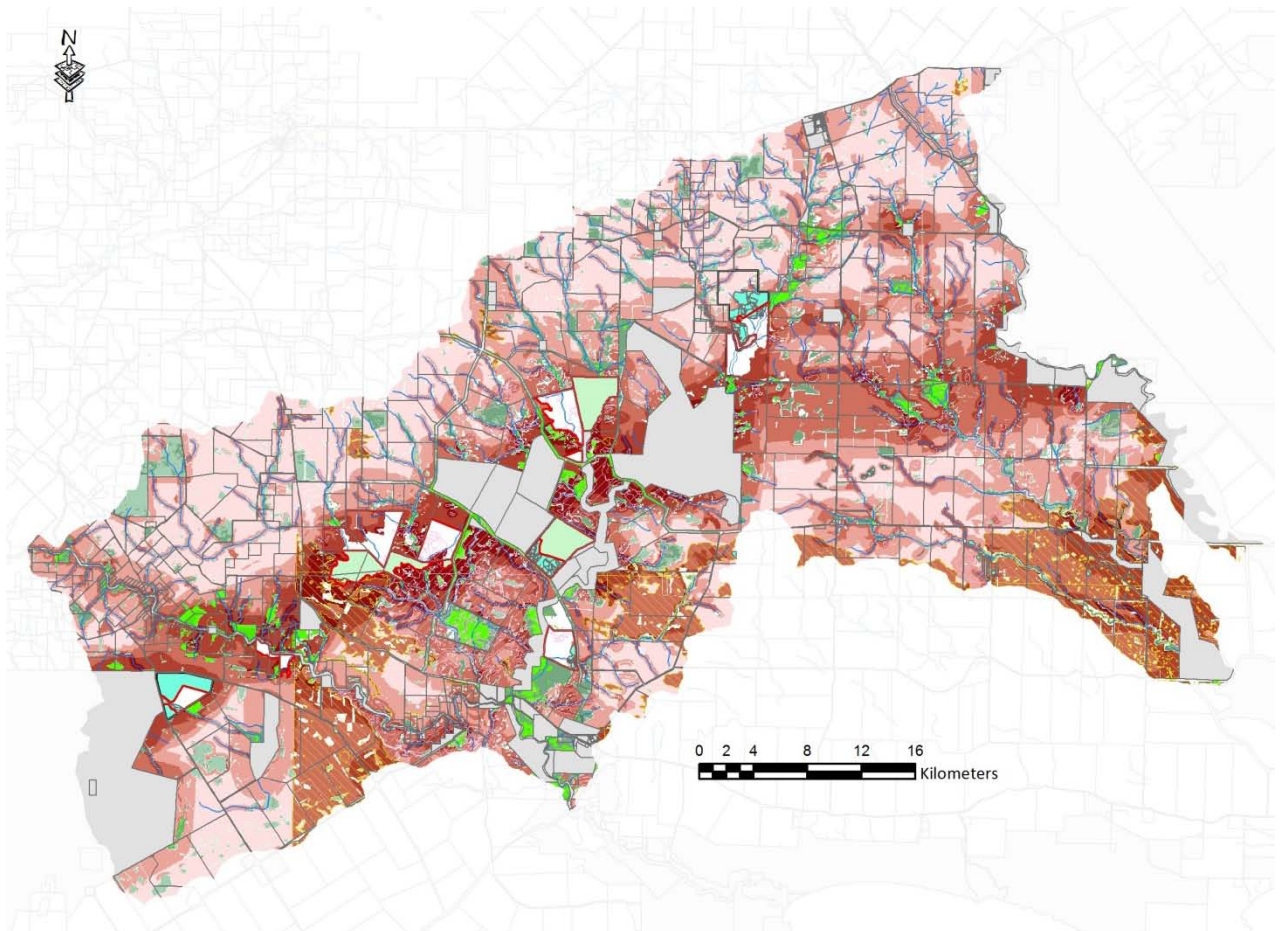


Gondwana Link

**PREPARATION OF THE SPATIAL GUIDE
FOR THE
FUNCTIONAL LANDSCAPE PLAN
FITZ-STIRLING LINKAGE**



Simon Neville

October 5 2012

**ECOTONES
& ASSOCIATES**

Acknowledgements

This version of the Fitz-Stirling Spatial Guide was produced by Gondwana Link Ltd (Amanda Keesing, Keith Bradby) with the active involvement of ABARES (Rob Lesslie, Jodie Mewett), Bush Heritage Australia (Angela Sanders, Simon Smale), DEC (Sarah Comer) and Paula Deegan.

Rob Lesslie (Principle Scientist, Land Use and Management at ABARES) has provided significant assistance with MCAS-S, including provision of training to Gondwana Link staff and other interested parties.

Great people in ABARES have developed a really useful tool, made it available free of charge, and continue to develop better versions!

Gondwana Link and their partners (esp Bush Heritage and Greening Australia) are involved in excellent work on land management in the modern world.

Keith Bradby & Amanda Keesing (Gondwana Link Ltd), Simon Smales & Angela Sanders (Bush Heritage Australia) and Sarah Comer (DEC) participated in workshops to develop the models, classify rate and weight the criteria, and generally test the thinking behind the Spatial Plan process.

Amanda Keesing has been a great project manager, as well as collaborating in the development process and assistance with dataset acquisition. And she organised the workshops as well!

Contents

1	Introduction	6
2	Spatial Plan Model	7
2.1	Foundation Components	7
2.2	Output Components	9
3	Dataset Preparation	10
3.1	MCAS-S Requirements	10
4	MCAS-S Component Development	12
4.1	Interpreting MCAS-S Descriptions	12
4.2	High Conservation Value Component	15
4.3	Connectivity & Linkage Component	22
4.4	Riparian Revegetation Component	30
4.5	Tammar Wallaby Component	34
4.6	Vegetation Priority	37
4.7	Revegetation Priority	40
5	Spatial Guide	46
6	References	48

Figures

Figure 1 – Spatial Guide Model Organisation	7
Figure 2 – Fitz-Stirling Linkages	9
Figure 3 – Example of a metadata (.tip) file for MCAS-S	11
Figure 4 – Classification Figures in MCAS-S	12
Figure 5 – Classified Continuous MCAS Input Layer	13
Figure 6 - Classified Categorical MCAS Input layer	13
Figure 7 – Weighting Inputs in an MCAS-S Composite Layer	14
Figure 8 – Vegetation in the Fitz-Stirling, and location of the ‘Newby Line’	15
Figure 9 – Schematic of Conservation Value Model Version 2.0	16
Figure 10 – Target Association Classification	17
Figure 11 – Slope Classification	18
Figure 12 – Association Value Classification	18
Figure 13 – Contiguous Area Classification	18
Figure 14 – Dieback Status Classification	19
Figure 15 – Distance from Edge Classification	19
Figure 16 – Naturalness Classification	19
Figure 17 – Final Criteria Weightings (% Influence)	20
Figure 18 – Final Criteria Ratings	20
Figure 19 – High Conservation Value Component: Modeled Conservation Value	21
Figure 20 – Connectivity & Linkage Component Model	22
Figure 21 - Proximity to VCL Layer	22
Figure 22 – Proximity to Crown Reserve Layer	23
Figure 23 – Proximity to GLink Property Layer	23
Figure 24 – Proximity to Revegetation Layer	24
Figure 25 – FS Linkage Lines	24
Figure 26 – Proximity to Major Linkage Layer	25
Figure 27 - Proximity to Minor Linkage Layer	25
Figure 28 – Contiguous Area Layer	26
Figure 29 – Vegetation Buffered by Contiguous Area Layer	26
Figure 30 – Proximity to Secured Vegetation Composite Layer	27
Figure 31 – Proximity to Linkage Composite Layer	27
Figure 32 – Vegetation Integrity/Proximity Composite Layer	28
Figure 33 – Connectivity & Linkage Component: Connectivity Value Map	29
Figure 34 – Riparian Revegetation Component Model	30
Figure 35 – Foreshore Condition Layer	31
Figure 36 – Catchment Vegetation % Layer	31
Figure 37 – Water Erosion Layer	32
Figure 38 - Scaled output values for Slope	32
Figure 39 – Slope Layer - Classified values	32
Figure 40 – Erosion Risk Composite Layer	33

Figure 41 – Riparian Revegetation Component: Riparian Revegetation Priority Map	33
Figure 42 – Tammar Wallaby Component Model	34
Figure 43 – Distance to Recordings of Tammar Wallaby Layer	34
Figure 44 - Distance to Existing Tammar Habitat Layer	35
Figure 45 - Distance to Potential Tammar Habitat Layer	35
Figure 46 - Actual Remnant Tammar Habitat Layer	36
Figure 47 – Tammar Wallaby Component: Revegetation Priority for Tammar Wallaby.	37
Figure 48 – Tammar Wallaby Component: Existing Vegetation Priority for Tammar Wallaby	37
Figure 49 – Vegetation Priority Component Model	38
Figure 50 – Connectivity Value Composite Layer	38
Figure 51 – Conservation Value Composite Layer	39
Figure 52 - Existing Vegetation Priority for Tammar Composite Layer	39
Figure 53 – Vegetation Priority Component: Existing Vegetation Priority	40
Figure 54 – Revegetation Component Model	41
Figure 55 – Connectivity Value Composite Layer	41
Figure 56 – Past Proteaceous Vegetation Layer	42
Figure 57 - Revegetation Priority for Tammar Wallaby Composite Layer	42
Figure 58 – Riparian Revegetation Priority Composite Layer	43
Figure 59 – Linkage Revegetation Composite Layer	43
Figure 60– Landscape Revegetation Composite Layer	44
Figure 61 – Revegetation Priority Component: Revegetation Priority	45
Figure 62 – Spatial Guide for the Functional Landscape Plan	47

1 Introduction

Ecotones and Associates were contracted to Gondwana Link Ltd (GLink) to prepare a Spatial Guide as part of their Functional Landscape Plan (FLP) for the Fitz-Stirling, a area of land stretching from the Fitzgerald National Park to the Stirling Range National Park in on the south coast of WA.

The background to the consultants' brief states:

"A Conservation Action Plan, the Fitz-Stirling Functional Landscape Plan (FLP), has been developed for the Fitz-Stirling area of Gondwana Link, the area between the Stirling Range and Fitzgerald River National Parks. Considerable effort has been undertaken to define conservation targets, develop methodologies to assess their status and define actions needed to meet the four defined objectives. The plan is open to constant updates and modifications to reflect work undertaken, changes in ideas and methodologies and new knowledge.

The FLP provides an action plan that can guide groups in their 'Gondwana Link' work. Each group is of course free to undertake any work they wish but it is hoped that this plan will assist groups to prioritise and direct the work they undertake if they wish to contribute to the Gondwana Link effort. The plan also helps Gondwana Link Ltd to identify priority works in response to enquiries from donors and other funding sources."

The development of a landscape plan which identifies key areas for implementation of all strategies is one of the six key strategic actions to achieve the four FLP objectives. It should allow GLink to determine

- where supportive activities are best undertaken;
- where are the top priority areas and what is most effective implementation sequence; and
- the relative benefits of different actions from different perspectives.

In planning for this project, GLink had determined that they wanted the process to be run using MCAS-S (the "Multiple Criteria Analysis Shell for Spatial Decision Support", ABARES 2011), free and very flexible software developed within ABARES¹.

The work involved four major stages:

- Development of a model outline for the Spatial Plan process, which would incorporate the major objectives of the CAP, while being achievable given the time and data constraints.
- Preparation of a range datasets for use in the MCAS-S software package.
- Further development of an existing Conservation Value model (Neville, 2009) to include all of the Fitz-Stirling area.
- Generation and then facilitation of the development of the MCAS-S components within a series of workshops with GLink staff and partners.

This document outlines the process, the datasets used, and the models developed. Details are provided on the assessment criteria used in each model, and the Draft Spatial Guide is presented.

¹ Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). www.abares.gov.au/mcass

2 Spatial Plan Model

The models developed in this project are a specific response to the Conservation Action Plan objectives, which in effect combine specific landscape-related objectives – such as targets for Proteaceous vegetation restoration – with the objective of creating a linkage between the east and west of the study area: the Fitzgerald National Park and the Stirling Range National Park.

The overall model design (shown in Figure 1) reflects this specific situation, and is not proposed as a model for other locations, or even as necessarily the best model for other groups in this study area.

Two main components are used in the Spatial Guide – one produces an indication of the most suitable areas to re-vegetate cleared land, and the other indicates the highest value remnant vegetation, as a guide to acquisition or restoration. These components in turn are informed by five foundation components:

- High Conservation Value – remnant vegetation values
- Connectivity & Linkage – importance to creating a functional linkage and landscape;
- Riparian Re-Vegetation; Tammar Wallaby Rehabilitation & Proteaceous Re-Vegetation – three models aimed at these specific components of the landscape, each backed by a specific CAP Objective.

These components are outlined below, and the model structure detailed.

