
**FLORA AND VEGETATION
OF
LOT 400 CARMEL**

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1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned to undertake ecological studies on Lot 400, Canning Road, Carmel. The Vincenti family (A., A.M., G.M., G. and J Vincenti) intend to clear a total of 16.02 hectares as an expansion to orchard facilities and associated fire breaks between the adjacent forest areas and the proposed orchard areas, see Figure 1. The proposed clearing area occurs in largely degraded low forests that have historically been associated with former cattle yards on the property.

A total of 168 vascular plant taxa from 39 plant families and 99 genera were recorded on Lot 400, Canning Road, Carmel. Of these, nine taxa were introduced plant taxa. Dominant families include Fabaceae (24 taxa), Proteaceae (15 taxa), Myrtaceae (9 taxa), Asteraceae (8 taxa), Asparagaceae (11 taxa), Cyperaceae (9 taxa), Orchidaceae (7 taxa) and Stylidiaceae (7 taxa).

No Threatened flora species gazetted under the *Wildlife Conservation Act* (1950-1980) were located on Lot 400, Canning Road, Carmel. No Priority flora species were located on Lot 400, Canning Road, Carmel.

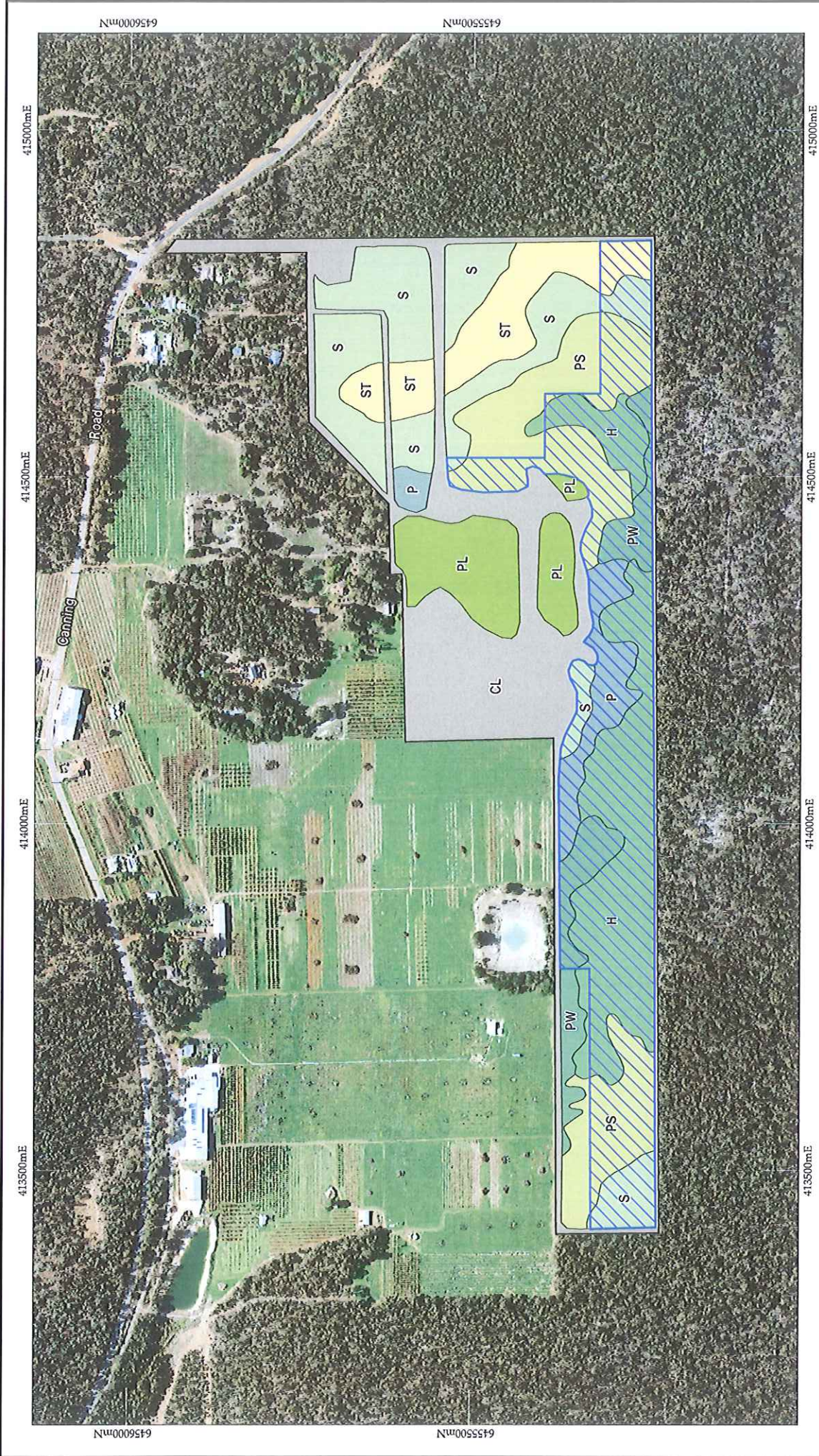
No Threatened flora species, pursuant to s179 of the *Environment Protection and Biodiversity Conservation Act* (1999) were located during the survey.

A total of six site-vegetation types were defined and mapped for Lot 400, Canning Road, Carmel. The site-vegetation types were based on the Havel's site-vegetation types for the Northern Jarrah Forest Region (Havel 1975a, 1975b). None of these communities are listed as threatened ecological communities or priority ecological communities (Department of Parks and Wildlife 2015e, 2015f; Department of the Environment 2015b). The proposed clearing will include the stunted mixed forests on the southern sandier soils.

The representation of the six site-vegetation types defined and mapped on Lot 400, Canning Road, Carmel were considered in a local and regional context. This assessment highlighted the following values:

- . the stunted nature of the Jarrah forest on the southern section of Lot 400 within the H and PW site-vegetation types in particular.
- . the central and northern sections of Lot 400 have been planted previously with pines and introduced Eucalypts.
- . the property has had cattle yards previously in some sections of Lot 400.
- . the six site-vegetation types are all present in the northern Jarrah forest, including representation within the conservation estate (Hedde *et al.* 1980b; Conservation Commission 2003).

During the botanical studies searches were made from potential habitat trees and although some trees were >50cm in diameter, no hollows suitable for cockatoo nesting were observed. The forested areas do support species such as Marri trees that are used for foraging by the listed Cockatoo species.



Legend:
 Proposed Clearing

Notes:
 Imagery: Landgate 2015, Google, DigitalGlobe (2015)

Scale 1:7,500
 MGA94 (Zone 50)
 CAD Ref: g2325V005.dgn
 Date: Dec-2015 | Rev: A | A4

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Lot 400, Canning Road, Carmel
Vegetation
 Showing Proposed Clearing

Figure:

2. INTRODUCTION

2.1 Location

Lot 44, Canning Road, Carmel is located on private land in the northern Jarrah forest. The property has been modified by previous clearing activities including planting of pines and introduced Eucalypt species. A small section of these planted areas has recently been cleared for an orchard and associated access.

