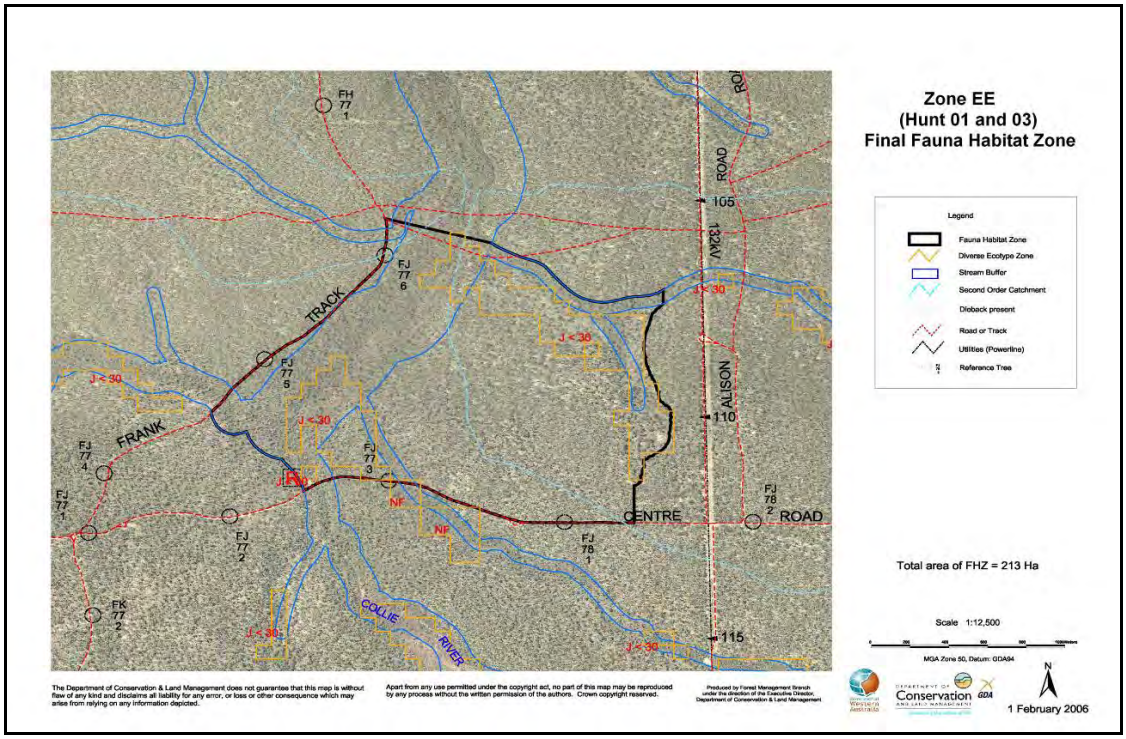
Guidelines for the Selection of Fauna Habitat Zones



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This Guideline supersedes Appendix 4 of the Forest Management Plan 2004-2013.

Acknowledgments

This guideline has been prepared by Forest Management Branch in consultation with specialist personnel in the Nature Conservation, Science and Regional Services Divisions of the Department. The principal authors are Dr Martin Rayner, Dr Stephen Ball, and Ms Christine Rumley.

Cover

Final FHZ EE in Hunt Block

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Custodian: Manager, Forest Management Branch
Approved by: Minister for Environment

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1. Acronyms and abbreviations

BRM	Basic Raw Materials
CALM	Department of Conservation and Land Management
CAR	Comprehensive, Adequate and Representative – as applied to the conservation reserve system
CALM Act	*Conservation and Land Management Act 1984*
DEZ	Diverse Ecotype Zone
DEC	Department of Environment and Conservation
DGPS	Differential Global Positioning System
EPA	Environmental Protection Authority
ESFM	Ecologically Sustainable Forest Management
FDIS	Fauna Distribution Information System
FHZ	Fauna Habitat Zone
FMB	Forest Management Branch
FMP	Forest Management Plan 2004-2013
FPC	Forest Products Commission
GIS	Geographic Information System
GPS	Global Positioning System
MLSA	Mining lease which is the subject of a State Agreement Act
PDWSA	Public Drinking Water Source Area
RFA	Regional Forest Agreement
SFM	Sustainable Forest Management (Division)
SILREC	SILviculture RECording system

2. Background

2.1. Purpose

The purpose of this document (*Guidelines for the Selection of Fauna Habitat Zones*) is to provide guidance for officers of the Department of Environment and Conservation (DEC) when establishing the final locations of fauna habitat zones (FHZs), as required by the *Forest Management Plan 2004–2013* (FMP).

2.2. Scope

This guideline applies to areas of native vegetation on State forest, timber reserves and freehold land held in the name of the *Conservation and Land Management Act 1984* (CALM Act) CEO within the geographic area of the Swan, South West and Warren regions.

The guideline is specifically for the purpose of selecting final locations for FHZs. Guidelines for the management of FHZs are incorporated within SFM Guideline No. 4 *Guidelines for Protection of the Values of Informal Reserves and Fauna Habitat Zones.*

2.3. Legislative and policy requirements

The FMP was prepared in accordance with the CALM Act for land vested in the Conservation Commission of Western Australia (Conservation Commission) within the Swan, South West and Warren regions of DEC. The CALM Act provides for the preparation of forest management plans, while the *Forest Products Act 2000* requires the Forest Products Commission (FPC) to ensure production contracts for native forest products are in accordance with the relevant management plan. Once this guideline is approved by the Minister for Environment, it replaces Appendix 4 as the guideline to be used in finalising the location of FHZs.

2.4. Custodianship and management of the guideline

This guideline is a controlled document. The custodian is the Manager of the Forest Management Branch (FMB) of the Sustainable Forest Management Division (SFM) of DEC.

This guideline will be reviewed when the next forest management plan is approved. If the FHZ definitions, design principles and objectives incorporated in this guideline require revision the process of revision will be subject to action 7.2.2 of the FMP which requires the guideline to be "prepared by the department with public consultation, submitted to the Conservation Commission for advice and approved by the Minister for the Environment". Other procedural aspects of this document, such as the listing of reference datasets or the positions responsible for actions, will be subject to review and revision as required, with approval by the Director Sustainable Forest Management.

3. Forest Management Plan 2004–2013 settings for FHZs

3.1. Origin and development of FHZs

FHZs are patches of forest systematically distributed across the landscape which are excluded from timber harvesting in the mid-term. This concept evolved from fauna and silvicultural research conducted in the Kingston area during the 1990s. Burrows *et al.* (2002) and the Conservation Commission's document titled *Implementing Ecologically Sustainable Forest Management: an Explanatory Paper by the Conservation Commission of Western Australia to accompany the proposed Forest Management Plan 2004–2013* provide an overview of the rationale and size requirements for FHZs.

The principal purpose of a FHZ is to help meet the FMP objective of ensuring that biodiversity recovers between one timber harvest rotation and the next. FHZs, in conjunction with amendments to the silvicultural guidelines, assist in the achievement of this objective by providing refugia for fauna vulnerable to disturbance and in the medium term as a source of fauna to recolonise disturbed areas as they regenerate. The systematic distribution of FHZs throughout the landscape was specifically designed to sample a broad range of soil and landform types to complement the existing formal conservation reserve system. In this way a diverse range of habitats and seral stages through time and space are established and maintained for the conservation of fauna.

3.2. FMP settings for FHZs

The FMP (Action 7 and Appendix 4) commits to:

- establishing a network of indicative FHZs by excluding from timber harvesting a total area of State forest and timber reserves outside informal reserves of between 50,000 and 55,000 hectares
- publishing maps showing the locations of indicative FHZs and a subsequent review of their location by 30 June 2004 on commencement of the FMP (1 January 2004),
- by 31 December 2004, the development of Guidelines for the Selection and Management of Fauna Habitat Zones
- establishing and maintaining a corporate spatial database for FHZs
- refining and finalising FHZ boundaries according to the criteria in Appendix 4 of the FMP or the proposed Guidelines for Selection and Management of Fauna Habitat Zones prior to the commencement of an operation, particularly timber harvesting, that would disturb the forest associated with the indicative FHZ.

The original design of the network of indicative FHZs to commence the FMP was a desktop GIS analysis process done at the landscape scale using the criteria in Appendix 4 which aimed to achieve:

- a systematic network across all forest types (jarrah, wandoo and karri)
- a separation distance of approximately three kilometres between FHZs and contiguous areas (greater than 200 hectares) of mature forest in existing formal reserves
- a gross area (including informal reserves) of at least 200 hectares for each FHZ
- FHZs having mainly forest classified as mature forest, however areas of regrowth were included in highly disturbed or fragmented environments
- connection with the informal reserve network

- inclusion of threatened ecological communities, old-growth forest, National Estate values and poorly represented vegetation communities where these values were present
- exclusion of *Phytophthora* dieback infestations
- preferably adjacent (or linkage by otherwise reserved habitat) to other areas of lesser disturbed forest
- avoidance of private property interfaces
- a minimum width at the narrowest point of a FHZ of 150 metres
- a small perimeter-to-area ratio.

The formal statement by the Minister for the Environment under the *Environmental Protection Act 1986* that the FMP could be implemented required the amalgamation of a number of indicative FHZs in the vicinity of the proposed Greater Kingston National Park. Implementation of this requirement formed one large consolidated FHZ with a total area of 4,144 hectares.

The FMP (Appendix 4) set limits on the area of forest previously available for timber production to be occupied by FHZs by stating "The area of indicative fauna habitat zones outside informal reserves will be between 50,000 and 55,000 hectares". In seeking to realise the intent of the FMP to establish "… a sufficiently extensive network of areas excluded from timber harvesting …" indicative FHZs were designed so that their gross area was as close to the 200 hectare required minimum area as possible. This gave the greatest number of indicative FHZs at the closest spacing throughout the forest available for timber harvesting.

The total net area of State forest allocated to FHZs as part of the modelling undertaken in 2003 and used to arrive at the sustained yield figures in the FMP was 52,042 hectares. This area is distributed over 283 FHZs and the Kingston amalgamation with an average net area (not including informal reserves) of indicative FHZs of 171 hectares excluding the Kingston amalgamation (see Table 1 below).

Table 1: FHZ area (hectares) settings used in the *Forest Management Plan 2004 – 2013*

	Indicative FHZs	Kingston amalgamation of FHZs	Total
Number of FHZs	283		
Gross[1] area of State forest and timber reserve in FHZs	57,462	4,144	61,606
Area of State forest and timber reserves in FHZs that is classified as informal reserve	8,992	572	9,564
Net[2] area of State forest and timber reserve in FHZs	48,470	3,572	52,042
Average gross area of FHZs	203		
Average net area of FHZs	171		

[1] Gross area of the FHZs is the sum of the area of informal reserves and the area outside the informal reserves that would otherwise be available for timber production.

[2] Net forest area of the FHZs is the area outside informal reserves that would otherwise be available for timber production.

While the minimum gross area of a FHZ must exceed 200 hectares, the gross and net area of an individual final FHZ may in some instances exceed the averages determined in development of the FMP and shown in Table 1. The gross area of an individual FHZ will be determined by habitat quality and boundary management criteria and may be up to 250 hectares. However, if the cumulative effect of finalising a number of FHZs is significantly in excess of the figures shown in Table 1, cancellation of one or a number of indicative FHZs will be required in order to comply with the requirements of the FMP. DEC will advise the Conservation Commission of the need to delete any indicative FHZ.

3.3. Definitions and categories of FHZ

The FMP defines two categories of FHZ, "indicative" and "final". The two FHZ categories differ in their status and as a consequence the type and extent of operations that may occur in them (see SFM Guideline No. 4 *Guidelines for Protection of the Values of Informal Reserves and Fauna Habitat Zones*).

During the process of selecting and approving a final location and boundary for a FHZ two further categories of FHZ may be generated, "recommended final" and final – "interim". An indicative FHZ will be categorised as "recommended final" when the analysis of its final location and boundary has been completed by DEC Forest Management Branch according to this guideline for submission to the Director SFM for approval.