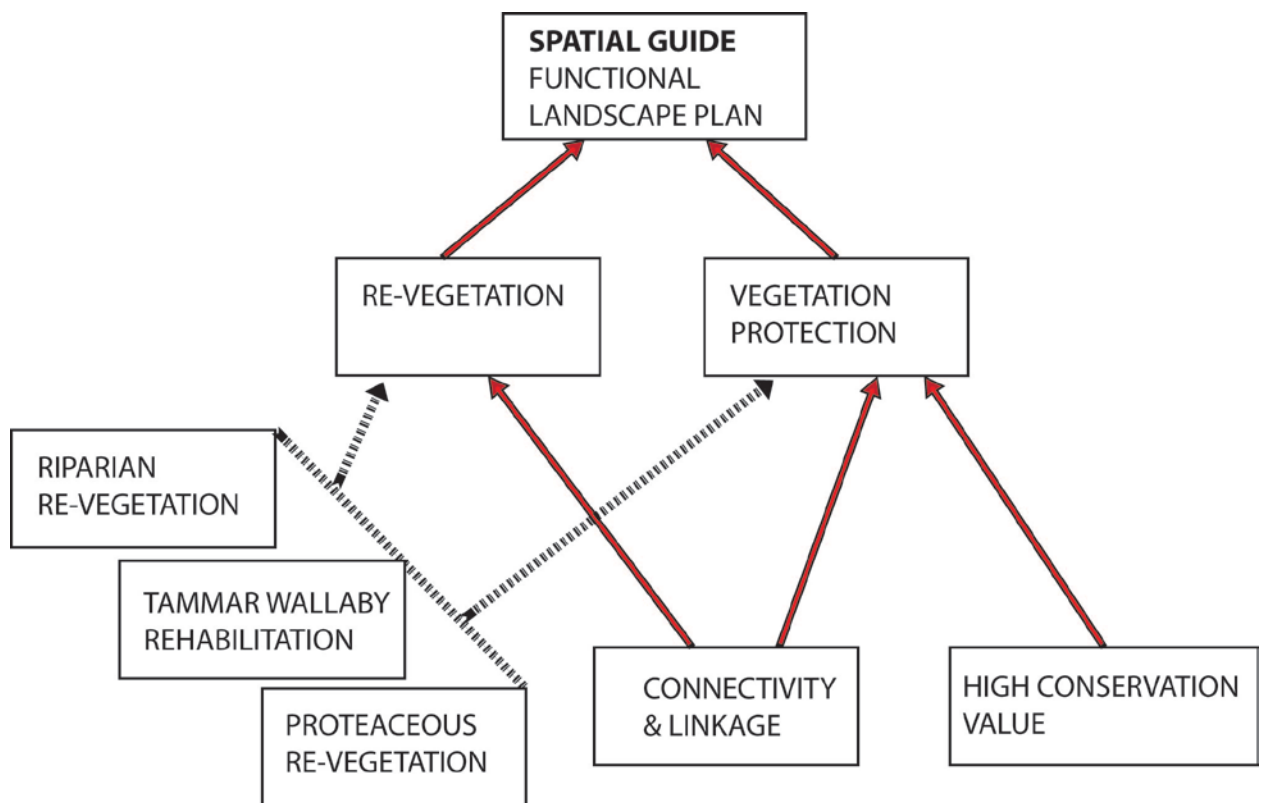


Figure 1 – Spatial Guide Model Organisation

2.1 Foundation Components

2.1.1 Riparian Revegetation

The Riparian component is used to identify areas that are part of a specific objective in the CAP:

Objective 3: By 2012, significantly improve the condition of at least 60% of the creeks within the Corackerup catchment and, by 2017, within the Monjebup and Mid-Pallinup catchments.

Riparian condition mapping has been completed for a large number of stream in the study area, including all major waterways. Calculations were made of the % of each major catchment under vegetation to allow

selection of poorly vegetated catchment as specified in the CAP objective. Riparian zones were defined as varying by stream order; Strahler stream order was calculated for each stream in the study area.

2.1.2 Tammar Wallaby

The Tammar Wallaby component is used to identify areas that are part of a specific objective in the CAP:

Objective 4: By 2017, increase the populations of tammar and black-gloved wallabies within the Fitz-Stirling area by 30%.

Tammar Wallaby have specific habitat requirements, whereas black-gloved wallabies prefer any vegetation which is in good condition. Therefore the component only deals with Tammar Wallaby, based on this strong preference for specific vegetation types with thick understory.

2.1.3 Proteaceous Vegetation

Although it does not have a specific component, the Proteaceous vegetation layer is used to identify areas that are part of a specific objective in the CAP:

Objective 1: By 2012, restore at least 16,000ha of native vegetation, including at least 2,000ha of Proteaceous-rich communities that support native insect, bird and other vertebrate pollinators.

Use of this layer identifies the best areas to re-vegetate for Proteaceous vegetation communities, based on mapping of prior communities by Newby. The layer is also used as an overlay in the final Spatial Guide to show areas of re-vegetation that would specifically satisfy this CAP objective.

2.1.4 Conservation Value

Any decision on property purchase or restoration of existing native vegetation requires an assessment of conservation value of the remaining vegetation. Conservation value mapping was carried out in a previous project (Assessment of Conservation Value, Neville 2009) but required an update for the Spatial Plan. The update generated conservation values for the western section of the link, where the absence of vegetation mapping from Newby meant that it was left out of the initial project. The model for the west lacks a number of criteria that the original model used, and uses a rough surrogate of Proteaceous vegetation presence to provide limited association criteria.

2.1.5 Connectivity/Linkage

All of the above values can be considered in the light of another in-principle objective of the FLP – to create a linkage between the east and west of the study area: the Fitzgerald National Park and the Stirling Range National Park.

The connectivity/linkage model required the consideration of a range of connectivity principles:

- building a 2 km wide core habitat linkage between the Stirling Range and Fitzgerald NP;
- building on existing nodes (patches over certain size) of native habitat; and
- building ecological permeability by creation of stepping stones and smaller linkages

It also required the incorporation of a line of best connection between east & west, a “linkage” line.

At the outset of the project, a line of linkage had been created for the study area by a visual assessment of the likely best line of connection. It was considered appropriate to subject this to a more stringent assessment, and so a GIS-based analysis using cost surfaces was undertaken.

This looked at the most efficient route (or routes) between the Fitzgerald and Stirling National Parks at each end of the study area, using the existing vegetation as stepping stones of no travel cost and minimizing the distance travelled across cleared land. Two versions were run:

- Cost of travel decreased with distance away from cleared land – weighting in favour of linkage passing through larger blocks of vegetation; and
- Cost of travel was the same for all uncleared land.

The result of each model were similar, and were also very similar to the original manually assessed linkages. This analysis provided a major and two minor linkage lines for incorporation in a “Linkage Model” combining connectivity and linkage.

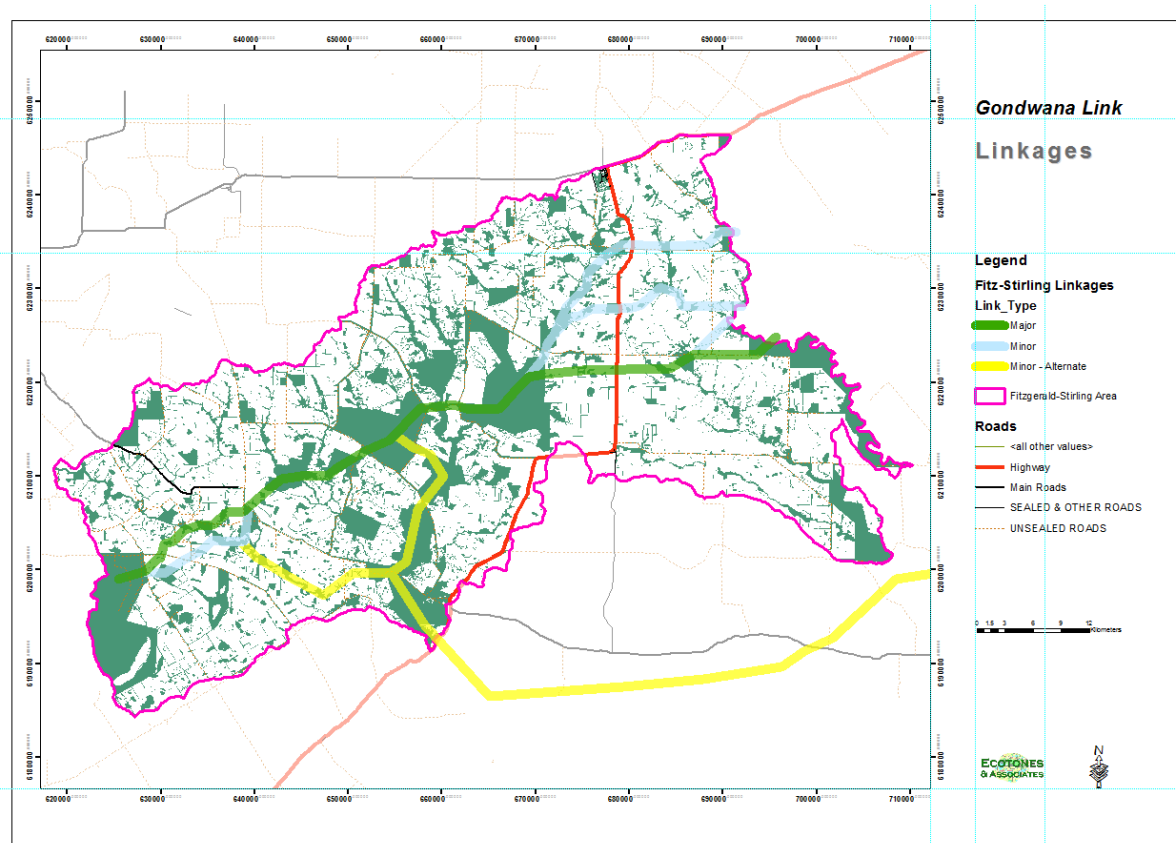


Figure 2 – Fitz-Stirling Linkages

2.2 Output Components

2.2.1 Existing Vegetation priorities

The areas of remaining native vegetation with greatest value were defined in the following terms:

- Highest conservation value
- Highest value for contributing to the FS Linkage; and
- Highest value in contributing to specific CAP objectives.

This output component was masked to remove all areas already in reserves, protected by covenants or already cleared.

2.2.2 Re-Vegetation Priorities

The model approach was to identify the best areas to re-vegetate, with emphasis on three sub-subjects –

- Areas with high suitability for Proteaceous vegetation,
- riparian revegetation priority areas (see below), and
- areas with potential for vegetation communities that support tamar and black-gloved wallabies (see below).

In order to spatially represent this objective, it was necessary to both model the best places to re-vegetate or secure Proteaceous vegetation, as well as to identify the value areas where revegetation with native vegetation would provide the greatest benefit for the FS linkage.

The areas of cleared land with greatest re-vegetation value were defined in the following terms:

- Highest value for contributing to the FS Linkage; and
- Highest value in contributing to the CAP objectives.

This output component was masked to remove all areas currently covered by native vegetation.

3 Dataset Preparation

In previous work carried out for GLink (see Neville, 2009), modeling was carried out within a GIS package – ArcGIS ArcView v9.3 – using the ModelBuilder environment. For the current project it was decided to use MCAS-S for ease of use and as it can easily be provided to 3rd parties for their use and modification.

The previous conservation model used a 25m pixel size, resulting in a fine spatial analysis: 25mx25m cells in an array 3664 x 2484 cells, meaning a total of 9.1 million cells in the grid, of which over 880,000 cells contain native vegetation. Analysis was only carried out for the cells covered in vegetation.

For this Spatial Guide, a coarser cell size was required as:

- Analysis would take place over the entire grid;
- MCAS-S starts to run slowly when grids contain over about 5 million cells, and in testing with a 25m grid the software performance was marginal.
- 3rd party processing power could vary from the optimum, so that finer-resolution grids may cause problems.

For these reasons we decided to double the size of the cell to 50m pixel size. While the resulting grid is still adequate to represent features in the study area, it contains ¼ of the cells, resulting in much faster processing and drawing times. The final grid contains 1833 x 1242 cells (total 2.28 million).

MCAS-S is a spatial software shell which can display spatial data but does not have full GIS functionality. So data held within MCAS-S must conform in:

- spatial extent
- resolution, and
- projection.

The user of MCAS-S therefore still requires GIS software for data preparation, and ArcGIS is the recommended software for the conversion process.

3.1 MCAS-S Requirements

When an MCAS-S project is set up, a data folder is created in the project directory, and a set of four sub-directories is created: Classified, Mask, Overlay and Primary. These hold the four different types of data for the project. These folders hold the following data types:

- Primary – base datasets for the project, held as grids or rasters.
- Mask – grids or rasters used to mask parts of the project maps – such as showing only the vegetated areas.
- Overlays – ESRI shapefiles used to provide additional information such as roads or rivers to the map view.
- Classified – holds classified rasters, which may have been produced from within MCAS-S.

