Biodiversity information explanatory document

Measuring value when removing or offsetting native vegetation

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VICTORIA State Government | Environment, Land, Water and Planning

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1. Introduction

The Department of Environment, Land, Water and Planning (DELWP) has developed a number of biodiversity information products that are used to measure biodiversity values at a site and across Victoria's landscape. These products are used to assess and consider impacts on biodiversity from land use and development, and to ensure biodiversity outcomes are delivered by the Victorian Government's investment programs.

Biodiversity information products include models, maps and assessment methods that:

- support the use of systematic and consistent approaches to measure the biodiversity value of native vegetation
- help communities understand the biodiversity value of native vegetation
- contribute to cost effective investment in biodiversity outcomes
- help align regulatory and investment programs.

1.1 Purpose of this document

This document explains the biodiversity information products used to measure the biodiversity value of native vegetation in Victoria in accordance with the *Guidelines for removal, destruction or lopping of native vegetation* (the Guidelines). It also describes where data is stored, and the systems and tools used to view the biodiversity information products.

Understanding the biodiversity value of native vegetation is important when:

- deciding where to focus efforts to avoid and minimise impacts from the removal of native vegetation
- assessing impacts when native vegetation is proposed to be removed in accordance with the Guidelines
- assessing gains from managing native vegetation as an offset in accordance with the Guidelines.

1.2 Structure of this document

Section 2 to 9 describe each of the biodiversity information products under three headings:

- Description – a short description of the product.
- Method – a summary of how the product was developed.
- Use – a brief summary of how the product is used when considering the removal and management of native vegetation in accordance with the Guidelines.

The information products covered in section 2 to 9 are:

- Ecological Vegetation Class (EVC)
- category of native vegetation
- extent of native vegetation
- sensitive wetlands and coastal areas
- native vegetation condition
- strategic biodiversity value
- habitat for Victoria's rare or threatened species
- location category.

Section 10 provides an overview of databases, systems and tools used including:

- the Victorian Biodiversity Atlas (VBA)
- NatureKit
- Native Vegetation Information Management (NVIM system
- Environmental Systems Modelling Platform (EnSym).

1.3 Scale of information

Biodiversity information exists at various scales. The products covered in this document can be grouped into two types based on their scale:

- *site-based information* that can be observed or measured at a site
- *landscape scale information* that is developed from a number of data sources and modelling techniques and is generally represented in statewide maps. This information cannot always be directly observed or measured at a site.

Some biodiversity information can be presented across both types, such as native vegetation condition. In these cases, the information can be observed or measured at a site and it is also represented in statewide maps.

2. Category of native vegetation

2.1 Description

Native vegetation is defined in planning schemes as *'plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses.'*[1] The Guidelines further classify native vegetation into two categories, a patch or a scattered tree.

Trees are categorised into different size classes based on the large tree benchmark Diameter at Breast Height (DBH) detailed in the bioregional Ecological Vegetation Class benchmarks (see section 3). This is done in accordance with the Guidelines.

2.2 Method

The Guidelines define the categories of native vegetation as follows.

A patch of native vegetation is:

- an area of vegetation where at least 25 per cent of the total perennial understorey plant cover[2] is native, or
- any area with three or more native canopy trees[3] where the drip line[4] of each tree touches the drip line of at least one other tree, forming a continuous canopy, or
- any mapped wetland included in the *Current wetlands map*.

A scattered tree is:

- a native canopy tree that does not form part of a patch.

The category of native vegetation is site-based information and is determined at the site. This can be done by an accredited native vegetation assessor completing a site assessment. It can also be done by a landowner using the *Applicant's guide – applications to remove, destroy or lop native vegetation* (Applicant's guide) and DELWP systems and tools described in section 10. Figure 1 shows an example of a landscape with scattered trees. Figure 2 shows an example of a patch of native vegetation.

2.3 Use

Native vegetation proposed to be removed or managed as an offset is categorised as a patch, a scattered tree or a combination of both. This categorisation affects how the native vegetation is mapped when it is proposed to be removed or managed at an offset site. The native vegetation category also determines how the condition score and gain score are measured.

The presence or absence of large trees is used to determine the assessment pathway of an application to remove native vegetation. When large trees are approved to be removed, the secured offset must include large trees.

Figure 1. Scattered trees

Figure 2. Patch of native vegetation

[1] Victoria Planning Provision – Definitions – Clause 72.

[2] Plant cover is the proportion of the ground that is shaded by vegetation foliage when lit from directly above. Areas that include non-vascular vegetation (such as mosses and lichens) but otherwise support no native vascular vegetation are not considered to be a patch for the purposes of the Guidelines. However, when non-vascular vegetation is present with vascular vegetation, it does contribute to cover when determining the percentage of perennial understorey plant cover.

[3] A native canopy tree is a mature tree (i.e. it is able to flower) that is greater than 3 metres in height and is normally found in the upper layer of the relevant vegetation type.

[4] The drip line is the outermost boundary of a tree canopy (leaves and/or branches) where the water drips on to the ground.

3. Ecological Vegetation Class

3.1 Description

There are many different vegetation types (grassland, heathland, forests etc.) found across the landscape. They can be classified on the basis of groups of native plant species and some of the biophysical factors that influence species distributions such as rainfall, topography, soil type and elevation. Ecological Vegetation Classes (EVCs) are the standard unit for classifying native vegetation types in Victoria, they exist within bioregions. Bioregional EVCs (BioEVC) have a documented benchmark for the characteristics of the vegetation type in its mature, natural (pre-1750) state. Each BioEVC also has a conservation status.

3.1.1 Bioregions

Bioregions are a landscape-scale approach to classifying the environment using a range of attributes such as climate, geomorphology, geology, soils and vegetation. There are 28 bioregions identified within Victoria, shown in Figure 3.

3.1.2 Ecological Vegetation Classes

EVCs are a key organising concept for native vegetation conservation. They provide a useful way to summarise and present complex ecological systems. EVCs can be determined at a site and have been modelled across the state to generate an EVC map. An example section of the statewide EVC map is shown in Figure 4.

3.1.3 Bio EVC Benchmarks

An BioEVC benchmark is based on the characteristics of mature stands of native vegetation that are likely to represent pre-settlement circumstances[5]. BioEVC benchmarks relate to a single EVC within one bioregion. The benchmarks contain a subset of indicative but not comprehensive lists of species for each EVC in a bioregion. This recognises that vegetation types vary, and can change seasonally.

3.1.4 Bioregional conservation status

The bioregional conservation status is determined for the BioEVC, and is a measure of the modern extent and quality, compared to its original (pre-1750) extent and condition. A BioEVC will have a bioregional conservation status of endangered, vulnerable, depleted, least concern or rare.

[5] This conforms with international practice which uses 1750 as a notional reference point for when the scale of human impacts on natural landscapes started to significantly accelerate due to the technological changes associated with the Industrial Revolution.

3.2 Method

3.2.1 EVC maps

EVC maps present a modelled distribution of EVCs in Victoria. Sections of the statewide EVC map were developed over a period of about 10 years from the late 1990s. These maps were developed using aerial photograph interpretation and on-ground mapping and provide an indication of what EVC may be present. Some of the EVCs specified in the map include mosaics or complexes of different vegetation types (for example a mix of grassland and wetland communities).

A mosaic or complex is a mapping unit which shows that at the scale of the map two (or more) EVCs cannot be delineated. If a habitat hectares assessment is undertaken then these EVCs should be delineated on-ground.

3.2.2 Bioregional conservation status

The criteria for determining the bioregional conservation status of a BioEVC is described in the EVC benchmark section of the DELWP website.

3.2.3 Determining the EVC at a site

EVCs can be determined on site by an accredited native vegetation assessor using the method described in the *Vegetation Quality Assessment Manual*, version 1.3, DSE, 2004 (VQAM). Assessors use the pre-1750 EVC map together with BioEVC descriptions, the BioEVC benchmarks and field observations to determine EVCs on site.

3.3 Use

Mapped EVCs that have a bioregional conservation status of Endangered are included in location category 2 in the *Location map* used to determine the assessment pathway of an application to remove native vegetation (see section 9).

