Vegetation and flora survey of the southern portion of the Waddington-Wongan Hills Road for the Shire of Wongan-Ballidu

For the purpose of a road upgrade

CPS 8506/1

November 2019

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Executive Summary

The Shire of Wongan Ballidu proposes to wide a 4 km section of Waddington-Wongan Hills Road west from the intersection with Northam – Pithara Road (the proposal). The proposed works include clearing of vegetation 1 – 2 m wide on the north eastern verge and vegetation trimming by hand on the south western verge. The desktop survey indicated that there was a high likelihood of conservation taxa occurring within the proposal.

The proposal was surveyed on the 11th and 21st of November at the end of spring. The vegetation was healthy with several species in flower or fruit. Five priority and one threatened species were recorded, with most recorded towards the central western end of the proposal. One Threatened Ecological Community is present – York gum woodlands – at the eastern end. Historic disturbances were noted in much of the area and included road maintenance, gravel removal, old tracks and roads, weeds and the presence of rabbits.

Traffic was busy during the survey period with many trucks using the road to deliver grain to the CBH facility close to Wongan Hills townsite. The road is also likely to be busy during the spring period with visitors going to the Wongan Hills range west of the proposal which supports a unique vegetation system, as well as the highly diverse wildflowers which occur on many of the roads in the area.

Environmental impacts will include clearing of native vegetation including conservation listed flora, land surface disturbance and temporary risks of soil erosion. The area of impact will be between 0.4 and 0.8 ha depending on the width of vegetation cleared.

1 Introduction

1.1 Background

The Shire of Wongan-Ballidu proposes to upgrade a four kilometre (km) section of the Waddington Wongan Hills Road (the proposal), located north west of the town of Wongan Hills in the central wheatbelt (Figure 1). The proposed works will require the trimming of vegetation on the south western verge, and widening of the road along the north eastern side by up to 2 metres which requires clearing of vegetation. Extensive land clearing and modification of the environment, including ongoing passive clearing through domestic and feral grazing, competition from weeds, inappropriate fire regimes and rising ground water tables causing salinity, have resulted in approximately 5.2 % of native vegetation remaining within the shire. The vegetation of the area is highly diverse with a significant number of species listed as rare.

Significant areas of native vegetation are present near the proposal including two reserves adjacent to the road, with Elphin Nature Reserve on the north and south ends of the western side, which includes the rifle range facility and Scientific Reserve on the northern side (Figure 2). The Wongan Hills range is located to the west. Much of the southern road reserve is bordered by farmland.

Waddington Wongan Hills Road provides access to CBH from the west as well as from the Northam – Pithara Road to the east. The road is particularly busy during harvest and a major component of traffic comprises B-double trucks delivering grain. The road also provides access to the geologically and floristically unique Wongan Hills range to the west and would have an increased use during spring during "wildflower" months. The current width of the sealed section of road is insufficient for safe passing of vehicles without going on to the shoulders. The Shire proposes to widen the sealed section of the road which will require the clearing of approximately 2 metres on the north eastern verge to allow for the construction of an appropriate road shoulder and drainage. The vegetation on the south western side will be trimmed which may involve some clearing within the existing road shoulder and drainage (road maintenance).

Jenny Borger Botanical Consulting (JBBC) was commissioned by Western Ecological to undertake the vegetation and flora survey component of the proposal in November 2019.

1.2 Objectives

The aims of the survey were to:

- Record vegetation types including vegetation communities which may be representative of any Threatened Ecological Communities
- Record the location of threatened and priority flora which may be directly impacted as well as those within 50 m of the proposed clearing on the north eastern side of the road
- Record the location of sandalwood (a registered species)
- Record significant weeds and other threats which may be present

The survey was undertaken on the 11th of November with some further survey on the 21st November following the arrival of the database search from the Department of Biodiversity, Conservation and Attractions which was delayed.

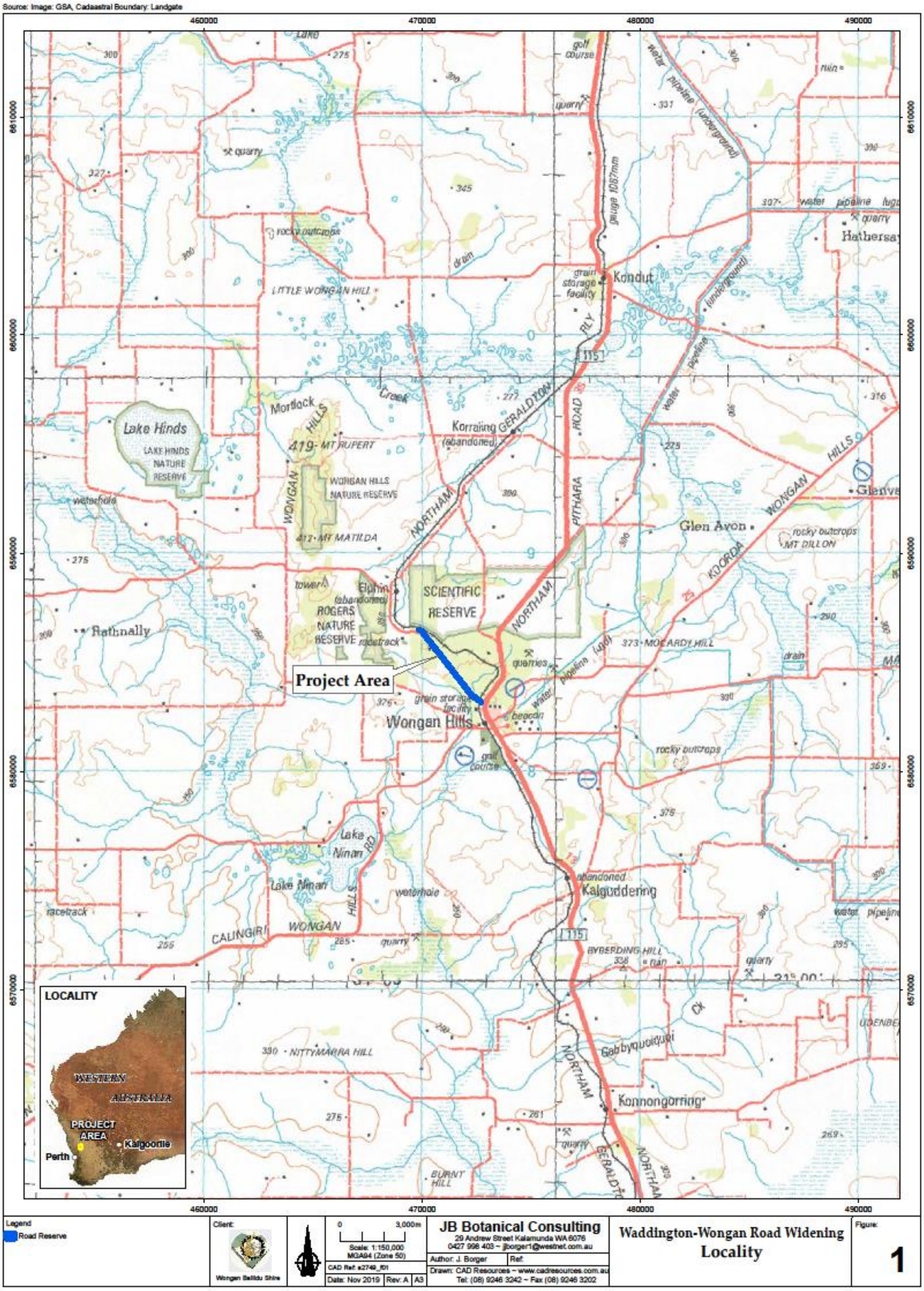


Figure 1: Location of the survey area

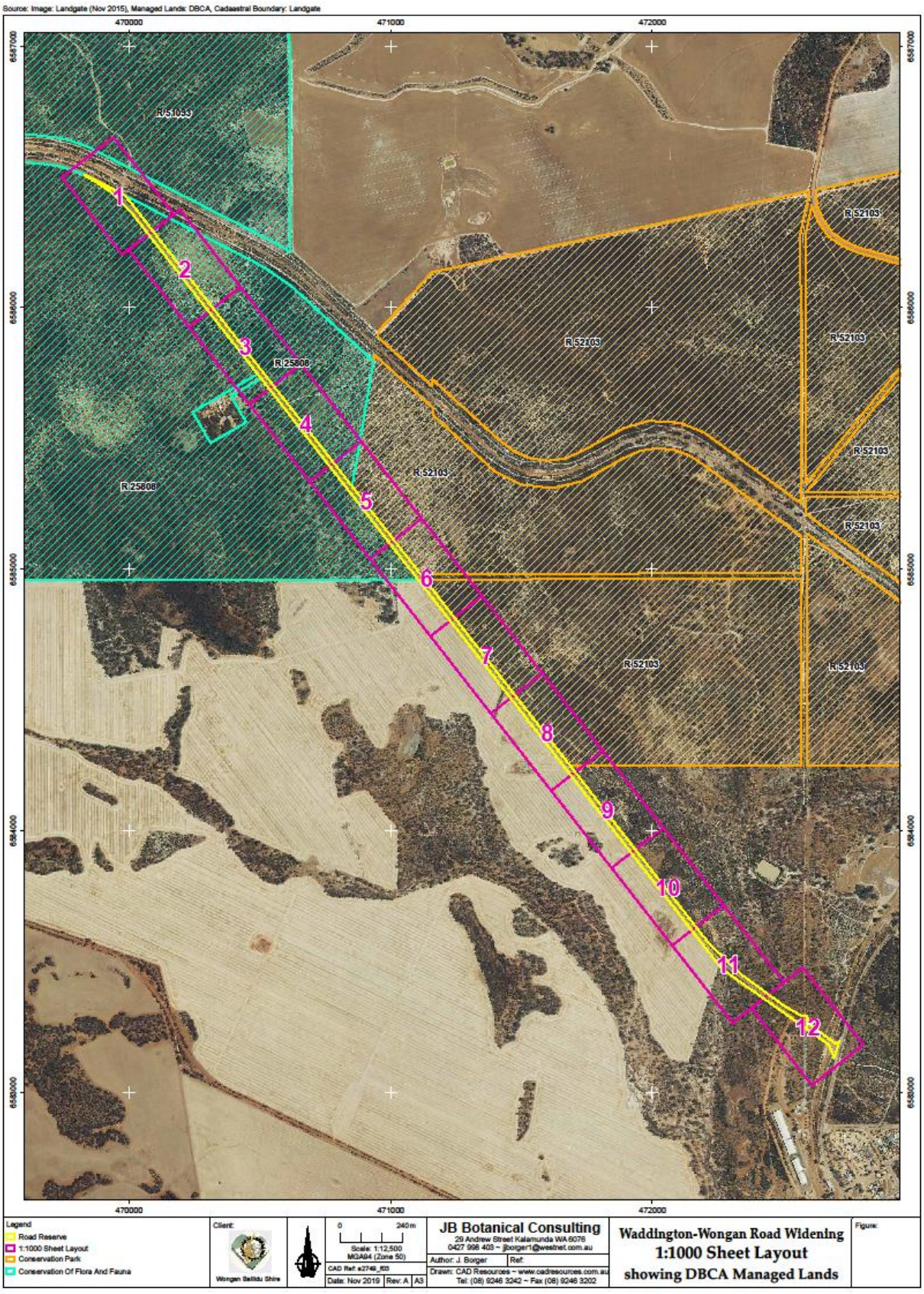


Figure 2: Location of DBCA Managed Lands. Elphin Nature Reserve (R 25808) is located at the western end; and Scientific Reserve (R 52103) is located on the northern side.

1.3 Environmental Context

1.3.1 Geology, landform and soils

The proposal lies within the Yilgarn block which is chiefly composed of granites and gneiss enclosing a number of greenstone belts of metamorphosed layered rocks which are harder and more resistant to weathering, often forming ranges of hills (e.g. Wongan Hills), with the granite and gneiss underlying the sandplains. The proposal is underlain by granites and gneiss which are close to the surface at a number of locations. Soils range from sandy earths with lateritic gravel to clay loam and clay, the latter associated with rock close to the surface.

The proposal is located within the Wongan Hills System (Stack et al 2006), northern zone of rejuvenated drainage, on a gently sloping low rise with drainage to the south into Lake Ninan and into the seasonally flowing Mortlock River which drains south into the Avon paleodrainage system. Drainage lines within the proposal are ephemeral being dry for much of the year, with flows during the wetter winter period and occasional flows following intense summer rainfall events.

1.3.2 Climate

The climate of the Wongan Hills area is described as Mediterranean with hot dry summers and cool wet winters, although well above average rainfall has been recorded in January 2017 and 2018, and in February 2017 (Figure 2). This is often as a result of tropical depressions (sometimes ex-tropical cyclones) moving south. The mean annual rainfall of 388.3 mm has been recorded at Wongan Hills (Bureau of Meteorology (BOM) Station 008137) over the period 1907 – 2019, with 242.2 mm received from May to August.

Rainfall was below average in 2017 (364.6 mm); slightly above average in 2018 (399.2 mm) and has been below average for much of 2019 with a total of 272.9 mm recorded to the end of November (Figure 3). Mean rainfall recorded in December is 10 mm, so it is highly likely that the annual rainfall will be very much below average.

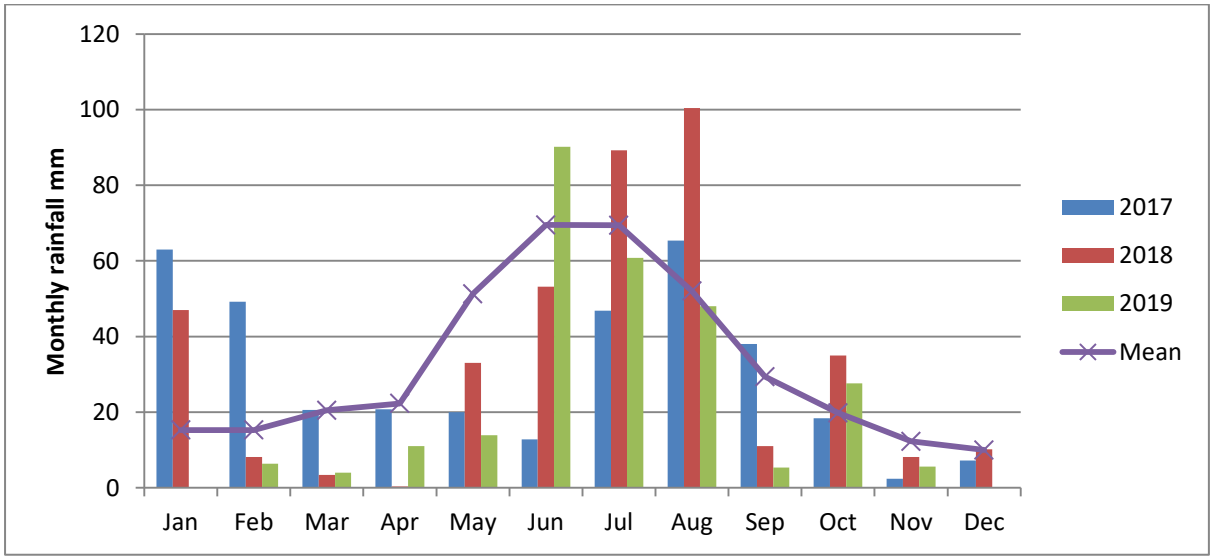


Figure 3: Monthly rainfall recorded at Wongan Hills. Slightly above average falls were recorded in 2018 with good falls recorded in July and August. The start of 2019 was very dry with below average rainfall recorded from January to May. 90 mm was recorded in June against the mean of 69.5 mm.

