



CLEARING PERMIT

Granted under section 51E of the Environmental Protection Act 1986

PERMIT DETAILS

Area Permit Number: CPS 8830/1
File Number: DWERVT5437~4
Duration of Permit: From 14 January 2022 to 14 January 2024

PERMIT HOLDER

Gems Brook Pty Ltd

LAND ON WHICH CLEARING IS TO BE DONE

Lot 12291 on Deposited Plan 203116, Boorara Brook

AUTHORISED ACTIVITY

The permit holder must not clear more than 3.27 hectares of native vegetation within the area cross-hatched yellow in Figure 1 of Schedule 1, and no more than 5.67 hectares of native vegetation within the area cross-hatched red in Figure 1 of Schedule 1.

CONDITIONS

1. Avoid, minimise, and reduce impacts and extent of clearing

In determining the *native vegetation* authorised to be cleared under this permit, the permit holder must apply the following principles, set out in descending order of preference:

- (a) avoid the clearing of *native vegetation*;
- (b) minimise the amount of *native vegetation* to be cleared; and
- (c) reduce the impact of clearing on any environmental value.

2. Weed and dieback management

When undertaking any clearing authorised under this permit, the permit holder must take the following measures to minimise the risk of introduction and spread of *weeds* and *dieback*:

- (a) clean earth-moving machinery of soil and vegetation prior to entering and leaving the area to be cleared;

- (b) ensure that no known *dieback* or *weed*-affected soil, *mulch*, *fill*, or other material is brought into the area to be cleared; and
- (c) restrict the movement of machines and other vehicles to the limits of the areas to be cleared.

3. Limits of clearing

- (a) Broadscale clearing of *native vegetation* is prohibited within the areas cross-hatched red in Figure 1 of Schedule 1.
- (b) Clearing within the areas cross-hatched red in Figure 1 of Schedule 1 is limited to the extent necessary to facilitate access to control blackberry (**Rubus* sp.), and the *incidental clearing* caused by the removal or killing of blackberry (**Rubus* sp.) using *low impact clearing* methods where practicable.

4. Directional clearing

The permit holder must conduct clearing activities in a slow, progressive manner towards adjacent *native vegetation* to allow fauna to move into adjacent *native vegetation* ahead of the clearing activity.

5. Records that must be kept

The permit holder must maintain records relating to the listed relevant matters in accordance with the specifications detailed in Table 1.

Table 1: Records that must be kept

| No. | Relevant matter | Specifications |
|-----|---|---|
| 1. | In relation to the authorised clearing activities generally | <ul style="list-style-type: none"> (a) the species composition, structure, and density of the cleared area; (b) the location where the clearing occurred, recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings; (c) direction of clearing; (d) the date that the area was cleared; (e) the size of the area cleared (in hectares); (f) actions taken to avoid, minimise, and reduce the impacts and extent of clearing in accordance with condition 1 of this permit; (g) actions taken to minimise the risk of the introduction and spread of <i>weeds</i> and <i>dieback</i> in accordance with condition 2 of this permit; and |

| No. | Relevant matter | Specifications |
|-----|-----------------|---|
| | | (h) actions taken to limit clearing within the areas cross-hatched red in Figure 1 of Schedule 1 in accordance with condition 3 of this permit. |

6. Reporting

The permit holder must provide to the *CEO* the records required under condition 5 of this permit when requested by the *CEO*.

DEFINITIONS

In this permit, the terms in Table have the meanings defined.

Table 2: Definitions

| Term | Definition |
|---------------------|--|
| CEO | Chief Executive Officer of the department responsible for the administration of the clearing provisions under the <i>Environmental Protection Act 1986</i> . |
| clearing | has the meaning given under section 3(1) of the EP Act. |
| condition | a condition to which this clearing permit is subject under section 51H of the EP Act. |
| dieback | means the effect of <i>Phytophthora</i> species on native vegetation. |
| department | means the department established under section 35 of the <i>Public Sector Management Act 1994</i> (WA) and designated as responsible for the administration of the EP Act, which includes Part V Division 3. |
| EP Act | <i>Environmental Protection Act 1986</i> (WA) |
| incidental clearing | the incidental death of native vegetation from the spraying and mechanical removal of blackberry. |
| low impact clearing | grubbing, pruning, slashing, burning, or the use of appropriate herbicides. |
| native vegetation | has the meaning given under section 3(1) and section 51A of the EP Act. |
| weeds | means any plant – (a) that is a declared pest under section 22 of the <i>Biosecurity and Agriculture Management Act 2007</i> ; or (b) published in a Department of Biodiversity, Conservation and Attractions species-led ecological impact and invasiveness ranking summary, regardless of ranking; or (c) not indigenous to the area concerned. |

END OF CONDITIONS



Mathew Gannaway
MANAGER
NATIVE VEGETATION REGULATION

*Officer delegated under Section 20
of the Environmental Protection Act 1986*

20 December 2021

SCHEDULE 1

The boundaries of the area authorised to be cleared is shown in the map below (Figure 1).

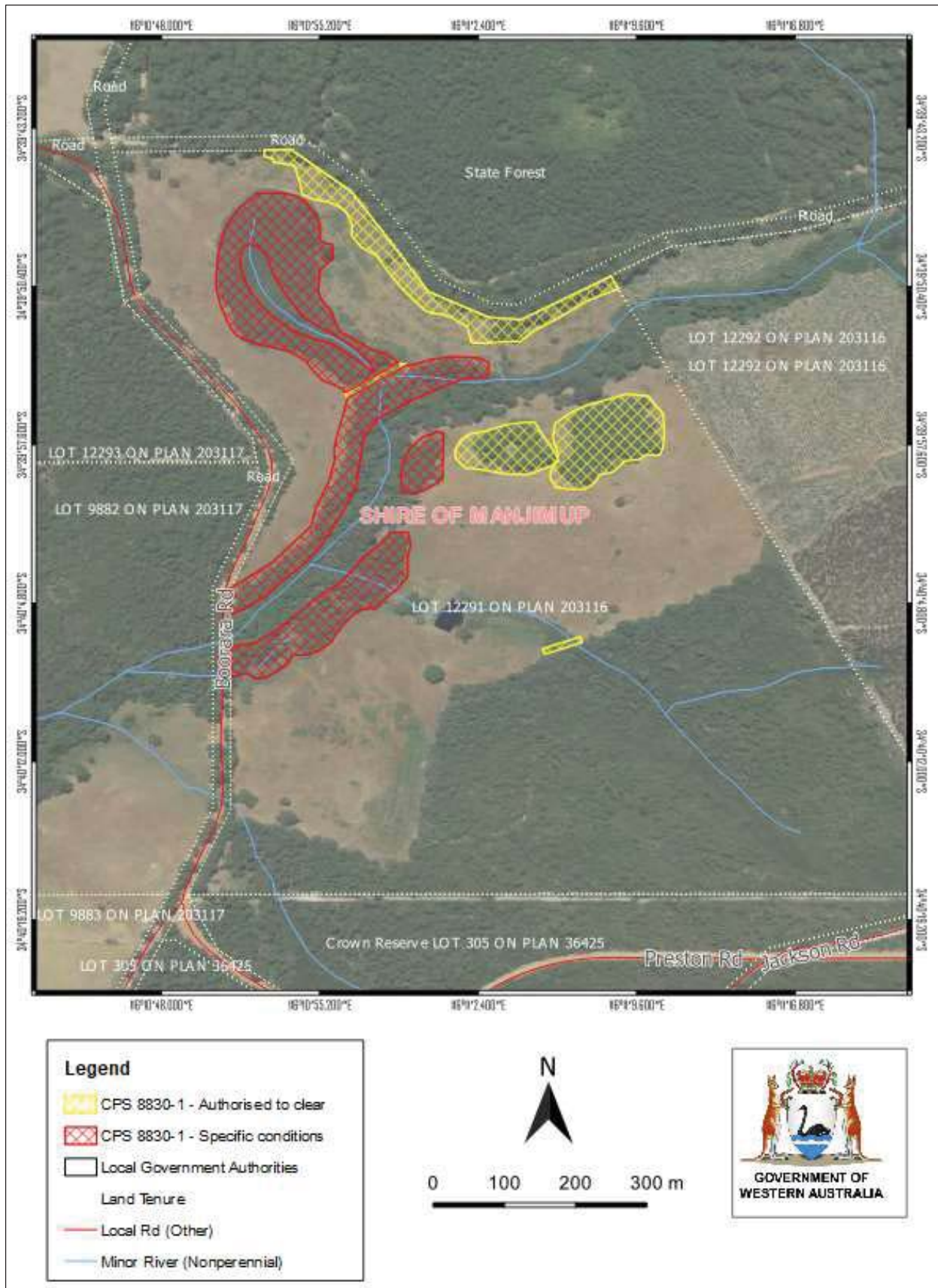


Figure 1: Map of the boundaries of the areas within which clearing may occur



Clearing Decision Report

1 Application details and outcome

1.1. Permit application details

| | |
|-----------------------|---|
| Permit number: | CPS 8830/1 |
| Permit type: | Area permit |
| Applicant name: | Gems Brook Pty Ltd |
| Application received: | 3 March 2020 |
| Application area: | 27.388 hectares of native vegetation |
| Purpose of clearing: | Re-establishing the property for primary production |
| Method of clearing: | Mechanical removal |
| Properties: | Lot 12291 on Deposited Plan 203116, Boorara Brook |
| Location (LGA area): | Shire of Manjimup |
| Localities (suburb): | Boorara Brook |

1.2. Description of clearing activities

The application is for the proposed clearing of 27.388 hectares of native vegetation within Lot 12291 on Deposited Plan 203116, Boorara Brook, for the purpose of re-establishing the property for primary production. This includes re-establishment and expansion of pasture for beef production with the potential to convert to Blue Gum (*Eucalyptus globulus*) plantations in the future. The application area is made up of multiple areas as shown in Figure 1 and labelled A-G.

1.3. Decision on application

| | |
|----------------|---|
| Decision: | Granted |
| Decision date: | 20 December 2021 |
| Decision area: | 8.94 hectares of native vegetation as depicted in Section 1.5, below. |

1.4. Reasons for decision

This clearing permit application was submitted, accepted, assessed and determined in accordance with sections 51E and 51O of the *Environmental Protection Act 1986* (EP Act). The Department of Water and Environmental Regulation (DWER) advertised the application for 21 days and no submissions were received.

In making this decision, the Delegated Officer had regard for the site characteristics (Appendix B), relevant datasets (Appendix G), a fauna survey and habitat tree assessment (Appendix A), advice from the Commissioner of Soil and Land Conservation (Appendix A), the clearing principles set out in Schedule 5 of the EP Act (Appendix C), relevant planning instruments (Section 3.3), the applicant's minimisation and mitigation measures (Section 3.1), and any other matters considered relevant to the assessment.

The assessment identified that the proposed clearing is at variance with Clearing Principles (f) and (g), and may be at variance with Clearing Principles (h) and (i) and will result in:

- the removal of riparian vegetation;
- potential water erosion, waterlogging and nutrient export;
- the deterioration of surface water quality;
- the potential introduction and spread of weeds and dieback to adjacent areas of remnant vegetation including nearby conservation areas; and
- potential impacts to ground-dwelling and arboreal fauna during the clearing activity.

After consideration of the available information, as well as the applicant's minimisation and mitigation measures (Section 3.1), the Delegated Officer determined that impacts over particular areas of the application area are unable to be adequately managed through conditions on a clearing permit, and that the clearing of Areas E, F and G (Figure 1) will not be granted.

In regard to the remaining areas, the proposed clearing is unlikely to lead to appreciable land degradation or have long-term adverse impacts on adjacent remnant vegetation, conservation areas, or fauna, and can be managed by restricting broadscale clearing in riparian areas to the extent necessary to facilitate access for the control of blackberry infestations, minimising the risk of the introduction and spread of weeds and dieback, and implementing slow directional clearing to allow fauna to move into adjacent vegetation ahead of the clearing activity.

The Delegated Officer decided to grant a clearing permit subject to conditions to:

- avoid, minimise to reduce the impacts and extent of clearing;
- prohibit the broadscale clearing of native vegetation within areas B, C1, C2 and C3 (Figure 2);
- clearing within areas B, C1, C2 and C3 (Figure 2) is limited to the extent necessary to facilitate access to control blackberry (*Rubus* sp.), and *incidental clearing* caused by the removal or killing of blackberry (*Rubus* sp) using *low impact clearing* methods where practicable;
- undertake slow, progressive one directional clearing to allow terrestrial fauna to move into adjacent habitat ahead of the clearing activity; and
- take hygiene steps to minimise the risk of the introduction and spread of weeds and dieback.

* *Incidental clearing being the incidental death of native vegetation from the spraying and mechanical removal of blackberry.*

* *low impact clearing methods being grubbing, pruning, slashing, burning, and the use of appropriate herbicides.*

1.5. Site maps

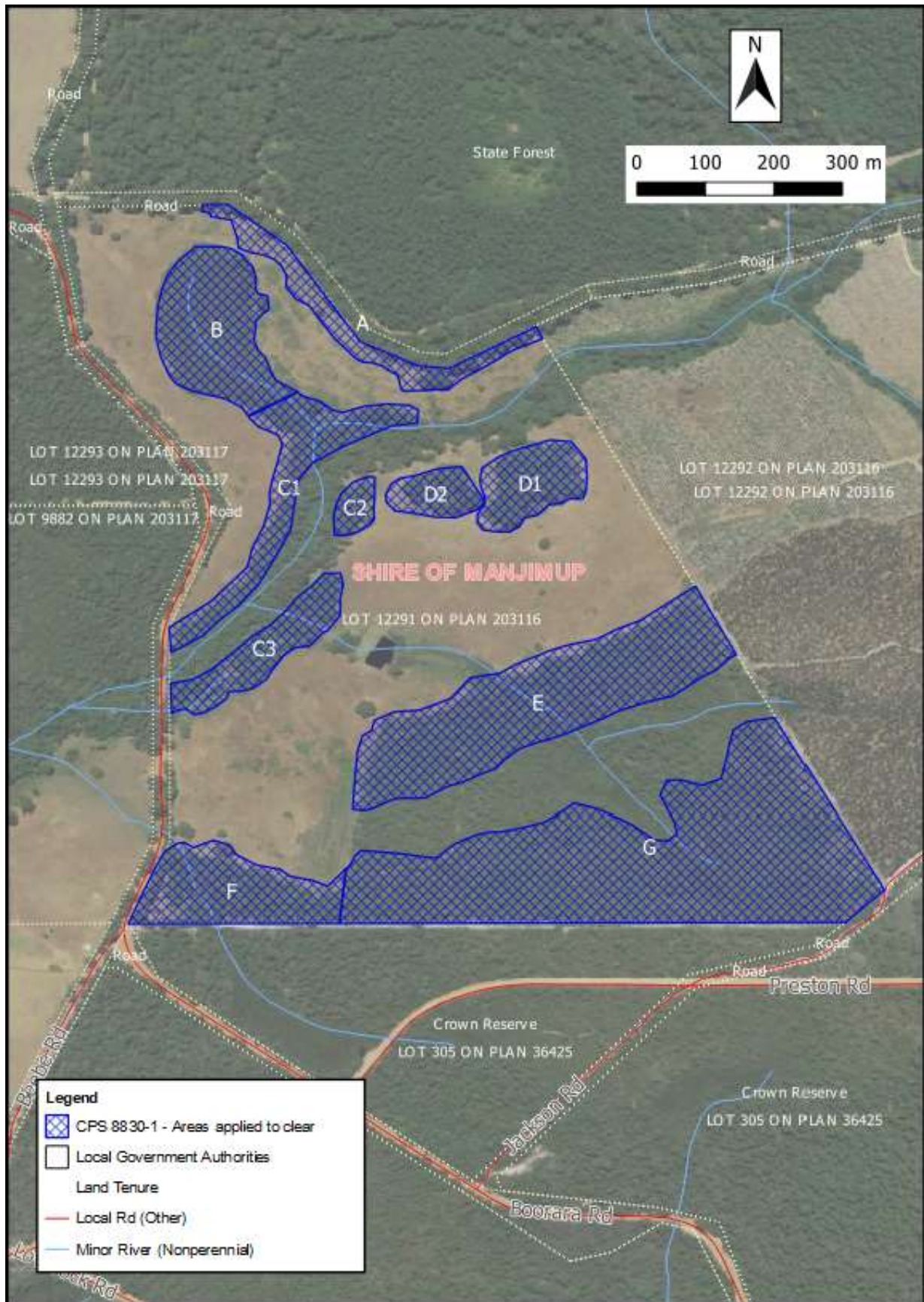


Figure 1: Map of the application area

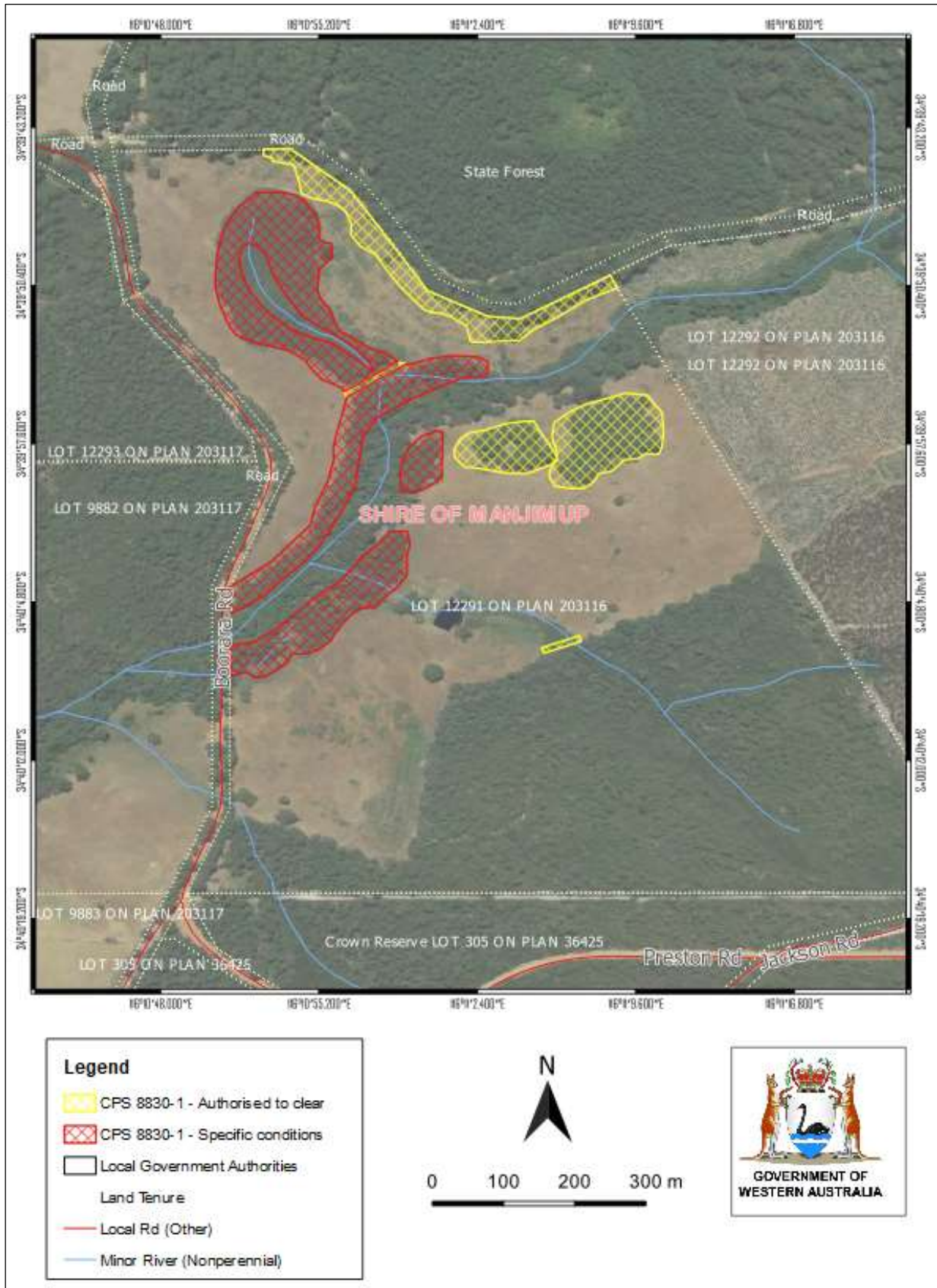


Figure 2: Map of the areas authorised to clear

The areas cross-hatched yellow indicate the areas authorised to be cleared under the granted clearing permit. The areas cross-hatched red indicate areas within which specific conditions apply.