EVCs and BioEVC benchmarks are used when completing a habitat hectare assessment to determine the condition of native vegetation to be removed or managed as an offset. The presence of an endangered EVC is considered:

- as an information source to focus efforts to avoid and minimise impacts on biodiversity from removing native vegetation at a site-level
- when deciding whether or not to approve an application to remove native vegetation.

Figure 3. Victorian bioregions

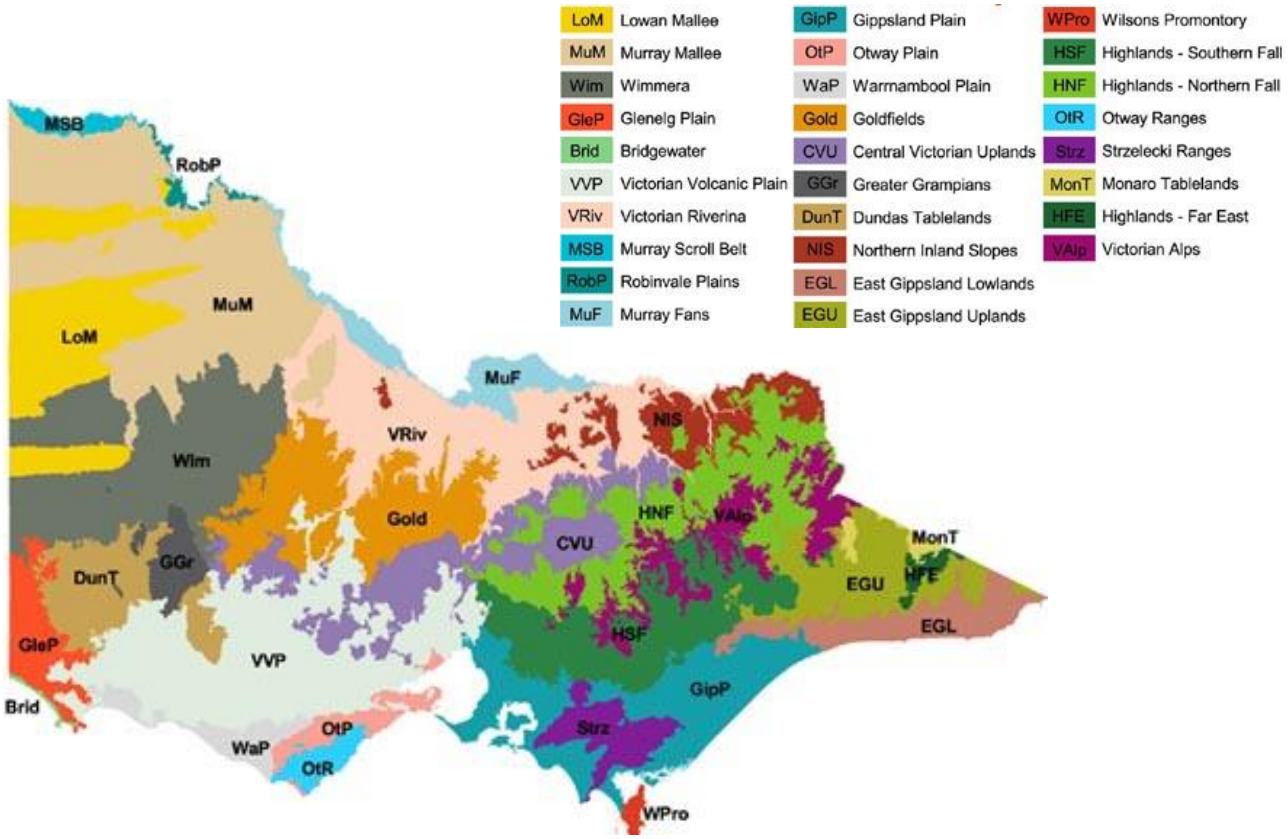
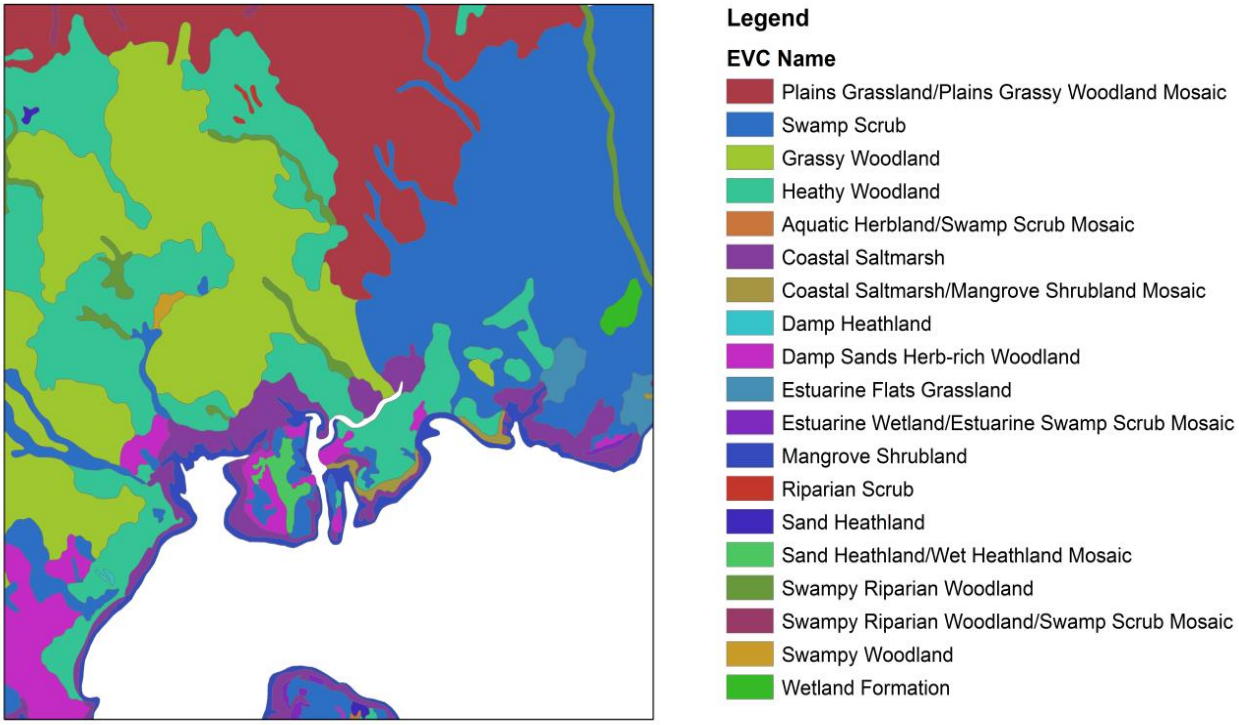


Figure 4. Zoomed section of Ecological Vegetation Class map



4. Extent of native vegetation

4.1 Description

The extent of native vegetation is the area of land covered by native vegetation. When removing native vegetation for development, or managing native vegetation at an offset site, extent is measured in hectares.

The extent of native vegetation at a site is measured or mapped by observation. Native vegetation extent is also represented at a landscape scale in a statewide map.

4.2 Method

4.2.1 Mapping native vegetation extent at a site

The extent of native vegetation is observed and mapped at the site, this is the site-based extent. This mapping is done after determining if the vegetation is a patch or a scattered tree (see section 2). All native vegetation proposed to be removed or protected and managed at an offset site is mapped.

A patch of native vegetation is mapped by drawing the boundary of the area to be protected or removed, The extent of native vegetation removal includes the area that may be impacted during construction, deemed losses and assumed losses as detailed in the *Assessor's handbook – applications to remove, destroy or lop native vegetation* (Assessor's handbook). If trees are located along the edge of the patch, the tree canopy drip-line is used to determine the outer boundary of the patch.

When scattered trees are proposed to be removed they are mapped by drawing a circle with a standard diameter, determined by the size of the tree:

- Small scattered trees are those with a DBH less than the large tree benchmark for the relevant BioEVC. The extent of a small scattered tree is mapped as a circle with a 10 metre radius with the trunk at the centre.
- Large scattered trees are those with a DBH equal to or greater than the large tree benchmark for the relevant EVC. The extent of a large scattered tree is mapped as a circle with a 15 metre radius with the trunk at the centre.