July and August were slightly below average followed by a very dry September, and slightly above average October.

Maximum temperatures (Figure 4) have been above average for much of 2019 with minima close to average. Despite the lower than average rainfall and warmer temperatures, the perennial vegetation was in a healthy condition, with green crowns and many species flowering at the time of survey in November which is likely to be a result of above average rainfall in June and October. Most herbs and grasses had dried off.

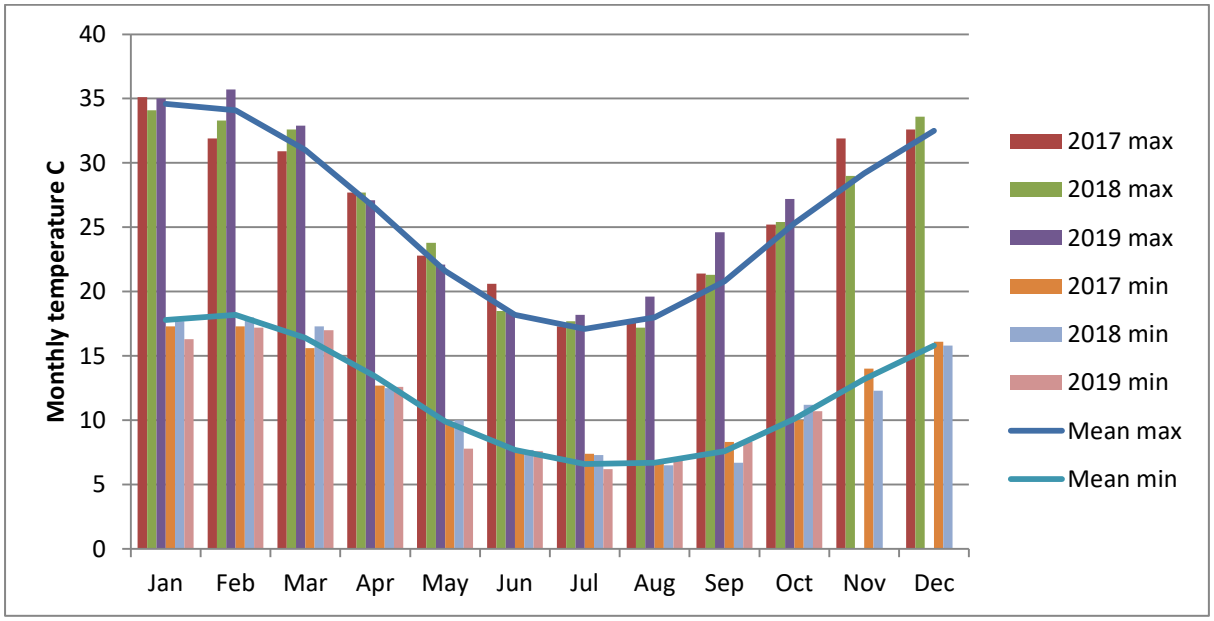


Figure 4: Minimum and maximum temperatures for 2017 - 2019 recorded at Wongan Hills with the long term means. Maximum temperatures were mainly above average in 2019, particularly in September and October. Minimum temperatures were below average in January, February and May 2019.

1.3.3 Vegetation

The proposal is located within the south-west province of Western Australia in the Avon Wheatbelt Interim Biogeographic Regionalisation of Australia (IBRA) region, and Avon Wheatbelt P1 IBRA subregion (Thackway & Cresswell 2017). Pre-European vegetation mapping by Beard (1979) is presented in Figure 5.

Three main vegetation systems described by Beard (1979) occur within the shire, with the proposal located within the Guangan (also known as Kwongan) system which is residual sandplain underlain by granitic rock surrounding the Wongan Hills. The dominant vegetation type within the shire is mallee and associated Allocasuarina thicket with different patches of vegetation such as *Ecdeiocolea monostachya* sedgeland determined by variations in soils types. On deeper sands *Eucalyptus oldfieldii* and *Allocasuarina acutivalvis* dominate in association with *Acacia* and *Grevillea* species. The eastern end of the road, adjacent to the Wongan Hills townsite, is located lower in the catchment and includes a defined drainage line which drains south to Lake Ninan. This area supports *Eucalyptus loxophleba* (York gum) and *Acacia acuminata* woodland. The York gum woodlands have recently been included within the Wheatbelt Woodlands Threatened Ecological Community (TEC).

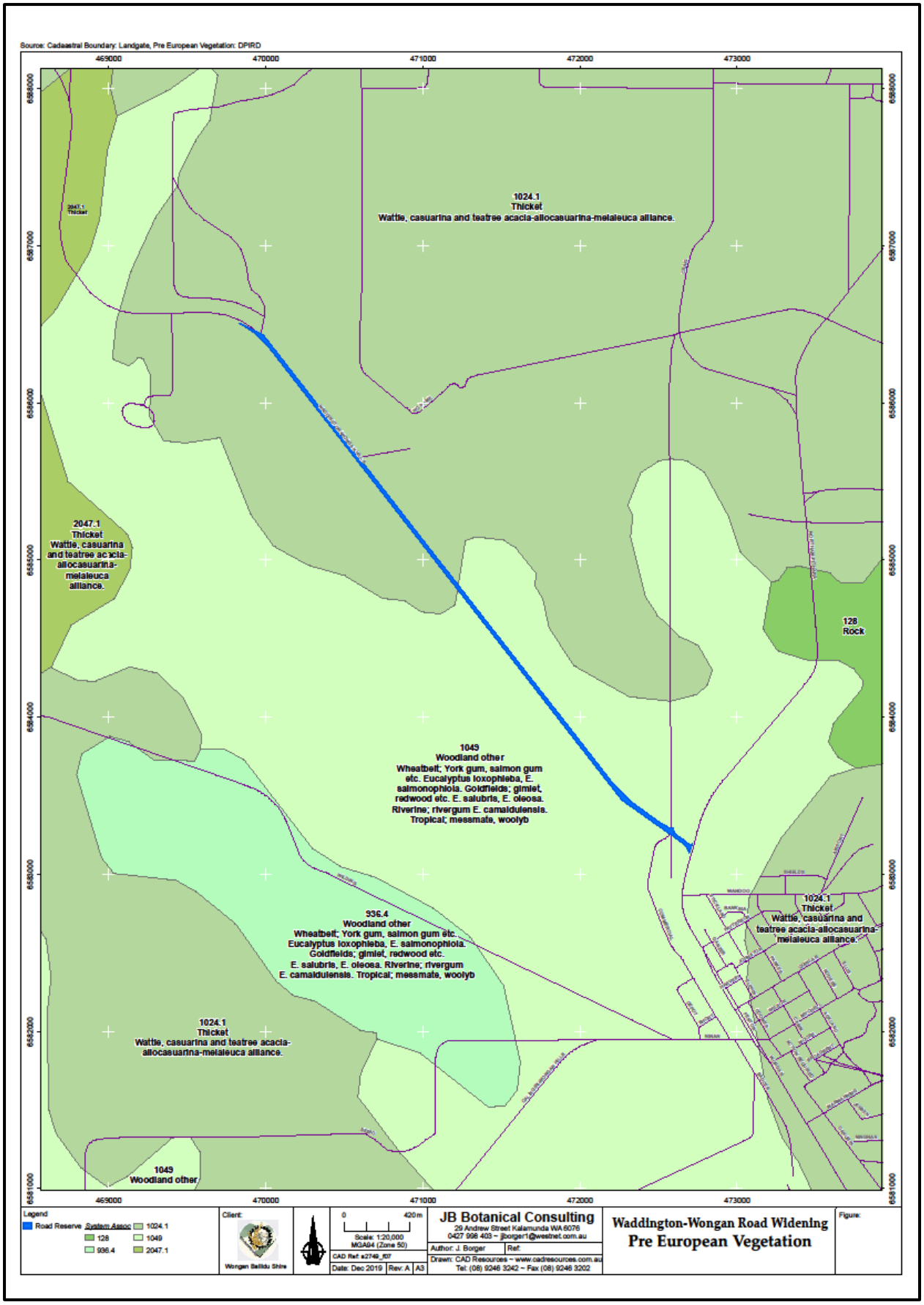


Figure 5: Pre-European vegetation mapping of the proposal area.

Two vegetation associations are mapped as occurring in the proposal area (Beard (1979); DBCA 2019: Statewide Vegetation Statistics 2018) (Figure 5):

1024.1 Thicket – Wattle, Casuarina and teatree: *Acacia-Allocasuarina-Melaleuca* alliance.

Guangan System: 4018 ha (8.18 %) remaining of pre-European extent

1049 Woodland other Wheatbelt; York gum, salmon gum etc. *Eucalyptus loxophleba and E. salmonophloia*

Guangan System: 29,277 ha (7.01 %) remaining of pre-European extent

1.3.4 Threatened Ecological Communities

One threatened ecological community (TEC) was mapped as occurring within the survey area – Eucalypt Woodlands of the Western Australian Wheatbelt – and is listed as Critically Endangered. The description (CoA 2018) distinguishes the ecological community as having an open tree canopy dominated by having eucalypt species with a single trunk. The TEC must have one of the key species listed in Table 1A and includes *Eucalyptus loxophleba* subsp. *loxophleba* and *Acacia acuminata.* Beard vegetation association 1049 – Medium woodland; Wandoo, York gum, Salmon gum, morrel and gimlet - corresponds to the TEC description.

1.3.5 Conservation listed flora

Due to the extensive clearing within the wheatbelt and unique landforms associated with Wongan Hills range, several threatened and priority taxa have been recorded within and near the proposal (Table 1; Figure 6).

Acacia filifolia, Acacia semicircinalis, Daviesia euphorbioides (T), Daviesia spiralis (P4), Conostylis wonganensis (T), *Stylidium coroniforme* subsp. *coroniforme* (T) and *Melaleuca sciotostyla* (T) have previously been recorded within or near the road reserve (DBCA 2019a, DBCA 2019b).

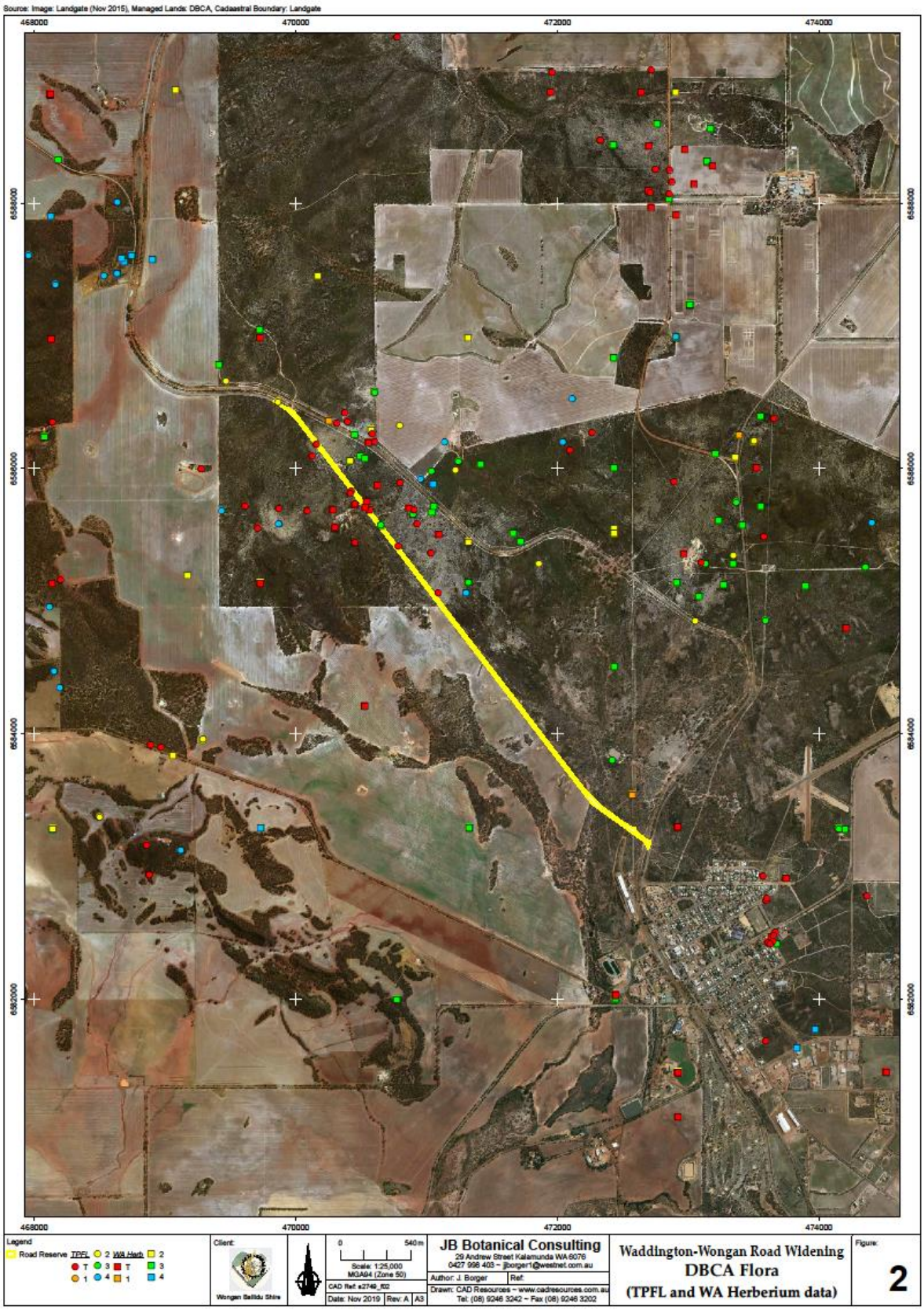


Figure 6: Locations of conservation flora provided by DBCA database search (Ref: 16-1119FL) which occur near the proposal