2.2 Climate

The survey area occurs within the northern Jarrah Forest Region as described by Beard (1990). The climate is dry Mediterranean, with winter rainfall of 1000 - 1400 mm and 5-6 dry months per year (Beard 1990). The average rainfall for Jarrahdale (located south of Carmel) is 1160.7 mm and the range of minimum and maximum temperatures range from 6.2 to 15.8 degrees for the minimum temperature and 15.4 to 30.7 degrees for the maximum temperature (Bureau of Meteorology 2015).

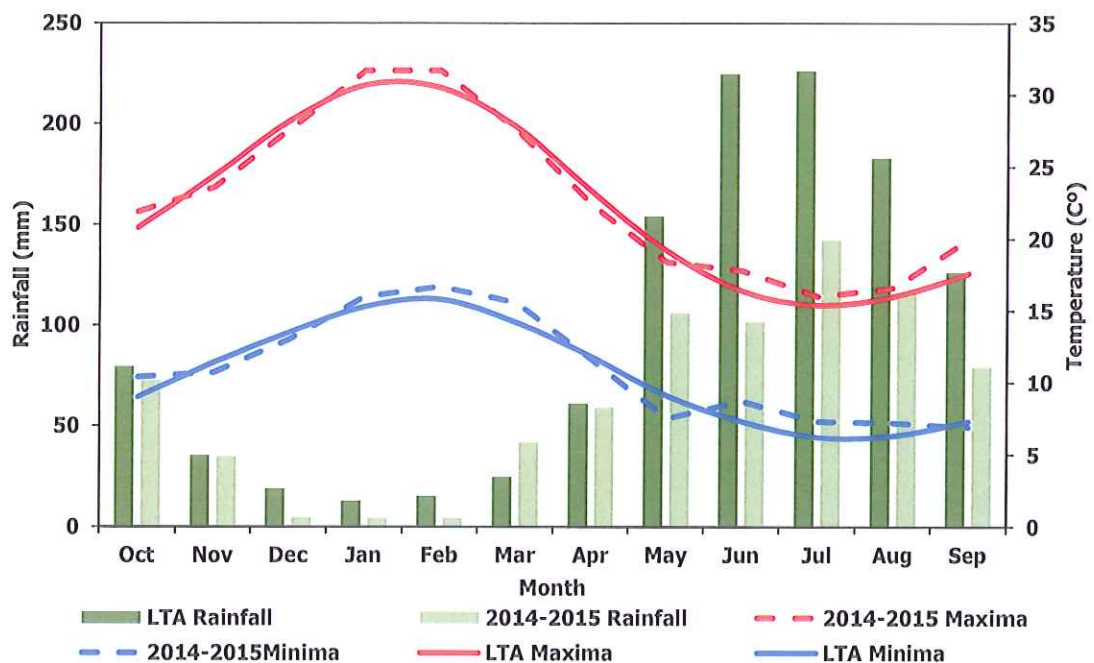


Figure 2: Rainfall and temperature data for Jarrahdale

Long term average (LTA) rainfall and temperature data (1882-2015), together with monthly rainfall and average maximum and minimum temperature data for 2014 and 2015 (October to September) are shown.

2.3 Landform and Soils

The survey area occurs on the lateritic capped Archaean granite and metamorphic rocks of the Darling Plateau. Churchward and McArthur (1980) undertook a study of the landforms and geology of the Darling System. The following landforms and soil units are represented in the survey area:

Dwellingup - "Gently undulating landscape with duricrust on ridges; sands and gravels in shallow depressions."

Yarragil - "Valleys of the western part of the plateau; sandy gravels on the slopes; orange earth in swampy floors."

2.4 Flora and Vegetation

Lot 400, Canning Road, Carmel lies within the Darling Botanical District of the South-western Botanical Province as recognized by Diels (1906) and later developed by Gardner (1942) and Beard (1979, 1980).

Previous workers have stressed the significance of the climate, landforms and soils in determining the distribution of plant communities in this area (Diels 1906; Williams 1932, 1942; Speck 1952, 1958; Lange 1960; Churchill 1961, 1968; Smith 1974; Seddon 1972; Havel 1968, 1975a, 1975b; Heddle *et al.* 1980a; Beard 1981, Mattiske and Havel 1998).

In vegetation mapping it is necessary to define and map the plant communities into groups with common characteristics in structure and floristics. This grouping and classification has been achieved by:

- . Havel on the Swan Coastal Plain (1968) and in the Northern Jarrah Forest (1975a, 1975b),
- . Beard (1979) in the Pinjarra area (1:250,000),
- . Heddle *et al.* (1980a) in the System 6 area; Perth, Pinjarra and Collie areas (1:250,000), and
- . Mattiske and Havel (1998) in the vegetation mapping for the Regional Forest Agreement.

The classification system of Heddle *et al.* (1980a), which utilized the concept of vegetation complexes, emphasized the relationships between the underlying landforms, soils and the plant communities. This latter system incorporated linkages with the previous work by Havel (1975a and b).

Two vegetation complexes as defined and mapped by Heddle *et al.* (1980) and Mattiske and Havel (1998) overlap the survey area. These complexes are Dwellingup 2 and Yarragil 1, as follows:

Dwellingup 2 (D2) - Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones.

Yarragil 1 (Yg1) – Open forest of *Eucalyptus marginata* subsp. *marginata* – *Corymbia calophylla* on slopes with admixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on valley floors in humid and subhumid zones.

The Dwellingup 2 (D2) vegetation complex is represented in the reserve system with 23.0% included in the formal and informal reserves (see Forest Management Plan, data supplied by Department of Conservation and Land Management – July 2003).

The Yarragil 1 (Yg1) vegetation complex is relatively well represented in the reserve system with 29.9% included in the formal and informal reserves (see Forest Management Plan, data supplied by Department of Conservation and Land Management – July 2003).

The dominant site-vegetation types on the slopes include H, P, PS, S and ST, with some localized evidence of higher soil moisture levels (PW). All of these site-vegetation types are well represented in the conservation estate and State Forest areas within the northern Jarrah forest.

It is not possible to assess the representation of these site-vegetation types at a regional scale as only sections of the Jarrah forest have been mapped at this finer scale of definition. Therefore it is necessary to rely on previous mapping over 4 decades by Dr Libby Mattiske and earlier publications by Heddle *et al.* (1980b) reviewed some of the representation in broad terms for these site-vegetation types.