When protecting scattered trees at an offset site all trees with a DBH of at least 75 per cent of the large tree benchmark are mapped as a circle with a 15 metre radius with the trunk at the centre, or twice the drip line of the trees, whichever is larger. Trees smaller than this size cannot generate gain, but can be protected.

The extent of all scattered trees is added to the extent of all patches of native vegetation to determine the total extent of vegetation to be removed or protected at an offset site.

The number of large trees contained in a patch of native vegetation to be removed or protected are also recorded.

4.2.2 The native vegetation extent map

Native vegetation extent is also mapped at a statewide scale in the *Native vegetation extent map*, this is the landscape scale extent. The *native vegetation extent map* includes intact areas typical of national parks and state forests as well as smaller patches and scattered trees typical of rural and peri-urban landscapes. This map is generated using computer software at a 25 x 25 metre grid scale, and converted to a 75 x 75 metre grid scale. Figure 5 provides an image of this map at a statewide scale.

The *Native vegetation extent map* builds on previous modelling techniques (from 2010[6]) that use:

- A variety of spectral imagery – 5 metre RapidEye, 10 metre Spot, 30 metre Landsat and 225 metre MODIS[7], with 50 metre ALOS[8] radar data to detect the likely presence of woody vegetation and then applied appropriate site-based training data, filters and analysis to help categorise woody vegetation as native or exotic (e.g. plantations, urban plantings, windbreaks).
- Time-series Landsat and MODIS imagery, with appropriate site-based training data to detect the likely presence of native grass-dominated areas. Time-series data can show fluctuations in growth patterns due to seasonal or climate events, which help discriminate between native and exotic grassland/pasture.

Updates to the 2010 native vegetation extent map include:

- improved identification of scattered trees with more than 100,000 individual trees added as single grid cells
- improved modelling of native pasture and wetland areas using recent (2010 to 2015) time series imagery

[6] Used to generate the 2013 *Native vegetation extent map*

[7] MODIS – Moderate Resolution Imaging Spectroradiometer

[8] ALOS – Advanced Land Observing Satellite

- added areas of native vegetation identified through stakeholder feedback on the 2013 *Native vegetation extent map*
- removal of areas of native vegetation cleared for development
- improved alignment with the Melbourne Strategic Assessment project data.

4.3 Use

4.3.1 Site-based extent

The native vegetation proposed to be removed is mapped on site. The extent of this native vegetation is used to measure the impact on biodiversity from its removal.

Similarly, native vegetation to be protected and managed at an offset site is mapped. The extent of this native vegetation is used to measure the biodiversity gains achieved by managing and protecting the vegetation.

4.3.2 Landscape scale extent

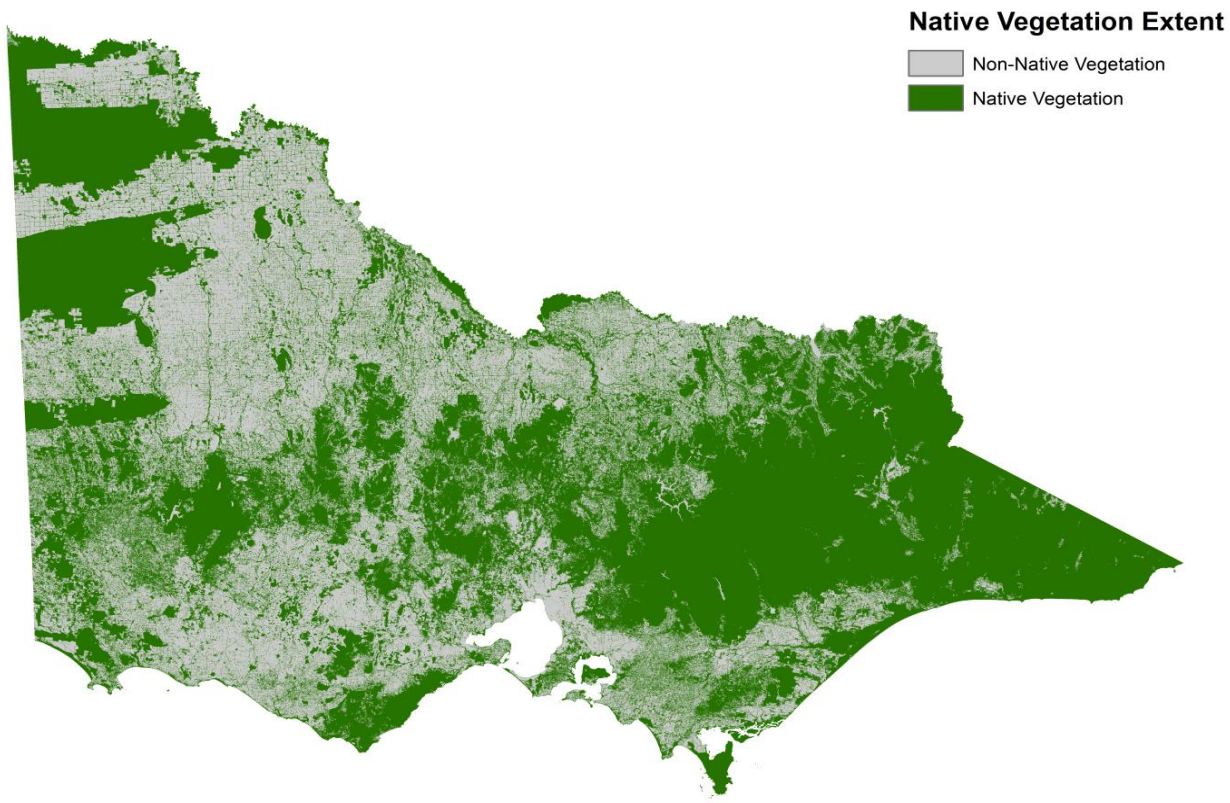
The map of the extent of native vegetation remaining across Victoria indicates where native vegetation is likely to be present. The *Native vegetation extent map* does not determine if a permit is required to remove native vegetation. This is determined by the presence of native vegetation at the site.

The *Native vegetation extent map* is used to develop the following maps:

- *Native vegetation condition map*
- Habitat importance maps for rare or threatened species
- *Location map* (25 x 25 metre grid scale).

When native vegetation has been approved for removal and the extent is spatially captured in a Geographic Information System (GIS) format, it can be used to periodically update other maps used in the regulations. This will ensure cumulative loss of native vegetation is factored into permit decision making.

Figure 5. Native vegetation extent map



5. Sensitive wetlands and coastal areas

5.1 Description

Wetlands in Victoria are shown in the *Current wetlands map*. DELWP defines wetlands as areas, whether natural, modified or artificial, subject to permanent or temporary inundation, that hold static or very slow moving water and develop, or have the potential to develop, biota adapted to inundation and the aquatic environment. They may be fresh or saline.

Some Victorian wetlands are considered to be particularly significant because of the values that they support, these include:

- wetlands designated under the Convention on Wetlands of International Importance (the Ramsar Convention)
- wetlands listed in the Directory of Important Wetlands of Australia.

Internationally important sites for Migratory Shorebirds of the East Asian-Australasian Flyway are also described in this section.

5.2 Method

5.2.1 Current wetlands map

The *Current wetlands map* is generated using digitised mapping based on aerial photo interpretation and field validation.

Polygon boundaries in the *Current wetlands map* indicate the maximum extent of inundation, determined using a combination of site features including extent of inundation in wet conditions, the distribution of hydric soils and geomorphological features such as break of slope.

5.2.2 Directory of Important Wetlands in Australia

The Directory of Important Wetlands of Australia is a list of nationally recognised important wetlands. There are over 150 listed wetlands in Victoria. A wetland may be considered nationally important if it meets at least one of the following criteria:

- it is a good example of a wetland type occurring within a biogeographic region in Australia
- it plays an important ecological or hydrological role in the natural functioning of a major wetland system or complex
- it is habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- it supports one per cent or more of the national population of any native plant or animal taxa
- it supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- it is of outstanding historical or cultural significance.