Table 1: Threatened and priority flora recorded within 20 km of the proposal (DBCA 2019)

Scientific Name	Code	Scientific Name	Code
Acacia cochlocarpa subsp. *cochlocarpa*	T	*Acacia filifolia*	P3
Acacia denticulosa	T	*Acacia phaeocalyx*	P3
Acacia pharangites	T	*Acacia repanda*	P3
Acacia pygmaea	T	*Angianthus micropodioides*	P3
Acacia vassalii	T	*Banksia dallanneyi* subsp. *pollosta*	P3
Conostylis wonganensis	T	*Chamelaucium* sp. Wongan Hills (B.H. Smith 1140)	P3
Dasymalla axillaris	T	*Daviesia nudiflora* subsp. *drummondii*	P3
Daviesia euphorbioides	T	*Dicrastylis velutina*	P3
Eremophila ternifolia	T	*Eucalyptus macrocarpa x pyriformis*	P3
Eucalyptus recta	T	*Gnephosis multiflora*	P3
Gastrolobium glaucum	T	*Gompholobium wonganense*	P3
Gastrolobium hamulosum	T	*Grevillea asparagoides*	P3
Lysiosepalum abollatum	T	*Grevillea roycei*	P3
Melaleuca sciotostyla	T	*Guichenotia impudica*	P3
Microcorys eremophiloides	T	*Hemiandra coccinea*	P3
Philotheca wonganensis	T	*Lepidosperma* sp. Meckering (R. Davis WW 27-32)	P3
Rhagodia acicularis	T	*Leucopogon* sp. Bungulla (R.D. Royce 3435)	P3
Stylidium coroniforme subsp. *coroniforme*	T	*Leucopogon tamminensis* var. *tamminensis*	P3
Verticordia staminosa subsp. *staminosa*	T	*Melaleuca sclerophylla*	P3
Acacia trinalis	P1	*Microcorys tenuifolia*	P3
Androcalva fragifolia	P1	*Persoonia pungens*	P3
Beyeria apiculata	P1	*Phebalium brachycalyx*	P3
Calandrinia sp. Piawaning (A.C. Beauglehole 12257)	P1	*Podotheca pritzelii*	P3
Dampiera glabrescens	P1	*Podotheca uniseta*	P3
Daviesia debilior subsp. *sinuans*	P3	*Schoenus pennisetis*	P3
Frankenia bracteata	P1	*Stylidium periscelianthum*	P3
Micromyrtus redita	P1	*Stylidium sacculatum*	P3
Scaevola tortuosa	P1	*Synaphea constricta*	P3
Acacia congesta subsp. *wonganensis*	P2	*Tetratheca retrorsa*	P3
Acacia drewiana subsp. *minor*	P2	*Thomasia tenuivestita*	P3
Acacia dura	P2	*Thysanotus tenuis*	P3
Boronia ericifolia	P2	*Verticordia huegelii* var. *tridens*	P3
Calandrinia wilsonii	P2	*Verticordia venusta*	P3
Calothamnus quadrifidus subsp. *asper*	P2	*Acacia botrydion*	P4
Eremophila sargentii	P2	*Banksia comosa*	P4
Gastrolobium wonganense	P2	*Banksia wonganensis*	P4
Grevillea endlicheriana subsp. Wongan Hills (G.J. Keighery 15351)	P2	*Daviesia spiralis*	P4
Grevillea kenneallyi	P2	*Eucalyptus caesia* subsp. *caesia*	P4
Guichenotia glandulosa	P2	*Eucalyptus caesia* subsp. *magna*	P4
Papistylus grandiflorus	P2	*Frankenia glomerata*	P4
Petrophile trifurcata	P2	*Hemigenia conferta*	P4
Tricoryne sp. Wongan Hills (B.H. Smith 794)	P2	*Lepidium pseudotasmanicum*	P4
Verticordia wonganensis	P2	*Loxocarya albipes*	P4

Table 2: Survey limitations

Potential Limitation	Extent
Contextual information at a regional and local scale	Not limiting Several surveys have been undertaken in the area and detailed information is available for most of the potential conservation taxa which may occur.
Competency/ experience	Partly limiting The botanist has surveyed in the Avon Wheatbelt region since 2002, including several years with WWF Australia on Woodland Watch and Healthy Bushland projects and extensive surveys under the DEC Hidden Treasures and Last Stands projects, including the Dalwallinu – Pithara area. No surveys have been undertaken within the Wongan Hills area; however the botanist is familiar with similar vegetation associations in the Central Wheatbelt and many resources are available to enable field identification of the conservation taxa. The Graduate field assistant has no previous experience in the wheatbelt flora but was supervised in the field and given specific tasks to do in which he was competent (for example recording GPS locations of sandalwood and priority flora which are easily identifiable and with which he became familiar with a session at the WA Herbarium).
Proportion of flora recorded and/ or collected, any identification issues	Partly limiting All flora present within the proposal were recorded. Many perennial species were flowering or had fruit present. Most grasses had fruiting structures present. Most forbs had dried off but some still had flowering/ fruiting structures present. Some perennial species which die back to a tuber or corm over the summer period may not be identifiable.
Was the appropriate area fully surveyed	Not limiting The area of potential impact is about 0.8 ha on the north eastern side of the proposal; and minimal on the south western side, where the direct impact will be limited to the existing road structure. The area was walked over including a 50 m wide strip adjacent to the north eastern shoulder of the road to record any potential threatened species which may be indirectly impacted.
Access restrictions within the survey area	Not limiting The proposal is located either side of an existing road. There were a number of locations along the road available for safe parking.
Survey timing, rainfall, season	Partly limiting The survey was undertaken at the end of spring following a year of below average rainfall. Most herbs and grasses had dried off; however enough reproductive structures were present to allow identification. The condition of the perennial vegetation was surprisingly healthy with many taxa in flower or fruit.
Disturbance that may have affected the results such as fire, flood or clearing	Partly limiting There are varying levels of disturbance within the proposal including road maintenance and clearing; fire (not recent); weeds; old clearing associated with gravel extraction; old roads and tracks; and grazing by feral animals. The main impact area is adjacent to the road and supports a disturbance community which is not representative of the mature vegetation associations away from the road reserve. The disturbance areas are likely to support a higher number of conservation taxa, particularly those that are disturbance dependent.

2. Methodology

2.1 Desktop Survey

The Shire of Wongan Ballidu provided maps showing a 4 km section of the Waddington Wongan Hills Road to the north west of the townsite (the proposal). A desktop survey was undertaken of the broader region, and a 20 km radius DBCA database search requested for records of threatened and priority flora (16-1119FL). A search on NatureMap was also undertaken prior to the survey and specimens of some of the conservation flora were viewed at the WA Herbarium to familiarise the surveyors (J Borger and S Rees) with the plants. Good descriptions and photos were available for many of the threatened flora in the publication – Threatened flora of the Western Central Wheatbelt (Collins 2009), as well as in "Declared Rare and Poorly Known Flora restricted to the Shire of Wongan-Ballidu (Stack et al, 2006) which included some of the priority taxa as well. Several *Acacia* species are listed as threatened or priority and the Wattle interactive key was used along with images taken at the herbarium to assist with field identifications.

Some images, distributions and descriptions of taxa were also available on FloraBase (DBCA 2019). A list of publications used is presented in Section 5 – References. The Bureau of Meteorology (BOM) website was accessed for information on weather conditions expected during the survey period as well as previous years, including 2019 prior to the survey for details on climatic conditions which may influence vegetation condition and presence/ absence of some taxa.

Aerial imagery of the area was studied prior to the survey to determine likely vegetation variations which would assist with vegetation mapping and potential locations of conservation listed flora.

2.2 Field Survey

The site was surveyed on the 11th November with a second visit occurring on the 20th November to check locations of conservation flora which were presented on the DBCA database search and not observed in the field. Some of these locations had been recorded several years ago and in some cases the plants were no longer present at the recorded site.

Both sides of the road reserve were surveyed and conservation flora and sandalwood locations were recorded by GPS. Vegetation descriptions were taken at a number of sites (relevés). Photographs and specimens were taken of flora including those unable to be determined/ verified in the field. Vegetation on the south-western side of the road reserve was mostly a few metres wide. Clearing is not proposed for this area; however some trimming will be undertaken. Some plants were present within the shoulder and drain area which may be impacted. The north-eastern side was bordered by a reserve and the vegetation was surveyed to 50 m from the edge of the proposed clearing. Vegetation was described using the National Vegetation Information System format and the change in vegetation type was recorded by GPS for accurate mapping.

Vegetation condition (Table 3; EPA 2016), threats and disturbances were also recorded.

Table 3: Vegetation Condition (adapted from Keighery 1994 and Trudgen 1988; EPA 2016)

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

3. Results

3.1 Summary of flora results

A total of 154 taxa were recorded from 35 families and 85 genera. The most well represented families were Myrtaceae (30 species from 10 genera), Fabaceae (24 species from 5 genera, including one weed (*Trifolium hirtum**) and Proteaceae (22 species from 8 genera). Nine weeds were recorded, including one plant of *Gazania linearis** and a few occurrences of African Lovegrass – *Eragrostis curvula**. Most weeds were grasses and occurred at the edges of the road or within the York gum woodland area at the southern end. No orchids and very few *Stylidium* were recorded as it is likely that they would have dried off. Ground cover (including dried herbs and grasses) was also very sparse in most areas which is indicative of a drier than usual spring. Ground cover was quite dense within the creek channel towards the eastern end of the area.

One *Eucalyptus* species – *E. torquata* (Coral gum) was present along the road verge near the entrance to the rifle club. These are native to the Kalgoorlie – Coolgardie area and are likely to have been planted. A list of taxa recorded during the survey is presented in Appendix 1.

The vegetation adjacent to the road was representative of a disturbance community and was often more diverse than adjacent remnant vegetation which was less disturbed. Some species are adapted to disturbance conditions and may include some of the conservation listed flora.

Table 4: Families with the most native species

Family	Genera	Species	Best represented genera
Myrtaceae	10	30	*Melaleuca* (11); *Eucalyptus* (6); *Verticordia* (5)
Fabaceae	4	23	*Acacia* (14); *Daviesia* (5)
Proteaceae	8	22	*Grevillea* (7); *Hakea* (6)

Native species in the three families – Myrtaceae, Fabaceae and Proteaceae – represent 48.3 % of native species recorded during the survey (Table 4). Acacias and Melaleucas were very common in much of the area.

Table 5: Weeds recorded in the survey area. Other species of weed may be present during winter and early spring.

Family	Scientific Name	Common Name
Poaceae	*Avena fatua**	Wild Oats; annual grass
Poaceae	*Briza maxima**	Blowfly grass; annual grass
Poaceae	*Eragrostis curvula**	African Lovegrass; perennial grass
Asteraceae	*Gazania linearis**	African daisy; perennial herb
Poaceae	*Hordeum leporinum**	Barley grass; annual grass
Poaceae	*Lolium rigidum**	Annual rye grass; annual grass
Asteraceae	*Monoculus monstrosus**	Stinking Roger; annual herb
Fabaceae	*Trifolium hirtum**	Rose clover; annual herb
Poaceae	*Triticum aestivum**	Wheat; annual grass

3.2 Threatened and priority flora

Six conservation listed flora were recorded including one Threatened species – *Daviesia euphorbioides*. The most common rare flora were *Daviesia spiralis* (38 plants) and *Acacia filifolia* (58 plants). These were recorded over much of the western survey area. Another species with a high count was *Hemigenia conferta* (104 plants estimate) which occurred in dense patches in one area. Each species will be described on the following pages. The locations are presented in Appendices 2 and 3.

3.2.1 Acacia filifolia P3

Family: Fabaceae

IBRA Regions: Avon Wheatbelt, Coolgardie, Geraldton Sandplains.

Range: Approximately 450 x 100 km; Coorow eastwards through Wongan Hills to near Burracoppin and Southern Cross

Figure 7: *Acacia filifolia* (FloraBase 2019)

No. of plants: 58

No. impacted: 18 within 3 metres of the current disturbance on the north-eastern verge area

Description: Open, wispy shrub, single-stemmed or sparingly branched at base, to 3 m high. Phyllodes sessile; 10 – 25 mm long and 0.7 – 1 mm wide with 8 broad flat-topped nerves; quadrangular to sub-quadrangular and occasionally terete in cross section. It is recorded as flowering from May to September. No pods were present at the time of survey.

Several shrubs occurred along the road verge in disturbed areas; however there were some populations away from the road which will not be impacted. Shrubs occurring on the southern side of the road are not likely to be impacted.

3.2.2 Acacia phaeocalyx P3

Figure 8: *Acacia phaeocalyx* (FloraBase 2019)

Figure 9: A. phaeocalyx field image

Family: Fabaceae **No. plants: 1 – outside impact area**

IBRA Regions: Avon Wheatbelt Range: 300 x 120 km; from Wongan Hills south to the Corrigin area; in local government areas: Beverley, Bruce Rock, Corrigin, Cunderdin, Dowerin, Kellerberrin, Quairading, Tammin, Trayning and Wongan-Ballidu.

Description: Intricately branched sprawling or compact pungent shrub to 0.8 m high growing on white or yellow sands often over laterite. Branchlets are pruinose (having a thick waxy, powdery coating); stipules are spinose 2 – 4 mm long and shallowly incurved; flowering has been recorded from April to June.

3.2.3 Acacia semicircinalis P4

Family: Fabaceae

Common Name: Wongan Wattle

IBRA regions: Avon Wheatbelt

LGA: Wongan-Ballidu

No. of plants: 2 on the southern side of the road – outside impact area

Figure 10: *Acacia semicircinalis* field photo

Description: Diffuse shrub to 1 m high with wiry branches; often prostrate; sometimes coarsely pungent. Flowering recorded from August to January; grows in gravelly soils and laterite on hills. This species is restricted to the Wongan Hills area. It was recorded near the rifle club near the crest of the hill.