3. OBJECTIVES

The objectives of the survey were to define the key biological values on Lot 400, Canning Road, Carmel, as follows:

- . to record the flora species present on the survey area and to search for threatened and priority flora species on the survey area.
- . to review the local and regional significance of the flora recorded on the survey area.
- . to define and map the site-vegetation types on the survey area.
- . to review the local and regional significance of the site-vegetation types recorded on the survey area.
- . to review the vegetation condition on the survey area.
- . to search for significant fauna values.
- . to prepare a report summarising the findings.

4. METHODS

4.1 Flora

The detailed recording of the vascular plant species was carried out in conjunction with the vegetation mapping program for the survey area.

All plant specimens which were collected during the field programme were dried and fumigated in accordance with the requirements of the West Australian Herbarium, and then sorted in readiness for identification.

Plant specimens were identified by the use of local and regional flora keys and by comparison with the named specimens held at the West Australian Herbarium. Plant taxonomists who are considered to be an authority on a particular plant group were consulted, when necessary.

The conservation status of all recorded flora was also checked against the current lists managed by the Department of Parks and Wildlife (2015g), see Appendix A.

The status of all introduced species were checked against the current listings of Declared Plant Pests managed by the Department of Agriculture and Food (2015) under the *Biosecurity and Agriculture Management Act 2007*.

4.2 Vegetation

The survey area recordings were undertaken at 83 sites and targeted searching was undertaken between sites for specific flora and fauna values.

At each recording site the following information was collected:

Soil types - (gravels, sandy-gravels, sandy-loam gravels, sandy-loams, loams, clay-loams, clays and peat)

Topography - (ridge, upper slope, mid-slope, lower slope, valley floor and swamp)

Outcropping - (type - granite, laterite, dolerite; quantity - numerous, moderate, few)

Logging History - (intensity heavy, moderate, light; quantity - number of stumps within a 20 metre radius)

Species were ranked according to the scale developed by Havel (1975a):

Tree species

Assessments were undertaken within a 20 metre radius from the observation point.

- 0 - absent
- 1 - one or two trees
- 2 - three to five trees
- 3 - more than five trees, but contributing less than one third of total stand
- 4 - between one third and one half of total stand
- 5 - more than one half of total stand

Understorey species

Assessments were undertaken within a 5 metre radius from the observation point.

- 0 - absent
- 1 - very rarely seen; only after a careful search
- 2 - present, observable, but in small numbers only
- 3 - common locally, but not uniformly over the whole area
- 4 - common over the whole area
- 5 - completely dominating the undergrowth

The physiological stress was determined for each species within an area of 20 metres radius from the observation point and ranked according to the following scale. The above system was developed by E.M. Mattiske and Associates and has been used previously in the northern Jarrah forest:

- 0 - healthy, no evidence of stress
- 1 - odd plant showing signs of stress, not dead
- 2 - one or two stressed plants, near death
- 3 - scattered stressed, (2-4) dead plants around plot
- 4 - susceptible plants dying or dead (>4 plants)
- 5 - "graveyard" death

A further subdivision of the time period since death was undertaken for stress levels greater than 3:

- R - Recent death (leaves recently desiccated or discoloured)
- M - Medium death (Bark but no leaves left on trees)
- O - Old death (no leaves or bark left on trees)

5. RESULTS

5.1 Flora

A total of 168 vascular plant taxa (from 39 plant families and 99 genera) was recorded on Lot 400, Canning Road, Carmel, Appendix C. Of these, nine taxa were introduced plant taxa. Dominant families include Fabaceae (24 taxa), Proteaceae (15 taxa), Myrtaceae (9 taxa), Asteraceae (8 taxa), Asparagaceae (11 taxa), Cyperaceae (9 taxa), Orchidaceae (7 taxa) and Styliaceae (7 taxa).

Of these 168 vascular plant species, a total of 9 species were introduced species. Although none of these nine species are listed as Declared Plant Pests under the *Biosecurity and Agriculture Management Act 2007*, two declared plant pests have been recorded previously on the property and management is currently underway to control these two additional species (Cotton Bush – *Gomphocarpus fruticosus* and Blackberry – *Rubus echinatus* and other *Rubus* species).

5.2 Threatened and Priority Flora Species

A review of potential flora species was undertaken by accessing the Naturemap listings (Department of Parks and Wildlife 2007-). This review highlighted the potential for six threatened flora, one presumed extinct and thirteen priority flora species (see Appendix B). Of the six threatened species listed at the State level, one is listed as endangered and 5 are listed as vulnerable pursuant to the *Environment Protection and Biodiversity Conservation Act (1999)*.

Despite searching on several occasions over several months, no Threatened flora species gazetted under the *Wildlife Conservation Act (1950-1980)* were located on Lot 400, Canning Road, Carmel. No Priority flora species were located on Lot 400, Canning Road, Carmel.

Despite searching on several occasions over several months, no Threatened flora species, pursuant to s179 of the *Environment Protection and Biodiversity Conservation Act (1999)* were located during the survey.

5.3 Vegetation

A total of six site-vegetation types were defined and mapped for the survey area and were representative of Havel's site-vegetation types for the Northern Jarrah Forest Region (Havel 1975a, 1975b), see Figure 1 above.

H - Open Forest of *Eucalyptus marginata* with less *Corymbia calophylla*, *Allocasuarina fraseriana* and *Banksia grandis* over a mixed understorey of *Mesomelaena tetragona*, *Stirlingia latifolia* and *Styphelia tenuiflora* on sands and sandy gravels.

This site type is equivalent to the site-vegetation type H as defined by Havel (1975a). This type occurs within the Dwellingup and Dwellingup-Hester complexes as defined by Heddle *et al.* (1980a). This site-vegetation type occurs on the lower and middle mildly undulating landscapes in the northern and eastern areas of the northern Jarrah forest. The H site-vegetation types is relatively widespread in distribution within the Northern Jarrah Forest and is well represented in the conservation estate (Heddle *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987, Conservation Commission 2003).

P - Open Forest of *Allocasuarina fraseriana* - *Eucalyptus marginata* - *Corymbia calophylla* with scattered understorey, including *Adenanthos barbiger*, *Grevillea wilsonii*, *Lechenaultia biloba* and a range of low herbs and sedges on sandy gravels.

This site type is equivalent to the site-vegetation type P as defined by Havel (1975a). This type occurs within the Dwellingup and Dwellingup-Hester complexes as defined by Heddle *et al.* (1980a). This site-vegetation type occurs on the mid to upper slopes with sandier soils on the undulating hills on the Darling Ranges. The P site-vegetation type is relatively widespread in distribution within the Northern Jarrah Forest and is well represented in the conservation estate

(Hedde *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987, Conservation Commission 2003).

This site-vegetation type tends to support less shrubs in the understorey and a range of low sedges and herbs. The key indicators are the *Allocasuarina fraseriana*, *Adenanthos barbiger* and *Grevillea wilsonii*. The composition of the P type differs from the PS and PW as a result of the different tolerances of the plant species on the drier sands and sandy gravels.

