

Flora assessment for Exmouth Quarries and Concrete Pty Ltd.

Purpose: Assessment of revegetation growth at boundary of M08/62, baseline data for Mining Proposal and Clearing Permit at M08/494.

Location: Tenement M08/494, Ashburton Mineral Field, Exmouth, WA.

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1.0 Background

The Mc Donald family of Exmouth have been operating a limestone quarry and block making plant at two tenements, M08/46 and M08/6 off Murat rd., South of Exmouth since 1986. The family partnership evolved into Exmouth Quarries and Concrete Pty. Ltd. (EQC) in 2015 as part of a cessation plan due to the illness of Mr Laurie Mc Donald. The tenements were transferred to EQC in 2019 following Mr Mc Donald's death.

In 2015 tenement M08/494 was applied for in 2012 and granted in 2015. A mining proposal for this tenement is currently under review, and a clearing permit for 1.85Ha, adjoining existing operations at M08/62 has been applied for.

In early September 2020 EQC's quarry manager became aware that the southern boundary between existing operations at M08/62 and M08/494 may have been breached, this was confirmed by GT Surveys on 23/09/2020. (Appendix 1.). This survey also noted that the topsoil bund from M08/62 had been pushed back into M08/494 during the installation of a limestone safety barrier at the boundary of M08/62 and M08/494.

Rather than create further disturbance by removing the topsoil, and potentially losing some of the seed bank contained within it, the decision was made to leave the bund in place as an additional safety barrier and revegetate the area between the limestone wall and the bund.

1.1 Location

The location of EQC's quarry operation is South of the Exmouth Townsite, on the Minilya – Exmouth Road (which becomes Murat Rd within the Exmouth townsite boundary.) (Figure 1).

1.2 Objective

The primary objective of this flora survey is to compare the revegetation efforts at M08/494 with the pristine and excellent vegetation located at M08/494, 30m south of the previously disturbed area. The three undisturbed areas surveyed will also inform part of the M08/494 mining proposal baseline data. Quadrats 3 and 4 provide a guideline as to the distance that the concentration of vegetation contained in the base of a gully extends up adjoining slopes. This information helps to create a guideline for the working distance from gullies to minimise the impact of quarry operations on vegetation.