3.2.4 Daviesia euphorbioides T

Family: Fabaceae

Common Name: Wongan Cactus

IBRA Regions: Avon Wheatbelt

LGAs: Dowerin, Goomalling and Wongan-Ballidu

No. plants: 1 (55 cm high)

Figures 11 & 12
Field images of *Daviesia euphorbioides.* (Fig 11) One plant was recorded at the site of a previous record. Old pods were present (Fig 12). The plant was located 4 m east of the edge of the bitumen, and 2 m east of the edge of the shoulder. No DRF markers were in place.

Description: Erect, spreading spiny shrub 0.4 to 0.8 m high. The species has very thick greyish green cylindrical stems 6 – 10mm in diameter which are pithy inside. Leaves are reduced to small recurved spines that are 3 – 5 mm long. Recorded flowering in June and July with seeds mature in November.

Habitat: recorded from scattered occurrences in the Wongan Hills, Goomalling and Dowering areas, growing in grey or brown sandy loam or clay over laterite in shrubland and heath with *Allocasuarina campestris, Grevillea hookeriana, G. armigera, Hakea scoparia* and *Ecdeiocolea monostachya.*

Figure 13: Disturbed habitat with *Daviesia euphorbioides* in the centre of the photo. Main species present include *Allocasuarina campestris, Grevillea armigera, Dampiera lindleyi, Goodenia glareicola, Gastrolobium spinosum* and *Melaleuca conothamnoides.*

Potential impact from proposal: The *Daviesia* may be just outside the area of direct impact; however it is likely to be susceptible from either future road maintenance or vehicle interactions. No DRF road markers are currently in place.

3.2.5 Daviesia spiralis P4

Figure 14: *Daviesia spiralis* phyllodes showing distinctive spirals (L) and habit (R). Many of the plants were flowering at the time of survey in November.

Family: Fabaceae Common Name: Spiral-leaved Daviesia

IBRA Regions: Avon Wheatbelt LGA: Wongan-Ballidu (restricted to this area)

No. of plants: 38; impact 1 (small plant) on south side of road (in drain) plus some may need to be trimmed; 14 are likely to be impacted on the north side of the road.

Description: Intricate rounded shrub to 1.5 m (1.7 m); the phyllodes are alternate, ascending, linear and twisted, with the phyllode base extending down the stem. Many of the shrubs were in flower at the time of survey, with flowering recorded from August to January.

3.2.6 Hemigenia conferta P4

Family: Lamiaceae

IBRA Region: Avon Wheatbelt

LGA: Wongan-Ballidu (restricted)

No. of plants: 101 (approx. count) – all outside the proposed impact area; unlikely to be negatively impacted. The population consisted of many small shrubs growing closely together.

Figure 15: *Hemigenia conferta* occurred in one location. Identification was based on vegetative characteristics and sepals.

Description: Erect to spreading shrub 0.3 – 1.4 m high (mostly spreading low shrubs to 0.5 m at the survey site); flowers purple, white & cream, recorded in September and October.

3.3 Vegetation Types

Nine vegetation communities were recorded with four within the woodland area at the eastern end of the road; and five on the sandplain/ lateritic complex from 0.5 – 4 km west of the town which will be further discussed within the context of the pre-European vegetation associations. Species marked with an asterisk denote it is a weed (introduced); for example *Avena fatua** (wild oats).

3.3.1 Vegetation Association 1049 Woodland other Wheatbelt: York gum, salmon gum etc.; *Eucalyptus loxophleba and E. salmonophloia etc.*

Guangan System: 29,277 ha (7.01 %) remaining of pre-European extent (2018)

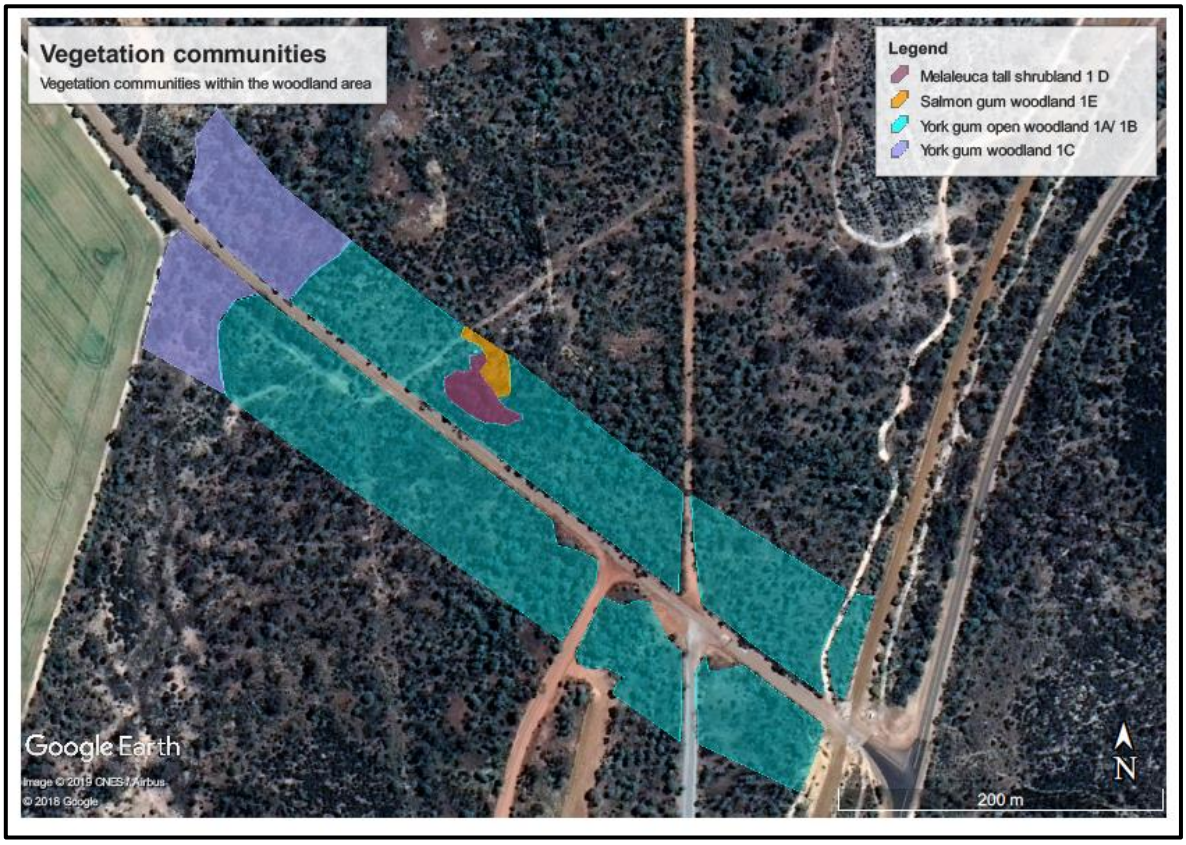


Figure 16: Vegetation community mapping for the southern woodland area which is representative of the Wheatbelt Woodlands TEC (0 – 0.5 km from townsite)

Vegetation Community 1A: *Eucalyptus loxophleba* subsp. *loxophleba* and *Acacia acuminata* low open woodland to low woodland over *Grevillea paniculata* open shrubland (TEC)	
Landform: Broad valley; gently sloping with drainage to the south west	
Relevés:R01 GPS: 472584 E/ 6583277 N R02 GPS: 472538 E/ 6583323 N	
Condition: Good to very good Description: *Eucalyptus loxophleba, Acacia acuminata* low isolated trees to low open woodland over *Grevillea paniculata* open shrubland over *Avena fatua*, Dianella revoluta* var. *divaricata, Waitzia acuminata, Ptilotus polystachyus* and *Enchylaena tomentosa* low tussock grassland.	
Condition: very good Description: *Eucalyptus loxophleba* subsp. *loxophleba, Acacia acuminata* low woodland over *Grevillea paniculata, Ericomyrtus tenuior, Rhagodia drummondii, Acacia colletioides* open shrubland over *Avena fatua*, Opercularia vaginata, Monachather paradoxus, Grevillea paniculata, Briza maxima** low tussock grassland	
Other species: *Borya sphaerocephala, Dampiera lavandulacea, Daviesia Leptosema, Desmocladus myriocladus, Glischrocaryon flavescens, Halgania lavandulacea, Melaleuca concreta, Neurachne alopecuroidea, Ptilotus eremita, Santalum spicatum, Schoenia cassiniana, Thysanotus manglesianus, Velleia rosea*	
Disturbances: weeds (dense cover in some areas); vehicle access tracks; clearing (old)	
Conservation taxa: *Santalum spicatum* (sandalwood)	

Vegetation type 1B: Eucalyptus loxophleba subsp. loxophleba, Acacia acuminata woodland (TEC)	
Landform: Broad ephemeral drainage line; drainage to the south	
Relevés: R04 Condition: Very good Description: *Eucalyptus loxophleba* subsp. *loxophleba, Acacia acuminata woodland over Grevillea paniculata, Stylobasium australe, Acacia microbotrya* open shrubland over *Austrostipa elegantissima, Monachather paradoxus, Enchylaena tomentosa, Rhagodia drummondii, Lepidosperma costale* open tussock grassland	
Other species: *Avena fatua*, Arthropodium dyeri, Dianella revoluta var. divaricata, Gilberta tenuifolia, Hordeum leporinum*, Melaleuca hamata, M. hamulosa, Monoculus monstrosus*, Trifolium hirtum**	
Disturbances: moderate weed cover; disturbance from construction of the road; ongoing road maintenance, rabbits	

Vegetation type 1C: Melaleuca hamata, Eucalyptus loxophleba subsp. loxophleba tall shrubland	
Landform: Broad valley; ephemeral drainage line	
Relevés: 03	
Condition: Very good to excellent	
Description: *Melaleuca hamata, Eucalyptus loxophleba* subsp. *loxophleba* tall shrubland (with isolated low trees) over *Lepidosperma costale*, *Desmocladus myriocladus, Dianella revoluta var. divaricata, Grevillea paniculata* and *Austrostipa trichophylla* open sedgeland	
Other species: *Acacia acuminata, Avena fatua*, Briza maxima*, Monachather paradoxus, Waitzia acuminata*	
Disturbances: weeds – mostly sparse; the understorey is in much better condition than the surrounding York gum woodland	

Vegetation type 1D: *Melaleuca* tall shrubland	
Landform: Broad valley; lower slope of small rise adjacent to ephemeral drainage line; granitic rock close to surface	
Relevés: 3b	
Condition: Excellent	
Description: *Melaleuca hamulosa, M. adnata* tall shrubland over *Grevillea hakeoides* subsp. *stenophylla, Gastrolobium bennettsianum* low isolated shrubs	
Disturbances: Old tracks and clearing adjacent to the area (north) – powerline; isolated weeds	

Vegetation type 1E: *Eucalyptus salmonophloia* woodland (TEC)	
Small patch adjacent to York gum woodland (south) and clearing to the north for a powerline	
Relevés: 3c	
Condition: Very good	
Description: *Eucalyptus salmonophloia* woodland over *Santalum acuminatum, S. spicatum* low isolated trees over *Daviesia nematophylla, Acacia colletioides, Rhagodia preissii* open shrubland over *Rhagodia drummondii, Dianella revoluta* var. *divaricata, Monachather paradoxus, Austrostipa elegantissima* and *Waitzia acuminata* low open shrubland	
Other species: *Acacia acuminata*, *Austrostipa trichophylla*, *Desmocladus myriocladus, Chamaexeros fimbriata, Grevillea hakeoides* subsp. *stenophylla, Velleia rosea*	
Disturbances: clearing; weeds (low to moderate)	
Conservation taxa: *Santalum spicatum* (Sandalwood)	

3.3.2 1024.1 Thicket – Wattle, Casuarina and teatree: *Acacia-Allocasuarina-Melaleuca* alliance.

Guangan System: 4018 ha (8.18 %) remaining of pre-European extent (2018)

Table 6: Summary of vegetation types occurring from 0.5 – 4 km west of Northam – Pithara Road

Code	Soil	Description
2A	Sandy loam over laterite	*Allocasuarina campestris* shrubland
2B	Clay loam over granite	*Melaleuca – Allocasuarina* shrubland with isolated low trees
2C	Shallow sandy clay loam over granite	*Calytrix depressa* low open shrubland over *Borya sphaerocephala* open forbland
2D	Sandplain	*Ecdeiocolea monostachya* open sedgeland
3	Sandy gravel over laterite on crests and upper slopes	*Eucalyptus pyriformis* sparse mallee shrubland over *Banksia armigera* shrubland

The vegetation on the road verges was pre-dominantly disturbance species forming a “community” often much more diverse and denser than the adjacent remnant vegetation with fewer disturbances. This was mainly 2 – 4 m wide, with a higher incidence of weeds on the south western side adjacent to farmland. Vegetation types 2A and 2B occurred in an area with a moderate level of historic disturbances including gravel removal, old roads and tracks and other disturbances to the land surface which may have impacted the vegetation type present. Old fire scars are present within the vegetation at the north western end (VTs 2D and 3 mainly) (Figures 17 & 18).