- PS - Open Forest of *Allocasuarina fraseriana* - *Eucalyptus marginata* - *Corymbia calophylla* - *Banksia grandis* with scattered understorey, including *Adenanthos barbiger*, *Leucopogon capitellatus* on gravels and sandy gravels.

This site type is a variant of the site-vegetation types P and S as defined by Havel (1975a). This type occurs within the Dwellingup and Dwellingup-Hester complexes as defined by Hedde *et al.* (1980a). This site-vegetation type occurs on the mid to upper slopes of the undulating hills on the Darling Ranges. This combined type of types P and S is relatively widespread in distribution within the Northern Jarrah Forest and is well represented in the conservation estate (Hedde *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987, Conservation Commission 2003).

This site-vegetation type tends to be dominated by specific shrub species which dominate the sandy-gravelly slopes of the Darling Ranges (e.g. *Allocasuarina fraseriana*, *Adenanthos barbiger* and *Banksia grandis* of site-vegetation types P and S) but which lack some of the key indicators of the P type (e.g. *Grevillea wilsonii*) and includes species which occur on the gravelly soils (*Hovea chorizemifolia* and *Leucopogon capitellatus*).

- PW - Open Forest of *Allocasuarina fraseriana* - *Eucalyptus marginata* - *Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii*, *Adenanthos barbiger*, *Babingtonia camphorosmae* on sandy gravels.

This type is a variant of site-vegetation types P and W as defined by Havel (1975a) due to the presence of moisture indicators such as *Babingtonia camphorosmae*. This type occurs within the Dwellingup, Dwellingup-Hester and Yarragil complexes as defined by Hedde *et al.* (1980a).

This site-vegetation type occurs on the lower slopes and less commonly the mid slopes of the undulating hills on the Darling Ranges. This site-vegetation type appears to be reflecting a change in the local plant communities within the survey area as the moister indicators are occurring in sandier soils and higher up in the landscape. The P and W types are well represented in the conservation estate and State forest area (Hedde *et al.* 1980b; Department of Conservation and Land Management 1987; Conservation Commission 2003). This site-vegetation type tends to be dominated by specific shrub species which dominate the sandy-gravelly slopes and moist soil conditions of the Darling Ranges (e.g. *Leschenaultia biloba*, *Allocasuarina fraseriana* (formerly *Casuarina fraseriana*), *Adenanthos barbiger* and *Banksia grandis* of site-vegetation type P and *Babingtonia camphorosmae* of the site-vegetation type W which dominates moister soils in the nearby forest areas).

- S - Open Forest of *Eucalyptus marginata* - *Banksia grandis* - *Allocasuarina fraseriana* with scattered understorey, including *Adenanthos barbiger*, *Leucopogon capitellatus* and *Styphelia tenuiflora* on gravels and sandy-gravels.

This type is equivalent to the site-vegetation type S as defined by Havel (1975a). This type occurs within the Dwellingup and Dwellingup-Hester complexes as defined by Hedde *et al.* (1980a) and Mattiske and Havel (1998). This site-vegetation type occurs on the upper slopes, and to a lesser degree mid slopes, of the undulating hills on the Darling Ranges. The type is widespread in distribution within the Northern Jarrah Forest and is well represented in the conservation estate (Hedde *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987).

This site-vegetation type tends to be dominated by specific shrub species which dominate the gravelly slopes of the Darling Ranges (e.g. *Adenanthos barbiger*, *Styphelia tenuiflora*, *Leucopogon capitellatus*, *Banksia grandis* and *Hovea chorizemifolia*).

ST - Open Forest of *Eucalyptus marginata* - *Corymbia calophylla* with scattered understorey, including *Leucopogon capitellatus*, *Leucopogon verticillatus*, *Pteridium esculentum*, *Clematis pubescens* and *Styphelia tenuiflora* on sandy-gravelly soils.

This type is a variant of site-vegetation types S and T as defined by Havel (1975a)). This type occurs within the Dwellingup and Dwellingup-Hester complexes as defined by Heddle *et al.* (1980a) and Mattiske and Havel (1998).

This site-vegetation type occurs on the upper slopes, and to a lesser degree mid slopes, of the undulating hills on the Darling Ranges. This type is widespread in distribution within the Northern Jarrah Forest and is well represented in the conservation estate (Heddle *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987).

This site-vegetation type tends to be dominated by specific species which dominate the loamy-gravelly slopes of the Darling Ranges (e.g. *Bossiaea aquifolium*, *Styphelia tenuiflora*, *Leucopogon capitellatus*, *Pteridium esculentum*, *Clematis pubescens* and *Hovea chorizemifolia*).

None of these communities (or site-vegetation types) are listed at threatened ecological communities or priority ecological communities (Department of Parks and Wildlife 2015e, 2015f; Department of the Environment 2015b).

5.4 Review of the Condition of Vegetation

The condition of the vegetation within Lot 400, Canning Road, Carmel varies substantially depending on underlying soil types (from moist to dry sands and sandy gravels to loamy – gravels) and the previous historical activities on the survey area:

- the stunted nature of the Jarrah forest on the southern section of Lot 400 within the H and PW site-vegetation types is related to the sandier leached soils. The southern area has been cleared in part by the previous establishment of bush tracks and fire breaks.
- the central and northern sections of Lot 400 have been planted previously with pines and introduced Eucalypts.
- the six site-vegetation types are all present in the northern Jarrah forest, including representation within the conservation estate (Heddle *et al.* 1980b; Conservation Commission 2003).

Overall, the eastern sections of the remnant vegetation supports taller forest trees and is less degraded.

5.5 Fauna Activity

A range of other common native species were observed during the survey including smaller common birds and kangaroos.

During the botanical studies searches were made from potential habitat trees and although some trees were >50cm in diameter, no hollows suitable for nesting by the listed cockatoo species were recorded. The forest areas do support species (such as the Marri (*Corymbia calophylla*) trees) that are used for foraging by the listed Cockatoo species, namely Carnaby's Black Cockatoo (E) (*Calyptorhynchus latirostris*); Forest Red-tailed Black Cockatoo (V) (*Calyptorhynchus banksia naso*) and Baudin's Black Cockatoo (V) (*Calyptorhynchus baudinii*), Department of Environment and Conservation 2008 and Department of Sustainability, Environment, Water, Populations and Communities (2012). These cockatoo species are listed as Endangered (E) or Vulnerable (V) pursuant to the *Environment Protection and Biodiversity Conservation Act* (1999).

5.6 Review of Clearing Principles

The following is a review of the relevant clearing principles as it relates to native vegetation.

Principle (a): Native vegetation should not be cleared if it comprises a high level of biodiversity.

