

**Assessment for Threatened and Priority Ecological Communities
and Flora, Laguna Green Granite Quarry, Marnigarup Rd,
Jerramungup, Western Australia**

April 2019



Australia Jowin Mining Industry Pty Ltd, Laguna Green Granite Quarry Project

Newland Environmental

**Assessment for Threatened and Priority Ecological Communities and Flora,
Laguna Green Granite Quarry, Marnigarup Rd, Jerramungup Western Australia**

Report prepared for Australia Jowin Mining Industry Pty Ltd Laguna Green Granite
Quarry Project, via Newland Environmental, Kalamunda WA 6076

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Cover photo: Quarry 1 within proposed quarry target area, burnt remnant native
vegetation in background

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Summary

The Laguna Green Granite Quarry property Lot 1 sits on Marnigarup Rd East, south east of Jerramungup near the south coast of Western Australia. Lot 1 is approximately 32 ha in size.

Lot 1 is surrounded by farmland on rural zoned private properties and adjoins public road reserve to the north.

Newland Environmental engaged Nathan McQuoid Landscape Ecologist of Bremer Bay to assess the proposed quarry target area on Lot 1 for the presence of the *Proteaceae dominated kwongkan shrublands of the southeast coastal floristic province of Western Australia (Proteaceae Dominated Kwongkan Shrubland)* Nationally Listed Threatened Ecological Community (TEC) and WA State Listed Priority Ecological Community (PEC); and the presence of Threatened and Priority Flora.

The *Proteaceae Dominated Kwongkan Shrubland* TEC/PEC is known to occur on sandplain and shallow duplex soils over shallow granite in the area near Lot 1.

A number of Threatened and Priority Flora are known to occur in the area near Lot 1.

A field assessment of the proposed quarry target area was conducted on April 24 2019, followed by the preparation of a report on the findings, was designed to meet the objectives:

- Examine for the presence of the Proteaceae Dominated Kwongkan Threatened/Priority Ecological Community.
- Map plant communities if possible.
- Compile a species list, as much as possible given the burn.
- Record any conservation-listed taxa with location coordinates.
- Provide an evaluation on the overall conservation value of Lot 1, especially the quarry target area.

The plant community and flora assessment recorded plant community structure, composition and site characteristics at nine sites within the proposed quarry target area.

The *Proteaceae Dominated Kwongkan Shrubland* PEC/TEC was not recorded on Lot 1, either in the proposed quarry target area or the remainder of Lot 1.

A vegetation of Lot 1 was mapped as plant communities, including the proposed quarry target area. Six major plant communities were found to be present.

The plant communities had condition ratings varying from Excellent to Very Degraded. The three common condition ratings were Excellent, Very Good and Degraded.

No Threatened or Conservation Priority Flora were recorded by the assessment.

The site relevé assessment and the stratified walk of the southern parts of Lot 1 recorded the presence of 60 plant taxa.

The conservation value of Lot 1 is significant due to the range of plant communities, the diversity of the flora, the intactness of the majority of the vegetation, the buffer it provides the adjacent farmland and river corridor, the protection of watercourses and the habitat value it provides.

A follow-up spring survey in 2019 or 2020 would help confirm the presence or absence of Threatened and Conservation Priority Flora, not able to be fully determined by this autumn 2019 survey.

Restoration post quarrying and to repair degraded sites will be successful through the use of the regenerative abilities and related processes of the native plants nearby on Lot 1.

The exotic trees Sugar Gum (*Eucalyptus cladocalyx*) and South Australian Blue Gum (*E. leucoxyton*) are present on Lot 1 and should be removed to maintain conservation values.

Acknowledgements

Charles Newland Principal of Newland Environmental for the opportunity to be involved in the assessment, the map figures and technical support for the assessment and report.

Libby Sandiford, Botanist of Albany for assistance with the identification of *Halgania anagaloides* var. Southern.

Introduction

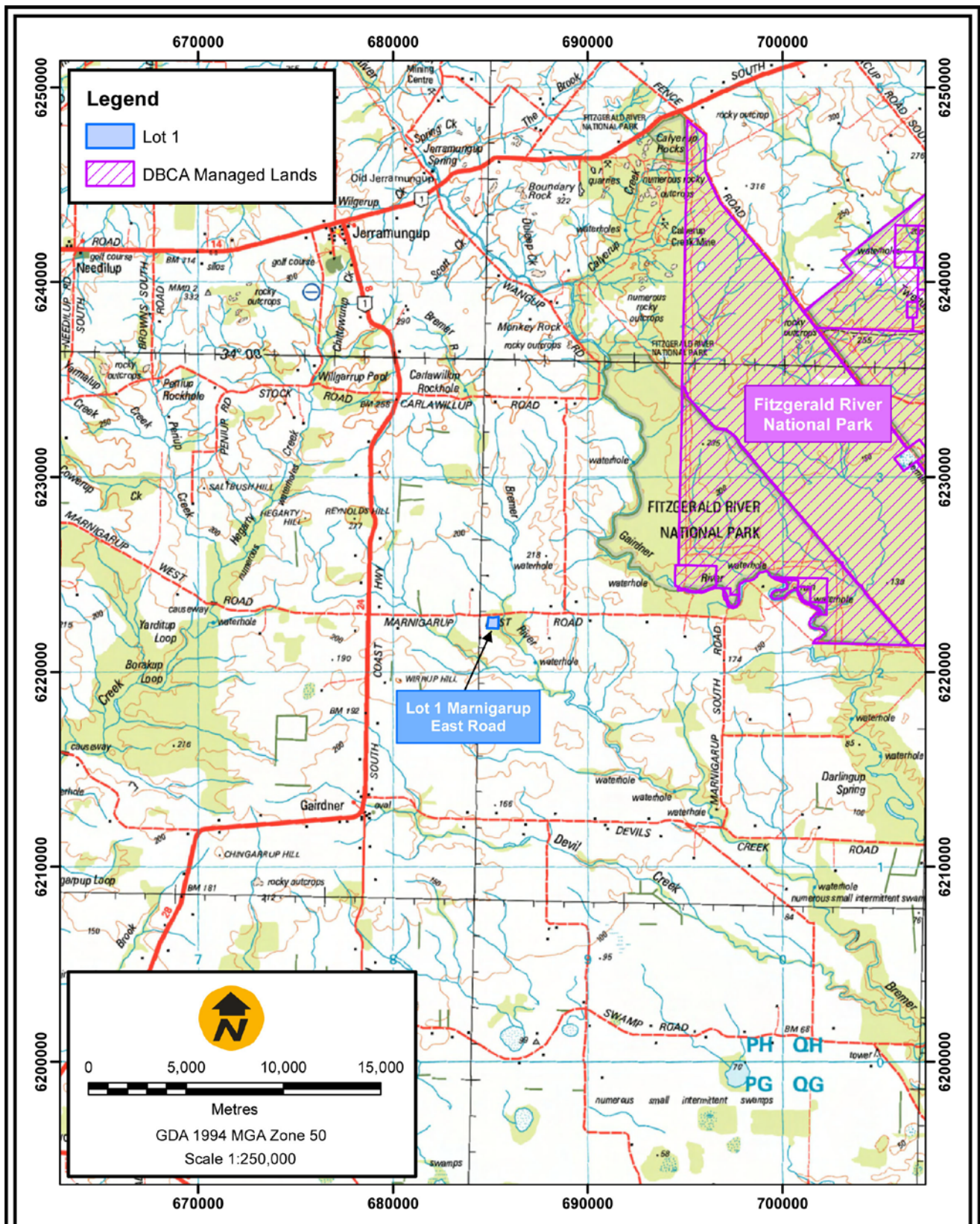
Location

The Laguna Green Granite Quarry property Lot 1 sits on Marnigarup Rd East, south east of Jerramungup near the south coast of Western Australia (Figure 1, Figure 2). Lot 1 is approximately 32 ha in size.

Lot 1 is adjoined to the west, south and east by farmland on rural zoned private properties, and to the north by public road reserve vested in the Shire of Jerramungup (Figure 3).



