GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

PARKS AND WILDLIFE SERVICE

Review of old-growth forest status – Public nomination

Dalgarup 0118 (Cell 5)

Parks and Wildlife Service

May 2020

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Cover images: Regrowth cohort in Dalgarup 0118 re-survey area (left). Canopy structure of late mature / senescent trees in re-survey area (right).

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Summary

A public nomination to review the old-growth forest status of jarrah forest within the Dalgarup 0118 timber harvest coupe was received by the Department of Biodiversity, Conservation and Attractions (DBCA) on 12 May 2020. The location details of a specific area of interest in cell 5 depicted on the Forest Products Commission (FPC) operations plan for the active coupe was subsequently received on 14 May.

Based on the results of an earlier detailed assessment in 2018 which found 75 hectares of previously unmapped jarrah old-growth forest in the coupe, a targeted field inspection and re-survey of the nominated area of interest and surrounds was conducted on 18 May, complemented by further stratification from aerial colour imagery on 19 May 2020.

Re-assessment using the DBCA *Procedures for the assessment, identification and demarcation of old-growth forest* (FEM075) found a similar pattern but higher number of indicators of human-induced disturbance (stumps, ring-barked trees either standing or fallen) than the 2018 assessment, most likely as more assessors were involved. The re-survey and inspection generated the same boundaries and extent of old-growth forest as the 2018 assessment, and no additional areas of jarrah old-growth forest were identified.

An assessment of the area using a variation of the historic procedures used by the former Conservation Commission did not provide a conclusive result in regard to whether the area should be defined as old-growth forest. The assessment was limited by the data available, and an inability to reliably determine the proportion of the upper crown canopy occupied by mature and senescent trees from aerial photography. However, the relatively high frequency of stumps and ring-barked trees, combined with the proportion and pattern of regrowth stems across the area suggest full application of the Conservation Commission procedures would likely also classify the forest in cell 5 as not old-growth forest.

Both the FEM075 and Conservation Commission procedures refer to stumps and ring-barked trees as indicators of previous disturbance; however, neither provides definitive guidance on whether old ring-barked trees (standing or blown over) should have equal weighting to stumps in determining old-growth forest status. It is noted that cell 5 of Dalgarup 0118 contains an unusually high number of ring-barked trees, representing an anomaly in this regard.

1 Introduction

The *Forest Management Plan 2014*-2023 (FMP) provides for the public to nominate to the Department of Biodiversity, Conservation and Attractions (DBCA) areas of forest which may be unmapped old-growth forest, for subsequent assessment to determine their old-growth forest status. Areas of old-growth forest are not available for timber harvesting.

Dalgarup forest is located west of Bridgetown. The majority of the forest block was included in Dalgarup National Park in 2004, one of the national parks created under the State Government's 2001 *Protecting our old-growth forests* policy. Dalgarup 0118 harvest coupe (176 hectares) is adjacent to the national park's western boundary and situated approximately 5km west of Bridgetown. DBCA records indicate that this section of forest was not included in the national park following stakeholder consultation, also noting it was not old-growth forest. It therefore remained State forest.

DBCA received a public nomination on 12 May 2020 requesting a review of the old-growth forest status for cells 3 and 5 depicted on the Forest Products Commission (FPC) operations plan for the Dalgarup 0118 harvest coupe (Figure 1). The nomination suggested there were few stumps (used as an indicator of previous harvest extent and intensity) in some areas and this lack of previous harvest disturbance indicated old-growth forest was present within the areas available for timber harvest. The geographic location of a specific patch of interest (approximately 2 hectares) within cell 5 of the coupe was provided on 14 May 2020.

As part of the routine coupe planning process, an earlier assessment of the old-growth forest status of all areas within the coupe had been undertaken in 2018, following formal referral of the area by the FPC on 15 November 2017. That review (Appendix 1), conducted in accordance with the DBCA *Procedures for the assessment, identification and demarcation of old-growth forest* (Procedure FEM075), identified 75 hectares of previously unmapped old-growth forest. Following final detailed coupe planning and exclusion of old-growth forest and other informal reserves, 72 hectares of the original 176 hectares remained available for timber harvest.

This report documents the results of a reassessment of the nominated area of interest, and a preliminary comparison to a set of procedures used by the former Conservation Commission (Conservation Commission of Western Australia, 2005) to determine the old-growth forest status of the nominated areas.

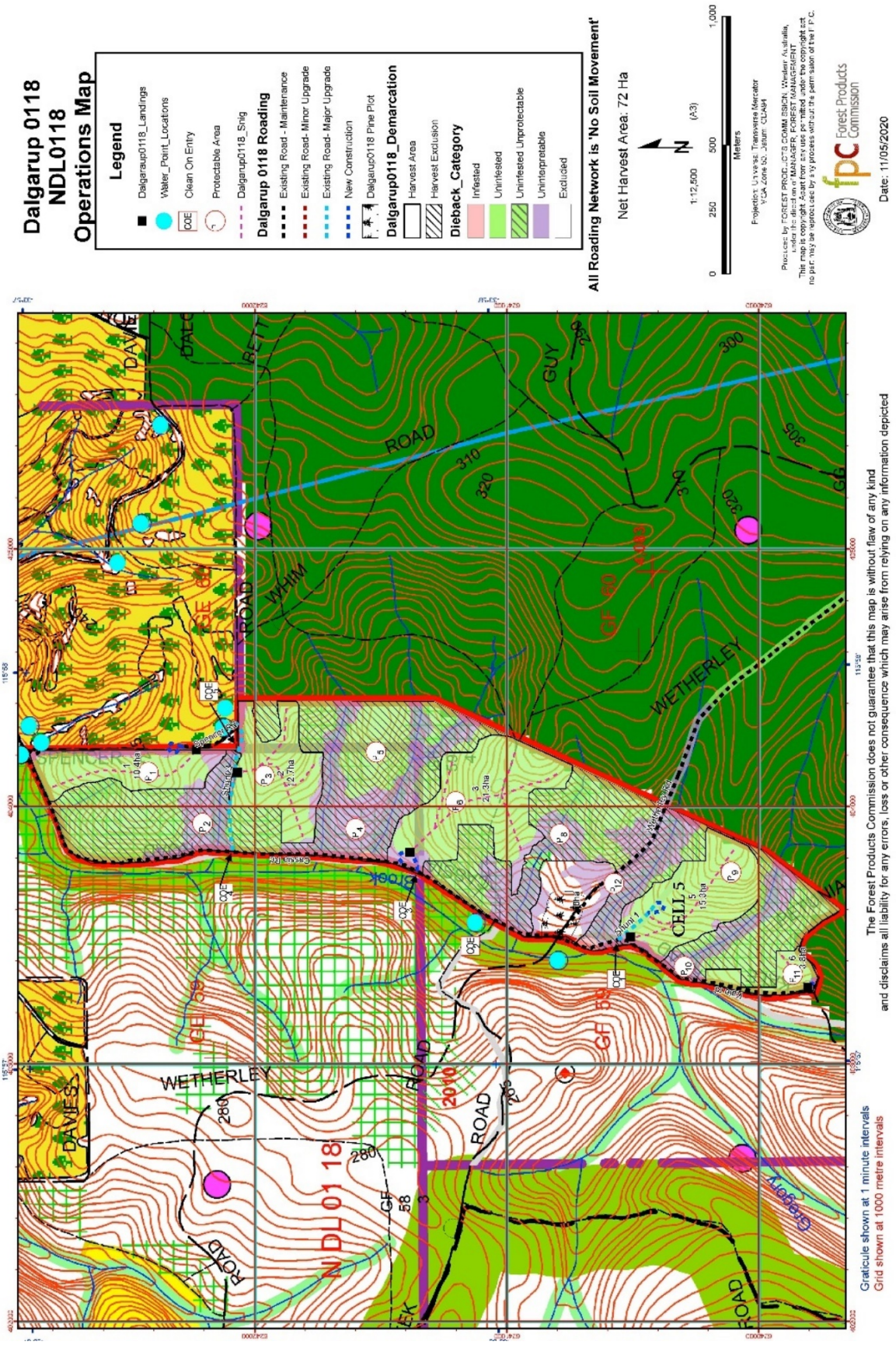


Figure 1 Operations map for Dalgarup 0118 depicting location of cell 5.

2 Method

The forest in Dalgarup 0118 is dominated by a mixture of jarrah and marri, with blackbutt present in the moist gullies of the sloping terrain. In this forest type, 'old-growth forest' is defined as 'uncut (never harvested) forest or forest subject to minimal disturbance and that is not affected by *Phytophthora cinnamomi*' (RFA 1998; Department of Parks and Wildlife 2017).