For further information on the Directory of Important Wetlands, see: http://www.environment.gov.au/water/wetlands/australian-wetlands-database/directory-important-wetlands

5.2.3 Ramsar sites

There are a number of wetlands in Victoria that are listed under the Ramsar Convention (Ramsar sites). These sites have been listed based on their international significance in terms of ecology, botany, zoology, limnology and/or hydrology. The Ramsar Convention has criteria for the designation of Ramsar wetlands which relate to identifying sites that contain representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity. For further information on the criteria for designating Ramsar wetlands, see *Australian Ramsar Site Nomination Guidelines,* available at: http://www.environment.gov.au/water/wetlands/publications/australian-ramsar-site-nomination-guidelines.

Detailed guidance on determining the site boundaries of Ramsar wetlands is provided in the *Boundary Description and Mapping Guidelines (Second Edition). Module 1 of the National Guidelines for Ramsar Wetlands – Implementing the Ramsar Convention in Australia,* Australian Government Department of the Environment, Canberra, 2014.

5.2.4 Migratory Shorebirds of the East Asian-Australasian Flyway

Internationally important sites for Migratory Shorebirds of the East Asian-Australasian Flyway consist of wetland and coastal areas that are habitat for one or more migratory shorebird species.

For further information about the East Asian-Australasian Flyway and designating important sites for migratory shorebirds within it, see: http://www.environment.gov.au/resource/migratory-shorebirds-east-asian-australasian-flyway-population-estimates-and

The mapped boundaries of these sites were drawn to ensure that the criteria for which they were listed as important sites for migratory shorebird were included within the boundary.

5.3 Use

When mapping native vegetation to be removed or managed as an offset, mapped wetlands are regarded as a patch of native vegetation. The *Current wetlands map* is included in NVIM and is used to identify wetlands because they can be difficult to identify and accurately assess on site due to their dynamic nature and inherent variability throughout the wetting and drying cycle.

Wetlands designated under the Ramsar Convention or listed in the Directory of Important Wetlands of Australia as well as internationally important sites for Migratory Shorebirds of the East Asian-Australasian Flyway (collectively referred to as sensitive wetlands and coastal areas in the Guidelines) are included in Location 2 of the *Location map* (see section 9).

This information is used:

- as an information source to focus efforts to avoid and minimise impacts on biodiversity from removing native vegetation at a site-level
- when considering whether or not to approve an application to remove native vegetation.

6. Native vegetation condition

6.1 Description

Most native vegetation in Victoria has been subject to some disturbance. Causes of disturbance include historical or current land use, weed infestations and pest animal invasion. These disturbances generally reduce the condition of native vegetation.

Native vegetation condition indicates how close the vegetation is to the EVC benchmark, the higher the condition score the closer it is to its pre-disturbance condition.

6.2 Method

6.2.1 Measuring native vegetation condition at a site

In Victoria, the condition of native vegetation at a site is measured using the Vegetation Quality Assessment (VQA) method. The VQA method is described in the VQA Manual and provides a practical and consistent method for quantifying native vegetation condition. The method involves identifying EVCs on site and determining the quality or condition of them by completing a habitat hectare assessment.[9]

The VQA method requires assessors to collect primary data on the presence of observable characteristics. This includes the percentage of vegetation cover and species diversity within life forms (e.g. trees, shrubs, and ground ferns). Information on the size of trees is also collected where relevant as an indicator of 'time to recovery of habitat values'. The data is then compared to EVC benchmark levels and combined by weighting their relative importance.

Update to the method described in the VQAM

The VQA Manual describes when a habitat zone should be defined based on the EVC and quality of native vegetation[10]. The following supersedes that advice when determining a habitat zone for native vegetation to be removed, or protected at an offset site in Victoria.

A habitat zone is a single continuous patch of the same EVC. Changes in habitat condition should generally not influence how a habitat zone is defined.

In general, a habitat zone should only be split based on the presence of a different EVC, not based on a change in the vegetation condition within an EVC. However, a habitat zone must be split when it cannot be reasonably represented by a single VQA because:

- the site condition score (out of 75) varies by at least 15 points, and
- the extent of the continuous patch of vegetation is greater than 1 hectare.

In addition, a habitat zone at an offset site must be split to exclude areas of the habitat zone that do not meet the eligibility criteria detailed in section 9.1.3 of the Guidelines. That is a minimum 'site condition score'[11] of 30 out of 75, and any treeless EVC must also have a minimum 'lack of weeds score'[12] of 7 out of 15.

The VQA results in a habitat score (out of 100) as a percentage of the benchmark. This score is divided by 100 to get the condition score from 0 to 1.

6.2.2 The native vegetation condition map

Modelled native vegetation condition is included in the statewide scale *Native vegetation condition map.* Figure 6 provides an image of this map. The *Native vegetation condition map* was developed from the 2010 native vegetation condition model which was based on the following two stage process:

1. A model is generated to determine a condition benchmark of vegetation types in Victoria. The condition benchmarks include environmental attributes for each vegetation type across Victoria. Attributes of vegetation types in very good condition are used to establish the pre-1750 condition benchmarks. The condition benchmarks for each vegetation type are then extrapolated to all locations where that vegetation type would have existed. All locations across Victoria are assigned a vegetation type with condition benchmark scores.

[9] A habitat hectare assessment forms part of a site assessment detailed in the Guidelines

[10] Refer section 5 of the VQAM *'Estimating the required number and size of habitat zones'*

[11] This is the site condition score determined in accordance with the VQAM

[12] This is the lack of weeds score determined in accordance with the VQAM

2. A model of the 2010 environmental attributes of native vegetation has been developed based on data from a large number of sites and a range of environmental data. The attributes are then compared to the relevant vegetation type condition benchmarks to determine a 2010 condition score. If the 2010 condition at the location is the same as the condition benchmark, the location is given a score of 1.00. A site that has a condition score of 0.50 is half the pre-1750 condition.

The 2010 model for native vegetation condition is presented at a 75 x 75 metre scale. This model has been masked with the *Native vegetation extent map* to create the *Native vegetation condition map*. All areas that are not native vegetation are given a condition score of 0.00 and areas mapped as native vegetation have scores from 0.01 to 1.00.

A second *Native vegetation condition map* is made by setting the minimum condition score of any area of native vegetation to 0.20 and assigning a score of 0.20 to all areas that are not mapped as native vegetation. This ensures that the lowest condition score for any area of native vegetation in Victoria is 0.20. This map is the map referenced in the Guidelines.