Figure 1. Regional location of Laguna green granite project



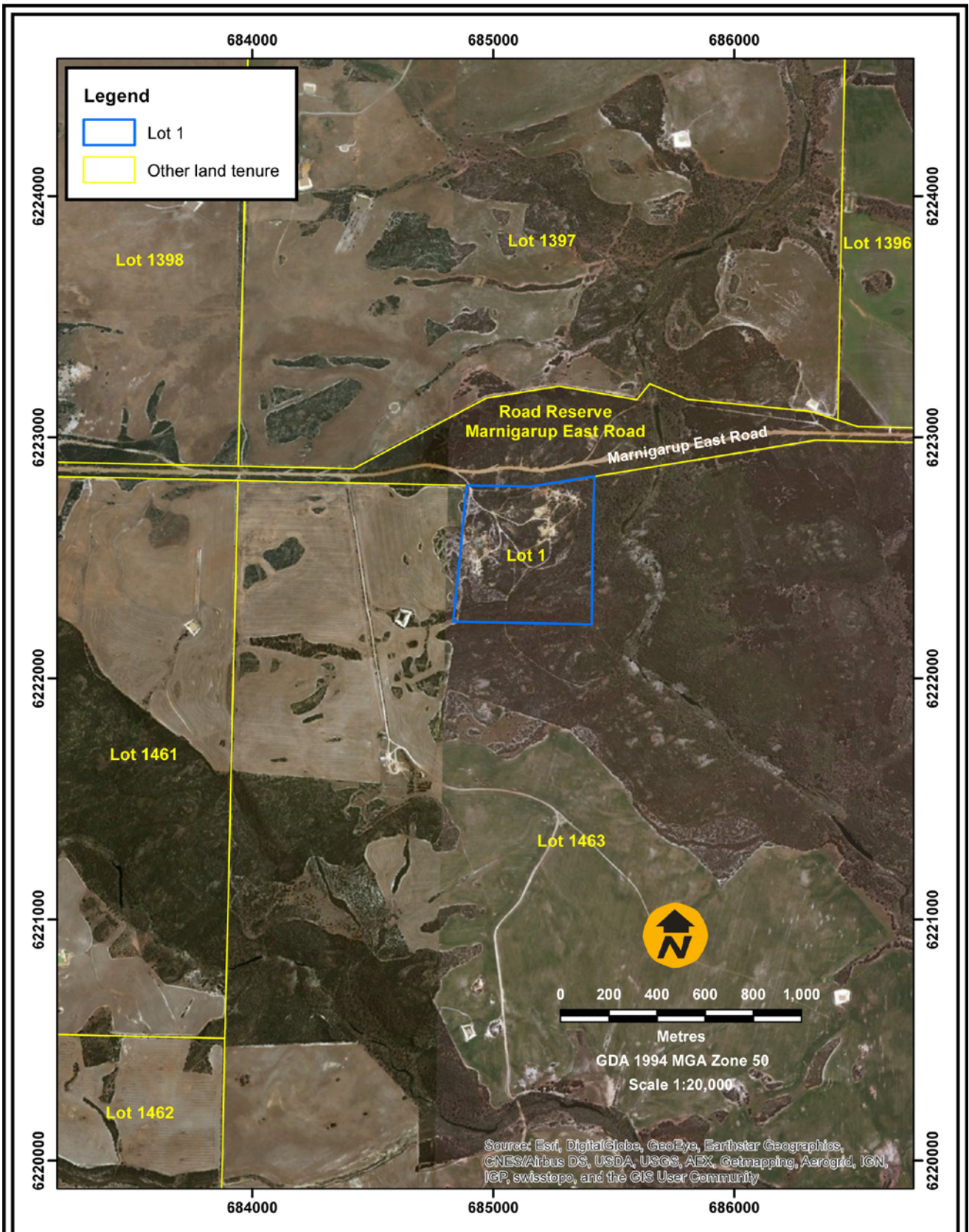
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Figure 2: Locality map for Lot 1 Marnigarup Rd

Authored: N McQuoid	Drawn: C Newland	Date: 19/05/2019	Print Size: A4
Figure 2 Locality Map Lot 1 Marnigarup East Road Jerramungup.mxd			
Base Maps: Natmap Digital 2008 Edition 'zone50_mga.ecw'			

Figure 2. Locality of Laguna green granite quarry Lot 1 Marnigarup Rd



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Figure 3: Land tenure adjoining Lot 1 Marnigarup Rd

Authored: N McQuoid	Drawn: C Newland	Date: 19/05/2019	Print Size: A4
Map Name: Figure 3 Land Tenure Adjoining Lot 1 Marnigarup Road.mxd			
Base Map: ESRI Basemap 'World Imagery' (image date 01/10/2015)			

Figure 3. Land tenure adjoining Lot 1 Marnigarup Rd

Scope and Objectives

The assessment target area is an old granite quarry south east of Jerramungup at Lot 1 on Marnigarup Rd East, which has been previously disturbed by granite quarrying activities. The entire area has been burnt recently so local knowledge would be invaluable in identifying plants.

The proposed areas for quarrying disturbance (quarry target area) basically cover previous disturbances with a few small new areas of undisturbed vegetation that might be needed. Undisturbed vegetation in the southern extent of Lot 1 would be avoided.

Undertake a site visit and prepare an assessment report to meet the objectives:

- Examine for the presence of the Proteaceae Dominated Kwongan Threatened/Priority Ecological Community.
- Map plant communities if possible.
- Compile a species list, as much as possible given the burn.
- Record any conservation-listed taxa with location coordinates.
- Provide an evaluation on the overall conservation value of Lot 1, especially the quarry target area.

The report would be required to support an extractive industry licence approval, a clearing permit application and EPBCA referral (possibly).

Background

Australia Jowin Mining Industry Pty Ltd Laguna Green Granite Quarry Project is proposing to restart quarry operations at its Lot 1 Marnigarup East Rd Jerramungup site. In order to commence its operations over the proposed quarry target area (Figure 4), the presence status of Threatened and Priority Ecological communities and Flora must be assessed.

Newland Environmental engaged Nathan McQuoid Landscape Ecologist of Bremer Bay to assess the proposed quarry target area on Lot 1 for the presence of the *Proteaceae dominated kwongkan shrublands of the southeast coastal floristic province of Western Australia (Proteaceae Dominated Kwongkan Shrubland)* Nationally Listed Threatened Ecological Community (TEC) (Commonwealth of Australia 2014) and WA State Listed Priority Ecological Community (PEC) (DBCA 2019); and the presence of Threatened and Priority Flora (DBCA 2018).

The *Proteaceae Dominated Kwongkan Shrubland* PEC (and TEC) consists of predominantly of obligate seeding proteaceous shrubland and heath (kwongkan) and mallee heath on sandplain, duplex sand/clay and gravels overlying Eocene sediments, quartzite, schist, Yilgarn and Albany Fraser granite and greenstone ranges. Its flora is characterised by high species diversity and a high degree of endemism, particularly in the Stirling Range, Fitzgerald River National Park, Ravensthorpe Range and Russell Ranges. Due to the high levels of endemism, there are few species that exist across the entire range of the dense, obligate seeding *Proteaceae* dominated shrublands and kwongan (sic) of the Esperance Sandplains, however particular species have been identified as common dominant species in each of its Ecodistricts (DBCA 2019).

The *Proteaceae Dominated Kwongkan Shrubland* TEC PEC is known to occur on sandplain and shallow duplex soils over shallow granite in the area near Lot 1.

The threats to the *Proteaceae Dominated Kwongkan Shrubland* include past threats as principally fragmentation from land clearing, and current threats being the plant disease *Phytophthora cinnamomi*, increased fire frequencies, invasive weeds and feral animals (DBCA 2019).

A number of Threatened and Priority Flora (DBCA 2018) are known to occur in the area near Lot 1. However, due to a recent fire (November 2018) affecting the vegetation and the nature of the granite substrates of Lot 1, the presence of Threatened and Priority Flora is unlikely. Notwithstanding, an assessment process including field survey is appropriate to test for presence.