The property has sections that have been cleared and planted previously with introduced trees and a small section that has been cleared recently for an orchard and an access track. Although a range of species were recorded, the property could not be considered representative of an area of high biodiversity in the local area as it has been subjected to disturbances such as the previous cattle yard activities. Consequently, clearing of native vegetation on Lot 400 is unlikely to be at variance with this Principle.

Principle (b): Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significant habitat for fauna indigenous to Western Australia.

A few larger trees (>50cm diameter at breast height) may provide habitats in the future for the listed Black Cockatoos (although no suitable hollows were recorded). The area supports species that may be suitable for foraging. The southern proposed clearing areas have been subjected to previous disturbances and as such are unlikely to provide a significant habitat for the Cockatoos. Therefore although this southern area is unlikely to be at variance with this principle it is recommended that discussions are held with appropriate Black Cockatoo specialists and with the Federal and State agencies it is difficult to determine the significance of the proposed clearing area.

Principle (c): Native Vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.

Despite searching on several occasions over several months, no Threatened flora species gazetted under the *Wildlife Conservation Act* (1950-1980) were located on Lot 400, Canning Road, Carmel. No Priority flora species were located on Lot 400, Canning Road, Carmel.

Despite searching on several occasions over several months, no Threatened flora species, pursuant to s179 of the *Environment Protection and Biodiversity Conservation Act* (1999) were located during the survey.

Principle (d): 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.

A total of six site-vegetation types were defined and mapped for Lot 400, Canning Road, Carmel. The site-vegetation types were based on the Havel's site-vegetation types for the Northern Jarrah Forest Region (Havel 1975a, 1975b). None of these communities are listed at threatened ecological communities or priority ecological communities (Department of Parks and Wildlife 2015e; Department of the Environment 2015b). Therefore the proposed clearing is not at variance with this Principle.

Principle (e): Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

As Lot 400 abut the State Forest and lands managed for water catchment and conservation the remnant areas on Lot 400 could not be considered to be significant in this context. Therefore, clearing of native vegetation on Lot 400 is unlikely to be at variance with this Principle.

Principle (f): Native vegetation should not be cleared if it is growing in, or in association with, and environment associated with a watercourse or wetland.

Although there are some species that reflect slightly higher soil moisture levels in the PW site-vegetation as mapped, there are no watercourses or wetlands on Lot 400 and therefore clearing of native vegetation on Lot 400 is not at variance with this Principle.

Principle (g): 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.

As Lot 400 abut the State Forest and lands managed for water catchment and conservation the remnant areas on Lot 400 could not be considered to be significant in this context. Therefore, clearing of native

vegetation on Lot 400 is unlikely to be at variance with this Principle.

Principle (h): Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

Lot 400 occurs on the upper slopes of the valley system and low undulating hills and any clearing is unlikely to cause appreciable land degradation. This is re-enforced by the activities on the adjacent orchard activities to the north of Lot 400. Therefore the proposed clearing is not at variance with this Clearing Principle.

Principle (i): Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water

Clearing of native vegetation at Lot 400 is not envisaged to cause deterioration in the quality of surface or underground water and is therefore not at variance with this Clearing Principle.

Principle (j): Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Clearing of native vegetation at Lot 400 is not envisaged to cause or exacerbate the incidence of flooding and is therefore not at variance with this Clearing Principle.

6. DISCUSSION

The survey effort builds on some thirty or so years of similar flora and vegetation studies in the region and therefore the information as provided reflects a substantial local knowledge of the northern Jarrah forest. Consequently the effort on the flora and vegetation values exceeds any needs that are required for government processing of the proposed clearing activities.

A review of potential flora species was undertaken by accessing the Naturemap listings (Department of Parks and Wildlife 2007-). This review highlighted the potential for six threatened flora, one presumed extinct and thirteen priority flora species (see Appendix B). Of the six threatened species listed at the State level, one is listed as endangered and 5 are listed as vulnerable pursuant to the *Environment Protection and Biodiversity Conservation Act* (1999).

A total of 168 vascular plant taxa (from 39 plant families and 99 genera) was recorded on Lot 400, Canning Road, Carmel. This range of species included both perennial and annual species and therefore the coverage of the flora was considered to be more than adequate. Of these 168 vascular plant species, a total of 9 species were introduced plant species were recorded in the recent assessment of the remnant areas of native vegetation. Although none of these nine species are listed as Declared Plant Pests under the *Biosecurity and Agriculture Management Act* 2007, two declared plant pests have been recorded previously on the property and management is currently underway to control these two additional species (Cotton Bush – *Gomphocarpus fruticosus* and Blackberry – *Rubus echinatus* and other *Rubus* species).

No Threatened flora species gazetted under the *Wildlife Conservation Act* (1950-1980) were located on Lot 400, Canning Road, Carmel. No Priority flora species were located on Lot 400, Canning Road, Carmel. No Threatened flora species, pursuant to s179 of the *Environment Protection and Biodiversity Conservation Act* (1999) were located during the survey.

A total of six site-vegetation types were defined and mapped for Lot 400, Canning Road, Carmel. The site-vegetation types were based on the Havel's site-vegetation types for the Northern Jarrah Forest Region (Havel 1975a, 1975b). All of the site-vegetation types are well represented in the conservation estate and the State forest areas (Heddle *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987).

None of these communities are listed at threatened ecological communities or priority ecological communities (Department of Parks and Wildlife 2015e, 2015f; Department of the Environment 2015b).

During the botanical studies searches were made from potential habitat trees and although some trees were >50cm in diameter, no hollows suitable for nesting by the listed cockatoo species were recorded. The forest areas do support species such as Marri trees that are used for foraging by the listed Cockatoo species. As the proposed clearing area is over a hectare and there is potential for foraging by the listed Black Cockatoos it is recommended that prior to clearing a specialist in assessing the Black Cockatoo species undertake targeted work once the proposed clearing boundaries are finalized and that the proposed activities are referred to the Department of the Environment and the Department of Parks and Wildlife for consideration in terms of whether the proposed clearing activities are significant.