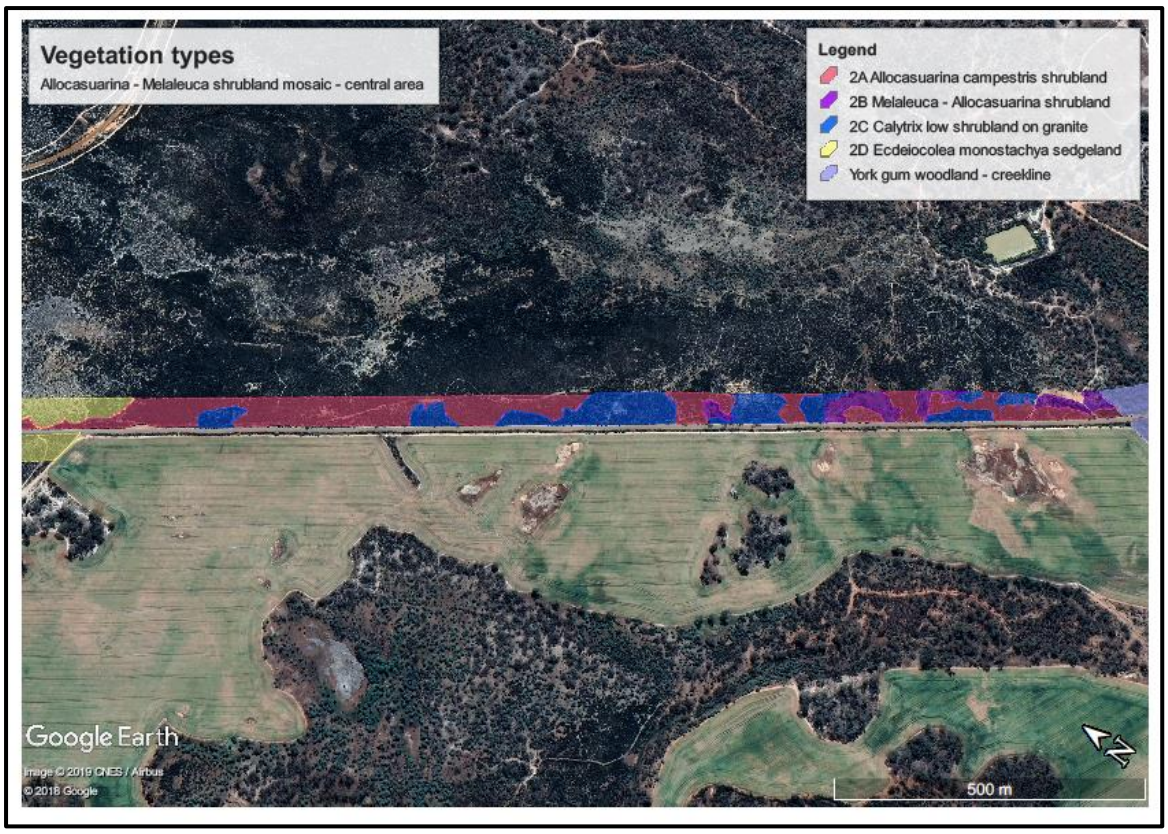


Figure 17: *Allocasuarina* – *Melaleuca* mosaic in the central area (0.5 – 3.0 km west of townsite)

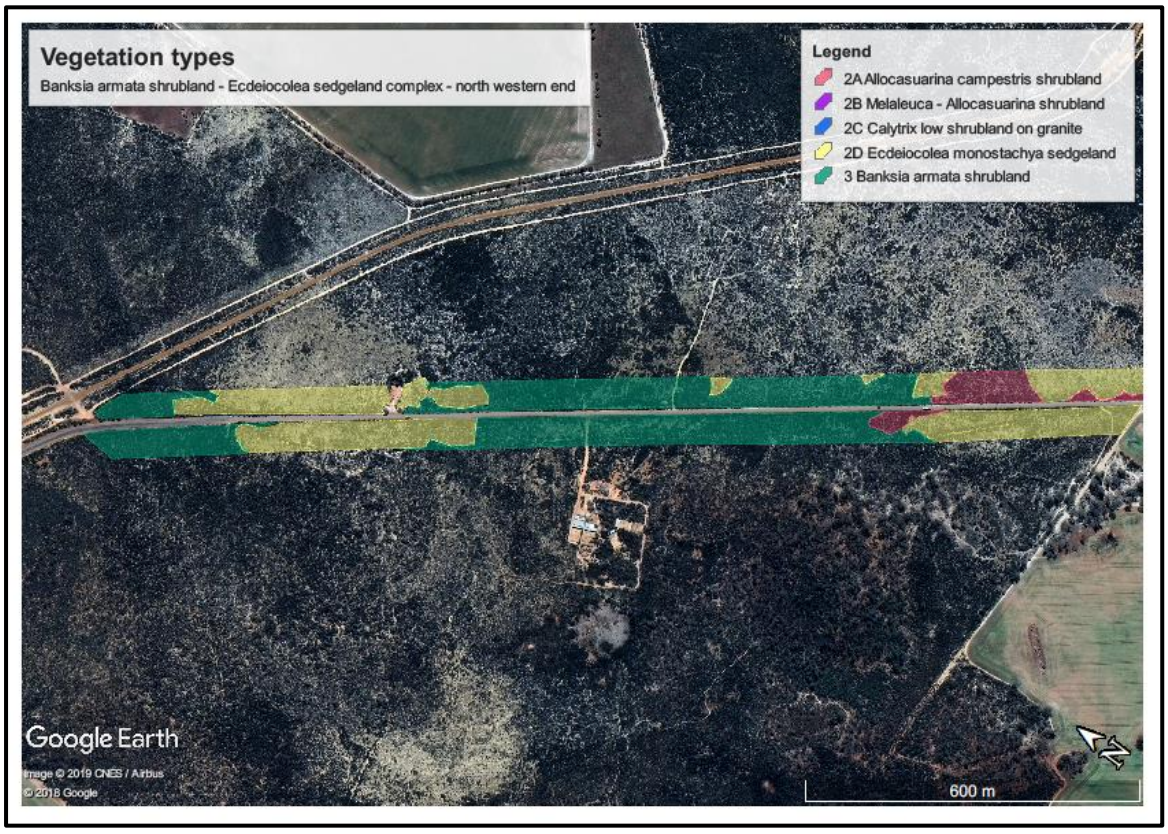
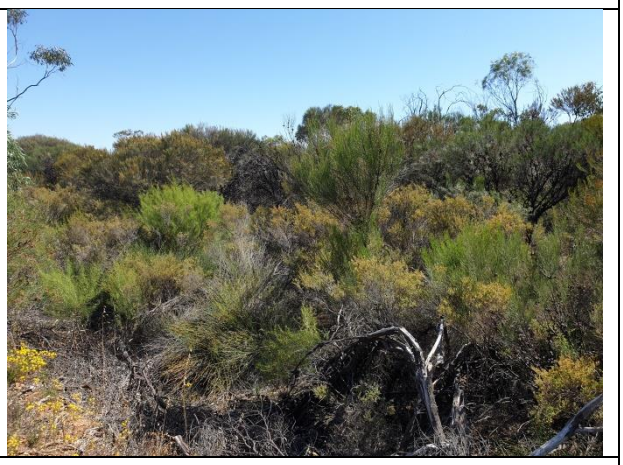


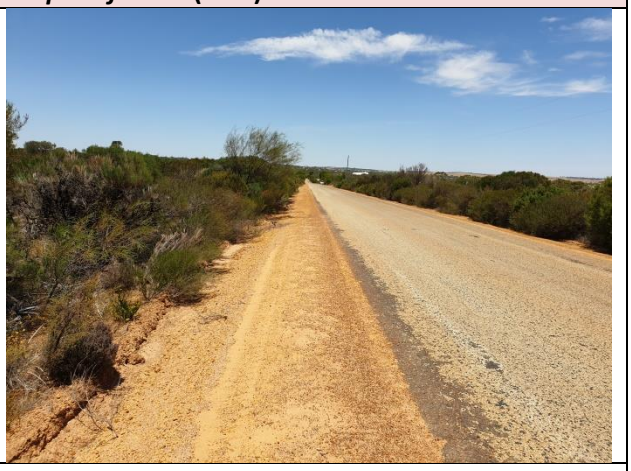
Figure 18: *Banksia armata* – *Ecdeiocolea* sedgeland association (3 – 4 km from townsite)

Vegetation type 2A: *Allocasuarina campestris* shrubland	
Relevés: 05; GPS 472259 E/ 6583518 N; R06	
Condition: Very good	
Description (R05): *Allocasuarina campestris, Daviesia hakeoides* subsp. *subnuda, Grevillea paniculata, Ericomyrtus tenuior, Hibbertia glomerosa* var. *glomerosa* shrubland to closed shrubland over *Hibbertia glomerosa* var. *glomerosa, Austrostipa elegantissima, Acacia restiacea, Stenanthemum pomaderroides, Opercularia vaginata* low open shrubland with sparse forbland and isolated grass tussocks	
Description (R06 – Mature): *Allocasuarina campestris* tall shrubland over *Melaleuca cordata, Hibbertia , Astroloma serratifolium, Calytrix depressa* shrubland over *Borya sphaerocephala, Ptilotus declinatus, Hyalosperma glutinosum* open forbland	
R09 – R10: *Allocasuarina campestris* regrowth; with *Gastrolobium bennettsianum, Acacia lasiocarpa var. bracteolata, Acacia filifolia* P3 (edge of road), *Hypocalymma angustifolium, Leptospermum erubescens*	
Other species: *Acacia assimilis* subsp. *assimilis, Austrostipa trichophylla, Avena fatua*, Briza maxima*, Dampiera lavandulacea, Eucalyptus loxophleba* subsp. *loxophleba* (isolated small trees), *Gastrolobium bennettsianum, Lepidosperma tenue, Monachather paradoxus, Muehlenbeckia adpressa, Olearia subsp. Eremicola, Waitzia acuminata*	
Disturbances: road maintenance; rabbits weeds - this photo is taken near the edge of the road and comprises some semi-mature regrowth, with mature shrubland in the background	

Vegetation type 2A: *Allocasuarina campestris* tall shrubland	
Relevés: Cleared area (old road)	
Condition: Degraded	
Description: isolated *Petrophile shuttleworthiana* and *Isopogon scabriusculus* subsp. *scabriusculus* low shrubs	
R10 – R11 (GPS: 471548 E/ 6584421 N): *Allocasuarina campestris* tall closed shrubland over *Melaleuca conothamnoides, Astroloma serratifolium* low isolated shrubs over *Neurachne alopecuroidea* low isolated grass tussocks	
Other species*: Acacia acuminata, Hakea scoparia, Hemigenia dielsii, H. westringioides, Verticordia brachypoda, V. chrysanthella*	
Disturbances: clearing – old road, compacted clay and laterite	

Vegetation type 2B: *Melaleuca – Allocasuarina* shrubland with isolated low trees	
Landform: low hill; pale brown shallow clay loam soils over granitic rock	
R08 – R09 GPS: 471912 E/ 6583953 N Condition: Excellent Description: *Allocasuarina campestris, Acacia saligna* tall sparse shrubland over *Melaleuca platycalyx, Hypocalymma angustifolium, Allocasuarina campestris, Hakea cygna* subsp. *cygna* shrubland over *Melaleuca marginata, Calytrix depressa, Stypandra glauca* low shrubland over isolated forbs	
Relevés: R09 471871 E/ 6584036 N Condition: Very good Description: Isolated *Acacia acuminata* and *Santalum spicatum* low trees over *Melaleuca concreta, Allocasuarina campestris, Melaleuca marginata, Hakea scoparia* shrubland over *Melaleuca marginata, Cassytha pomiformis* (vine), *Astroloma serratifolium, Melaleuca conothamnoides, Ecdeiocolea monostachya* low shrubland over N*eurachne alopecuroidea, Borya sphaerocephala* and *Waitzia acuminata* low sparse grass tussocks and forbs	
Other species: *Calothamnus quadrifidus* subsp. *angustifolius, Dampiera lindleyi, Daviesia hakeoides subsp. subnuda, Dodonaea divaricata, Eucalyptus loxophleba subsp. loxophleba (edge of road), Gastrolobium bennettsianum, Goodenia glareicola, Grevillea hakeoides* subsp. *stenophylla, G. paniculata, Hibbertia rupicola, Isopogon divergens, Melaleuca radula, Santalum acuminatum, Verticordia chrysanthella*	
Disturbances: road maintenance; old tracks and clearing (mostly with regrowth)	
	
Melaleuca platycalyx	*Calothamnus quadrifidus*

Vegetation type 2B	
Landform: low rise; pale brown clay loam over laterite and granite	
Relevés: 10	
Condition: Good to very good	
Description: *Acacia acuminata* tall isolated shrubs or low trees over *Allocasuarina campestris, Melaleuca adnata* open shrubland over *Astroloma serratifolium, Ericomyrtus tenuior, Hemigenia conferta, Hakea scoparia, Verticordia monadelpha* low shrubland over *Neurachne alopecuroidea*, *Amphipogon turbinatus*, *Waitzia acuminata* low sparse tussock grassland and sparse forbs	
Other species: *Melaleuca conothamnoides*	
Disturbances: old gravel pit; clearing; tracks; surface erosion around pit area.	

Vegetation type 2B: Disturbance vegetation on road verges: mixed shrubland; 2 – 5 m wide *Acacia dielsii, Allocasuarina campestris, Daviesia spiralis, Grevillea armigera, Verticordia brachypoda, Hypocalymma angustifolium, Cassytha pomiformis* (vine)	
Relevés:	
Condition: Very good	
Description: Mixed shrubland to open shrubland; species diversity much higher than *Allocasuarina campestris shrubland; Daviesia spiralis, Acacia dielsii* and *Grevillea armigera* very common; the parasitic *Cassytha pomiformis* (Dodder laurel) was present on many shrubs	
Other species: *Acacia acuminata, A. filifolia, A. lasiocarpa var. bracteolata, Allocasuarina acutivalvis* subsp. *acutivalvis, Astroloma serratifolium, Austrostipa elegantissima, Avena fatua** (Wild oats), *Bossiaea eriocarpa, Briza maxima** (Blowfly grass), *Comesperma integerrimum, Eragrostis curvula** (African lovegrass), *Ericomyrtus tenuior, Eucalyptus loxophleba* subsp. *loxophleba, Gastrolobium spinosum, Grevillea hakeoides subsp. stenophylla, G. petrophiloides subsp. petrophiloides, Hakea scoparia, Hemigenia dielsii, H. westringioides, Hibbertia glomerosa var. glomerosa, Monachather paradoxus, Olearia sp. Eremicola, Santalum acuminatum, S. spicatum, Triticum aestivum** (wheat), *Verticordia brachypoda, V. chrysanthella , V. densiflora var. cespitosa, V. eriocephala, V. monadelpha, Waitzia acuminata*	
Disturbances: clearing (historic and recent); road maintenance; weeds – variable sparse to dense	

	
Verticordia brachypoda	*Verticordia monadelpha*
	
Verticordia chrysanthella	*Grevillea armigera*

Vegetation type 2Ca: *Calytrix depressa* low open shrubland over *Borya sphaerocephala* open forbland	
GPS: 472204 E/ 6583647 N (degraded gravel pit area); 472097 E/ 6583766 N (edge of road)	
Landform: low rise; shallow brown sandy soils over granitic rock	
Image: R07 4722088 E/ 6583819 N	
Condition: excellent	
Description (R07): *Calytrix depressa* and *Stypandra glauca* low open shrubland over *Borya sphaerocephala, Ptilotus declinatus, Waitzia acuminata, Schoenia cassiniana, Schoenus hexandrus*	
Other species: *Allocasuarina campestris, Dianella revoluta var. divaricata, Ericomyrtus tenuior, Lolium rigidum*, Melaleuca fulgens subsp. fulgens, Muehlenbeckia adpressa, Opercularia vaginata, Seringia velutina*	
Disturbances: gravel removal; road maintenance; weeds; old tracks	