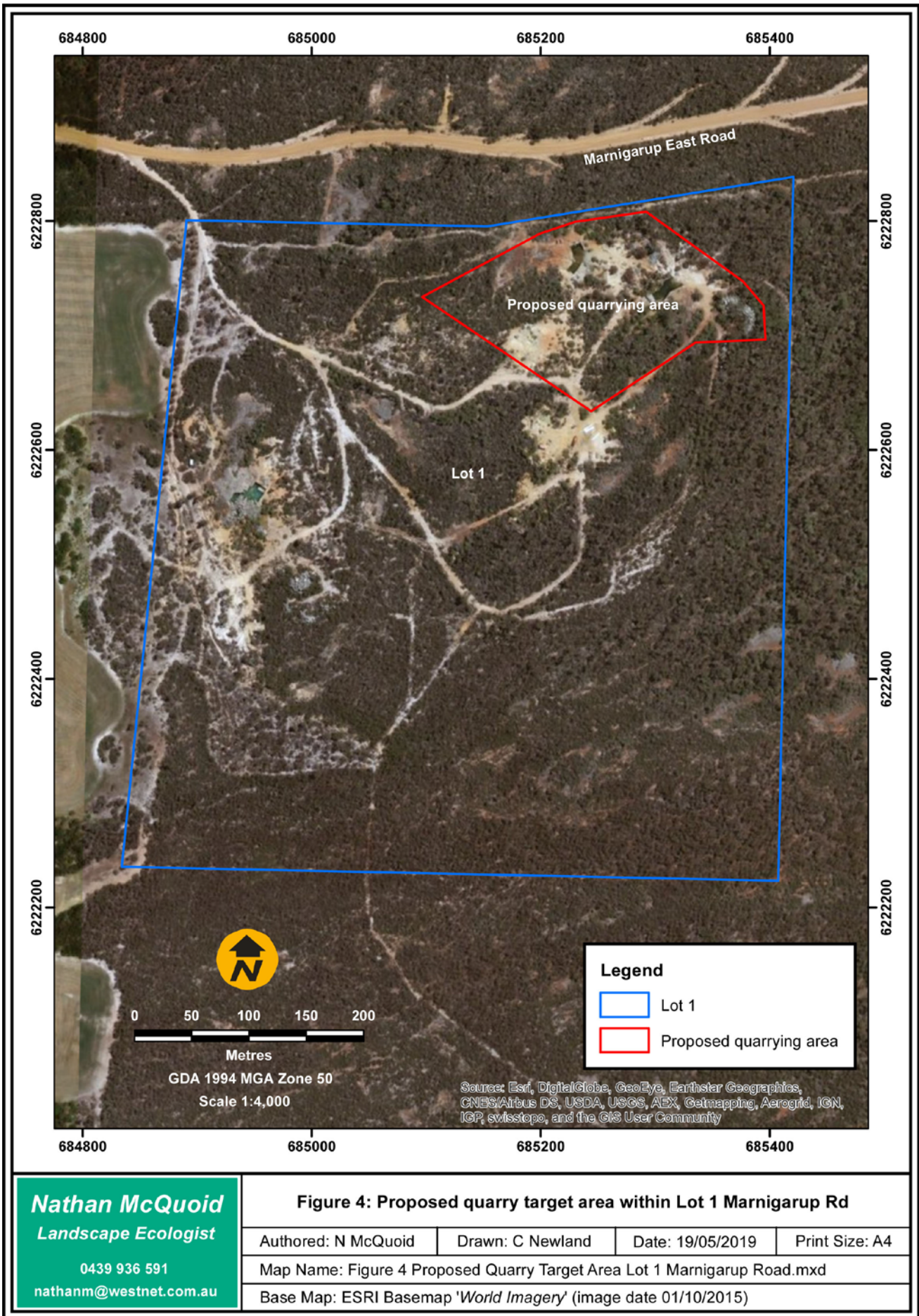


Figure 4. Proposed quarry target area within Lot 1 Marnigarup Rd

Methods

Field and Desktop Assessment

The field assessment was designed to meet the scope. As the majority of Lot 1 had been recently burnt (November 2018), the assessment was undertaken to examine plants present and consider whether the material available was suitable from which to establish identification.

The desktop review of the Department of Biodiversity, Conservation and Attractions (DBCA) Priority and Threatened Ecological Communities (DBCA 2019) was undertaken prior to the field assessment by Newland Environmental, in particular consideration of the *Proteaceae Dominated Kwongkan Shrubland* TEC PEC (Commonwealth of Australia 2014; DBCA 2019) as most likely to occur at Lot 1. The December 2018 list of Threatened and Conservation Priority Flora (DBCA 2018) was reviewed following the field assessment to check for potential existence of these Flora among flora recorded during the assessment.

The *Proteaceae Dominated Kwongkan Shrubland* PEC/TEC and Threatened and Priority Flora occurrences in the district are well known to the author, who has experience in their identification and in the case of the PEC/TEC across its varied iterations and expressions, which was an advantage to the assessment.

The field assessment of Lot 1 Marnigarup Rd was conducted on April 24 2019. The assessment focussed on the proposed quarry target area, with a stratified walk over the remainder of Lot 1 to observe and note its vegetation and the presence of the *Proteaceae Dominated Kwongkan Shrubland* PEC/TEC and Threatened and Priority Flora known and able to be identified given the burnt vegetation.

The proposed quarry target area (Figure 4) was traversed and typical plant communities selected and examined for the presence of the *Proteaceae Dominated Kwongkan Shrubland* PEC/TEC, and the presence of known Threatened and Priority Flora. Nine sites within plant communities of the proposed quarry target area were assessed and recorded by site relevé following the Perth Bushland Flora Survey method (Keighery 1994) (Appendix 1) and marked by GPS waypoint (Figure 5).

Photographs of the plant communities at the nine sites (Appendix 1) and other locations on Lot 1 were taken using an Olympus TG 5 compact camera.

Coordinates were recorded using a Garmin GPS unit GPS76, on UTM Grid WGS 1984 and downloaded using Mac GPSPPro.

The survey was conducted under Department of Biodiversity, Conservation and Attractions Scientific Flora Licence No SL012476 issued to Nathan McQuoid, valid until October 17 2019; and Permit to Take Declared Rare Flora No. 55-1819 issued to Nathan McQuoid, valid until October 30 2019.