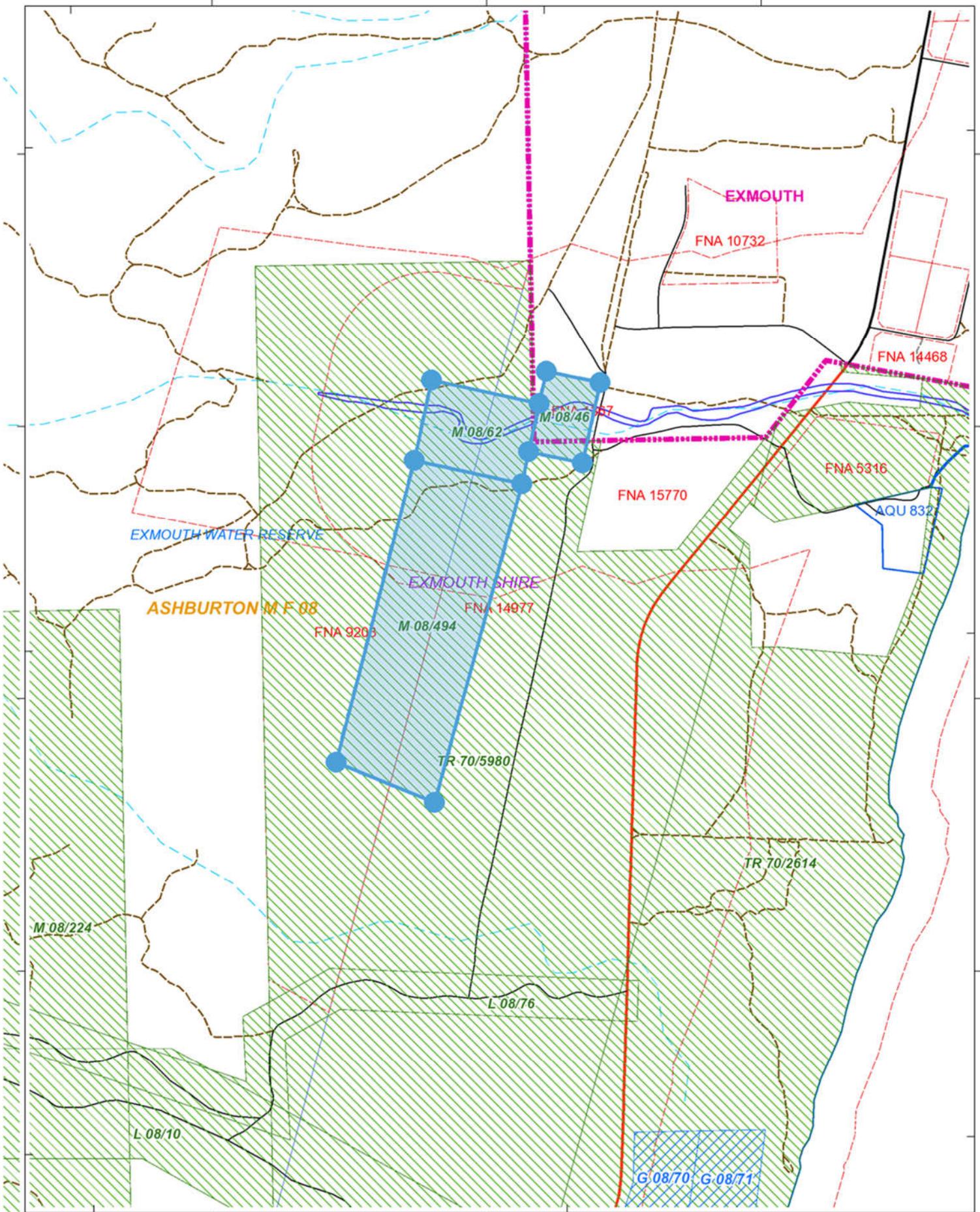


Figure 1. Location of EQC’s quarry operations, red and black line is the Exmouth Minilya rd. The gulf coastline is indicated by a dark green outline.

2.0 Physical Environment

2.1 Climate

The climate of Exmouth is arid, semi-desert to sub-tropical with variable summer and winter rainfall. Cyclonic activity can be significant in the area which can affect the annual rainfall. The nearest Australian Government Bureau of Meteorology (BoM) recording site is at Learmonth Airport. Learmonth has recorded an average annual rainfall of 260 mm since records began at that location in 1945. Most of the rain typically falls within the first half of the year, with September to November/December having the smallest rainfall (Figures 2 &3). Exmouth has experienced 1/100-year rainfall in 2021(Fig 2)

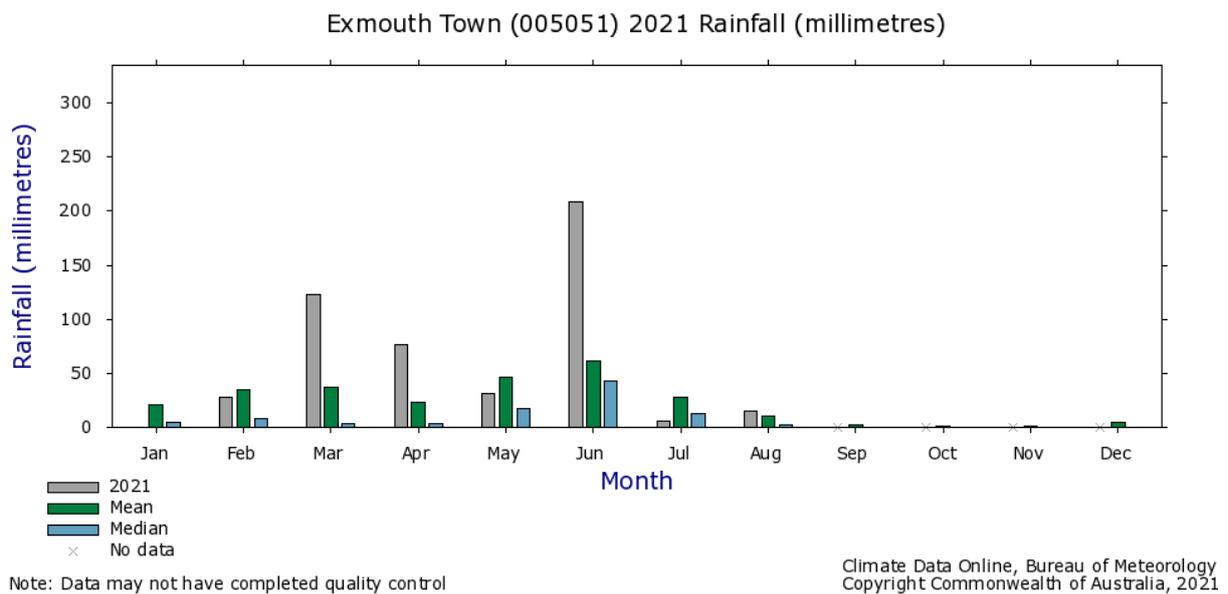


Figure 2. Average rainfall at Exmouth Townsite 2021, 3 +75ml rainfall events.