There are a number of specific requirements for data preparation, including the following:

- Datasets must be consistently captured and complete for the region of interest:
 - If data are missing for certain areas, the value of -9999 can be used as 'no data'
 - If data are inconsistently captured then it is better to create separate layers and merge them in MCAS-S
- The data can be input as Primary data, Overlays or Masks; the same raster data can be used for both primary and mask layers.
- While GIS data formats can generally support multiple attributes, MCAS-S can only use one. Some spatial datasets held as shapefiles will have data held in many fields, and values from individual data fields must be extracted as separate grids for use in MCAS-S.
- The Grid value field will be used by MCAS-S and so should contain numbers that either directly represent the dataset (continuous) or are a class code (categorical).
- Data should be as "raw" as possible, if you wish to classify the data; then use MCAS-S to do this. For example, slope data should be input as percent or degrees rather than slope classes such as 'flat' or 'steep'.
- Categorical data such as land use or vegetation types need to have a unique numeric identifier and an accompanying text file given exactly the same name as the dataset and a specific format.
- Metadata for Datasets for MCAS-S can be created with Name, Description, Custodian, Currency, and Lineage.

- The metadata is contained in a text file placed in the same folder as the grid, and identified with the gridname and a .tip suffix:

Modeled Conservation Value
Description: Modeled Conservation Value of existing native vegetation
 Custodian: Gondwana Link
 Currency: 2011
 Lineage: Conservation Value of existing native vegetation modeled using VegModel2 (Neville 2009). Criteria sourced from Gondwana Link & partners. Note - the western portion of the FS area uses a modified method which lacks detailed veg mapping, although some detail has been added on Target veg species in terms of current proteaceous veg and Moort. This side of the coverage is less accurate and may not be directly comparable to the eastern side.

Figure 3 – Example of a metadata (.tip) file for MCAS-S

We set up an ArcView map document (MCAS_Prep_50m.mxd) for pre-processing and converting all the necessary datasets. There were a variety of ways in which datasets were processed to make them suitable for MCAS-S. The major components of the workflow are:

- Identify the dataset required
- Identify the way in which it will be used – as continuous data or categorical data.
- Pre-Processing - Undertake any necessary initial processing, such as
 - Conversion from shapefile to raster.
 - Re-classification.
 - Euclidean distance for proximity features, or
 - Calculations on fields (such as area to create rasters of area).
- MCAS-S Processing
 - Sample or re-sample the dataset to the standard resolution and location,
 - Re-project the raster during re-sampling or export
 - Export the raster to the appropriate MCAS Folder.

The ArcGIS map document used had its ArcToolbox Environment Settings set up to ensure a standard set of output rasters. Settings pre-set for all MCAS-S analysis were:

- Output coordinates [GDA_1994_MGA_Zone_50]
- Processing extent [standard Fitz-Stirling study area shapefile, with a single snap raster to ensure exact coincidence of rasters in analysis]
- Raster Analysis [cell size fixed at 50m, and mask set for the Fitz-Stirling study area].

More process detail is provided in the descriptions for the individual models in Section 5 - MCAS-S Component Development.

4 MCAS-S Component Development

These components were developed through a detailed process, including the following steps:

- Research – research into and assessment of the regional context, determination of the CAP priorities which underlay the model framework; [Gondwana Link, Greening Australia, Bush Heritage Australia]
- Model framework development – consideration of a framework to incorporate priorities, which is still possible given the project timeframe and resources [Gondwana Link, Ecotones & Associates]
- Collection and consolidation of regional datasets [Gondwana Link]
- Development of datasets to suit model components and criteria [Ecotones & Associates].
- Initial Component development [Ecotones & Associates].
- Model refinement and initial workshop assessment [Gondwana Link, Greening Australia, Bush Heritage Australia, Ecotones & Associates].
- Workshops for final input layer selection, layer classification & rating; layer weighting. [Gondwana Link, Greening Australia, Bush Heritage Australia, Ecotones & Associates].

4.1 Interpreting MCAS-S Descriptions

The figures illustrating the MCAS-S components (like MCAS) use a number of conventions. Key amongst these is the use of a Red-Blue colour ramp to indicate values. Depending on the number of value classes selected, the ramp will be more or less complex, but in all cases, Red=high value, Blue=low value, and Green = middle value.

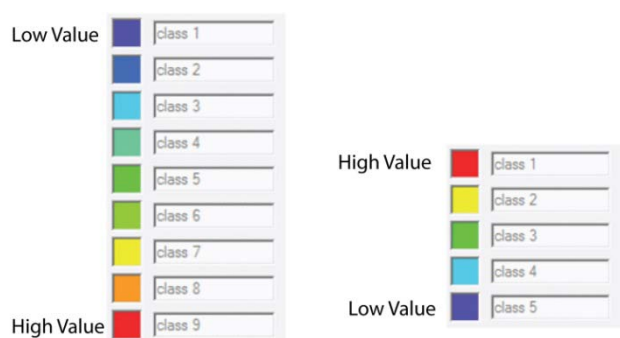


Figure 4 – Classification Figures in MCAS-S

There are two main types of MCAS-S input layers: continuous, and categorical. Continuous datasets contain values that range from a lower to an upper value, either floating point or integer. They may contain a very large number of individual values, and so need to be classified to ascribe values. This classification can be done in a number of ways, but has two main steps: selection of the number of classes and selection of the method of classification – equal interval, equal value, log, or custom (manual). The classification is done using controls on the left of MCAS-S, which are shown below in Figure 5 and in figures throughout this section detailing the components. **The use of classes determines the shape of the relationship between the input value and the output value, the speed with which output values change and the values where these changes start.**

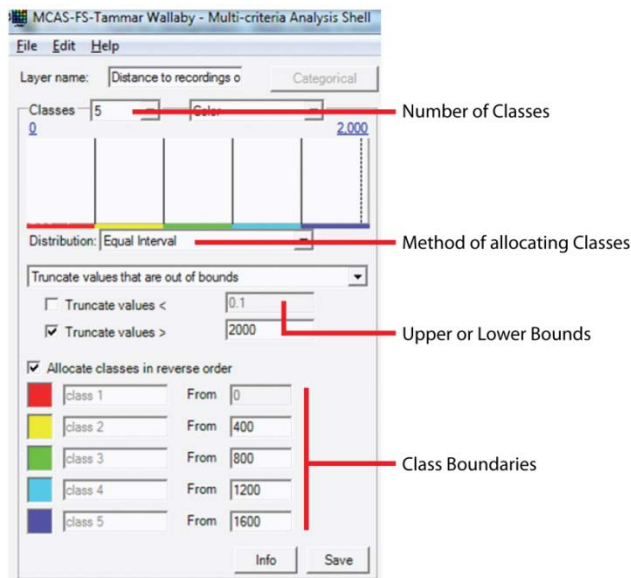


Figure 5 – Classified Continuous MCAS Input Layer

Categorical data will contain a discrete number of values, each of which represents a category, such as soil type or vegetation condition. The MCAS classification sets the number of Value Classes, and the user allocated a class value to each category, as shown in Figure 6.

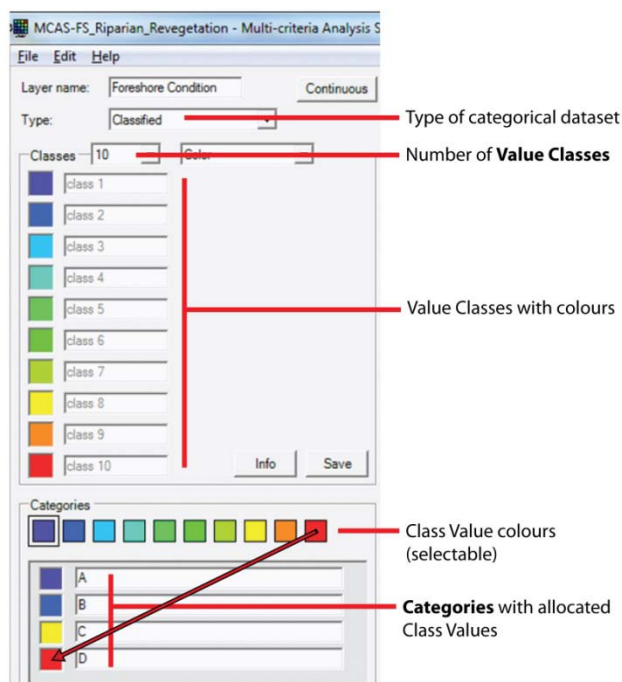


Figure 6 - Classified Categorical MCAS Input layer

A third important aspect of MCAS is the weighting of the input layers when they are combined in a Composite Model. The major controls for this are shown in Figure 7. The most significant control here is the selection and weighting of each input layer. This controls which layers are used and their importance in the final composite output.

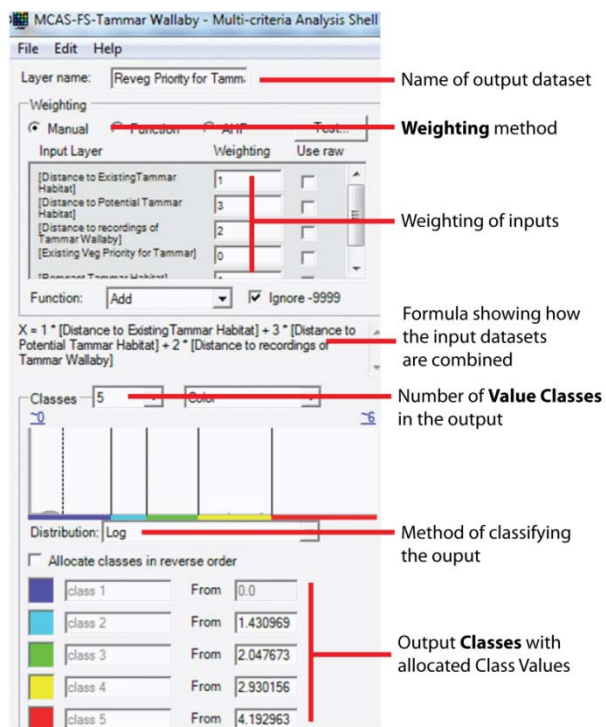


Figure 7 – Weighting Inputs in an MCAS-S Composite Layer

4.2 High Conservation Value Component

This component was developed outside of MCAS-S. It is an extension of a previous model created in the Modelbuilder environment of ArcGIS GIS software.

4.2.1 Data

As previously described (Neville, 2009), the principle dataset used in the conservation value model is a classification of vegetation associations carried out by Ken Newbey, which covers most of the Fitz-Stirling (FS) study area. It provides the most detailed dataset which has coverage over the greatest part of the study area. The principle classification used within the Newbey dataset is the ASOC_CODE (vegetation association), along with area and location. Other datasets used are dieback mapping, and a slope map derived from a 10m digital elevation model.

The combination of vegetation associations – including target associations identified due as conservation priorities in the Fitz-Stirling Functional Landscape Plan– and landscape allows inclusion of values relevant to fauna as well as flora. However the Newbey vegetation mapping does not extend for the whole FS area, and so a surrogate dataset was created to cover the western section – on the west of the ‘Newby Line’ shown in Figure 2.

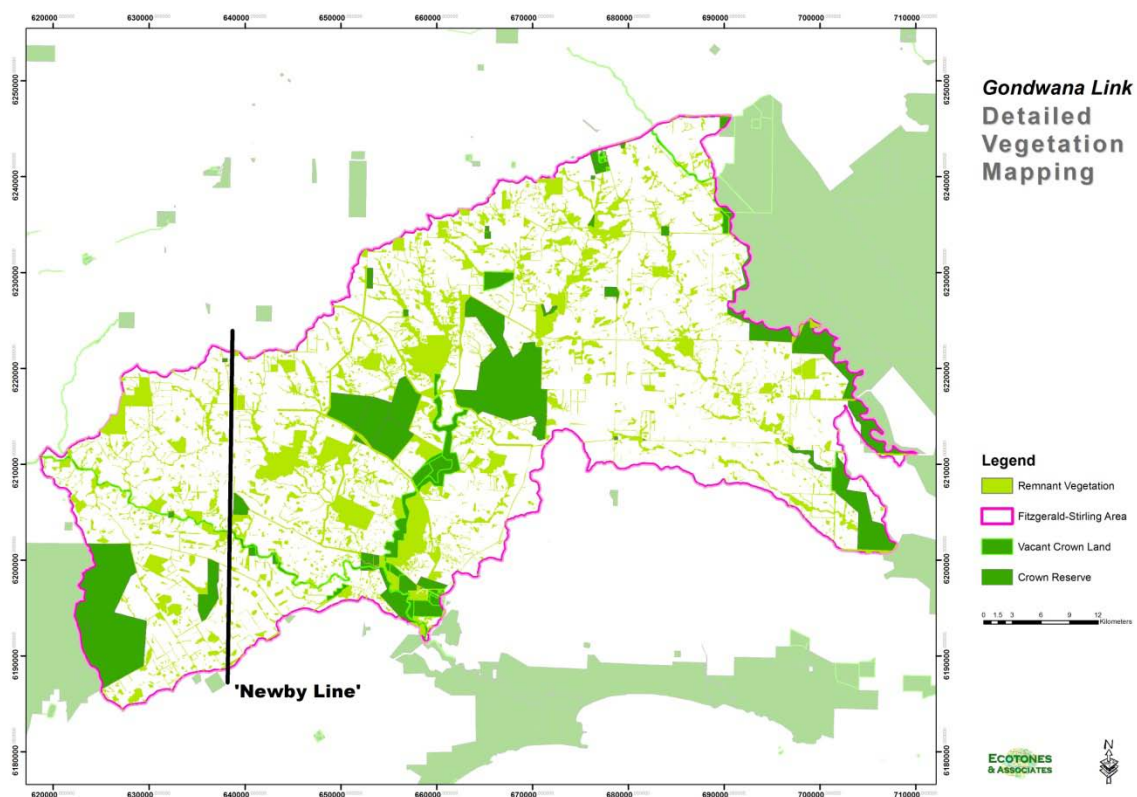


Figure 8 – Vegetation in the Fitz-Stirling, and location of the ‘Newby Line’

For the current project, additional processes have been added to the model to calculate values for the west of the study area. The model is referred to as Version 2. The discussion below only refers to these new processes – for any additional detail refer to the original modeling report (Neville 2009).