2 Legislative context

The clearing of native vegetation in Western Australia is regulated under the EP Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (Clearing Regulations).

In addition to the matters considered in accordance with section 51O of the EP Act (see Section 1.4), the Delegated Officer has also had regard to the objects and principles under section 4A of the EP Act, particularly:

- the precautionary principle
- the principle of intergenerational equity
- the principle of the conservation of biological diversity and ecological integrity.

Other legislation of relevance for this assessment include:

- *Biodiversity Conservation Act 2016* (WA) (BC Act)
- *Biosecurity and Agriculture Management Act 2007* (BAM Act)
- *Conservation and Land Management Act 1984* (WA) (CALM Act)
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)
- *Soil and Land Conservation Act 1945* (WA)

The key guidance documents which inform this assessment are:

- *A guide to the assessment of applications to clear native vegetation* (DER December 2013)
- *Procedure: Native vegetation clearing permits* (DWER October 2019)
- Technical guidance – *Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA 2016)

3 Detailed assessment of application

3.1. Avoidance and mitigation measures

The applicant provided additional information in support of clearing application CPS 8830/1 whereby the objective is to clear portions of remnant vegetation on Lot 12291 on Deposited Plan 203116, Boorara Brook, to allow the property to fulfill its potential for primary production, primarily the raising of beef cattle but with the potential for Blue Gum (*Eucalyptus globulus*) plantations in later years (Gems Brook 2020).

An objective is to control and ultimately eliminate blackberry (**Rubus* sp.) and Bracken Fern (*Pteridium esculentum* [G.Forst.] Cockayne subsp. *esculentum*) from the creek systems. Blackberry is not considered native vegetation under the EP Act and therefore does not require a clearing permit. However, Bracken Fern and other understorey flora is considered native vegetation under the EP Act. The control and ultimate elimination of blackberry from the creek systems cannot occur without the removal of Bracken Fern and potentially other native flora species.

DWER sought advice from the Commissioner of Soil and Land Conservation in regard to land degradation risks associated with the proposed land clearing. After such advice was received (DPIRD 2020) a request for further information was sent to the applicant to provide the identification of avoidance, minimisation, and mitigation options to eliminate, reduce or otherwise mitigate the need for, and scale of, the proposed clearing of riparian native vegetation and to manage land degradation issues, and to provide details of proposed measures to manage the identified land degradation risks.

On 27 February 2021, Gems Brook Pty Ltd (Gems Brook) advised that they do not wish to jeopardise the functioning and ecology of the main stream and is aware of the importance of riparian vegetation. The watercourse is currently heavily infested with blackberry (**Rubus* sp). Gems Brook aims to control the spread, if not eradicate, the blackberry from the property. To do this, some access to the stream zone is necessary, and the application involves some judicial clearing of riparian vegetation. The proposed clearing of vegetation adjacent to the stream zone is generally on the south-western portion and is designed to match the width of vegetation in place further upstream. Most of the proposed clearing of the strips of vegetation adjacent to the stream involves returning formerly cleared land to pasture by clearing bracken-dominated scrub. Apart from narrowing the width of the strips of vegetation adjacent to the stream to be cleared, no additional avoidance, minimisation or mitigation measures could be provided to DWER (Gems Brook 2021a).

Gems Brook advised that they are aware of land degradation risks and have not sought to clear important stream-side vegetation, has not sought to clear all of the native vegetation in the southern portion of the property, and aims to eradicate blackberry from the property (Gems Brook 2021a). Wind erosion will be avoided by maintaining quality pasture on the property and by maintaining appropriate stock numbers. Eutrophication will be avoided by the

maintenance of an effective stream zone vegetation strip, by the appropriate use of fertilizers, and by ensuring cattle are not able to disrupt the stream-zone through the appropriate use of fencing. Waterlogging will be avoided by control/eradication of blackberry infestations in the stream-zone, allowing natural water flows and by maintenance of healthy pasture. The applicant advised that Gems Brook is a capable farming enterprise with extensive knowledge and experience in working on and in the lands and forests of the lower south-west of Western Australia (Gems Brook 2021a).

A targeted fauna survey and habitat tree assessment of the proposed clearing areas was provided by the applicant (Harewood 2021).

After consideration of the DPIRD (2020) advice, the fauna assessment of Harewood (2021), and the strategies provided by Gems Brook (2020) and Gems Brook (2021a) DWER's preliminary assessment identified that the proposed clearing was likely to result in unacceptable impacts to the environment. In particular, the assessment identified that the proposed clearing would result in:

- increased water erosion, waterlogging and nutrient export;
- an associated increased risk of deterioration of surface water quality; and
- the loss of a substantial area of foraging habitat for black cockatoos.

The applicant was invited to make a submission on DWER's draft decision, and subsequently identified additional strategies to avoid, minimise and mitigate the clearing of riparian vegetation and potential land degradation impacts. On 28 October 2021 (Gems Brook 2021b) Gems Brook confirmed that:

- Area G (Figure 1) can be withdrawn from the application (See Figure 3).
- Approval to clear all other areas is still requested.
- Broadscale clearing of blackberry and Bracken Fern from Area B (Figure 1) is still sought. It would be impossible to clear away the blackberry from this area without also clearing Bracken Fern.
- A narrow strip along the drainage line running in a north-westerly direction from the main creekline (Area B) will not be cleared and has been excluded from a revised application area (Figure 3). The drainage line is damp and boggy in winter and best to leave largely untouched
- The purpose of the clearing is to establish or re-establish pasture on the property, including the application of fertiliser, namely two tonnes per hectare of "Tekfoss 2" lime and trace elements.
- After approximately two years, the intention is to establish a Blue Gum (*Eucalyptus globulus*) plantation on the cleared areas (in a similar fashion to the Gems Brook property immediately adjacent to the east).
- Cattle will be run on the property after pasture establishment/re-establishment, before planting to Blue Gum.
- To avoid cattle pugging in the vicinity of the main creekline which runs through the property from north-east to south-west, clearing to remove blackberry adjacent to this creekline in Areas C1, C2 and C3 (Figure 1) will be delayed until after cattle have been removed and before the planting of Blue Gum.
- The location of two all-weather crossings over drainage lines running into the main creekline are shown on the revised application area (Figure 3). These crossings will comprise 400 millimetre concrete pipes with gravel topping, allowing vehicular traffic all year round.

In consideration of the additional information and revised application area (Figure 3) provided by Gems Brook (2021b) DWER sought updated advice from the Commissioner of Soil and Land Conservation. On 25 November 2021 DPIRD (2021) provided updated advice in respect to land degradation risks associated with the revised clearing, and the revised application area proposed. This decision report considers the revised application area and information of Gems Brook (2021a; 2021b), DPIRD advice (DPIRD 2020; DPIRD 2021) and the targeted fauna survey and habitat tree assessment (Harewood 2021).

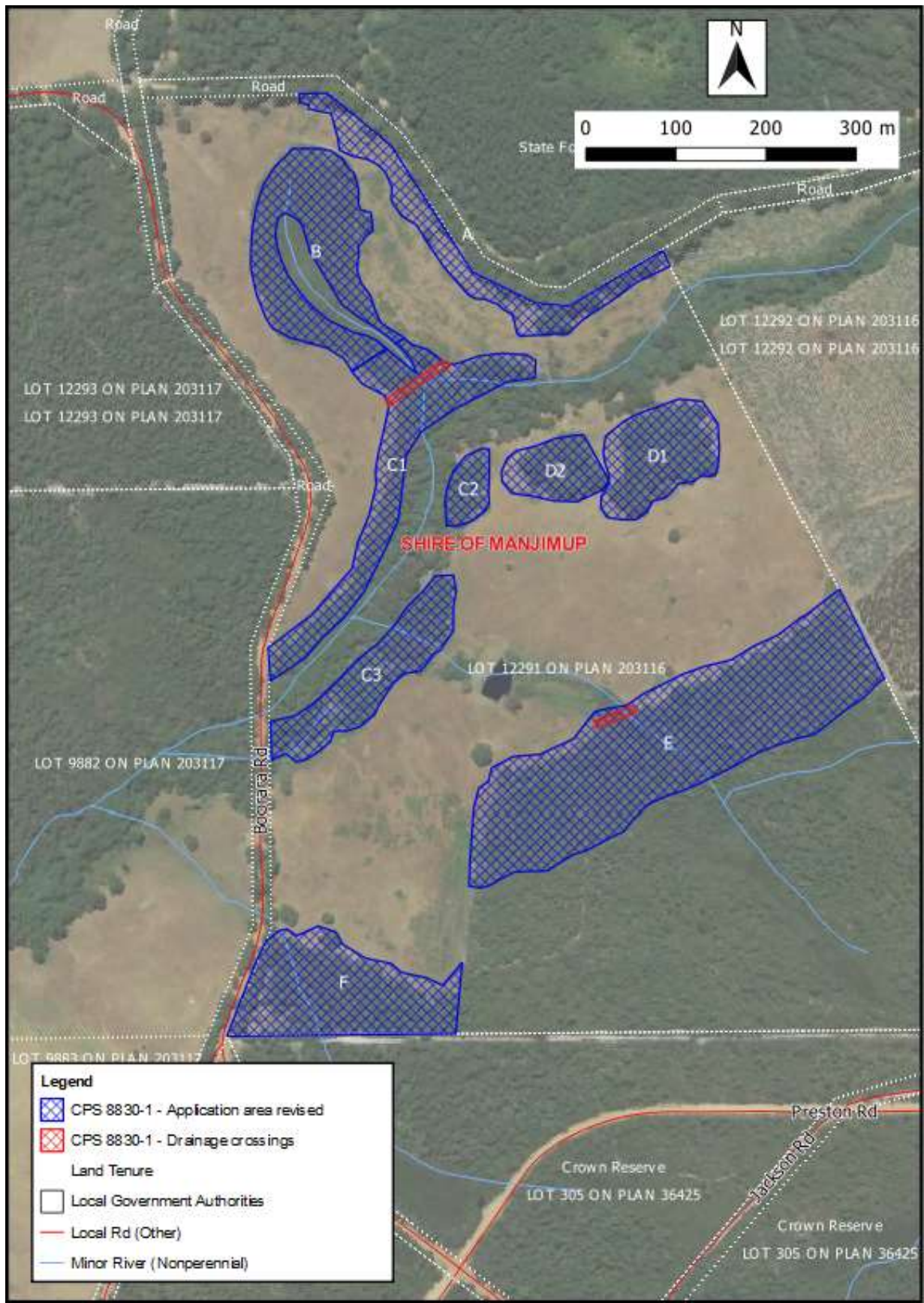


Figure 3: Map of the revised application area

3.2. Assessment of impacts on environmental values

In assessing the application, the Delegated Officer has had regard for the site characteristics (Appendix B) and the extent to which the impacts of the proposed clearing present a risk to biological, conservation, or land and water resource values.

The assessment against the clearing principles (**Error! Reference source not found.**) identified that the impacts of the proposed clearing present a potential risk to the biological values of fauna habitat, nearby conservation areas, watercourses, and land and water resource values that required further consideration. The consideration of these potential impacts, and the extent to which they can be managed through conditions applied in line with sections 51H and 51I of the EP Act, is set out below.

3.2.1. Biological values (fauna habitat). Clearing Principle (b)

Assessment:

Twenty-one conservation significant fauna taxa have been recorded within the local area. The vegetation within the application area may provide suitable habitat for eight terrestrial and arboreal fauna species listed under the BC Act, or as Priority fauna by the Department of Biodiversity, Conservation and Attractions (DBCA) (Table 1).

Table 1: Fauna of significance potentially occurring over the application area

| Species | | Status |
|----------------------------------|---|--------|
| Carnaby's Cockatoo | <i>Calyptorhynchus latirostris</i> | EN |
| Baudin's Cockatoo | <i>Calyptorhynchus baudinii</i> | EN |
| Forest Red-Tailed Black Cockatoo | <i>Calyptorhynchus banksii</i> subsp. naso; | VU |
| Noisy Scrub-bird | <i>Atrichornis clamosus</i> | EN |
| Western Ringtail Possum | <i>Pseudocheirus occidentalis</i> | CR |
| Quokka | <i>Setonix brachyurus</i> | VU |
| Brush-tailed Phascogale (SW) | <i>Phascogale tapoatafa wambenger</i> | CD |
| Quenda | <i>Isoodon fusciventer</i> | P4 |

Harewood (2021) undertook a targeted fauna survey and black cockatoo habitat tree assessment of the proposed clearing areas. The survey included delineation of fauna habitats (Appendix E), the installation of camera traps across the application area over a 45 day period targeting the identified conservation-significant species, a series of day and night transects across the application area searching for and recording any evidence of the target species (such as calls, tracks, scats, runnels, dreys, and tree hollows), and an assessment of black cockatoo habitat trees and foraging habitat. An assessment of the quality of habitat to targeted species was undertaken (summarised in Appendix B4). Table 2 summarises the suitability of habitat over the application area in respect to the eight target species.

None of the targeted species were recorded except Baudin's cockatoo. The assessment concluded that the vast majority of the trees present are relatively young and represent regrowth from historical clearing events. Because of their relatively young age most trees do not contain hollows. Seven trees were identified within the application area as containing possible hollows potentially suitable for black cockatoos to use for nesting (Appendix E). Closer inspection using a drone discounted six of these trees. One tree (Tree 2) in Area E may be marginally suitable only given it is very shallow depth. The hollow showed no evidence of actual use. Suitable black cockatoo foraging habitat was noted predominantly in the southern half of the application area (Areas E, F and the removed Area G) in areas containing Marri, Jarrah and Blackbutt where foraging evidence and a flock of Baudin's Cockatoos were observed.

The Noisy Scrub-bird occurs at two locations in coastal areas from Two Peoples Bay Nature Reserve to Cheyne Beach and on Bald Island (Gillian *et al* 2007). Due to the disjunct and marginal habitat it is unlikely to occur. Habitat for the Brush-tailed Phascogale (south-west) is generally of poor quality given a general absence of hollow-bearing trees required by the species for both daytime refuge and breeding. Similarly habitat for the Quokka is not of high quality and disjunct and the species is unlikely to occur.

Although areas of dense continuous mid-storey vegetation occurring in or adjacent to drainage lines appears suitable for the Western Ringtail Possum, no distinctive dreys or other evidence, or sightings, of the species was recorded during the survey (Harewood 2021). Areas of dense vegetation at ground level along drainage lines provide suitable habitat for the Quenda.

Table 2: Fauna of significance habitat preferences and summary of findings (Harewood 2021)

| Species | Status | Habitat preferences | Fauna survey findings (Harewood 2021) |
|----------------------------------|--------|---|--|
| Carnaby's Cockatoo | EN | Breeding hollows have an entrance diameter of at least 100 millimetres. Breeding typically in eucalypt woodlands in the wheatbelt. Feeds on a variety of fruit including proteaceous species such as Banksia and Marri. | Quality foraging habitat was identified as those areas containing Marri, Jarrah and Blackbutt in the southern half of the application area. One marginally-sized breeding hollow may represent in Area E |
| Baudin's Cockatoo | EN | Eucalypt forest and woodland of the south-west. Reliant on large tree-hollows in eucalypts, in which they breed. Breeding hollows have an entrance diameter of at least 100 millimetres. Feeds on a variety of fruit including Jarrah and Marri. | Quality foraging habitat was identified as those areas containing Marri, Jarrah and Blackbutt in the southern half of the application area. One marginally-sized breeding hollow may represent in Area E |
| Forest Red-Tailed Black Cockatoo | VU | Eucalypt forest and woodland of the south-west. Reliant on large tree-hollows in eucalypts, in which they breed. Breeding hollows have an entrance diameter of at least 100 millimetres. Feeds on a variety of fruit including Jarrah, Marri and Allocasuarina. | Quality foraging habitat was identified as those areas containing Marri, Jarrah and Blackbutt in the southern half of the application area. One marginally-sized breeding hollow may represent in Area E |
| Noisy Scrub-bird | EN | Inhabits ecological communities that support a dense understorey or lower stratum of sedges and shrubs, a dense accumulation of leaf litter and an abundant population of litter-dwelling invertebrates. Prefers low, closed forests 5 to 15 metres in height and dominated by <i>Eucalyptus</i> sp. or <i>Agonis</i> sp. and <i>Banksia littoralis</i> and occur within steep and wetter gullies, and drainage lines of hills and granite mountains, and on the margins of freshwater lakes (DAWE 2020). | Habitat appears to be generally absent except in small areas of the application area making it unlikely that a population could persist. |
| Western Ringtail Possum | CR | Utilises a variety of shelters including dreys (within WA peppermint), tree hollows and forks, grass trees (<i>Xanthorrhoea</i> spp.), hollow logs, rabbit burrows and forest debris. Studies have shown that the rate of sighting for the species correlates with the abundance of WA peppermint and presence of hollow bearing trees (Shedley and Williams, 2014). | Superficially, areas of dense continuous midstorey vegetation which generally occur in or adjacent to the drainage lines appears suitable. |
| Quokka | VU | In the southern forest of WA, the quokka prefers Jarrah, Marri and Karri forest and riparian habitats with a sedge dominated understorey. Habitat occupancy in the region is influenced by burn patchiness, complex vegetation structure and habitat that supports a low density of near-surface fuel (DEC, 2013). | Vegetation present is unlikely to represent suitable habitat. While some areas may be suitable, they are unlikely to harbour a self-sustaining population given their limited extent. |
| Brush-tailed Phascogale (SW) | CD | Preferred habitat is within dry sclerophyll forests and open woodlands that contain hollow-bearing trees. Is active between dusk and dawn, and forages almost entirely amongst the tree canopy (DEC, 2012b). | Habitat is generally of poor quality given a general absence of hollow-bearing trees which the species requires for daytime refuge and breeding. |
| Quenda | P4 | Prefers scrubby, often swampy, vegetation with dense cover up to one metre in height. Often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations within the Jarrah forest are usually associated with watercourses (DEC, 2012a) | Appears to be suitable habitat along some sections of the drainage lines where sedges and blackberry are densest. |

The Priority 4 Quenda is potentially present over the application area. Quenda require a dense understorey for cover (van Dyck and Strahan 2008), including exotic species such as blackberry that the applicant proposes to control, and any dense vegetation within the application area, particularly along drainage lines, could potentially be utilised. Suitable black cockatoo foraging habitat was noted within Areas E, F (and the removed area G) where both foraging evidence and a flock of Baudin's Cockatoos were observed. While the clearing of these two areas may contribute to

the cumulative loss of black cockatoo foraging habitat that has occurred throughout the south-west of Western Australia, such habitat is common in the local area which retains 72 per cent remnant vegetation (Appendix B2). Exotic weed species have been recorded over the application area and adjacent native vegetation may be susceptible to both weed invasion and dieback disease (*Phytophthora sp.*) (Groves *et. al.*, no date) which clearing process may exacerbate.

Conclusion:

For the reasons set out above, it is considered that the impacts of the proposed clearing on fauna and fauna habitat can be managed by implementing the applicant’s avoidance and minimisation strategies, minimising the risk of the introduction and spread of weeds and dieback, and implementing slow directional clearing to allow fauna to move into adjacent vegetation.

Conditions:

To address the above impacts, the following management measures will be required as conditions on the clearing permit:

- avoid, minimise to reduce the impacts and extent of clearing;
- take hygiene steps to minimise the risk of the introduction and spread of weeds and dieback; and
- implement slow directional clearing to allow fauna to move into adjacent vegetation ahead of the clearing activity.

3.2.2. Conservation Areas. Clearing Principle (h)

Assessment

A large number of conservation areas occur within the local area (Appendix B1). Most notably, the application area is located adjacent to the Boorara-Gardner National Park and the Gardner State Forest (Figure 4).