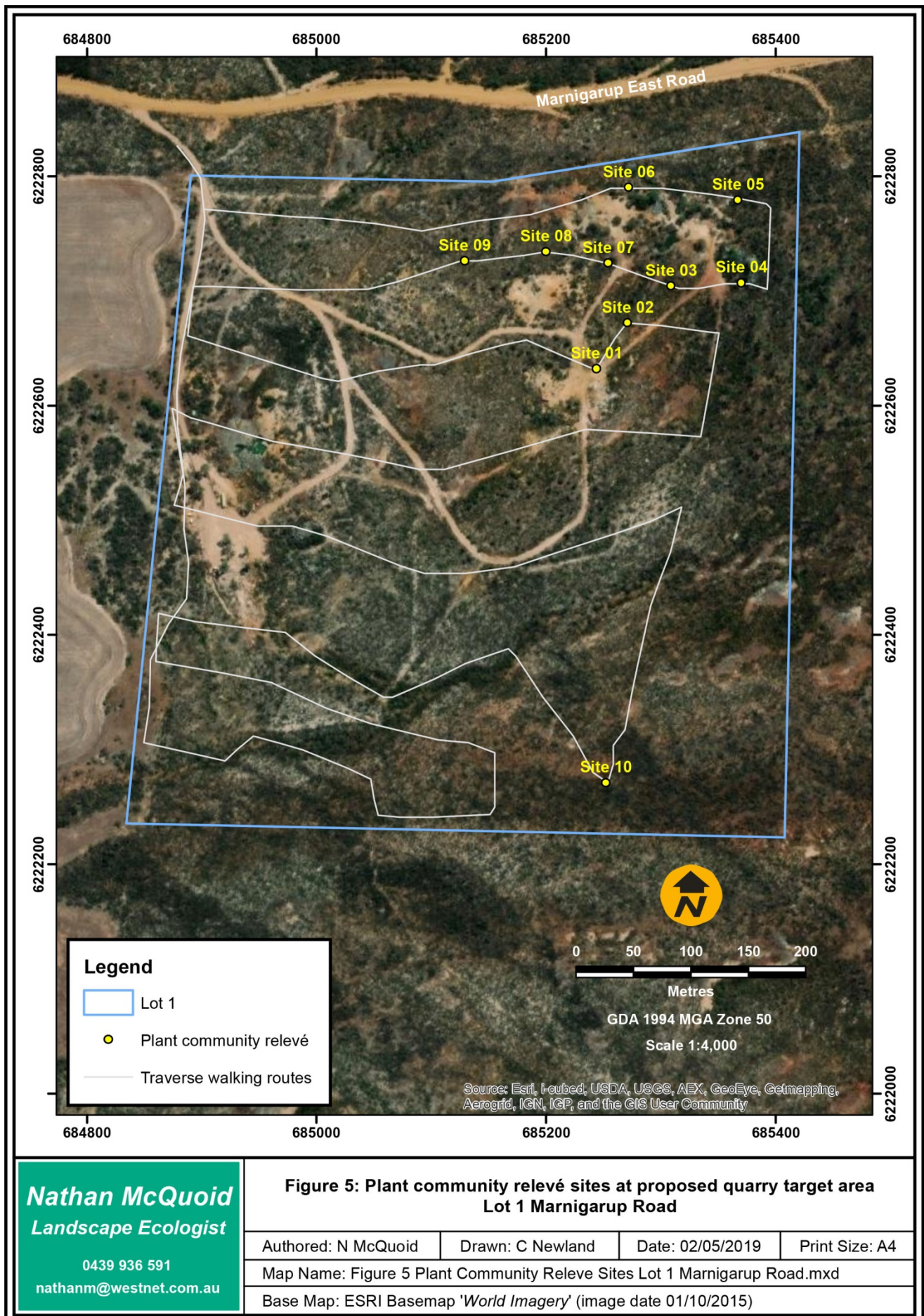


Figure 5. Plant community relevé sites, proposed quarry target area Lot 1

Constraints and limitations

The author has a significant working knowledge of the Threatened, Priority and other conservation significant flora of the Bremer Bay and Jerramungup areas. This includes experience in flora survey work in the Jerramungup and Ravensthorpe area through involvement in the investigation of floristics and vegetation in a number of projects and surveys in the area. This has included vegetation mapping of the Ravensthorpe Range (Craig et al 2008), a number of targeted Threatened and Priority Flora surveys for mineral exploration and trail developments, and development of nominations for TECs. The author is able to infer the presence of TEC's.

The timing of the field assessment during April, out of the typical Spring flowering season recommended by the WA Environmental Protection Authority Technical Guideline (EPA 2106), was considered not to be a concern as the *Proteaceae Dominated Kwongkan Shrubland* PEC/TEC is able to be identified regardless of flowering status of the flora present, and as the area had been burnt recently, the number of live mature plants was limited. Notwithstanding, it is possible that Threatened and Priority Flora could be present on Lot 1, including in the proposed quarry target area. However, it is unlikely given the substrates present and the flora typically occurring, and that most plants could be identified from material present.

The scope of this assessment was to investigate the presence of a Priority/Threatened Ecological Community, the potential presence of Threatened and Conservation Priority Flora, and from the assessment and within the constraints of a recently burnt site, map the vegetation if possible. As such, many plants could be identified (Table 1), sufficient for broad scale vegetation mapping (Figure 5) and description use, although given the timing of the assessment and regeneration status of the plants, the mapping and inventory are not as comprehensive had the site been unburnt and the assessment conducted in Spring.

Due to the relatively small area of the proposed quarry target area, assessment intensity was sufficient to cover the representative vegetation of the area with a degree of detail.

In significant parts of proposed quarry target area, ground disturbance from past quarrying operations including clearing had altered, removed or added to plant communities, resulting in structural and floristic change.

Results

The plant community and flora assessment recorded plant community structure, composition and site characteristics at nine sites within the proposed quarry target area (Appendix 1). This site data, as well as observations of other parts of Lot 1 noted during the field visit (Plate 1), provides the basis by which to meet the assessment scope and objectives.



Plate 1. Site 10, southern section of Lot 1, view north east.

The *Proteaceae Dominated Kwongkan Shrubland* PEC/TEC was not recorded on Lot 1, either in the proposed quarry target area or the remainder of Lot 1. Only two taxa of the Proteaceae family were recorded during the assessment: *Isopogon buxifolius* observed in the southern centre of Lot 1 and *Hakea laurina* recorded at site 004 and observed in the southern section of Lot 1 (Table 1). Neither taxon was present as more than a few individuals and as such does not meet the structural or compositional requirements to comprise the *Proteaceae Dominated Kwongkan Shrubland* PEC/TEC (Commonwealth of Australia 2014; DBCA 2019).

The vegetation of Lot 1 as plant communities, including the proposed quarry target area, is mapped (Figure 6). The map shows six major plant communities present:

1. Woodland on granite derived loams of Mo or Swamp Yate (*Eucalyptus occidentalis*).

2. Mallee shrubland on sand over clay duplex of Hook-leaved Mallee (*Eucalyptus uncinata*).
3. Mallee shrubland over dark cracking clay of Open-fruited Mallee (*Eucalyptus annulata*) and *E. calycogona*.
4. Shrubland on shallow and broken granite of Rock Oak (*Allocasuarina huegeliana*), Willyurwur or Rock Wattle (*Acacia lasiocalyx*) and One-sided Bottlebrush (*Calothamnus quadrifidus*).
5. Low to medium shrubland on shallow granite of Granite Bottlebrush (*Melaleuca elliptica*), Broombush (*M. hamata*) and *Thryptomene australis*.
6. Altered community containing medium and low shrublands of Rock Wattle, Rock Sheoak Mallee (*E. sporadica*) and introduced trees of Sugar Gum (*E. cladocalyx*) and South Australian Blue Gum (*E. leucoxyton*).

The vegetation community condition was assessed according to plant community due to the complexity of polygons that would result if each individual area was mapped. The vegetation community condition map is provided as Figure 7. The plant communities had condition ratings varying from Excellent to Very Degraded. For simplicity, the most common condition rating was used to describe each community, these being: Excellent, Very Good and Degraded. The range of condition ratings for each plant community is described below:

1. Mo woodland on loam: Condition excellent, mostly undisturbed. All burnt 2017?
2. Mallee shrubland on sand over clay duplex: Condition rating Excellent to Good, mostly Excellent. Excellent in undisturbed areas. Good in disturbed areas from tracks and clearings. Intermediate rating Very Good used. All burnt 2017?
3. Mallee shrubland on dark cracking loamy clay: Condition excellent, mostly undisturbed. All burnt 2017?
4. Shrubland on shallow and broken granite: Condition rating Excellent to Very Degraded, mostly Excellent. Excellent in undisturbed areas. Degraded in cleared areas undergoing regenerating. Very Degraded on tracks. Intermediate rating Very Good used. All burnt 2017?
5. Low to medium shrubland on shallow granite: Condition rating Condition Good to Very Degraded. Good in small less disturbed areas. Very Degraded in very disturbed quarried remainder. Intermediate rating Degraded used. All burnt, 2017?
6. Altered community: Condition rating Condition Very Good to Very Degraded - mostly Degraded. Very Good in less disturbed areas. Degraded in cleared areas. Very Degraded in quarried areas. Intermediate rating Degraded used. All burnt, 2017?