7. LIST OF PARTICIPANTS

The following personnel were involved in various stages of the project:

Principal Plant Ecologist and Study Coordinator:
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Senior Botanist/Ecologist:
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APPENDIX A1: DEFINITION OF THREATENED AND PRIORITY FLORA SPECIES (Department of Parks and Wildlife 2015c)

| Conservation Code | Category |
|-------------------|--|
| T | <p>Threatened Flora (Declared Rare Flora – Extant)</p> <p>“Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the <i>Wildlife Conservation Act 1950</i>).</p> <p>Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:</p> <ul style="list-style-type: none"> • CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild • EN: Endangered – considered to be facing a very high risk of extinction in the wild • VU: Vulnerable – considered to be facing a high risk of extinction in the wild.” |
| P1 | <p>Priority One – Poorly Known Species</p> <p>“Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.”</p> |
| P2 | <p>Priority Two – Poorly Known Species</p> <p>“Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.”</p> |
| P3 | <p>Priority Three – Poorly Known Species</p> <p>“Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities 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 localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.”</p> |
| P4 | <p>Priority Four – Rare Threatened and other species in need of monitoring</p> <p>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.</p> <p>b. Near Threatened - Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>c. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.”</p> |
| P5 | <p>Priority Five – Conservation Dependent Species</p> <p>“Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.”</p> |

APPENDIX A2: DEFINITION OF THREATENED FLORA SPECIES (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*)

| Category Code | Category |
|---------------|--|
| Ex | <p>Extinct</p> <p>Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.</p> |
| ExW | <p>Extinct in the Wild</p> <p>Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.</p> |
| CE | <p>Critically Endangered</p> <p>Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.</p> |
| E | <p>Endangered</p> <p>Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.</p> |
| V | <p>Vulnerable</p> <p>Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.</p> |
| CD | <p>Conservation Dependent</p> <p>Taxa which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.</p> |

APPENDIX A3: DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (Department of Parks and Wildlife 2015d)

| Category Code | Category |
|---------------|---|
| PTD | <p>Presumed Totally Destroyed</p> <p>An ecological community will be listed as Presumed Totally Destroyed if there are no recent records of the community being extant and either of the following applies:</p> <ul style="list-style-type: none"> (i) records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or; (ii) all occurrences recorded within the last 50 years have since been destroyed. |
| CE | <p>Critically Endangered</p> <p>An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting any one of the following criteria:</p> <ul style="list-style-type: none"> (i) The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the immediate future. |
| E | <p>Endangered</p> <p>An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. The ecological community must meet any one of the following criteria:</p> <ul style="list-style-type: none"> (i) The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the short term future. |
| V | <p>Vulnerable</p> <p>An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one of the following criteria:</p> <ul style="list-style-type: none"> (i) The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; (ii) The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; (iii) The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes. |

**APPENDIX A4: DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (Commonwealth
Environment Protection and Biodiversity Conservation Act 1999)**

Three categories exist for listing threatened ecological communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

| Listing Category | Explanation of Category |
|------------------------------|---|
| Critically endangered | If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future. |
| Endangered | If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future. |
| Vulnerable | If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future. |

APPENDIX A5: DEFINITION OF PRIORITY ECOLOGICAL COMMUNITIES (Department of Parks and Wildlife 2015d)

| Category Code | Category |
|----------------------|---|
| P1 | <p>Poorly-known ecological communities Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist.</p> |
| P2 | <p>Poorly-known ecological communities Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, un-allocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.</p> |
| P3 | <p>Poorly known ecological communities</p> <ul style="list-style-type: none"> (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or; (ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes. |
| P4 | <p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> |
| P5 | <p>Conservation Dependent ecological communities Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p> |

APPENDIX A6: CATEGORIES AND CONTROL OF DECLARED (PLANT) PESTS IN WESTERN AUSTRALIA (Department of Agriculture and Food 2015) (*Biosecurity and Agriculture Management Regulations 2013*)

| Control Category | Control Measures |
|--|---|
| <p style="text-align: center;">C1 (Exclusion)</p> <p>'(a) Category 1 (C1) — Exclusion: if in the opinion of the Minister introduction of the declared pest into an area or part of an area for which it is declared should be prevented'</p> <p>Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.</p> | <p>In relation to a category 1 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.</p> |
| <p style="text-align: center;">C2 (Eradication)</p> <p>'(b) Category 2 (C2) — Eradication: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is feasible'</p> <p>Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.</p> | <p>In relation to a category 2 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.</p> |
| <p style="text-align: center;">C3 (Management)</p> <p>'(c) Category 3 (C3) — Management: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is not feasible but that it is necessary to —</p> <p>(i) alleviate the harmful impact of the declared pest in the area; or (ii) reduce the number or distribution of the declared pest in the area; or (iii) prevent or contain the spread of the declared pest in the area.'</p> <p>Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.</p> | <p>In relation to a category 3 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to —</p> <p>(a) alleviate the harmful impact of the declared pest in the area for which it is declared; or (b) reduce the number or distribution of the declared pest in the area for which it is declared; or (c) prevent or contain the spread of the declared pest in the area for which it is declared.</p> |

APPENDIX A7: DEFINITION OF VEGETATION CONDITION SCALE (Keighery 1994)

| Condition Rating | Description |
|--------------------------------|--|
| Pristine (1) | Pristine or nearly so, no obvious sign of disturbance. |
| Excellent (2) | Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. |
| Very Good (3) | Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing. |
| Good (4) | Vegetation structure significantly altered by obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback, grazing. |
| Degraded (5) | Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing. |
| Completely Degraded (6) | 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 or shrubs. |

**APPENDIX B: POTENTIAL THREATENED AND PRIORITY FLORA WITHIN 5KM OF LOT 400,
CARMEL, 2015**

| Family | Species | State Conservation Code | Federal Conservation Code |
|----------------|---|--------------------------------|----------------------------------|
| Orchidaceae | <i>Cyanicula ixioides</i> subsp. <i>ixioides</i> | P4 | |
| | <i>Diuris drummondii</i> | T | V |
| | <i>Thelymitra stellata</i> | T | E |
| Proteaceae | <i>Conospermum undulatum</i> | T | V |
| Fabaceae | <i>Acacia anomala</i> | T | V |
| | <i>Acacia aphylla</i> | T | V |
| | <i>Acacia horridula</i> | P3 | |
| | <i>Acacia oncinophylla</i> subsp. <i>patulifolia</i> | P4 | |
| | <i>Bossiaea modesta</i> | P2 | |
| Rutaceae | <i>Boronia tenuis</i> | P4 | |
| Elaeocarpaceae | <i>Tetralochea</i> sp. Granite (S. Patrick SP1224) | P3 | |
| Malvaceae | <i>Lasiopetalum bracteatum</i> | P4 | |
| | <i>Thomasia glutinosa</i> var. <i>glutinosa</i> | P3 | |
| Thymelaeaceae | <i>Pimelea rara</i> | P4 | |
| Myrtaceae | <i>Scholtzia</i> sp. Bickley (W.H. Loaring s.n. PERTH 06165184) | presumed extinct | |
| Lamiaceae | <i>Hemigenia rigida</i> | P1 | |
| Solanaceae | <i>Anthocercis gracilis</i> | T | V |
| Stylidiaceae | <i>Stylidium striatum</i> | P4 | |
| Asteraceae | <i>Pithocarpa corymbulosa</i> | P3 | |