Within a mining lease which is the subject of a State Agreement Act (MLSA), the locations of FHZs are to be determined with regard to the requirements of the FMP, and through consultation with relevant companies using processes prescribed under, and consistent with, rights the lease holder has under the relevant Agreement Act. Figure 1 illustrates the area of State forest covered by mining leases subject to an MLSA. A FHZ that has been approved by the Director SFM as final will have an "interim" status where it is located within an MLSA. Interim FHZs will be finalised once mining and rehabilitation operations are completed in the area and the State has accepted back from the company responsibility for management of the mined areas. The locations of MLSAs for the purposes of these guidelines are shown in Figure 1.

Consequently, four categories of FHZ are recognised for the purposes of providing guidance on the process of finalising the location of FHZs (Table 2).

Table 2.: Definition of the four categories of FHZ

FHZ Category	Definition	Database/Map	Comment
Indicative	A FHZ which is one of the FHZs (283) designed and located during the development of the FMP and whose location was published at the commencement of the FMP.	Recorded as "indicative" in DEC's FHZ register, corporate spatial database, and on maps.	Subsequent adjustments were made to the location of some indicative FHZs in the process described in Action 7.3 of the FMP.
Recommended final	A FHZ whose boundary and location have been subject to analysis according to the design criteria in this guideline, and for which the recommended boundary and location have been forwarded to the Director SFM for consideration.	No change made to the "indicative" category in DEC's FHZ register, corporate spatial database, or on maps.	Transient stage in the design process.
Final	A FHZ whose boundary and location have been approved by the Director SFM as final.	Recorded in DEC's FHZ register, corporate spatial database and shown on maps as "final".	The "recommended final" location and boundary are often, but not always, the approved and consequently "final" version.
Interim	A FHZ occurring in an MLSA whose boundary and location have been approved by the Director SFM.	Recorded in DEC's FHZ register, corporate spatial database, and shown on maps as "interim".	The final location of a FHZ within an MLSA is subject to consultation by the state with the lease holder using processes prescribed under, and consistent with, rights under the relevant Agreement Act.

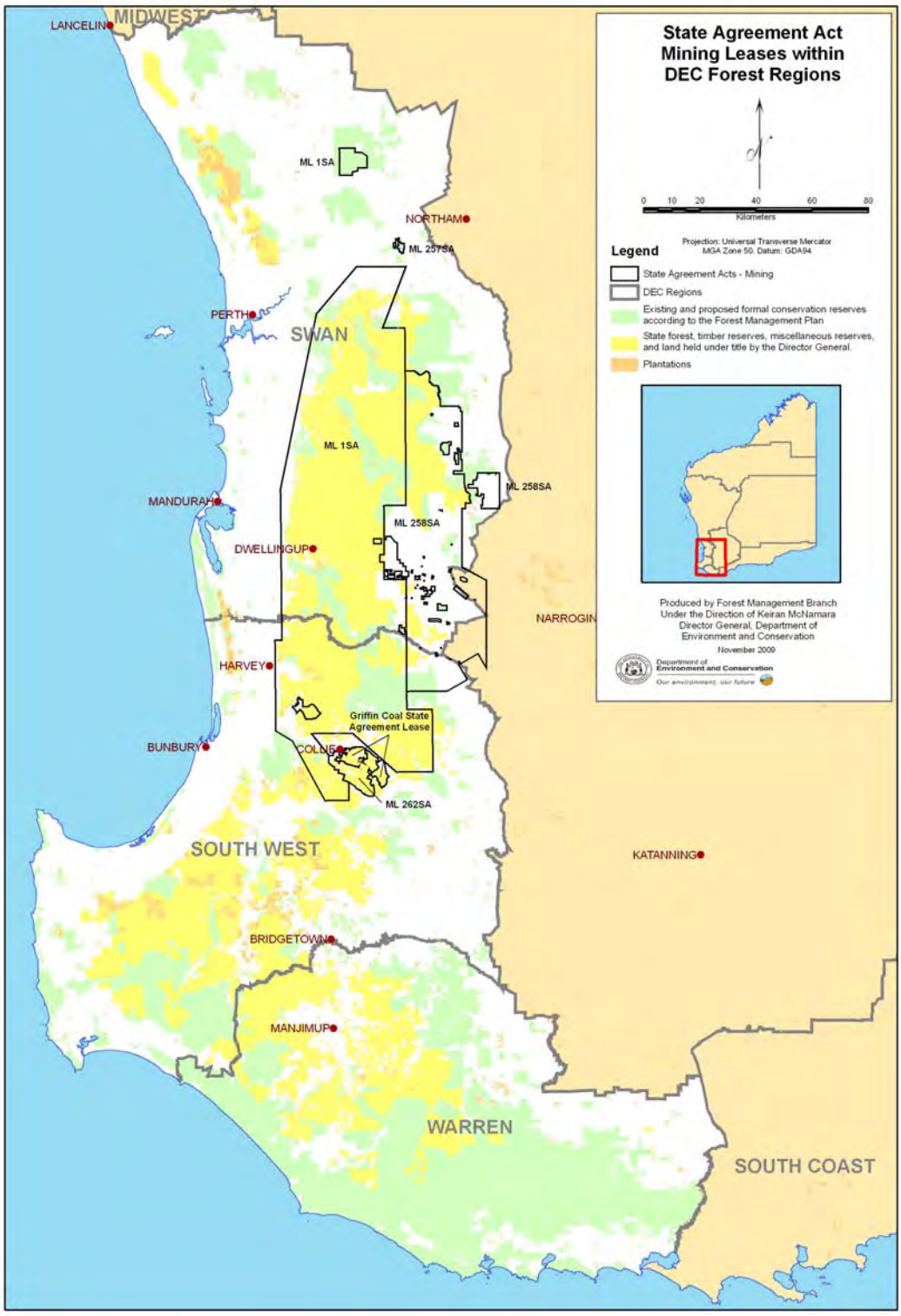

Figure 1: Location of mining leases subject to a relevant State Agreement Act

4. Guiding principles for selecting the final locations of FHZs

The network of FHZs is established to complement the formal and informal conservation reserve system within the Swan, South West and Warren regions of DEC. While the intent of FHZs is not to establish a system of permanent reserves (individual FHZs can be relocated over time as areas of regenerating forest are able to fulfil and replace the habitat in existing FHZs), a set of design principles has been identified to guide the selection of FHZ locations and boundaries. The intent of the design process for each FHZ is to select a single patch of the landscape that meets the selection criteria for habitat and that can be managed to minimise future impacts through the exclusion of timber harvesting and processes that could potentially degrade the habitat values.

The following design principles have been identified to guide the finalisation of FHZs. They are categorised into three sections: *Spacing and size* which stands alone because it is the starting point of the FHZ network, and *Priority "A" principles* which take precedence over the Priority "B" group of principles.

4.1. Spacing and size

Guiding principle 1

An even and systematic spacing between FHZs and between FHZs and formal reserves will best sample the full range of habitat across the forest.

A key consideration in the concept of FHZs is that even without a full knowledge of habitat requirements, a systematic distribution of FHZs would overlie a broad range of soil and landforms and consequently include the broadest range of habitats protected from disturbance. In addition, accepting that animals differ in their dispersal abilities, but that the dispersal ability of many animals is poorly known, an even spacing of FHZs should assist dispersal.

The spacing and size of indicative FHZs are related, and the network of indicative FHZs has been designed on the basis of an average area and placed on a systematic spacing. Consequently, the starting point for the process of finalising the location of a FHZ will be the suitability of the indicative location. However, priority "A" principles will take precedence over the average area or spacing in the finalisation of individual FHZs and if necessary, indicative FHZs will be deleted to meet total net area requirements.

4.2. Priority "A" principles

4.2.1. Habitat or fauna populations

Guiding principle 2

Selection for FHZ location using habitat quality will generally provide a more useful FHZ than selection using the known presence or abundance of fauna populations.

The concept of the FHZ is to provide a broad range of habitat for fauna, including those whose requirements are poorly understood, and this is partially achieved through the principle of spacing. However, locating the FHZ to include populations of fauna that are known to be vulnerable to disturbance from timber harvesting is justified, especially where the presence of the fauna population can be treated as a good indicator of high-quality mature habitat.

4.2.2. Forest maturity

Guiding principle 3

Mature forest provides a greater range of tree habitat elements than less-mature forest.

Mature forest provides a greater range of habitat elements than young regrowth forest and is consequently better able to support a wider range of fauna to provide a source of animals to recolonise regrowth forest following harvesting. Mature forest generally contains a higher frequency of larger, hollow-bearing trees and ground logs than young regrowth forest.

4.2.3. Habitat diversity

Guiding principle 4

The wider the range of habitat type in the FHZ the more suitable it will be for a wide variety of fauna.

The inclusion within a FHZ of a diverse array of habitat elements and types should provide for a wide variety of fauna to persist in the landscape.

To contribute to the diversity of habitat types protected from disturbance, less well-represented habitat types (including habitats not closely linked to forest maturity) should be included within a FHZ where this does not significantly compromise the overall habitat quality of the FHZ.

Focussing heavily on the habitat requirements of individual taxa should be avoided. However, the inclusion of habitat elements for specific taxa may be justified where the fauna taxon is threatened or the change required to the location of the FHZ to include habitat for that taxon does not significantly change the overall habitat quality to a wide variety of taxa.

4.2.4. Long-term habitat quality

Guiding principle 5

Habitat selection should consider likely changes in habitat quality and impacting process over time.

Selecting the location of a FHZ should consider the expected average habitat quality over several decades, and should therefore take into consideration potential changes that would affect the abundance and quality of habitat such as:

- development of tree hollows
- impacts of invasive species such as *Phytophthora cinnamomi*
- successional changes to floristic composition and structural diversity following disturbance (e.g. fire, past timber harvesting, and past silvicultural treatments)
- internal roads that provide ready access to people and the consequent risk to habitat
- sites that are attractive to people for recreation and which consequently increase the risk of disturbance to habitat
- possible land-use changes in adjacent land, particularly private property
- possible changes to water availability and vegetation condition arising from climate change.

The application of this principle should not lead to the selection of a location that has a markedly lower habitat quality in the short-term.

4.2.5. Linkage with formal and informal reserves

Guiding principle 6

Establishing linkages between FHZs and existing areas of formal and informal reserves will facilitate connectivity of quality habitat, thereby assisting fauna movement and dispersal.

Linking FHZs with the informal reserve network (especially stream reserves that would have provided moist refugia in previous drying phases such as during the late Pleistocene era) and through informal reserves to formal reserves will enhance the ability of fauna to move through the landscape.

4.3. Priority "B" principles

4.3.1. Perimeter/area ratio

Guiding principle 7

Greatest protection of habitat is provided by FHZs with lower perimeter/area ratio.

A low perimeter/area ratio will reduce the interface through which various forms of disturbance (e.g. invasive species) enter a FHZ and make on-ground management simpler.

4.3.2. Indigenous versus non-indigenous vegetation

Guiding principle 8

The fauna habitat quality of indigenous vegetation is more valuable than that of non-indigenous vegetation.

The inclusion within a FHZ of tracts of non-indigenous vegetation such as introduced pine or eucalypt plantations, trial plots or rehabilitation should be avoided. Such vegetation may support only a limited range of fauna, and can potentially contribute to future weed control issues in native forests.

However, the relative merits of locating a FHZ adjacent to areas of non-indigenous vegetation should be assessed on a case-by-case basis. Some non-indigenous plants are known to be valuable to fauna (e.g. *Pinus radiata* may be a locally important food source for black cockatoos, *Calyptorhynchus* spp.), and some non-indigenous plants (e.g. some eucalypts from the eastern states of Australia) have a higher resistance to *Phytophthora cinnamomi* than indigenous species.

4.3.3. Inclusion of non-fauna values

Guiding principle 9

Where fauna habitat values are not significantly compromised, the design of a FHZ should aim to include non-fauna values (e.g. threatened flora, significant cultural sites).