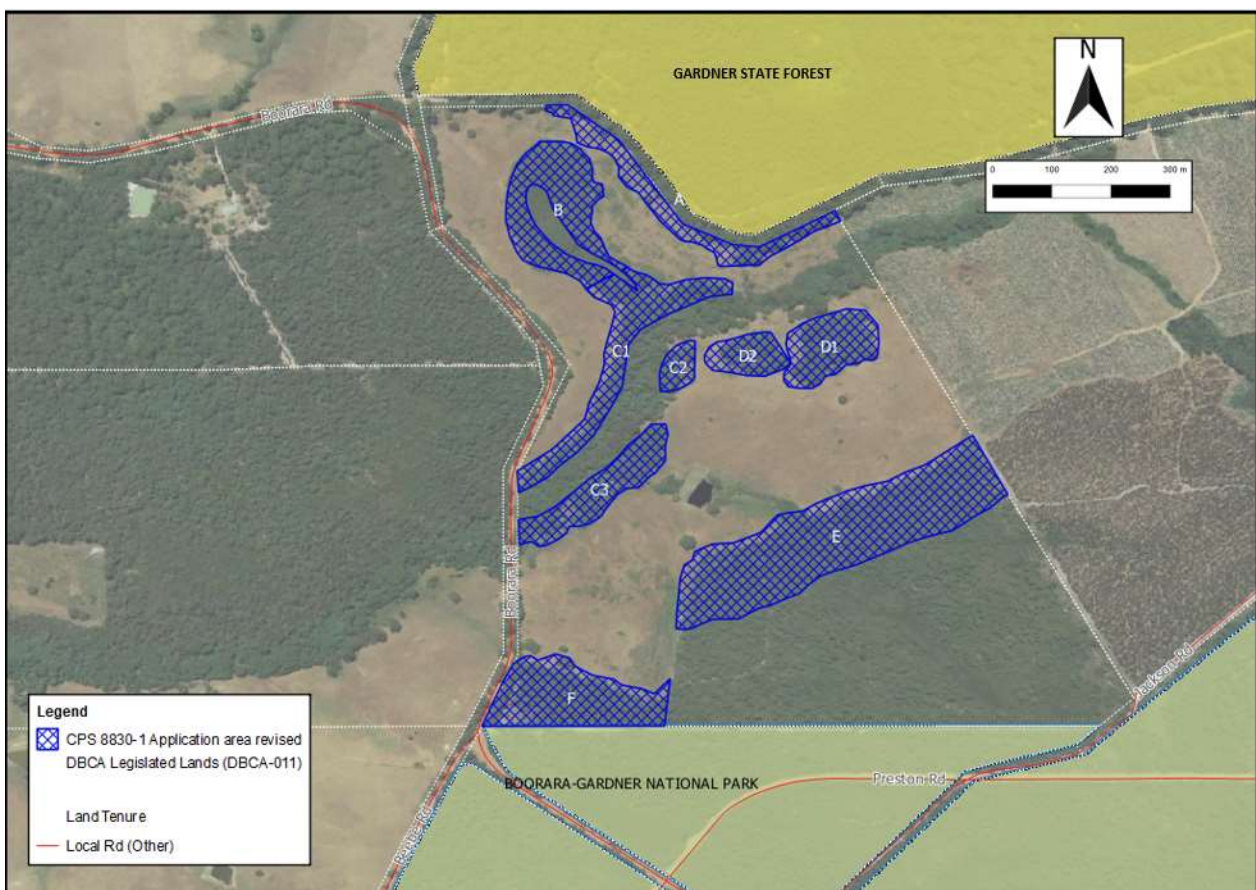


Figure 4: DBCA managed lands in the immediate vicinity of the revised application area

The vegetation within the southern portion of the application area is only separated from Boorara-Gardner National Park by a firebreak. The vegetation within the northern portion of the application area is separated from Gardner State Forest by a 20 metre wide road reserve.

The northern portion of the application area (Area A) is completely degraded and separated from conservation areas by a 20 metre wide road reserve and the risk of spreading weeds and dieback from clearing this area is low. The

southern portion of the application area is considered to be in good to excellent condition and the clearing of these areas and subsequent introduction of pasture has the potential to spread weeds and dieback into Boorara-Gardner National Park. Therefore, the proposed clearing may be at variance to this principle as the environmental values of Boorara-Gardner National Park may be impacted by weed and dieback spread.

Conclusion

For the reasons set out above, it is considered that the impacts of the proposed clearing on nearby conservation areas can be managed by implementing the applicant's avoidance and minimisation strategies and minimising the risk of the introduction and spread of weeds and dieback.

Conditions

To address the above impacts, the following management measures will be required as conditions on the clearing permit:

- avoid, minimise to reduce the impacts and extent of clearing; and
- take hygiene steps to minimise the risk of the introduction and spread of weeds and dieback.

3.2.3. Native vegetation growing in, or in association with, a watercourse. Clearing Principle (f)

Assessment:

The application area intersects a significant stream and associated drainage lines (seeps) (Figure 5). These watercourses are tributaries of the Gardner River which is located approximately four kilometres downstream to the south-west. Two habitat descriptions of Harewood (2021) align with native vegetation growing in association with a watercourse (Appendix E):

- Habitat 2: Tea Tree (*Melaleuca*) Low Woodland with fringing areas of Bracken Fern (heath/ shrubland) with sedges; and
- Habitat 5: Tea Tree (*Melaleuca*) Low Closed Forest over Sedgeland

Native vegetation within components of Areas B, and C1-C3 is considered to be growing in, or in association with, an environment associated with a watercourse. Portions of Areas E and F also include vegetation growing in association with a watercourse, and proposed clearing is at variance to this principle.

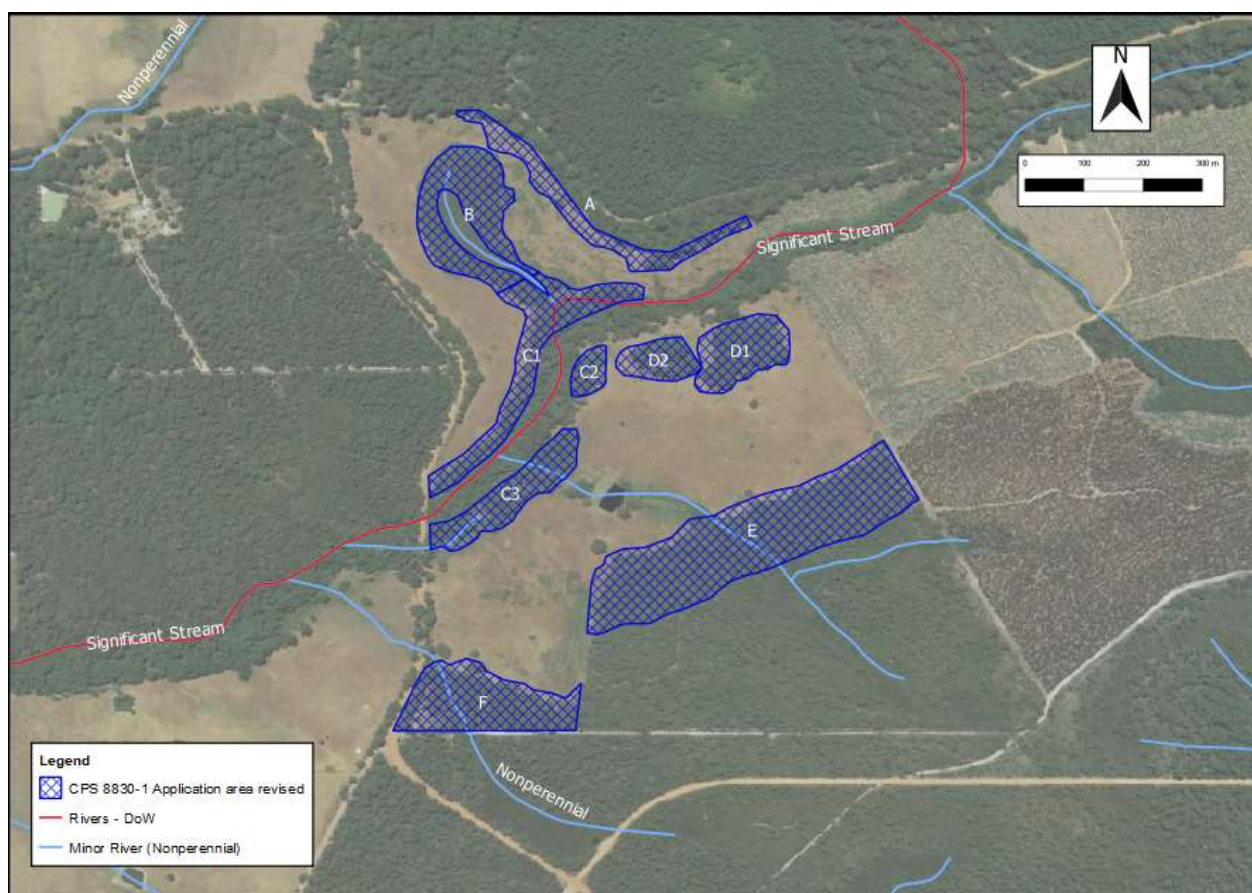


Figure 5: Mapped watercourses in the vicinity of the revised application area

It is noted that the majority of the significant creekline was deliberately excluded from the original application area (Figure 1) consistent with the applicant's objective to maintain a vegetated riparian zone, and that riparian vegetation associated with the tributary entering the significant creekline from the north was excluded from the revised application area (Figure 3; Figure 5). It is understood the applicant is of the view that these exclusions are sufficient to protect the environmental values of the creekline. Furthermore, the application documentation submits that the clearing of areas with Areas B and C1-C3 will allow access to control and ultimately eliminate blackberry from the creek system (Gems Brook 2020; 2021a; 2021b) thus further improving and protecting the riparian values.

Blackberry (including five species of **Rubus*) is a Category 3 declared pest under the BAM Act. Areas infested with Category 3 pests are required under the BAM Act to be managed in such a way that alleviates the impact, reduces the number or distribution or prevents or contains the spread of the declared pest. The recommendation is to treat to destroy all plants, prevent seed set and prevent the spread of seed or plant parts within and from the area.

DPIRD (2021) advised that control measures for blackberry include slashing, burning and follow-up with applications of recommended herbicides. Areas C1-C3 are water accumulating areas and Area B is an open drainage depression landform where water accumulates and channels the stream flow. The retention of vegetation within the wettest part of Area B will be important as waterlogging may be problematic. The wettest part of Area B has been excluded from the revised application area.

It is acknowledged that access to blackberry infestations is a key constraint to their control, with it often being located amongst dense riparian vegetation. However, it is considered that broadscale clearing of Areas B and C1-C3 is unlikely to be necessary to eliminate the infestation on the property and instead selective clearing should be sufficient to provide access. Furthermore, (see Section 3.2.4), the proposed clearing may result in an increased risk of waterlogging, water erosion and eutrophication. Therefore clearing should be restricted to that required to provide access to control the blackberry infestations. Such clearing is not expected to result in the loss of significant riparian vegetation values noting the exclusion areas and the mitigating benefits of blackberry control and/or elimination. A hygiene condition will also be applied to the permit to ensure the clearing does not result in unintended spread of blackberry or other weeds, or dieback (e.g. through movement of machinery). The approximately 0.1 hectares of clearing required for two creekline crossings (Figure 3) will not significantly impact riparian vegetation.

Conclusion:

For the reasons set out above, it is considered that the impacts of the proposed clearing on native vegetation growing in, or in association with, an environment associated with a watercourse can be managed by implementing the applicant's avoidance and minimisation strategies, restricting broadscale clearing in riparian areas to the extent necessary to facilitate access for the control of blackberry infestations with a preference for low impact clearing methods which do not result in significant soil disturbance, and by minimising the risk of the introduction and spread of weeds and dieback.

Conditions:

To address the above impacts, the following management measures will be required as conditions on the clearing permit:

- avoid, minimise to reduce the impacts and extent of clearing;
- prohibit the broadscale clearing of native vegetation within areas B, C1, C2 and C3 (Figure 2);
- clearing within areas B, C1, C2 and C3 (Figure 2) limited to the extent necessary to facilitate access to control blackberry (**Rubus* sp), and *incidental clearing* caused by the removal or killing of blackberry (**Rubus* sp) using low impact clearing methods; and
- take hygiene steps to minimise the risk of the introduction and spread of weeds and dieback.

** Incidental clearing being the incidental death of native vegetation from the spraying and mechanical removal of blackberry.*

3.2.4. Water and Land Resources. Clearing Principles (g), and (i)

Assessment:

The application area is mapped within four soil-landscape subsystems including:

- Minor Valleys S1 Subsystem (Pimelia) (254PvS1)
- Angove Subsystem (Northcliffe) (254NfAN)
- Major Valleys V2 Subsystem (Pimelia) (254PvV2)
- Crowea (Pimelia) Brown duplex Phase (254PvCRb).

Advice on the impact of proposed clearing on land and water resources was obtained from the Commissioner of Soil and Land Conservation Advice via land degradation subject matter experts from DPIRD.

DPIRD staff undertook a site assessment and provided the following initial advice (DPIRD 2020) based upon the original application area (Figure 1):

- Wind erosion – Most landforms and soil types on the property have reduced exposure to wind, including lower slopes and swamps. The Crowea map unit includes some upper slopes and ridge landforms and therefore has a higher risk profile but most of this area of the property is already cleared. The risk of wind erosion from the proposed clearing is low (Appendix B1; Appendix G).
- Water erosion – The property is located within a very high rainfall zone where water erosion risk due to landform and soil types, particularly on steeper slopes, may increase if native vegetation is cleared. Assessment of all map units suggests water erosion is a risk particularly in the Minor and Major Valleys map units (that is, most of the application area except the southeast portion of Area G). On site assessment found evidence of rilling near watercourses (that is, near Areas C1-C3) and on partly cleared firebreaks on slopes of the Angove map unit (that is, Area G). The risk of water erosion from the proposed clearing is high (Appendix B1; Appendix G).
- Waterlogging – Waterlogging is a limitation in the dominant map units, particularly on swampy areas and valley floors where signs of waterlogging are already present. Onsite assessment found that there are many swampy and wet areas on the property, including patches of reeds mid slope on some cleared areas (west of Area E) indicating hill side seepages. Most of the valley floor and swamp areas accessed by cattle also showed signs of pugging which seals the soil surface and further exacerbates waterlogging by impeding infiltration. Removal of native vegetation from this area for the establishment of the land for agricultural use will increase the risk of waterlogging and cause land degradation on the property (Appendix B1; Appendix G).
- Nutrient export – Phosphorus export risk is a strong limitation in most units, particularly on swampy areas and valley floors. Clearing of native vegetation for the establishment of agriculture is likely to increase nutrient enrichment of surface water bodies. Assessment of all map units suggests that eutrophication is a risk, with up to 25 per cent of some units having a very high to extreme risk of phosphorus loss. The coarse, gritty nature of sands in the Angove unit (that is, majority of Area G) are likely to be very susceptible to this as the dominant soils exhibit low to extremely low water or nutrient storage ability (Appendix B1; Appendix G).
- Salinity – No salinity is occurring on the property and no significant change is expected from the proposed clearing (Appendix B1; Appendix G).

Therefore, the proposed clearing is likely to result in increased water erosion, waterlogging and nutrient export.

In relation to the proposed land use (that is, grazing/horticulture), advice was also received from DPIRD on land capability across the property. In giving its advice, DPIRD applied a land capability assessment rating system which involves the use of five Classes with Class 1 indicating high capability and Class 5 low capability. DPIRD advised that from the on-site assessment, it appears that most Class 1, 2 and 3 capability land has already been cleared. The remaining areas of the property contain mostly poorer soils and landforms which have Class 4 and Class 5 capability. These areas generally have high degrees of physical limitations for a land use and carry strong degradation risks. Much of the targeted clearing appears to be of Class 4 and Class 5 capability land and onsite observations indicate land degradation is already occurring in some areas (DPIRD 2020).

DPIRD concluded that the proposed clearing as described over the original application area (Figure 1) may be at variance with Clearing Principle (g) and this conclusion is supported by this assessment. Proposed clearing is likely to result in unacceptable impacts to the environment including:

- increased water erosion, waterlogging, and nutrient export; and
- an associated increased risk of deterioration of surface water quality.

Based on the available information it was considered that impacts over certain areas are unable to be adequately managed through conditions on a clearing permit, and that the clearing of Areas E, F and G (totalling approximately 18 hectares) should not be granted. These areas are the largest and most intact remnants, include drainage lines and are adjacent to a hill side seep, and include the Angove map unit which comprises coarse sands with low water and nutrient retention capability. Therefore, the clearing of these areas is expected to substantially increase nutrient and water export from the property as well as water erosion.

It is considered that the broadscale clearing of Areas B and C1-C3 should also not be granted. These areas currently show signs of pugging and erosion and the denuding of these areas will only exacerbate this. As discussed in Section 3.2.3, however, low impact partial clearing to assist the landowner to access and control blackberry infestations is considered acceptable noting the potential biodiversity benefits of blackberry control including those off-site (e.g. prevention of incursions downstream or in surrounding vegetation through reduced seed source).

After the initial assessment additional information was provided by Gems Brook (2021b), with a commitment to remove Area G from the application area (Section 3.1; Figure 3). With the removal of Area G from the application area no native vegetation under application is mapped as the Angove Subsystem (Northcliffe) (254NfAN) (Figure 6).

Advice on the impact of proposed clearing on land and water resources was obtained from the Commissioner of Soil and Land Conservation Advice (DPIRD 2021) via land degradation subject matter experts from DPIRD in respect to the revised application area (Figure 3), and the additional information and strategies provided by the applicant (Gems Brook 2021a; Gems Brook 2021b) (Section 3.1).

DPIRD (2021) updated advice concurred with the DWER assessment that the clearing of Areas E, F (and G) should not be granted noting the waterlogging and nutrient export risk, water erosion risk, and associated downstream impacts. Previous advice of DPIRD (2020) was utilised to inform the DPIRD (2021) conclusion.

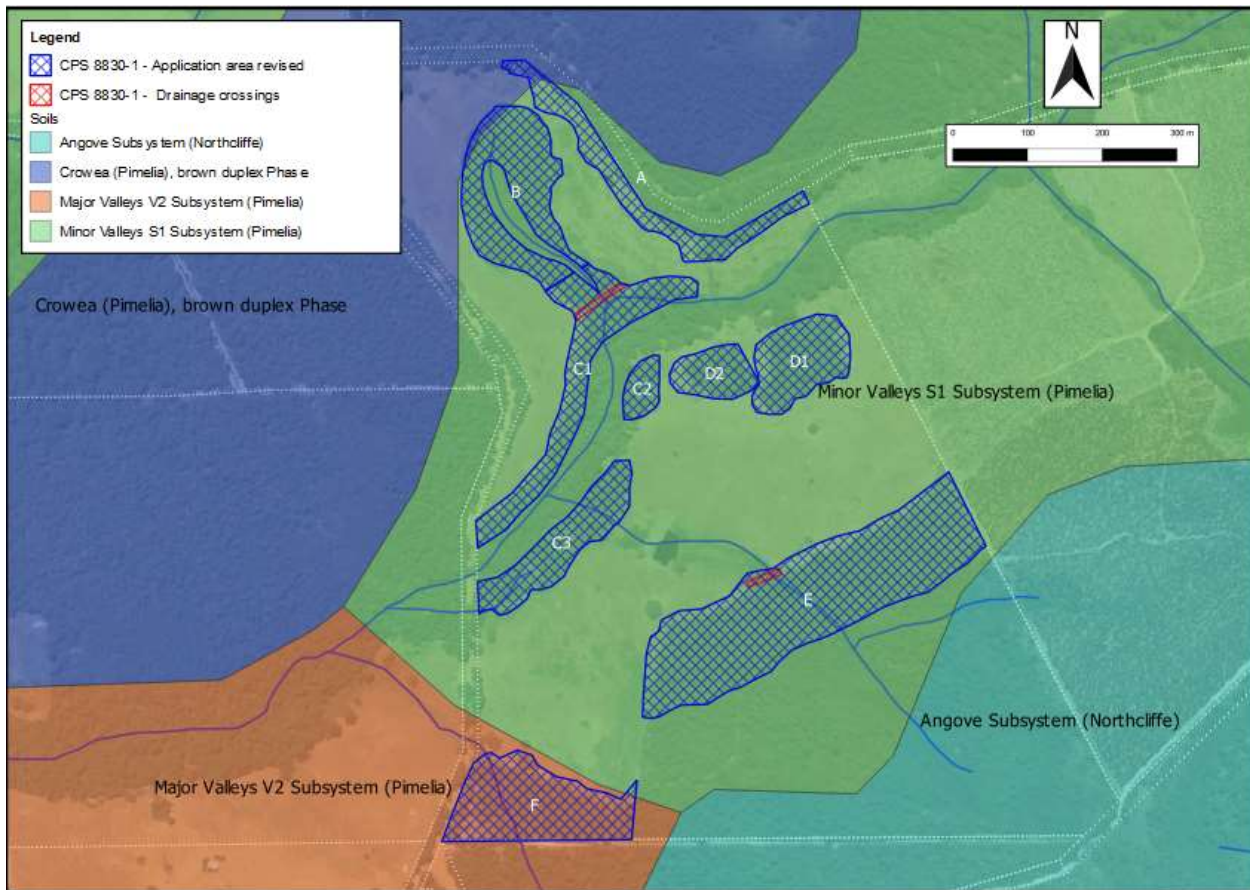


Figure 6: Soil-landscape mapping

In regard to the remaining areas, Area A is largely degraded with unimproved pasture and supporting predominantly Bracken Fern with occasional small eucalypts, shrubs and sedges, and Areas D1 and D2 are relatively small (1.864 hectares), surrounded by cleared areas, and do not contain drainage lines. Therefore, it is considered that the clearing of these areas can be approved as it is unlikely to result in significant land degradation risk. The approximately 0.1 hectares of clearing required for two creekline crossings (Figure 3) will not impact water or land resources. The assessment has concluded that

- Areas A, D1 and D2, and two drainage crossings, can be granted in full (Figure 2); and the clearing of
- Areas B and C1, C2 and C3 can be granted in part (Figure 2) (see Section 3.2.3).