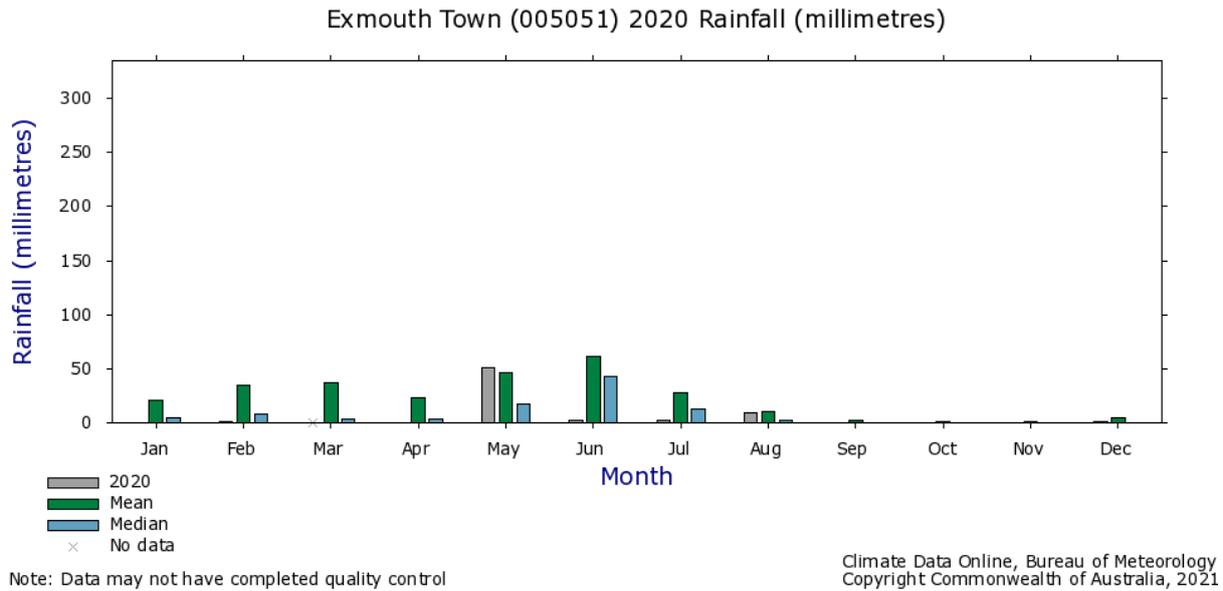


Figure 3 Average rainfall data from Exmouth Townsite 202, less than average rainfall for most months except May.

2.2 Soils and Landforms

The Cape Range anticline comprises Tertiary-aged interbedded sandstone and limestone sediments that have been the subject of sampling and drill investigation for both oil and high-grade limestone mineralisation that commenced in 1962 and has been ongoing up to 1999.

The survey area contains a significant thicknesses of industrial grade limestone in the Trealla limestone unit grading in excess of 55% CaO and with very low percentages of MgO, SiO₂ and Fe₂O₃. The area of M08/494 comprises Trealla Limestone together with a thin cover of poorly sorted colluvium comprising clay, silt, sand and gravel.

3.0 Biological Context

3.1 IBRA Regions

There are 85 recognised Interim Biogeographical Regionalisation of Australia (IBRA) regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (Environment Australia, 2000). Western Australia supports 53 IBRA subregions and the survey area lies within the Carnarvon 1 (*CAR1 – Cape Range subregion*) IBRA region.

The Carnarvon bioregion consists of a mosaic of saline alluvial plains with samphire and saltbush low shrublands (Kendrick and Mau, 2002). Bowgada low woodlands occur on sandy ridges and plains, Snakewood scrub is found on clay flats and tree to shrub steppe over hummock grasses are found on and between the red sand dune fields. The limestone stratum includes *Acacia stuartii* and *A. Bivenosa* shrublands in the north where extensive tidal flats in sheltered embayment's support mangroves.

The Cape Range and Giralia dune fields form the northern part of the Carnarvon Basin. They are made up of rugged tertiary limestone ranges, extensive areas of red Aeolian dune field, Quaternary coastal beach dunes and mud flats and includes *Acacia* shrublands, *Triodia* on

limestone and red dune field and extensive hummock grasslands on the Cape Range and eastern dune fields.

3.2 Flora and Vegetation

The Carnarvon Botanical District typically comprises of Acacia scrub and low woodland becoming tree or shrub steppe in the north with halophytes along the lower river courses (Beard, 1990). Department of Agriculture and Food (2005) 1:250 000 vegetation series map (based on the work of J.S. Beard) identifies one broad terrestrial vegetation type that occurs within the survey area (Table 1&2, Figure 4).