6.3 Use

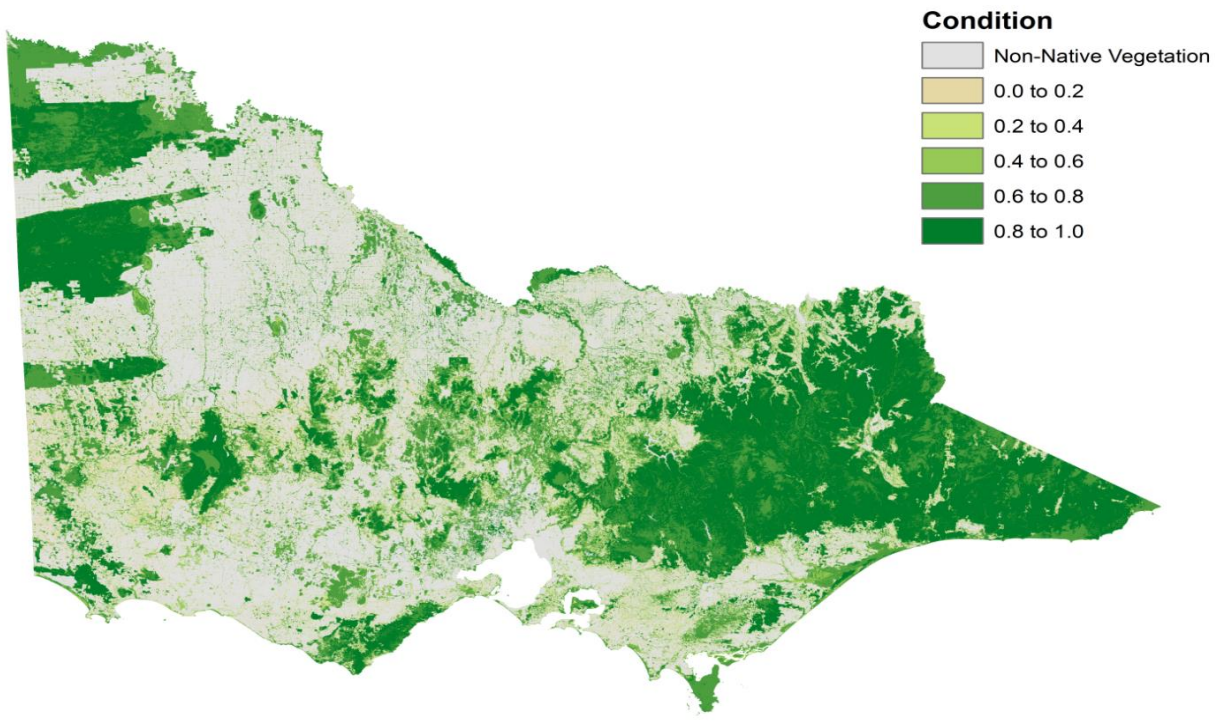
Information on native vegetation condition is used at a site-based and landscape scale. When a site assessment is required as detailed in the Guidelines, the site assessed condition score is used. When a site assessment is not required the modelled condition score from the *Native vegetation condition map* with a minimum score of 0.20 is used.

The native vegetation condition score is used:

- as an information source to focus efforts to avoid and minimise impacts on biodiversity from removing native vegetation at a site-level
- to determine the impact on biodiversity from removing native vegetation and to calculate whether species offsets are required
- when considering whether or not to approve an application to remove native vegetation
- when determining the biodiversity value at an offset site.

Native vegetation condition modelling is also used in the process for developing the *Strategic biodiversity value map*, and when applying the species-general offset test detailed in the Guidelines.

Figure 6. Native vegetation condition map



7. Strategic biodiversity value

7.1 Description

The *Strategic biodiversity value map* is a landscape scale map that combines information on biodiversity values with connectivity and fragmentation information to show the relative value of landscapes across Victoria.

The map provides a strategic view of the ranked contribution of a location for the conservation of Victoria's biodiversity. A higher strategic biodiversity value score indicates a location that contains more, and less common biodiversity values relative to other locations with a lower score. Higher scores tend to be in contiguous areas of native vegetation. Figure 7 provides an image of the *Strategic biodiversity value map* at a statewide scale.

7.2 Method

The *Strategic biodiversity value map* was created by combining and analysing biodiversity information across Victoria using Zonation conservation planning software[13]. The objective of this analysis was to rank all locations across Victoria for their ability to represent rare or threatened vertebrate fauna, vascular flora, and the full range of Victoria's native vegetation. The data used includes:

- species habitat distribution models
- models of uncertainty of the likelihood of modelled species habitat
- models of vegetation types in Victoria
- a model of native vegetation condition.

The analysis first looks for locations with the least biodiversity value and then identifies the location with the next lowest level of biodiversity value. This process continues until there is a complete ranking of locations across the state. The biodiversity value that informed the ranking is based on the modelled range and likelihood of species habitat or vegetation type in a location, compared to pre-settlement levels.

This analysis results in the areas with little biodiversity value being ranked lower, the most degraded and poorly located examples of the most common habitat or vegetation in the middle of the ranking, and the best and most well-connected examples of species' habitats across the state ranked highest. This means that some locations with low condition vegetation can be more highly ranked because they provide links for habitats, or are the only remaining habitat for certain species.

Further information about the method for generating the *Strategic biodiversity value map* is located at https://www.environment.vic.gov.au/biodiversity/natureprint

A second *Strategic biodiversity value map* has been made by setting the minimum strategic biodiversity value score to 0.10. This is done to ensure that the lowest strategic biodiversity value score for any location in Victoria is 0.10. This map is referenced in the Guidelines.

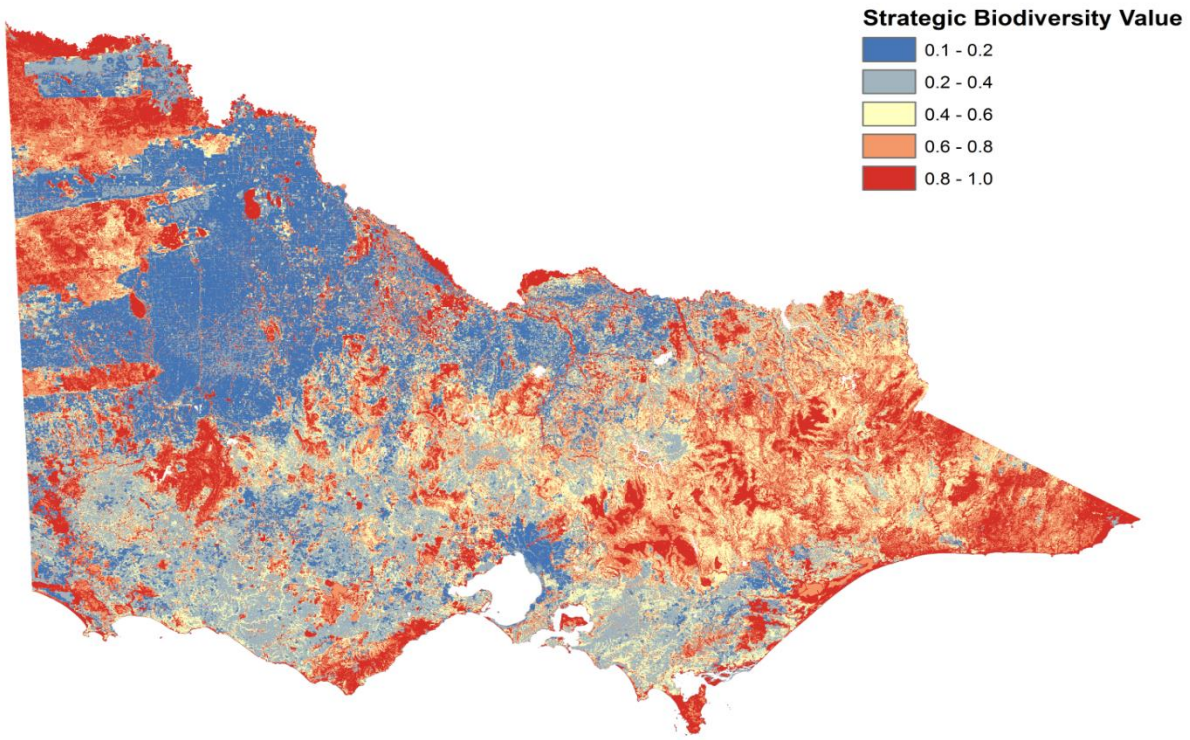
7.3 Use

The strategic biodiversity value score is used:

- as an information source to focus efforts to avoid and minimise impacts on biodiversity from removing native vegetation at a site-level
- to determine the impact on biodiversity from removing native vegetation
- when considering whether or not to approve an application to remove native vegetation
- when determining the biodiversity value at an offset site.

[13] http://cbig.it.helsinki.fi/software/zonation

Figure 7. Strategic biodiversity value map



8. Habitat maps for rare or threatened species

8.1 Description

Fauna and flora species have different habitat requirements. They need a place to live and reproduce. They also need to tolerate changes in the weather, and flood and fire disturbances. As a result of these different needs, species are found in different locations across the landscape. Some species have highly specific habitat requirements (such as the Mountain Pygmy-possum), while other species can thrive in a number of different habitat types (such as the Australian Magpie).

Habitat distribution models (HDMs) have been developed for all rare or threatened Victorian species[14] where sufficient data is available.

HDMs collect and compare information on where a species has been recorded, and relate that data to environmental variables, such as soil, prevailing climate and topography. Sophisticated statistical and mathematical processes are then used to estimate the distribution of a species' habitat.