In reaching the above conclusion, the applicant's proposed measures outlined in Section 3.1 to mitigate land degradation impacts have been considered. After clearing and improving pasture for the running cattle the establishment of a Blue Gum plantation is proposed. The key measures identified to mitigate water erosion, waterlogging and nutrient export were; the removal of Area G from the clearing application, the retention of a stream zone vegetation strip, the appropriate use of fertilizers, excluding cattle from stream-zones by fencing, controlling/eradicating blackberry, allowing natural water flows, and maintaining healthy pasture. The applicant is of the view that these measures are sufficient to protect against land degradation.

In the consideration of DPIRD (2020) and DPIRD (2021) advice, it is considered that these measures are insufficient as nutrient export is likely to increase with the conversion of Areas E and F to agriculture, even with appropriate application of fertilisers. Areas E and F contain drainage lines as well as being next to a hillside seep suggesting that their clearing will increase water export, initiating further waterlogging, erosion and nutrient export. These factors

have implications for downstream surface water quality with a drainage reporting to a significant creekline that is a tributary of the Gardner River running through the property.

The control of blackberry and exclusion of cattle from a ~50 metre wide stretch of creekline will assist in natural regeneration of that area and resilience to land degradation. However, Areas B and C1-C3 (predominantly of Teatree, Peppermint, Warren River Cedar) already have signs of waterlogging, pugging and water erosion (DPIRD 2020) and downstream areas are likely to experience increased erosion, waterlogging and nutrient loading. Clearing is required to gain access to and to control/eradicate significant blackberry infestations but broadscale clearing should be discouraged.

Conclusion:

For the reasons set out above, it is considered that the impacts of the proposed clearing on water and land resources over certain areas of the revised application area (Figure 3) are unable to be adequately managed through conditions on a clearing permit, and that the clearing of Areas E and F should not be granted. Impacts of the proposed clearing on water and land resources in Areas A, D1, D2 and two drainage crossings can be managed by implementing the applicant's avoidance and minimisation strategies and minimising the risk of the introduction and spread of weeds and dieback. Impacts of the proposed clearing on water and land resources in Areas B and C1, C2 and C3 can be managed by implementing the applicant's avoidance and minimisation strategies, restricting broadscale clearing to the extent necessary to facilitate access for the control of blackberry infestations, and by minimising the risk of the introduction and spread of weeds and dieback.

Conditions:

To address the above impacts, the following management measures will be required as conditions on the clearing permit:

- avoid, minimise to reduce the impacts and extent of clearing;
- prohibit the broadscale clearing of native vegetation within areas B, C1, C2 and C3 (Figure 2);
- clearing within areas B, C1, C2 and C3 (Figure 2) limited to the extent necessary to facilitate access to control blackberry (**Rubus sp.*), and *incidental clearing* caused by the removal or killing of blackberry (**Rubus sp.*) using low impact clearing methods; and
- take hygiene steps to minimise the risk of the introduction and spread of weeds.

** Incidental clearing being the incidental death of native vegetation from the spraying and mechanical removal of blackberry.*

3.3. Relevant planning instruments and other matters

The clearing permit application was advertised on the DWER website on 19 March 2020, inviting submissions from the public within a 21 day period. No submissions were received.

On 19 March 2020, DWER sought advice from the Shire of Manjimup. On 30 March 2020, the Shire of Manjimup (2020) provided the following advice:

- The Shire has no objection to the application and there are no planning or other matters which would affect the proposal.
- The land is zoned by the Local Planning Scheme No. 4 as 'Priority Agriculture' and planning approval for clearing of native vegetation is not required.
- The purpose of primary production (including pasture, beef cattle and future horticulture) does not require local government planning approval.

On 19 March 2020 DWER sought advice from the Commissioner of Soil and Land Conservation. On 25 May 2020, the DPIRD (2020) provided advice about land degradation risks associated with the proposed clearing. After this advice was received the applicant revised the application area (Figure 3) and provided additional land management strategies (Section 3.1).

In light of the revised application area and additional land management strategies provided, DWER sought updated advice from the Commissioner of Soil and Land Conservation. On 25 November 2021, the DPIRD (2021) provided updated advice about land degradation risks associated with the revised clearing proposed. DPIRD advice has been incorporated into the assessment under Principles (f), (g), (i) and (j).

According to available databases, no Aboriginal sites of significance have been mapped within the application area. It is the responsibility of the applicant to comply with the *Aboriginal Heritage Act 1972* and ensure that no unauthorised impacts to Sites of Aboriginal Significance occur through the clearing process.

The vegetation within the application area does not occur within surface water or groundwater areas proclaimed under the *Rights in Water and Irrigation Act 1914*, or Public Drinking Water Source Areas.

Appendix A. Additional information received

| Description | Reference |
|--|--------------------|
| Supporting documentation provided by the applicant for application CPS 8830/1. | Gems Brook (2020) |
| Response from the applicant to a request for further information from DWER. | Gems Brook (2021a) |
| A modified application submitted by the applicant, including the withdrawal of Area G, and further clarification on minimisation and avoidance strategies. | Gems Brook (2021b) |
| Commissioner of Soil and Land Conservation advice in regard to land degradation impacts associated with proposed clearing of 27,388 hectares of native vegetation for the purpose of primary production, pasture, beef cattle and possible horticulture in the future. | DPIRD (2020) |
| A targeted fauna survey and habitat tree assessment of the proposed clearing areas. | Harewood (2021) |
| Updated advice from the Commissioner of Soil and Land Conservation in relation to land degradation impacts associated with a revised application submitted by the applicant Gems Brook (2021b). | DPIRD (2021) |

Appendix B. Site characteristics

B.1 Site characteristics

| Characteristic | Details | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------------------------|---|--------------------|------------------------|---------------|-------------------------------|---|---|----------------------|----|----|----------------------|----|-------|-------------------------------|---|-------|--------------------|---|-------|----------|---|-------|----------|---|-------|--------------------------------------|---|-------|----------|---|-------|---------------------|----|-------|-----------------------|---|-------|
| Local context | <p>The application area consists of 10 areas of remnant vegetation in the Shire of Manjimup within a property proposed for agricultural pursuits in the Warren IBRA bioregion of Thackway and Cresswell (1995). Minor rivers bisect the property and large areas of DBCA managed lands are located immediately to the north and to the south of the application area.</p> <p>Spatial data indicates the local area (10 kilometre radius from the area proposed to be cleared) retains approximately 72 per cent of the original native vegetation cover.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ecological linkage | <p>Proposed clearing is not located within an Environmentally Sensitive Area (ESA), or any recognised ecological linkage. Despite the proximity of DBCA lands managed for conservation purposes, the extent of vegetation remaining in the local area indicates that the application area is unlikely to form part of a significant ecological linkage with any conservation area.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Conservation areas | <table border="1"> <thead> <tr> <th>DBCA Managed lands</th> <th>No. of associated lots</th> <th>Proximity (m)</th> </tr> </thead> <tbody> <tr> <td>Boorara-Gardner National Park</td> <td>8</td> <td>0</td> </tr> <tr> <td>Gardner State Forest</td> <td>47</td> <td>18</td> </tr> <tr> <td>Shannon State Forest</td> <td>35</td> <td>2,829</td> </tr> <tr> <td>D'Entrecasteaux National Park</td> <td>3</td> <td>3,529</td> </tr> <tr> <td>Jane National Park</td> <td>3</td> <td>4,486</td> </tr> <tr> <td>1229/123</td> <td>2</td> <td>5,748</td> </tr> <tr> <td>1222/672</td> <td>2</td> <td>5,922</td> </tr> <tr> <td>Executive Director of CALM (H358322)</td> <td>1</td> <td>5,965</td> </tr> <tr> <td>1023/797</td> <td>1</td> <td>6,889</td> </tr> <tr> <td>Warren State Forest</td> <td>13</td> <td>8,694</td> </tr> <tr> <td>Shannon National Park</td> <td>1</td> <td>9,134</td> </tr> </tbody> </table> | DBCA Managed lands | No. of associated lots | Proximity (m) | Boorara-Gardner National Park | 8 | 0 | Gardner State Forest | 47 | 18 | Shannon State Forest | 35 | 2,829 | D'Entrecasteaux National Park | 3 | 3,529 | Jane National Park | 3 | 4,486 | 1229/123 | 2 | 5,748 | 1222/672 | 2 | 5,922 | Executive Director of CALM (H358322) | 1 | 5,965 | 1023/797 | 1 | 6,889 | Warren State Forest | 13 | 8,694 | Shannon National Park | 1 | 9,134 |
| DBCA Managed lands | No. of associated lots | Proximity (m) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Boorara-Gardner National Park | 8 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gardner State Forest | 47 | 18 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Shannon State Forest | 35 | 2,829 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D'Entrecasteaux National Park | 3 | 3,529 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Jane National Park | 3 | 4,486 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1229/123 | 2 | 5,748 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1222/672 | 2 | 5,922 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Executive Director of CALM (H358322) | 1 | 5,965 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1023/797 | 1 | 6,889 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Warren State Forest | 13 | 8,694 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Shannon National Park | 1 | 9,134 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Vegetation description | <p>The application area is located within the Warren Interim Biogeographic Regionalisation for Australia (IBRA) bioregion. Four South West Forest vegetation complexes (Mattiske and Havel 1998) have been mapped over the application area (Appendix F):</p> <ul style="list-style-type: none"> Granite Valleys (S1): Tall open forest of <i>Eucalyptus diversicolor</i>-<i>Corymbia calophylla</i> on slopes with some <i>Eucalyptus patens</i> and <i>Eucalyptus megacarpa</i> on valley floors in hyperhumid and perhumid zones (central and northern portions of application area). Angove (A): Open forest of <i>Eucalyptus marginata</i> subsp. <i>marginata</i>-<i>Banksia ilicifolia</i>-<i>Nuytsia floribunda</i> with some <i>Eucalyptus diversicolor</i> on gently sloping sandy terrain in hyperhumid and perhumid zones (southeast portion of application area). Granite Valleys (Vh2): Tall open forest of <i>Eucalyptus diversicolor</i>- <i>Eucalyptus patens</i> on slopes with <i>Agonis flexuosa</i>-<i>Allocasuarina decussata</i>-<i>Callistachys lanceolata</i> on valley floors in hyperhumid and perhumid zones (south-west portion of application area). Crowea (CRb): Tall open forest of <i>Corymbia calophylla</i>-<i>Eucalyptus diversicolor</i> on upper slopes with <i>Allocasuarina decussata</i>-<i>Banksia grandis</i> on upper slopes in hyperhumid and perhumid zones (northern fringe of application area). <p>Based on a fauna survey of the application area (Harewood, 2021), a site inspection undertaken by the Department of Primary Industries and Regional Development (DPIRD 2020), and supporting documentation provided with the application (Gems Brook Pty Ltd, 2020), the vegetation within the application area comprises:</p> <ul style="list-style-type: none"> <u>Area A (1.307 ha)</u> – Unimproved pasture with Bracken Fern and occasional small trees/shrubs/sedges. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Characteristic | Details |
|-----------------------------------|--|
| | <ul style="list-style-type: none"> • <u>Area B (2.575 ha)</u> – Teatree low woodland with Bracken Fern, sedges and significant blackberry (<i>*Rubus</i> sp) infestation. • <u>Areas C1-C3 (3.677 ha)</u> – Warren river cedar (<i>Taxandria juniperina</i>) and Peppermint (<i>Agonis flexuosa</i>) with occasional Karri (<i>Eucalyptus diversicolor</i>) over native sedges and significant blackberry infestation. • <u>Areas D1-D2 (1.864 ha)</u> – 50-80 year old Karri regrowth with a patchy mid and understorey. • <u>Areas E (5.582 ha) and F (2.186 ha)</u> –Jarrah (<i>Eucalyptus marginata</i>), Marri (<i>Corymbia calophylla</i>) and Blackbutt (<i>Eucalyptus patens</i>) open forest over tall open shrubland/open shrubland; includes drainage lines comprising tea tree low closed forest with scattered Marri and Jarrah over sedgeland. • <u>Area G (10.198 ha)</u> – Jarrah/Marri/Blackbutt open forest over tall open shrubland/open shrubland in the west transitioning to Jarrah/Bullich (<i>Eucalyptus megacarpa</i>) open woodland over tall open shrubland/open shrubland in the east; includes drainage lines comprising tea tree low closed forest with scattered Marri and Jarrah over sedgeland. |
| Vegetation condition (Appendix D) | <p>The site inspection undertaken by DPIRD (2020) observed the vegetation condition in swampy areas and creeklines (Areas B and C1-C3) as mixed, from ‘good to very poor’. DPIRD reported that many of these areas are dominated by serious incursions of blackberry and are currently exposed to grazing. Uncontrolled cattle movement has forced paths through the vegetation in some places.</p> <p>In relation to upland locations (Areas E to G), DPIRD described the vegetation as generally in ‘good’ condition with some dense regrowth of natives in areas after the Northcliffe fires in 2015. The supporting documentation provided with the application states that there is evidence of past timber harvesting in these areas (Gems Brook Pty Ltd, 2020). This observation is supported by the fauna survey which outlines that most trees on the property are relatively young and appear to represent regrowth from historical clearing events estimated to have been 50 to 60 years ago (Harewood, 2021).</p> <p>In relation to Areas D1-D2, the fauna survey outlines that midstorey and understorey vegetation is variable in density but is generally sparse (Harewood, 2021). In relation to Area A, site photos from the fauna survey show this area is highly modified dominated by non-native grasses.</p> <p>Based on available information, vegetation condition of the application area is considered to vary from completely degraded to excellent using the Keighery (1994) condition scale (Appendix D). A breakdown by the portions of the application area is as follows:</p> <ul style="list-style-type: none"> • <u>Area A</u> – Completely Degraded • <u>Areas B, C1-C3 and D1-D2</u> – Degraded to Good • <u>Areas E to G</u> – Good to Very Good to Excellent |
| Climate and landform | <p>The climate experienced in the area is a Mediterranean climate, with dry, hot summers and cool, wet winters. Average rainfall is 987millimetres per annum with the majority falling between June and August (BOM 2021).</p> <p>The application area is mapped predominantly in the Minor Valleys S1 Subsystem (Pimelia) of valleys in granitic terrain with narrow swampy floors, and predominantly the mid to lower slopes, footslopes and poorly drained drainage depressions (DPIRD 2020).</p> |
| Soil description | <p>The soils within the application area are mapped within the following soil-land subsystems:</p> <ul style="list-style-type: none"> • Minor Valleys S1 Subsystem (Pimelia) (254PvS1): Valleys in granitic terrain, narrow swampy floor; less than 20 metre relief. Gravelly yellow duplex soils on smooth flanks; Jarrah-Marri-Karri forest. Peaty soils on narrow floor; wattle low forest (61 per cent of the application area – north and central areas). • Angove Subsystem (Northcliffe) (254NfAN): Gently sloping sandy terrain; slight dissections. Humus podzols on broad crests; kangaroo grass sedgeland, teatree heath. Sandy yellow duplex soils in shallow dissections; Jarrah woodland (30.7 per cent of the application area – southeast corner). |

| Characteristic | Details |
|----------------|---|
| | <ul style="list-style-type: none"> Major Valleys V2 Subsystem (Pimelia) (254PvV2): Valleys in granitic areas; 20-40 metre relief; smooth, moderate slopes; narrow terrace (7.6 per cent of the application area – south-west corner). Crowea (Pimelia) Brown duplex Phase (254PvCRb). Brown gravelly duplex soils and red earths; Karri-Marri forest (one per cent of the application area – northern fringe). <p>NB: The revised application area (Figure 3) removed proposed clearing areas within the Angove Subsystem (Northcliffe).</p> |

| Land degradation risk | Land degradation risk (DPIRD 2020) | | | | |
|-----------------------|---|---|--|---|--|
| | Degradation factor | Soil type | | | |
| | | Minor Valleys S1 Subsystem (Pimelia) (254PvS1). | Angove Subsystem (Northcliffe) (254NfAN) | Crowea (Pimelia) Brown duplex Phase (254PvCRb) | Major Valleys V2 Subsystem (Pimelia) (254PvV2) |
| Wind erosion | 100% of map unit has a low to high risk | 100% of map unit has a low to high risk | 15% of map unit has a very high risk | 100% of map unit has a low to high risk | |
| Water erosion | 39% of map unit has a high to very high risk | 5% of map unit has a high risk | 23% of map unit has a high to very high risk | 49% of map unit has a high to extreme risk | |
| Salinity | 100% nil or partial risk | 100% nil or partial risk | 100% nil or partial risk | 100% nil or partial risk | |
| Surface salinity | 100% slight to nil | 100% slight to nil | 100% slight to nil | 100% slight to nil | |
| Flood | 16% has a high risk | 100% has nil to moderate risk | 100% has nil to moderate risk | 100% has nil to moderate risk | |
| Waterlogging | 16% of map unit has a high to very high risk | 33% of map unit has a high to very high risk | 100% of map unit has a nil to moderate risk | 1% of map unit has a very high risk | |
| Phosphorous export | 25% of map unit has a very high to extreme risk | 17% of map unit has a very high to extreme risk | 9% of map unit has a very high risk | 23% of map unit has a very high to extreme risk | |

| Waterbodies | Type of inland water | | |
|-------------|---|--|---------------|
| | Type of inland water | Description | Proximity (m) |
| | Hydrography, Linear | Watercourse - Minor, Perennial | 0 |
| | Hydrography, Linear | Earth Dam | 0 |
| | Rivers | Significant Stream | 0 |
| | Rivers | Boorara Brook : Minor River | 1,765 |
| | Rivers | Gardner River : Mainstream | 3,098 |
| | Rivers | : Major Trib | 3,850 |
| | Rivers | Canterbury River : Major River | 4,308 |
| | Geomorphic Wetlands, Augusta To Walpole | Paluslope (Seasonally Inundated Slope) | 5,016 |
| | Rivers | : Mainstream | 5,263 |
| | Rivers | Gardner River Dam: Mainstream | 5,264 |
| | Geomorphic Wetlands, Augusta To Walpole | Palusplain (Seasonally Waterlogged Flat) | 5,755 |
| | Geodata, Lakes | Sub_To_Inund | 5,770 |
| | Hydrography, Lakes (Medium Scale 250k GA) | Sub_To_Inund | 5,770 |