Table 1 Terrestrial Vegetation Types within the Survey areas (DAFWA, 2005)

Vegetation Association	Beard Code	Description
663	a3Sr t1Hi	Hummock grassland with scattered shrubs or mallee Triodia spp. Acacia spp., Grevillea spp. Eucalyptus spp.

Table 2. Remnant Vegetation Ratio.

	Pre-European Area (ha)*	Current Extent (ha)	Remaining %	Conservation Status **	% In IUCN Class I-IV Reserves*
IBRA Bioregion – Carnarvon	8,382,975	8,369,554	99.8%	Least concern	3.6%
Beard Vegetation Association - 663	29,021	27,642	95.25%	Least concern	22.5%

Botanical studies of the Cape Range area have shown there are 630 species of vascular plants, grouped into seven major vegetation communities, which have been identified by Keighery and Gibson (1993) within an area of 2 185 square kilometres. They cite 12 species as being endemic and a further 6 as restricted to Cape Range. Nine further taxa have been included to the DEC Priority Species list as endemic realizing a total of 21 endemic flowering taxa.

The area contains both tropical and temperate floras at the extremes of their ranges, the 13 endemic taxa and seven others are largely confined to the Cape Range peninsula. The region contains at least five unique minor vegetation communities confined to the limestone ranges.

3.3 Declared Rare Flora

Declared Endangered Flora Database identified 5 species.

Priority 3 – *Acacia alexandri*, *Corchorus congener*,

Priority 2 - - *Acanthocarpus rupestris*, *Hamierlia kempeana* subsp. *Rhadinophylla* and *Triospora esiangkara*.