The consolidation of important non-fauna values within a FHZ can extend the area around these features that is protected from disturbance during timber harvesting operations. The inclusion of populations of threatened or priority flora could potentially also contribute to the overall habitat value of the FHZ for some fauna taxa.

4.3.4. Facilitating FHZ management

Guiding principle 10

The long-term effectiveness of the FHZs will be improved when they are located so that the identification, demarcation and ongoing management for the purpose of fauna conservation are practicable.

The design of a FHZ should aim to use physical features (e.g. streams and roads) as external boundaries where priority "A" design principles are not significantly compromised. Such "hard" boundaries reduce the cost of on-ground demarcation and reduce the risk of demarcation and management errors.

Placing a FHZ adjacent to private property should be avoided as much as possible without compromising overall habitat quality, because it will usually increase management costs and reduce its effectiveness, owing to constraints associated with the ongoing management of prescribed fire, feral animals and weed invasion.

4.3.5. Least cost to the community

Guiding principle 11

Where a number of configurations for an FHZ meet the design criteria, the recommended design will aim to minimise social and economic costs to the community.

There are two aspects to this principle:

1. Where two or more configurations of a final FHZ have comparable habitat value then the principle of least cost to other forest users, and hence the community, should be used to recommend the final location.
2. The design of a FHZ should not exclude an area of forest that would otherwise be available for a land-use that is incompatible with the management of FHZs (e.g. timber harvesting) but is so small or narrow that it is impractical for that land-use.

5. Process for selecting the final locations of FHZs

5.1. Introduction

The objective of this section is to define a sequence of steps to convert the location of an indicative FHZ into an interim or final FHZ. Figure 2 illustrates the steps in the process.

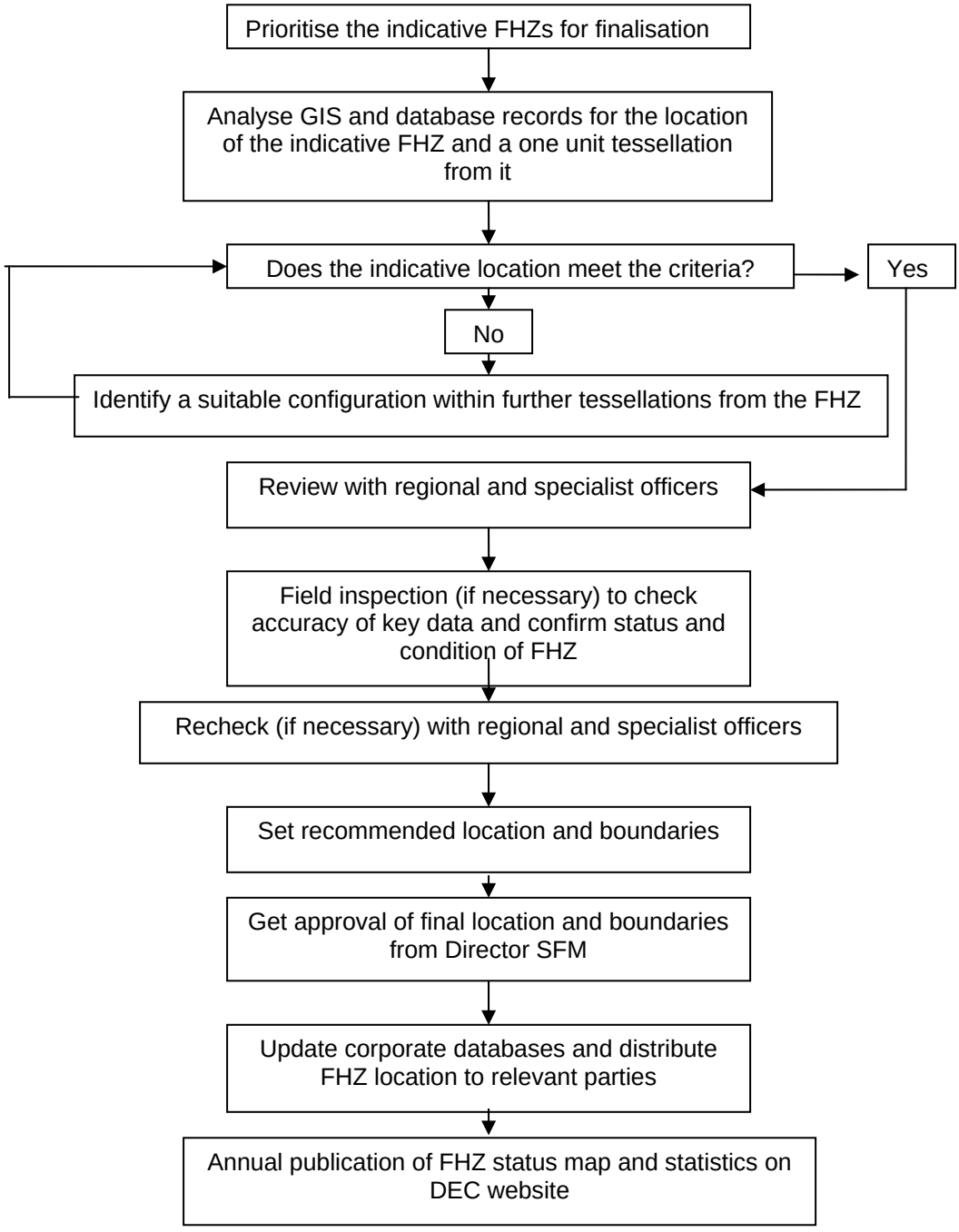

Figure 2: Work process for finalising the location of an FHZ

5.2. Setting the priority for finalising the location of indicative FHZs

Objective

To finalise the location and boundaries of FHZs in an order that minimises the loss of opportunity in selecting habitat and meets the time requirements of operations.

There were 283 indicative FHZs at the commencement of the FMP and it was logistically impractical to finalise all FHZs immediately. Setting priorities to determine the order in which indicative FHZs are to be finalised is necessary.

The following steps are required:

1. FMB will establish and maintain a register that uniquely identifies each FHZ and its status as indicative, final or interim within the corporate spatial database.

2. The spatial location of future disturbance operations within State forest will be collated annually. These locations will be buffered within a GIS by a distance of 1.5 kilometres, and then intersected with the corporate spatial dataset to generate a list for analysis. The disturbance operations may include:

    - the annual timber harvest plan and rolling three-year timber harvest plan
    - proposed public firewood areas
    - proposed clearing, road re-alignment or infrastructure applications
    - catchment thinning programs
    - other activities as advised by DEC area managers
    - proposed mining operations.

3. The listing and relative priorities will require regular review and update throughout the year to accommodate changes in the sequencing of access to harvest coupes, which can arise due to delays in the preparation for timber harvesting or operational factors. Regular liaison with the FPC and other proponents of disturbance operations will be necessary.

4. Regional SFM staff will assist in the collation and sourcing of information on the location of proposed disturbances, while FMB will undertake the prioritisation in liaison with the proponents of the disturbance operation and the Director SFM.

5.3. Confirmation of indicative location or definition of the options for analysis of final FHZ locations

Objective

To confirm whether or not the indicative location meets the selection criteria and if not to identify a sequence in which the options for final location of the FHZ will be analysed.

The locations of indicative FHZs have been established using the objectives set out in Appendix 4 of the FMP. Therefore, it can be expected that an indicative FHZ, on most occasions, will already occupy or be in the vicinity of the most suitable location and the finalisation process will refine the boundaries around that location.

The first step in finalising the location of a FHZ is to confirm whether or not the indicative location meets the selection objectives. If so, the zone boundaries can be finalised and the examination of further options is not necessary.

If further options are required, an analysis will be undertaken on the existing location and a one unit tessellation of the indicative FHZ. If a final location and boundaries can be identified that meet the selection objectives then the FHZ will be finalised and no more analysis of options is required.

If a final location and boundaries that meet the selection objectives cannot be identified in the initial analysis then the target area for analysis should be expanded by further incremental tessellation from the indicative position. The extent to which the analysis extends out from the indicative position will be governed by the guidelines on permissible separation: extending the analysis of options beyond 1.5 kilometres from the indicative location would impact on the potential location of adjacent FHZs.

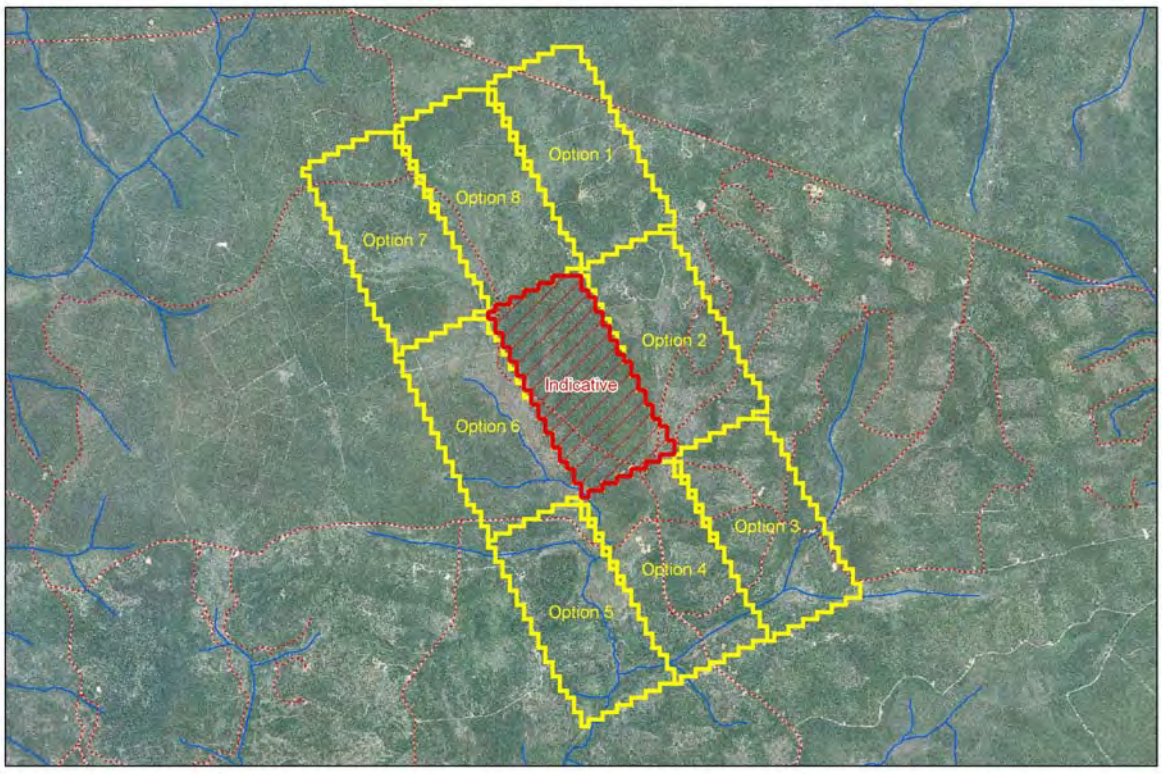

Figure 3: Illustration of the options arising from applying a one unit tessellation pattern around the location of an indicative FHZ

5.4. Determination of the permissible separation distance between FHZs

Objective

To ascertain the permissible separation distance between FHZs and between a FHZ and the nearest formal conservation reserve.

A key feature of the network of FHZs is its systematic spacing, where the distance between the boundaries of adjacent FHZs and between the boundaries of a FHZ and the nearest formal conservation reserve should be between two and four kilometres (measured as plan form distance). However, there are some exceptions where the separation distance may be outside these specifications.

The permissible spacing may be greater than four kilometres:

- in forest blocks where more than 20 per cent of the area in the block is already contained within existing and proposed formal and informal reserves
- in areas surrounded or largely surrounded by non-native vegetation, such as dams, plantations or cleared private property in which opportunities to recolonise surrounding forest are limited
- in areas where a higher separation distance would capture greater variation in habitat quality between FHZs
- to accommodate the greater concentration/amalgamation of indicative FHZs in Warrup, Corbal, Mersea, Dudijup and Kingston forest blocks adjacent to the proposed Greater Kingston National Park. This amalgamation was a Ministerial Condition on implementation of the FMP.