| Characteristic | Details | | | | | | | | | | | | | | | | | | | | | | |
|---|--|---|-------|-----------------|------------|-------------|----------------|--------------|---------------|------------------|---------------|-------------------------|--|------------------------|------|-------------------------|------|-----------------|---|--------------|------|-----------------------------|--------------------|
| | Geomorphic Wetlands, Augusta To Walpole | Dampland (Seasonally Waterlogged Basin) | 5,898 | | | | | | | | | | | | | | | | | | | | |
| | Geomorphic Wetlands, Augusta To Walpole | Sumpland (Seasonally Inundated Basin) | 6,030 | | | | | | | | | | | | | | | | | | | | |
| | Rivers | Minor Trib | 7,236 | | | | | | | | | | | | | | | | | | | | |
| | Geodata, Lakes | W_Body_Void | 7,293 | | | | | | | | | | | | | | | | | | | | |
| | Hydrography, Lakes (Medium Scale 250k GA) | W_Body_Void | 7,293 | | | | | | | | | | | | | | | | | | | | |
| | Geodata, Lakes | Swamp | 8,137 | | | | | | | | | | | | | | | | | | | | |
| | Hydrography, Lakes (Medium Scale 250k GA) | Swamp | 8,137 | | | | | | | | | | | | | | | | | | | | |
| | Rivers | Buldanian Creek : Minor River | 8,495 | | | | | | | | | | | | | | | | | | | | |
| | Rivers | Doggerup Creek : Significant Stream | 8,537 | | | | | | | | | | | | | | | | | | | | |
| | Geomorphic Wetlands, Augusta To Walpole | Floodplain (Seasonally Inundated Flat) | 8,553 | | | | | | | | | | | | | | | | | | | | |
| | Rivers | Blackwater Creek : Minor River | 9,217 | | | | | | | | | | | | | | | | | | | | |
| | Rivers | Major River | 9,371 | | | | | | | | | | | | | | | | | | | | |
| | Rivers | Meerup River : Major River | 9,371 | | | | | | | | | | | | | | | | | | | | |
| | Geomorphic Wetlands, Augusta To Walpole | Lake (Permanently Inundated Basin) | 9,439 | | | | | | | | | | | | | | | | | | | | |
| | Geodata, Lakes | Lake | 9,602 | | | | | | | | | | | | | | | | | | | | |
| | Hydrography, Lakes (Medium Scale 250k GA) | Lake | 9,602 | | | | | | | | | | | | | | | | | | | | |
| Doggerup Creek System (WA104) is listed within the Directory of Important wetlands and is located approximately 8.5 kilometres to the south-west. | | | | | | | | | | | | | | | | | | | | | | | |
| Hydrogeography | <table border="1"> <tr> <td>Division</td> <td>South West</td> </tr> <tr> <td>Zone</td> <td>Warren Denmark</td> </tr> <tr> <td>Basin</td> <td>Shannon River</td> </tr> <tr> <td>Catchment</td> <td>Gardner River</td> </tr> <tr> <td>RIWI Act surface</td> <td>None - Warren River and Tributaries (~7.3 km north-west)</td> </tr> <tr> <td>RIWI Act rivers</td> <td>None</td> </tr> <tr> <td>RIWI groundwater</td> <td>None</td> </tr> <tr> <td>CAWS Act</td> <td>None - Warren River Water Reserve (~9.5 km north)</td> </tr> <tr> <td>PDWSA</td> <td>None</td> </tr> <tr> <td>Groundwater salinity</td> <td>500-1,000 TDS mg/l</td> </tr> </table> | | | Division | South West | Zone | Warren Denmark | Basin | Shannon River | Catchment | Gardner River | RIWI Act surface | None - Warren River and Tributaries (~7.3 km north-west) | RIWI Act rivers | None | RIWI groundwater | None | CAWS Act | None - Warren River Water Reserve (~9.5 km north) | PDWSA | None | Groundwater salinity | 500-1,000 TDS mg/l |
| Division | South West | | | | | | | | | | | | | | | | | | | | | | |
| Zone | Warren Denmark | | | | | | | | | | | | | | | | | | | | | | |
| Basin | Shannon River | | | | | | | | | | | | | | | | | | | | | | |
| Catchment | Gardner River | | | | | | | | | | | | | | | | | | | | | | |
| RIWI Act surface | None - Warren River and Tributaries (~7.3 km north-west) | | | | | | | | | | | | | | | | | | | | | | |
| RIWI Act rivers | None | | | | | | | | | | | | | | | | | | | | | | |
| RIWI groundwater | None | | | | | | | | | | | | | | | | | | | | | | |
| CAWS Act | None - Warren River Water Reserve (~9.5 km north) | | | | | | | | | | | | | | | | | | | | | | |
| PDWSA | None | | | | | | | | | | | | | | | | | | | | | | |
| Groundwater salinity | 500-1,000 TDS mg/l | | | | | | | | | | | | | | | | | | | | | | |

B.2. Vegetation extent

| | Pre-European | Current Extent | Remaining | Current Extent in DBCA Managed Lands | |
|--------------------------------------|--------------|----------------|-----------|--------------------------------------|------|
| | (ha) | (ha) | (%) | (ha) | (%) |
| IBRA Bioregion | | | | | |
| Warren | 833,986 | 659,432 | 79.1 | 558,485 | 67.0 |
| South West vegetation complex | | | | | |
| Granite Valleys (S1) | 25,607 | 21,662 | 84.6 | 19,516 | 76.2 |
| Angove (A) | 39,698 | 34,737 | 87.5 | 31,437 | 79.2 |
| Granite Valleys (Vh2) | 9,968 | 8,395 | 84.2 | 7,311 | 73.3 |
| Crowea (CRb) | 52,753 | 45,425 | 86.1 | 43,136 | 81.8 |
| Local Area | | | | | |
| 10 kilometre radius | 33,513 | 24,056 | 72.0 | | |

B.3 Flora of significance potentially occurring over the application area

| Threatened taxon | Status (WA) | Habitat | Likelihood of occurrence/significant impacts |
|------------------------------|-------------|--|---|
| <i>Kennedia glabrata</i> | VU | Known from granite outcrops (including islands) where it grows in shallow skeletal soils in swales and cracks on the rock surface with a suite of other species similarly adapted to these extreme sites, and one atypical occurrence in a peaty swamp area on an old fence line / firebreak. (CALM 2006; Western Australian Herbarium 1998-) | Unlikely to occur. Available site information and aerial imagery does not indicate the presence of granite outcrops in the area. The species is unlikely to occur in areas suitable for agricultural development. No significant impacts expected. |
| Priority Taxon | Status (WA) | Habitat | Likelihood of occurrence/significant impacts |
| <i>Schizaea rupestris</i> | P2 | This species is a fern which is known from gullies, creek banks and shaded moist rock faces (Western Australian Herbarium, 1998). Also known from NSW where it has been recorded in caves and at waterfalls. | Known from one record within the local area, approximately 5,650 metres away. This species needs well sheltered wet areas. The creekline running through the middle of the property has been grazed by cattle and includes areas of blackberry. The creekline is likely too disturbed and is unlikely to provide sufficient shelter. The other drainage lines on the property are seeps that are unlikely to be sufficiently wet and sheltered. The species is unlikely to occur within the application area. |
| <i>Actinotus repens</i> | P3 | A suffrutescent, prostrate perennial, to 5 cm high, c. 20 cm wide. It occurs on sandy clay and mud in valleys along creeklines and edges of other water channels from the Waroona area south to Walpole, amongst Eucalyptus or Melaleuca dominated woodland (Henwood, 2013). | Known from nine records within the local area with the closest approximately 1,450 metres away. Has the potential to occur within the application area although the level of grazing and presence of blackberries reduces the likelihood somewhat. The majority of the creek has already been left out of the application area (that is, the most suitable habitat has been avoided). Given this and that 9 of the 12 TPFL records are known from conservation lands, significant impacts to the conservation of the species, if present, are not expected. |
| <i>Lomandra ordii</i> | P4 | Robust, tufted plant known from grey or black sand along river banks often in association with Karri/Marri or Jarrah and/or Agonis/Taxandria species, sedges and rushes (CALM, 2006; Western Australian Herbarium, 1998-). | Known from 20 records within the local area with the closest approximately 1,780 metres away. Has the potential to occur within the application area mainly in the vicinity of the creekline running through the middle of the property. May be resilient to disturbance such as grazing. However, the species is P4 meaning it has undergone a reasonable level of survey effort and while uncommon/rare it is currently relatively secure. 30 of the 36 populations in DBCA's Threatened and Priority flora (TPFL) database are known from conservation lands. Therefore, significant impacts to the conservation of the species, if present, are not expected. |
| <i>Myriophyllum trifidum</i> | P4 | This species was formerly named <i>Meziella trifida</i> . It is a semi-aquatic herb found in open grey sandy clay depressions in winter-wet flats (Brown et al., 1998). It grows in very low heath of teatree (<i>Pericalymma</i> sp.) and twine rushes (<i>Restio</i> sp. and <i>Leptocarpus</i> sp.). It is also thought likely to inhabit shallow Melaleuca depressions (Brown et al., 1998). | Known from 18 records within the local area with the closest approximately 5,650 metres away. The habitat present within the application area is unlikely to be suitable. The creekline running through the middle of the property contains tall vegetation. The teatree thicket in the north is also too tall and the other drainage lines are not winter-wet flats – they are slopes where seepage is occurring. The species was previously listed as Threatened by the Commonwealth but was downgraded due to the level of security – the species occurs in at least 47 locations with the majority in national parks where threats can be more easily managed. Therefore, significant impacts to the conservation of the species, if present, are not expected. |

B.4 Fauna of significance potentially occurring over the application area

| Species | | Status |
|----------------------------------|---|--------|
| Carnaby's Cockatoo | <i>Calyptorhynchus latirostris</i> | EN |
| Baudin's Cockatoo | <i>Calyptorhynchus baudinii</i> | EN |
| Forest Red-tailed Black Cockatoo | <i>Calyptorhynchus banksii</i> subsp. naso; | VU |
| Noisy Scrub-bird | <i>Atrichornis clamosus</i> | EN |
| Western Ringtail Possum | <i>Pseudocheirus occidentalis</i> | CR |
| Quokka | <i>Setonix brachyurus</i> | VU |
| Brush-tailed Phascogale (SW) | <i>Phascogale tapoatafa wambenger</i> | CD |
| Quenda | <i>Isoodon fusciventer</i> | P4 |

Habitat value to Fauna of significance potentially occurring over the application area (Harewood 2021)

| Habitat | "Black cockatoos" | Noisy Scrub-bird | Western Ringtail Possum | Quokka | Brush-tailed Phascogale | Quenda |
|--|-------------------|-------------------|-------------------------|----------------------|-------------------------|----------------------|
| 1 Grassland with some scattered Karri trees and shrubs/sedges. | Negligible - Low | No value | Very low | Negligible -Very low | Negligible - Low | Negligible -Very low |
| 2 Tea Tree (<i>Melaleuca</i>) Low Woodland - scattered groves of Karri trees and peppermint. Fringing areas dominated by bracken fern (heath/ shrubland) with sedges | Negligible - Low | Possibly suitable | Moderate | Low - Moderate | Negligible - Low | Moderate |
| 3 Warren River Cedar Low Closed Forest with some scattered and small groves of Karri trees and peppermint | Negligible - Low | Possibly suitable | Moderate | Low - Moderate | Negligible - Low | Moderate |
| 4 Karri Tall Open Forest over Tall Open Shrubland /Shrubland | Moderate | Negligible | Low | Low | Low | Moderate |
| 5 Tea Tree (<i>Melaleuca</i>) Low Closed Forest with some scattered Marri and Jarrah trees over Sedgeland | Low - Moderate | Low | Good - Moderate | Low - Moderate | Low - Moderate | Good - Moderate |
| 6 Jarrah/Marri/Blackbutt Open Forest over Tall Open Shrubland/Open Shrubland | Good | Negligible | Good - Moderate | Negligible | Moderate | Low - Moderate |
| 7 Jarrah/Bullich Open Woodland over Tall Open Shrubland/Open Shrubland | Good - Moderate | Low | Low | Low | Moderate | Good - Moderate |

B.5 Significant ecological communities

No Threatened Ecological Communities (TECs) have been mapped within ten kilometres of the application area. Two state-listed Priority Ecological Communities (PECs) have been mapped within ten kilometres of the application area.

| Common name | Common ID | Status (WA) | Proximity (km) |
|---|--|-------------|----------------|
| Aquatic invertebrate assemblages of granite outcrops associated with Burnside Batholith (formerly Southern granite pool community (Muirillup Rock, Northcliffe) | Invertebrate assemblages of granite outcrops | P2 | ~ 5.17 km east |

| | | | |
|--|----------------------|----|----------------|
| Epiphytic Cryptogams of the Karri forest | Epiphytic cryptogams | P3 | ~ 6.90 km west |
|--|----------------------|----|----------------|

Appendix C. Assessment against the clearing principles

| Assessment against the clearing principles | Variance level | Is further consideration required? |
|---|------------------------------|------------------------------------|
| Environmental value: biological values | | |
| <p><u>Principle (a):</u> <i>“Native vegetation should not be cleared if it comprises a high level of biodiversity.”</i></p> <p><u>Assessment:</u> According to available databases, eight flora taxa of conservation significance have been recorded within the local area, including one Threatened flora taxa, and seven Priority (P) flora taxa including; two P2, one P3 and four P4 taxa (Western Australian Herbarium, 1998-). None of these records occur within the application area. The potential presence of three of the eight taxa can be ruled out based on mapped soil types and vegetation associations. An assessment of the likelihood of occurrence/significant impacts for the remaining five taxa is included in Appendix B3. The assessment concludes that significant impacts to conservation significant flora taxa from the proposed clearing are not expected.</p> <p>Two state-listed Priority ecological communities (PECs) have been mapped within the local area, including invertebrate assemblages of granite outcrops (P2) and epiphytic cryptogams of the Karri Forest (P3) (Appendix B5). Noting the vegetation types and vegetation condition within the application area, and the distance to the nearest mapped occurrences of the PECs, vegetation within the application area is not likely to represent any PECs.</p> <p>The native vegetation of the application area is not likely to comprise a high level of biodiversity.</p> | Not likely to be at variance | No |
| <p><u>Principle (b):</u> <i>“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.”</i></p> <p><u>Assessment:</u> According to available databases, 21 conservation significant fauna taxa have been recorded within the local area. The vegetation within the application area may provide suitable habitat for eight terrestrial and arboreal fauna species listed under the BC Act, or as Priority fauna by DBCA (Appendix B4).</p> | Not likely to be at variance | Yes Refer to Section 3.2.1 |
| <p><u>Principle (c):</u> <i>“Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, threatened flora.”</i></p> <p><u>Assessment:</u> A review of available databases determined that one Threatened flora taxon, the Vulnerable <i>Kennedia glabrata</i>, has been recorded within the local area. This species is known from three records within the local area, with the nearest occurring at approximately 4.4 kilometres distant. This species is associated with granite outcrops. Due to the lack of habitat within the application area, and distance to known records, it is unlikely that <i>Kennedia glabrata</i> occurs (Appendix B3). It is unlikely that the vegetation under application includes, or is necessary for, the continued existence of Threatened flora.</p> | Not likely to be at variance | No |
| <p><u>Principle (d):</u> <i>“Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.”</i></p> <p><u>Assessment:</u> A review of available databases determined that no communities listed as Threatened Ecological Community (TEC) have been mapped within the application area, or within the local area within ten kilometres of the application area. The application area is not likely to comprise the whole or a part of, or be necessary for the maintenance of a TEC.</p> | Not likely to be at variance | No |

| Assessment against the clearing principles | Variance level | Is further consideration required? |
|---|------------------------------|------------------------------------|
| Environmental value: significant remnant vegetation and conservation areas | | |
| <p><u>Principle (e):</u> <i>“Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.”</i></p> <p>The national objectives and targets for biodiversity conservation in Australia has a target to prevent clearance of ecological communities with an extent below 30 per cent of that present pre-1750, below which species loss appears to accelerate exponentially at an ecosystem level (Commonwealth of Australia 2001).</p> <p>Noting the extent of vegetation remaining within the Warren IBRA bioregion, the four mapped vegetation complexes, and the local area (Appendix B2), the vegetation within the application area is not considered to occur within an area that has been extensively cleared.</p> | Not likely to be at variance | No |
| <p><u>Principle (h):</u> <i>“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.”</i></p> <p><u>Assessment:</u> A large number of conservation areas occur within the local area (Appendix B1). Most notably the application area is located adjacent to the Boorara-Gardner National Park and the Gardner State Forest. The vegetation within the southern portion of the application area is only separated from Boorara-Gardner National Park by a firebreak. The vegetation within the northern portion of the application area is separated from Gardner State Forest by a 20 metre wide road reserve.</p> | May be at variance | Yes Refer to Section 3.2.2 |
| Environmental value: land and water resources | | |
| <p><u>Principle (f):</u> <i>“Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.”</i></p> <p><u>Assessment:</u> The application area is located within the Gardner River catchment and intersects a significant stream (a non-perennial creekline) and associated drainage lines. These watercourses are tributaries of the Gardner River which is located approximately four kilometres downstream to the south-west. Native vegetation under application is growing in, or in association with, an environment associated with a watercourse.</p> | At variance | Yes Refer to Section 3.2.3 |
| <p><u>Principle (g):</u> <i>“Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.”</i></p> <p><u>Assessment:</u> The application area is mapped within four soil-landscape subsystems. Due to the risk outputs of the soil-landscape subsystems present (Appendix F), the purpose of the application, and the final land use, advice was sought from subject matter experts at the Department of Primary Industries and Regional Development (DPIRD) on the land degradation risks associated with the proposed clearing (Appendix G).</p> | At variance | Yes Refer to Section 3.2.3 |
| <p><u>Principle (i):</u> <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.”</i></p> <p><u>Assessment:</u> The application area is not situated within any groundwater areas proclaimed under the <i>Rights in Water and Irrigation Act 1914</i> (RIWI Act). Groundwater salinity within the application area is mapped between 500 to 1,000 milligrams per litre total dissolved solids (That is, ‘fresh’). Proposed clearing is not likely to contribute to increased salinity. The application area is not located within any proclaimed surface water areas under the RIWI Act. The application area intersects a creekline and drainage lines that are tributaries of the Gardner River located approximately four kilometres downstream to the south-west. The clearing of native vegetation for an agriculture purpose has the potential to cause water erosion, as well as eutrophication by increased nutrient enrichment.</p> | May be at variance | Yes Refer to Section 3.2.3 |

| Assessment against the clearing principles | Variance level | Is further consideration required? |
|---|------------------------------|------------------------------------|
| <p><u>Principle (j)</u>: <i>“Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.”</i></p> <p><u>Assessment</u>: DPIRD (2020) noted that there is an increased risk of waterlogging associated with the proposed clearing, however, DPIRD (2020) summarised that the risk of flooding is low, due to the combination of landscape position and soil types. Given this, the proposed clearing is not likely to be at variance with this principle.</p> | Not likely to be at variance | No |

Appendix D. Vegetation condition rating scale

Vegetation condition is a rating given to a defined area of vegetation to categorise and rank disturbance related to human activities. The rating refers to the degree of change in the vegetation structure, density and species present in relation to undisturbed vegetation of the same type. The degree of disturbance impacts upon the vegetation's ability to regenerate. Disturbance at a site can be a cumulative effect from a number of interacting disturbance types.

Considering its location, the scale below was used to measure the condition of the vegetation proposed to be cleared. This scale has been extracted from Keighery, B.J. (1994) *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*. Wildflower Society of WA (Inc). Nedlands, Western Australia.

Measuring vegetation condition for the South West and Interzone Botanical Province (Keighery 1994)

| Condition | Description |
|---------------------|--|
| Pristine | Pristine or nearly so, no obvious signs of disturbance. |
| Excellent | Vegetation structure intact, with disturbance affecting individual species; weeds are non-aggressive species. |
| Very Good | Vegetation structure altered, with obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and/or grazing. |
| Good | Vegetation structure significantly altered by very 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 and/or grazing. |
| Degraded | 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/or 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 or shrubs. |

Appendix E. Fauna survey – Information excerpts (Harewood 2021)

Table 1: Example Images of the Fauna Habitats within the Application Area

| |
|---|
|  |
| <p>Fauna Habitat Description: Grassland with some scattered karri trees and shrubs/sedges. Present in a small section of the application area in the north east - mapped as part of application area due to overlapping canopy cover from adjoining property/road reserve.</p> |
| <p>Black Cockatoo Habitat Value: Negligible/Low value given dominance of grassland and absence of other vegetation. Some possible minor foraging habitat value.</p> |
| <p>Western Ringtail Possum Habitat Value: Very low value given absence of coherent midstorey vegetation. Some very occasional small peppermints.</p> |
| <p>Quenda Habitat Value: Negligible/Very low value given absence of coherent groundcover vegetation.</p> |
| <p>South-Western Brush-tailed Phascogale: Negligible/Low value given absence of hollow bearing trees/coherent woodland.</p> |
| <p>Quokka Habitat Value: Negligible/Very low value given absence of coherent groundcover vegetation.</p> |
| <p>Noisy Scrub-bird Habitat Value: No value given absence of dense undergrowth vegetation.</p> |

| |
|---|
|  |
| <p>Fauna Habitat Description: Tea Tree (<i>Melaleuca</i>) Low Woodland with some scattered and small groves of karri trees and peppermint in southern section. Some fringing areas dominated by bracken fern (heath/shrubland). Natural ground cover (sedges) in some areas however much of this area is infested with blackberry. Occupies drainage line in northern section of application area.</p> |
| <p>Black Cockatoo Habitat Value: Negligible/Low value given dominance of tea tree and almost complete absence of favoured foraging vegetation and hollow bearing trees.</p> |
| <p>Western Ringtail Possum Habitat Value: Moderate value given presence of continuous midstorey and peppermint (in some areas).</p> |
| <p>Quenda Habitat Value: Moderate value given presence of some coherent groundcover vegetation including dense blackberry.</p> |
| <p>South-Western Brush-tailed Phascogale: Negligible/Low value given absence of hollow bearing trees/coherent eucalyptus woodland.</p> |
| <p>Quokka Habitat Value: Low/moderate value given presence of some dense groundcover</p> |
| <p>Noisy Scrub-bird Habitat Value: Possibly suitable but limited to areas of dense blackberry. It is not known if this species would find this vegetation type suitable.</p> |



Fauna Habitat Description: Warren River Cedar Low Closed Forest with some scattered and small groves of karri trees and peppermint. Natural ground cover (sedges) in some areas however much of this area is infested with blackberry. Occupies drainage line in middle section of application area.