4.2.2 Process

All basic model processes have been kept for the Version 2 of the model. It still has 25mx25m cells in an array 3664 x 2484 cells, for a total of 9.1 million cells. Analysis is carried out using the Spatial Analyst extension of ArcView 9.2, and running processes in a modeling environment call ModelBuilder.

The major difference in Version 2 is the additional of a new processing line, and the combination of the original processing line and this new line in the final part of the model. The additions are shown in the process diagram below. Version (2.0) of the model is shown in the following figure, and now comprises four major stages:

- Initial data input and classification;

- Secondary stage of combination of data into initial criteria
- A final assessment stage, and
- A combination stage ('Select target').

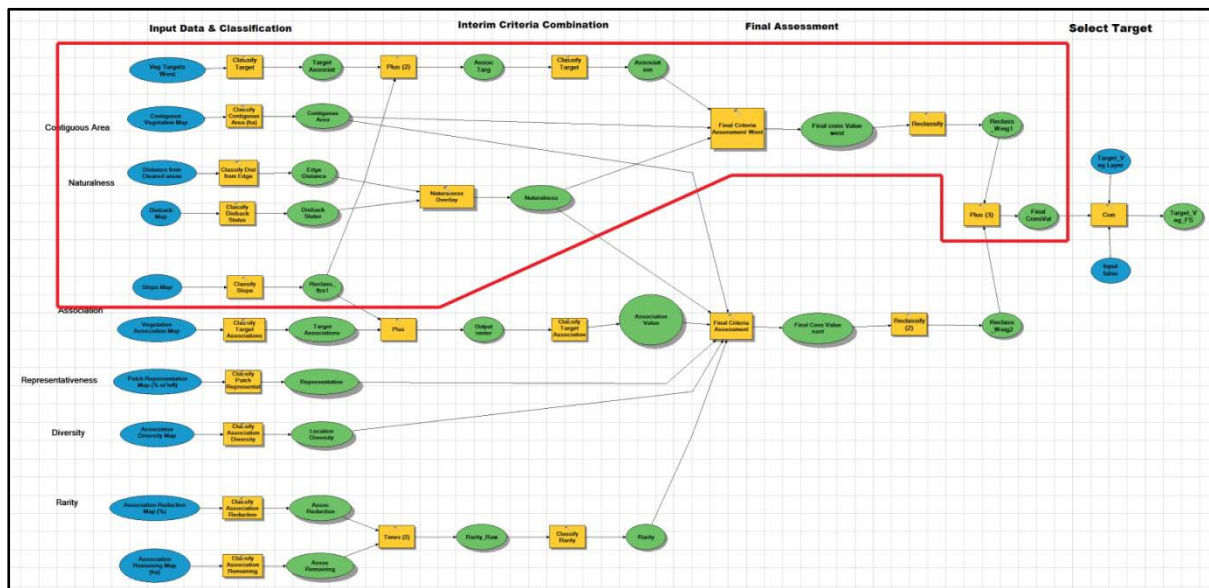


Figure 9 – Schematic of Conservation Value Model Version 2.0

The final result is a map showing the results of the weighted assessment of various criteria, which identifies conservation significance of vegetation in the study area. The final result depends totally on the criteria chosen and the way these criteria are weighted in their importance. These decisions were made by Gondwana Link, Greening Australia, Bush Heritage Australia and University of Queensland staff in a workshop facilitated by the consultant.

The selection of criteria, and the weighting and rating of these was an iterative process, aimed at creating maps that accord with existing understanding based on current ground-truthing and pre-existing knowledge. On-going fine-tuning of the results is possible by staff, and the model will be supplied in a form ready for this.

4.2.3 Criteria

The Western section criteria are based on Version 1, however the lack of vegetation mapping means that the following are not available:

- Representativeness
- Rarity
- Diversity (habitat & species)

The assessment criteria that are available are:

- Area
- Naturalness
- Threat of human interference (Margules 1981)

In addition, some rough mapping was carried out of location of Proteaceous vegetation in the western section to allow the incorporation of:

- Special interest (eg specific values such as endangered species habitat) – 'Vegetation Targets'.

In this initial section these are dealt with briefly.

Area

At the reserve scale, size of conservation areas is seen to be important for conserving viable populations of sufficiently representative numbers of species. While this applies to a degree at all scales, at smaller scales size has important implications for degradation as well – small individual areas of remnant vegetation, surrounded by farmland, are prone to species invasion and structural degradation over time.

The criterion used was:

- the size of the contiguous vegetation area that each patch is part of [Contiguous Area].

Naturalness & Threat of Human Interference

We mapped distance from cleared land as a surrogate for human interference and naturalness, based on general principles as well as field observations on weed invasion and other impacts and their relationship to distance from cleared farmland.

We also have dieback mapping, showing likely areas of dieback infestation.

Special interest associations

This is an important criterion, selecting for associations are areas that have high specific values such as endangered sp habitat, or very productive associations (such as Proteaceous communities) which support higher levels of faunal populations. Special associations are as follows:

Proteaceous communities: *Banksia attenuata*; *Banksia verticillata*; *Banksia heath*, *Dryandra* complex; Sand., and *Eucalytus phaenophylla* association to a lesser extent.

Mallet and moort woodlands: *Eucalyptus astringens*; *Eucalyptus platypus*

Yate woodlands: *Eucalyptus occidentalis*

The only part of this available for the western section was Proteaceous communities.

In addition, as breakaway formations are associated with high levels of species diversity and rare species, so a slope map was created from the 10m DEM and areas above 10° slope given higher values.

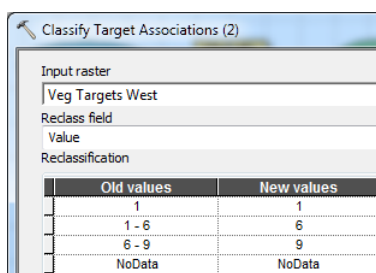
The following three criteria could be used in a subsequent assessment to help target Gondwana Link land acquisition:

4.2.4 Rating and Weighting

Rating and weighting scales were adapted from Version1 of the model, and adjusted in order to provide a values comparable to those from the original model. For each criterion, we have to establish a suitable set of classes, and classify all the occurrences into (usually) a good to bad scale. In each screenshot below, we see a classification screen and a list of classification classes with a corresponding new value – effectively a scaled value, where 1 is lowest value and 9 is the highest for conservation. These screens indicate the values used for new components in VegModel V2.0.

Association

Target Communities (Old Value 6-9): *Banksia attenuata*; *Banksia verticillata*; *Banksia heath*, *Dryandra* complex;



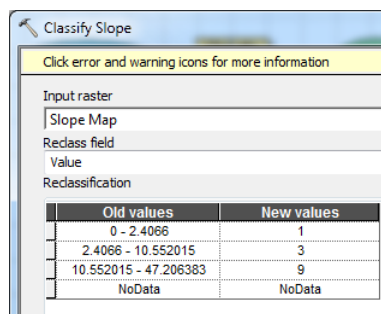
Old values	New values
1	1
1 - 6	6
6 - 9	9
NoData	NoData

Figure 10 – Target Association Classification

Slope

Slope is classified into three classes, which are rated in Figure 11.

- Low (0-2.4°)
- Moderate (2.4-10.5°), and
- High (over 10.5°) – the target breakaways.

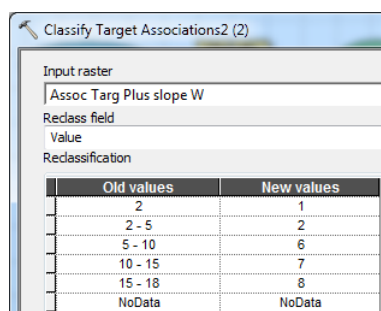


Old values	New values
0 - 2.4066	1
2.4066 - 10.552015	3
10.552015 - 47.206383	9
NoData	NoData

Figure 11 – Slope Classification

Combined Association Value

The values given to association and slope are *added* together to identify target associations, with any association scoring over 10 given a high final value. This ensures that a reasonable score in either of the two input criteria will give a high final rating.



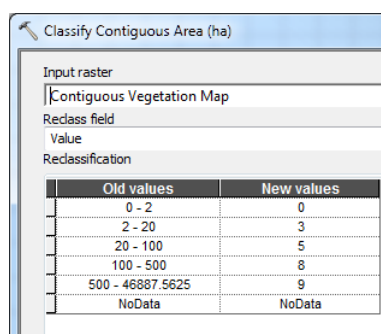
Old values	New values
2	1
2 - 5	2
5 - 10	6
10 - 15	7
15 - 18	8
NoData	NoData

Figure 12 – Association Value Classification

Contiguous Area

Vegetation polygons were merged by area, multi-part polygons split, and the resulting polygons converted to grid (remveggrid). A raster of cleared land was created (inverse of remnant vegetation), and Euclidean distance calculated to cleared land (distoclear). The Con tool was used to assess all remveggrid cells – if the distoclear was >50m, vegetation =1, otherwise 0. All cells closer than 50m to cleared land were removed from the contiguous veg layer. The resulting grid was converted back to polygon and Area was re-calculated. The resulting areas were converted to a raster. A re-class was used to convert this continuous data into a set of grid values corresponding to classes shown below.

This scale scores areas over 100ha high (8-9), while allocating 0 to areas below 2 ha, as shown below.



Old values	New values
0 - 2	0
2 - 20	3
20 - 100	5
100 - 500	8
500 - 46887.5625	9
NoData	NoData

Figure 13 – Contiguous Area Classification

Naturalness (Threat).

Naturalness has been calculated as a combination of dieback status and distance from edge – the latter a surrogate for vegetation condition, which is not available for the study area.

Dieback Status

Dieback status is available from FMIS dataset, which classifies dieback status as follows:

FMISCODE	Category
1	Infested - high confidence
2	Infested - medium confidence

- 3 Infested - low confidence
- 4 Unmappable
- 5 Uninterpretable
- 6 Uninfested - low confidence
- 7 Uninfested - medium confidence
- 8 Uninfested - high confidence
- 9 Not interpreted

All infested classes were taken as infested, all non-infested classes taken as die-back free. Other classes were given a mid value – see below.

Old values	New values
1	0
2	0
3	0
4	5
5	5
6	7
7	9
8	9

Figure 14 – Dieback Status Classification

Distance from Edge


A grid was made of all non-vegetated (cleared) areas extending well beyond the FS study area. Straight-line distance was then assessed within vegetation polygons to measure distance from the nearest cleared area. – Further away is better, up to a max value over 2000m.

Old values	New values
0 - 25	0
25 - 100	1
100 - 250	3
250 - 400	5
400 - 2000	8
2000 - 4531.142089844	9
NoData	NoData

Figure 15 – Distance from Edge Classification

Final Naturalness Ratings

The values given to Dieback status and Edge Distance are combined in a *weighted overlay* to identify least impacted areas. In this overlay, shown below, areas with dieback (value 0) and with edge distance value=0 (ie within 25m of cleared land) rate -10. Either class will strongly reduce their final naturalness value.



Naturalness Overlay

Weighted overlay table




Raster	% Influence	Field	Scale Value
 Dieback Status	30	VALUE	
		0	-10
		5	0
		7	6
		9	10
		NODATA	-12
		 Edge Distance	70
0	-10		
1	-4		
3	0		
5	4		
8	8		
9	10		
NODATA	NODATA		

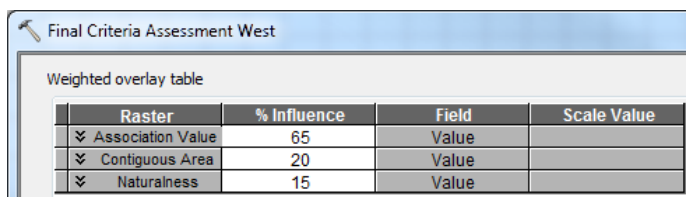
Figure 16 – Naturalness Classification

4.2.5 Multi-Criteria analysis

In the final analysis, all of the criteria are combined through a series of weighting and rating steps. This is as simple as possible, and produces a final map of value for conservation.

The weighted overlay tool combines a range of inputs (each of which is a Grid or raster), which have all been classified along the lines of the last section. The classification values are given scale values, which can be 1-9 or -10 to +10. In any criterion, a particular class can be excluded from all further analysis, using the “Restricted” scale value. The use of negative values allows single criterion to pull the overall score down – to offset other positive aspects.

In addition, each criterion has been given an overall weighting – a % influence – to indicate its relative importance overall. In Version 1 these values were based on the opinion and experience of the project staff in a half-day workshop. These staff represented Gondwana Link, Greening Australia, Bush Heritage Australia and the University of Queensland.