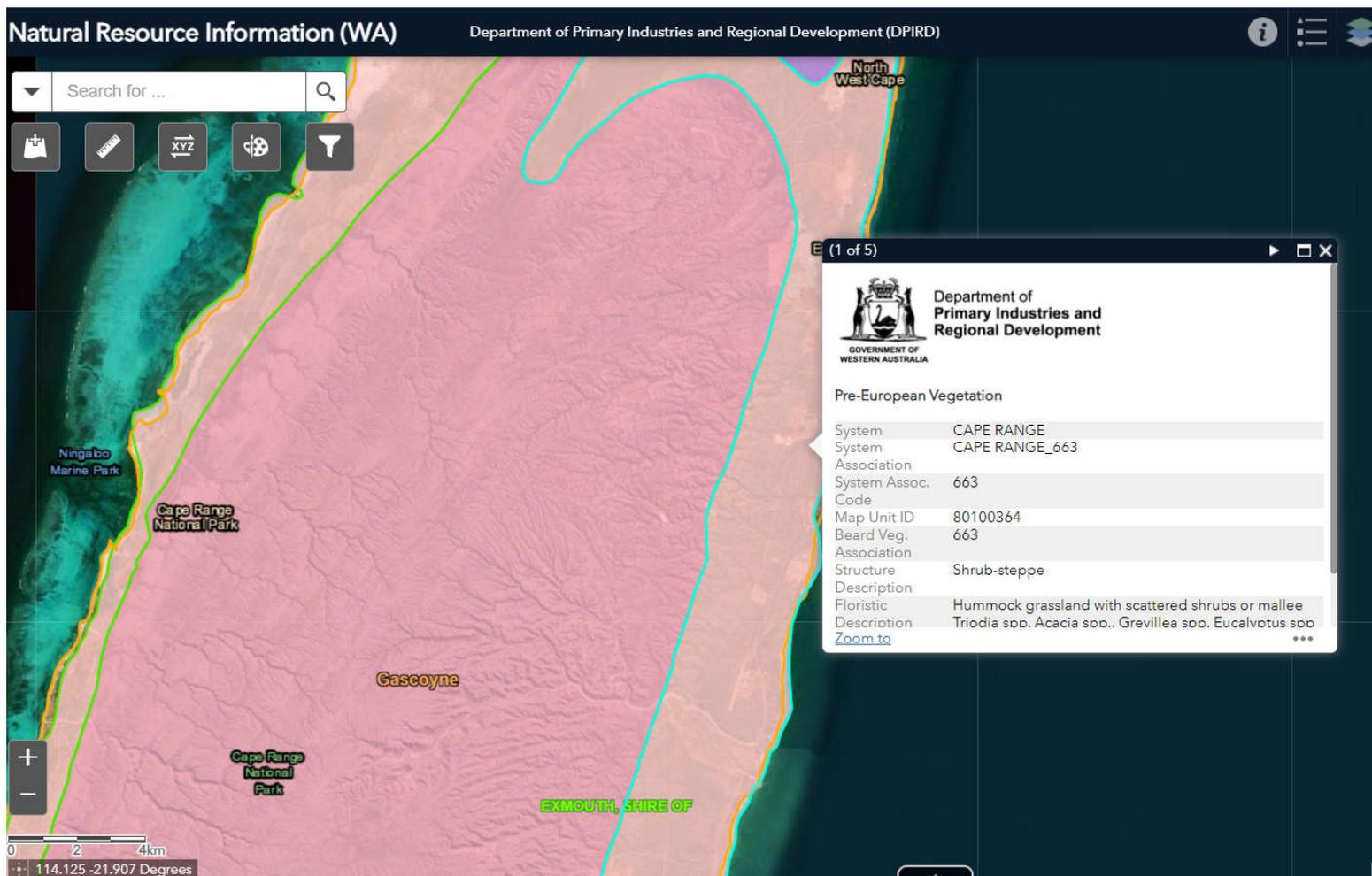


Figure 4. Map of Northwest Cape with Beard Vegetation Association 663 indicated by pale pink shading.

3.4 Vegetation Clearing, Extent and Status.

The current extent of vegetation types that remain is important in considering the significance of proposed clearing. That is, vegetation that is poorly represented is of greater significance and proposed impacts to such vegetation types is also considered to be of greater significance in terms of impact assessment.

Where clearing of native vegetation is proposed to occur, from a biodiversity perspective and not considering any other land degradation issues present, there are now several key criteria being applied to clearing permits. The criteria, as outlined in the Western Australia Environmental Protection Authority (EPA) Position Statement No. 2, Environmental Protection of Native Vegetation in Western Australia: Clearing of native vegetation, with reference to the agricultural area (EPA, 2000). This position statement is used to help reverse the long-term decline in the quality and extent of Australia's native vegetation cover and applies to all areas of native remnant vegetation in the state, with reference to the agricultural area. The criteria are as follows:

- the “threshold level” below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30% of the pre-clearing extent of the vegetation type
- a level of 10% of the original extent is regarded as being a level representing “endangered”
- clearing which would put the threat level into the class below should be avoided
- from a biodiversity perspective, stream reserves should generally be in the order of at least 200m wide.

The status of remaining vegetation can be delineated into five different classes:

- presumed extinct: Probably no longer present in the bioregion
 - *Endangered: <10% of pre-European extent remains
 - *Vulnerable: 10-30% of pre-European extent exists
 - *Depleted: >30% and up to 50% of pre-European extent exists
 - least concern: >50% pre-European extent exists and subject to little or no degradation over much of this area.
- * Or a combination of depletion, loss of quality, current threats and rarity gives a comparable status.

4.0 Methodology

4.1 Site Selection

Four quadrat sites were selected to represent the diversity of geologies, soil types and microhabitats found within tenement M08/494. The quadrats were surveyed in September 2021 after the Northwest Cape region had experienced above average yearly rainfall, and 3 rain events in excess of 75ml since March 2021 (Figure 2). Tenement M08/494 has not been exposed to fire since 1999.

Quadrat1 is the disturbed area at the boundary of M08/494 and M08/62. The vegetation in this area was inadvertently removed during the process of installing limestone safety barrier at the edge of the pit face. It contains a topsoil bund which is comprised of soil and seed removed from M08/62, a disturbed lane way that traverses the area between the bund and the wall. The lane way is 10m wide x 400m long.

Quadrat 2 is in pristine bushland adjoining the road that traverses the quarry and is representative of the vegetation in the proposed clearing area.

Quadrat 3 is at the base of the first gully in M08/494, gully areas are excluded from the Mining proposal, due to the diversity and density of vegetation within them. The topsoil in this area contains more clay and loose gravel than the other three sites.

Quadrat 4 is located 25 m away from the gully on the southern slope, although this area is not included in the clearing permit it may be considered for future works. This quadrat provides a guideline to the distance operations need to remain from a gully to minimise impact on vegetation. Although this is a minor tributary of an ephemeral creek it is important to establish a safe working distance, considering Environmental Protection Authority (EPA) Position Statement No. 2, Environmental Protection of Native Vegetation in Western Australia “from a biodiversity perspective, stream reserves should generally be in the order of at least 200m wide”

4.2 Survey Techniques

Quadrats 10 x 10 meters in size were implemented for all the sites, with methods listed below. Species identified outside of the quadrat, but in 5- 10m proximity were noted, and listed as outside the quadrat.

4.3 Methods used at survey sites

At the survey sites 10 x 10 quadrats were cordoned off using a measuring tape and an optical square. Once the edges of the square were marked, the flora was systematically catalogued from shortest species to tallest. Species were identified on site using several field guides, a sample of species which were unable to be identified on site were pressed between paper and cardboard and dried for storage and identification.