Black Cockatoo Habitat Value: Negligible/Low value given dominance of tea tree and almost complete absence of favoured foraging vegetation and hollow bearing trees.

Western Ringtail Possum Habitat Value: Moderate value given presence of continuous midstorey and some peppermint.

Quenda Habitat Value: Moderate value given presence of some coherent groundcover vegetation including dense blackberry.

South-Western Brush-tailed Phascogale: Negligible/Low value given absence of hollow bearing trees.

Quokka Habitat Value: Low/moderate value given presence of some dense groundcover

Noisy Scrub-bird Habitat Value: Possibly suitable but limited to areas of dense blackberry. It is not known if this species would find this vegetation type suitable.



Fauna Habitat Description: Karri Tall Open Forest over Tall Open Shrubland/Shrubland. Appears to be largely regrowth from historical clearing event. Borders drainage line in central eastern section of application area.

Black Cockatoo Habitat Value: Moderate value given presence of woodland though karri is not a favoured foraging source and there is an obvious lack of hollow bearing trees. Some value as roosting habitat.

Western Ringtail Possum Habitat Value: Low value given absence of continuous midstorey component.

Quenda Habitat Value: Moderate value given presence of some coherent groundcover vegetation and dense leaf litter.

South-Western Brush-tailed Phascogale: Low value given absence of hollow bearing trees.

Quokka Habitat Value: Low value given absence of dense sedges/higher groundcover.

Noisy Scrub-bird Habitat Value: Negligible value given coherent very dense understorey absent.



| |
|--|
| Fauna Habitat Description: Tea Tree (<i>Melaleuca</i>) Low Closed Forest with some scattered marri and jarrah trees over Sedgeland. Occupies drainage line which cuts diagonally across southern section of application area. |
| Black Cockatoo Habitat Value: Low/Moderate value given dominance of tea tree but occasional favoured foraging species (marri/jarrah). |
| Western Ringtail Possum Habitat Value: Good/Moderate value given presence of continuous midstorey and some peppermint. |
| Quenda Habitat Value: Good/Moderate value given presence of some coherent groundcover vegetation. |
| South-Western Brush-tailed Phascogale: Low/Moderate value given hollow bearing trees uncommon. |
| Quokka Habitat Value: Low/moderate value given presence of some dense groundcover |
| Noisy Scrub-bird Habitat Value: Low value given coherent very dense understorey discontinuous. |



| |
|--|
| Fauna Habitat Description: Jarrah/Marri/Blackbutt Open Forest over Tall Open Shrubland/Open Shrubland. Occupies central and south western section of application area. |
| Black Cockatoo Habitat Value: Good value given presence of favoured foraging species (marri/jarrah). Suitable breeding habitat appears to be generally absent (only one marginal hollow identified). Some potential roosting habitat. |
| Western Ringtail Possum Habitat Value: Good/Moderate value given presence of some continuous midstorey and some peppermint. |
| Quenda Habitat Value: Low/Moderate value given presence of some coherent groundcover vegetation. |
| South-Western Brush-tailed Phascogale: Moderate value given woodland habitat with some hollow bearing trees. |
| Quokka Habitat Value: Low/moderate value given presence of some dense groundcover |
| Quokka Habitat Value: Negligible value given absence of dense sedges/higher groundcover. |
| Noisy Scrub-bird Habitat Value: Negligible value given very coherent dense understorey absent. |



Fauna Habitat Description: Jarrah/Bullich Open Woodland over Tall Open Shrubland/Open Shrubland. Occupies south easter section of application area.

Black Cockatoo Habitat Value: Good/Moderate value given presence of favoured foraging species (jarrah). Suitable breeding habitat appears to be generally absent (no large hollow bearing trees identified in this area). Some potential roosting habitat.

Western Ringtail Possum Habitat Value: Low value given discontinuous midstorey.

Quenda Habitat Value: Good/Moderate value given presence of some coherent groundcover vegetation.

South-Western Brush-tailed Phascogale: Moderate value given woodland habitat with some hollow bearing trees.

Quokka Habitat Value: Low value given presence of some dense groundcover but appears generally marginal.

Quokka Habitat Value: Low value given coherent very dense understory discontinuous.

Table 2: Summary of Habitat Tree Observations

| Tree ID | Number of Possible Hollows | Status | Justification |
|---------|----------------------------|-------------------------------|--|
| 1 | 2+ | Unsuitable Hollows/No Hollows | Marri (near dead) with one possible large side entry hollow. When examined with the drone this hollow was found to be non-existent. Some possible spout type hollows in small branches unsuitable (too small) for black cockatoos. |
| 2 | 1 | Unused Hollow | Marri with one possible large side entry hollow. When examined with the drone this hollow was found to have some depth but very shallow. No signs of use by any fauna. Classified as an unused hollow but possibly marginally suitable for black cockatoos due to shallowness. |
| 3 | 1 | No Hollows | Marri with possible upward facing chimney style hollow. Upon closer inspection with a drone, the hollow was found to be non-existent/very shallow. |
| 4 | 2+ | No Hollow/Unsuitable Hollows. | Dead Marri with a possible upward facing chimney style hollow and several spout type hollows. Upon closer inspection with a drone, all the potential hollows were found to be non-existent or too shallow for use by black cockatoos. |
| 5 | 2+ | No Hollow/Unsuitable Hollows. | Jarrah with possible upward facing chimney style hollow and several spout type hollows. Upon closer inspection with a drone, all the potential hollows were found to be non-existent or too shallow for use by black cockatoos. |
| 6 | 1 | No Hollow | Dead Jarrah with possible upward facing chimney style hollow. Upon closer inspection with a drone, the hollow was found to have no depth. |
| 7 | 1 | No Hollows | Dead Karri with possible upward facing chimney style hollow. Upon closer inspection with a drone, the hollow was found to be non-existent. |

Appendix F. Soil map units (DPIRD 2019)

Minor Valleys S1 Subsystem (Pimelia) (254PvS1):

symbol: 254PvS1 **name:** Minor Valleys S1 Subsystem (Pimelia)
type:soil-landscape **rank:** subsystem **status:** current

brief description: Valleys in granitic terrain, narrow swampy floor; <20 m relief. Gravelly yellow duplex soils on smooth flanks; Jarrah-Marri-Karri forest. Peaty soils on narrow floor; Wattle low forest.

soil: Loamy gravels, Duplex sandy gravels and Wet and Semi-wet soils

soil notes: Gravelly yellow duplex soils (Dy3.62) are on the smooth flanking slopes. Some red earths and brown gravelly duplex soils also occur and there are peaty and humus podzols on the deep sands of the swampy floors.

landform: Shallow (<5 m deep), swampy floored, minor valleys

landform notes: S1 are valleys set in the granitic plateau and are often upstream from V2. They are usually less than 20 m deep and often have swampy floor which is sometimes without a stream channel. The flanking slopes are less than 10 degrees

geology: colluvium and deeply weathered mantle over gneiss

vegetation: Marri-jarrah-karri-banksia-paperbark forest

vegetation notes: Jarrah-marri as tall open forests are dominant on the slopes but sometimes there is much karri as well as scattered *Banksia grandis*, *Agonis flexuosa* and *Persoonia longifolia*; a dense shrub layer occurs and this may include *Hovea elliptica*, *Bossiaea linophylla*, *B. Grevillea* spp., *Acacia myrtifolia*, *A. pentadenia*, *A. urophylla* and *Pimelia clavata*; creepers are mainly *Hardenbergia comptoniana*, *Kennedia prostrata*, *K. coccinea* and *Clematis microphylla*. The narrow floors have a dense scrub of *Agonis juniperina*, *Oxylobium lanceolatum* and *Lepidosperma longitudinale*.

location: Southern Forests between the Donnelly River and Northcliffe

other information: 254PvS1 is very similar to 254MpYN and these two subsystems could possibly be amalgamated. Landform, geology, soil and vegetation notes adapted from the South Coast and Hinterland survey (Churchward et al., 1988). Land unit allocations based on the description in Churchward et al. and DEM generated slope maps. This subsystem is now recognised as occurring in a number of soil-landscape systems.

similar units: 254PvS1 is very similar to 254DwS1 and 254NfS1. It is also very similar to 254MpYN and these two subsystems could possibly be amalgamated. As originally mapped by Churchward et al. (1988), S1 extends from Pemberton east to Denmark. It has since been placed into a number of different soil-landscape systems to recognise variations occurring across this range..

landform pattern: **landform element:**

relief/modal slope class(s):

morphological type(s):

slope:

Occurs in Projects

| Code | Name | Mapped (ha) | Scale | Reference | Year | Reliability |
|------|--|-------------|----------|---|------|--|
| SCH | South Coast and hinterland landforms and soils | 7,436 | 1:100000 | Churchward, H.M., McArthur, W.M., Sewell, P.L. and Bartle, G.A. (1988). Landforms and soils of the south coast and hinterland, W.A., Northcliffe to Many Peaks. CSIRO Australia. Inst. of Nat. Res. and Env., Div. of Water Resources, Div. Report 88/1 | 1988 | Medium data quality, midscale or imprecise mapping |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
 Assists, but does not replace on site assessment recommended for an area on an individual property.
 Department of Primary Industry and Regional Development (Feedback Welcome: soil.maps@dpird.wa.gov.au)

Zone Land Units (WA Soil Groups by Qualifier and Landscape Position in Zone percent of Map Unit)

| WASG Name | Qualifier | Landscape | % | MySoil | Simple Landscape |
|--------------------------------|-----------------------------|------------------------------------|----|------------------------------|-------------------------------------|
| Yellow deep sand | good sand, very deep | slopes 3-5% | 8 | Coloured sands | Gentle slopes |
| Friable red/brown loamy earth | good neutral subsoil | slopes 10-15% | 2 | Deep loamy duplexes & earths | Moderate slopes |
| Brown deep loamy duplex | good neutral subsoil | slopes 10-15% | 2 | Deep loamy duplexes & earths | Moderate slopes |
| Brown deep loamy duplex | good neutral subsoil | slopes 5-10% | 5 | Deep loamy duplexes & earths | Gentle slopes |
| Friable red/brown loamy earth | good neutral subsoil | slopes 15-30% | 2 | Deep loamy duplexes & earths | Steep slopes |
| Yellow/brown deep sandy duplex | good neutral subsoil | footslopes <3% | 6 | Deep sandy duplexes | Poorly drained flats and footslopes |
| Loamy gravel | neutral subsoil | slopes 15-30% | 5 | Gravels | Steep slopes |
| Deep sandy gravel | poor sand, very deep | slopes 5-10% | 5 | Gravels | Gentle slopes |
| Duplex sandy gravel | neutral subsoil | slopes 3-5% | 5 | Gravels | Gentle slopes |
| Duplex sandy gravel | neutral subsoil | slopes 5-10% | 5 | Gravels | Gentle slopes |
| Loamy gravel | neutral subsoil | slopes 10-15% | 12 | Gravels | Moderate slopes |
| Loamy gravel | neutral subsoil | slopes 5-10% | 20 | Gravels | Gentle slopes |
| Wet soil | very shallow rock substrate | Poorly drained drainage depression | 1 | No information | Waterways |
| Wet soil | peaty | Poorly drained drainage depression | 3 | No information | Waterways |
| Wet soil | loam topsoil | Poorly drained drainage depression | 2 | No information | Waterways |
| Wet soil | deep sand | Poorly drained drainage depression | 5 | No information | Waterways |
| Gravelly pale deep sand | poor sand, very deep | slopes 3-5% | 1 | Pale sands | Gentle slopes |
| Pale deep sand | poor sand, effective duplex | slopes 3-5% | 2 | Pale sands | Gentle slopes |
| Pale deep sand | poor sand, very deep | slopes 3-5% | 2 | Pale sands | Gentle slopes |
| Semi-wet soil | deep sand | Poorly drained drainage depression | 5 | Semi-wet soils | Waterways |
| Semi-wet soil | sandy earth | footslopes <3% | 2 | Semi-wet soils | Poorly drained flats and footslopes |

Summary My Soil by simple landscape (percent of Map Unit)

| Land | tot | Saline wet | Semi-wet soils | Calcareous sands | Pale sands | Coloured sands | Sandy earths | Shallow sand | Gravels | Deep sandy duplexes | Shallow sandy duplexes | Alkaline shallow duplex | Shallow loam | Deep loamy duplexes & earths | Clays & shallow loamy duplexes | Self-mulching clays | Calcareous loamy earths | Stony soils | Bare rock | No information |
|-------------------------------------|-----|------------|----------------|------------------|------------|----------------|--------------|--------------|---------|---------------------|------------------------|-------------------------|--------------|------------------------------|--------------------------------|---------------------|-------------------------|-------------|-----------|----------------|
| Gentle slopes | 53 | | | | 5 | 8 | | | 35 | | | | | 5 | | | | | | |
| Moderate slopes | 16 | | | | | | | | 12 | | | | | 4 | | | | | | |
| Poorly drained flats and footslopes | 8 | | 2 | | | | | | | 6 | | | | | | | | | | |
| Steep slopes | 7 | | | | | | | | 5 | | | | | 2 | | | | | | |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
 Assists, but does not replace on site assessment recommended for an area on an individual property.
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Land Qualities summary - % Map Unit (column 1 most limiting, 4 least)

| o | C | C1 | C2 | C3 | C4 |
|---|------------------------|-------------------------|--------------------|--------------------------|--------------------------|
| 1 | pH | | | | |
| 1 | 0-10 acidity | very strongly acid: 0 % | strongly acid: 0 % | | |
| 1 | 0-10 alkalinity | strongly alkaline: 0 % | alkaline: 0 % | | |
| 1 | 50-80 acidity | very strongly acid: 0 % | strongly acid: 3 % | | |
| 1 | 50-80 alkalinity | strongly alkaline: 0 % | alkaline: 0 % | | |
| 1 | acidification risk | presently acid: 33 % | high: 65 % | moderate: 0 % | low: 2 % |
| 2 | SALINITY | | | | |
| 2 | salinity risk | presently saline: 0 % | high: 0 % | moderate: 0 % | nil or partial: 100 % |
| 2 | surface salinity | extreme: 0 % | high: 0 % | moderate: 0 % | slight to nil: 100 % |
| 3 | SOME PLANT LIMITS | | | | |
| 3 | rooting depth | very shallow: 0 % | shallow: 1 % | moderately shallow: 10 % | v deep to moderate: 89 % |
| 3 | sub surface compact | high: 30 % | moderate: 66 % | low: 4 % | |
| 3 | water repel | high: 10 % | moderate: 10 % | low: 0 % | nil: 80 % |
| 3 | water storage | extremely low: 7 % | very low: 4 % | low: 0 % | high to moderate: 89 % |
| 4 | EROSION | | | | |
| 4 | flood risk | high: 16 % | moderate: 0 % | low: 0 % | low: 84 % |
| 4 | instability | high: 0 % | moderate: 0 % | low: 0 % | nil to very low: 100 % |
| 4 | water erosion | extreme: 0 % | very high: 23 % | high: 16 % | nil to moderate: 61 % |
| 4 | wind erosion | extreme: 0 % | very high: 0 % | high: 65 % | nil to moderate: 35 % |
| 5 | WATER & DRAINAGE | | | | |
| 5 | site drainage | very poor: 11 % | poor: 5 % | moderate: 8 % | high: 76 % |
| 5 | waterlogging | very high: 11 % | high: 11 % | moderate: 8 % | nil to low: 76 % |
| 6 | OTHER QUALITIES | | | | |
| 6 | excavation ease | very low: 7 % | low: 11 % | moderate: 5 % | high: 77 % |
| 6 | microbial purification | very low: 18 % | low: 10 % | moderate: 21 % | high: 51 % |
| 6 | phosphorus loss | extreme: 16 % | very high: 9 % | high: 18 % | nil to moderate: 57 % |

Land capability assessment (Class %, code and description)

| Land Use | o | pc1_2 | pc3 | pc4_5 | Code | Cap Rating desc |
|------------------------|---|-------|-----|-------|------|---------------------------------------|
| Annual horticulture | 1 | 0 | 59 | 41 | B2 | 50-70% of the area is Class 1, 2 or 3 |
| Dry Cropping | 4 | 0 | 54 | 46 | B2 | 50-70% of the area is Class 1, 2 or 3 |
| Grazing | 5 | 17 | 60 | 23 | B1 | >70% of the area is Class 1, 2 or 3 |
| Perennial horticulture | 2 | 44 | 25 | 31 | B2 | 50-70% of the area is Class 1, 2 or 3 |
| Vineyards | 3 | 44 | 33 | 23 | B1 | >70% of the area is Class 1, 2 or 3 |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
Assists, but does not replace on site assessment recommended for an area on an individual property.
Department of Primary Industry and Regional Development (Feedback Welcome: soil.maps@dpiird.wa.gov.au)

Angove Subsystem (Northcliffe) (254NfAN)

symbol: 254NfAN **name:** Angove Subsystem (Northcliffe)
type:soil-landscape **rank:** subsystem **status:** current

brief description: Gently sloping sandy terrain; slight dissections. Humus podzols on broad crests; Kangaroo Grass sedge/land, Teatree heath. Sandy yellow duplex soils in shallow dissections; Jarrah woodland.

soil: Semi-wet soils, Wet soils, Pale deep sands and Grey deep sandy duplexes

soil notes: Churchward (1992): The dominant soils are yellow duplex profiles with a light greybrown sand A horizon, having a bleached A2 horizon over a mottled, structureless clay B horizon. The profiles are acidic (Dy 5.81). Dark organic staining is common at the interface of the A and B horizons. These soils merge with humus podzols developed on deep sand.Churchward et al. (1988): Yellow duplex soils with grey-brown sand surface horizons are dominant. The A2 horizons are usually bleached while B horizons are mottled pale yellow and grey clay at a depth of 20 to 30 cm (Dy5.81). Dark organic staining may be at the A-B interface and this zone may be cemented. Humus podzols are developed on the deeper sands and in some areas podzols may be as extensive as the duplex profiles.

landform: Very gentle sandy slopes and divides

landform notes: Churchward (1992): This unit comprises very gentle slopes and some broad drainage divides. It is sometimes identified on the edges of the Quagering unit where it appears to represent a slight erosional modification of the Quagering unit. Local relief is < 20 m and it ranges from 60 to 250 m AHD.Churchward et al. (1988): This unit often comprises gentle slopes and heads of broad swampy valleys and as such is frequently down-slope from Quagering; sometimes it occupies broadly complex crests. Local relief is usually less than 20 m elevation is from 140 m a.s.l. inland to 40 m near the coast.

geology: sandy sediments and quartzite over weathered mantle over gneiss

geol notes: Churchward (1992): The surface of this unit is dominated by quartzose sands and grits. The presence of cobbles indicates that some of the quartzose materials are of sedimentary origin. Others appear to have been derived from local quartzite. The substrate to the sands is often kaolinitic clay, the result of weathering of gneissic rocks.Churchward et al. (1988): Shallow unconsolidated sandy sediments occur extensively and these often include quartzose cobbles. These sediments often overlie kaolinitic clays of weathered granite.

vegetation: Jarrah-banksia-Christmas tree woodland and ti-tree heath

vegetation notes: Churchward (1992): Low open woodlands of depauperate jarrah and Banksia ilicifolia, Xylomelum occidentale and Nuytsia floribunda are usually present. A dense heath layer is dominated by Agonis parviceps, Pultenaea reticulata, Kingia australis, Adenanthos obovatus, Leucopogon australis, Leptospermum firmum, and Dasypogon bromeliifolius.Churchward et al. (1988): Dense heath communities are dominant in the unit and these comprise Agonis parviceps, Anarthria scabra, Evandra aristata, Beaufortia sparsa, Acacia divergens and Homalospermum firmum; scattered poor jarrah, marri, Banksia ilicifolia, Nuytsia floribunda and Kingia australis may be present.