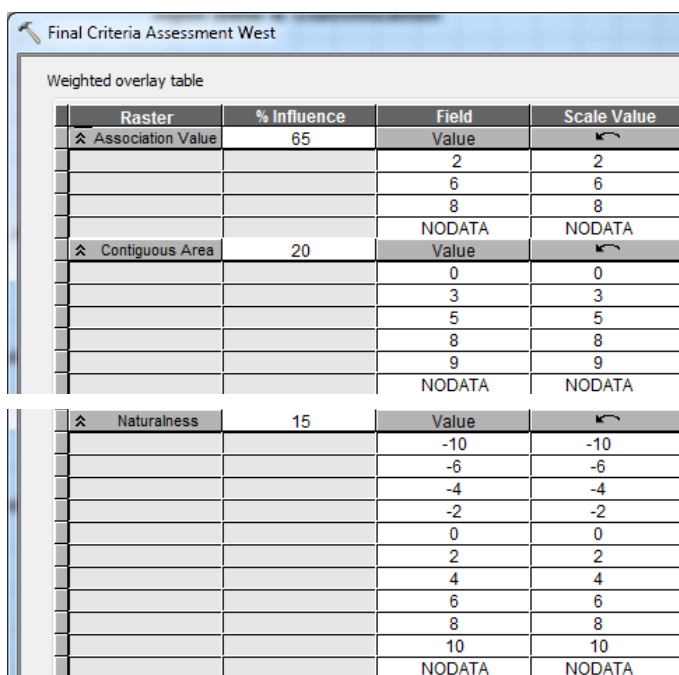


Raster	% Influence	Field	Scale Value
Association Value	65	Value	
Contiguous Area	20	Value	
Naturalness	15	Value	

Figure 17 – Final Criteria Weightings (% Influence)

In Version 2, some modification has been necessary, but the overall split of influence between individual factors and broader scale factors remains. The % influence values shown indicate strong weighting to individual vegetation association patch through Association value (65%). This factor is set high to provide a similar weighting for individual factors as in Version 1, which also included Representation (20%) and Rarity (15%), for a total of 60% of the overall influence.

The other two factors – Contiguous Area (10%) and naturalness (15%) relate to the value of the location, and aspects of the size and diversity of the vegetation area a cell is in.



Raster	% Influence	Field	Scale Value
Association Value	65	Value	
		2	2
		6	6
		8	8
		NODATA	NODATA
Contiguous Area	20	Value	
		0	0
		3	3
		5	5
		8	8
		9	9
		NODATA	NODATA
Naturalness	15	Value	
		-10	-10
		-6	-6
		-4	-4
		-2	-2
		0	0
		2	2
		4	4
		6	6
		8	8
		10	10
		NODATA	NODATA

Figure 18 – Final Criteria Ratings

Outputs

The outputs from the separate Western & Eastern sections of the model are combined in the last processes to provide a single seamless dataset of conservation value shown in Figure 15 below. Large areas of vegetation tend to have higher conservation values, but outliers of special associations also score highly. In Version 2, the highest values are next to and in the Stirling Range National Park, which may reflect the simpler model used in the Western part of the area. The large areas of Vacant Crown Land along Corackerup Creek contain the next highest values in the study area.

The final output was saved as a single grid layer at the resolution of the MCAS components, and used as an input to the two final components as shown in Figure 1.

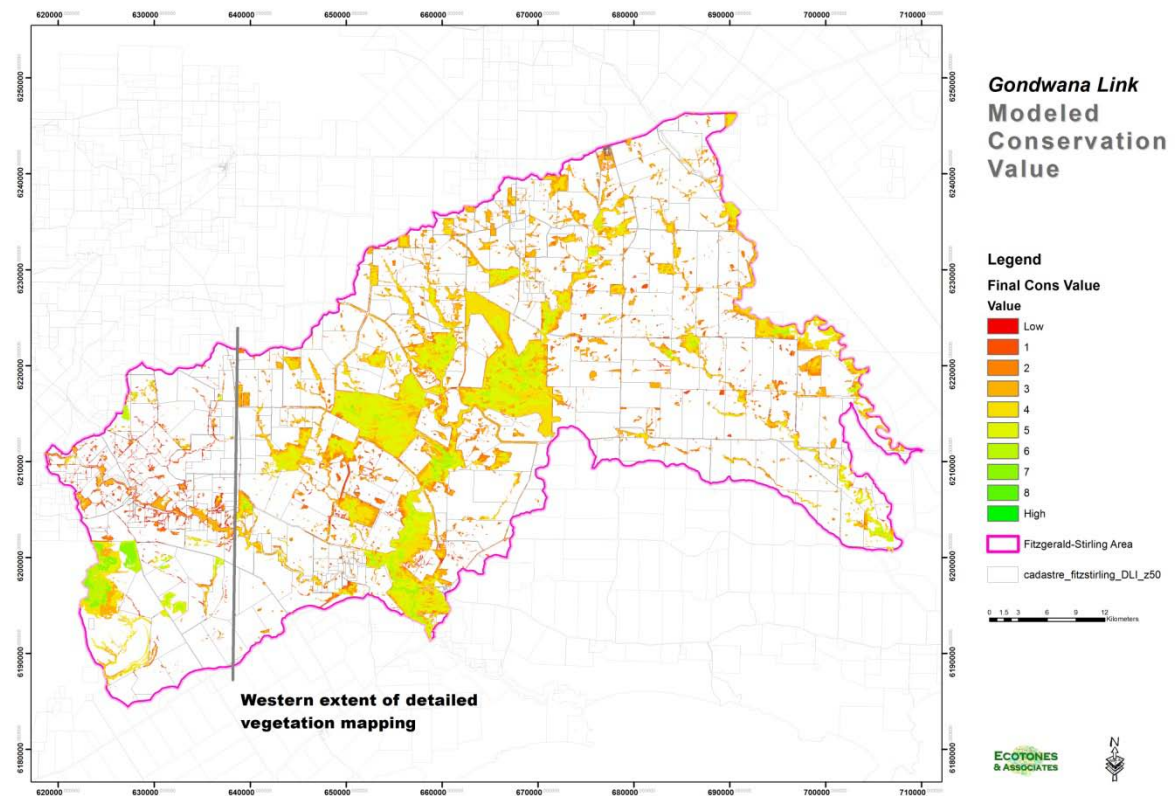


Figure 19 – High Conservation Value Component: Modeled Conservation Value

4.3 Connectivity & Linkage Component

The Connectivity and Linkage component is designed to indicate both those areas where revegetation would assist in creation of the main linkage, as well as areas where the remnant native vegetation is important in creating such a linkage.

The connectivity/linkage model includes three major composite inputs based on connectivity principles:

- Proximity to Linkage – the core habitat linkage between the Stirling Range and Fitzgerald NP.
- Vegetation Integrity/Proximity - building on existing nodes (patches over certain size) of native habitat
- Proximity to Secured Vegetation - building ecological permeability by creation of stepping stones and smaller linkages.

A total of eight input layers are used to create these composites, as shown in Figure 20 below.

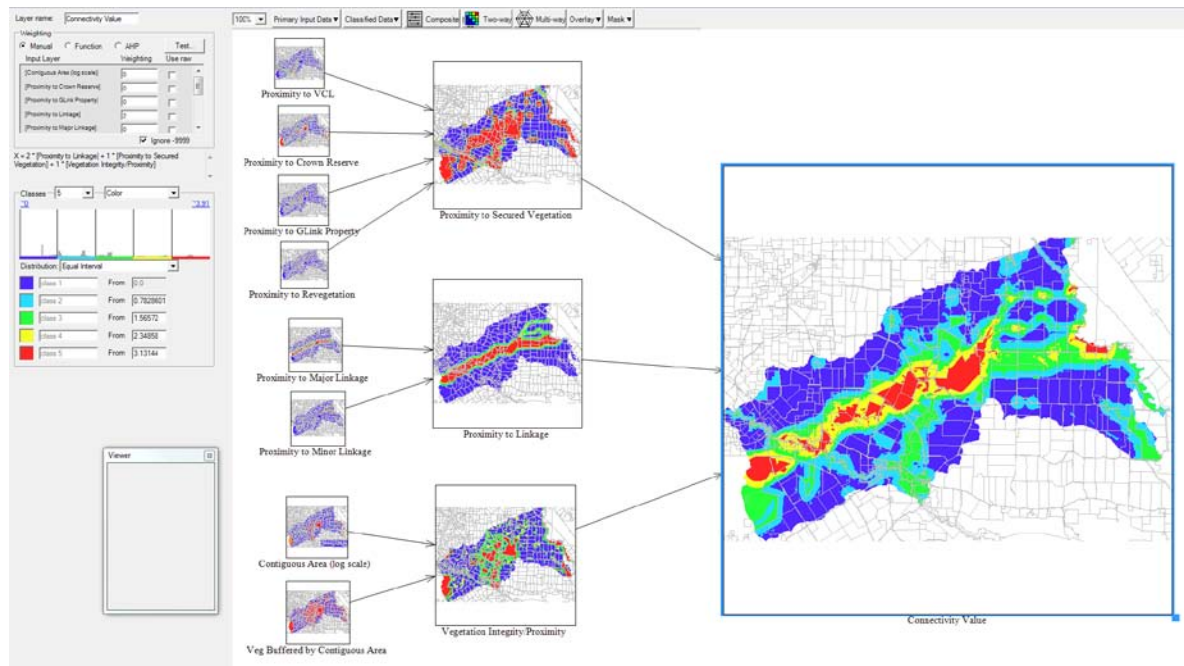


Figure 20 – Connectivity & Linkage Component Model

4.3.1 Input Layers

Proximity to VCL

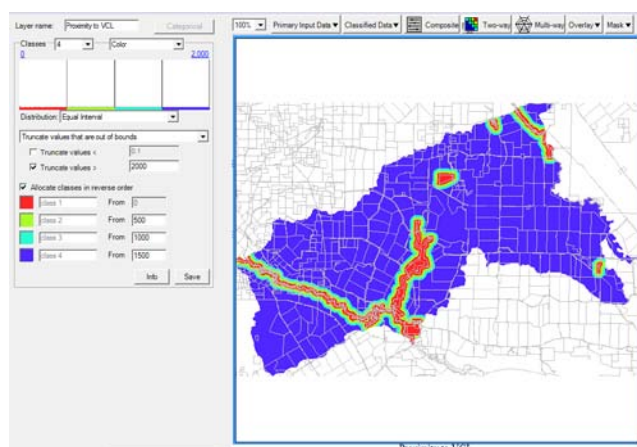


Figure 21 - Proximity to VCL Layer

Metadata

Distance from Vacant Crown Land
Description: Distance from Vacant Crown Land
Custodian: GLink
Currency: 2012
Lineage: Distance from Vacant Crown Land calculated using Euclidean Distance.

Classification

Proximity to VCL was classified into four 500m classes – and truncated beyond that. Value is highest (1) at 0m, then reduces to 0 beyond 2000m.

Proximity to Crown Reserve

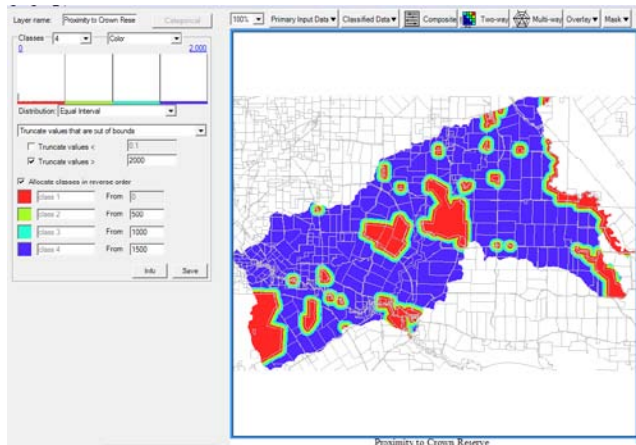


Figure 22 – Proximity to Crown Reserve Layer

Metadata

Distance from Crown Reserve
Description: Distance from Crown Reserve
Custodian: GLink
Currency: 2012
Lineage: Distance from Crown Reserve calculated using Euclidean Distance.

Classification

Proximity to Crown reserve was classified into four 500m classes – and truncated beyond that. Value is highest (1) at 0m, then reduces to 0 beyond 2000m.

Proximity to GLink Property

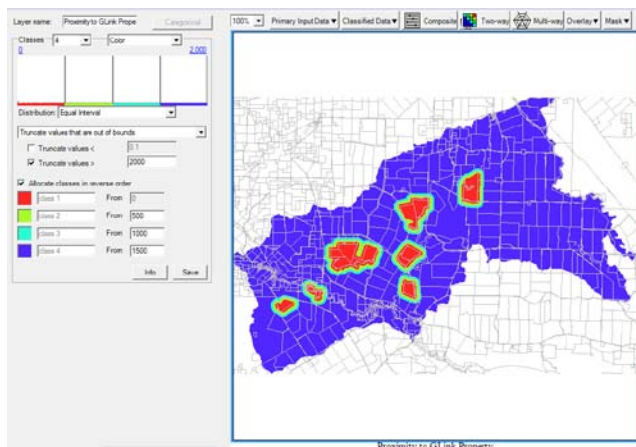


Figure 23 – Proximity to GLink Property Layer

Metadata

Distance from GondwanaLink Properties
Description: Distance from Gondwanalink Properties & private properties with Covenants
Custodian: GLink
Currency: 2012
Lineage: Distance from GondwanaLink Properties & private properties with Covenants calculated using Euclidean Distance.