The permissible spacing may be less than two kilometres:

- in areas where a smaller separation distance would capture a wider variety of habitat types and quality
- temporarily, in locations where the status of the adjacent FHZ is indicative and initial analysis indicates it will be moved further away;
- in Warrup, Corbal, Mersea, Dudijup and Kingston forest blocks (Kingston amalgamation) adjacent to the proposed Greater Kingston National Park. This amalgamation was a Ministerial Condition on implementation of the FMP.

The following steps are required to establish whether the circumstances exist for a variation to the accepted spacing of between two and four kilometres:

1. Calculate the percentage of any forest block within the analysis that comprises existing and proposed formal and informal reserves.

2. Examine the status of adjacent FHZs (indicative, final, interim) and the location of other significant features that may influence the average spacing that might be achieved. This may include the presence of:
    - final or interim FHZs
    - plantations of exotic species
    - major infrastructure (e.g. powerlines, conveyor belts, highways)

- private property interfaces
- broad connectivity to formal reserves through informal reserve networks within the landscape.

3. Determine whether any adjacent indicative FHZs require complementary or preliminary analysis in order to finalise the location of the FHZ. If the proposed location involves a significant shift of the FHZ (greater than 1.5 kilometres) then adjacent FHZs may require complementary analysis in order to finalise the location of the zone. Determination of whether any adjacent indicative FHZs are likely to be relocated towards the FHZ is required. This may be due to the presence of features identified in step 2 (above).

4. Identify whether the FHZ is within a MLSA and therefore will be assigned an "interim" status.

5.5. Reporting of values within the target area to progress FHZ location

Objective

To examine records contained in appropriate corporate datasets to inform the finalisation of the location of the FHZ.

A range of datasets, photographs and maps are held by DEC that can contribute to the process of selecting the final location of a FHZ. Corporate datasets will be assembled within a GIS where they and other associated databases will be sequentially examined for the occurrence of records within the area of analysis. The name and version date of the corporate dataset used and the outcome of each of these data checks should be recorded in a standard checklist for each indicative FHZ examined (see Appendix 1 for an example). Disturbance activities such as gravel leases and basic raw materials sites are approved at the district level and will be checked through the regional and district SFM staff.

The presence or absence in the latest version of the relevant corporate record of the following attributes should be recorded and used to identify recommended locations for the FHZ.

Location and spacing

1 Formal and informal reserves
2 Mine sites
3 Plantations
4 Reservoirs
5 Roading (present and proposed)
6 Adjacent private property
7 Powerlines and conveyor belts
8 Second order catchments
9 Remnant vegetation
10 Timber harvesting (annual and three-year harvest plans)

Mature habitat

11 Old-growth forest
12 Mature forest structure
13 Regrowth forest
14 Sawlog cutting history, including silvicultural objectives for last harvest

Vegetation and flora values

15 Less-well reserved vegetation complexes
16 Darling Scarp Forest Ecosystem
17 Threatened ecological communities
18 Centres of endemic flora
19 Centres of relictual flora
20 Centres of disjunct flora
21 Declared rare (and priority) flora
22 Areas of high species richness

Fauna values

23 Threatened fauna (includes priority fauna)
24 FDIS land system/landscape unit
25 FDIS reports for the associated harvesting area/coupe

***Phytophthora* dieback status**

26 Protectable *Phytophthora* dieback free/*Phytophthora* dieback occurrence
27 Dieback impact
28 Disease risk areas

Heritage values

29 Indigenous heritage sites
30 Cultural heritage sites
31 Non-Indigenous heritage sites

Management implications

32 Apiary sites
33 Recreation sites
34 Public drinking water source areas
35 Wildflower licences
36 Gazetted or nominated public firewood collection areas
37 Basic raw material extraction sites
38 Fire history (recorded as year of last prescribed or wildfire)

There will be instances where recent timber harvesting or other disturbance activities have occurred in the target area but where the routine data update cycle to record the current spatial extent of the activity in the corporate dataset has not been completed. For example, records of *Phytophthora* dieback occurrence and the extent of timber harvesting and silvicultural treatments are updated annually and may therefore require supplementary field confirmation. This may include the interpretation or acquisition of new aerial photography. Alternatively, additional spatial data may be sourced to confirm or amend the extent of on-ground disturbance that has occurred since the last corporate data update within the target area. In instances where the corporate dataset is incomplete across the target area (e.g. recent intensive *Phytophthora* dieback interpretation may not be available across the entire area) historical records and field inspection will provide the basis to progress the finalisation of the FHZ.

5.6. Generation of boundaries for the recommended FHZ

Objective

Identify a contiguous area of a minimum of 200 hectares and a maximum of 250 hectares that meets the habitat selection design objectives and provides practical boundaries for future management of the FHZ within the landscape.

The selection of a final location and boundaries for a FHZ involves a desktop analysis reviewing the location of the indicative FHZ against the criteria in this guideline and if necessary, identifying alternative locations in the vicinity of the indicative location. Because a high degree of importance is placed on systematically spacing FHZs (guiding principle 1) alternative locations will typically fall within approximately 1.5 kilometres of an indicative FHZ's location. Alternative locations may overlap.

5.6.1. Design objectives and preferences

The principles for designing a FHZ and their relative importance provide a logical basis for deciding between alternative locations. A set of priority-weighted objectives (see Table 3) provides a means of addressing the various guiding principles, indicating the datasets to be used, what preferences should be applied to the data, and what principles are invoked. Each objective is assigned a priority (H = high, M = medium, L = low) and in the design process, where objectives conflict, the lower priority objective would normally be subservient to the higher priority objective.

As an example, one objective seeks to "incorporate mature habitat elements". This is identified as having a high priority because it invokes two priority "A" guiding principles:

1. Selection of a FHZ location using habitat quality will generally provide a more useful FHZ than selection using the known presence or abundance of a fauna population.

2. Mature forest provides a greater range of habitat elements than less-mature forest.

Achieving this objective means that in the absence of a population of a species known to be vulnerable to disturbance from timber harvesting, areas containing old-growth forest and habitat trees meeting the definition in the jarrah silviculture guideline (Department of Conservation and Land Management 2004) are the highest preference for inclusion in the FHZ. Next preferred is mature regrowth forest, then immature regrowth with well-developed understorey, and least preferred is immature regrowth with less-well developed understorey. This objective indicates that the following datasets should be consulted:

- old-growth forest (corporate spatial data)
- mature forest structure (corporate spatial data)
- regrowth forest (corporate spatial data)
- sawlog cutting history, including silvicultural objectives for last harvest (corporate spatial data)
- relative density of primary and secondary habitat trees (where available from field observations).

In many instances it will be necessary to trade off between different objectives. For example, an alternative location with a convoluted boundary (i.e. poorly meeting the objective of minimising the perimeter/area ratio) may nonetheless be justified if the location has the greatest component of old-growth forest and habitat trees. Furthermore, there may be a FHZ where a particular objective is poorly satisfied by all the alternative locations. For example, in a heavily disturbed landscape, such as one that has been recently harvested and/or recently rehabilitated after mining, there is likely to be little opportunity to incorporate undisturbed mature habitat elements in any location.

The overall aim of the finalisation process is to propose a location that best satisfies the combination of design objectives. Owing to the number of objectives, the number of spatial datasets used to inform decisions on those objectives, and the spatial variation in the data, it is impossible to develop a mechanistic decision process that integrates all this information in a consistently useful way. Therefore, it is the responsibility of the designer(s) of the recommended FHZ to adequately document the logic used. In doing so the principles and objectives in this guideline and the data used in coming to the recommended final location and boundaries for the FHZ should be noted.

Table 3: Design objectives and the relative priority to meet them when finalising the location and boundaries of FHZs

Objective	Priority	Comments and preferences	Guiding principle
Maintain the spacing to neighbouring FHZs and formal reserves established by the indicative FHZ network.	H	The sequence of analysing options will mean that the spacing set by the indicative FHZ will control the spacing of the final FHZ. However, there may be more than four kilometres between an FHZ and formal reserves in the following situations: a in areas surrounded or largely surrounded by cleared land in which opportunities to recolonise surrounding forest are limited b in forest blocks where more than 20 per cent of the area in the block is already contained within existing and proposed formal and informal reserves c in areas where a higher separation distance would capture a wider variety of habitat types. DATASETS: Most recent corporate data on FHZ locations	1
The gross area of each FHZ to be a minimum of 200 hectares and a maximum of 250 hectares.	H	Aim for a minimum size of 210 hectares to allow for minor discrepancies between real (on-ground) and mapped boundary locations (e.g. tracks and streams). There will be some variation in total area among FHZs due to preferences for habitat and adopting practical boundaries along existing tracks and natural features in the landscape (such as streams and diverse ecotype zones). However, the maximum size of an individual FHZ should not exceed 250 hectares. The maximum number of FHZs will be obtained by keeping the gross area of each individual FHZ close to the 200 hectare target, and monitoring the cumulative total area and net area as FHZs are finalised. DATASETS: None (derived statistic)	Section 2.2
Incorporate mature habitat elements.	H	Priority for the inclusion of forest structure is: 1 old-growth forest and highest density of habitat trees as identified in field surveys 2 mature regrowth 3 immature regrowth with well-developed understorey 4 immature regrowth with less-well developed understorey 5 immature regrowth on minesites rehabilitated with indigenous vegetation. DATASETS: 11, 12, 13, 14 (See section 4.5)	2 3 4
Include locations of threatened fauna.	H	Include translocations as well as naturally-occurring populations DATASETS: 23 (see section 4.5)	2 4
Include poorly-represented habitats.	H	Can include poorly-represented ecotones as well as poorly-represented habitat types DATASETS: 15, 16, 17 (See section 4.5)	2 4

Objective	Priority	Comments and preferences	Guiding principle
Include features that are known habitat requirements of fauna.	H	Priority is for inclusion of habitat elements of species listed in FDIS as having a high probability of occurrence in the area. Examples include: closed shrubland in riparian zones (may be suitable for quokkas); large mature marri (as feeding habitat for black cockatoos); swampy depressions (may be suitable breeding area for frogs); tall multiple-headed *Xanthorrhoea* with well-developed skirts (known to be important daytime dens of ring-tailed possums). The inclusion of permanent water sources (whether natural or the artificial water points maintained for fire suppression purposes) is highly desirable. DATASETS: Field observations, 24, 25 (see section 4.5)	2 3 4
Incorporate contiguity between FHZs and informal reserves and seek indirect linkages with formal reserves.	H	The merits of linkage of FHZs with informal reserves and through them to formal reserves should be evaluated in terms of the following: 1 facilitating fauna dispersal between otherwise separate areas of informal reserve 2 increasing viability of local fauna populations within the FHZ 3 consolidating a habitat interface (e.g. diverse ecotype zone (DEZ) and adjacent mature forest) that is a poorly reserved interface at a local or regional scale. Any area of informal stream reserve that adjoins a FHZ should be included if it does not make the FHZ less than 150 metres wide. Any area of informal reserve (excluding stream reserves) should generally be included as part of a FHZ if more than 50 per cent of its boundary adjoins the FHZ. However, the FHZ should exclude any areas of informal reserve that make it less than 150 metres wide. The preference is for contiguous areas providing enhanced linkage to other areas of lesser disturbed forest. DATASETS: 1 (see section 4.5)	6
Incorporate topographic diversity (landform and aspect).	H	Refers to diversity in slope, aspect, and landform (streams, valleys, mid-slopes, ridges). Where possible, the inclusion of moist southerly aspects is desirable to facilitate the persistence of species in a drying climate. DATASETS: Field observations, contour map	4
Avoid adjacency to private and/or cleared property.	H	The impact of private property on fauna habitat values is generally negative; however, this may vary with land-use. For example, a cleared paddock next to a FHZ may result in weed and feral animal invasions and constraints on fire management in the FHZ. However, a private *Pinus radiata* plantation could be considered beneficial as a feeding area for cockatoos. The proximity to private property should generally be as low as practicable owing to the restrictions enforced by the Health Department regarding minimum off-sets associated with the aerial fox-baiting program, as well as the increased potential for the incursion of weed species. The Health Department requires a set-back for aerial baiting of 500 metres from private property, 250 metres either side of major (bitumen or gravel) roads and 500 metres from established recreation sites. The set-back for ground application is 20 metres from private property. Locations adjacent to private plantations should generally be avoided because they may create issues with groundwater or wildlings control from seeding over time. Likely future changes in the private property land use should also be considered. An exception may be where the adjacent property has significant native vegetation which is under a Land for Wildlife or similar scheme. DATASETS: 5, 6, 9 (see section 4.5)	5 10