4.4 Identifying species

The following field guides were used to identify plants on site:

Mitchell, A. A. & Wilcox, D. G. & Laidlaw, E. & Western Australia. Department of Agriculture. (1988). Arid shrubland plants of Western Australia. Nedlands, W.A: University of Western Australia Press with the Western Australian Dept. of Agriculture

Napier, Judymae. & Van Leeuwen, Stephen. & Western Australia. Department of Conservation and Land Management. (1996). Common plants of the Pilbara. Como, W.A: Department of Conservation and Land Management

Wajon, J. E & Wajon, J. E & Wajon, Eddy (2000). Colour guide to spring wildflowers of Western Australia. Part 2, Perth and the Southwest. Wajon Pub, Winthrop, W.A

These books and sources were used to identify samples off site:

Brown, Andrew. & Buirchell, Bevan J. (2011). A field guide to the Eremophilas of Western Australia. [Hamilton Hill, W.A.]: Simon Nevill Publications

Florabase. <https://florabase.dpaw.wa.gov.au/>

Gardner, C. A. & Parkinson, H. F. (1959). Wildflowers of Western Australia. Perth: Western Australian Newspapers

Morcombe, Michael. (1968). Australia's western wildflowers. [Perth]: Landfall Press
The Wildflower Society of Western Australia.
<https://www.facebook.com/groups/129636970391772/>

4.5 Survey Limitations

Several limitations relating to the ecological assessment of the site have been considered and these are described below.

Certain limitations are inherent in all ecological assessments. Due to the complexity and diversity of natural systems, surveys are necessarily a random and/or limited sampling exercise, and localised populations of flora or variation in communities may not be directly encountered during the field survey process.

Many flora species are dormant for part of the year or only emerge after certain events such as flooding or fire. Additionally, many species do not flower every year whilst a proportion flower in non-peak times and may have been inconspicuous or dormant at the time of the survey. As the seasons change, the flora inventory for each community also changes and if supplementary surveys or surveys during the dry season were undertaken, the suite of flora and potentially also the descriptions of the vegetation units may reflect this.

Fungi and non-vascular flora (e.g., algae, mosses and liverworts) were not addressed as part of the assessment.

5.0 Results

Thirty-three native plant species and 1 introduced species were identified from 346 plants surveyed in 4 quadrats spanning 160m². Acacia species had the greatest species representation, six species were recorded. *Triodia wiseana* had the greatest abundance and was recorded at every quadrat. One introduced species was recorded from the survey area. *Cenchrus ciliaris* (Buffel Grass) was recorded from three vegetation units. It is not listed under the Agriculture and Related Resources Protection Act, 1976 as a Declared Plant, however, is a widespread weed of the region.

No species listed as Declared Rare Flora or Threatened (T or X) under the WC Act or as Threatened under the EPBC Act were recorded from within the survey area.

Appendix 2 contains a complete list of the quantity and species of vegetation in each quadrat.

5.1 Quadrat 1. Safety Boundary. Vegetation Condition – Good.

Location: Lat -21.9783435S Long 114.1143834 21°58'41.8"S 114°06'50.9"E

Limestone surface with pockets of stony soil and pindan soil bordered by a white limestone rock retaining wall to the north and a red pindan clay and limestone rock bund to the south. Exposed limestone covered 70% of the surface of the 10m x 10m quadrat. Vegetation covered 20% of the quadrat area.

Three species of shrub up to 2m tall were identified, however the dominant species at the site were *Ptilotus rotundifolius* (Royal Mulla Mulla) and *Corchorus walcottii*, these 2 species

accounted for 10% of the vegetated area. The remaining area was vegetated with 4 species of small shrub and numerous types of herbs and grasses.

A total of 21 different native plant species were identified and 2 weed species *Cenchrus ciliaris* and *Euphorbia drummondii*.



Figure 5 Photo point quadrat 1, topsoil bund with abundant colonising and herbaceous species with grasses, herbs and small shrubs on the flat area.

5.2 Quadrat 2. Future Works. Vegetation Condition - Pristine

Location: Lat -21.979638, Long 114.113967 21°58'46.7"S 114°06'50.3"E

Exposed Trealla Limestone covered 30-40% of the 10mx10m quadrat. A thin layer of pindan clay topsoil filled shallow pockets in between the exposed limestone. Low shrubs and grass vegetation covered 80% of the quadrat. *Triordia wiseana* was the dominant vegetation 70%,

and *Melaleuca cardiophylla* contributed a further 15-20%. Only 2 herb species were identified within the quadrat and one *Eremophila* sp.