The HDMs do not predict whether or not a species currently occupies the habitat at a particular location. Many factors can influence whether a species is present in the habitat at any given time, including:

- biogeography
- size of the habitat patch and distance from other suitable habitat
- natural disturbance cycles
- historic catastrophes
- the impact of predators or disease
- seasonal factors.

Understanding the likely distribution of a species habitat is important when making decisions about native vegetation (habitat) removal. Individual observations of species are an important source of information, but habitat distribution modelling provides valuable information when making decisions about land use that could impact on habitat.

It is also helpful to understand the relative importance of the habitat for a species. The relative importance of habitat in different places is determined by the amount of habitat available, its condition, and how well the habitat is connected across the landscape.

Some species have a greater chance of survival in larger or well-connected natural landscapes compared to landscapes with smaller and less connected remnants. *Habitat importance mops* (HIMs) reflect this variation in the ability of species to access substantial areas of habitat and to move across the landscape. HIMs indicate which patches of habitat may be relatively more important to a species' persistence than others.

8.2 Method HDMs

HDMs are based on Victorian species observation records from the Victorian Biodiversity Atlas (VBA, see section 10) that have been collected since 1980. These models also use interstate species records from BirdLife Australia, and South Australia and New South Wales government databases. The inclusion of interstate species records ensures that natural ranges are appropriately considered, resulting in markedly improved habitat predictions within Victoria.

Species records are then related to environmental features such as rainfall, temperature, terrain or soil type, which may help to predict how a species is distributed across the landscape. Only environmental predictors, resolved to 75 metre pixels, that are mapped comprehensively across the whole of Victoria and beyond (covering much of south eastern Australia) have been used. Predictor variables include gridded climate data, an independent data set of radiometric data (a useful surrogate for soils and regolith), and a range of variables derived from digital elevation models that illustrate landscape features such as terrain wetness, duration of solar radiation and height above water.

HDMs identify not only the current known species distribution but also potential habitat. Where potential habitat is identified based on the environmental features of a location, but in a geographic area that in a pre-1750 era is considered unlikely to have been used by the species, this is masked out of the model.

8.3 Method NVR2017 HIMs

The HIMs used in the native vegetation removal regulations are known as NRV2017 HIMs. The HIMs are used to assess impacts when native vegetation is to be removed and to determine value when native vegetation is protected at an offset site, in

[14] Rare or threatened species listed as 'critically endangered', 'endangered', 'vulnerable', or 'rare' in DELWP maintained Advisory Lists of plants, vertebrate fauna, or invertebrate fauna.

accordance with the Guidelines. Images of two HIMS are provided at Figure 8 and Figure 9.

The processes undertaken to develop the HDMs into NVR2017 HIMs include:

- environmental masking
- application of a threshold
- specialist review and adjustments
- clipping to native vegetation extent and Victorian state boundary
- assigning habitat importance scores.

These processes are described in more detail below.

8.3.1 Environmental masking

A number of 'sub-catchments' with similar biogeographical characteristics have been defined across Victoria. They are shown in an environmental mask. This mask is used to remove or reduce the inclusion of likely habitat as follows:

- When making **fauna** maps, the environmental mask is used to reduce the score of the HDM in all 'sub-catchments' where the species has not been recorded. This means that if a 'sub-catchment' was modelled in the HDM as highly likely habitat but the species had never been recorded in the 'sub-catchment', its likelihood of being habitat is reduced by half.
- When making **flora** maps, the environmental mask is used to remove areas of likely habitat from the HDM in all 'sub-catchments' where the species has not been recorded.

8.3.2 Application of a threshold

A threshold is used to remove lower likelihood habitat from the masked HDMs (i.e. after the environmental mask has been applied). All habitat below a particular threshold value is removed as follows:

- Thresholds for **fauna** species were determined by fauna group experts. This removes areas of lower likelihood habitat from the model.
- Thresholds for **flora** species were statistically derived to ensure that 95 per cent of all known records were retained in the modelled habitat. Areas of lower likelihood are removed.

8.3.3 Specialist review and adjustments

The mapped result, HDMs that have undergone environmental masking and the application of a threshold were reviewed by a number of specialists to supplement the largely automated process. Feedback from specialists resulted in further adjustments, including:

- removing the environmental mask in locations where the species was known to occur but where the observations had not yet been added to the VBA
- applying the environmental mask in locations where the species was not known to occur
- adding updated records as buffered points where recent data was available.

Through this process habitat importance maps were manually generated for any rare or threatened species where there was insufficient data available to generate a reliable HDM using an automated process. Records in the VBA that occur within the *Native vegetation extent map* are buffered to create a 75 x 75 metre cell map of buffered points for the species.

8.3.4 Clipping to native vegetation extent and Victorian state boundary

The final step to refine the extent of likely habitat for the native vegetation removal regulations is to remove areas of habitat that are not classified as native vegetation in the 75 x 75 metre *Native vegetation extent map* or are not within Victoria. This process is applied to fauna and flora models in the same way, and results in the final extent of the HIMs used when the Guidelines are applied.

8.3.5 Assigning habitat importance scores

A habitat importance score is assigned to each location of habitat in the species' map. In some cases, all locations are regarded as equally important and the scores are unranked. In other cases. there are locations that are considered more important than other locations and scores are ranked.

The method for assigning a habitat importance score to the map depends on the classification of the species' habitat as highly localised or dispersed

Classifying the species habitat

Classification of a species habitat is based on the area of likely habitat remaining in Victoria for the species.

Highly localised habitats

Highly localised habitats for rare or threatened species are very limited in extent and are typically

geographically restricted. For example, some species may only be found in one or two locations over a few hundred hectares.

Any species that has a mapped extent in the NVR2017 HIM of 2,000 hectares or less is classified as highly localised habitat.

Dispersed habitats

Dispersed habitats for rare or threatened species are less limited in extent and less restricted than highly localised habitats. Any species that has an NVR2017 HIM extent of more than 2,000 hectares is classified as dispersed habitat.

The use of 2,000 hectares of extent to distinguish between highly localised and dispersed habitat aligns with the IUCN Red List criterion VU D2.[15]

Ranking locations within HIMs

Once the species' habitats have been classified, a ranking is assigned to differentiate between locations of habitat.

Unranked habitat importance maps

When a single instance of vegetation removal (habitat loss) could result in a significant impact on a species, or when all the species habitat is equally important, the habitat score is not ranked. All locations within the HIM for these species are assigned a habitat importance score of 1.00. This applies to:

- all highly localised habitat maps
- a few dispersed habitat maps where all habitat is equally important.

Ranked habitat importance maps

It is useful to differentiate the importance of dispersed habitat for a species when there are locations that are more important than others. Differentiation of habitat highlights areas of dispersed habitat that are likely to be more important for a species because of the habitat characteristics at the location. This is done by assigning a ranked habitat importance score to all locations in the map. Habitat importance scores range from 0.10 to 1.00

Fauna and flora models are treated differently because of their habitat requirements.

Fauna species are generally quite mobile and the importance of an area relative to other areas is based on the species' home range, its ability to move through the landscape to other populations and the presence of key habitat characteristics such as trees when these are important. The condition of native vegetation plays a less important role for most fauna species.

Flora species are generally less mobile than fauna and native vegetation condition is considered the most important factor when determining the importance of one location in relation to other locations of likely habitat. Landscape context including connectivity and size plays a lesser role.

8.3.6 Important areas for dispersed species habitats

In addition to the NVR2017 HIM(s) including all of a dispersed habitat, the ranking provided by the habitat importance score and data from the VBA is used to determine important areas of habitat within dispersed species habitat. Separate maps are developed to represent these (called top ranked maps). These maps are used in addition to the NVR2017 HIM when calculating and assessing biodiversity losses and gains. Important locations such as locations with large populations of a species and roosting sites have been included in these maps.