	
Calytrix depressa	*Ptilotus declinatus*

Vegetation type 2Cb: *Acacia acuminata* isolated low trees over *Grevillea paniculata* shrubs	
Landform: granite outcrop; shallow sandy soils over rock	
Relevés: R08 471992 E/ 6583873 N	
Condition: Degraded to good	
Description: *Acacia acuminata* isolated low trees over *Grevillea paniculata, Avena fatua*, Dianella revoluta var. divaricata, Acacia restiacea, Ptilotus polystachyus, Calytrix depressa* low sparse shrubland/ open tussock grassland over *Waitzia acuminata, Borya sphaerocephala, Hyalosperma glutinosum, Hibbertia glomerosa* var. *glomerosa, Briza maxima** low forbland; bare granite outcrop areas away from the road ~ 20 m	
Other species: *Alyxia buxifolia, Acacia assimilis* subsp. *assimilis, A. saligna, Allocasuarina campestris, Austrostipa elegantissima, Cassytha pomiformis , Comesperma integerrimum, Eragrostis curvula*, Eucalyptus loxophleba* subsp. *loxophleba* (edge of road), *Melaleuca marginata, M. platycalyx, Podolepis lessonii, Solanum hoplopetalum, Stypandra glauca*	
Disturbances: clearing; moderate to dense weeds, mainly grasses; old tracks	

Vegetation type 2D: *Ecdeiocolea monostachya* open sedgeland with *Allocasuarina campestris* at the edges

Landform: low hill; pale yellow sandy loam; sandplain

Relevés:

Condition:

Description: *Allocasuarina campestris, Acacia filifolia* tall isolated shrubs to tall sparse shrubland over *Ecdeiocolea monostachya, Verticordia brachypoda, V. monadelpha, Psammomoya choretroides* open sedgeland over *Waitzia acuminata, Neurachne alopecuroidea* low open forbland

Description (470228 E/ 6586113 N): *Eucalyptus moderata, E. pyriformis, Callitris roei* isolated mallee and low trees over *Allocasuarina campestris, Callitris roei* isolated shrubs over *Ecdeiocolea monostachya, Gastrolobium bennettsianum, G. spinosum, Melaleuca conothamnoides, Mesomelaena preissii* sedgeland over *Waitzia acuminata* low sparse forbland

Other species: *Acacia sericocarpa, Banksia armata* var. *ignicida, Beaufortia bracteosa, Borya sphaerocephala, Cassytha pomiformis , Daviesia spiralis* (roadside), *Gazania linearis** (roadside); *Grevillea armigera, Grevillea hakeoides* subsp. *stenophylla, Opercularia vaginata, Stylidium repens, Tricoryne tenella*

Disturbances: fire; old tracks; isolated weeds; road maintenance; gravel pit

Eucalyptus pyriformis

Tricoryne tenella

Vegetation type 3: *Banksia armigera* shrubland	
Landform: Low hill, crest and upper slopes; sandy loam with lateritic gravel over laterite	
Relevés: R10	
Condition: Very good to excellent	
Description: *Eucalyptus pyriformis* isolated mallee shrubs over *Allocasuarina acutivalvis* subsp. *acutivalvis, Petrophile shuttleworthiana, Santalum acuminatum* tall open shrubland over *Banksia armata* var. *ignicida, Gastrolobium spinosum, Grevillea armigera, Persoonia coriacea, Allocasuarina campestris* shrubland over *Opercularia vaginata, Mesomelaena preissii* sparse forbland (perennial)	
Other species: *Acacia filifolia, A. semicircinalis, A. latipes* subsp. *latipes, Allocasuarina corniculata, Beaufortia bracteosa, Calytrix depressa, Cassytha aurea var. hirta (on Banksia) , Conospermum stoechadis, Conostylis setigera subsp. setigera (sterile; tentative), Daviesia spiralis, Eucalyptus leptopoda* subsp. *arctata (sterile; tentative), E. moderata, E. torquata (roadside; planted), Grevillea eryngioides, Hakea scoparia, Isopogon divergens, Leptospermum erubescens, Leucopogon sp. Avon, Melaleuca conothamnoides, M. cordata, Persoonia rufiflora, Petrophile shuttleworthiana, Santalum acuminatum, Scaevola humifusa, Stenanthemum pomaderroides, Verticordia eriocephala, Waitzia acuminata*	
Disturbances: road maintenance; isolated weeds; old tracks; clearing – edge effects; fire, rabbits	

4. Discussion

4.1 Summary of survey results

The proposal is located in a highly diverse flora region. Due to the high level of clearing and landscape modification many of these are currently listed as rare or threatened. The proposal is located in the lower catchment of the Wongan Hills area and comprises a low hill which drains into an ephemeral drainage system connected to the Mortlock River and Avon River catchments. The Shire of Wongan – Ballidu proposes to upgrade the eastern 4km section of Waddington-Wongan Hills Road which services areas to the north west of Wongan Hills townsite, including the CBH grain handling facilities. A vegetation and flora survey was undertaken in November 2019 from which five priority and one threatened species were recorded. Many of these plants were recorded in the road reserve area, with those on the north eastern side more likely to be negatively impacted than the individuals on the south western side (Table 7).

Previous road work and maintenance has disturbed the road verges and a unique suite of species have colonised the edges of the road. Many of these thrive in disturbed areas and may be shorter lived perennials which are replaced by other species as the site matures. Many of the conservation listed flora recorded during the survey occurred close to the road, for example *Daviesia spiralis* and *Acacia filifolia*. Seed reserves from these species will have built up in these areas and will be removed during the road upgrade. It is likely that some of this seed will be present in areas adjacent to the proposal and will establish in the future; however much will be removed. A possible management option to reduce the loss of species will be discussed.

Table 7: Potential impact to conservation flora (0 – 2 m from edge current disturbance)

Scientific Name	Code	Total	Impact area	Outside
Daviesia euphorbioides	T	1	0	1 (at risk)
Acacia filifolia	P4	58	18	40
Acacia phaeocalyx	P3	1	0	1
Acacia semicircinalis	P4	2	0	2
Daviesia spiralis	P4	38	15	23
Hemigenia conferta	P4	101	0	101

4.2 Threatened flora

One species of threatened flora – *Daviesia euphorbioides* (1 plant) – is located near the proposal and should be avoided if possible. It is located within 4 m of the edge of the seal and 2 m from the edge of the shoulder. If the proposed clearing of 2 m occurs then very little vegetation would be left as a buffer. No DRF markers are currently in place and discussions should be held with DBCA on the management of this plant. One option to reduce the risk of impact to this plant would be to minimise the width of the shoulder along this stretch of road, thus increasing the vegetative buffer which would result after road works.

Stylidium coroniforme subsp. *coroniforme* (T) was recorded in Elphin Nature Reserve in 2010 on lateritic soils over laterite within *Banksia armata* associations with an occurrence about 15 m south of the road reserve (outside the impact area). No plants were observed within the road reserve

area. The species is a perennial with a woody rootstock which remains viable after the aerial growth has died off; however the dried off aerial parts would still be recognisable if it had occurred in the survey area.

Conostylis wonganensis (T) has been recorded within the road reserve outside the proposed impact area near the Rifle Club entrance. No plants were observed and previous record sites were checked. A previous record for *Melaleuca sciotostyla* (T) is located within the road reserve east of the rifle range entrance. No plants were observed at this location. No clearing of this area is proposed other than trimming of vegetation.

4.3 Weeds

Nine species of weeds were recorded in the proposal area, with many located within the York gum woodland area at the eastern end, and occasional dense occurrences on the SW road verge adjacent to farmland. Weeds were present along the NE road verge; however most occurrences were isolated, except near some of the granite outcrop areas. African lovegrass (*Eragrostis curvula**) is a perennial grass which was present at a few locations, mainly on the southern verge adjacent to farmland. It is an aggressive weed which can also pose a fire risk. Wild oats (Avena fatua*) was the most common weed and formed a major component of the York gum woodland understorey. One plant of *Gazania linearis** was recorded at the edge of a parking area on the northern verge (GPS 471198 E/ 6584877 N). Removal of this single plant would be recommended to reduce the risk of spread.

4.4 Potential Environmental Offsets – rehabilitation of historic cleared areas

Two disused borrow pits are present adjacent to the proposal, one located at the north end of the proposal within Elphin NR between Waddington – Wongan Hills Road and the rail line (0.1 ha) and another area 0.6 km west of the intersection with the Northam – Pithara Road (0.15 ha) (Figure 19). To rehabilitate these areas the following actions would be required:

- Deep ripping of the compacted land surface
- Landscaping
- Placement of topsoil which contains seed reserves over the ripped and landscaped surface
- Placement of removed vegetation over the topsoil which will reduce the risk of wind erosion.
- Weed control
- Liaison with DBCA for any works undertaken at Site 1 (Elphin NR)

Drainage at the western site (Site 1) would be closed as it is significantly lower than the surrounding landscape reducing any risk of increased water erosion. Site 2 is located on a gentle slope and the risk of erosion would be very low. Rehabilitation of the sites would also reduce recharge to the groundwater table although the impact on reducing the threat of salinity in nearby valley areas would be minimal. As the sites would be a disturbance areas it is likely that many of the species removed from the proposed clearing would establish and offset losses from the clearing.

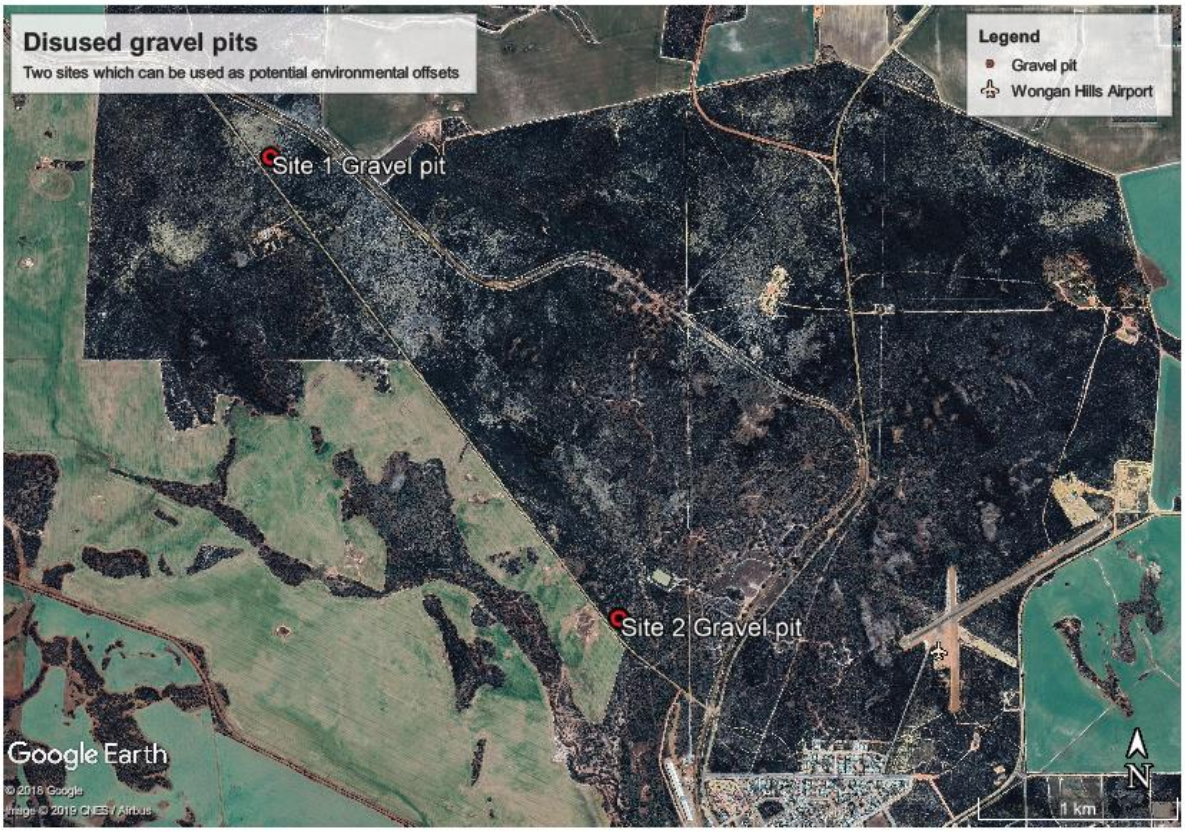


Figure 19: Two disused gravel pits located adjacent to the proposal which could be used as environmental offsets.

4.5 Assessment against the 10 Clearing Principles

An assessment of the proposal against the EPA's 10 clearing principles is discussed in Table 8.

4.6 Conclusions

Impact to priority listed flora cannot be avoided; however where there are many plants (for example ~ 200m south east of the rifle range entrance) the proposed width of clearing could be reduce to 1m to reduce the number of plants impacted. Potential environmental offsets should be investigated to see if disposal of topsoil and vegetation can be used to rehabilitate other disturbed areas as they will contain a seed reserve of many of the species present along the road verge. Weed seed will also be transported; however a weed management program can be developed for any potential offset sites. The Shire will need to liaise with DBCA in management of the remaining conservation flora, particularly Daviesia euphorbioides (T).

The risk of environmental harm (such as erosion) should be low if recommended road construction procedures are followed and works take place at times of lowest risk relating to climate events.

Table 8: Assessment of the proposal against the 10 clearing principles

Clearing Principle		Comment
1	Native vegetation should not be cleared if it comprises a high level of biological diversity.	**Proposal may be at variance with this principle** The proposal is located NW of Wongan Hills townsite within the central wheatbelt of Western Australia, in a SE to NW direction, from a valley area supporting York gum woodlands to the upper slopes and crest of a low hill. Two vegetation associations were mapped as occurring by Beard (1979) and the field results broadly align with those descriptions. The woodland area comprises mainly York gum (*Eucalyptus loxophleba*) with small areas of Salmon gum (*Eucalyptus salmonophloia*) to the north outside the area of impact. The majority of the area is included within the *Allocasuarina – Melaleuca* alliance, with a mosaic of vegetation types occurring which are determined by soil type and geology (shallow to deeper soils; sandy loams to clay loam and laterite and granitic rock). Significant areas of Banksia shrubland occur on the upper slopes and crest associated with laterite. The landforms and geology around Wongan Hills are quite unique and support a high diversity of taxa including some species which are endemic to the area. Many of these occur within the Wongan Hills range itself, although some have been recorded within the proposal area. The remnant vegetation within the road verge areas comprises mainly disturbance communities (from previous road work and maintenance activities) which have higher species diversity than the adjacent mature vegetation, particularly in the *Allocasuarina – Melaleuca – Banksia* area, which is over 80 % of vegetation. Many of the conservation listed flora were recorded within a few metres of the road within the disturbed areas. Species such as *Grevillea armigera*, *Grevillea eryngioides, Bossiaea eriocarpa , Daviesia hakeoides* subsp*. subnuda Daviesia spiralis P4, Gastrolobium spinosum, Verticordia chrysanthella, Verticordia densiflora var. cespitosa, Verticordia eriocephala, Verticordia monadelpha and Grevillea petrophiloides* subsp*. petrophiloides* were very common on the road verge but not within the mature bushland areas. The woodland areas had lower species diversity which may be a result of the survey timing (late spring) and some annual species may not have been identifiable or present, but may have been in winter and early spring. Perennial diversity within the woodland area was lower than the shrublands to the west. The woodland area also supported a higher component of weeds, particularly grasses, in the understorey which may have reduced diversity. The condition of the vegetation within the woodland area was generally poorer than the shrublands.