Objective	Priority	Comments and preferences	Guiding principle
Maintain low perimeter-area ratio; and a minimum width of 150 metres.	M	Each FHZ will have a minimum width of 150 metres. Width can be measured between any two parallel tangents of the FHZ's boundary. Note: tangents should be based on the original vector version of the FHZ boundaries (not a rasterised derivative). Each FHZ must be a single (unbroken) polygon. DATASETS: None (derived statistics)	7
Use "hard" external boundaries.	M	Hierarchy of use is: 1 Features mapped on corporate datasets (e.g. roads, streams) 2 Unmapped features (e.g. unmapped tracks discovered during a field check). The future management of activities within or adjacent to an FHZ should be considered when boundaries are being selected. The selection of "hard" boundaries (such as roads and topographical features) to define the external boundary of a final FHZ is preferred. Such boundaries are readily identified in the field and provide a clear separation to future disturbances that may occur adjacent to the FHZ. The use of roads to form the boundaries of a FHZ also provides opportunities for subsequent control of future access. Using major infrastructure (highways, conveyor belts, powerlines) as boundaries for FHZs should generally be avoided owing to the higher frequency of disturbance associated with the maintenance of these utilities. Where informal reserves such as stream buffers and diverse ecotype zones are used to form the boundaries of FHZs, the external boundary of these informal reserves should be adopted. Where a ridgeline is selected to form a section of the FHZ boundary, consideration should be given to the disease status of the sub catchments and if warranted, the boundary may be placed approximately 20 metres beyond the ridgeline to minimise the potential for the spread of *Phytophthora cinnamomi* into the FHZ. DATASETS: 1 (stream buffer component), 5 (see section 4.5)	10
Exclude areas currently infested by *Phytophthora cinnamomi*, or at high risk of future infestation.	M	Hierarchy of choice is: 1 The FHZ and its vicinity do not have any known occurrences of *Phytophthora cinnamomi* (Pc) infestations. 2 Pc infested areas are excluded from an FHZ (but are adjacent or nearby). 3 Pc is within an FHZ but low in the landscape. 4 Pc is widespread in an FHZ but flora are resistant. 5 Pc is widespread in an FHZ but susceptible flora persist / are regenerated. Given the distribution of Pc, preferences 1 and 2 are usually not achievable. Consider the risk of specific vectors (e.g. does the area have an extensive network of vehicle tracks?) to the risk of future infestation. DATASETS: Field observations, 26, 27, 28 (See section 4.5)	5
Include areas with high structural diversity of the understorey and mid-storey.	M	Structural diversity of the mid-storey and understorey may be influenced by past harvesting, silvicultural treatments, and fire history. DATASETS: Field observations, 12, 13, 14, 38 (See section 4.5)	2 4
Include areas with high floristic values.	M	Floristic diversity applies to tree and understorey species. Examples include areas recorded as centres of relictual flora, centres of disjunct flora, areas of high species richness, and known occurrences at the local scale. DATASETS: 18, 19, 20, 22 (see section 4.5)	2 4 9

Objective	Priority	Comments and preferences	Guiding principle
Exclude areas with land/waterway degradation.	M	Examples include areas affected by salinity, and streams affected by acid sulphates. DATASETS: Field observations, 9 (see section 4.5)	2 10
Exclude areas with high levels of invasive species (other than Pc).	M	Examples include plant diseases, exotic weed infestations and feral animals (e.g. pigs). Note however that some invasive species may provide significant fauna habitat values e.g. pines near a FHZ may provide a food source for cockatoos. DATASETS: Field observations, 2, 3, 5, 6, 7, 9, 32, 33 (See section 4.5)	5 8
Exclude BRM and mineral extraction sites.	M	Assess risk of the site facilitating the establishment of invasive organisms within the FHZ. Hierarchy of choice is: 1 Exclude large, recently-used, and/or still-bare extraction sites 2 Small, long-since-used, and/or revegetated sites. If revegetated, prefer indigenous vegetation (natural or human-assisted). DATASETS: Field observations, 2, 37 (see section 4.5)	5 10
Incorporate diverse ground cover types.	L	Possible surface types include: deep leaf litter, scattered branches, hollow logs, bare earth, granite boulders, and lateritic outcrops. DATASETS: Field observations	2 4
Exclude internal roads.	L	Hierarchy of choice is: 1 Exclude well-maintained and frequently-used roads. 2 Exclude untrafficable roads. DATASETS: Field observations, 5 (see section 4.5)	5 10
Include threatened flora.	L	Hierarchy of choice is 1 Declared rare flora 2 Priority flora.	4 9
Avoid areas known for recreational activities that reduce fauna habitat quality.	L	Assess the specific risk of each form of recreation to local fauna values. For example, activities that generate high levels of traffic and soil disturbance may reduce fauna habitat values by increasing the risk of spreading Pc; conversely shooting of feral animals may be beneficial to local fauna. DATASETS: Field observations, Consultation with Visitor and Regional Services, 33 (see section 4.5)	5 10
Include areas with regenerating cohorts of tree and understorey species.	L	Hierarchy of preference is: 1 Regeneration in tree species 2 Regeneration in understorey species. DATASETS: Field observations, 12, 13, 14, 38 (see section 4.5)	2 5 8
Least cost to the community.	L	Where different configurations of FHZs are identified as meeting the criteria, the configuration that imposes the least cost on the community should be adopted. Consideration can be given to timber and non-timber social and economic uses of the forest and the cost of excluding them and the likely direct cost of management of the FHZ. DATASETS: 10 (see section 4.5)	11

5.7. Review of preferences with specialist DEC regional staff

Objective

To review the option(s) and incorporate any additional information not held on corporate databases that may be relevant to the final location of a FHZ.

For each FHZ to be finalised, advice should be received as necessary from DEC's regional leaders of Nature Conservation, Parks and Visitor Services and SFM. These officers have knowledge of information that will not be held on corporate databases, and are responsible for maintaining links to other ongoing biodiversity research, monitoring and works programs that may be relevant. Relevant officers should review the options developed and assist with any further information or liaison required (e.g. with relevant district or specialist officers), as well as provide input to any issues that may need to be checked in the field. In addition, it may be necessary to seek other specialist advice on fauna distribution or requirements from specialists in Science Division or external to DEC.

FMB will record any issues identified during the consultation process, including recommendations for field verification, and will be responsible for documenting outcomes.

5.8. Field reconnaissance of the potential location(s) for a FHZ

Objective

To confirm the accuracy of records used in the design process, measure and record habitat and site attributes, and to check issues relevant to the determination of appropriate boundaries.

Field reconnaissance of the potential location(s) for a FHZ may be necessary. A field reconnaissance by FMB personnel will check the accuracy of corporate records, address any queries identified during the design process and confirm the status and condition of the area as being suitable for an FHZ.

5.9. Finalisation of the design and location of a recommended FHZ

Objective

To assimilate the information obtained from desktop GIS analysis of corporate records, specialist advice and field reconnaissance to identify the most appropriate location for an FHZ.

The following steps are required:

1. Integrate the information gathered during the design/analysis process with the results of field reconnaissance and specialist advice to recommend a final location and boundary for an indicative FHZ.

2. Review the results of field reconnaissance and the recommended location of a FHZ with the regional leader Nature Conservation and/or regional ecologist to confirm the recommended location and boundary.

3. Calculate the total area within the recommended FHZ boundary to confirm that the total area is over 200 hectares. This would be after the incorporation of minor adjustments and the correction of discrepancies between the mapped and actual field location of boundary features.

4. Compile a summary document and associated maps for the recommended FHZ. A summary of the analysis process, which records the decisions taken and contributing information, together with maps, should be prepared for each FHZ.

An example of the detail and format of a summary checklist and supporting maps is included in appendices 1 and 2.

5.10. No location satisfactorily meets the selection criteria

The situation may arise where it is not possible to identify a location that adequately meets the habitat and spacing criteria, for example in a heavily fragmented landscape. In this case a final FHZ will not be established and the indicative FHZ will be noted for deletion.

5.11. Approval and dissemination of location and boundaries of a final FHZ

The dataset checklist, summary document and supporting maps are to be forwarded to the Director SFM for consideration and approval of the final location and boundaries of a FHZ. The Director SFM will notify FMB in writing of the approved final location of a FHZ.

Following approval of the final location of a FHZ, FMB will notify any disturbance proponent, the relevant regional manager and relevant regional leaders of the FHZ location. FMB will then distribute the digital boundary of the finalised FHZ to relevant officers to assist them in their role with planning and operational requirements. FMB will also update and maintain the corporate spatial database and the FHZ register.

The proponent of any disturbance will ensure that the boundaries of the final FHZ are accurately depicted on all operational maps prior to commencement of disturbance activities and will demarcate the external boundary of the FHZ in the field to the standards specified in the SFM Guideline No. 4 *Guidelines for the Protection of the Values of Informal Reserves and Fauna Habitat Zones*.

6. Relocation of a final FHZ

The following circumstances may give rise to the relocation of a final FHZ.

1. A final FHZ may become available for disturbance once new areas of comparable habitat value can be provided to replace those in the existing FHZ. The planning horizon for FHZ relocation is intended to be long term (most likely over several decades), and would depend on the habitat characteristics of the replacement area.

2. The relocation of a final FHZ may also be warranted if significant new information about species or impacting processes warrants a review of the FHZ's location (e.g. following a major incursion of salinity or substantial degradation of vegetation from the spread of *Phytophthora* spp).

3. Interim FHZs may require relocation or re-establishment following mining operations in the area.

Proposals to relocate a final FHZ will be considered on a case-by-case basis by the Director SFM. In those instances where a final FHZ is recommended for relocation, a full re-analysis of possible locations and selection of a new final location will be undertaken in accordance with these guidelines.

7. Amendment of the boundary of a final FHZ

Circumstances may arise where it will be necessary or desirable to change the boundary of a final (or interim) FHZ. These could include, for example the future incursion of a major utility infrastructure or an unforeseen proposal to conduct disturbance operations associated with scientific research adjacent to or within a portion of a FHZ.

Proposals to amend a portion of the boundary of a final FHZ will be considered on a case-by-case basis by the Director SFM. Should an amendment be approved, an area of at least equivalent size and habitat value to the portion proposed to be excised from the FHZ will be sought to be added to the remainder of the FHZ to maintain a contiguous area of a minimum of 200 hectares.

8. Data management

8.1. Corporate data relevant to this guideline

The implementation of this guideline requires the production and maintenance of the following corporate databases:

- *FHZ status* – FHZs are those areas identified on DEC's corporate spatial database as FHZ. DEC will assign a unique identifier to each FHZ and identify its status as indicative, final or interim. FMB is the corporate custodian of this database.
- *FHZ register* – DEC will establish and maintain a FHZ register to prioritise and record the progress towards finalisation of each indicative FHZ. This register will also list the running total area and total net area of all FHZs within the corporate spatial database. FMB is the corporate custodian of this register.
- FMB will be responsible for arranging dissemination of the FHZ status to enable its inclusion in the annual corporate data distribution program.

8.2. Responsibilities for data collection, distribution and custodianship

The currency and completeness of the contributing datasets for the design process remain the responsibility of the respective corporate data custodians in DEC. The manager of FMB is responsible for the collation of appropriate versions of the data used to inform the design process, and is responsible for maintaining records and summary documentation of any FHZ for which the finalisation process is underway. These include records of the design process, checklists, field documentation and summary reports.