The 2018 old-growth forest assessment report (Appendix 1) describes the natural features and disturbance history of the forest in the coupe, and the analysis to determine the old-growth forest status of all areas within the coupe. The public nomination submitted in May 2020 focussed on a subset of the coupe (cell 5), so a targeted field inspection and re-survey of the main area of cell 5 including the nominated area of interest (2 hectares) was undertaken, in order to validate the old-growth forest status.

Experienced field officers from DBCA re-surveyed over 16 hectares of the central area of cell 5 using Procedure FEM075. This included the nominated area of interest. In addition, the location and tree growth form (regrowth or mature) were also recorded for select trees along the survey transects. This data was used to inform a subsequent stratification of regrowth and mature canopy cover using aerial photographs.

The resurvey involved six field assessors walking transects to record the presence of stumps from harvest events and other disturbance indicators across the 16 hectares. This provided complete coverage of the area at a higher intensity of sampling than the 2018 assessment.

The field data was imported to a GIS environment for comparison with the earlier assessment, and to assist photo-interpretation of the proportion that regrowth stems contributed to the total canopy cover. Both FEM075 and the historic Conservation Commission procedures apply a minimum mappable unit of two hectares to determine old-growth forest extent and boundaries.

2.1 Systematic comparison with the 2018 assessment

Old-growth forest status is determined through the intersection of multiple datasets describing land tenure, forest type, structure, harvest and other disturbance history and disease occurrence. Datasets of stump location and number gathered from field surveys are also combined to inform old-growth forest status.

Datasets were analysed to compare the location, type (stumps and ring-barked trees) and number of disturbance indicators recorded in each assessment. An exact comparison was confounded by a small portion of cell 5 having been harvested by the time of the re-survey. The few indicator points recorded in the original assessment that were buried under harvest debris were assumed to still be there during the re-survey. This enabled a comparison between the extent and boundaries of old-growth forest derived from the re-survey with those derived in the 2018 assessment.

2.2 Comparison with Conservation Commission procedures

The historic procedures used by the former Conservation Commission are described in the 2005 document *Assessment criteria and process for the Conservation Commission review of old-growth amendments*. Those procedures evolved over time and were replaced by the current FEM075 procedures, which were finalised in consultation with the Conservation and Parks Commission in 2017. Both the FEM075 and the historic Conservation Commission procedures ultimately determine the old-growth forest status using a stump/disturbance threshold (below which areas are deemed minimally disturbed and hence old-growth forest). In a two-step process, the Conservation Commission procedures determined a stump/ disturbance threshold from patches of forest where mature or senescent trees comprised more than 50 per cent of the total crown cover. All those areas containing stump numbers below this threshold are subsequently classified as old-growth forest.

However, a major challenge in implementing the procedure in mixed species, multi-aged stands, such as that found in cell 5 of Dalgarup 0118, is determining the proportion of total crown cover comprising mature and senescent trees. The Conservation Commission procedures involved intensive ground-based sampling of canopy cover, which can be time-consuming and imprecise.

Within the short period available, an approach more tailored to the data and technology now available was adopted whereby the proportion of crown cover was measured from aerial photographs, informed by the location, diameter and growth form (regrowth, young mature, mature, over-mature) of a sample of trees recorded throughout the re-surveyed area. These data were aligned to aerial photographic images (50 cm resolution) from which the colour, shape, size and vertical position of the crowns were used to guide a broader photo-interpretation. This provided the proportion of regrowth to mature canopy cover within patches considered likely from the ground inspection to comprise approximately 50 per cent of the total canopy crown cover contributed by mature or senescent trees. These areas were then used to infer the stump/disturbance indicator threshold to apply across the survey area.

3 Results

3.1 General

The forest structure and condition within harvest cell 5 reflect a history of natural and human-induced disturbance not commonly seen in the jarrah forest. It is considered likely a combination of bushfire and storm events created patches of regeneration that were pole-sized by the time a harvest event occurred in the 1940s. The silvicultural system applied at that time appears to have been a mix of single tree selection and the Australian group selection system, which targeted merchantable trees larger than 90 cm diameter.

Ring-barking (i.e. removal of a strip of bark around the complete circumference of the tree, in this case with an axe) of large, potentially merchantable trees has also occurred across the area. While the reason is unknown, this may have been

associated with the 1940s harvest event or a separate land clearing initiative around that period. The ring-barking has also created a regeneration cohort or allowed adjacent younger trees to grow, as the ring-barked trees died.

The cumulative impact of the harvesting and ring-barking, and the subsequent forest growth and fire events has given rise by 2020 to a fine-scale mosaic of patches dominated by regrowth, young mature and/or overmature trees. There are many trees blown over by storms of varying size across the area, including a high proportion of the ring-barked trees. Within this multi-aged, mixed species forest there are distinct age groups, with very large senescing trees in some locations exceeding 1.5 metres diameter; a cohort of young mature trees around the 80-90cm size class; older regrowth trees around 65cm diameter; and a cohort of young regrowth around 25-35cm diameter that are likely to have regenerated following the 1940s cutting.

3.2 Comparison to 2018 assessment of old-growth forest status

Procedure FEM075 includes ring-barked trees and stumps from harvest as evidence of past disturbance (the ring-barked trees constitute historical silvicultural treatment). The re-survey results were consistent with the 2018 assessment. Overall, the re-survey identified a significant number of additional stumps and ring-barked trees that had not been recorded in the 2018 assessment. This is often the case when a larger number of assessors are deployed to an area, enabling a more detailed inspection across the landscape (three assessors undertook the 2018 survey while six assessors were involved in the re-survey). Figure 2 depicts the location and type of disturbance indicators recorded in the re-surveyed area, with the ‘new’ or additional indicators shown separately. This figure indicates:

- The areas previously identified as old-growth forest from the 2018 assessment were not completely re-surveyed, and it is possible additional disturbance indicators would be identified in some patches with additional sampling/survey effort.
- The nominated area of interest contained few stumps but a high number of ring-barked trees that had died and were either standing or fallen to ground. The dispersed location, targeted species (jarrah only), tree size (generally larger than 90 cm diameter) and type of axe marks on the ring-barked trees suggest they could have been prepared for felling as part of the 1940s harvesting, or as a prelude to land settlement in the area. Remnant fence posts were also recorded in the survey area.
- The location of some stumps and ring-barked trees could not be verified in the re-survey because harvesting had progressed through some patches.
- An average of eight disturbance indicators per hectare (16 per two hectares) were recorded in the re-survey, higher than the 2018 survey due to greater survey effort.

The number and pattern of stumps and ring-barked trees recorded in the re-survey generated the same extent and boundaries of old-growth forest as the 2018 assessment.