Figure 6. Plant communities for Lot 1 Marnigarup Rd

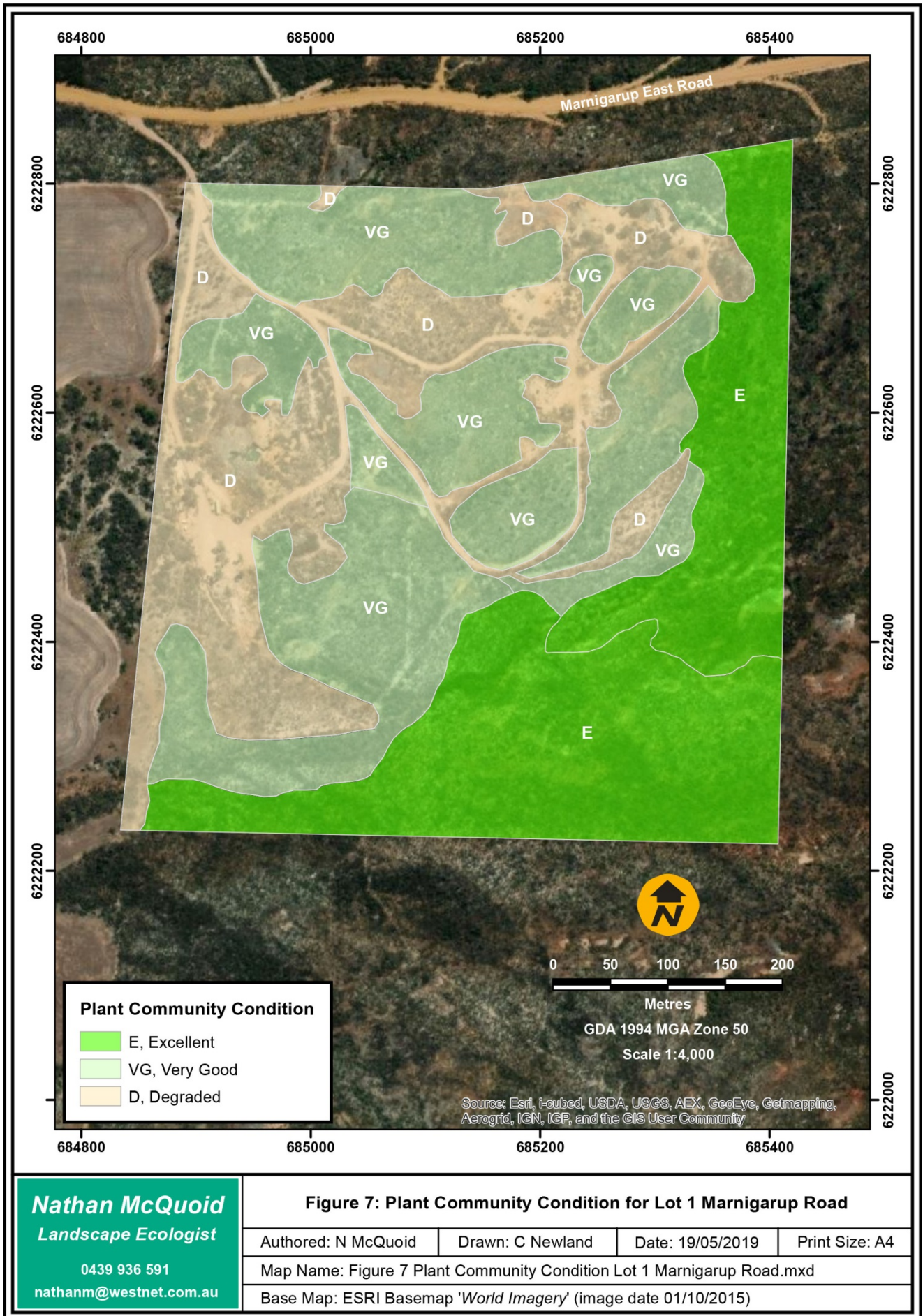


Figure 7. Plant community condition for Lot 1 Marnigarup Rd

No Threatened or Conservation Priority Flora was recorded by the assessment. The current DBCA Threatened and Conservation Priority Flora list (DBCA 2019) was interrogated post field visit to test for taxa recorded (Table 1) as listed, no flora recorded was found to appear on the list.

The site relevé assessment and the stratified walk of the southern parts of Lot 1 recorded 60 plant taxa to be present. Table 1 lists these plants together with their habit and sites and other places they were recorded.

Table 1. Plant taxa recorded on Lot 1 Marnigarup Rd. * = introduced

No.	Taxon	Form	Sites
1	<i>Acacia assimilis</i>	Shrub	006,
2	<i>Acacia lasiocalyx</i>	Large shrub, tree	001, 002, 003, 004, 005, 007, 008, 009
3	<i>Allocasuarina huegeliana</i>	Tree, large shrub	002, 003, 007, 008
4	<i>Allocasuarina humilis</i>	Low shrub	002, 003, 007, 008, 009
5	<i>Alyogyne huegelii</i>	Annual shrub	001, 002, 003, 005, 007
6	<i>Austrostipa sp.</i>	Grass	001, 005
7	<i>Beaufortia gracilis</i>	Low shrub	006
8	<i>Beyeria lechenaultii</i>	Low shrub	001, 004, 006, 007, 008
9	<i>Billardiera heterophylla</i>	Climber	001, 004
10	<i>Calothamnus quadrifidus</i>	Medium shrub	001, 002, 007, 008, 009
11	<i>Carpobrotus modestus</i>	Groundcover	001, 006, 009
12	<i>Commersonia sp.</i>	Herb	005, 007
13	* <i>Conyza bonariensis</i>	Biannual weed	002, 003, 007
14	<i>Dampiera sp. 1</i>	Herb	007, 008, 009
15	<i>Dampiera sp. 2</i>	Herb	008, 009
16	<i>Daviesia preissii</i>	Low shrub	004, 005, 007, 008
17	<i>Desmocladius flexuosus</i>	Rush	005
18	<i>Desmocladius lateriflorus</i>	Rush	008
19	<i>Dianella revoluta</i>	Large herb	008
20	* <i>Ehrharta longiflora</i>	Grass weed	003, 005
21	<i>Eucalyptus annulata</i>	Mallee	010
22	<i>Eucalyptus calycogona</i>	Mallee	010
23	* <i>Eucalyptus cladocalyx</i>	Tree weed	006, 008, 009
24	<i>Eucalyptus flocktoniae</i>	Mallee	010
25	* <i>Eucalyptus leucoxylon</i>	Small tree weed	006
26	<i>Eucalyptus occidentalis</i>	Tree, sometimes mallee	001, 002, 003, 004, 005, 006, 007, 009
27	<i>Eucalyptus pleurocarpa</i>	Mallee	007
28	<i>Eucalyptus sporadica</i>	Tall mallee	006, 007, 009
29	<i>Eucalyptus uncinata</i>	Mallee	010
30	<i>Gastrolobium parviflorum</i>	Shrub, toxic	004, 006, 007, 008
31	<i>Goodenia affinis</i>	Herb	002, 004, 005
32	<i>Gyrostemon subnudus</i>	Low shrub	001, 002, 003, 004, 007, 008, 009
33	<i>Hakea laurina</i>	Large shrub	004, southern Lot 1
34	<i>Halqania anagalloides var. Southern</i>	Low shrub	006
35	<i>Hibbertia sp.</i>	Low shrub	009
36	* <i>Hypochoeris glabra</i>	Annual weed	004, 005, 007
37	<i>Isopogon buxifolius</i>	Low - medium shrub	Southern centre Lot 1
38	<i>Lasiopetalum rosmarinifolium</i>	Low shrub	007
39	<i>Lepidosperma sp.</i>	Sedge	001, 002, 006, 007, 008, 009
40	<i>Lepidosperma tenue</i>	Sedge	004
41	<i>Lomandra collina</i>	Rush	004, 006
42	<i>Lomandra sp.?</i>	Rush	009