Classification

Proximity to Gondwana Link Property was classified into four 500m classes – and truncated beyond that. Value is highest (1) at 0m, then reduces to 0 beyond 2000m.

Proximity to Revegetation

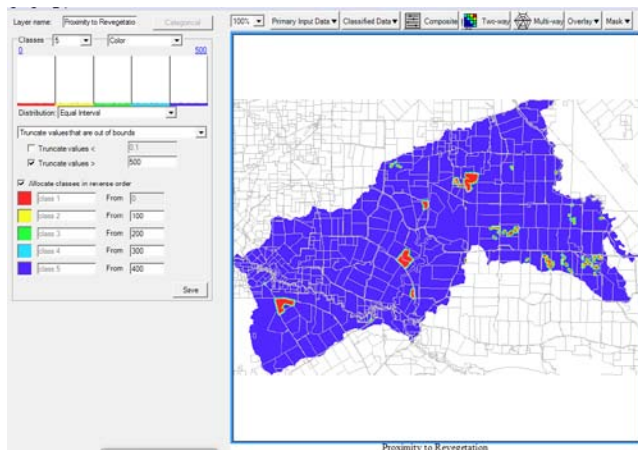


Figure 24 – Proximity to Revegetation Layer

Metadata

Distance from Revegetation
 Description: Distance from Revegetation
 Custodian: GLink
 Currency: 2012
 Lineage: Current areas of deliberate revegetation in the FS area by Euclidian distance.

Classification

Proximity to Revegetation was classified into four 100m classes – and truncated beyond that. Value is highest (1) at 0m, then reduces to 0 beyond 400m. This is a much closer proximity based on the assumption that these areas have less ecological value and a much lower level of security.

Linkages

Major and minor linkages were calculated using a cost path analysis. Source and Sink were set as the Fitzgerald & Stirling Range National parks. 2 separate cost surfaces were developed:

- 1 – cost was set at 9 for cleared vegetation, with cost dropping with distance from cleared land (ie. larger patches of vegetation were easier to travel through.)
- 2 - cost set up so that vegetation incurred no cost, cleared vegetation 1 per cell.

Least cost paths were developed using both surfaces. These were very similar, and a single final linkage shapefile created from these. This has been classified into Major, Minor and alternate lines.

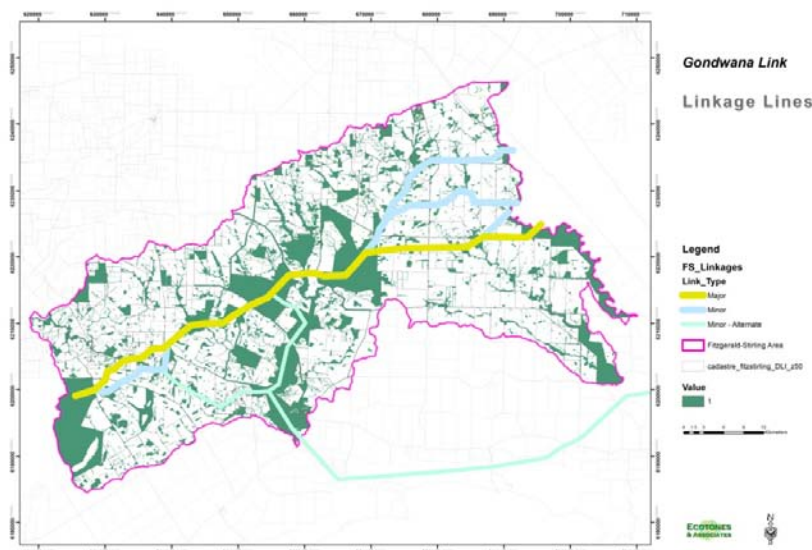


Figure 25 – FS Linkage Lines

Proximity to Major Linkage

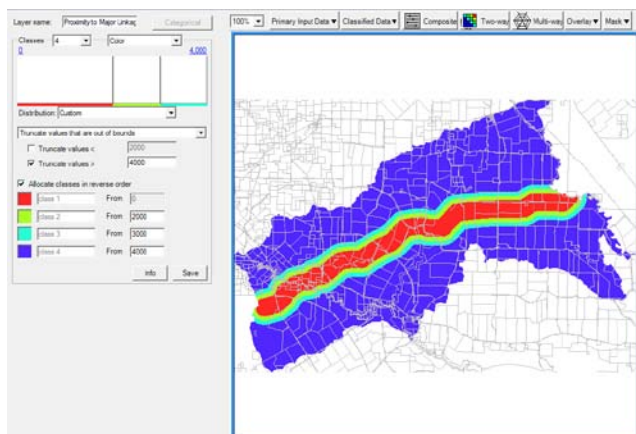


Figure 26 – Proximity to Major Linkage Layer

Metadata

Distance from Major Linkage

Description: Distance from Major Linkage

Custodian: GLink

Currency: 2012

Lineage: Distance from Major Linkage (GLink, 2012) calculated using Euclidean Distance.

Classification

Proximity to Major Linkage was classified into four classes (0-2000m, 2000-3000m, 3000-4000m) – and truncated beyond them. Value varies from 1 at 0m to 0.65 at 2000m, from .65-0.5 between 2000 and 3000m, from 0.5-0 between 3000 and 4000m, and then reduces to 0 beyond 4000m.

Proximity to Minor Linkage

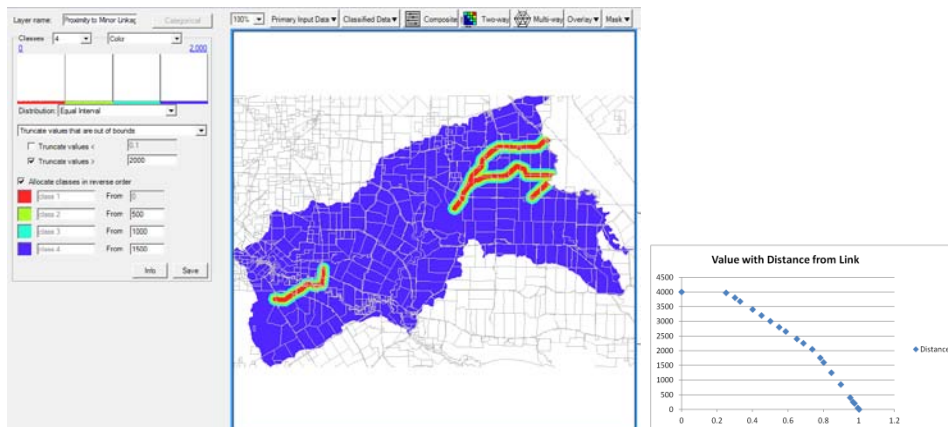


Figure 27 - Proximity to Minor Linkage Layer

Metadata

Distance from Minor Linkage

Description: Distance from Minor Linkage

Custodian: GLink

Currency: 2012

Lineage: Distance from Minor Linkage (GLink, 2012) calculated using Euclidean Distance.

Classification

Proximity to Major Linkage was classified into four classes (0-500m, 500-1000m, 1000-1500m) – and truncated beyond 2000m. Value varies from 1 at 0m to 0.75 at 500m, from .75-0.5 between 500 and 1000m, from 0.5-0.25 between 1000 and 1500m, and reduces to 0 at 2000m.

Contiguous Area

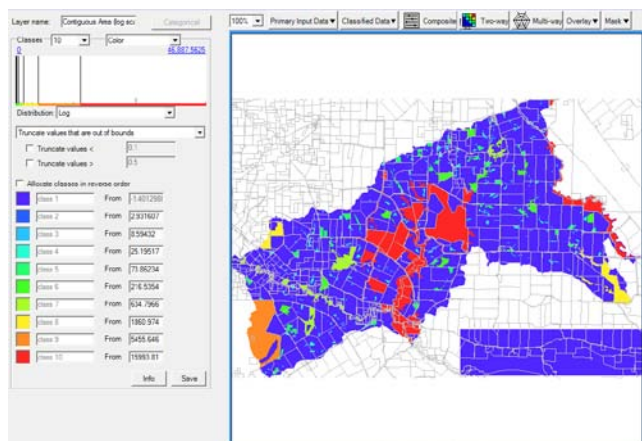


Figure 28 – Contiguous Area Layer

Metadata

Contiguous Vegetation Area

Description: Contiguous Vegetation Area

Custodian: GLink

Currency: 2012

Lineage: Areas of contiguous vegetation. All remnant veg polygons were merged into a single polygon, and then this multi-part polygon was split, and rasterised at 25m resolution. Euclidean distance from cleared areas was calculated, and with a Con statement `[Con(dist>50, 1, 0)]`, any cell less than 50m from cleared land was excluded from contiguous veg area [1]. Resulting raster was reconverted to polygons to re-calculate areas of resulting polygons, and then rasterised at 50m for use in MCAS.

Classification

Contiguous Area was classified into 10 classes using a log distribution. Value is 0.1 below approx 2 ha, and 10 above approx 16,000ha.

Vegetation Buffered by Contiguous Area

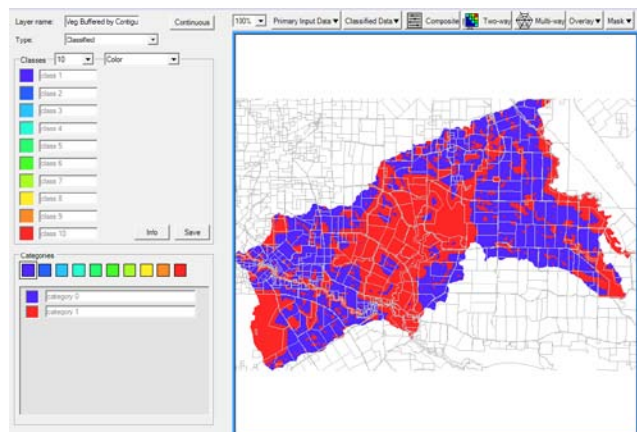


Figure 29 – Vegetation Buffered by Contiguous Area Layer

Metadata

Contiguous Vegetation Buffered

Description: Contiguous Vegetation Buffered

Custodian: GLink

Currency: 2012

Lineage: Buffered areas around contiguous vegetation [contigarea]. Buffers vary in distance depending on the area of the contiguous vegetation:

Area(ha)	Buffer Width (m)
0-2	0
2-10	50
10-100	100
100-1000	250
1000-10000	500
>10000	1000

Classification

Classified data with two categories (inside buffer and outside it). Inside buffer area value as 1, outside 0.

4.3.2 Interim Composite Layers

Proximity to Secured Vegetation

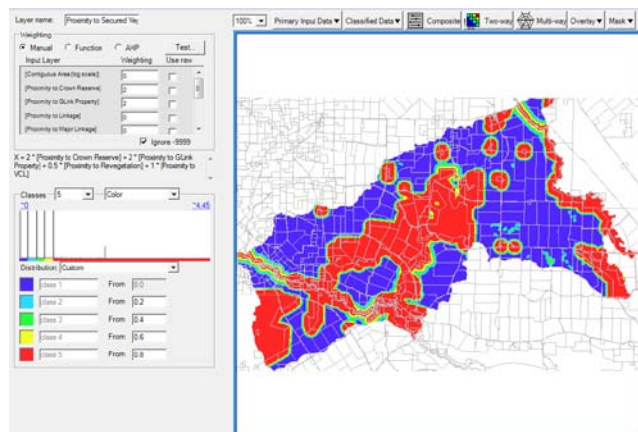


Figure 30 – Proximity to Secured Vegetation Composite Layer

A combination of the four proximity layers provides a single layer showing proximity to any permanent vegetation. Weightings are as follows: Proximity to Crown Reserve and Gondwana Link property both at 2, Proximity to VCL 1, and Proximity to Revegetation 0.5. The weights indicate an assessment of the relative security of each type. Proximity to more than one layer will result in higher values, but the classification used ensures a cut-off above 1.0, so that double-counting is mostly avoided. The highest values occur where cells are in close proximity to more than one type of secured vegetation.

Proximity to Linkage

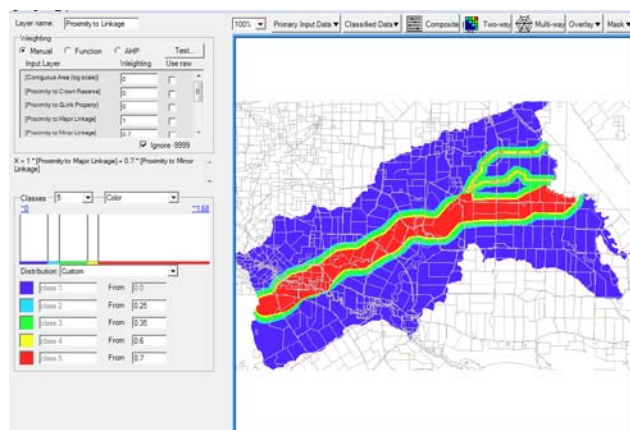


Figure 31 – Proximity to Linkage Composite Layer

A combination of the two linkage proximity layers provides a single layer showing proximity to linkage. Weightings are as follows: Proximity to Major Linkage at 1, Proximity to Minor Linkage 0.7. The weights were manually set to ensure that the minor linkage showed on the output, but only just. Highest values (up to 1.0) occur in close proximity to both types of linkage, which is appropriate given that these areas offer multiple options for connection.