A total of 6 native species were identified within quadrat 2, and no weed species. Within a 10m radius of the quadrat an additional 2 species were identified, *Solanum lasiophyllum* and *Senna artemisioides*.



Figure 6. Photo point Quadrat 2, pristine area typical of M08/494 dominated by *Triordia wiseana* and *Melaleuca cardiophylla* vegetation.

5.3 Quadrat 3 Gully Base. Vegetation Condition Excellent

Location: Lat -21.980838, Long 114.113625 21°58'51.0"S 114°06'49.1"E

Positioned in a shallow limestone gully with stony soil/gravel at its base, quadrat 3 had 60% vegetation cover and 40% exposed limestone surface. A *Eucalyptus xerothermica* and 4

acacia species were the dominant vegetation at the base of the gully, at the northern side of the quadrat vegetation was more typical of the *Triordia wiseana* and *Melaleuca cardiophylla* vegetation surveyed at quadrat 2. This quadrat contained the only climber, *Duperreya commixta*. Six herbaceous species were identified, with the yellow *Abutilon sp.* most abundant. The weed species *Cenchrus ciliaris* was present.



Figure 7. Photo point Quadrat 3, base of an ephemeral gully, with small *Eucalyptus xerothermica* and several acacia species.

5.4 Quadrat 4. South Slope. Vegetation Condition Excellent.

Location: Lat -21.980982, Long 114.113654, 21°58'51.5"S 114°06'49.2"E

Quadrat 4 was located 25m to the south of the gully quadrat on a north facing slope of predominantly limestone rock interspersed with pockets of pindan and stony soils, vegetation cover was 70% and exposed stone accounted for 40% of the surface area. The vegetation composition and coverage are very similar to Quadrat 2 with *Triordia wiseana* and

Melaleuca cardiophylla the most abundant species. However, unlike quadrat 2 the presence of *Sarcostemma viminale australe* (caustic bush) was noted outside of the quadrat area and in quadrat 3. No weed species were observed in the quadrat, although clumps of *Cenchrus ciliaris* are in the surrounding area.



Figure 8 Photo point 25meters up slope from gully base at Q3 and vegetation returned to mostly *Triordia wiseana* and *Melaleuca cardiophylla*.

6.0 Conclusions

Revegetation efforts at Quadrat 1 at the boundary of M08/494 and M08/62 have been assisted by the uncharacteristic rainfall that Exmouth has received this year. The seed bank contained in the topsoil bund in this quadrat has also supplemented revegetation, particularly of herbaceous species. In addition to numerous herb species several shrubs and larger colonising plants have established, additional vegetation could be established by scarifying the flat space

between the bund and the limestone wall, however this will prevent vehicle access in the event of fire.

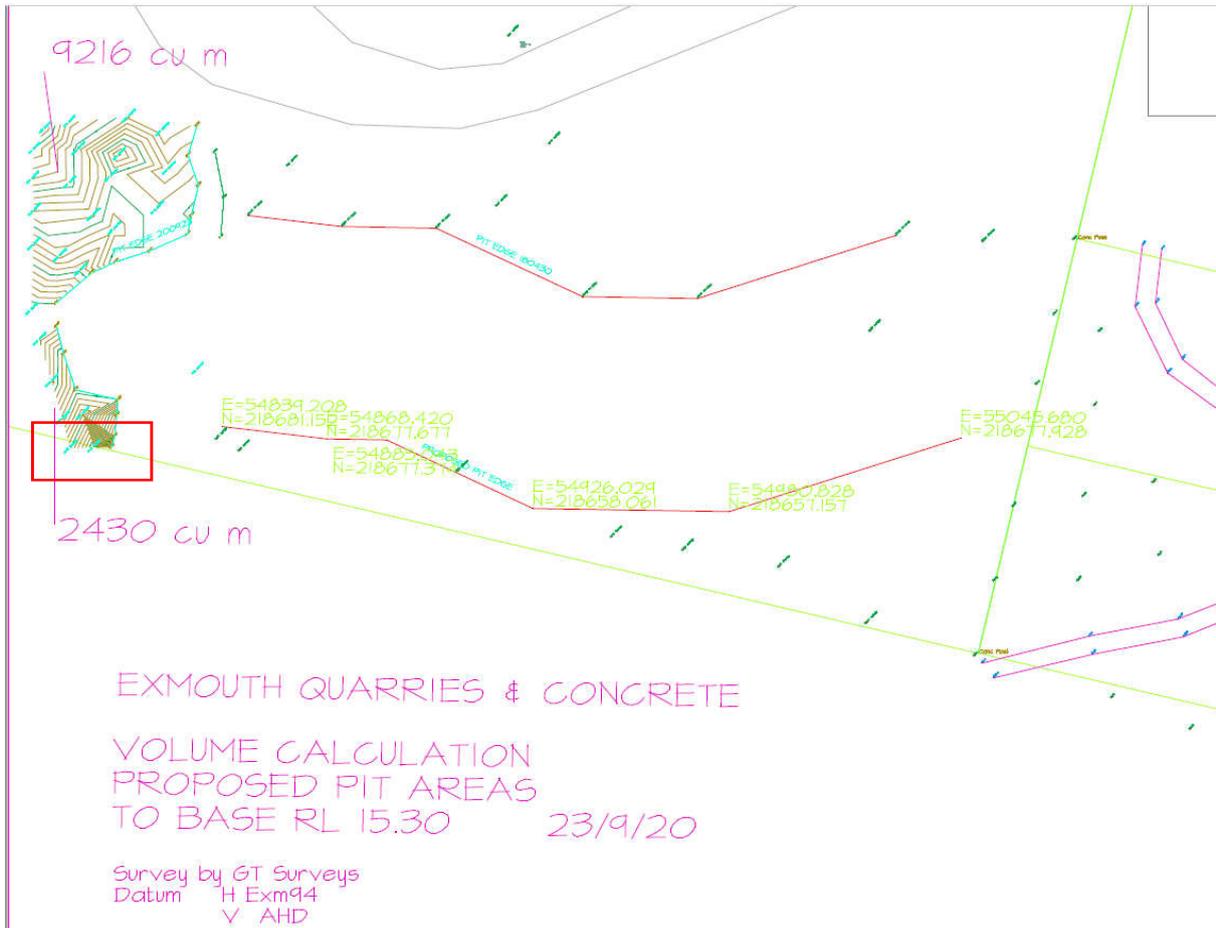
The pristine vegetation at quadrat 2 in the proposed clearing area is well represented throughout M08/494, as indicated at Quadrat 4. The current Beard Vegetation Association – 663 lists this area as retaining 95.25% of its original vegetation.