APPENDIX C: VASCULAR PLANT SPECIES ON THE RESPECTIVE SITE-VEGETATION TYPES, CARMEL, 2015

Note: * denotes introduced species

| Family | Species | H | P | PS | PW | S | ST |
|-------------------|---|---|---|----|----|---|----|
| Dennstaediaceae | <i>Pteridium esculentum</i> | | | | | X | X |
| Zamiaceae | <i>Macrozamia riedlei</i> | | | X | | X | X |
| Pinaceae | * <i>Pinus pinaster</i> | | | X | | | |
| Poaceae | <i>Amphipogon amphipogonoides</i> | | | | X | X | |
| | <i>Amphipogon turbinatus</i> | X | X | | | | |
| | * <i>Briza maxima</i> | | | | | | X |
| | <i>Neurachne alopecuroidea</i> | | | X | | | |
| | <i>Tetrarrhena laevis</i> | | X | X | | X | X |
| | Poaceae sp. | | X | | | X | |
| Cyperaceae | <i>Cyathochaeta avenacea</i> | X | X | X | X | X | X |
| | <i>Lepidosperma ?apricola</i> | | X | | | | X |
| | <i>Lepidosperma gracile</i> | | | X | | X | X |
| | <i>Lepidosperma squamatum</i> | X | X | | X | | X |
| | <i>Lepidosperma squamatum sens. lat</i> | | X | X | X | X | |
| | <i>Lepidosperma tenue</i> | X | | | | X | |
| | <i>Mesomelaena tetragona</i> | X | X | X | X | | |
| | <i>Tetrraria capillaris</i> | X | X | X | X | X | X |
| | <i>Tetrraria octandra</i> | X | X | | | | |
| Restionaceae | <i>Alexgeorgea nitens</i> | | | | X | | |
| | <i>Desmocladius fasciculatus</i> | X | X | X | | | |
| | <i>Desmocladius flexuosus</i> | | | X | | X | X |
| | <i>Hypolaena exsulca</i> | X | | | X | | |
| | <i>Loxocarya cinerea</i> | X | | X | | X | X |
| Anarthriaceae | <i>Lyginia barbata</i> | X | | | | | |
| Asparagaceae | <i>Chamaescilla corymbosa</i> | X | X | X | X | | |
| | <i>Lomandra caespitosa</i> | X | X | X | | X | |
| | <i>Lomandra hermaphrodita</i> | X | | X | X | | X |
| | <i>Lomandra sonderi</i> | X | X | X | | | |
| | <i>Lomandra sparteae</i> | | X | | | | |
| | <i>Lomandra sp.</i> | X | | | | X | |
| | <i>Thysanotus dichotomus</i> | | | X | | X | X |
| | <i>Thysanotus fastigiatus</i> | | X | X | | X | |
| | <i>Thysanotus sparteus</i> | X | | X | | | |
| | <i>Thysanotus thyrsoideus</i> | | X | | | | |
| | <i>Thysanotus sp.</i> | | | | | X | X |
| Xanthorrhoeaceae | <i>Xanthorrhoea gracilis</i> | X | X | X | X | X | |
| | <i>Xanthorrhoea preissii</i> | X | X | X | X | X | X |
| Colchicaceae | <i>Burchardia congesta</i> | X | X | X | X | X | X |
| Hemerocallidaceae | <i>Dianella revoluta</i> | X | X | | | X | X |
| | <i>Tricoryne elatior</i> | | | | | X | |
| | <i>Tricoryne humilis</i> | X | X | | | | |

APPENDIX C: VASCULAR PLANT SPECIES ON THE RESPECTIVE SITE-VEGETATION TYPES, CARMEL, 2015

Note: * denotes introduced species

| Family | Species | H | P | PS | PW | S | ST |
|----------------------------|--|---|---|----|----|---|----|
| Haemodoraceae | <i>Anigozanthos manglesii</i> | x | | | x | | |
| | <i>Anigozanthos</i> sp. | x | x | | | | |
| | <i>Conostylis pusilla</i> | x | | | | | |
| | <i>Conostylis setigera</i> | x | | x | | x | x |
| | <i>Conostylis setosa</i> | x | x | x | x | | x |
| | <i>Haemodorum</i> sp. | x | x | | | x | x |
| Iridaceae | * <i>Gladiolus caryophyllaceus</i> | x | | x | x | | x |
| | <i>Orthrosanthus laxus</i> | | | | | x | x |
| | <i>Patersonia babianoides</i> | | | x | | x | |
| | <i>Patersonia umbrosa</i> var. <i>xanthina</i> | x | x | x | x | x | x |
| | * <i>Romulea rosea</i> | x | x | | | | |
| | * <i>Watsonia meriana</i> | | | | | x | |
| Orchidaceae | <i>Caladenia flava</i> | x | x | x | x | x | |
| | <i>Caladenia</i> sp. | x | x | x | x | x | x |
| | <i>Diuris</i> sp. | | x | | | | |
| | <i>Pterostylis vittata</i> | | x | x | | | |
| | <i>Pterostylis</i> sp. | x | x | x | x | x | x |
| | <i>Pyrorchis nigricans</i> | x | | x | | x | |
| | <i>Thelymitra</i> sp. | x | x | x | | | |
| Casuarinaceae | <i>Allocasuarina fraseriana</i> | x | x | x | x | x | |
| | <i>Allocasuarina humilis</i> | | | | x | | |
| Proteaceae | <i>Adenanthos barbiger</i> | x | x | x | x | x | x |
| | <i>Banksia dallanneyi</i> var. <i>dallanneyi</i> | x | x | x | x | x | x |
| | <i>Banksia grandis</i> | x | x | x | x | x | x |
| | <i>Banksia sessilis</i> | x | | x | x | x | |
| | <i>Grevillea synapheae</i> | x | x | x | x | x | x |
| | <i>Grevillea wilsonii</i> | x | x | | | | |
| | <i>Hakea amplexicaulis</i> | x | | x | x | x | |
| | <i>Hakea lissocarpha</i> | x | x | x | x | x | x |
| | <i>Hakea ruscifolia</i> | | | x | | | |
| | <i>Hakea undulata</i> | x | | x | | | |
| | <i>Isopogon dubius</i> | x | | | | | |
| | <i>Persoonia elliptica</i> | | | x | x | x | x |
| | <i>Persoonia longifolia</i> | x | | x | | | x |
| | <i>Stirlingia latifolia</i> | x | | x | x | | |
| <i>Synaphea petiolaris</i> | x | | | x | | | |
| Amaranthaceae | <i>Ptilotus manglesii</i> | x | x | x | x | x | |
| Ranunculaceae | <i>Clematis pubescens</i> | | | | | x | x |
| Lauraceae | <i>Cassytha</i> sp. | | | | x | | |
| Droseraceae | <i>Drosera erythrorhiza</i> | x | x | x | x | x | |
| | <i>Drosera glanduligera</i> | | | | | x | |
| | <i>Drosera pallida</i> | x | x | x | x | x | |
| | <i>Drosera stolonifera</i> | x | x | x | x | x | |
| Pittosporaceae | <i>Billardiera</i> sp. | | | x | | | |