No.	Taxon	Form	Sites
43	<i>Leucopogon sp.</i>	Low shrub	002, 008,
44	<i>Lysiosepalum involucreatum</i>	Low shrub	001, 002, 004, 007, 008
45	<i>Melaleuca acuminata</i>	Large shrub	004
46	<i>Melaleuca elliptica</i>	Large shrub	005, 006, 007, 009
47	<i>Melaleuca hamata</i>	Medium shrub	005, 006, 007, 008, 009, 010
48	<i>Muehlenbeckia adpressa</i>	Climber	003, 005, 007
49	<i>Neurachne alopecuroidea</i>	Grass	004, 005, 006, 007, 008, 009
50	<i>Nicotiana sp?</i>	Herb	Near 002
51	<i>Patersonia occidentalis</i>	Sedge-like Herb	004, 007
52	<i>Phyllanthus calycinus</i>	Low shrub	007
53	<i>Pimelea sp.</i>	Low shrub	008
54	<i>Rytidosperma caespitosa</i>	Grass	001, 003, 004, 005, 006, 007
55	<i>Senecio sp.</i>	Herb	001, 002, 003,
56	<i>Senna artemisioides</i>	Low shrub	003,
57	* <i>Solanum nigrum</i>	Perennial weed	003, 004, 007
58	<i>Solanum symonii</i>	Large herb	005, 007
59	<i>Thryptomene australis</i>	Medium shrub	001, 002, 005,
60	<i>Waitzia sp.</i>	Herb	005, 009

The conservation value of Lot 1 is significant due to the range of plant communities, the diversity of the flora (Table 1), the intactness of the majority of the vegetation and the buffer it provides adjacent farmland and river corridor remnant native vegetation. The vegetation also protects minor watercourses that drain Lot 1 to the east into the Bremer River, and provides habitat value to what is likely a range of animals.

The proposed quarry target area has been disturbed by previous quarrying activities, with disturbance comprising vegetation clearing in patches, rock piles from quarrying operations, a number of access tracks and large holes in the granite sheet from direct quarrying of granite. Notwithstanding the disturbance, the regeneration of native plants in the disturbed sites is occurring and, in some cases, strongly. Restoration post quarrying and to repair degraded sites will be successful if the regenerative abilities and related processes required of the native plants are taken into account.

South west of the proposed quarry target area, further disturbed patches occur where clearing, track access rock piling and limited quarrying activities have taken place. At this site, along the western boundary and within the proposed quarry target area, the exotic Sugar Gum (*Eucalyptus cladocalyx*) and South Australian Blue Gum (*E. leucoxyton*) have been planted for apparent amenity purposes (Plate 2). These detract from the conservation value of Lot 1, which has a significant stand of locally native Mo or Swamp yate (*E. occidentalis*) through the eastern part of the property, and which is regenerating strongly into disturbed areas nearby.



Plate 2. Exotic sugar gum (*Eucalyptus cladocalyx*) in the proposed quarry target area.

Discussion

Some plants recorded in the relevé sites could only be identified to genus level due to their immaturity and lack of flowering material as the assessment was conducted in autumn in burnt vegetation. The genera recorded are not likely to represent Threatened or Conservation Priority Flora as matched to these genera on the current list (DBCA 2018). However, the possibility exists that Threatened and Conservation Priority Flora may be present on the site and due to the limited amount and immaturity of plant material as affected by the fire and the season, it was missed. Spring survey in 2019 and 2020 would be able confirm the presence or absence of Threatened and Conservation Priority Flora.

The proposed quarry target area has been disturbed to varying degrees by previous quarrying activities, with disturbance comprising vegetation clearing in patches, rock piles from quarrying operations, a number of access tracks and large holes in the granite sheet from direct quarrying of granite. Notwithstanding the disturbance, the regeneration of native plants in the disturbed sites is occurring and in some cases strongly. Restoration post-quarrying and to repair degraded sites will be successful if the regenerative abilities and disturbance response processes required of the native plants are taken into account.

The natural regenerative abilities of some plants are stronger than others. Mo or swamp yate (*Eucalyptus occidentalis*) of the deeper loamy soils and watercourses, and the wattle (*Acacia lasiocalyx*) and sheoak (*Allocasuarina huegeliana*) of the granite sheets, are precocious regenerators from seed following disturbance. These plants have the ability to move into places near parent plants when these places are disturbed. Other plants such as mallees and resprouting shrubs of *Melaleuca elliptica* and *M. hamata* do not readily move or colonise disturbed sites away from immediately adjacent to parent plants.

The exotic Sugar Gum (*Eucalyptus cladocalyx*) and South Australian Blue Gum (*E. leucoxylon*) have been planted along the western boundary and within the proposed quarry target area what is apparently amenity purposes by previous owners. Mature trees have since dropped seed, which has produced a second generation of exotic weedy eucalypts. These plantings detract from the conservation value of Lot 1, which has a significant stand of locally native Mor or Swamp yate (*E. occidentalis*) through the eastern part of the property, and which is regenerating strongly into disturbed areas nearby.

Recommendations

As the assessment for the presence of Threatened and Priority Conservation Flora was conducted in autumn rather than the optimum spring (EPA 2016), a follow up targeted search for flora listed such during spring in the proposed quarry target area is recommended. This assessment would be a relatively simple and uncomplicated survey of the same sites and a grid search of the target area, which would be an addendum to this autumn assessment.

Planned regeneration of the disturbed areas following quarrying could include enhancement of the natural abilities of the site's plants. This could be achieved by the strategic placement of seed-laden branches from adjacent mature plants directly onto selected disturbed sites during late autumn or early winter. Known as 'brush mulching', this technique has been used successfully in restoration of degraded farmland in the area near Lot 1, and given the large amount of suitable material available on Lot 1 near the proposed quarry target area, it would lend itself well to support the repair of the site.

The removal of the exotic sugar gum and South Australian blue gum from wherever they occur on Lot 1 is recommended. Cutting them down and applying Glyphosate at 1:3 with water immediately to the cut stumps would kill the trees. Seed material would be gathered up and disposed of off-site or buried to prevent regeneration.

References

Commonwealth of Australia (2014) *Proteaceae Dominated Kwongkan Shrubland: a nationally-protected ecological community*. Department of the Environment, Canberra ACT

Craig G.F., Hickman E.J., Newell J., McQuoid N.K., Rick A.M., and Sandiford E.M. (2008) *Vegetation of the Ravensthorpe Range, Western Australia: Mt Short to Kundip 1:10 000 scale*. Department of Environment and Conservation, South Coast Natural Resource Management, Albany WA

Department of Biodiversity, Conservation and Attractions (DBCA) (2019) *Priority Ecological Communities for Western Australia*, Version 28, 17 January 2019. Department of Biodiversity, Conservation and Attractions, Kensington WA

Environmental Protection Authority (EPA) (2016). *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*. EPA, Western Australia.

Keighery B.J. (1994). *Bushland Plant Survey: A guide to plant community survey for the community*. Wildflower Society of Western Australia (Inc.), Nedlands

Appendix

Field assessment data sheets

STRUCTURAL VEGETATION, FLORA – Relevé		SITE_ID: 001
Date: 24 April 2019	GPS Wpt: 001	Structural comm. type (app 2) Remnant wattle shrubland, burnt
Recorder: N McQuoid	Photo no. + direction: 1 NE	
Location: Southern central corner of quarry footprint.		

Condition: Pristine Excellent Very Good Good Degraded	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS Gritty S SCL SL SP ZCL ZL ZS
Litter (% cover & depth) < 5% - 2 cm	Bare Ground (% cover) 80% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		Single <i>Eucalyptus occidentalis</i> nearby
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	<i>Eucalyptus occidentalis</i>
Shrub (S1)	> 2	2 - 10	<i>Acacia lasiocalyx</i> burnt
Shrub (S2)	1-2		
Shrub (S3)	0-1	2 - 10	<i>Beyeria lechenaultii</i> , <i>Calothamnus quadrifidus</i> , <i>Alyogyne hugeliana</i> , <i>Thryptomene australis</i> , <i>Gyrostemon subnudus</i> , <i>Lysiosepalum involucreatum</i> , <i>Eucalyptus occidentalis</i> , <i>Acacia lasiocalyx</i>
Sedge/Rush (VR)		< 2	<i>Lepidosperma</i> sp.
Herb (H)		< 2	<i>Senecio</i> sp, <i>Carpobrotus modestus</i>
Grass (G)		< 2	<i>Rytidosperma caespitosa</i> , <i>Austrostipa</i> sp.
Other (climbers) (C)		< 2	<i>Billardiera heterophylla</i>

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent
* = Introduced



Site 1, view north east

STRUCTURAL VEGETATION, FLORA – Relevé		SITE_ID: 002
Date: 24 April 2019	GPS Wpt: 002	Structural comm. type (app 2) Allocasuarina shrubland, burnt
Recorder: N McQuoid	Photo no. + direction: 1 N	
Location: Remnant north of southern central bend of quarry footprint.		