location: Southern Forests between Fly Brook and Nornalup

other information: Landform, geology, soil and vegetation notes adapted from the South Coast and Hinterland (Churchward et al., 1988) and Manjimup (Land Resources Series No. 10 - Churchward, 1992) surveys. Land unit allocations are based on these descriptions in Churchward and DEM generated slope data (using ER-Mapper and the mostly 5-10 m contour maps available in 2003). The name Angove was first used by Churchward et al. (1988) and was mapped as occurring from the Donnelly River to the Kent River. It has since been placed into a number of different soil-landscape systems to recognise variations occurring across this range.

similar units: Angove sometimes identified on the edges of the Quagering unit (254NfQA) where it appears to represent a slight erosional modification of the Quagering unit.

landform pattern: **landform element:**

relief/modal slope class(s):

morphological type(s):

slope:

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
Assists, but does not replace on site assessment recommended for an area on an individual property.
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Occurs in Projects

| Code | Name | Mapped (ha) | Scale | Reference | Finish | Reliability |
|------|--|-------------|----------|--|--------|--|
| MNJ | Manjimup land resources survey | 463 | 1:100000 | Churchward, H.M. (1992). Soils and landforms of the Manjimup area, Western Australia. Land Resources Series No. 10. Department of Agriculture, Western Australia | 1992 | High data quality, midscale or imprecise mapping |
| SCH | South Coast and hinterland landforms and soils | 28,400 | 1:100000 | Churchward, H.M., McArthur, W.M., Sewell, P.L. and Bartie, G.A. (1988). Landforms and soils of the south coast and hinterland, W.A., Northcliffe to Manypeaks. CSIRO Australia. Inst. of Nat. Res. and Env., Div. of Water Resources, Div. Report 88/1 | 1988 | Medium data quality, midscale or imprecise mapping |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
 Assists, but does not replace on site assessment recommended for an area on an individual property.
 Department of Primary Industry and Regional Development (Feedback Welcome: soil.maps@dpiird.wa.gov.au)

Zone Land Units (WA Soil Groups by Qualifier and Landscape Position in Zone percent of Map Unit)

| WASG Name | Qualifier | Landscape | % | MySoil | Simple Landscape |
|---------------------------|------------------------------|---------------------|----|------------------------|-------------------------------------|
| Grey deep sandy duplex | poor sand, good acid subsoil | slopes 5-10% | 10 | Deep sandy duplexes | Gentle slopes |
| Grey deep sandy duplex | poor sand, good acid subsoil | slopes 3-5% | 9 | Deep sandy duplexes | Gentle slopes |
| Duplex sandy gravel | acid subsoil | slopes 10-15% | 5 | Gravels | Moderate slopes |
| Duplex sandy gravel | acid subsoil | slopes 5-10% | 3 | Gravels | Gentle slopes |
| Wet soil | deep sandy duplex | poorly drained flat | 7 | No information | Poorly drained flats and footslopes |
| Wet soil | deep sand | swamp | 10 | No information | Swamps |
| Pale deep sand | acid sand | slopes 3-5% | 3 | Pale sands | Gentle slopes |
| Pale deep sand | poor sand, very deep | slopes 5-10% | 5 | Pale sands | Gentle slopes |
| Pale deep sand | poor sand, effective duplex | slopes 3-5% | 7 | Pale sands | Gentle slopes |
| Semi-wet soil | shallow sandy duplex | slopes 3-5% | 5 | Semi-wet soils | Gentle slopes |
| Semi-wet soil | shallow sandy duplex | poorly drained flat | 5 | Semi-wet soils | Poorly drained flats and footslopes |
| Semi-wet soil | deep sandy duplex | poorly drained flat | 11 | Semi-wet soils | Poorly drained flats and footslopes |
| Semi-wet soil | deep sandy duplex | footslopes <3% | 5 | Semi-wet soils | Poorly drained flats and footslopes |
| Semi-wet soil | deep sand | slopes 1-3% | 10 | Semi-wet soils | Gentle slopes |
| Grey shallow sandy duplex | good acid subsoil | slopes 5-10% | 5 | Shallow sandy duplexes | Gentle slopes |

Summary My Soil by simple landscape (percent of Map Unit)

| Land | tot | Saline wet | Semi-wet soils | Calcareous sands | Pale sands | Coloured sands | Sandy earths | Shallow sand | Gravels | Deep sandy duplexes | Shallow sandy duplexes | Alkaline shallow duplex | Shallow loam | Deep loamy duplexes & earths | Clays & shallow loamy duplexes | Self-mulching clays | Calcareous loamy earths | Stony soils | Bare rock | No information |
|-------------------------------------|-----|------------|----------------|------------------|------------|----------------|--------------|--------------|---------|---------------------|------------------------|-------------------------|--------------|------------------------------|--------------------------------|---------------------|-------------------------|-------------|-----------|----------------|
| Gentle slopes | 57 | | 15 | | 15 | | | | 5 | 19 | 5 | | | | | | | | | |
| Moderate slopes | 5 | | | | | | | | 5 | | | | | | | | | | | |
| Poorly drained flats and footslopes | 28 | | 21 | | | | | | | | | | | | | | | | | 7 |
| Swamps | 10 | | | | | | | | | | | | | | | | | | | 10 |

Land Management Units (percent of Map Unit)

| LMU | % |
|---|----|
| Deep sandy duplexes on Gentle slopes | 19 |
| Gravels on Gentle slopes | 3 |
| Gravels on Moderate slopes | 5 |
| No information on Poorly drained flats and footslopes | 7 |
| Pale sands on Gentle slopes | 15 |
| Semi-wet soils on Gentle slopes | 15 |
| Semi-wet soils on Poorly drained flats and footslopes | 21 |
| Shallow sandy duplexes on Gentle slopes | 5 |
| Swamps | 10 |

Soil Series: none allocated

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
Assists, but does not replace on site assessment recommended for an area on an individual property.
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Land Qualities summary - % Map Unit (column 1 most limiting, 4 least)

| o | C | C1 | C2 | C3 | C4 |
|---|------------------------|--------------------------|---------------------|--------------------------|--------------------------|
| 1 | pH | | | | |
| 1 | 0-10 acidity | very strongly acid: 19 % | strongly acid: 18 % | | |
| 1 | 0-10 alkalinity | strongly alkaline: 0 % | alkaline: 0 % | | |
| 1 | 50-80 acidity | very strongly acid: 0 % | strongly acid: 8 % | | |
| 1 | 50-80 alkalinity | strongly alkaline: 0 % | alkaline: 0 % | | |
| 1 | acidification risk | presently acid: 100 % | high: 0 % | moderate: 0 % | low: 0 % |
| 2 | SALINITY | | | | |
| 2 | salinity risk | presently saline: 0 % | high: 0 % | moderate: 0 % | nil or partial: 100 % |
| 2 | surface salinity | extreme: 0 % | high: 0 % | moderate: 0 % | slight to nil: 100 % |
| 3 | SOME PLANT LIMITS | | | | |
| 3 | rooting depth | very shallow: 0 % | shallow: 0 % | moderately shallow: 27 % | v deep to moderate: 73 % |
| 3 | sub surface compact | high: 15 % | moderate: 85 % | low: 0 % | |
| 3 | water repell | high: 42 % | moderate: 5 % | low: 0 % | nil: 53 % |
| 3 | water storage | extremely low: 5 % | very low: 7 % | low: 30 % | high to moderate: 58 % |
| 4 | EROSION | | | | |
| 4 | flood risk | high: 0 % | moderate: 0 % | low: 10 % | low: 90 % |
| 4 | instability | high: 0 % | moderate: 0 % | low: 0 % | nil to very low: 100 % |
| 4 | water erosion | extreme: 0 % | very high: 0 % | high: 5 % | nil to moderate: 95 % |
| 4 | wind erosion | extreme: 0 % | very high: 0 % | high: 57 % | nil to moderate: 43 % |
| 5 | WATER & DRAINAGE | | | | |
| 5 | site drainage | very poor: 17 % | poor: 16 % | moderate: 20 % | high: 47 % |
| 5 | waterlogging | very high: 17 % | high: 17 % | moderate: 20 % | nil to low: 47 % |
| 6 | OTHER QUALITIES | | | | |
| 6 | excavation ease | very low: 0 % | low: 17 % | moderate: 16 % | high: 67 % |
| 6 | microbial purification | very low: 46 % | low: 22 % | moderate: 0 % | high: 32 % |
| 6 | phosphorus loss | extreme: 10 % | very high: 7 % | high: 23 % | nil to moderate: 60 % |

Land capability assessment (Class %, code and description)

| Land Use | o | pc1_2 | pc3 | pc4_5 | Code | Cap Rating desc |
|------------------------|---|-------|-----|-------|------|---------------------------------------|
| Annual horticulture | 1 | 0 | 55 | 45 | B2 | 50-70% of the area is Class 1, 2 or 3 |
| Dry Cropping | 4 | 0 | 17 | 83 | C2 | >70% of the area is Class 4 or 5 |
| Grazing | 5 | 10 | 68 | 22 | B1 | >70% of the area is Class 1, 2 or 3 |
| Perennial horticulture | 2 | 5 | 42 | 53 | C1 | 50-70% of the area is Class 4 or 5 |
| Vineyards | 3 | 5 | 62 | 33 | B2 | 50-70% of the area is Class 1, 2 or 3 |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.

Assists, but does not replace on site assessment recommended for an area on an individual property.

Department of Primary Industry and Regional Development (Feedback Welcome: soil.maps@dpiird.wa.gov.au)

Major Valleys V2 Subsystem (Pimelia) (254PvV2)

symbol: 254PvV2 **name:** Major Valleys V2 Subsystem (Pimelia)
type:soil-landscape **rank:** subsystem **status:** current

brief description: Valleys in granitic areas; 20-40 m relief; smooth, moderate slopes; narrow terrace.

soil: Loamy gravels, Duplex sandy gravels, Friable red/brown loamy earths and Brown loamy earths

soil notes: Gravelly yellow duplex soils (Dy2.62) are common but some brown gravelly duplex soils and red earths are present; earthy sands and yellow duplex soils are on narrow terraces. There are some narrow swampy floors with peaty podzols.

landform: Major valleys 20-40 m deep

landform notes: Major valleys (generally upstream from V1) and are usually 20 to 40 m deep; the slopes are smooth and range from 10 to 20%. There are few rock out-crops.

geology: colluvium and weathered mantle over gniess

vegetation: Marri-jarrah-karri forests

vegetation notes: Marri-jarrah-karri tall open forests occur with scattered *Banksia grandis* and *Agonis flexuosa*. There is a dense shrub layer of *Bossiaea linophylla*, *B. aquifolium*, *B. laidlawiana*, *Chorizema ilicifolia*, *Hovea elliptica* and *Acacia pentadenia*. *Agonis juniperina* and *Oxylobium lanceolatum* are present where floors are swampy.

location: Southern Forests between the Donnelly River and Northcliffe

other information: Landform, geology, soil and vegetation notes adapted from the South Coast and Hinterland survey (Churchward et al., 1988). Land unit allocations based on the description in Churchward et al. and DEM generated slope maps. This subsystem is now recognised as occurring in a number of soil-landscape systems.

landform pattern: **landform element:**

relief/modal slope class(s):

morphological type(s): open depression (vale)

slope:

Occurs in Projects

| Code | Name | Mapped (ha) | Scale | Reference | Year | Reliability |
|------|--|-------------|----------|--|------|--|
| MNJ | Manjimup land resources survey | 15 | 1:100000 | Churchward, H.M. (1992). Soils and landforms of the Manjimup area, Western Australia. Land Resources Series No. 10. Department of Agriculture, Western Australia | 1992 | High data quality, midscale or imprecise mapping |
| SCH | South Coast and hinterland landforms and soils | 6,841 | 1:100000 | Churchward, H.M., McArthur, W.M., Sewell, P.L. and Bartle, G.A. (1988). Landforms and soils of the south coast and hinterland, W.A., Northcliffe to Manypeaks. CSIRO Australia. Inst. of Nat. Res. and Env., Div. of Water Resources, Div. Report 88/1 | 1988 | Medium data quality, midscale or imprecise mapping |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.

Assists, but does not replace on site assessment recommended for an area on an individual property.

Department of Primary Industry and Regional Development (Feedback Welcome: soil.maps@dpiird.wa.gov.au)

Zone Land Units (WA Soil Groups by Qualifier and Landscape Position in Zone percent of Map Unit)

| WASG Name | Qualifier | Landscape | % | MySoil | Simple Landscape |
|--------------------------------|----------------------|-----------------------------|----|------------------------------|-----------------------------------|
| Friable red/brown loamy earth | good neutral subsoil | slopes 15-30% | 8 | Deep loamy duplexes & earths | Steep slopes |
| Friable red/brown loamy earth | good neutral subsoil | slopes 10-15% | 5 | Deep loamy duplexes & earths | Moderate slopes |
| Friable red/brown loamy earth | good neutral subsoil | slopes 5-10% | 5 | Deep loamy duplexes & earths | Gentle slopes |
| Brown loamy earth | good neutral subsoil | slopes 10-15% | 10 | Deep loamy duplexes & earths | Moderate slopes |
| Brown loamy earth | good neutral subsoil | well drained footslopes <3% | 4 | Deep loamy duplexes & earths | Well drained flats and footslopes |
| Brown deep loamy duplex | good neutral subsoil | slopes 15-30% | 8 | Deep loamy duplexes & earths | Steep slopes |
| Friable red/brown loamy earth | good neutral subsoil | slopes >30% | 1 | Deep loamy duplexes & earths | Steep slopes |
| Yellow/brown deep sandy duplex | good neutral subsoil | well drained floodplain | 1 | Deep sandy duplexes | Well drained floodplain |
| Duplex sandy gravel | neutral subsoil | slopes 5-10% | 15 | Gravels | Gentle slopes |
| Loamy gravel | neutral subsoil | slopes 15-30% | 5 | Gravels | Steep slopes |
| Loamy gravel | neutral subsoil | slopes 10-15% | 12 | Gravels | Moderate slopes |
| Loamy gravel | neutral subsoil | slopes 5-10% | 11 | Gravels | Gentle slopes |
| Loamy gravel | neutral subsoil | slopes 3-5% | 10 | Gravels | Gentle slopes |
| Wet soil | peaty | poorly drained floodplain | 1 | No information | Poorly drained floodplain |
| Yellow sandy earth | good neutral subsoil | well drained footslopes <3% | 3 | Sandy earths | Well drained flats and footslopes |
| Brown sandy earth | good neutral subsoil | well drained floodplain | 1 | Sandy earths | Well drained floodplain |

Summary MySoil by simple landscape (percent of Map Unit)

| Land | tot | Saline wet | Semi-wet soils | Calcareous sands | Pale sands | Coloured sands | Sandy earths | Shallow sand | Gravels | Deep sandy duplexes | Shallow sandy duplexes | Alkaline shallow duplex | Shallow loam | Deep loamy duplexes & earths | Clays & shallow loamy duplexes | Self-mulching clays | Calcareous loamy earths | Stony soils | Bare rock | No information |
|-----------------------------------|-----|------------|----------------|------------------|------------|----------------|--------------|--------------|---------|---------------------|------------------------|-------------------------|--------------|------------------------------|--------------------------------|---------------------|-------------------------|-------------|-----------|----------------|
| Gentle slopes | 41 | | | | | | | | 36 | | | | | 5 | | | | | | |
| Moderate slopes | 27 | | | | | | | | 12 | | | | | 15 | | | | | | |
| Poorly drained floodplain | 1 | | | | | | | | | | | | | | | | | | | 1 |
| Steep slopes | 22 | | | | | | | | 5 | | | | | 17 | | | | | | |
| Well drained flats and footslopes | 7 | | | | | | 6 | | | | | | | 4 | | | | | | |
| Well drained floodplain | 2 | | | | | | 1 | | | 1 | | | | | | | | | | |

Land Management Units (percent of Map Unit)

| LMU | % |
|---|----|
| Deep loamy duplexes & earths on Gentle slopes | 5 |
| Deep loamy duplexes & earths on Moderate slopes | 15 |
| Deep loamy duplexes & earths on Well drained flats and footslopes | 4 |
| Deep sandy duplexes on Well drained floodplain | 1 |
| Gravels on Gentle slopes | 36 |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
 Assists, but does not replace on site assessment recommended for an area on an individual property.
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Map Unit Report: Major Valleys V2 Subsystem (Pimelia) (254PvV2)

| LMU | % |
|---|----|
| Gravels on Moderate slopes | 12 |
| No information on Poorly drained floodplain | 1 |
| Sandy earths on Well drained flats and footslopes | 3 |
| Sandy earths on Well drained floodplain | 1 |
| Steep slopes | 22 |

Soil Series: none allocated

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
Assists, but does not replace on site assessment recommended for an area on an individual property.
Department of Primary Industry and Regional Development (Feedback Welcome: soil.maps@dpiird.wa.gov.au)

Land Qualities summary - % Map Unit (column 1 most limiting, 4 least)

| o | C | C1 | C2 | C3 | C4 |
|---|------------------------|-------------------------|--------------------|-------------------------|--------------------------|
| 1 | pH | | | | |
| 1 | 0-10 acidity | very strongly acid: 0 % | strongly acid: 0 % | | |
| 1 | 0-10 alkalinity | strongly alkaline: 0 % | alkaline: 0 % | | |
| 1 | 50-80 acidity | very strongly acid: 0 % | strongly acid: 1 % | | |
| 1 | 50-80 alkalinity | strongly alkaline: 0 % | alkaline: 0 % | | |
| 1 | acidification risk | presently acid: 2 % | high: 98 % | moderate: 0 % | low: 0 % |
| 2 | SALINITY | | | | |
| 2 | salinity risk | presently saline: 0 % | high: 0 % | moderate: 0 % | nil or partial: 100 % |
| 2 | surface salinity | extreme: 0 % | high: 0 % | moderate: 0 % | slight to nil: 100 % |
| 3 | SOME PLANT LIMITS | | | | |
| 3 | rooting depth | very shallow: 0 % | shallow: 0 % | moderately shallow: 1 % | v deep to moderate: 99 % |
| 3 | sub surface compact | high: 42 % | moderate: 39 % | low: 19 % | |
| 3 | water repel | high: 0 % | moderate: 19 % | low: 0 % | nil: 81 % |
| 3 | water storage | extremely low: 0 % | very low: 0 % | low: 0 % | high to moderate: 100 % |
| 4 | EROSION | | | | |
| 4 | flood risk | high: 0 % | moderate: 1 % | low: 2 % | low: 97 % |
| 4 | instability | high: 0 % | moderate: 0 % | low: 1 % | nil to very low: 99 % |
| 4 | water erosion | extreme: 1 % | very high: 21 % | high: 27 % | nil to moderate: 51 % |
| 4 | wind erosion | extreme: 0 % | very high: 0 % | high: 53 % | nil to moderate: 47 % |
| 5 | WATER & DRAINAGE | | | | |
| 5 | site drainage | very poor: 1 % | poor: 0 % | moderate: 0 % | high: 99 % |
| 5 | waterlogging | very high: 1 % | high: 1 % | moderate: 0 % | nil to low: 99 % |
| 6 | OTHER QUALITIES | | | | |
| 6 | excavation ease | very low: 22 % | low: 1 % | moderate: 0 % | high: 77 % |
| 6 | microbial purification | very low: 1 % | low: 2 % | moderate: 29 % | high: 68 % |
| 6 | phosphorus loss | extreme: 1 % | very high: 22 % | high: 27 % | nil to moderate: 50 % |

Land capability assessment (Class %, code and description)

| Land Use | o | pc1_2 | pc3 | pc4_5 | Code | Cap Rating desc |
|------------------------|---|-------|-----|-------|------|---------------------------------------|
| Annual horticulture | 1 | 9 | 41 | 50 | B2 | 50-70% of the area is Class 1, 2 or 3 |
| Dry Cropping | 4 | 0 | 50 | 50 | B2 | 50-70% of the area is Class 1, 2 or 3 |
| Grazing | 5 | 29 | 69 | 2 | B1 | >70% of the area is Class 1, 2 or 3 |
| Perennial horticulture | 2 | 49 | 28 | 23 | B1 | >70% of the area is Class 1, 2 or 3 |
| Vineyards | 3 | 50 | 27 | 23 | A2 | 50-70% of the area is Class 1 or 2 |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
 Assists, but does not replace on site assessment recommended for an area on an individual property.
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Crowea (Pimelia) Brown duplex Phase (254PvCRb)

symbol: 254PvCRb **name:** Crowea (Pimelia), brown duplex Phase
type:soil-landscape **rank:** phase **status:** current

brief description: Brown gravelly duplex soils and red earths; karri-marri forest.