Vegetation Integrity/Proximity

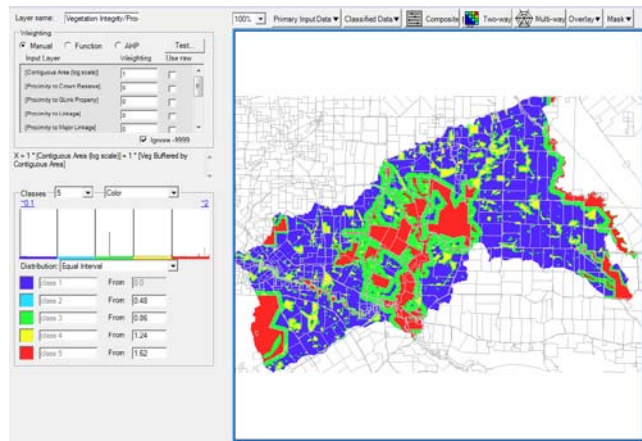


Figure 32 – Vegetation Integrity/Proximity Composite Layer

A combination of the Contiguous Area layer and Veg Buffered by Contiguous Area layer provides a single layer showing Vegetation Integrity/Proximity. Weightings for the input layers are equal, so they have a 50% effect each. In effect they are two aspect of the one layer, but the intention was to provide value based on both contiguous area, and buffers in relation to the size of that area. The maximum input value is 2, and the equal interval classification splits this into 5 classes where the highest values (between 0.9 and 1.0) are for the largest contiguous areas. Mid-size contiguous areas rate next (between 0.8 and 0.9) and smaller contiguous areas between 0.6 and 0.8. The variably-sized buffers rate between 0.4 and 0.5, and other areas rate 0.

4.3.3 Output Composite – Connectivity Value

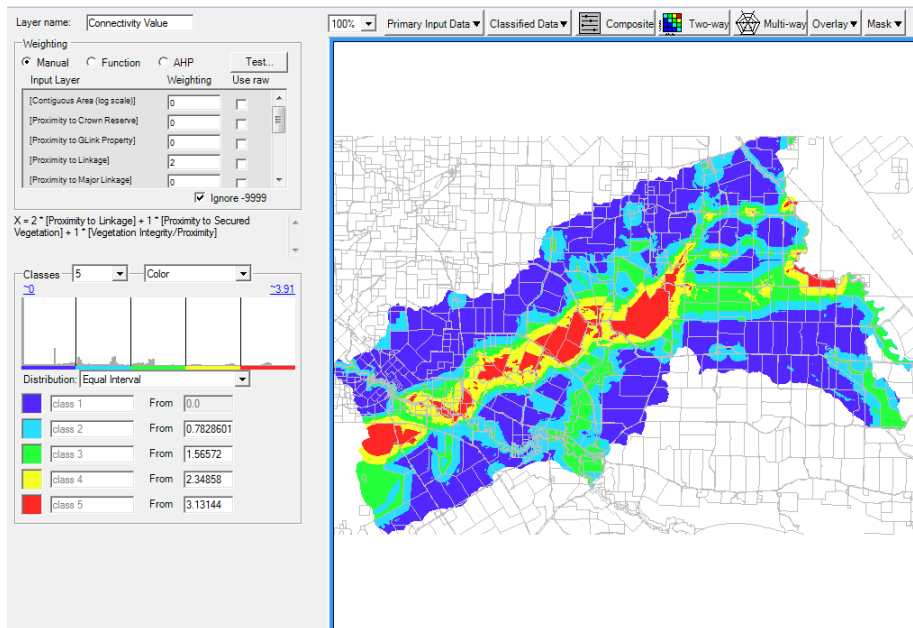


Figure 33 – Connectivity & Linkage Component: Connectivity Value Map

Connectivity Value is a combination of three input composites:

- Proximity to Linkage (2 – 50%)
- Proximity to Secured Vegetation (1 – 25%), and
- Vegetation Integrity/Proximity (1 – 25%).

Linkage provides half of the weighing and the two aspects of connectivity the other half. This reflects the aim to incorporate a range of connectivity principles:

- building a 2 km wide core habitat linkage between the Stirling Range and Fitzgerald NP.
- building on existing nodes (patches over certain size) of native habitat
- building ecological permeability by creation of stepping stones and smaller linkages

with the line of best connection between east & west, the “linkage” line.

4.4 Riparian Revegetation Component

The Riparian Revegetation component is designed to indicate riparian zones which should be revegetated as a priority. Three main criteria inform the process:

- Foreshore condition
- Percent of catchment under vegetation; and
- Erosion Risk.

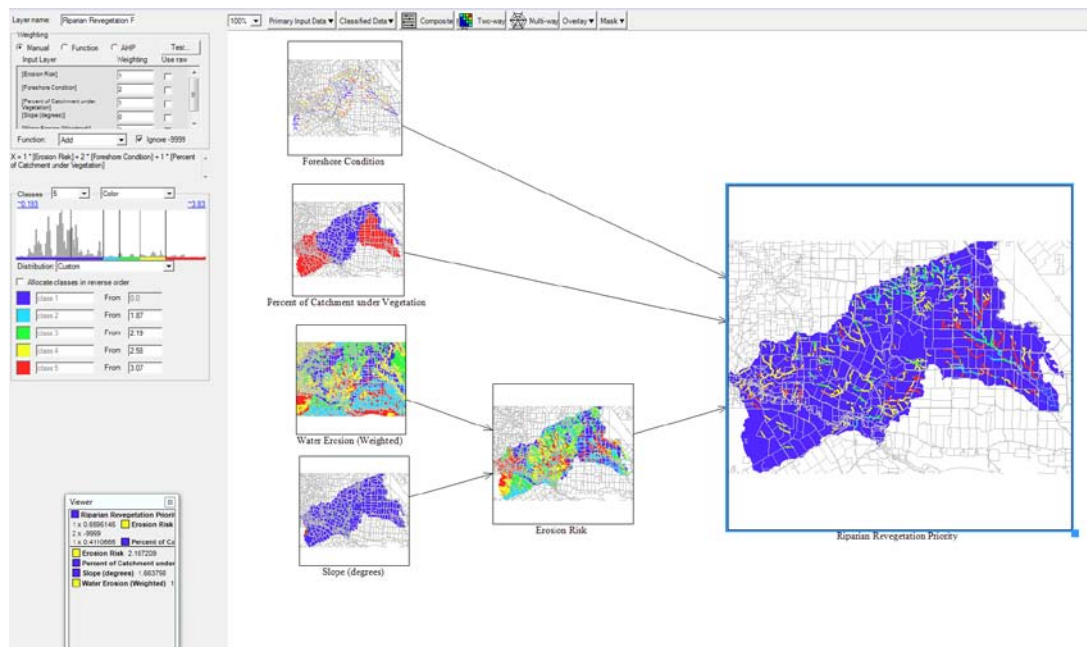


Figure 34 – Riparian Revegetation Component Model

Foreshore condition is derived from foreshore surveys using the Penn-Scott classification, and has been conducted for most (but not all) streams in the study area. Catchment vegetation has been calculated at a coarse scale (6 sub-catchments covering the study area), and is intended to satisfy CAP objectives for improving landscape scale vegetation cover. Erosion risk reflects a desire to reduce soil and nutrient loss through overland erosion by targeting revegetation to areas with higher erosion risk, and is calculated from a combination of slope (derived from the DEM) and a classification of water erosion risk for Land Unit Mapping Units (soils) carried out by AGWA.

4.4.1 Input Layers

Foreshore Condition

Metadata

Riparian Vegetation Condition

Description: Riparian Vegetation Condition – Penn classification

Custodian: GLink

Currency: 2012

Lineage: Stream condition has been mapped for a significant subset of streams in the FS area. Each stream has been buffered to 200m, and the condition value given to the rasterisation of the buffers.

0=Non-Riparian (>200m)

1=A

2=B

3=C

4=D

Classification

Classified data with four categories (4 classes of veg condition from A-D, plus & no data). A 10 class rating scale is used, with highest values given to categories C (0.8) and D (1.0). Categories A (0.1) and B (0.1) are given low values to remove from priorities.

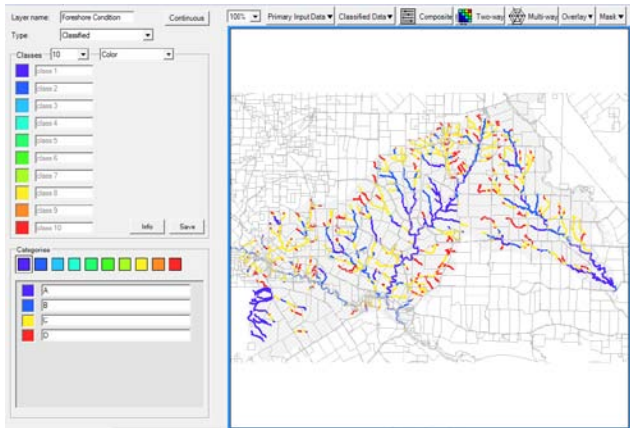


Figure 35 – Foreshore Condition Layer

Percent of Catchment under Vegetation

Metadata

Percentage of Subcatchment currently under vegetation
 Description: Percentage of subcatchment under Vegetation
 Custodian: GA
 Currency: 2011
 Lineage: Area of vegetation (DAFWA June 2011) as a % of total subcatchment area (Subcatchments as provided to Ecotones & Assoc)

Classification

Continuous data, displayed into two classes of greater than/less than 0.3 (30%). The lowest (16.5%) is given a value of 1, the highest (66%) is given a value of 0, and the remaining values are scaled in between.

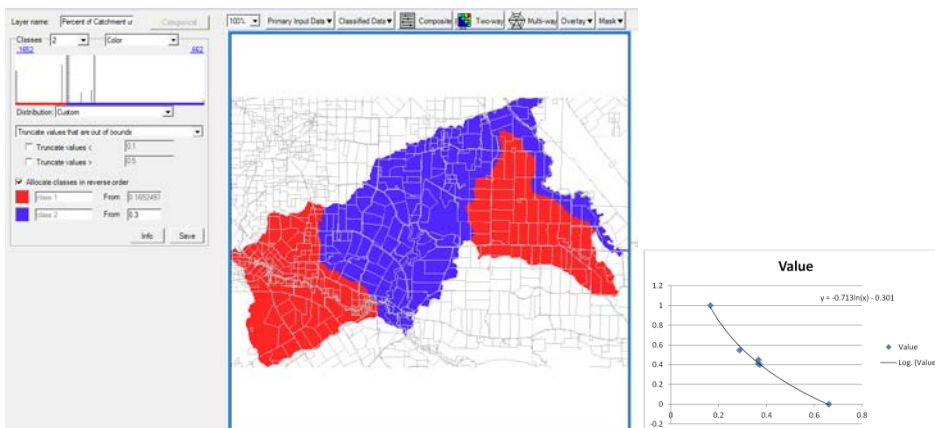


Figure 36 – Catchment Vegetation % Layer

Water Erosion Risk (weighted)

Metadata

Water Erosion Hazard for Land Unit Mapping Units (soils)
 Description: Weighted Water Erosion Hazard for Land Unit Mapping (soils)
 Custodian: DAFWA
 Currency: 2005
 Lineage: Water Erosion Hazard has been calculated for soils, and attributed to Map Units from the Ag WA land unit mapping (van Gool, 2005). This index is a weighted value for each Land Unit calculated by the formula:

$$((0.1 * \text{Water Erosion Hazard Low}) + (0.2 * \text{Water Erosion Hazard Med}) + (0.4 * \text{Water Erosion Hazard High}) + (0.6 * \text{Water Erosion Hazard Very High}) + (0.9 * \text{Water Erosion Hazard Extreme}))$$

Classification

The water erosion hazard layer is continuous data that has been classified using an equal area method into 5 classes. Output values are scaled to 0 for the minimum Class 1 values (0) and 1 for the maximum Class 5 values (52).

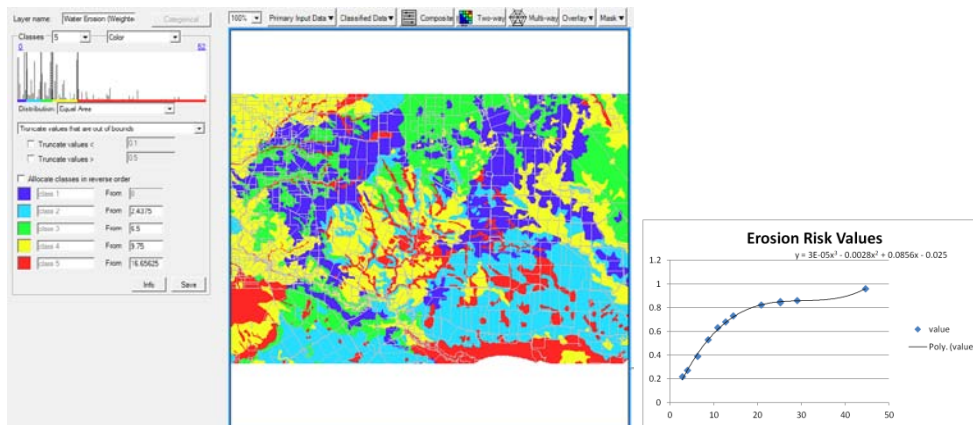


Figure 37 – Water Erosion Layer

Slope (degrees)

Metadata

Terrain Slope

Description: Terrain Slope

Custodian: DLI

Currency: 2011

Lineage: Terrain Slope in degrees, calculated from Landmonitor DEM

Classification

The slope layer is continuous data that has been manually classified into 3 classes. However output values are scaled between 0 for the minimum Class 1 values (0) and 1 for the maximum Class 5 values (47.2) as shown in Figure 26.