APPENDIX C: VASCULAR PLANT SPECIES ON THE RESPECTIVE SITE-VEGETATION TYPES, CARMEL, 2015

Note: * denotes introduced species

| Family | Species | H | P | PS | PW | S | ST |
|-----------------------------|--|---|---|----|----|---|----|
| Fabaceae | <i>Acacia applanata</i> | | | | | X | |
| | <i>Acacia barbinervis</i> | X | X | | X | X | |
| | <i>Acacia preissiana</i> | X | X | | | X | |
| | <i>Acacia pulchella</i> | X | X | X | X | X | X |
| | <i>Bossiaea aquifolium</i> | X | | X | | | X |
| | <i>Bossiaea ornata</i> | X | X | X | X | X | X |
| | <i>Daviesia decurrens</i> | | | X | | X | |
| | <i>Daviesia incrassata</i> | | | X | | | |
| | <i>Daviesia preissii</i> | | | X | | X | X |
| | <i>Daviesia rhombifolia</i> | | | | | X | |
| | <i>Gastrolobium spinosum</i> | X | | | | | |
| | <i>Gompholobium capitatum</i> | X | | | | | |
| | <i>Gompholobium knightianum</i> | X | | X | | | X |
| | <i>Gompholobium marginatum</i> | | X | | X | X | X |
| | <i>Gompholobium polymorphum</i> | | X | | | | |
| | <i>Gompholobium preissii</i> | X | X | | | | |
| | <i>Gompholobium tomentosum</i> | | X | X | X | X | |
| | <i>Hovea chorizemifolia</i> | X | X | X | X | X | X |
| | <i>Hovea trisperma</i> | X | | X | X | X | X |
| | <i>Kennedia coccinea</i> | X | X | X | X | X | |
| | <i>Kennedia prostrata</i> | X | X | X | X | X | |
| | <i>Labichea punctata</i> | X | X | X | X | X | |
| | <i>Mirbelia dilatata</i> | | | | X | | |
| <i>Sphaerolobium medium</i> | | | | X | | | |
| Oxalidaceae | <i>Oxalis</i> sp. | | X | X | | X | |
| Rutaceae | <i>Boronia fastigiata</i> | X | | | | | |
| | <i>Philotheca spicata</i> | X | X | X | X | X | X |
| Polygalaceae | <i>Comesperma virgatum</i> | X | | | | | |
| Phyllanthaceae | <i>Phyllanthus calycinus</i> | X | | X | X | X | X |
| Rhamnaceae | <i>Trymalium ledifolium</i> | | X | | | X | |
| | <i>Trymalium odoratissimum</i> subsp. <i>odoratissimum</i> | X | X | | X | | |
| Elaeocarpaceae | <i>Tetratheca hirsuta</i> | X | | X | | X | |
| Dilleniaceae | <i>Hibbertia acerosa</i> | X | X | X | X | X | |
| | <i>Hibbertia amplexicaulis</i> | X | | | X | X | |
| | <i>Hibbertia commutata</i> | | X | X | X | X | |
| | <i>Hibbertia huegelii</i> | X | X | X | X | | |
| | <i>Hibbertia hypericoides</i> | X | X | X | X | X | X |
| | <i>Hibbertia pachyrrhiza</i> | X | X | | X | | |
| | <i>Hibbertia perfoliata</i> | | | | | X | X |
| Thymelaeaceae | <i>Pimelea suaveolens</i> | X | | X | X | X | |
| Myrtaceae | <i>Astartea scoparia</i> | | | X | X | X | |
| | <i>Babingtonia camphorosmae</i> | X | X | | X | | |
| | <i>Corymbia calophylla</i> | X | X | X | X | X | X |
| | <i>Eucalyptus marginata</i> | X | X | X | X | X | X |

APPENDIX C: VASCULAR PLANT SPECIES ON THE RESPECTIVE SITE-VEGETATION TYPES, CARMEL, 2015

Note: * denotes introduced species

| Family | Species | H | P | PS | PW | S | ST |
|--------------------------|----------------------------------|---|---|----|----|---|----|
| Myrtaceae (continued) | <i>Eucalyptus</i> sp. | | | X | | | |
| | <i>Hypocalymma angustifolium</i> | | | | X | | |
| | <i>Hypocalymma robustum</i> | X | X | X | X | X | |
| | <i>Kunzea glabrescens</i> | | | | | X | |
| | * <i>Leptospermum laevigatum</i> | X | | X | | | |
| Araliaceae | <i>Trachymene pilosa</i> | X | X | X | X | X | |
| Apiaceae | <i>Actinotus glomeratus</i> | X | | X | | | |
| | <i>Pentapeltis peltigera</i> | X | X | X | X | X | X |
| | <i>Platysace compressa</i> | X | | X | X | X | X |
| | <i>Platysace tenuissima</i> | | X | | | | |
| | <i>Xanthosia candida</i> | | | X | X | X | |
| | <i>Xanthosia huegelii</i> | | | | X | X | |
| Epacridaceae | <i>Leucopogon capitellatus</i> | | | | | X | X |
| | <i>Leucopogon nutans</i> | X | X | X | X | X | |
| | <i>Leucopogon propinquus</i> | X | X | X | | X | X |
| | <i>Leucopogon verticillatus</i> | | X | X | | X | X |
| | <i>Styphelia tenuiflora</i> | X | | X | | X | |
| Primulaceae | * <i>Lysimachia arvensis</i> | | | | X | | X |
| Rubiaceae | <i>Opercularia echinocephala</i> | X | X | X | X | X | X |
| | <i>Opercularia vaginata</i> | | | X | | | |
| Goodeniaceae | <i>Dampiera alata</i> | | | | X | | |
| | <i>Dampiera linearis</i> | X | X | X | | X | X |
| | <i>Lechenaultia biloba</i> | X | X | X | X | X | X |
| | <i>Scaevola calliptera</i> | X | X | X | X | X | X |
| Stylidiaceae | <i>Levenhookia pusilla</i> | | | | X | X | |
| | <i>Stylidium amoenum</i> | | | | | X | |
| | <i>Stylidium lateriticola</i> | | X | | | | X |
| | <i>Stylidium pilliferum</i> | | X | | | | |
| | <i>Stylidium repens</i> | | | | X | X | |
| | <i>Stylidium schoenoides</i> | X | X | | X | | |
| | <i>Stylidium</i> sp. | X | | | | X | |
| Asteraceae | * <i>Hypochaeris glabra</i> | X | X | X | X | X | |
| | <i>Lagenophora huegelii</i> | X | X | X | X | X | X |
| | <i>Podotheca</i> sp. | | | | X | X | |
| | <i>Quinetia urvillei</i> | | | | X | X | |
| | <i>Trichocline spathulata</i> | X | | X | X | X | X |
| | * <i>Ursinia anthemoides</i> | X | X | | X | X | |
| | <i>Waitzia suaveolens</i> | | | X | X | | |
| | Asteraceae sp. | X | | | | | |