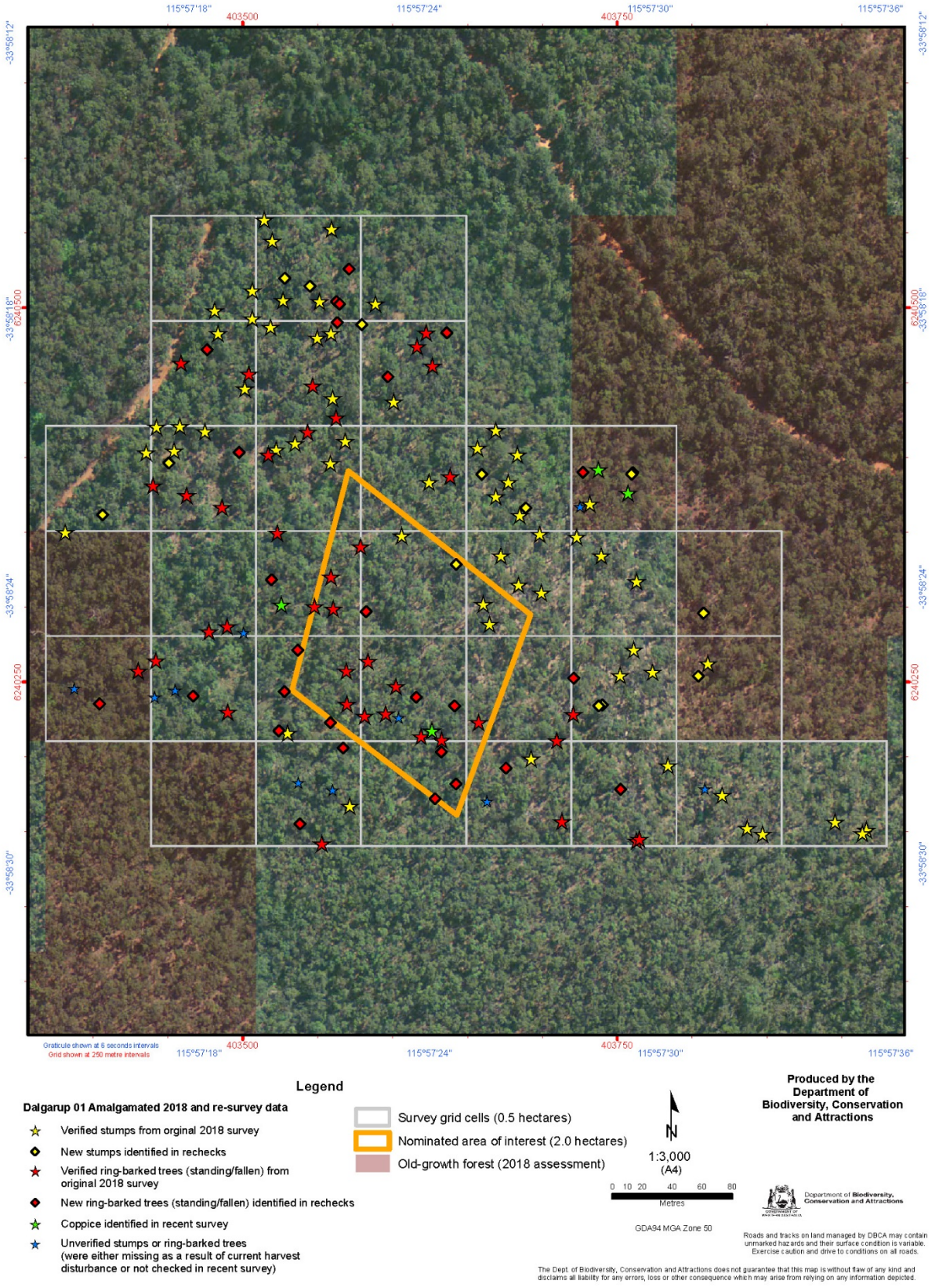


Figure 2 Location and type of disturbance indicators (stumps, ring-barked trees) recorded within the portion of cell 5 in the re-survey and 2018 assessment.

3.3 Comparison to historic Conservation Commission procedure

The relative proportion of upper canopy cover occupied by mature and senescent trees was unable to be confidently determined using field data combined with interpretation of the available colour imagery at 50 cm resolution, even within a stereo 3-D environment. The relative complexity of multiple growth forms in mixture at small spatial scales (and in this instance similar structure and size for regrowth and mature tree crowns in some areas) proved too complex for this approach.

This prevented a definitive comparison between the extent and boundaries of old-growth forest determined under FEM075 with those that would have been determined under the historic Conservation Commission procedures. However, the threshold number of stumps derived by the Commission during later application of the procedures ranged up to 4.0 stumps per hectare in western jarrah forest (below which an area was considered minimally disturbed and hence old-growth jarrah forest).

The Commission procedures include a general statement under the section on page 20 on 'Disturbance assessment' that *"The types of evidence of harvesting events to be noted in assessments include ... heads, cross-cut logs, treatment (e.g. ring-barking)..."* but do not specifically describe how ring-barked trees were incorporated in an assessment. This suggests ring-barked trees would have also been considered equivalent evidence of harvest disturbance and included in the count of disturbance indicators (with stumps) when determining old-growth forest status.

Figure 3 depicts the combined stump and ring-barked tree count across the two-hectare combinations of the surveyed area. The counts exceeded a minimum of 16 per two hectares (or eight per hectare) in all combinations. On this basis, it is considered likely that a complete application of the historic Conservation Commission procedures would not classify the area within cell 5 as jarrah old-growth forest.

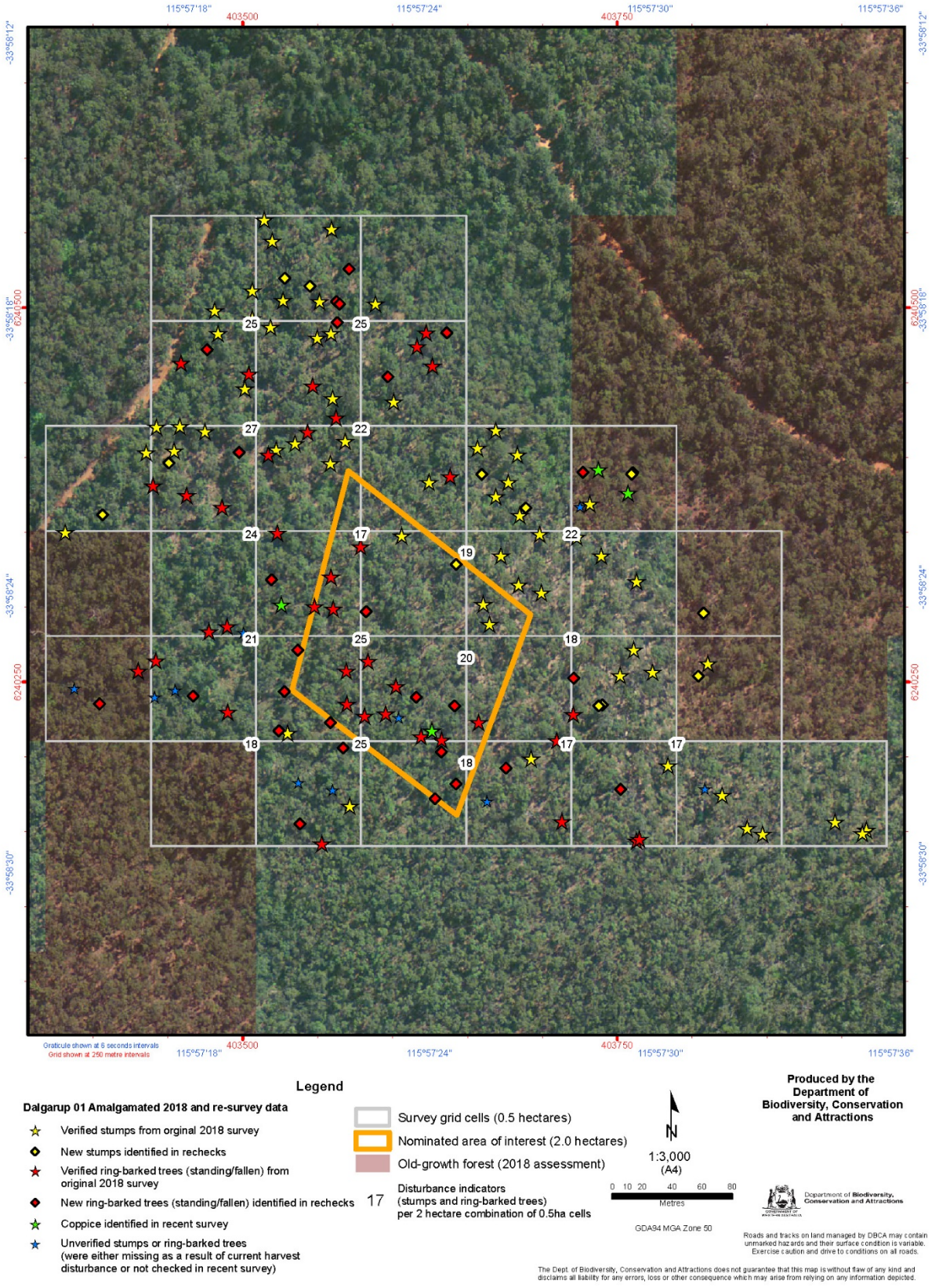


Figure 3 Total number of disturbance indicators per two hectares (comprising combinations of four 0.5 hectare survey grid cells).

4 Conclusions

Both the field inspection and targeted survey indicate that the findings of the initial (2018) report compiled by DBCA in relation to the old-growth forest status in cell 5 of Dalgarup 0118 were consistent with procedure FEM075. No additional stands of minimally disturbed forest were identified that complied with the jarrah old-growth forest definition of ‘uncut forest or forest subject to minimal disturbance which is not known to be affected by *Phytophthora cinnamomi*’. No changes to the old-growth forest status within cell 5 of Dalgarup 0118, beyond those previously identified, are recommended.

Application of the historic Conservation Commission procedures was attempted but did not give a definitive result. Based on previous assessments by the Conservation Commission and the level of disturbance indicators across the area it is considered unlikely use of those procedures would result in any part of the cell being reclassified as old-growth forest.

Both the FEM075 and Conservation Commission procedures refer to stumps and ring-barked trees as indicators of previous disturbance; however, neither provides definitive guidance on whether old ring-barked trees (standing or blown over) should have equal weighting to stumps in determining old-growth forest status. It is noted that cell 5 of Dalgarup 0118 contains an unusually high number of ring-barked trees, representing an anomaly in this regard.

References

Conservation Commission of Western Australia, 2005. *Assessment criteria and process for the Conservation Commission review of old-growth amendments*. Conservation Commission of Western Australia, Perth.

Department of Parks and Wildlife, 2017, *Procedures for the assessment, identification and demarcation of old-growth forest* FEM Procedure No FEM075, Department of Parks and Wildlife, Perth.