Clearing Principle		Comment
2	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.	**Proposal is unlikely to be at variance with this principle** The proposed clearing will impact a 1 – 2 m width along the NE verge of the Waddington –Wongan Hills Road. The vegetation is diverse and is utilised mainly by birds and insects, and to a lesser extent reptiles and mammals. Numerous *Acacia* species, particularly *Acacia dielsii*, had galls present (usually caused by wasps). A few trees are present along the road, most of which do not have nesting holes. Trees also include some that have been planted. A number of larger trees, particularly within the woodland area – Salmon gum woodland, are likely to support more bird and bat nesting sites. Significant areas of remnant vegetation which are less disturbed are located adjacent to and close to the proposal.
3	Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora	**Proposal may be at variance with this principle** Four priority species (*Acacia filifolia, A. phaeocalyx, A. semicircinalis* and *Daviesia spiralis*) and one threatened species *(Daviesia euphorbioides)* were recorded in or near the proposal which may be impacted, and one priority species – *Hemigenia conferta* – was recorded within 50 m of the proposal (outside impact area). The threatened species was located at 2 metres from the current clearing so may be at risk of clearing. It is recommended that discussions take place with DBCA to decide on whether a permit to take is required, or narrower shoulders could be used at this location to avoid direct clearing. If the latter action is taken then DRF road markers should be erected in the area so that the Shire is aware of its location and the site avoided during future road works. Only one plant was found within 50 m of the road. A population of this species has been recorded in the rail reserve to the north.
4	Native vegetation should not be cleared if it compromises the whole or part of, or is necessary for the maintenance of a threatened ecological community	**Proposal may be at variance with this principle** The York gum – Salmon woodland area is representative of the Eucalypt Woodlands of the Wheatbelt Threatened Ecological Community (TEC). Up to 0.1 ha of woodland vegetation on the road verge (north side) could be impacted.

<table>
<tr><th colspan="2">Clearing Principle</th><th>Comment</th></tr>
<tr><td>5</td><td>Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.</td><td>Proposal may be at variance with this principle

The application area falls within the Avon Wheatbelt Biogeographic Regionalisation of Australia (IBRA) bioregion in which approximately 18.53% of the pre-European vegetation remains (see table). The proposal is located in an area which currently has a number of significant remnants present. The proposed clearing of between 0.4 and 0.8 ha will have a slight impact although the importance of the road verge vegetation as a corridor will not be impacted in the long term as the new verge is likely to support similar high diversity vegetation as the current verge on the NE side of the road. The SW verge vegetation will only be trimmed and minor clearing of isolated plants within the current road maintenance area will occur. It will still function as a corridor linking vegetation close to Wongan Hills townsite to the reserve at the western end.

<table>
<tr><th></th><th>Pre-European area (ha)</th><th>Current extent (ha)</th><th>Remaining %</th><th>Conservation Status</th><th>Pre-European % in DBCA Managed Lands (and post clearing %)</th></tr>
<tr><td>IBRA Bioregion – Avon Wheatbelt</td><td>9,517,109</td><td>1,763,070</td><td>~18.53</td><td>Vulnerable</td><td>2.41 (9.86)</td></tr>
<tr><td>IBRA Subregion P1</td><td>6,524,180</td><td>1,366,585</td><td>~20.95</td><td>Vulnerable</td><td>2.54 (9.26)</td></tr>
<tr><td>Beard veg assoc. – 1024.1</td><td>417,383.34</td><td>29,277</td><td>7.01</td><td></td><td>0.8 (12.21)</td></tr>
<tr><td>Beard veg assoc. - 1049</td><td>49, 123.28</td><td>4018</td><td>8.18</td><td></td><td>0.34 (3.94)</td></tr>
</table>
</td></tr>
<tr><td>6</td><td>Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.</td><td>Proposal is unlikely to be at variance with this principle
An ephemeral watercourse is located at the western end of the woodland area and supports York gum woodland similar to the woodland on the adjacent bank/ lower valley slope. The proposal is likely to impact on a wider area than other areas as the road is constructed on an earth bank raising the level above the floor of the drainage line to align with the road on either side. The Shire needs to elect how it will widen this stretch of road – whether it is only the seal or whether the earth structure will also be widened.

The vegetation is not representative of riparian communities.</td></tr>
</table>

Clearing Principle		Comment
7	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.	**Proposal is unlikely to be at variance with this principle** The proposal is bounded by a Scientific Reserve on the NE side and by Elphin Nature Reserve at the NW end south of the road. The impact to Elphin NR is likely to be minimal as the only impact will be trimming by hand. Clearing will occur on the side adjacent to the Scientific Reserve. The width of clearing is proposed to be 1 – 2 m which will cause some impact by reducing the width of the vegetation buffer between the road reserve and the reserve. Several species of threatened and priority flora have been recorded within the reserve, but these will be outside the direct clearing impact.
8	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation	**Proposal is unlikely to be at variance with this principle** The total area to be cleared will be between 0.4 and 0.8 ha. The seal will be widened by 2 m thus protecting up to half of the cleared area against erosion. The shoulder will be constructed with suitable road base material which will form a stable slope.
9	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.	**Proposal is unlikely to be at variance with this principle** The clearing associated with the proposal may cause some deterioration in water quality if it is wet at the time of the works occurring and the water is present in the drainage line. This can be managed by undertaking works when the chance of high intensity rainfall is lowest. This could occur during summer thunderstorms or tropical lows (ex-tropical cyclones) that have moved over the south west land division. The total area of clearing is proposed to be between 0.4 – and 0.8 ha which will have minimal impact on the local groundwater table. This potential low impact could be offset to some degree by managing/ rehabilitating nearby Shire managed cleared areas such as disused borrow pits.
10	Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	**Proposal is unlikely to be at variance with this principle** Minimal changes will occur to the layout of the road and this is unlikely to cause or exacerbate the incidence of flooding from what occurs with the current design. The road has a low grade and is surrounded by vegetation which can be used to discharge excess flow from the road (drainage design).

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Appendix 1: List of flora recorded in the survey area

Family	Scientific Name	Code
Amaranthaceae	*Ptilotus declinatus*	
Amaranthaceae	*Ptilotus eremita*	
Amaranthaceae	*Ptilotus polystachyus*	
Apocynaceae	*Alyxia buxifolia*	
Asparagaceae	*Arthropodium dyeri*	
Asparagaceae	*Chamaexeros fimbriata*	
Asparagaceae	*Thysanotus manglesianus*	
Asteraceae	*Blennospora drummondii*	
Asteraceae	*Gazania linearis**	Weed
Asteraceae	*Gilberta tenuifolia*	
Asteraceae	*Hyalosperma glutinosum*	
Asteraceae	*Monoculus monstrosus**	Weed
Asteraceae	*Olearia* sp. Eremicola (Diels & Pritzel)	
Asteraceae	*Podolepis lessonii*	
Asteraceae	*Schoenia cassiniana*	
Asteraceae	*Waitzia acuminata*	
Boraginaceae	*Halgania lavandulacea*	
Boryaceae	*Borya sphaerocephala*	
Casuarinaceae	*Allocasuarina corniculata*	
Casuarinaceae	*Allocasuarina acutivalvis subsp. acutivalvis*	
Casuarinaceae	*Allocasuarina campestris*	
Celastraceae	*Psammomoya choretroides*	
Chenopodiaceae	*Enchylaena lanata*	
Chenopodiaceae	*Rhagodia drummondii*	
Chenopodiaceae	*Rhagodia preissii*	
Cupressaceae	*Callitris roei*	
Cyperaceae	*Schoenus hexandrus*	
Cyperaceae	*Lepidosperma costale*	
Cyperaceae	*Lepidosperma tenue*	
Cyperaceae	*Mesomelaena preissii*	
Dilleniaceae	*Hibbertia acerosa*	
Dilleniaceae	*Hibbertia glomerosa* var. *glomerosa*	
Dilleniaceae	*Hibbertia rupicola*	
Ecdeiocoleaceae	*Ecdeiocolea monostachya*	
Ericaceae	*Astroloma serratifolium*	
Ericaceae	*Leucopogon* sp. Avon (J. Buegge D34)	
Ericaceae	*Lysinema pentapetalum*	
Fabaceae	*Acacia acuminata*	
Fabaceae	*Acacia assimilis* subsp. *assimilis*	
Fabaceae	*Acacia colletioides*	
Fabaceae	*Acacia dielsii*	

Family	Scientific Name	Code
Fabaceae	*Acacia filifolia*	P3
Fabaceae	*Acacia lasiocarpa* var. *bracteolata*	
Fabaceae	*Acacia latipes* subsp. *latipes*	
Fabaceae	*Acacia microbotrya*	
Fabaceae	*Acacia phaeocalyx*	P3
Fabaceae	*Acacia restiacea*	
Fabaceae	*Acacia saligna*	
Fabaceae	*Acacia semicircinalis*	P4
Fabaceae	*Acacia sericocarpa*	
Fabaceae	*Acacia tetragonophylla*	
Fabaceae	*Bossiaea eriocarpa*	
Fabaceae	*Daviesia euphorbioides*	T
Fabaceae	*Daviesia hakeoides* subsp. *subnuda*	
Fabaceae	*Daviesia leptosema*	
Fabaceae	*Daviesia nematophylla*	
Fabaceae	*Daviesia spiralis*	P4
Fabaceae	*Gastrolobium bennettsianum*	
Fabaceae	*Gastrolobium spinosum*	
Fabaceae	*Gastrolobium trilobum*	
Fabaceae	*Trifolium hirtum**	Weed
Geraniaceae	*Erodium cygnorum*	
Goodeniaceae	*Dampiera lavandulacea*	
Goodeniaceae	*Dampiera lindleyi*	
Goodeniaceae	*Goodenia glareicola*	
Goodeniaceae	*Scaevola humifusa*	
Goodeniaceae	*Velleia rosea*	
Haemodoraceae	*Conostylis setigera* subsp. *setigera* (sterile; tent.)	
Haloragaceae	*Glischrocaryon flavescens*	
Hemerocallidaceae	*Dianella revoluta var. divaricata*	
Hemerocallidaceae	*Tricoryne tenella*	
Hemerocallidaceae	*Stypandra glauca*	
Lamiaceae	*Hemigenia conferta*	P4
Lamiaceae	*Hemigenia dielsii*	
Lamiaceae	*Hemigenia westringioides*	
Lauraceae	*Cassytha aurea* var. *hirta*	
Lauraceae	*Cassytha pomiformis*	
Malvaceae	*Seringia velutina*	
Myrtaceae	*Baeckea grandis*	
Myrtaceae	*Beaufortia bracteosa*	
Myrtaceae	*Calothamnus gilesii*	
Myrtaceae	*Calothamnus quadrifidus* subsp. *angustifolius*	
Myrtaceae	*Calytrix depressa*	
Myrtaceae	*Ericomyrtus tenuior*	

Family	Scientific Name	Code
Myrtaceae	*Eucalyptus loxophleba subsp. loxophleba*	
Myrtaceae	*Eucalyptus leptopoda* subsp. *arctata* (tent; sterile)	
Myrtaceae	*Eucalyptus moderata*	
Myrtaceae	*Eucalyptus salmonophloia*	
Myrtaceae	*Eucalyptus torquata*	Planted
Myrtaceae	*Eucalyptus pyriformis*	
Myrtaceae	*Hypocalymma angustifolium*	
Myrtaceae	*Leptospermum erubescens*	
Myrtaceae	*Melaleuca acuminata subsp. websteri*	
Myrtaceae	*Melaleuca adnata*	
Myrtaceae	*Melaleuca concreta*	
Myrtaceae	*Melaleuca conothamnoides*	
Myrtaceae	*Melaleuca cordata*	
Myrtaceae	*Melaleuca fulgens subsp. fulgens*	
Myrtaceae	*Melaleuca hamulosa*	
Myrtaceae	*Melaleuca hamata*	
Myrtaceae	*Melaleuca marginata*	
Myrtaceae	*Melaleuca platycalyx*	
Myrtaceae	*Melaleuca radula*	
Myrtaceae	*Verticordia brachypoda*	
Myrtaceae	*Verticordia chrysanthella*	
Myrtaceae	*Verticordia densiflora var. cespitosa*	
Myrtaceae	*Verticordia eriocephala*	
Myrtaceae	*Verticordia monadelpha*	
Poaceae	*Amphipogon turbinatus*	
Poaceae	*Austrostipa elegantissima*	
Poaceae	*Austrostipa trichophylla*	
Poaceae	*Avena fatua**	Weed
Poaceae	*Briza maxima**	Weed
Poaceae	*Eragrostis curvula**	Weed
Poaceae	*Hordeum leporinum**	Weed
Poaceae	*Lolium rigidum**	Weed
Poaceae	*Monachather paradoxus*	
Poaceae	*Neurachne alopecuroidea*	
Poaceae	*Triticum aestivum**	Weed
Polygonaceae	*Muehlenbeckia adpressa*	
Polygonaceae	*Comesperma integerrimum*	
Polygonaceae	*Comesperma volubile*	
Proteaceae	*Banksia armata var. ignicida*	
Proteaceae	*Conospermum stoechadis*	
Proteaceae	*Grevillea armigera*	
Proteaceae	*Grevillea eryngioides*	
Proteaceae	*Grevillea hakeoides* subsp. *stenophylla*	