8.3. Annual publication of a map depicting the status of all FHZs

The manager of FMB will produce and publish on the DEC website the area statistics and a map depicting the status of FHZs as at 30 June each year. This map will display three classes of FHZ:

- Indicative FHZs – any of the 283 FHZs which were established at the commencement of the FMP that have not been re-categorised by the Director SFM as final or interim
- Final FHZs – FHZs outside MLSAs whose location and boundaries have been finalised
- Interim FHZs – FHZs inside MLSAs whose location and boundaries have been finalised.

Current mining areas will be shown on the maps; however, indicative FHZs will be removed from current mining areas, and will be reinstated once mining and rehabilitation operations are completed or relocated in accordance with this guideline.

9. Responsibilities for implementation

The responsibilities for implementation of various actions in this guideline are (Table 4):

DEC FMB

- undertake the process of selecting indicative FHZs
- maintain contributing records and datasets;
- prioritise and select final FHZ locations.

DEC Director SFM

- approve the location and boundaries of recommended FHZs.

Conservation Commission

- audit the adherence of DEC to these guidelines, and publish the results.

Disturbance proponents (FPC, DEC, other government agencies, mining companies, other)

- contribute data and information to the planning process as required
- provide comment as required;
- demarcate and comply with FHZ boundaries.

Table 4: Summary of roles and responsibilities associated with the finalisation of the location of FHZs

Task(s)	Responsibility	Frequency
Maintain a corporate register and GIS theme of status of FHZs.	DEC FMB	Ongoing
Update priorities for FHZ finalisation.	DEC FMB	In accordance with planning timelines
Approval of final locations of FHZs or the relocation of final FHZs.	DEC Director SFM	As required
Demarcation of FHZ boundaries.	Disturbance proponent	In advance of operations
Comply with boundaries and management guidelines for FHZs.	Disturbance proponent	Ongoing
Publication of map and statistics on the status of FHZs.	DEC FMB	Annual
Audit compliance with Guidelines for the Selection of Fauna Habitat Zones.	Conservation Commission	As required

10. Glossary

Term	Definition
Block	An administrative subdivision of the forest, varying in size from about 3,000 to 8,000 hectares.
Boundary – hard	A boundary created along a topographic feature that can be mapped.
Boundary – soft	A boundary that does not coincide with any mappable topographic feature.
Buffer strip	A strip of vegetation retained on the edge of a feature such as a stream or rock outcrop. Buffer strips can serve a variety of purposes in the landscape, including protection of the feature from a disturbance activity, and provide flora and fauna habitat and aesthetic values.
Catchment	The surface area from which water runs off to a river or any other collection reservoir.
Coupe	An area of forest over which timber harvesting as a single unit is planned. It may be associated with more than one silvicultural objective (e.g. a number of discrete gaps or clear-fells or a combination of both).
Dieback - Phytophthora	In the south-west of Western Australia a disease of plants caused by infection by soil-borne organisms of the genus *Phytophthora.*
Disturbance	Any range of conditions affecting the condition of a natural area. Disturbance may be natural (e.g. fire) or human induced (e.g. timber harvesting).
Diverse ecotype zone	A category of informal reserve that is defined by vegetation characteristics in the department's corporate spatial database. Diverse ecotype zones include rock outcrops larger than 0.2 hectares, wetlands, heath, sedge, herb and low-density woodland communities.
Ecosystem	A community or an assemblage of communities of organisms, interacting with one another and the environment in which they live.
Ecotone	A transition area between different plant communities.
Endangered	A taxon is endangered when it is not critically endangered but is facing a very high risk of extinction in the near future.
Endangered – critically	A taxon is critically endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
Endemic	Flora or fauna that are confined in their natural occurrence to a particular region.
Fauna	The animals inhabiting an area; including mammals, birds, reptiles, amphibians and invertebrates. Usually restricted to animals occurring naturally and excluding feral or introduced animals. With respect to the *Wildlife Conservation Act 1950*, fauna are: a any animal indigenous to any state or territory of the Commonwealth or the territorial waters of the Commonwealth b Any animal that periodically migrates to and lives in any state or territory of the Commonwealth or the territorial waters of the Commonwealth

Term	Definition
	c Any animal declared as fauna pursuant to subsection (2), and includes in relation to any such animal d any class or individual member thereof e the eggs, larvae or semen f the carcass, skin, plumage or fur thereof, but does not include any prescribed animal or prescribed class of animal.
Feral	An introduced or domestic animal now living in the wild.
Fire regime	The combination of season, intensity, interval, extent and patchiness of fire in a given area over a period of time.
Flora	The plants growing in an area; including flowering and non-flowering plants, ferns, mosses, lichens, algae and fungi. Usually restricted to species occurring naturally and excluding weeds. With respect to the Wildlife Conservation Act, flora refers to any plant (including any wildflower, palm, shrub, tree, fern, creeper or vine) which is: (a) native to the state or (b) declared to be flora pursuant to subsection (4), and includes any part of flora and all seeds and spores thereof.
Floristic	Of or relating to flowers, a flora, or the phytogeographical study of plants and animals.
Forest	An area, incorporating all living and non-living components, that is dominated by trees having usually a single stem and a mature or potentially mature stand height exceeding two metres and with existing or potential crown cover of overstorey strata about equal to or greater than 20 per cent.
Forest ecosystem	An indigenous ecosystem with an overstorey of trees that form greater than 20 per cent crown cover. These ecosystems should normally be discriminated at a resolution requiring a map-standard scale of 1:100,000. Preferably these units should be defined in terms of floristic composition in combination with substrate and position within the landscape.
Guideline	Principles, standards and practices for meeting goals that have been established as desirable outcomes for management. They can be quantitative or qualitative.
Habitat	A component of an ecosystem providing food and shelter to a particular organism.
Hygiene – in relation to dieback	Actions that decrease the risk of the pathogen being introduced spread or intensified.
Landform	All the physical, recognisable, naturally formed features of land having a characteristic shape. Includes major forms such as a plain, mountain or plateau, and minor forms such as a hill, valley or alluvial fan.
Landscape	The visual elements of both the natural and the built environment and including landforms, vegetation, waterform, land-use and architecture.
Mature forest structure	Forest containing an overstorey of mature trees having greater than 20 per cent canopy cover. May include previous cutting to shelterwood, thinning or selective silvicultural objectives.

Term	Definition
National estate	Areas identified in the department's corporate spatial database that represent elements of the natural environment, the Aboriginal environment and the historic environment which are of special value to the Australian community, present and future.
Old-growth forest	Forest recorded in DEC's corporate database as meeting the criteria for definition as old-growth forest.
Patch	A group of trees resulting from a natural regeneration event or a past management activity such as gap creation and regeneration.
Prescribed burning	The planned application of fire under selected fuel and weather conditions to a defined area to achieve specific management objectives.
Rare species	Taxa which are uncommon, not widely distributed, or occurring sparsely across their range.
Reserve – conservation	An area set aside primarily for the conservation of natural ecosystems but which may allow a level of recreation consistent with the proper maintenance and restoration of the natural environment.
Reserve – formal	One of the land categories of national park, nature reserve, conservation park, or CALM Act sections 5(1)(g) or 5(1)(h) reserves for the purpose of conservation.
Reserve – informal	An area set aside for conservation under an approved management plan; has had opportunity for the public to comment on changes to reserve boundaries; able to be accurately defined on a map; and is of an area and design sufficient to sustain the values it seeks to protect.
Riparian	Pertaining to the banks of streams, rivers or lakes.
Seral stage	A temporal stage in the process of vegetation succession.
Flora	The plants growing in an area; including flowering and non-flowering plants, ferns, mosses, lichens, algae and fungi. Usually restricted to species occurring naturally and excluding weeds. With respect to the Wildlife Conservation Act, flora refers to any plant (including any wildflower, palm, shrub, tree, fern, creeper or vine) which is: (a) native to the state or (b) declared to be flora pursuant to subsection (4), and includes any part of flora and all seeds and spores thereof.
Floristic	Of or relating to flowers, a flora, or the phytogeographical study of plants and animals.
Forest	An area, incorporating all living and non-living components, that is dominated by trees having usually a single stem and a mature or potentially mature stand height exceeding two metres and with existing or potential crown cover of overstorey strata about equal to or greater than 20 per cent.
Stand	A group of trees or patch of forest than can be distinguished from other groups on the basis of size, age, species composition, condition or other attribute.
Structure	When applied to a forest, is the vertical and spatial distribution of the vegetation.

Term	Definition
Tessellate	The process of sequentially defining a regular arrangement of adjacent divisions of space around the indicative fauna habitat zone. For example, an individual chess-board square has a tessellation of regularly arranged squares adjacent to it.
Threatening process	Those processes which may result in the long-term reduction of biodiversity. Examples include predation and habitat change by introduced animals; competition and displacement by introduced plants and destruction and modification of habitat.
Threatened ecological community	Ecological communities approved by the Minister for Environment as threatened and listed on the department's Threatened Ecological Community Database.
Vegetation complex	A combination of distinct site vegetation types usually associated with a particular geomorphic, climatic, floristic and vegetation structural association.
Weed	A plant, often a self-sown exotic, growing where it is not wanted.

11. References

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12. Appendix 1: Example of a summary checklist

Final Fauna Habitat Zone Location - Checklist

Region	Swan	**Date of Document Compilation**	27-Jan-09	**Stereo Photos**	Project No.
Block	Clare	**API Map Number**	104		Run
Compartment	07	**Date of Skyview Imagery**			Photo Nos.
FHZ FMIS ID	33	**Date of Field Check**	14&15-Jan-09		Date
					Scale

Mature Habitat & Threatened Species

	Corporate Dataset Name	Dataset Current as at:	Present in Database	Absent in Database	Value/Status within Boundary of Recommended FHZ	Present in Database	Absent in Database	Value/Status within Target Area (an area extending approximately 5 km from the boundaries of the Indicative FHZ)
Old-growth	OLDGROWTH_STANDARDUNDER_REVIEW	02-Dec-08	☐	☑		☑	☐	Target area contains approx. 4 ha of old growth forest
Mature Forest	DECFMPMATURE	08-Dec-04	☑	☐	Approximately 98% mature forest	☑	☐	Target area is approximately 56% mature forest
Poorly Represented Vegetation Complexes	DSCP-VEGC	23-Nov-05	☐	☑		☐	☑	
Darling Scarp Vegetation	DSCP-VEGC	23-Nov-05	☐	☑		☐	☑	
Threatened Ecological Communities	TEC SITES, TEC COMMUNITY BOUNDARIES	01-Aug-08	☐	☑		☐	☑	
Centres of Endemic Flora	NE-FLORA-ENDEMICS$99	01-Mar-98	☐	☑		☐	☑	
Centres of Relictual Flora	NE-FLORA-RELICTUAL$99	01-Mar-98	☐	☑		☐	☑	
Centres of Disjunct Flora	NE-FLORA-DISJUNCT$99	01-Mar-98	☐	☑		☐	☑	
Declared Rare Flora	DEFL	01-Aug-08	☐	☑		☑	☐	There are 20 records of DRFs in the target area (1 endangered, 19 priority)
Areas of High Species Richness	NE-FLORA-RICHNESS$99	01-Mar-98	☐	☑		☐	☑	
Threatened Fauna	THREATENED_FAUNA	01-Aug-08	☐	☑		☑	☐	8 records of threatened fauna in target area (3 vulnerable, 5 priority)
FDIS Land System / Landscape Unit	FDISFAUNAMAPMGA	17-Jul-03	☑	☐	Darling plateau: Jarrah Uplands N (37%), Jarrah Valleys N (18%), Granite Outcrops (40%), Depressions/Swamps E (1%)	☑	☐	Darling Plateau: Jarrah Uplands N (37%), Jarrah Valleys N (18%), Granite Outcrops (40%), Depressions/Swamps E (1%)
FDIS Harvesting Reports	FDIS HARVEST PLAN 2008	05-Aug-08	☑	☐	10 species were identified as having a high probability of occurring in the area	☑	☐	10 species were identified as having a high probability of occurring in the area
Formal/Informal Reserves	STATUS-JUNE08-WITHOUT-FHZ	24-Nov-08	☑	☐	3% is other informal reserve	☑	☐	4% of the target area is formal reserve, 18% is informal reserve (Incl. CAR)
Regrowth Forest	REGEN-SPECIES$08, REGEN-YEAR$08	05-Aug-08, 30-Jul-08	☐	☑		☑	☐	The target area contains a mosaic of Jarrah dominant regen from 1995-2000 (9%)
Sawlog Cutting History / SILREC	DECADE-LAST$08, SILREC$08	14-Aug-08, 01-Aug-08	☑	☐	1930s (6%), 1980s (94%)	☑	☐	Pre-1920 (6%), 20s (0%), 30s (30%), 50s (6%), 60s (5%), 70s (7%), 80s (23%), 90s (12%), 2000s (2%), SILREC mean: 1985-2000 (28%)
Year of Last Burn	FIRE-HISTORY$08	22-Aug-08	☑	☐	1981-82 (100%)	☑	☐	1981-82 (10%), 87-88 (3%), 89-90 (11%), 91-92 (1%), 97-98 (5%), 98-99 (6%), 2004-05 (34%)

Other Fauna/Flora Considerations

The Nature Conservation Regional Leader was consulted on the 22nd December 2008 and the 23rd January 2009 concerning the options for the finalisation of the indicative FHZ labelled 23. The proposed FHZ was the preferred option because it had good structural diversity throughout the option, the least dieback and superior spacing to reserves and other FHZs.

