periods or inappropriate conditions that would lead to surface water quality deterioration. Clearing is to be undertaken shortly before commencement of infrastructure construction (< 3 months), limiting the period during which cleared land is subject to erosion that would lead to surface water quality decline. The proposed clearing is not likely to be at variance with principle (i).	
Principle (j)	**Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.**
The proposed clearing envelope intersects with the ephemeral Southern Creek. The size of the Southern Creek catchment has been reduced over the past five years since the commencement of mining at the site and the resulting volume of water flowing through the catchment and intersecting with the proposed clearing envelope has also declined. The proposed clearing for infrastructure is expected to further reduce the volume of water produced by the catchment and so potential for causing or exacerbating the incidence or intensity of flooding is minimal. The proposed clearing is not likely to be at variance with principle (j).	

5. REFERENCES

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6. APPENDICES

APPENDIX 1 - SURFACE WATER ASSESSMENT

Groundwater Resource Management (2018) *Report on Pilgangoora Lithium-Tantalum Project 5 MTPA Definitive Feasibility Study Surface Water Management.* Prepared for Pilbara Minerals Limited.

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APPENDIX 2 – *ECOLOGIA* ENVIRONMENT SURVEY REPORT

ecologia Environment (2018) Altura Mining Ltd: Pilgangoora Lithium Project – M45/1260. Level 1 Fauna and Reconnaissance Flora and Vegetation Assessment

APPENDIX 3 – ANIMAL PLANT MINERAL BIOLOGICAL SURVEY REPORT

Animal Plant Mineral Pty Ltd (2022) *Pilbara Minerals: TSF Options 2 and 5, Pilgangoora Project Biological Survey, Pilbara, Western Australia*

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APPENDIX 4 – SITE ENVIRONMENTAL RISK ASSESSMENT PROCESS

The Site Environmental Risk Assessment was undertaken to identify the high-level environmental risks for the construction, operation and closure phases for the Project. The primary objectives of the risk assessment process were to identify major environmental risks to ensure:

- Prioritisation of risk management activities
- Adequate control measures are in place to manage the identified major risks
- Identification of risks that require additional control measures
- Development of an Environmental Obligations Register
- Understanding amongst key operational staff of the environmental risks associated with the project.

Each identified risk or potential impact was analysed for likelihood and consequence and a risk ranking assigned. The levels for likelihood and consequence used are detailed in Table 1 and Table 2.

The risk matrix (Table 3) combines the level of likelihood and consequence to determine the level of associated risk. The risk rating (or environmental impact) for each risk was categorised as extreme (red), high (orange), medium (yellow) or low (green).

For each risk, an assessment was made of the associated risk rating assuming no operational controls or treatments were in place. This provided the inherent risk for the hazard. The risk rating for each risk or potential impact was then re-assessed assuming the proposed operational controls were in place to provide a residual risk rating. The risk assessment is included as Table 10.

Table 1: Likelihood definitions

LIKELIHOOD	#	DESCRIPTION
Almost Certain	1	The event is a common or frequent occurrence or an ongoing impact (e.g. daily).
Likely	2	The event is expected to occur under some conditions, or has occurred more than once.
Possible	3	The event will probably occur, or has occurred under some conditions (e.g. yearly).
Unlikely	4	Known to have occurred but not often.
Rare	5	Very unlikely/may occur in exceptional circumstances.

Table 2: Consequence definitions

CONSEQUENCE	#	DESCRIPTION
Insignificant	A	Confined to the immediate area, rapid clean up, no environmental damage.
Minor	B	Confined to an isolated area, rapid clean up using internal resources, minimal environmental damage, vegetation recovery within 1-2 years.
Moderate	C	Impact confined to the mine, clean up may require external assistance, moderate environmental damage, vegetation recovery within 2-5 years, regulatory report required.
Major	D	Major environmental impact, extends beyond mine, considerable clean up using internal and external resources, vegetation recovery takes 5+ years, potential for prosecution and adverse publicity.
Catastrophic	E	Severe environmental impact, extensive clean up and recovery period, requires ongoing internal and external resources, vegetation may not recover, prosecution.

Table 3: Environmental Risk Matrix

RISK MATRIX		CONSEQUENCE				
		Insignificant (A)	**Minor (B)**	**Moderate (C)**	**Major (D)**	**Catastrophic (E)**
Likelihood	**Almost Certain (1)**	Moderate	High	Critical	Critical	Critical
	Likely (2)	Moderate	Moderate	High	Critical	Critical
	Possible (3)	Low	Moderate	Moderate	High	High
	Unlikely (4)	Low	Low	Moderate	Moderate	High
	Rare (5)	Low	Low	Low	Moderate	Moderate