Family	Scientific Name	Code
Proteaceae	*Grevillea obliquistigma* subsp. *funicularis*	
Proteaceae	*Grevillea paniculata*	
Proteaceae	*Grevillea petrophiloides* subsp. *petrophiloides*	
Proteaceae	*Grevillea shuttleworthiana* subsp. *shuttleworthiana*	
Proteaceae	*Hakea cygna subsp. cygna*	
Proteaceae	*Hakea erecta*	
Proteaceae	*Hakea multilineata*	
Proteaceae	*Hakea platysperma*	
Proteaceae	*Hakea recurva subsp. recurva*	
Proteaceae	*Hakea scoparia*	
Proteaceae	*Isopogon divergens*	
Proteaceae	*Isopogon dubius*	
Proteaceae	*Isopogon scabriusculus* subsp. *scabriusculus*	
Proteaceae	*Persoonia coriacea*	
Proteaceae	*Persoonia rufiflora*	
Proteaceae	*Petrophile shuttleworthiana*	
Proteaceae	*Synaphea spinulosa subsp. major*	
Restionaceae	*Desmocladus myriocladus*	
Rhamnaceae	*Stenanthemum pomaderroides*	
Rubiaceae	*Opercularia vaginata*	
Santalaceae	*Santalum acuminatum*	
Santalaceae	*Santalum spicatum*	Registered
Sapindaceae	*Dodonaea divaricata*	
Solanaceae	*Solanum hoplopetalum*	
Solanaceae	*Solanum lasiophyllum*	
Stylidiaceae	*Stylidium repens* (dried off; tentative)	
Surianaceae	*Stylobasium australe*	

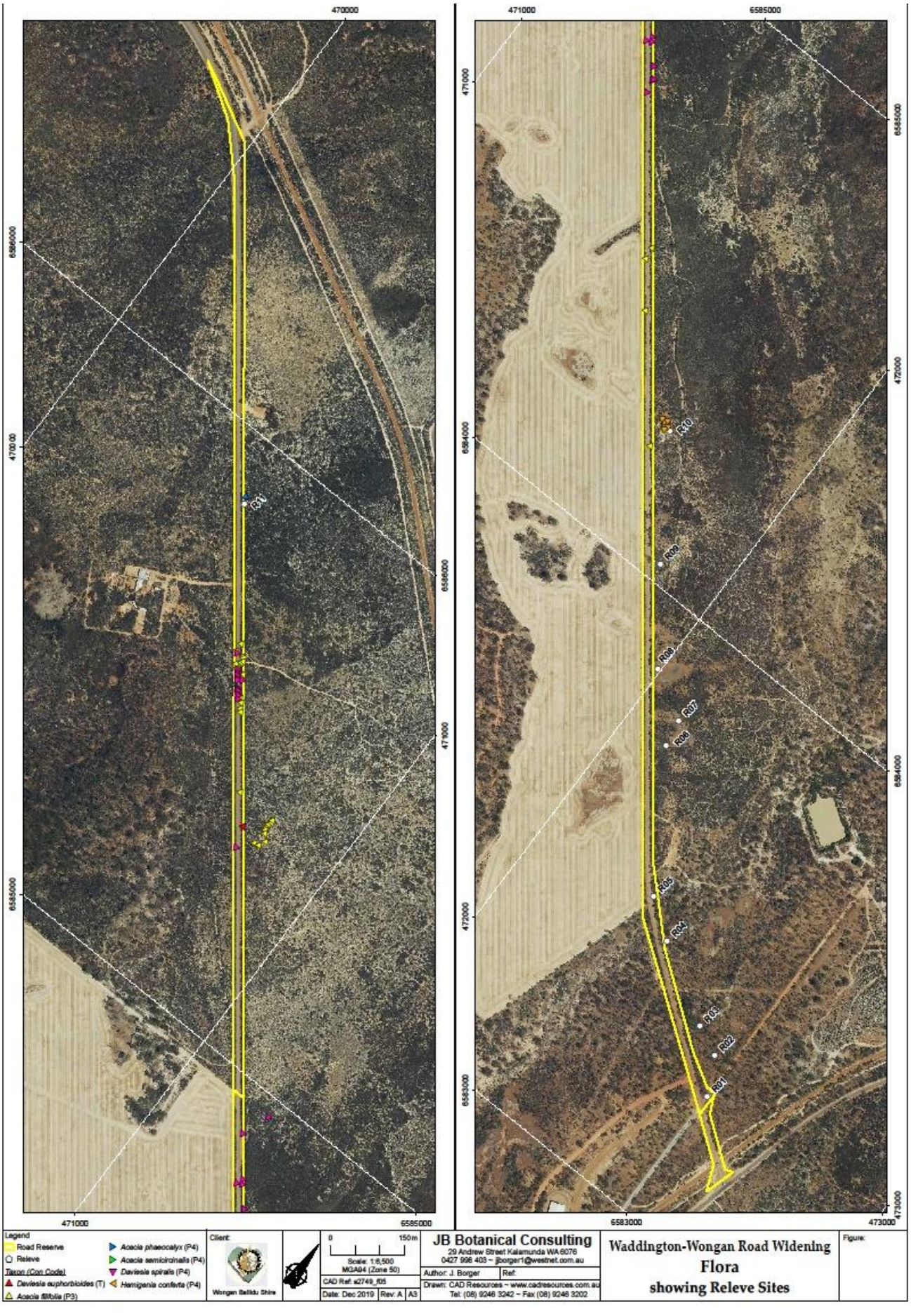
Appendix 2: Locations of conservation listed flora

Scientific Name	Code	Easting	Northing	No.
Acacia filifolia	P3	470561	6585692	5
Acacia filifolia	P3	470582	6585657	1
Acacia filifolia	P3	470582	6585640	2
Acacia filifolia	P3	470598	6585620	1
Acacia filifolia	P3	470600	6585638	1
Acacia filifolia	P3	470603	6585639	2
Acacia filifolia	P3	470604	6585613	1
Acacia filifolia	P3	470606	6585628	1
Acacia filifolia	P3	470607	6585633	1
Acacia filifolia	P3	470619	6585609	2
Acacia filifolia	P3	470620	6585608	1
Acacia filifolia	P3	470623	6585612	4
Acacia filifolia	P3	470646	6585573	2
Acacia filifolia	P3	470654	6585566	3
Acacia filifolia	P3	470659	6585556	4
Acacia filifolia	P3	470663	6585552	1
Acacia filifolia	P3	470760	6585427	1
Acacia filifolia	P3	470843	6585367	2
Acacia filifolia	P3	470843	6585406	1
Acacia filifolia	P3	470843	6585414	7
Acacia filifolia	P3	470844	6585401	2
Acacia filifolia	P3	470845	6585420	1
Acacia filifolia	P3	470845	6585424	1
Acacia filifolia	P3	470847	6585395	6
Acacia filifolia	P3	470852	6585370	1
Acacia filifolia	P3	470858	6585384	4
Acacia filifolia	P3	471480	6584512	2
Acacia filifolia	P3	471482	6584489	1
Acacia filifolia	P3	471545	6584408	1
Acacia filifolia	P3	471714	6584207	1
Acacia phaeocalyx	P3	470416	6585886	1
Acacia semicircinalis	P4	470623	6585586	2
Daviesia euphorbioides	T	470804	6585379	1

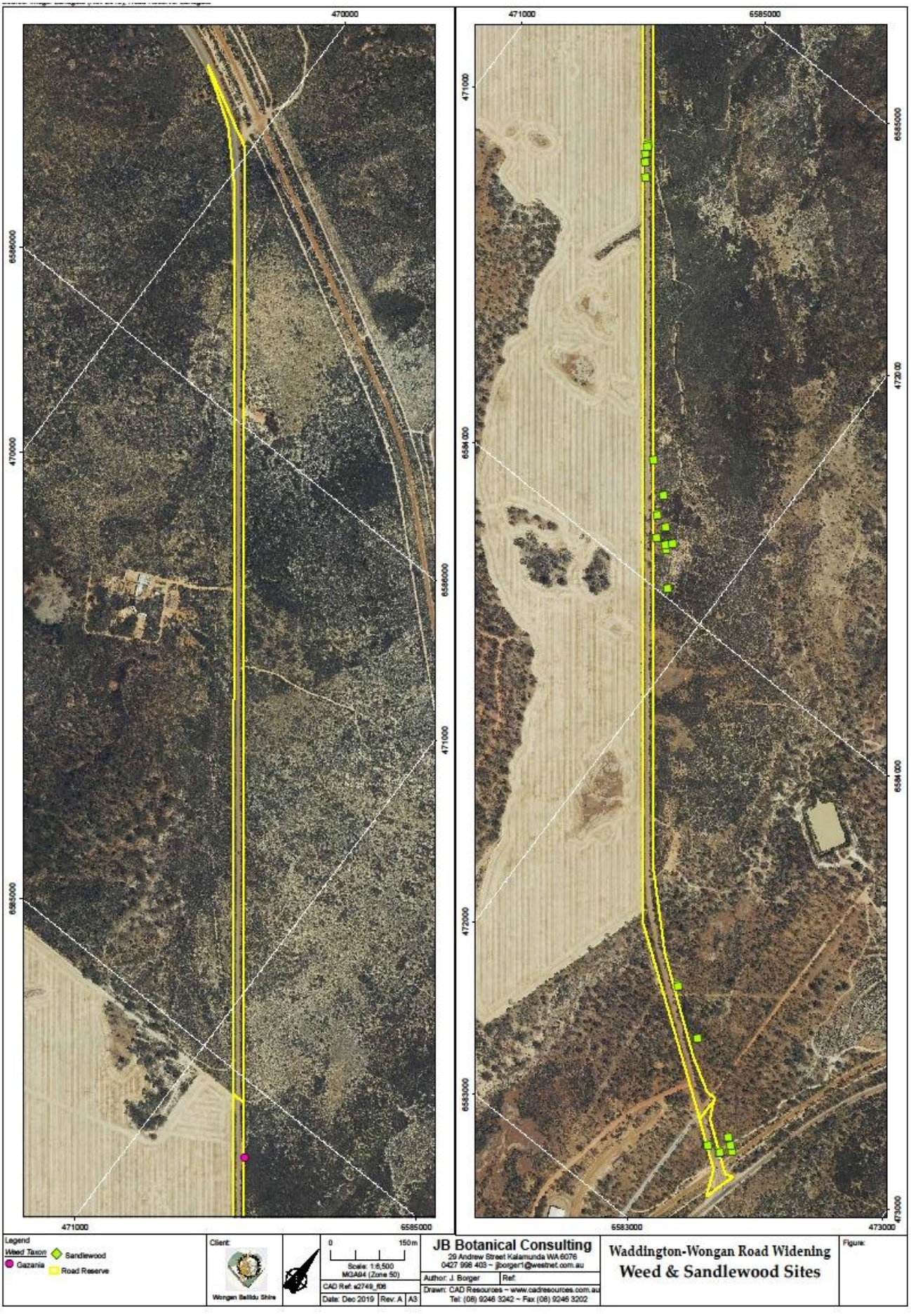
Appendix 2 continued

Scientific Name	Code	Easting	Northing	No.
Daviesia spiralis	P4	470586	6585633	1
Daviesia spiralis	P4	470606	6585609	2
Daviesia spiralis	P4	470611	6585604	1
Daviesia spiralis	P4	470612	6585601	1
Daviesia spiralis	P4	470614	6585599	1
Daviesia spiralis	P4	470618	6585594	1
Daviesia spiralis	P4	470619	6585591	2
Daviesia spiralis	P4	470627	6585581	3
Daviesia spiralis	P4	470628	6585579	1
Daviesia spiralis	P4	470628	6585597	1
Daviesia spiralis	P4	470631	6585577	1
Daviesia spiralis	P4	470633	6585575	1
Daviesia spiralis	P4	470637	6585570	2
Daviesia spiralis	P4	470639	6585568	2
Daviesia spiralis	P4	470642	6585564	3
Daviesia spiralis	P4	470818	6585334	1
Daviesia spiralis	P4	471172	6584903	1
Daviesia spiralis	P4	471192	6584961	1
Daviesia spiralis	P4	471220	6584820	3
Daviesia spiralis	P4	471226	6584833	1
Daviesia spiralis	P4	471231	6584824	3
Daviesia spiralis	P4	471264	6584789	1
Daviesia spiralis	P4	471278	6584766	2
Daviesia spiralis	P4	471279	6584769	1
Daviesia spiralis	P4	471285	6584740	1
Hemigenia conferta	P4	471717	6584256	25
Hemigenia conferta	P4	471713	6584248	6
Hemigenia conferta	P4	471708	6584265	50
Hemigenia conferta	P4	471697	6584262	20

Appendix 3: Mapped locations of conservation flora



Appendix 4: Location of Santalum spicatum (Sandalwood)



Appendix 5: GPS locations of Santalum spicatum (Sandalwood)

Scientific Name	Easting	Northing	Count	Age
Santalum spicatum	472493	6583361	1	
Santalum spicatum	472399	6583418	2	
Santalum spicatum	471857	6584073	3	2 adults x1 juvenile
Santalum spicatum	471850	6584078	1	
Santalum spicatum	471860	6584090	3	1 adult; 1 juvenile
Santalum spicatum	471828	6584078	2	
Santalum spicatum	471828	6584078	4	
Santalum spicatum	471830	6584106	1	
Santalum spicatum	471802	6584115	11	3 adults; 8 juveniles
Santalum spicatum	471378	6584618	1	
Santalum spicatum	471359	6584641	2	
Santalum spicatum	471350	6584655	3	
Santalum spicatum	471342	6584673	1	
Santalum spicatum	471344	6584668	1	
Santalum spicatum	471906	6584015	1	
Santalum spicatum	471788	6584152	1	
Santalum spicatum	471730	6584194	1	
Santalum spicatum	472638	6583209	1	
Santalum spicatum	472664	6583212	3	
Santalum spicatum	472665	6583215	1	
Santalum spicatum	472683	6583231	3	1 adult; 2 juvenile
Santalum spicatum	472660	6583248	1	
Santalum spicatum	472674	6583238	3	

Appendix 6: DBCA Conservation codes

Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

CONSERVATION CODES

For Western Australian Flora and Fauna

Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T **Threatened species**

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR **Critically endangered species**

Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN **Endangered species**

Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.

VU **Vulnerable species**

Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.

EX **Extinct species**

Species where *"there is no reasonable doubt that the last member of the species has died"*, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).

Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.

EW **Extinct in the wild species**

Species that *"is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form"*, and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).

Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

MI **Migratory species**

Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).

Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

CD **Species of special conservation interest (conservation dependent fauna)**

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).

Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

OS **Other specially protected species**

Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.
(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

[1] The definition of flora includes algae, fungi and lichens
[2] Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Last updated 3 January 2019