Condition: Pristine Excellent Very Good Good Degraded	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS Gritty S SCL SL SP ZCL ZL ZS
Litter (% cover & depth) < 2%	Bare Ground (% cover) 90% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop - near Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10	< 2	<i>Allocasuarina hugeliana</i> burnt
Mallee (M1)	> 8		
Mallee (M2)	< 8		Few <i>Eucalyptus occidentalis</i> to NE
Shrub (S1)	> 2	< 2	<i>Calothamnus quadrifidus</i> burnt
Shrub (S2)	1-2	< 2	<i>Allocasuarina hugeliana</i> burnt, dead, <i>A. humilis</i> burnt
Shrub (S3)	0-1	2 - 10	<i>Daviesia</i> sp, <i>Gyrostemon subnudus</i> , <i>Acacia lasiocalyx</i> , <i>Leucopogon</i> sp, <i>Thryptomene australis</i> , <i>Allocasuarina humilis</i> resprouts, <i>Lysiosepalum involucreatum</i>
Sedge/Rush (VR)		2 - 10	<i>Lepidosperma</i> sp.
Herb (H)		< 2	<i>Senecio</i> sp, <i>Goodenia affinis</i> , * <i>Conyza bonariensis</i>
Grass (G)		< 2	<i>Rytidosperma caespitosa</i> , <i>Neurachne alopecuroidea</i>
Other (climbers) (C)		< 2	<i>Muehlenbeckia adpressa</i>

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent
• = Introduced



Site 2, view north

STRUCTURAL VEGETATION, FLORA – Relevé		SITE_ID: 003
Date: 24 April 2019	GPS Wpt: 003	Structural comm. type (app 2) Allocasuarina and Acacia shrubland, burnt
Recorder: N McQuoid	Photo no. + direction: 1 NE	
Location: East end of southern remnant in from southern boundary of quarry footprint		

Condition: Pristine Excellent Very Good Good Degraded		
Aspect: N NE E SE S SW W NW		Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other		Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow		Soil Type: C CL CLS CS L LS Gritty S SCL SL SP ZCL ZL ZS
Litter (% cover & depth) < 2%		Bare Ground (% cover) 80% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring		Topographic position: Upland Wetland Rock Outcrop Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10	< 2	<i>Allocasuarina hugeliana</i> burnt, <i>Eucalyptus occidentalis</i> to north, <i>Acacia lasiocalyx</i>
Mallee (M1)	> 8		
Mallee (M2)	< 8		
Shrub (S1)	> 2	< 2	<i>Acacia lasiocalyx</i> burnt, some unburnt to north
Shrub (S2)	1-2		
Shrub (S3)	0-1	2 - 10	<i>Alyogyne hugeliana</i> , <i>Allocasuarina humilis</i> burnt, <i>Acacia lasiocalyx</i> , <i>Senna artemisioides</i> , <i>Eucalyptus occidentalis</i> , <i>Gyrostemon subnudus</i> , * <i>Solanum nigrum</i>
Sedge/Rush (VR)			
Herb (H)		< 2	<i>Senecio</i> sp., * <i>Conyza bonariensis</i>
Grass (G)		< 2	* <i>Ehrharta longifolia</i> , <i>Rytidosperma caespitosa</i>
Other (climbers) (C)		< 2	<i>Muehlenbeckia adpressa</i>

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent
• = Introduced



Site 3, view north east

STRUCTURAL VEGETATION, FLORA – Relevé		SITE_ID: 004
Date: 24 April 2019	GPS Wpt: 004	Structural comm. type (app 2) Allocasuarina and Acacia shrubland, burnt
Recorder: N McQuoid	Photo no. + direction: 1 NNE	
Location: Southeast corner of quarry footprint in front of rock dump pile		

Condition: Pristine Excellent Very Good Good Degraded	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other	Rock: 0 <2 2-10 10-20 20-50 >50 except pile
Soil Colour: Grey Dark Brown burnt Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth) < 2%	Bare Ground (% cover) + 80% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30	< 2	<i>Eucalyptus occidentalis</i> dead
Tree (T3)	< 10	2 - 10	<i>Eucalyptus occidentalis</i>
Mallee (M1)	> 8		<i>Eucalyptus occidentalis</i> resprouting
Mallee (M2)	< 8		
Shrub (S1)	> 2	< 2	<i>Hakea laurina</i> dead, <i>Acacia lasiocalyx</i> dead
Shrub (S2)	1-2	< 2	<i>Gastrolobium parviflorum</i> dead, <i>Calothamnus quadrifidus</i> dead, <i>Melaleuca hamata</i> resprouting
Shrub (S3)	0-1	< 2	<i>Gastrolobium parviflorum</i> , <i>Eucalyptus occidentalis</i> , <i>Daviesia preissii</i> , <i>Hakea laurina</i> , <i>Acacia lasiocalyx</i> , <i>Beyeria lechenaultii</i> , * <i>Solanum nigrum</i> , <i>Gyrostemon subnudus</i> , <i>Lysiosepalum involucreatum</i> , <i>Melaleuca acuminata</i>
Sedge/Rush (VR)		< 2	<i>Lepidosperma tenue?</i> , <i>Lomandra collina</i>
Herb (H)		< 2	* <i>Hypochaeris glabra</i> , <i>Patersonia occidentalis</i> , <i>Goodenia affinis</i>
Grass (G)		< 2	<i>Neurachne alopecuroidea</i> , <i>Rytidosperma caespitosa</i>
Other (climbers) (C)		< 2	<i>Billardiera heterophylla</i>

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent
• = Introduced



Site 4, view north north east

STRUCTURAL VEGETATION, FLORA – Relevé		SITE_ID: 005
Date: 24 April 2019	GPS Wpt: 005	Structural comm. type (app 2) Allocasuarina and Acacia shrubland, burnt
Recorder: N McQuoid	Photo no. + direction: 1 WSW	
Location: East side of quarry footprint, out from quarry 2 north of rock dump pile		

Condition: Pristine Excellent Very Good Good Degraded Burnt	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth) < 2%, < 1 cm where present	Bare Ground (% cover) 70% bare
Hydrology: Good drain Poor drain both – sheet granite Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30	2 - 10	<i>Eucalyptus occidentalis</i> burnt
Tree (T3)	< 10	< 2	<i>Eucalyptus occidentalis</i> burnt
Mallee (M1)	> 8		
Mallee (M2)	< 8		
Shrub (S1)	> 2	2 - 10	<i>Melaleuca elliptica</i> burnt resprouting
Shrub (S2)	1-2	< 2	<i>Melaleuca elliptica</i> burnt, <i>Thryptomene australis</i> , <i>Melaleuca hamata</i> resprouting
Shrub (S3)	0-1	2 - 10	<i>Daviesia preissii</i> , <i>Alyogyne hugeliana</i> , <i>Melaleuca elliptica</i> resprouts, <i>Thryptomene australis</i> , <i>Solanum symonii</i> , <i>Acacia lasiocalyx</i> , <i>Eucalyptus occidentalis</i>
Sedge/Rush (VR)		< 2	<i>Desmocladius flexuosus</i>
Herb (H)		< 2	<i>Goodenia affinis</i> * <i>Hypochaeris glabra</i> , <i>Commersonia</i> sp., <i>Waitzia</i> sp.
Grass (G)		< 2	* <i>Ehrharta longiflora</i> , <i>Neurachne alopecuroidea</i> , <i>Rytidosperma caespitosa</i> , <i>Austrostipa</i> sp.
Other (climbers) (C)		< 2	<i>Muehlenbeckia adpressa</i>