soil: Loamy gravels, Red deep loamy duplexes and Friable red/brown loamy earths

soil notes: The main soils have brown, gravelly A horizons often 50 to 100 cm thick, and mottled clay B horizons with a dominant hue of 7.5 YR (Dy 2.61, Dy 2.62). Red earth's or red duplex soils also occur.

landform: Broad ridge crests

landform notes: The unit comprises broadly convex ridge crests and the flanks of gentle upper slopes and ridges. When examples of this unit are wide enough, the terrain may be slightly undulating, about 20 m high. CRb tends to be on the flanks of the ridge tops and merges downslope with major valley units such as Donnelly, Warren and Lefroy. West of Manjimup, Crowea is at 300 m AHD but its elevation declines southward to about 60 m near the Dombakup pine plantation.

geology: weathered mantle over gneiss

geol notes: The deep kaolinitic mantle developed from gneissic rock is a common substrate to a colluvial surface mantle. Fresh rock outcrops are rare.

vegetation: Karri-marri-banksia-she oak forest

vegetation notes: A tall, open forest (40 to 80 m high) of *Eucalyptus diversicolor* (karri) and marri is dominant, with *Banksia grandis*, *Allocasuarina decussata* and *Persoonia longifolia* as a low tree layer. Of significance in the dense shrub layer are *Acacia pentadenia*, *Trymalium floribundum*, *Chorilaena quercifolia*, *Hovea elliptica* (oval-leaved hovea), *Bossiaea linophylla* and *Clematis pubescens*.

location: Southern Forests between the Donnelly River and Northcliffe

other information: Landform, geology, soil and vegetation notes adapted from the Manjimup survey (Land Resources Series No. 10 - Churchward, 1992).

landform pattern: **landform element:**
relief/modal slope class(s):
morphological type(s): **slope:**

Occurs in Projects

| Code | Name | Mapped (ha) | Scale | Reference | Finish | Reliability |
|------|--|-------------|----------|--|--------|--|
| MINJ | Manjimup land resources survey | 25,253 | 1:100000 | Churchward, H.M. (1992). Soils and landforms of the Manjimup area, Western Australia. Land Resources Series No. 10. Department of Agriculture, Western Australia | 1992 | High data quality, midscale or imprecise mapping |
| SCH | South Coast and hinterland landforms and soils | 17,739 | 1:100000 | Churchward, H.M., McArthur, W.M., Sewell, P.L. and Bartle, G.A. (1988). Landforms and soils of the south coast and hinterland, W.A., Northcliffe to Manypeaks. CSIRO Australia. Inst. of Nat. Res. and Env., Div. of Water Resources, Div. Report 88/1 | 1988 | Medium data quality, midscale or imprecise mapping |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
 Assists, but does not replace on site assessment recommended for an area on an individual property.
 Department of Primary Industry and Regional Development (Feedback Welcome: soil.maps@dpiird.wa.gov.au)

Zone Land Units (WA Soil Groups by Qualifier and Landscape Position in Zone percent of Map Unit)

| WASG Name | Qualifier | Landscape | % | MySoil | Simple Landscape |
|-------------------------------|-----------------------------|---------------------|----|------------------------------|------------------|
| Yellow deep sand | good sand, very deep | slopes 1-3% | 2 | Coloured sands | Gentle slopes |
| Yellow deep sand | fair sand, effective duplex | slopes 3-5% | 1 | Coloured sands | Gentle slopes |
| Yellow deep sand | good sand, very deep | slopes 3-5% | 4 | Coloured sands | Gentle slopes |
| Friable red/brown loamy earth | good neutral subsoil | slopes 10-15% | 3 | Deep loamy duplexes & earths | Moderate slopes |
| Brown deep loamy duplex | good neutral subsoil | slopes 10-15% | 8 | Deep loamy duplexes & earths | Moderate slopes |
| Brown deep loamy duplex | good neutral subsoil | slopes 15-30% | 5 | Deep loamy duplexes & earths | Steep slopes |
| Red deep loamy duplex | good neutral subsoil | slopes 3-5% | 4 | Deep loamy duplexes & earths | Gentle slopes |
| Brown loamy earth | good neutral subsoil | slopes 15-30% | 2 | Deep loamy duplexes & earths | Steep slopes |
| Friable red/brown loamy earth | good neutral subsoil | slopes 5-10% | 5 | Deep loamy duplexes & earths | Gentle slopes |
| Deep sandy gravel | poor sand, very deep | slopes 3-5% | 3 | Gravels | Gentle slopes |
| Duplex sandy gravel | neutral subsoil | crests & slopes <3% | 5 | Gravels | Gentle slopes |
| Deep sandy gravel | poor sand, very deep | slopes 1-3% | 3 | Gravels | Gentle slopes |
| Loamy gravel | no clay loam in top 80cm | slopes 5-10% | 15 | Gravels | Gentle slopes |
| Loamy gravel | neutral subsoil | slopes 10-15% | 5 | Gravels | Moderate slopes |
| Loamy gravel | neutral subsoil | crests & slopes <3% | 5 | Gravels | Gentle slopes |
| Loamy gravel | neutral subsoil | slopes 5-10% | 15 | Gravels | Gentle slopes |
| Loamy gravel | neutral subsoil | slopes 3-5% | 5 | Gravels | Gentle slopes |
| Duplex sandy gravel | neutral subsoil | slopes 5-10% | 1 | Gravels | Gentle slopes |
| Pale deep sand | poor sand, effective duplex | slopes 3-5% | 2 | Pale sands | Gentle slopes |
| Yellow sandy earth | good neutral subsoil | slopes 1-3% | 2 | Sandy earths | Gentle slopes |
| Shallow gravel | sandy matrix | crests & slopes <3% | 5 | Stony soils | Gentle slopes |

Summary My Soil by simple landscape (percent of Map Unit)

| Land | tot | Saline wet | Semi-wet soils | Calcareous sands | Pale sands | Coloured sands | Sandy earths | Shallow sand | Gravels | Deep sandy duplexes | Shallow sandy duplexes | Alkaline shallow duplex | Shallow loam | Deep loamy duplexes & earths | Clays & shallow loamy duplexes | Self-mulching clays | Calcareous loamy earths | Stony soils | Bare rock | No information |
|-----------------|-----|------------|----------------|------------------|------------|----------------|--------------|--------------|---------|---------------------|------------------------|-------------------------|--------------|------------------------------|--------------------------------|---------------------|-------------------------|-------------|-----------|----------------|
| Gentle slopes | 77 | | | | 2 | 7 | 2 | | 52 | | | | | 9 | | | | 5 | | |
| Moderate slopes | 16 | | | | | | | | 5 | | | | | 11 | | | | | | |
| Steep slopes | 7 | | | | | | | | | | | | | 7 | | | | | | |

Land Management Units (percent of Map Unit)

| LMU | % |
|---|----|
| Coloured sands on Gentle slopes | 7 |
| Deep loamy duplexes & earths on Gentle slopes | 9 |
| Deep loamy duplexes & earths on Moderate slopes | 11 |
| Gravels on Gentle slopes | 52 |
| Gravels on Moderate slopes | 5 |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.

Assists, but does not replace on site assessment recommended for an area on an individual property.

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Map Unit Report: Crowea (Pimelia), brown duplex Phase (254PvCRb)

| LMU | % |
|-------------------------------|---|
| Pale sands on Gentle slopes | 2 |
| Sandy earths on Gentle slopes | 2 |
| Steep slopes | 7 |
| Stony soils | 5 |

Soil Series: none allocated

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
Assists, but does not replace on site assessment recommended for an area on an individual property.
Department of Primary Industry and Regional Development (Feedback Welcome: soil.maps@dpird.wa.gov.au)

Land Qualities summary - % Map Unit (column 1 most limiting, 4 least)

| o | C | C1 | C2 | C3 | C4 |
|---|------------------------|-------------------------|--------------------|-------------------------|--------------------------|
| 1 | pH | | | | |
| 1 | 0-10 acidity | very strongly acid: 0 % | strongly acid: 0 % | | |
| 1 | 0-10 alkalinity | strongly alkaline: 0 % | alkaline: 0 % | | |
| 1 | 50-80 acidity | very strongly acid: 0 % | strongly acid: 0 % | | |
| 1 | 50-80 alkalinity | strongly alkaline: 0 % | alkaline: 0 % | | |
| 1 | acidification risk | presently acid: 24 % | high: 76 % | moderate: 0 % | low: 0 % |
| 2 | SALINITY | | | | |
| 2 | salinity risk | presently saline: 0 % | high: 0 % | moderate: 0 % | nil or partial: 100 % |
| 2 | surface salinity | extreme: 0 % | high: 0 % | moderate: 0 % | slight to nil: 100 % |
| 3 | SOME PLANT LIMITS | | | | |
| 3 | rooting depth | very shallow: 0 % | shallow: 0 % | moderately shallow: 5 % | v deep to moderate: 95 % |
| 3 | sub surface compact | high: 48 % | moderate: 44 % | low: 8 % | |
| 3 | water repell | high: 8 % | moderate: 14 % | low: 0 % | nil: 78 % |
| 3 | water storage | extremely low: 11 % | very low: 2 % | low: 1 % | high to moderate: 86 % |
| 4 | EROSION | | | | |
| 4 | flood risk | high: 0 % | moderate: 0 % | low: 0 % | low: 100 % |
| 4 | instability | high: 0 % | moderate: 0 % | low: 0 % | nil to very low: 100 % |
| 4 | water erosion | extreme: 0 % | very high: 7 % | high: 16 % | nil to moderate: 77 % |
| 4 | wind erosion | extreme: 0 % | very high: 15 % | high: 41 % | nil to moderate: 44 % |
| 5 | WATER & DRAINAGE | | | | |
| 5 | site drainage | very poor: 0 % | poor: 0 % | moderate: 0 % | high: 100 % |
| 5 | waterlogging | very high: 0 % | high: 0 % | moderate: 0 % | nil to low: 100 % |
| 6 | OTHER QUALITIES | | | | |
| 6 | excavation ease | very low: 7 % | low: 0 % | moderate: 5 % | high: 88 % |
| 6 | microbial purification | very low: 0 % | low: 8 % | moderate: 21 % | high: 71 % |
| 6 | phosphorus loss | extreme: 0 % | very high: 9 % | high: 16 % | nil to moderate: 75 % |

Land capability assessment (Class %, code and description)

| Land Use | o | pc1_2 | pc3 | pc4_5 | Code | Cap Rating desc |
|------------------------|---|-------|-----|-------|------|---------------------------------------|
| Annual horticulture | 1 | 6 | 69 | 25 | B1 | >70% of the area is Class 1, 2 or 3 |
| Dry Cropping | 4 | 0 | 66 | 34 | B2 | 50-70% of the area is Class 1, 2 or 3 |
| Grazing | 5 | 37 | 42 | 21 | B1 | >70% of the area is Class 1, 2 or 3 |
| Perennial horticulture | 2 | 54 | 39 | 7 | A2 | 50-70% of the area is Class 1 or 2 |
| Vineyards | 3 | 54 | 39 | 7 | A2 | 50-70% of the area is Class 1 or 2 |

Information modelled from broad scale mapping generalised for whole of map unit as at: 29-03-2019.
Assists, but does not replace on site assessment recommended for an area on an individual property.
Department of Primary Industry and Regional Development (Feedback Welcome: soil.maps@dpiird.wa.gov.au)

7.0 ASSESSMENT OF LAND DEGRADATION RISKS FOR MAP UNITS

Table 3 summarises the risk of land degradation for the proposed clearing.

Table 3 Risk assessment summaries for map units on proposed clearing area

| Risk categories | Map unit 1 Minor Valleys (S1) Subsystem (Pimelia) | Map unit 2 Angove subsystem (Northcliffe) | Map unit 3 Crowea subsystem, brown duplex phase (Pimelia) | Map unit 4 Major Valleys (V2) Subsystem (Pimelia) |
|--|--|--|--|--|
| Wind erosion | 100% of map unit has a low to high risk | 100% of map unit has a low to high risk | 15% of map unit has a very high risk | 100% of map unit has a low to high risk |
| <p>Discussion: Will removal of native vegetation be likely to contribute to wind erosion.</p> <p>Most landforms and soil types on this property have reduced exposure to wind, including lower slopes and swamps. The map unit 254PvCRb, with upper slopes and ridge landforms, has 15% very high risk identified. Most of this unit is already cleared, and further clearing is unlikely to have an impact. The risk of wind causing land degradation is low.</p> | | | | |
| Water erosion | 39% of map unit has a high to very high risk | 5% of map unit has a high risk | 23% of map unit has a high to very high risk | 49% of map unit has a high to extreme risk |
| <p>Discussion: Is removal of native vegetation likely to contribute to water erosion?</p> <p>In this very high rainfall zone, water erosion risk may increase due to landform and soil types, particularly on steeper slopes, if the native vegetation is removed. Assessment of all map units suggests that water erosion is a risk, particularly in valleys of the Pimelia System, ranging from 25-50% of the area with a high to extreme risk of erosion.</p> <p>On site assessment found that the risk of water erosion is likely to increase with the clearing of native vegetation and the establishment of the land for agricultural use. In addition to previously mentioned signs of rilling in Section 6.4, they were also observed on areas of partly cleared firebreaks on slopes of map unit Angove subsystem (254NFAN) (Image 6 in Appendix 1).</p> | | | | |

| Risk categories | Map unit 1 Minor Valleys (S1) Subsystem (Pimelia) | Map unit 2 Angove subsystem (Northcliffe) | Map unit 3 Crowea subsystem, brown duplex phase (Pimelia) | Map unit 4 Major Valleys (V2) Subsystem (Pimelia) |
|---|--|--|--|--|
| Salinity risk | 100% nil or partial risk | 100% nil or partial risk | 100% nil or partial risk | 100% nil or partial risk |
| Surface salinity | 100% slight to nil | 100% slight to nil | 100% slight to nil | 100% slight to nil |
| <p>Discussion: Will the removal of native vegetation contribute to a rise in groundwater table and on site or off site salinity?</p> <p>No salinity is occurring on the property. No significant change is expected. The risk of salinity causing land degradation is low</p> | | | | |
| Flood risk | 16% has a high risk | 100% has nil to moderate risk | 100% has nil to moderate risk | 100% has nil to moderate risk |
| <p>Discussion: Will the removal of native vegetation contribute to flooding?</p> <p>Valley floor and swampy units have a risk of flooding. In this area the risk is considered to be low with the combination of landscape position and soil types.</p> | | | | |
| Waterlogging | 16% of map unit has a high to very high risk | 33% of map unit has a high to very high risk | 100% of map unit has nil to moderate risk | 1% of map unit has a very high risk |
| <p>Discussion: Will removal of native vegetation contribute to waterlogging?</p> <p>Waterlogging is a limitation in the dominant map units, particularly on swampy areas and valley floors where signs of waterlogging are already present. Onsite assessment found that there are many swampy and wet areas on the property, including patches of reeds mid slope on some cleared areas indicating hill side seepages (Image 4 in Appendix 1). Most of the valley floor and swamp areas accessed by cattle also showed signs of pugging which seals the soil surface and further exacerbates waterlogging by impeding infiltration (see Images 1-3 in Appendix 1).</p> <p>Removal of native vegetation from this area for the establishment of the land for agricultural use will increase the risk of waterlogging causing land degradation on the property.</p> | | | | |
| Phosphorus export risk | 25% of map unit has a very high to extreme risk | 17% of map unit has a very high to extreme risk | 9% of map unit has a very high risk | 23% of map unit has a very high to extreme risk |
| <p>Discussion: Will removal of native vegetation be likely to contribute nutrient enrichment of surface and/or groundwater bodies leading to eutrophication.</p> <p>Phosphorus export risk is a strong limitation in most units, particularly on swampy areas and valley floors. Clearing of native vegetation for the establishment of agriculture is likely to increase nutrient enrichment of surface water bodies. Assessment of all map units suggests that eutrophication is a risk, with up to 25% of some units having a very high to extreme risk of phosphorus loss.</p> <p>The coarse, gritty nature of sands in the Angove subsystem (254NfAN) are likely to be very susceptible to this as the dominant soils exhibit low to extremely low water or nutrient storage ability (see Images 7 & 8 in Appendix 1).</p> | | | | |

Appendix H. Sources of information

H.1. GIS databases

Publicly available GIS Databases used (sourced from www.data.wa.gov.au):

- 10 Metre Contours (DPIRD-073)
- Aboriginal Heritage Places (DPLH-001)
- Aboriginal Heritage Places (DPLH-001)
- Cadastre (LGATE-218)
- Cadastre Address (LGATE-002)
- Contours (DPIRD-073)
- DBCA – Lands of Interest (DBCA-012)
- DBCA Legislated Lands and Waters (DBCA-011)
- Directory of Important Wetlands in Australia – Western Australia (DBCA-045)
- Environmentally Sensitive Areas (DWER-046)
- Flood Risk (DPIRD-007)
- Groundwater Salinity Statewide (DWER-026)
- Hydrography – Inland Waters – Waterlines
- Hydrological Zones of Western Australia (DPIRD-069)
- IBRA Vegetation Statistics
- Imagery
- Local Planning Scheme – Zones and Reserves (DPLH-071)
- Native Title (ILUA) (LGATE-067)
- Offsets Register – Offsets (DWER-078)
- Pre-European Vegetation Statistics
- Public Drinking Water Source Areas (DWER-033)
- Ramsar Sites (DBCA-010)
- Regional Parks (DBCA-026)
- Remnant Vegetation, All Areas
- RIWI Act, Groundwater Areas (DWER-034)
- RIWI Act, Surface Water Areas and Irrigation Districts (DWER-037)
- Soil Landscape Land Quality – Flood Risk (DPIRD-007)
- Soil Landscape Land Quality – Phosphorus Export Risk (DPIRD-010)
- Soil Landscape Land Quality – Subsurface Acidification Risk (DPIRD-011)
- Soil Landscape Land Quality – Water Erosion Risk (DPIRD-013)
- Soil Landscape Land Quality – Water Repellence Risk (DPIRD-014)
- Soil Landscape Land Quality – Waterlogging Risk (DPIRD-015)
- Soil Landscape Land Quality – Wind Erosion Risk (DPIRD-016)
- Soil Landscape Mapping – Best Available
- Soil Landscape Mapping – Systems
- Wheatbelt Wetlands Stage 1 (DBCA-021)

Restricted GIS Databases used:

- ICMS (Incident Complaints Management System) – Points and Polygons
- Threatened Flora (TPFL)
- Threatened Flora (WAHerb)
- Threatened Fauna
- Threatened Ecological Communities and Priority Ecological Communities
- Threatened Ecological Communities and Priority Ecological Communities (Buffers)

H.2. References

- Bamford Consulting Ecologists (Bamford) (2013). Plants known to be used for foraging, roosting and nesting by black-cockatoos in south-western Western Australia. Data compiled from the literature (Davies, 1966; Saunders, 1974, 1979a, b, 1980; Saunders *et al.* 1982; Saunders, 1986; Johnstone and Storr, 1998; Higgins 1999; Johnstone and Kirkby, 1999, 2008; Groom, 2011; Johnstone *et al.* 2011; DSEWPaC, 2012a, b; c, R. Johnstone *pers. comm.*) in Bamford (2013) Wedgetail Circle, Parkerville Fauna Assessment. Prepared for Coterra Environment. Bamford Consulting Ecologists. Prepared by Jeff Turpin, Simon Cherriman and Mike Bamford. 14th August 2013.
- Bureau of Meteorology (BOM) (2020) Climate Data Online. Available online at: www.bom.gov.au/climate/data/index.shtml.
- Brown, A., Thomson-Dans, C. and Marchant, N. (1998). Western Australia's Threatened Flora. Como, Western Australia: Department of Conservation and Land Management.
- Commonwealth of Australia (2001) National Objectives and Targets for Biodiversity Conservation 2001-2005, Canberra.
- Commonwealth of Australia (2017) Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo.
- Department of Biodiversity, Conservation and Attractions (DBCA) (2007-) NatureMap: Mapping Western Australia's Biodiversity. Department of Parks and Wildlife. URL: <http://naturemap.dpaw.wa.gov.au/>. Accessed March 2020.
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