RFA (1998). Comprehensive Regional Assessment. A Regional Forest Agreement for Western Australia. Maps. Vol. 2. Joint Commonwealth and Western Australian RFA Steering Committee, Perth. 185 pp

Appendices

Appendix 1 2018 Assessment Report for Dalgarup 0118

Department of Biodiversity, Conservation and Attractions	**Review of old-growth forest status**

Forest Block/ Compartment	Dalgarup 01
Region	South West
District	Blackwood
Date of request	15 November 2017
Origin of request	Forest Products Commission
Location and site description	Dalgarup forest block is located approximately 15 kilometres west of Bridgetown. The coupe is bound by Kale and Petunia Road south of Wetherly Road and Cassia Road north of Wetherley. Part of the Dalgarup pine plantation and Dalgarup National Park form the eastern boundary. The topography of the coupe is characterised by a series of precipitous parallel ridges and intervening streams and gullies that run east to west across the entire length of the coupe (see Appendix 1 – Base map). Fertile, loamy and heavy soils are present in the gullies and lower slopes, while upper slopes are more dominated by gravelly soils with shallow rock (granite) present.
Old-growth forest definition/s applied to assessment area	Jarrah and jarrah/tingle forest – uncut (never harvested) forest or forest subject to minimal disturbance which is not affected by *Phytophthora cinnamomi*

Summary	A review of the nominated area was conducted in accordance with the *Procedures for the assessment, identification and demarcation of old-growth forest* (FEM Procedure FEM075). The review confirmed that of the 174 hectares that encompass the Dalgarup 01 forest coupe, 75 hectares (comprised of 8 separate patches) of minimally disturbed cells met the definition of old-growth jarrah forest. Of these 75 hectares, 3.5 hectares was previously classified diverse ecotype zone (DEZ) which was found to be forest (> 30% crown cover). A further 0.5 hectares of this former DEZ was reclassified to non old-growth jarrah forest.

Informal reserve assessment review– ID number: B-082

Report Reviewed	28 MAR 18 MER
Endorsed	M. Rayner
	Manager, Forest Management Branch

1. Collation of background data and refinement of the assessment area

1.1 Forest type and structure

Historical Aerial Photography Interpretation (API) of imagery capture in 1955 and interpreted in 1961, along with recent high-resolution digital stereo imagery acquired in 2013 were examined to determine forest type, structure and composition, and identify any changes to forest characteristics over time.

The 1955 API indicated that the northern portion of the harvest coupe above Camp Creek Rd was predominantly jarrah/marri (JM) mixed mass stand, consisting of 70 per cent crown cover (M70) and a height class of 25-29 metres (A).

The southern portion of the coupe below Camp Creek Rd was similarly a jarrah/marri mixed forest type, however the forest structure was varied. The southern sections of this area were classified as 'massed' forest stands of between 50 and 70 per cent crown cover, with a height class of 25-29 metres. Two pole stands (P) were recorded in the eastern and south-eastern section of these cells. Within these areas the upper strata crown cover ranged from between 6-30 per cent, with total crown cover varying from 50 to 70 per cent, and height class of 25-29 metres. Several sapling stands (S) surrounded a large cleared area on the western boundary of the coupe. These stands consisted of a sparse number (0-1 percent) of mature trees occupying the upper strata and a sapling or scrub understorey. Total crown cover in these areas ranged between 20-70 per cent, with a height class of 25-29 metres (Appendix 2).

Analysis of 2013 stereo imagery was generally consistent with the 1955 API and subsequent records of harvesting. However, there were three areas of interest (AOI) that were significantly different to historic photo interpretation and may require further investigation in the field (Appendix 2).

- AOI 1 - Originally interpreted as a mass stand, the area clearly appears to be a pole and a sapling stand in the 2013 stereo imagery. The dramatic alterations in forest structure and composition suggest a major disturbance event has impacted this area. In addition, the appearance of pine 'wildling' infestations are clearly visible in this area and along the edge of the coupe boundary adjacent to the neighbouring pine plantation.
- AOI 2 - Although forest structure corresponds with the original API, the composition has markedly changed. Recorded in the DBCA informal reserve system as a non-forest diverse ecotype zone (DEZ) with a total crown cover of less than 30 per cent; recent imagery depicts the area as forested with 55 per cent total crown cover visible, therefore excluding it from being classified as DEZ.

- AOI 3 - The 1955 photography clearly depicts the area as being cleared, however interpretation conducted in 1961 also indicates the establishment of two pine plots at this site. In turn, the un-natural disturbance appears to have had significant influence on the growing patterns of surrounding cells.

1.2 Harvest history

Departmental records in relation to harvesting indicate that the entire coupe has been subjected to one harvest in the decade of 1940-1949, this is depicted in Appendix 3.

1.3 *Phytophthora* dieback status

Phytophthora cinnamomi occurrence mapping of the coupe was completed on the 5th December 2018 by NPC Consulting Dieback Mapping and Management. The project area, consisting of approximately 174 hectares, was interpreted for presence of *Phytophthora* dieback. Most of the coupe was classified as uninfested (119 hectares), with a considerable area (53 hectares) categorised as uninterpretable. Uninterpretable areas were associated with creeks and gullies and some upper slope vegetation where thick Soap Bush (*Trymalium floribundum*) and wildlings from adjacent pine plantations were present. Two small infested areas, totalling 1 hectare, were identified on the western boundary. An area of approximately 5 hectare area of Pine was excluded from interpretation (Appendix 4).

1.5 Fire history

Fire history records indicate the forest within the coupe has been burnt regularly since the 1940s. Prescribed burns were documented in every decade between 1940-2010. Three bushfires were recorded in the vicinity of coupe in 1945,1952 and 2016. Impacts however appeared mostly confined to the south, south-west and north-east edges. A plantation burn was recorded in the 2008 for an area of pine adjacent to the north-east boundary.

1.6 Other disturbances

During field surveys evidence of an old fence line running north-south was detected throughout much the coupe (see Appendix 5). A search of records was unable to confirm if the area had been subject to a possible grazing lease. At least some of the historic fence line appears to be associated with area cleared for pine plots on the eastern boundary.

2. Stratification of disturbance history using aerial photograph interpretation and other datasets

Both historical (1955) and recent photography (2013) was examined to detect evidence of previous harvest or other disturbances within the coupe. Some internal tracks and gaps in the canopy were visible, along with a cleared area and pine (both planted and wild). However, it was not possible to clearly differentiate the pattern and extent of relative disturbance classes in areas cutover many decades ago. No other earlier aerial photography coverage within the

decade of harvest (and hence more likely to depict extent of cutting) was available. Therefore, to capture the full extent of disturbance patterns in the coupe a full field survey was conducted.

3. Field survey of stump occurrence and other disturbance indicators

The survey area was defined using the boundaries of the harvest exclusion zones and *Phytophthora* dieback occurrence. Areas that were particularly steep were also avoided due to issues with occupational health and safety (OHS). Nevertheless, almost the entire coupe was surveyed for stump occurrence and hence potential old-growth forest. A 0.5 hectare FMIS cell grid was used to provide a systematic basis for field sampling, with each 0.5 hectare grid square surveyed for the presence of stumps and other evidence of unnatural disturbance (snig tracks, landings and gravel pits) including those identified in the desktop image analysis.

Consistent with 1940s cutting, and regularly encountered throughout a large proportion of the coupe, was large stumps and their associated regeneration cohort (Figure 1 and 2).

Figure 1. A typical stump in Dalgarup 01 coupe depicting distinctive marks of felling using axe and cross cut saw; characteristically used by fallers prior to 1950s (Beggs, 1971).

Figure 2. Depicts a regeneration cohort in Dalgarup 01. Cohorts within the coupe generally measured above 30cm; the jarrah regeneration within the coupe was consistent with 1940s cutting.

Deep scoured snig tracks along with a landing and several forest tracks were also identified throughout the coupe.

A significant decline in stump intensity was noticeable in steeper areas adjacent to creek lines and down the side of gullies, suggesting steep terrain prevented the extraction of timber from these areas at the time of harvest.

The three AOI that were originally identified in desktop analysis, along with a fourth area identified in the field were carefully investigated for disturbance and the results are as follows:

- AOI 1 - Classified in 1955 as a mass stand jarrah forest. Imagery from 2013 clearly depicted a significant change in the structure and composition of the forest at this site. Field investigation uncovered evidence of severe fire damage to understorey vegetation (Figure 3) and regenerative trees species, indicating a fire/s may have been the main catalyst for the structural disturbance at this site.

Figure 3. Depicts fire damage to Balga (*Xanthorrhoea preissii*) trunks at AOI 1.

The intensity and severity of fire damage many have also been influenced by the sites topographical characteristics which include a north-west aspect on sloping ground with a shallow, rocky substrate. In addition, the recovery potential of this site has been significantly undermined by the infestation of pine wilding from the adjacent pine plantation. The fast-growing wildlings disturb the natural patterns of succession by inhibiting the regeneration of native vegetation, consequently further altering forest type composition and structure (Pickett et al. 1987).