8.4 Use

The NVR2017 HIM(s) are used:

- as an information source to focus efforts to avoid and minimise impacts on biodiversity from removing native vegetation at a site-level
- to determine the impact on biodiversity from removing native vegetation, including determining whether species offsets are required
- when considering whether or not to approve an application to remove native vegetation
- when determining the biodiversity value at an offset site, including determining whether species offsets are generated
- as an input in the *Location map* that is used to determine the assessment pathway of an application to remove native vegetation.

[15] Vulnerable (VU) with a small or restricted population (D) with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future and is thus capable of becoming Critically Endangered or even Extinct in a very short time period (2). VU D2

Figure 8. NVR2017 Habitat importance map for *Caladenia lowanensis* (highly localised species)

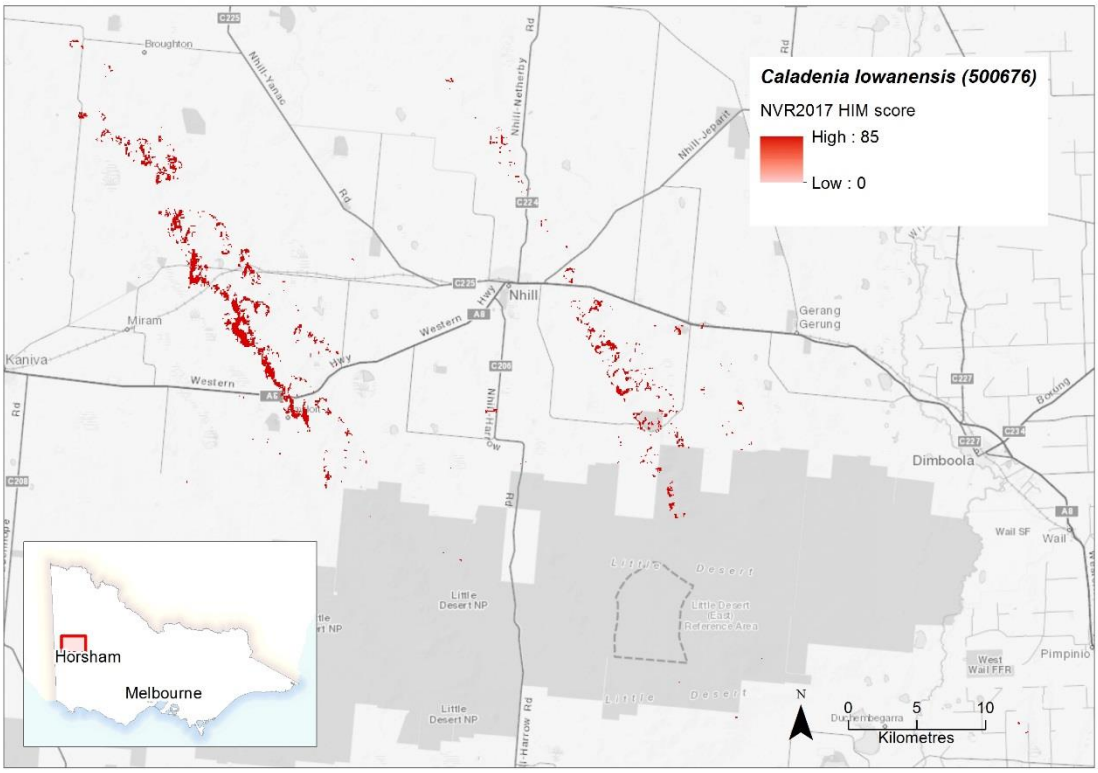
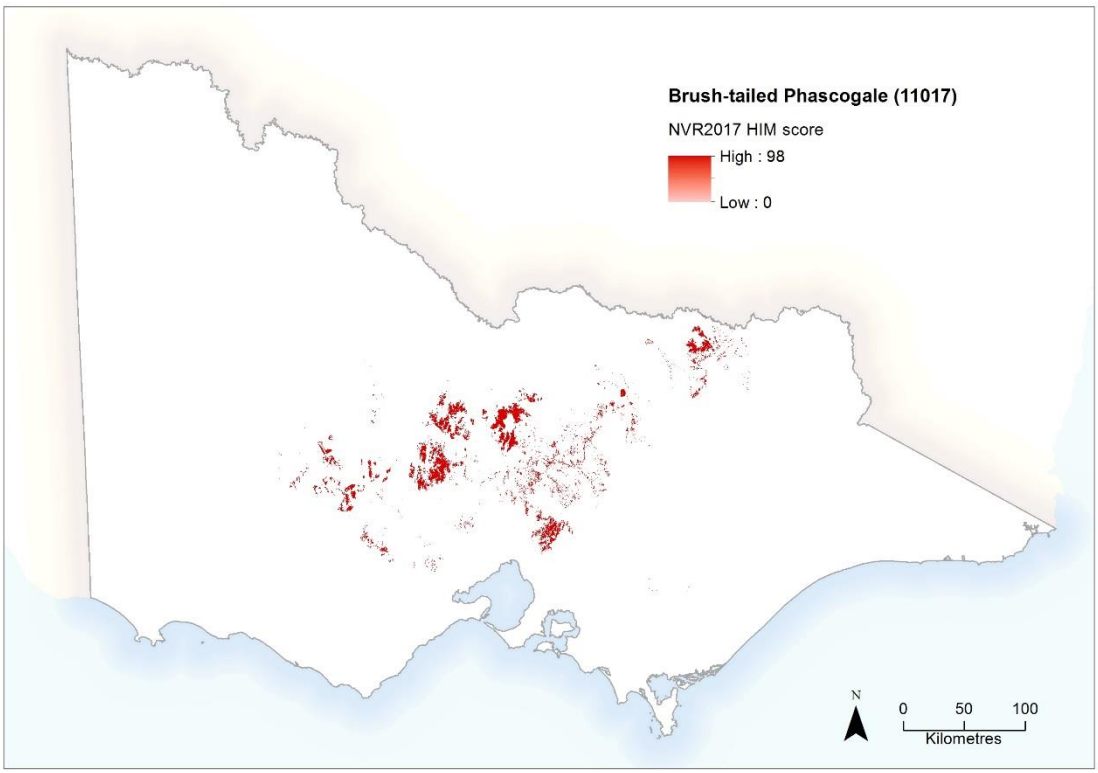


Figure 9. NVR2017 Habitat importance map for Brush-tailed Phascogale (dispersed species)



9. Location category

9.1 Description

Different locations in the landscape have different biodiversity values. A *Location map* has been developed using some of the biodiversity products described in this document. This map is purpose built for indicating the potential risk to biodiversity from removing a small amount (0.5 hectares or less) of native vegetation at any given location across the landscape. It shows three location categories, location 1, location 2 and location 3, which represent the different levels of risk. Figure 10 provides an image of the *Location map* at a statewide scale.

9.2 Method

Location categories in the *Location map* are determined as follows:

9.2.1 Location 3

Location 3 includes all areas where the removal of less than 0.5 hectares of native vegetation could have a significant impact on habitat for a rare or threatened species. All locations within highly localised habitats are assigned location category 3. For dispersed species habitats, the impact of removing less than 0.5 hectares at each location across Victoria is calculated individually using the species-general offset test described in the Guidelines and modelled condition scores.

Any location where the species-general offset threshold is greater than 0.005 per cent is assigned location category 3.

9.2.2 Location 2

Any location that includes a mapped endangered EVC, sensitive wetland or coastal area that is not already location category 3, and is native vegetation in the *Native vegetation extent map* is assigned location category 2. Endangered EVC is described in section 3, sensitive wetland and coastal area is described in section 5.