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

• = Introduced



Site 5, view west south west

STRUCTURAL VEGETATION, FLORA – Relevé		SITE_ID: 006
Date: 24 April 2019	GPS Wpt: 006	Structural comm. type (app 2) Mallee shrubland patch
Recorder: N McQuoid	Photo no. + direction: 1 S	
Location: East side of quarry footprint, out from quarry 2 and towards rock pile to north		

Condition: Pristine Excellent Very Good Good Degraded	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS Gritty S SCL SL SP ZCL ZL ZS
Litter (% cover & depth) Patchy, - 2 cm where present	Bare Ground (% cover) 70% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10	2 - 10	<i>Eucalyptus occidentalis</i> . Off edge is * <i>Eucalyptus leucoxylon</i> , * <i>E. cladocalyx</i> planted
Mallee (M1)	> 8		
Mallee (M2)	< 8	2 - 10	<i>Eucalyptus sporadica</i> , <i>E. occidentalis</i>
Shrub (S1)	> 2		
Shrub (S2)	1-2	2 - 10	<i>Acacia assimilis</i> , <i>Melaleuca hamata</i> resprouting, <i>M. elliptica</i> , <i>Beyeria lechenaultii</i> , <i>Gastrolobium parviflorum</i> , <i>Beaufortia gracilis</i> resprouting
Shrub (S3)	0-1	< 2	<i>Eucalyptus occidentalis</i> , <i>Eucalyptus sporadica</i>
Sedge/Rush (VR)		< 2	<i>Lepidosperma sp.</i> , <i>Lomandra collina</i>
Herb (H)		< 2	<i>Halgania anagaloides</i> var. Southern, <i>Carpobrotus modestus</i>
Grass (G)		< 2	<i>Neurachne alopecuroidea</i> , <i>Rytidosperma caespitosa</i>
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent
* = Introduced



Site 6, view south

STRUCTURAL VEGETATION, FLORA – Relevé		SITE_ID: 007
Date: 24 April 2019	GPS Wpt: 007	Structural comm. type (app 2) Low woodland and mallee
Recorder: N McQuoid	Photo no. + direction: 1 W	
Location: Remnant in centre of footprint between quarries 1 and 4		

Condition: Pristine Excellent Very Good Good Degraded Burnt	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS Gritty S SCL SL SP ZCL ZL ZS
Litter (% cover & depth) Very sparse, almost none	Bare Ground (% cover) 80% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30	< 2	<i>Eucalyptus occidentalis</i> (1) burnt
Tree (T3)	< 10	2 - 10	<i>Eucalyptus occidentalis</i> burnt, <i>Allocasuarina hugeliana</i> few
Mallee (M1)	> 8		
Mallee (M2)	< 8	2 - 10	<i>Eucalyptus sporadica</i> burnt, <i>E. pleurocarpa</i> (1) burnt
Shrub (S1)	> 2	2 - 10	<i>Melaleuca hamata</i> , <i>Acacia lasiocalyx</i> burnt, <i>Melaleuca elliptica</i> burnt
Shrub (S2)	1-2	< 2	<i>Allocasuarina humilis</i> , <i>Melaleuca hamata</i> , <i>M. elliptica</i> all burnt
Shrub (S3)	0-1	2 - 10	New growth: <i>Gyrostemon subnudus</i> , <i>Daviesia preissii</i> , <i>Acacia lasiocalyx</i> , <i>Alyogyne hugeliana</i> , <i>Phyllanthus calycinus</i> , <i>Lysiosepalum involucreatum</i> , <i>Allocasuarina hugeliana</i> , <i>Calothamnus quadrifidus</i> , <i>Gastrolobium parviflorum</i> , <i>Lasiopetalum rosmarinifolium</i> , <i>Beyeria lechenaultii</i> , <i>Solanum symonii</i> , * <i>S. nigrum</i>
Sedge/Rush (VR)		< 2	<i>Lepidosperma</i> sp., <i>Patersonia occidentalis</i>
Herb (H)		< 2	<i>Commersonia</i> sp., <i>Dampiera</i> sp., <i>Waitzia</i> sp., * <i>Hypochaeris glabra</i> , * <i>Conyza bonariensis</i>
Grass (G)		< 2	<i>Neurachne alopecuroidea</i> , <i>Rytidosperma caespitosa</i>
Other (climbers) (C)		< 2	<i>Muehlenbeckia adpressa</i>

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent
* = Introduced



Site 7, view west

STRUCTURAL VEGETATION, FLORA – Relevé		SITE_ID: 008
Date: 24 April 2019	GPS Wpt: 008	Structural comm. type (app 2) Acacia shrubland over broken granite
Recorder: N McQuoid	Photo no. + direction: 1 ENE	
Location: North west of footprint north of quarry 4		

Condition: Pristine Excellent Very Good Good Degraded Burnt	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS Gritty S SCL SL SP ZCL ZL ZS
Litter (% cover & depth) Tiny patches, almost none	Bare Ground (% cover) 60% bare rock and sand
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10	< 2	<i>Allocasuarina hugeliana</i> (1) burnt. * <i>E. cladocalyx</i> (3) above quarry 4.
Mallee (M1)	> 8		
Mallee (M2)	< 8		
Shrub (S1)	> 2	< 2	<i>Acacia lasiocalyx</i> burnt
Shrub (S2)	1-2	< 2	Mainly at east end: <i>Melaleuca hamata</i> , <i>Acacia lasiocalyx</i> (unburnt patch), <i>Allocasuarina humilis</i> burnt, <i>Beyeria lechenaultii</i> , <i>Leucopogon</i> sp., <i>Calothamnus quadrifidus</i> , <i>Gastrolobium parviflorum</i> , <i>Lysiosepalum involucreatum</i>
Shrub (S3)	0-1	2 - 10	<i>Gyrostemon subnudus</i> , <i>Daviesia preissii</i>
Sedge/Rush (VR)		2 - 10	<i>Lepidosperma</i> sp., <i>Desmocladius lateriflorus</i> , <i>Dianella revoluta</i>
Herb (H)		< 2	<i>Pimelea</i> sp., <i>Dampiera</i> sp 1., <i>Dampiera</i> sp. 2
Grass (G)		< 2	<i>Neurachne alopecuroidea</i>
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent
* = Introduced



Site 8, view east north east

STRUCTURAL VEGETATION, FLORA – Relevé		SITE_ID: 009
Date: 24 April 2019	GPS Wpt: 009	Structural comm. type (app 2) Melaleuca and Allocasuarina shrubland
Recorder: N McQuoid	Photo no. + direction: 1 ENE	
Location: North west corner of footprint		

Condition: Pristine Excellent Very Good Good Degraded Burnt	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth) Almost none	Bare Ground (% cover) 70% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10	< 2	<i>Eucalyptus occidentalis</i> (1) on boundary burnt. * <i>E cladocalyx</i> (2) to SW
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	<i>Eucalyptus sporadica</i> NW edge
Shrub (S1)	> 2	< 2	<i>Acacia lasiocalyx</i> burnt
Shrub (S2)	1-2	2 - 10	<i>Allocasuarina humilis</i> , <i>Melaleuca hamata</i> , <i>Calothamnus quadrifidus</i> (1 unburnt), <i>M. elliptica</i> , <i>M. sp non</i> – resprouter, <i>Allocasuarina humilis</i>
Shrub (S3)	0-1	< 2	<i>Melaleuca elliptica</i> , <i>M. hamata</i> , <i>Gyrostemon subnudus</i>
Sedge/Rush (VR)		2 - 10	<i>Lepidosperma sp.</i> , <i>Lomandra sp.?</i>
Herb (H)		< 2	<i>Dampiera sp 1.</i> , <i>Dampiera sp. 2.</i> , <i>Waitzia sp.</i> , <i>Carpobrotus modestus</i> , <i>Hibbertia sp.</i>
Grass (G)		< 2	<i>Neurachne alopecuroidea</i>
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent
* = Introduced



Site 9, view east north east