As noted in the 2021 EPA report on the Exmouth Gulf region gully areas, such as that surveyed at quadrat 3 have a greater diversity and density of shrubs and trees, they also provide habitat and corridors for fauna, these areas require protection zones that extend for at least 25m up the slopes from the base of the gully.

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- Western Australian Planning Commission (1998) *Exmouth – Learmonth (Northwest Cape) Structure Plan*, December 1998.

Appendix 1 Survey Data showing encroachment into tenement M08/494 in the Southwest corner of M08/62 (Red rectangle).



Appendix 2. Variety and number of species in each 10m xm10m quadrat.

Trees/Mallees	Q1	Q2	Q3	Q4	Herbs	Q1	Q2	Q3	Q4	Other species 5 m radius outside quadrats	Q1	Q2	Q3	Q4
Acacia Bivenosa	5	1	1	3	Abutilon sp.			23						
Acacia citrinoviridis			5		Corchorus walcottii	3				Dysphania kalpari				4
Acacia Pyrafolia	2				Dicladanthera forrestii					Eremophila forrestii				3
Acacia sclerosperma			2		Goodenia tenuiloba	2	7	3		Eremophila longifoilia		2		
Acacia tetraegonophylla			2		Ptilotus exaltatus	27				Leptosema macrocarpum			1	
Eucalyptus xerothermica			1		Sida corrugata	2				Sarcostemma viminale australe		2		3
Acacia gregorii			5		Stackhousia muricata	2	2	4		Senna artemisioides			2	3
Shrubs	Q1	Q2	Q3	Q4	Trichodesma zeylanicum	17				Sida corrugata		1		
Eremophila latrobei		1			Brachicombe ciliocarpa			1		Solanum phlomoides			3	
Gossypium robinsonii	2				Swainsonia formosa	1				Tribulus platypterus	2			
Hybanthus aurantiacus	2				Euphorbia drummondii	10								
Indigofera rugosa	4				Streptoglossa decurrens			2		Introduced Species	Q1	Q2	Q3	Q4
Leptosema macrocarpum	4		1		Grasses	Q1	Q2	Q3	Q4	Cenchrus ciliaris	9	0	4	2
Melaleuca cardiophylla		15	4	12	Eriachne flaccida	7								
Sarcostemma viminale australe			1		Triodia pungens			3						
Scaevola cunninghamii		2			Triodia wiseana	18	60	15	47					
Scaevola pulchella	4				Vines/Creepers	Q1	Q2	Q3	Q4					
Solanum diversiflorum	8			2	Duperreya commixta			1						
					Total Species	19	5	17	6					
					Total Plants	120	79	76	71					

Appendix 3. Location of Exmouth Western Australia.