- AOI 2 - Visual inspection revealed most of the area to be poor quality jarrah forest. There was limited evidence of stumps and other disturbance indicators, perhaps a reflection of the poor harvest potential of the site.

- AOI 3 - The site was cleared in 1955 and re-established as pine plots, the site is highly disturbed with pine wildings starting to infest the edges of the surrounding native forest.

- AOI 4 - Although the site contained few stumps, there was a significant number of standing dead and fallen dead jarrah trees which displayed prominent horizontal axe mark around base of the trunk, this was the result of a technique known as ring-barking – refer to Figure 4.

Figure 4. Standing dead jarrah in AOI 4 with ring-barking scarring around its base

The axe marks on the ring-barked tree appeared to be part of the same harvest event as the stumps located in the vicinity. The horizontal axe marks on the base of these stumps were

similar in age and condition to the axe marks on the ringbarked trees. The trees also appeared to be mostly large, good quality jarrah, suggesting that that they were a part of the harvest operation and not cleared for other land uses. The removal of these tree had similar disturbance impacts to the forests canopy structure.

The GPS location of stumps and other evidence of disturbance indicators were recorded, and a map prepared from the GPS data. Appendix 5 depicts the results of the field survey.

4. Analysis of stump and other data to determine old-growth forest status

A GIS application was used to analyse the field spatial data. In this application 0.5 hectare and 2 hectare grids were intersected with the disturbance distribution data to provide a disturbance intensity map (Appendix 6) and assist in defining the boundaries of the minimal disturbance areas, and hence potential old-growth forest with in the coupe.

In western jarrah forest, a threshold of six or less stumps per 2 hectares (four combined 0.5 hectare cells) generally indicates minimal disturbance from past harvesting and possible old-growth forest. In many of the cells surveyed stump counts exceeded this threshold and were therefore categorised as more than minimally disturbed. The status of these areas therefore remains as non old-growth forest.

A large portion of the coupe recorded low stump counts (including the AOI). A strong correlation was evident between cells identified as minimally disturbed and steep terrain. Many of these cells adjoined existing old-growth adjacent to the coupe. In these areas limited evidence of previous harvest disturbance qualified these cells to be reclassified as jarrah old-growth forest.

In AOI 2 the cells that were originally classified as DEZ were found to contain sufficient crown cover to constitute a forested area, thus qualifying them for inclusion as old-growth forest and it is recommended that these areas be reclassified accordingly. Although there was minor stump evidence in AOI 1 and AOI 3, and some of the cells were not surveyed for OHS reason, other disturbance evidence; including clearing, pine planting, fire and weed infestations, was significant. Consequently, these cells were excluded from being considered minimally disturbed. It is recommended that they remain classified as non-old-growth forest.

The recommended boundaries of old-growth forest are depicted in Appendix 7 and summarised in section 5 (below).

5. Recommendations

As depicted on the map in Appendix 7:

Recommendation	Area (ha)	Classification	Map colour
5.1	75	Reclassify to jarrah old-growth forest	Brown

7

6. Proposed corporate data amendments

The following amendments to corporate datasets and plans are required:

Item	Description	Required?
6.1	Amendment of the corporate informal reserve dataset	Yes
6.2	Amendment of the corporate harvest history dataset	Yes
6.3	Amendment of the corporate old-growth forest dataset	Yes
6.4	A revised harvest coupe map depicting the additional informal reserves and reclassified old-growth forest	Yes

7. References

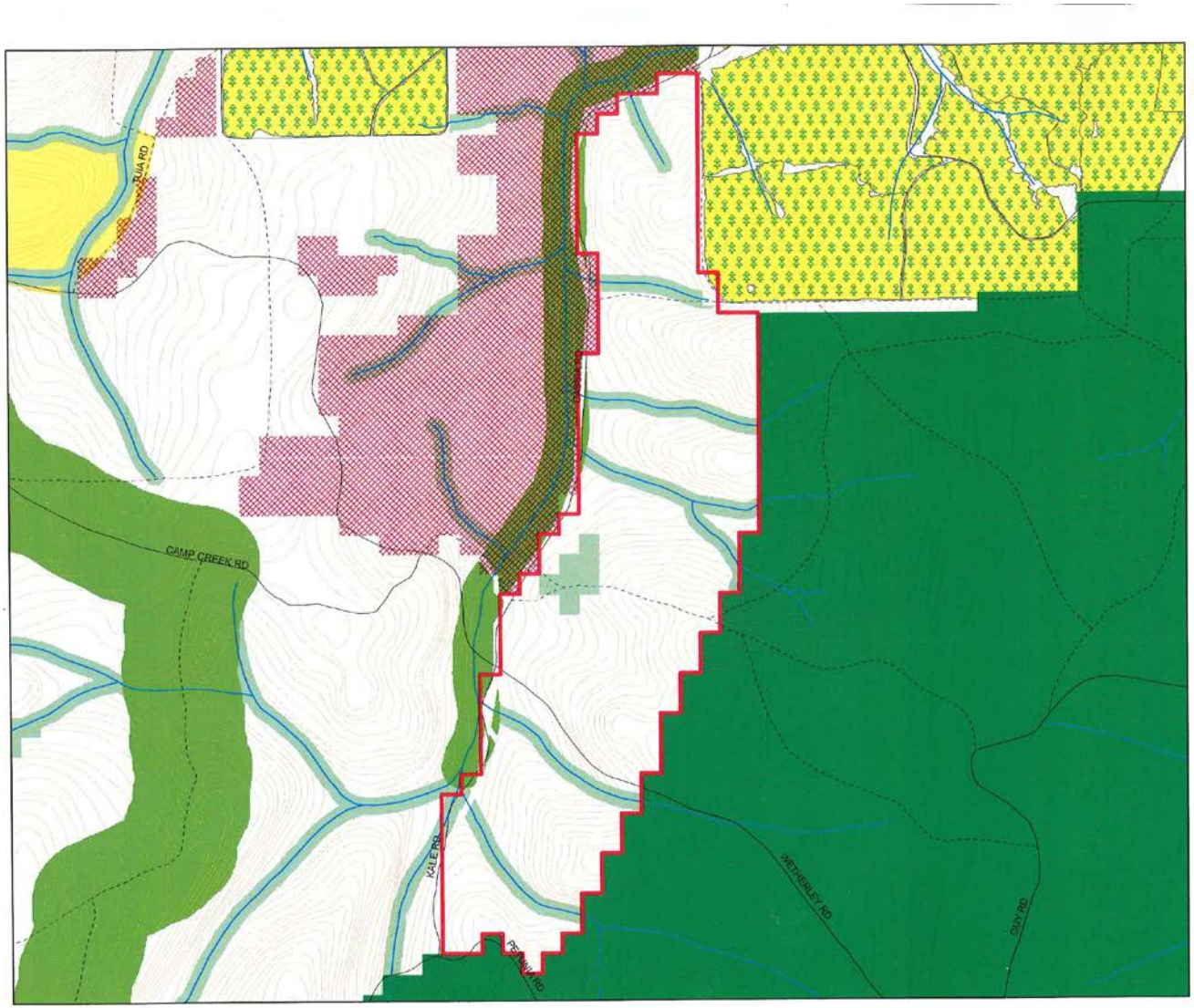
Beggs, BJ (ed.)1971, *Forestry in Western Australia*, 3rd edn, William C. Brown, Western Australia.

Bradshaw, J 2012, *Jinkers and Whims: a pictorial history of timber-getting*, Vivid Publishing, Fremantle.

Pickett, S.T.A.; Collins, S.L.; Armesto, J.J. 1987a: A hierarchical consideration of causes and mechanisms of succession. Plant Ecology 69: 109–114.

8. Appendices

Appendix 1	Harvest coupe base map.
Appendix 2	Section of original API map and/ or recent aerial interpretation.
Appendix 3	Harvest history and harvest frequency from FMIS database.
Appendix 4	Section of the *P.cinnamomi* protectable areas map.
Appendix 5	Disturbance locations map depicting areas surveyed and GPS location of stumps and other disturbance indicators.
Appendix 6	FMIS cells disturbance intensity map.
Appendix 7	Old-growth forest status map: depicting the area to be classified as old-growth forest and DEZ.