Dieback Status

Protectable Dieback Free	DIEBACK$08	01-Jul-08	☑	☐	Approximately 2% is recorded as infested.	☑	☐	Approximately 5% is recorded as infested
Dieback Impact	DIEBACK-IMPACT	2-Nov-07	☑	☐	100% low impact	☑	☐	83% low impact, 8% moderate impact, 9% high impact
Disease Risk Areas	DISEASE-RISK-AREA	31-Dec-77	☑	☐	100% declared disease risk area in 1975	☑	☐	100% declared disease risk area in 1975

Cultural Heritage

Aboriginal Heritage Sites	ABORIGINAL SITES, ABORIGINAL HERITAGE SITES REGISTER	27-Jan-08, 27-Jan-08	☐	☑		☑	☐	3 art sites - 'South Canning' 04, 10, 11
Cultural Heritage Commission	HERITAGE COMMISSION SITES, HERITAGE COUNCIL OF W A	27-Jan-08, 27-Jan-08	☐	☑		☐	☑	
Non-Indigenous Heritage Sites - RATIS	RATIS HERITAGE SITES	27-Jan-08	☐	☑		☐	☑	

Contiguity of FHZ Design

Formal/Informal Reserves (1)	STATUS-LP2008	30-Jun-08	☑	☐	There is linkage to other formal and informal reserves via stream and CAR informal reserves.	☑	☐	There is linkage to other formal and informal reserves via stream and CAR informal reserves.
Mines	MINING_TENEMENT, MINING-SAA$01	8-Oct-08, 26-Jun-08	☑	☐	Within the SAA mining area and mining tenement owned by Alcoa	☑	☐	Within the SAA mining area and mining tenement owned by Alcoa
Plantations	PLANTATION-ANNUAL-REPORT	23-Jun-08	☐	☑		☐	☑	
Reservoirs	RESERVOIRS$	29-Oct-07	☐	☑		☐	☑	
Roading (Present & Future)	ROADS_	13-Nov-08	☑	☐	Bounded by Rutherglen Road, Powerline Road and an un-named forest track	☑	☐	Brookton Highway, Rutherglen and Leona Roads
Harvesting (Present & Future)	HARVEST PLAN 08-10	15-Aug-08	☑	☐	Adjacent to Clare 02 2009 harvest coupe	☑	☐	Clare 02 2009 harvest coupe
Adjacent Private Property	STATUS-lp2008	30-Jun-08	☐	☑		☐	☑	
Remnant Vegetation	REMNANT_VEGETATION	22-Feb-07	☐	☑	Adjacent to remnant vegetation contained within the private property	☑	☐	Contains approx. 40 ha of remnant vegetation along the Brookton Hwy
Powerlines/Conveyor Belts	VOLTAGE_CARRIER_LINE	08-Oct-08	☑	☐	Bounded by the Boddington-Forrestfield Powerline	☑	☐	Bisected by the Boddington-Forrestfield Powerline
2nd Order Catchments	2_ORDER.CAT	12-Oct-07	☑	☐	Within the Upper Canning second order catchment	☑	☐	Within the Upper Canning second order catchment

Management Implications

Apiary Sites	APIARY SITES	27-Jan-08	☑	☐	A current apiary site is approx. 600 m south-east	☑	☐	7 sites within the target area
Recreation Sites and PVS Issues	CULTURAL POINTS, Personal Communication	27-Jan-08, 22-Jan-09	☐	☑		☑	☐	Area contains Brookton and Canning Campsites on Bibbulmun Track
Drinking Water Catchments	PUBLIC DRINKING WATER SUPPLY AREAS	13-Nov-08	☑	☐	Within the Canning River Catchment Area	☑	☐	Parts of Canning River & Mundaring Weir Catchment Areas
Wildflower Licences	Personal Communication	02-Jan-09	☐	☑		☐	☑	
Gazetted Firewood Collection Areas	FIREWOOD_ALL, DALE05	21-Jun-07, 01-Oct-08	☐	☑		☑	☐	Brady 2007 and Dale 2008 firewood collection areas
Basic Raw Material Extraction (gravel, shale, sand)	CULTURAL_LINES	13-Nov-08	☐	☑		☐	☑	

FHZ Spacing

Low Perimeter/Area Ratio	Area: 225 ha; Perimeter: 7247 m; Ratio: 31	FHZ Spacing (Reserve-FHZ)	<2km (2)	☐	
Minimum 200ha	225 ha		2-4km	☑	Helena National Park is approx. 4 km north-east
Width @ Narrowest Point >150m	> 150 m		>4km (3)	☑	Monadnocks Conservation Park is approx. 5.8 km south-west
Least Cost to Community		FHZ Spacing (FHZ-FHZ)	<2km (2)	☑	Indicative FHZ 28 is approx. 850 m south-east
FHZ ID potentially impacted by shift	24, 27, 28		2-4km	☑	Indicative FHZ 24 is approx. 2.5 km north-east, Indicative FHZ 27 is approx. 2.4 km south-west
Percentage of Forest Block reserved	29% a type of informal reserve		>4km (3)	☐	
FHZ Status	Interim				

(1) - FHZ may be wholly or partly in Informal Reserve

(2) - Warrup, Corbal, Meresa, Dadlup & Kingston blocks adjacent to proposed Greater Kingston National Park (GKNP)

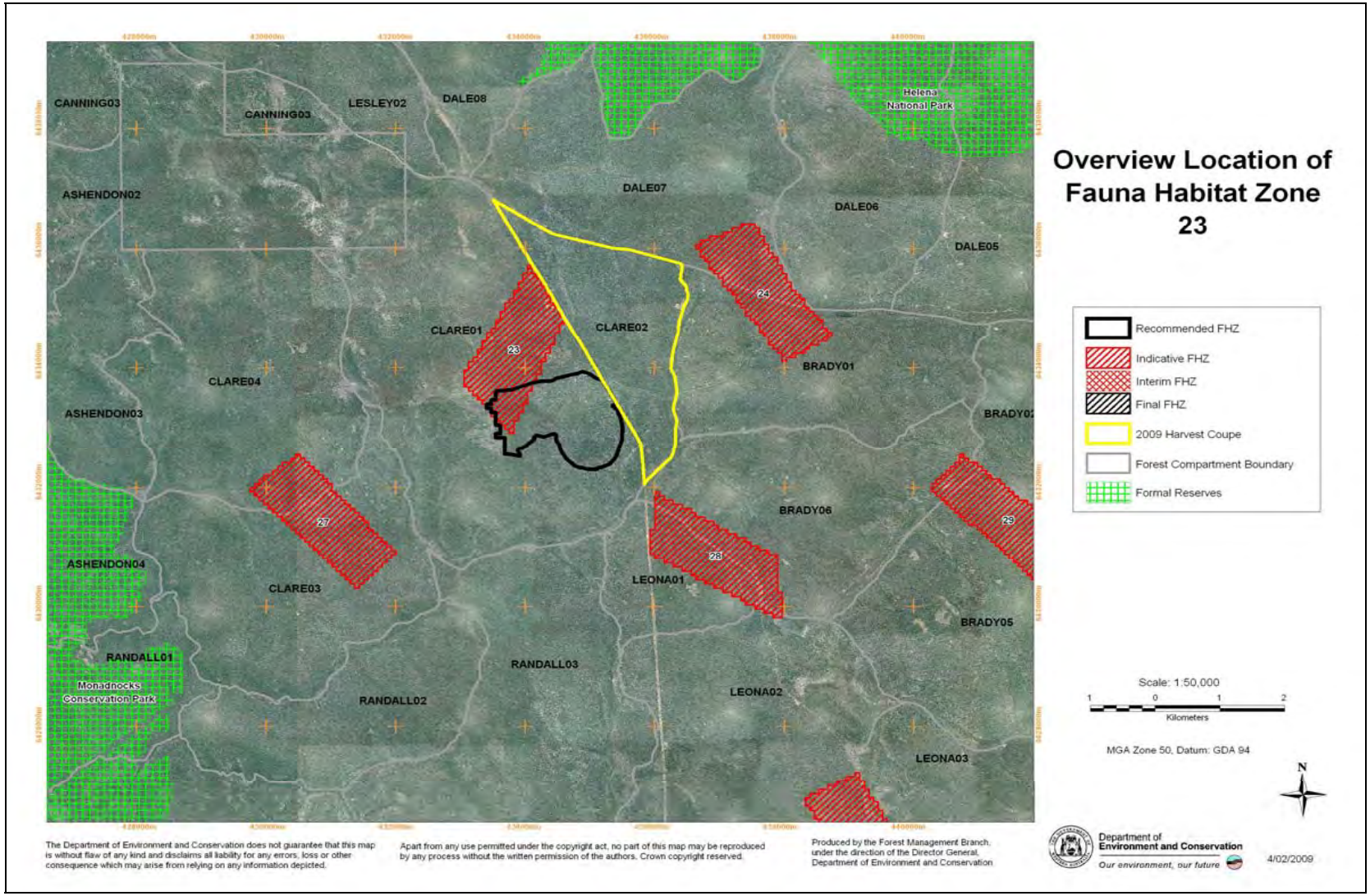
(3) - Areas surrounded largely by cleared land, >20% already in existing and proposed formal and informal reserves, where greater separation would capture a wider variety of habitat types, and accommodate greater concentration of FHZs near GKNP