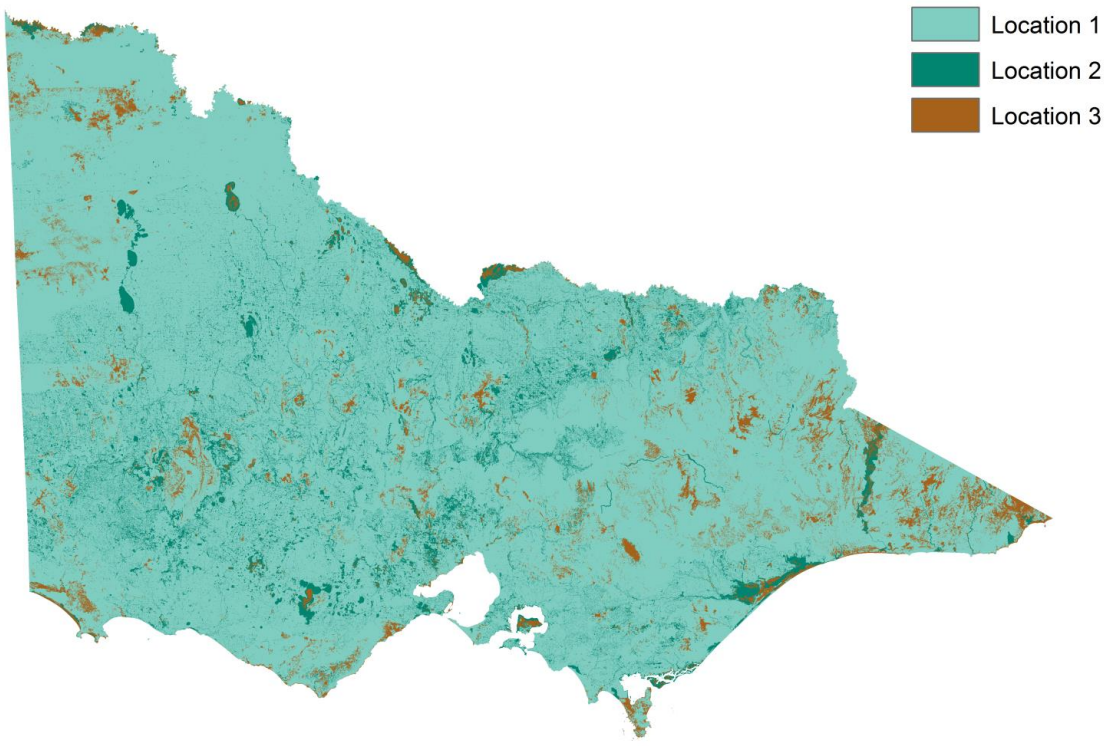
9.2.3 Location 1

Any location that is not native vegetation in the 25 x 25 metre scale *Native vegetation extent map* and any location not mapped as location 3 or 2 is assigned location category 1. This ensures that all locations in Victoria have a category in the *Location map*.

9.3 Use

When native vegetation is proposed to be removed, the *Location map* and the extent of native vegetation to be removed are used to determine the assessment pathway of the application. *The Location map must not be used for any other purpose.*

Figure 10. Location map



10. Databases, systems and tools

DELWP systems and tools help people to:

- view and record primary data about plants and animals in Victoria
- access and view the mapped products described in this document
- use the mapped products described in this document when completing an application to remove native vegetation or when managing native vegetation as an offset.

The mapped products described in this document can be requested and downloaded as spatial layers from the Victorian Spatial DataMart or the Victorian Government portal using either of the following links.

- http://services.land.vic.gov.au/SpatialDatamart/index.jsp
- https://www.data.vic.gov.au/

Information updates

Periodic remodelling of the biodiversity information products can occur when significant new data becomes available or modelling techniques are improved.

Modelled and mapped biodiversity information products are developed considering the:

- costs associated with collecting and analysing information (e.g. acquisition of field data or satellite imagery)
- ability to extrapolate existing data to provide a landscape or contextual view (e.g. modelling of species habitats)
- ability to access and understand the information (e.g. design and delivery of summary products and web access)
- ability to contribute to the improvement of information (e.g. systems for capturing new data and guidance on key areas for improvement).

DELWP systems and tools used to view and analyse the mapped products are described below.

10.1 Victorian Biodiversity Atlas

The VBA allows users to view and record data. This online database holds information about plants and animals that occur in terrestrial, aquatic and marine environments in Victoria. The following groups are included:

- vertebrate and invertebrate animals
- vascular and non-vascular plants
- fungi.

The VBA includes native and naturalised exotic species (including weeds and pests) but should not hold data on cultivated or domesticated species.

The database is used by government agencies, environmental consultants, researchers and the public to share information about the distribution and abundance of species in Victoria. Data in the VBA is used when developing HDMs and NVR2017 HIMs.

Interested people can register to be a contributor to the VBA. Contributors are able to create projects and survey sheets for capturing field data. They can also enter general observations of a species – locations where a species is found. Data is submitted for expert review and, once verified, the records are published and viewable by all other users.

More information about the VBA is available on the DELWP website.

10.2 NatureKit

NatureKit is a user-friendly online tool to display and produce maps of Victoria's biodiversity. It allows users to zoom in and out, pan around the map, identify features, perform queries on databases, generate reports, and create printable maps (in PDF format). NatureKit displays information on Victoria's:

- flora and fauna distribution
- native vegetation
- investment prospects
- marine bathymetry and habitat
- disturbance
- land administration and classification.

NatureKit can be accessed at:
http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit

10.3 Native Vegetation Information Management

Native Vegetation Information Management (NVIM) has been developed to support the implementation of the Guidelines. NVIM is an online system that enables users to view information about Victoria's native vegetation and biodiversity assets, except the habitat importance maps for rare or threatened species. It also analysis mapped products when native vegetation is proposed to be removed or protected at an offset site.

Two tools have been developed within the NVIM system, these are:

- the native vegetation removal tool that supports applicants wishing to remove native vegetation
- the native vegetation offset tool that supports landowners proposing to protect native vegetation at an offset site.

NVIM tools can be accessed at https://nvim.delwp.vic.gov.au.

10.3.1 NVIM native vegetation removal tool

This tool provides applicants with access to information required to apply for approval to remove native vegetation. The tool includes mapping functions that allow a user to identify and map the native vegetation they are proposing to remove.

The tool uses this information and analyses the relevant statewide mapped products to determine the assessment pathway of the application. If the application is in the Basic or Intermediate Assessment Pathway *a Native vegetation removal report* is generated. This report contains information about the native vegetation to be removed and the offset that needs to be secured if the application is approved. The report is downloaded by the user and submitted with an application to remove native vegetation. The native vegetation mapped by the user can also be downloaded and saved for future use.

10.3.2 NVIM native vegetation offset tool

This tool provides landowners with access to information required when proposing to protect native vegetation at an offset site. The tool includes mapping functions that allow a user to identify and map the native vegetation or area they are proposing to protect and manage.

The tool uses this information and analyses the relevant statewide mapped products to generate a *Native vegetation offset* report. This report and native vegetation mapped by the user can be downloaded and included with a proposal to establish an offset site.

This tool enables users to calculate the general habitat units of gain that will be generated at their offset site once it has been established. The tool can only be used for first party general offset sites that do not require a gain scoring assessment. Only general habitat units of gain are generated at these offset sites.

10.4 Environmental Systems Modelling Platform

EnSym is a decision support software that helps users prioritise natural resource investment, understand the environmental benefits of vegetation management and the impacts from removing native vegetation.

A number of EnSym tools have been developed, including the EnSym Native vegetation regulations tool (NVR tool). The NVR tool uses spatial GIS data of proposed native vegetation removal or protection and analyses relevant statewide mapped products to:

- calculate offset requirements for proposed native vegetation removal applications in the Detailed Assessment Pathway, and generate a *Native vegetation removal report* that is included with an application to remove native vegetation
- calculate species and general habitat units of gain that can be generated when a gain scoring assessment is completed, and generate a *Native vegetation offset report* that is included with a proposal to establish an offset site.

The NVR tool can also be used to identify areas that could meet native vegetation offset requirements by generating a map showing locations where a defined set of species coexist.

The EnSym native vegetation tool is available to download on request and is used under licence. Consultants and other key groups can use it to test native vegetation removal and offset scenarios. It produces scenario testing reports that show offset requirements when native vegetation is proposed to be removed or habitat units of gain when native vegetation is proposed to be managed as an offset. These can be used to finalise proposals.

Final reports submitted with an application to remove native vegetation or a proposal to establish an offset site, are generated by DELWP. Further information about the EnSym NVR tool, including how to request access is located at https://ensym.dse.vic.gov.au/nvr_tool.

delwp.vic.gov.au