Appendix 1

Old-Growth Forest Status Review

Dalgarup 01

Base Map

LEGEND

- Proposed Harvest Coupe
- FPC Plantation - Coniferous
- Contour

EXCLUSION AREAS

- Existing and Proposed Conservation Reserves
- CAR Informal Reserves
- Other Informal Reserves
- Old Growth Forest
- Final Fauna Habitat Zones
- Indicative Fauna Habitat Zones
- Interim Fauna Habitat Zones

Map created on: 7/03/2018

Scale: 1:12 500

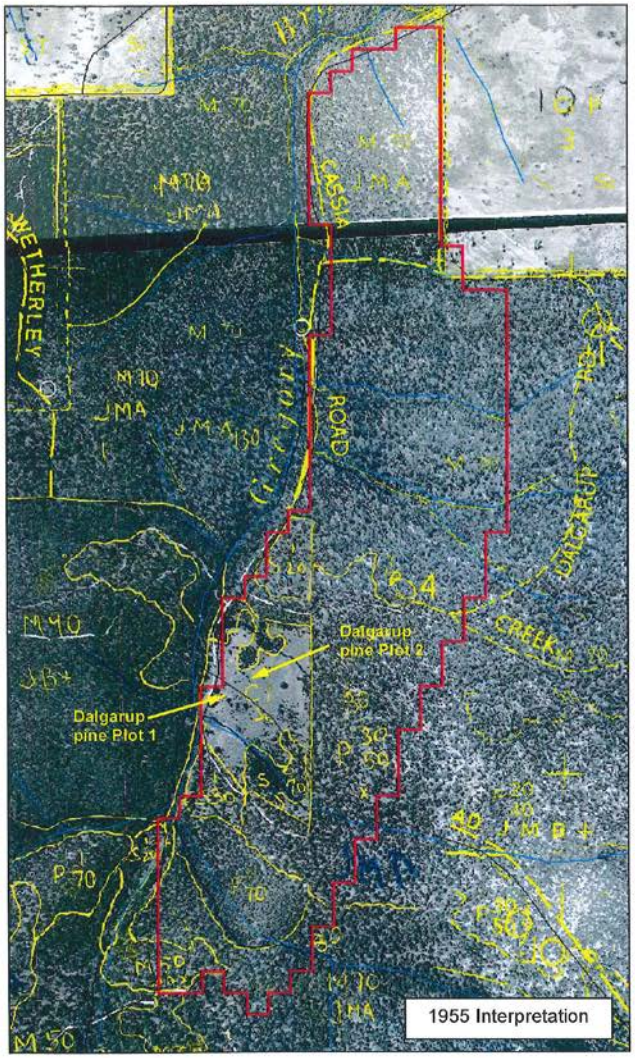
0 100 200 400 600
Metres

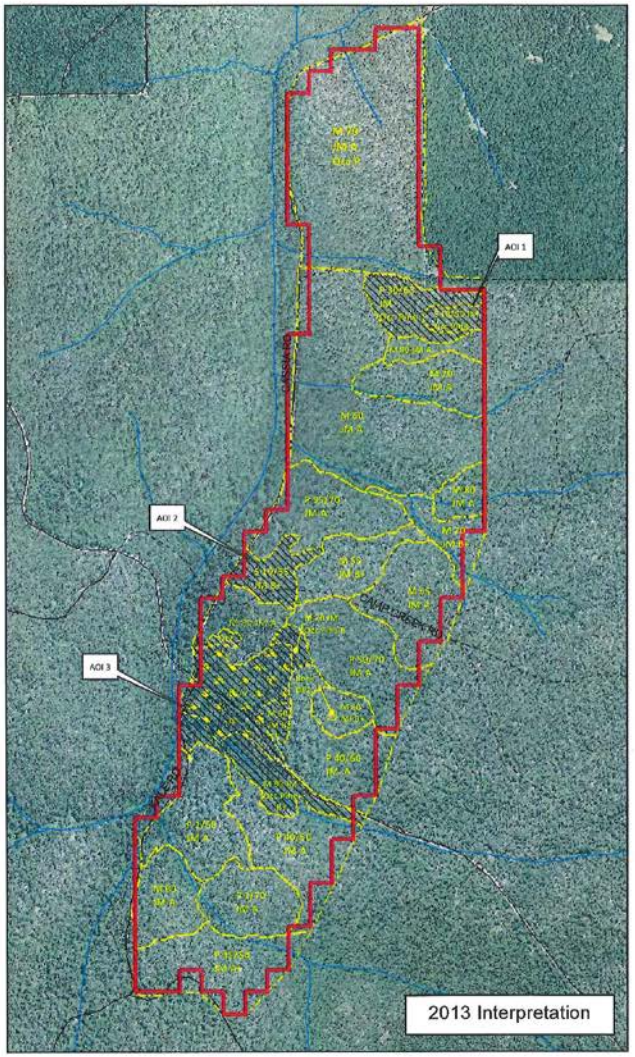
Produced by the Forest Management Branch,
Under the direction of the Director General,
Department of Biodiversity, Conservation and Attractions

Projection: Universal Tranverse Mercator,
MGA Zone 50, Datum: GDA 94

Department of Biodiversity, Conservation and Attractions

PARKS AND WILDLIFE SERVICE





Appendix 2

Old-Growth Forest Status Review

Dalgarup 01

Historical and Recent Aerial Photo Intepretation

LEGEND

- Proposed Harvest Coupe
- Areas of interest (AOI)

HISTORIC AERIAL PHOTO INTERPRETATION

API: 117
Photography: Balingup 1955
Interpretation: H.A.W Feb 1961

RECENT AERIAL PHOTO INTERPRETATION

Photography: 2013, Stereo Imagery
Interpretation: Feb 2018

Map created on: 20/03/2018

Scale: 1:12 500

0 100 200 400 600
Meters

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MGA Zone 50. Datum: GDA 94

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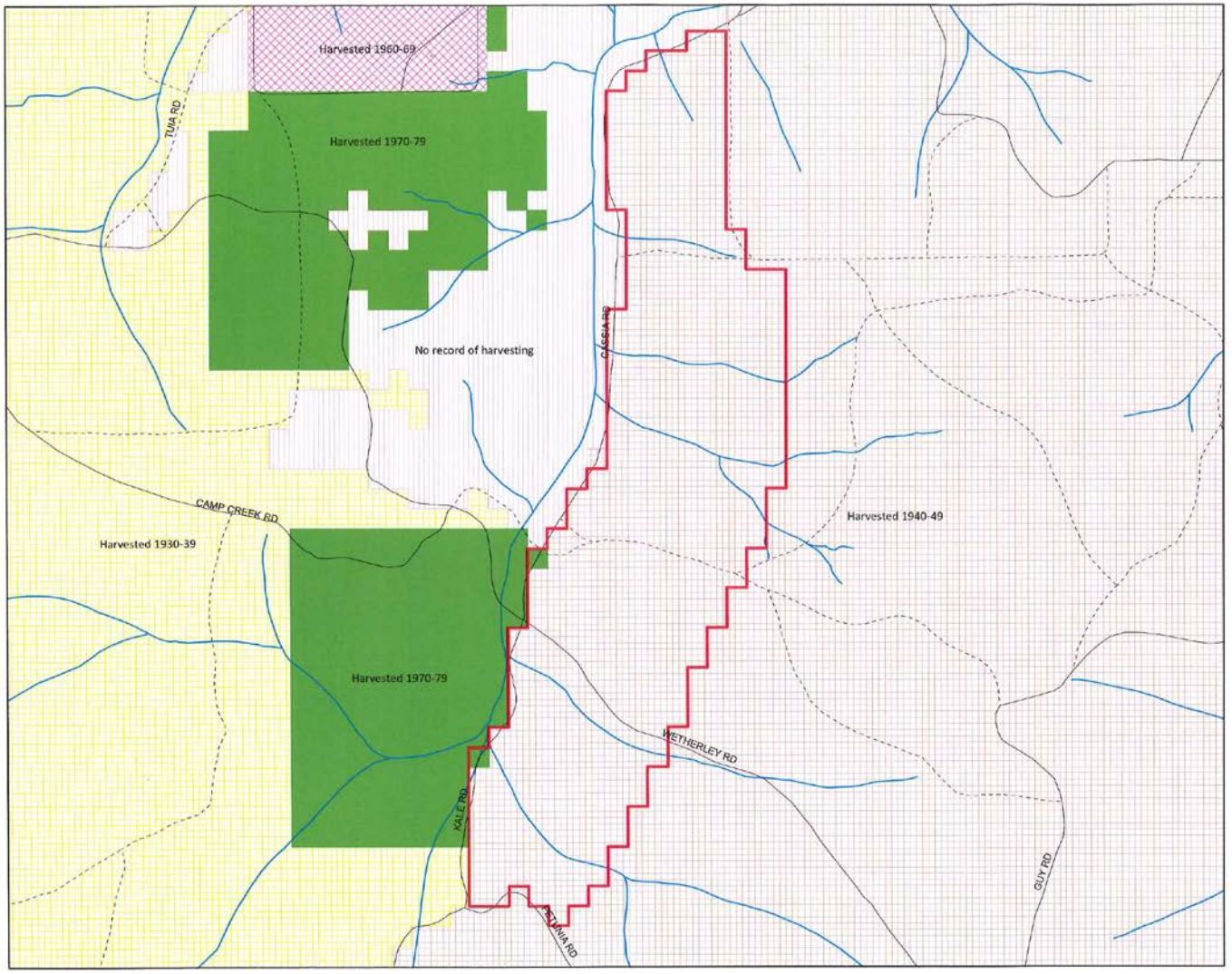