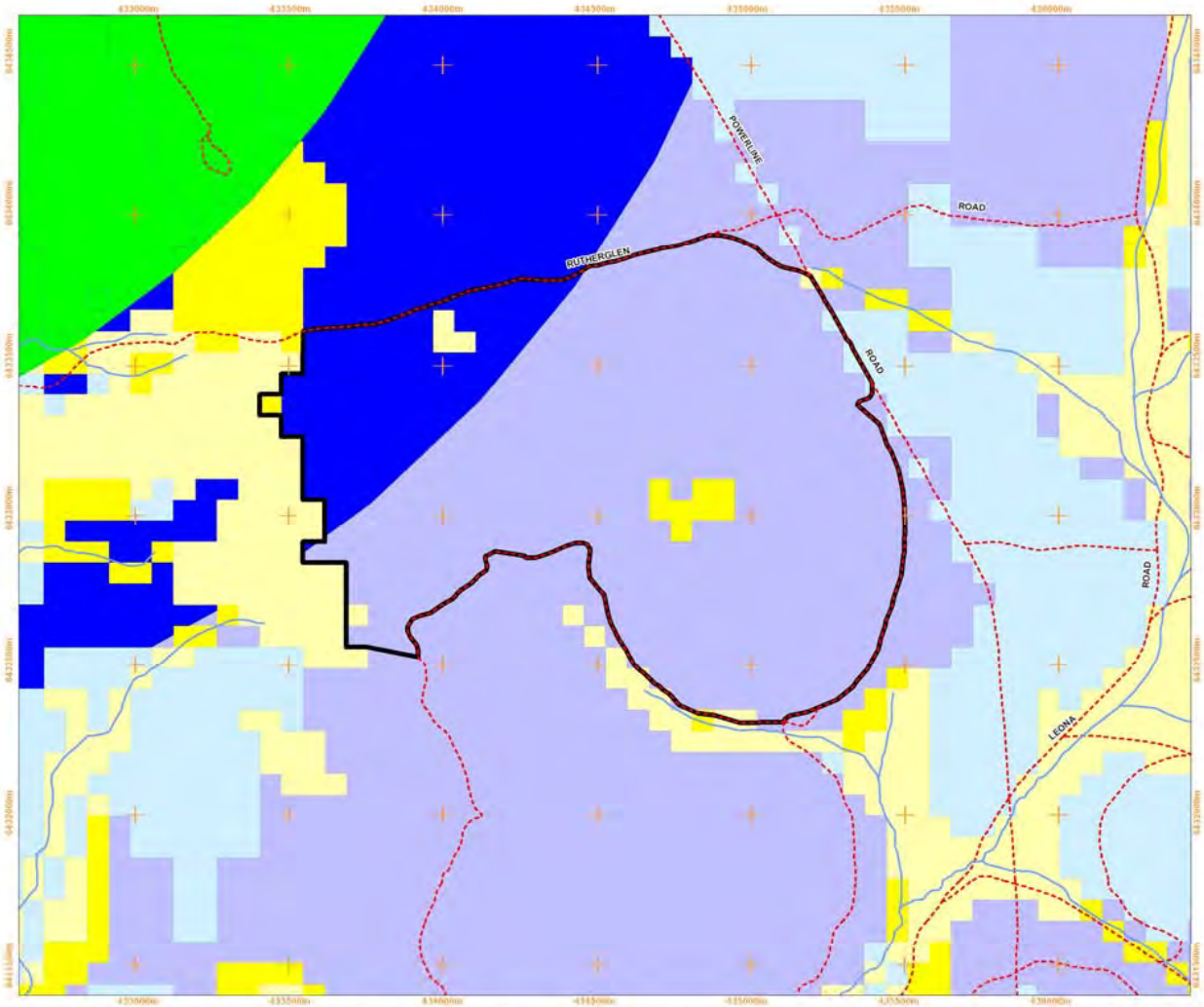
Final Integration:

The proposed FHZ is 225 hectares and is located within the Clare 01 forest compartment. The proposed FHZ is directly south of the indicative location. The final boundaries of the proposed FHZ were re-shaped to incorporate a greater range of topographical features, provide linkages to other reserves and to utilise 'hard' boundaries.

Checklist version May 2007

13. Appendix 2: Examples of standard maps





Forest Structure Surrounding Fauna Habitat Zone 23

- Recommended FHZ
- Within 3km of >200ha reserved mature forest
- Other public land
- Reserve - mature
- Reserve - not mature
- SF - mature but outside 3km band
- SF - mature and within 3 km band
- SF - not mature
- Roads and Tracks
- Rivers, Streams and Waterways

Scale: 1:12,500

0 250 500 750 1000

Meters

MGA Zone 50, Datum: GDA 94

N

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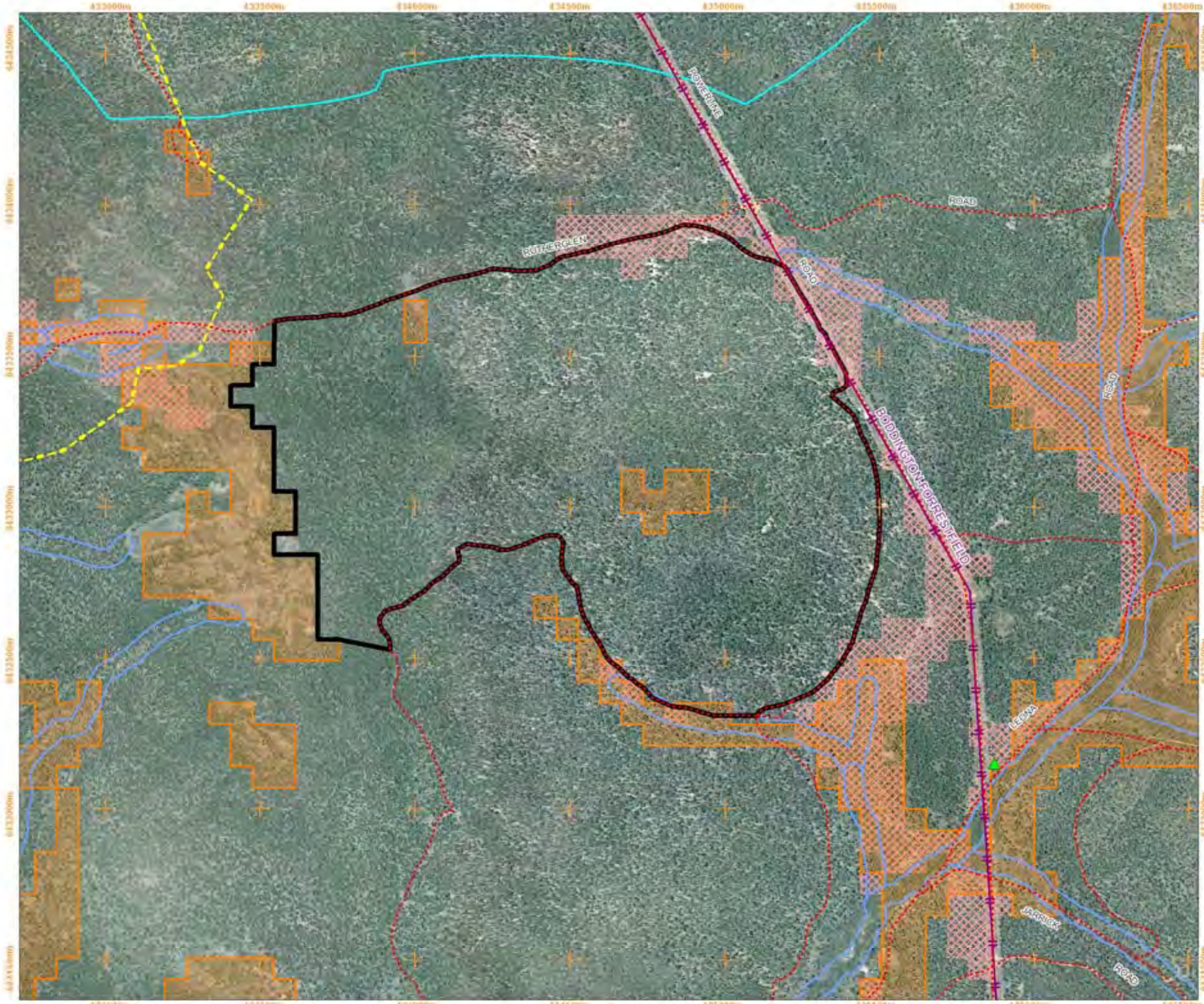

Select Values in the Vicinity of Fauna Habitat Zone 23

- Recommended FHZ
- Diverse Ecotype Zone (DEZ)
- Dieback present
- Apiary Site
- Roads and Tracks
- Bibbulmun Track
- Powerline
- Stream Buffer
- Second Order Catchment Boundary

Scale: 1:12,500

0 250 500 750 1000

Meters

MGA Zone 50, Datum: GDA 94

N

The Department of Environment and Conservation does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

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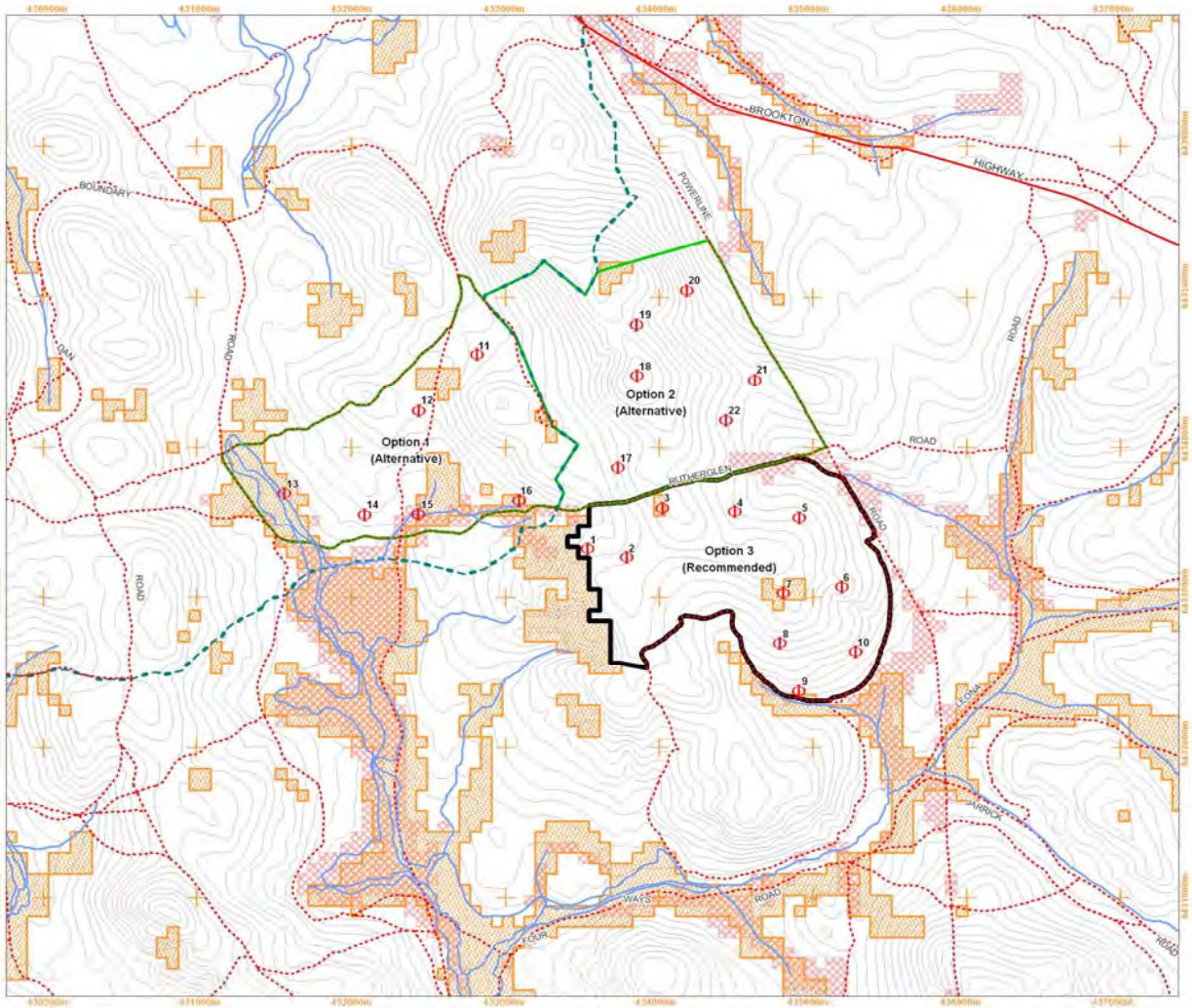

Field Check of Fauna Habitat Zone 23

- Recommended FHZ
- Alternative Options Considered
- Field Inspection Points
- Diverse Ecotype Zone (DEZ)
- Dieback present
- Bibbulmun Track
- Roads and Tracks
- Rivers, Streams and Waterways

Scale: 1:25,000

500 0 500 1000

Meters

MGA Zone 50, Datum: GDA 94

N

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