Appendix 3

Old-Growth Status Review

Dalgarup 01

Harvest History

LEGEND

- Proposed Harvest Coupe
- No record of harvesting
- Harvested before 1920
- Harvested 1920-29
- Harvested 1930-39
- Harvested 1940-49
- Harvested 1950-59
- Harvested 1960-69
- Harvested 1970-79
- Harvested 1980-89
- Harvested 1990-99
- Harvested 2000-2009
- Harvested 2010 and after

Map created on: 13/03/2018

N

Scale: 1: 12 500

0 150 300 450 600

Meters

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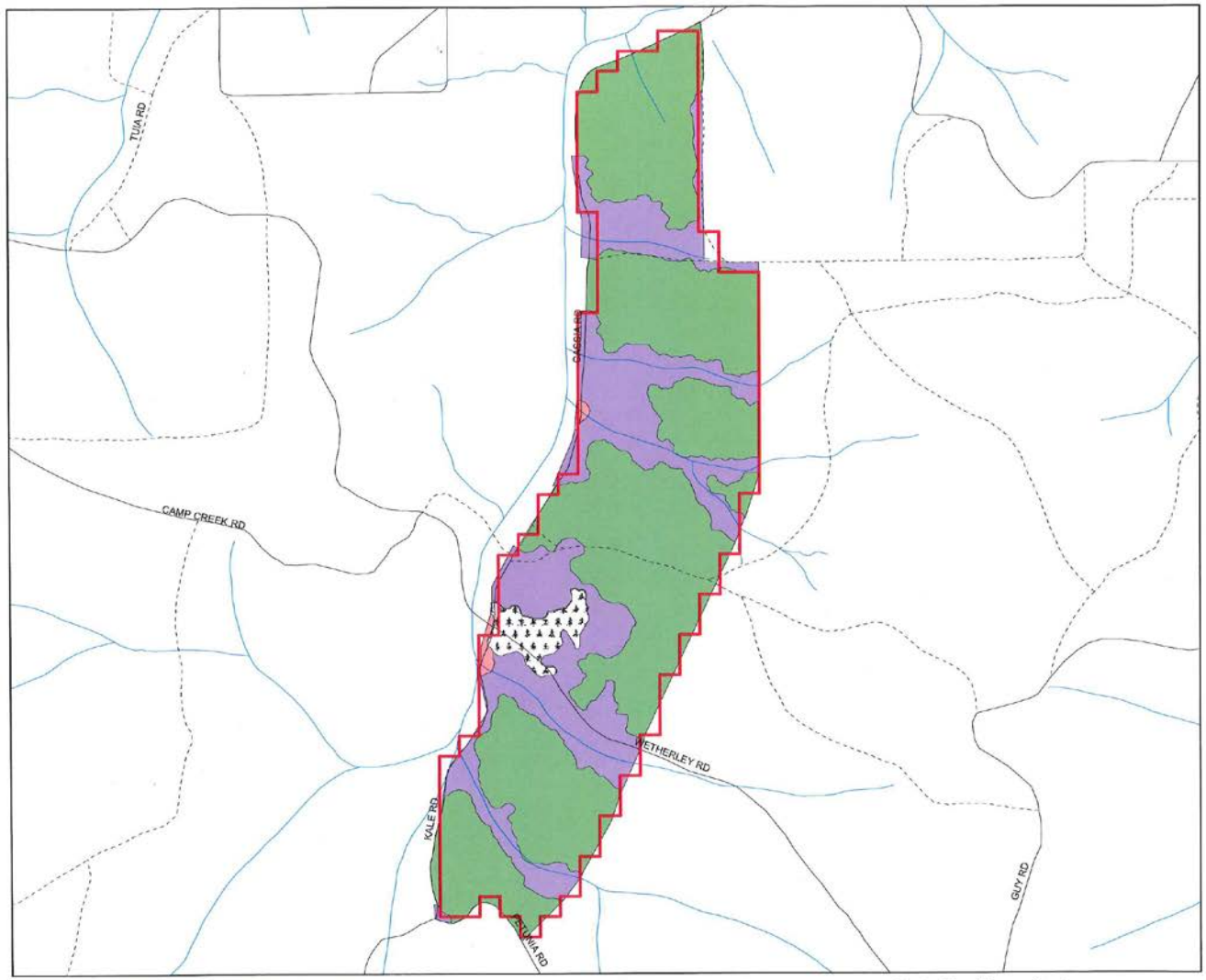
Projection: Universal Tranverse Mercator, MGA Zone 50. Datum: GDA 94



Appendix 4

Old-Growth Forest Status Review

Dalgarup 01

***Phythophthora cinnamomi* Occurrence**

LEGEND

- Proposed Harvest Coupe
- Uninfested
- Uninterpretable
- Infested
- Excluded (Pine)

Map created on: 14/03/2018

Scale: 1:12 500

0 150 300 450 600

Meters

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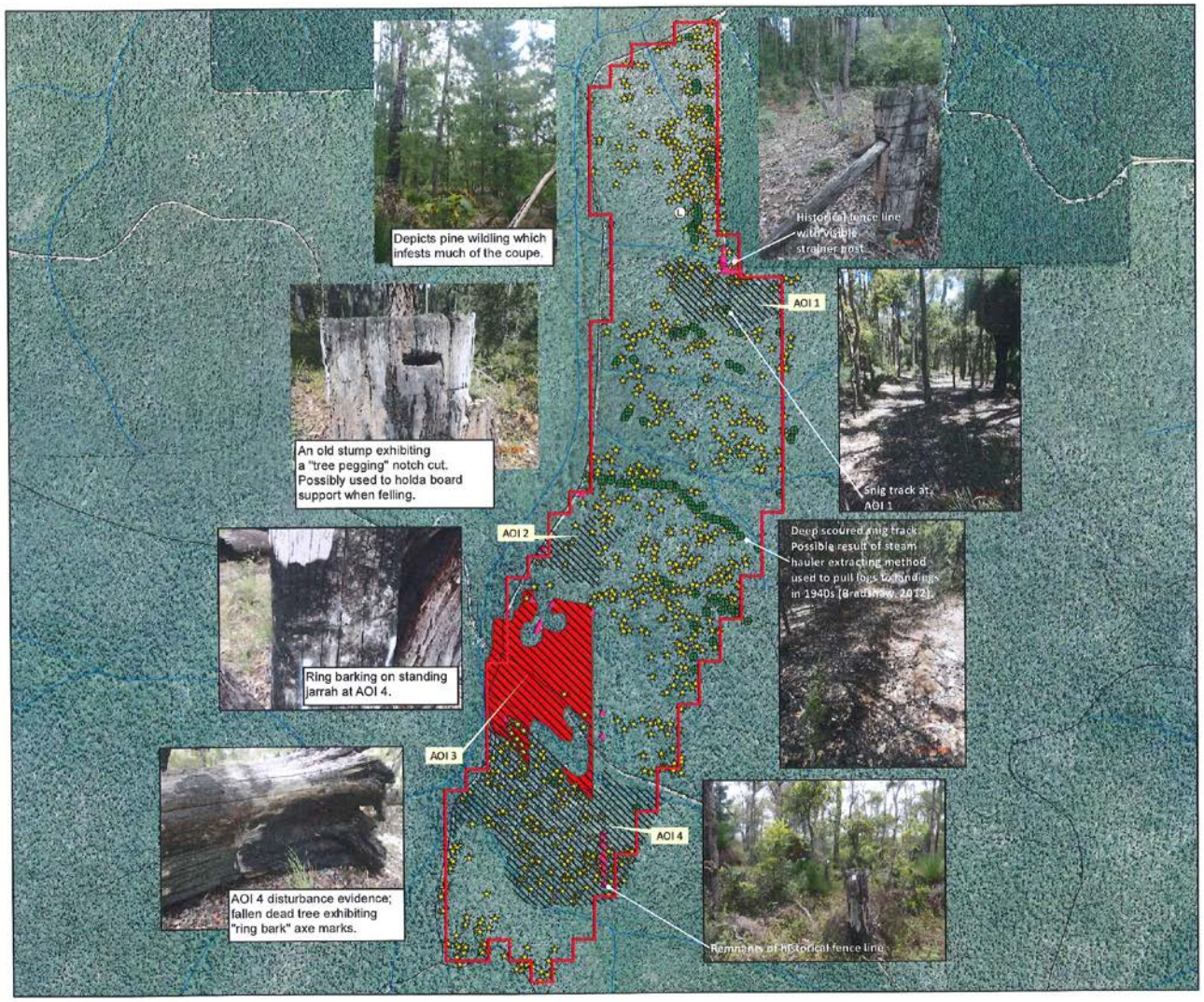

Appendix 5

Old-Growth Forest Status Review

Dalgarup 01

Disturbance Locations

LEGEND

- Proposed Harvest Coupe
- Areas of Interest (AOI)

Disturbances

- Landing
- Historical fence line
- Forest track or snig track
- Stump
- Area cleared 1955

Map created on: 20/03/2018

Scale: 1:12 000

0 90 180 360 540
Meters

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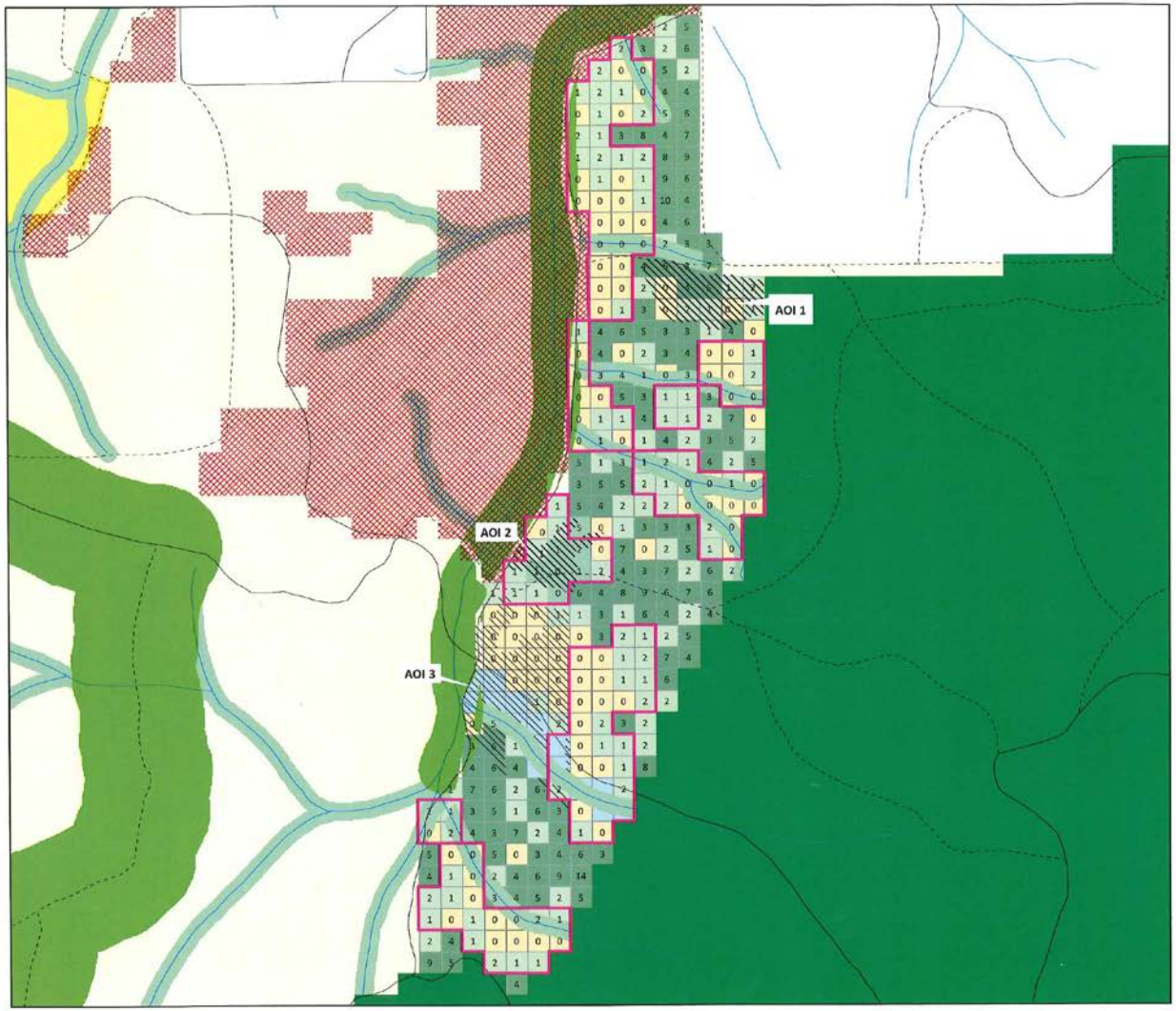
Appendix 6

Old-Growth Forest Status Review

Dalgarup 01

Disturbance Levels



LEGEND

- Proposed Harvest Coupe
- Areas of interest
- Undisturbed (0 stumps per hectare)
- Minimally Disturbed (1-2 stumps per hectare)
- Disturbed (>2 stumps per hectare)
- Not surveyed
- Mininmal disturbance area

Map created on: 21/03/2018

Scale: 1:12 000

0 150 300 450 600

Meters

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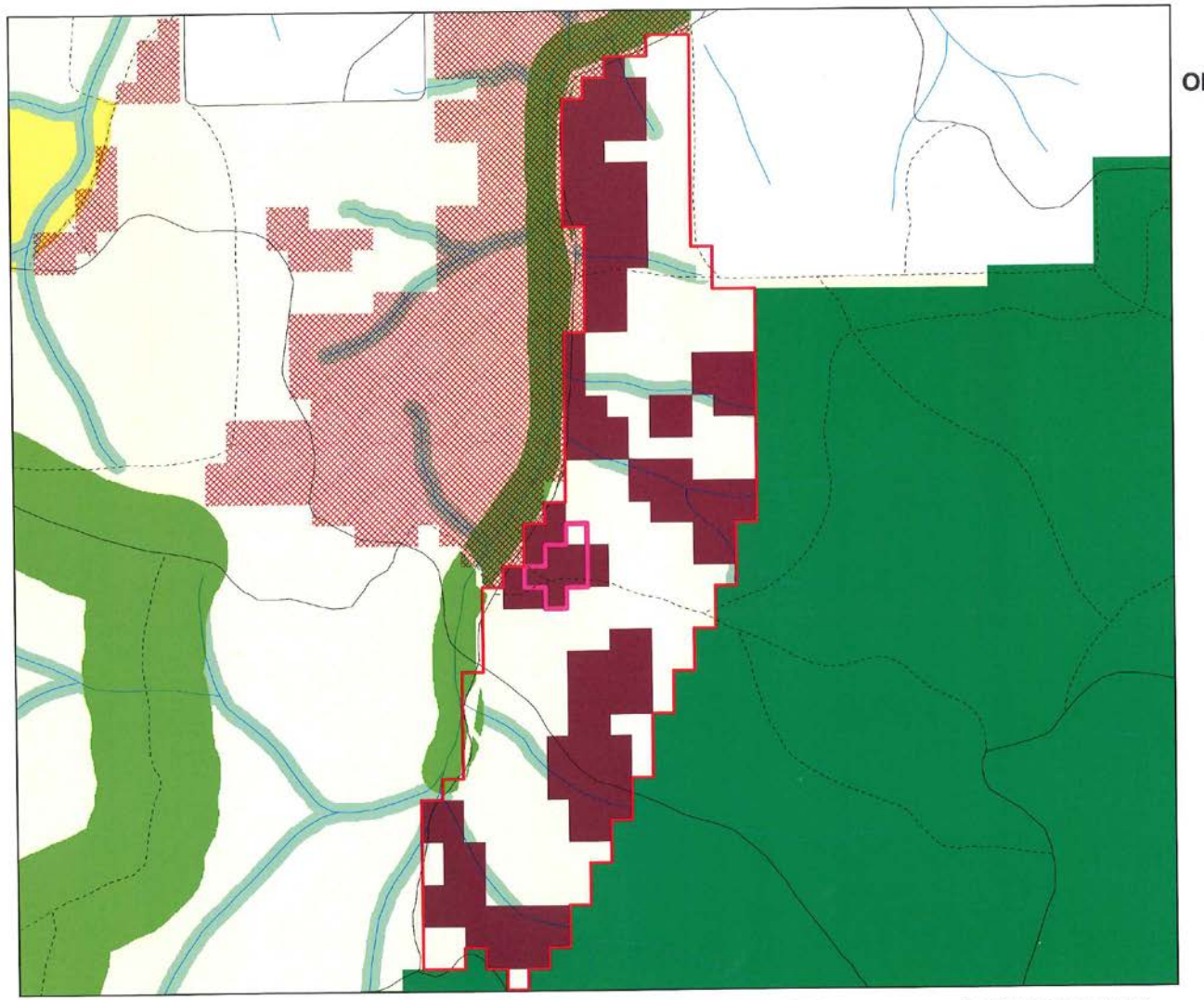
Appendix 7



Old-Growth Forest Status Review

Dalgarup 01

Old-Growth Forest Status

LEGEND

Proposed Harvest Coupe

Reclassify to old-growth forest

Reclassify from DEZ into forest and old-growth forest

Map created on: 21/03/2018

Scale: 1:12 000

0 100 200 400 600

Meters

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