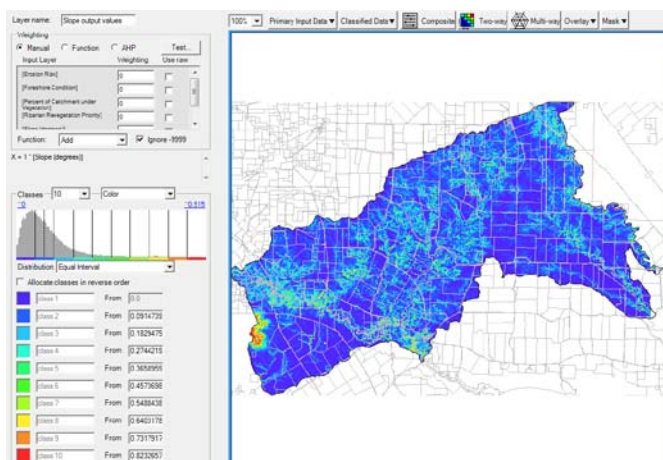


Figure 38 - Scaled output values for Slope

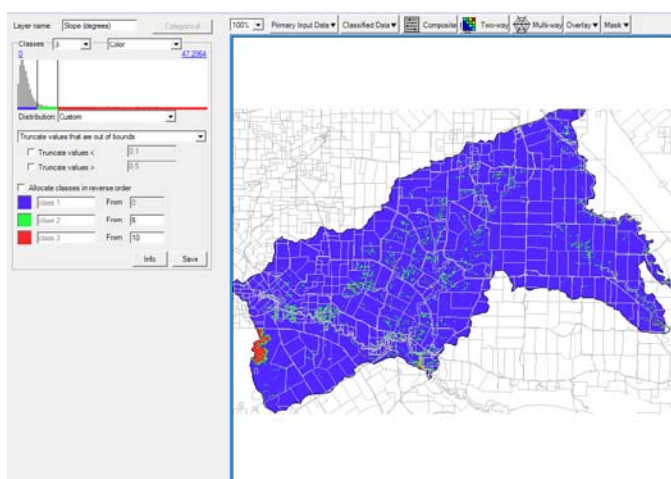


Figure 39 – Slope Layer - Classified values

4.4.1 Interim Composite Layer

Erosion risk

The purpose of this interim layer is to provide a composite index of erosion based a combination of water Erosion risk (the Weighted Water Erosion Hazard for Land Unit Mapping (soils), a probabilistic assessment based on soil % within each land unit); and additional input of slope based on the much finer scale DEM. The output combines two input datasets:

- Weighted Water Erosion Hazard: Weighting is 3 - 75% of the input influence, indicating this is very significant.
- Slope (%): Weighting is 1 – 25% of influence, to ensure better identification of specific areas of high slope.

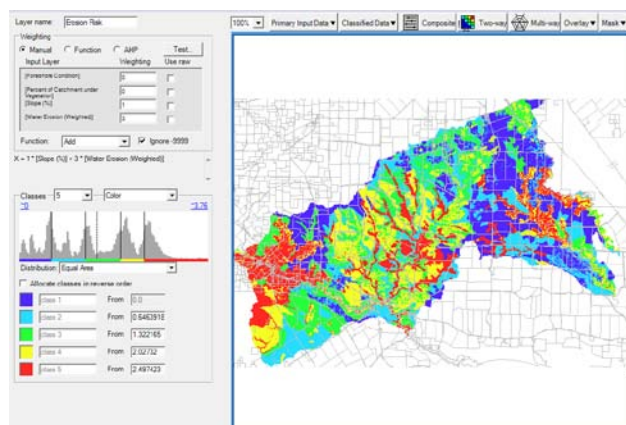


Figure 40 – Erosion Risk Composite Layer

4.4.1 Output Composite – Riparian Revegetation Priority

The purpose of this composite layer is to provide an index of revegetation priority in riparian zones combining the above inputs. The output combines three input datasets:

- Foreshore Condition: Weighting is 2 - 50% of the input influence. Foreshore condition is both the most important single criterion, but as it is limited in area to 200m buffers each side of the surveyed creek-lines, it also defines the extent of this composite.
- Percent of catchment under vegetation: Weighting is 1 – 25% of influence, to ensure higher priority value in sub-catchments with lower vegetation cover.
- Erosion Risk (%): Weighting is 1 – 25% of influence, to ensure higher priority value on areas with erosion risk problems.

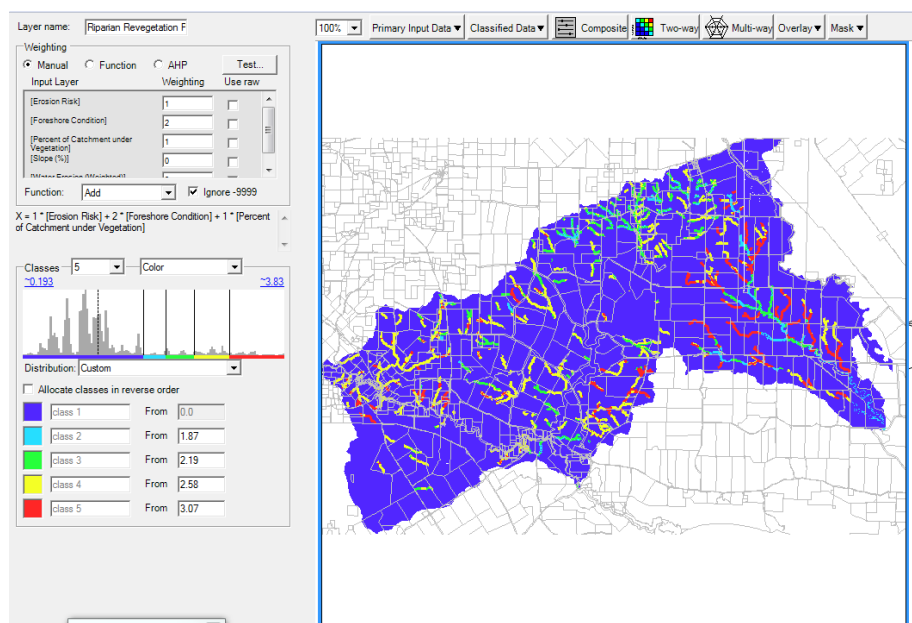


Figure 41 – Riparian Revegetation Component: Riparian Revegetation Priority Map

4.5 Tammar Wallaby Component

The Tammar Wallaby component produces two output datasets:

- Revegetation priority for Tammar Wallaby and
- Existing vegetation priority for Tammar Wallaby.

Each output uses three of the four inputs detailed below.

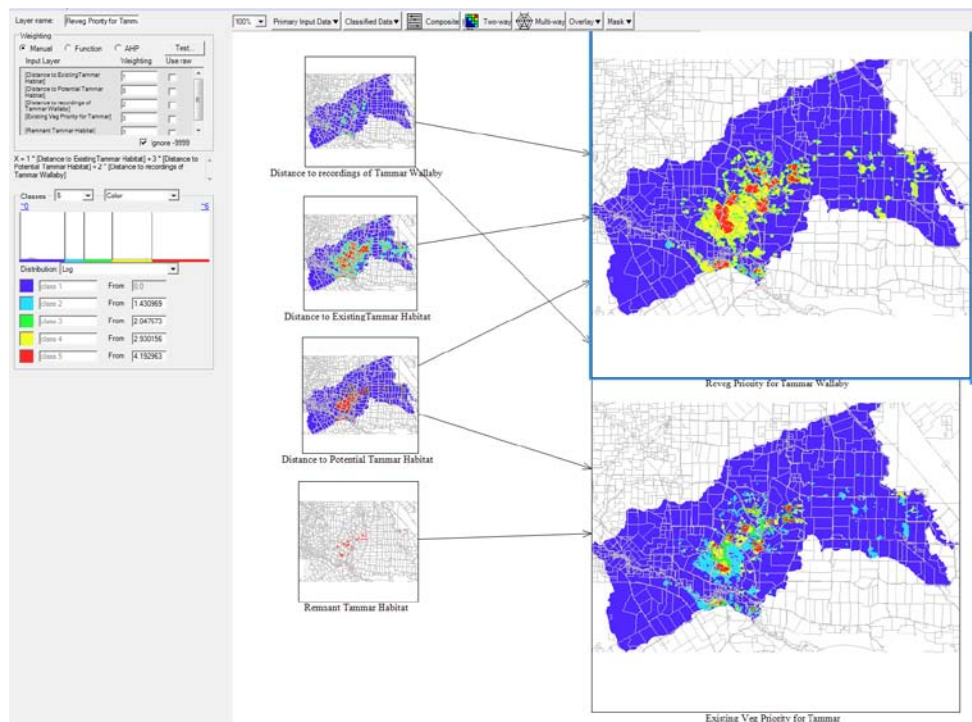


Figure 42 – Tammar Wallaby Component Model

4.5.1 Input Layers

Distance to Recordings

Metadata

Distance from Tammar Wallaby (*Eugenii derbianus*) recordings
 Description: Distance from Tammar Wallaby (*Eugenii derbianus*) recordings
 Custodian: G Link
 Currency: August 2012
 Lineage: Euclidean distance from locations of Tammar Wallaby (*Eugenii derbianus*) recordings

Classification

Continuous data, classified into five equal interval classes of 400m up to 2000m, and no value above 2000m. Closest distance class has highest value.

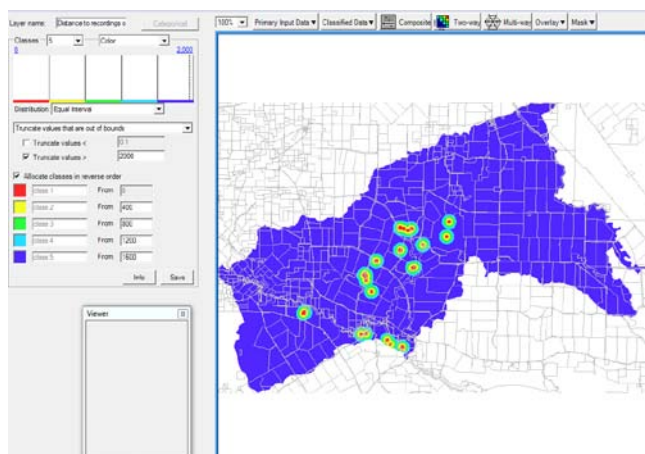


Figure 43 – Distance to Recordings of Tammar Wallaby Layer

Distance to Existing Tammar Habitat

Metadata

Distance from existing remnant Tammar Wallaby habitat
Description: Distance from remnant Tammar Wallaby habitat
Custodian: G Link
Currency: June 2006
Lineage: Euclidean distance from remnant Tammar Wallaby habitat as mapped by Newby in Veg Mapping of the Fitz-Stirling
Mapping of the Fitz-Stirling

Classification

Continuous data, classified into four custom classes of 0-250m, 250-500m, 500-1500m and 1500-2000m. No value above 2000m.

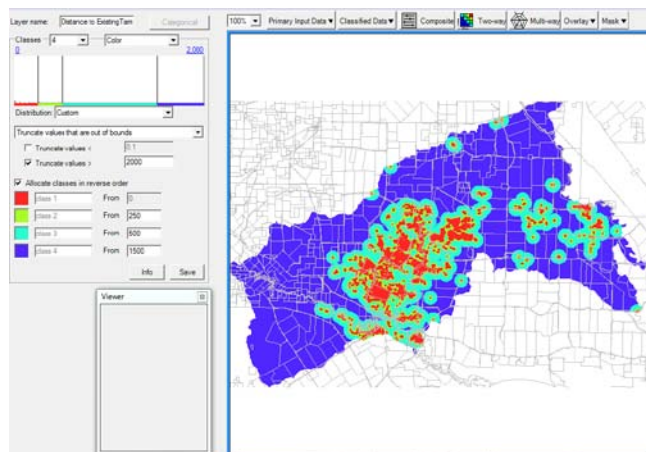


Figure 44 - Distance to Existing Tammar Habitat Layer

Distance to Potential Tammar Habitat

Metadata

Distance from potential Tammar Wallaby habitat
Description: Distance from potential Tammar Wallaby habitat
Custodian: G Link
Currency: June 2006
Lineage: Euclidean distance from potential Tammar Wallaby habitat as mapped by Newby in Veg Mapping of the Fitz-Stirling
Mapping of the Fitz-Stirling

Classification

Continuous data, classified into three equal classes of 0-100m, 100-200m, 200-300m. No value above 300m.

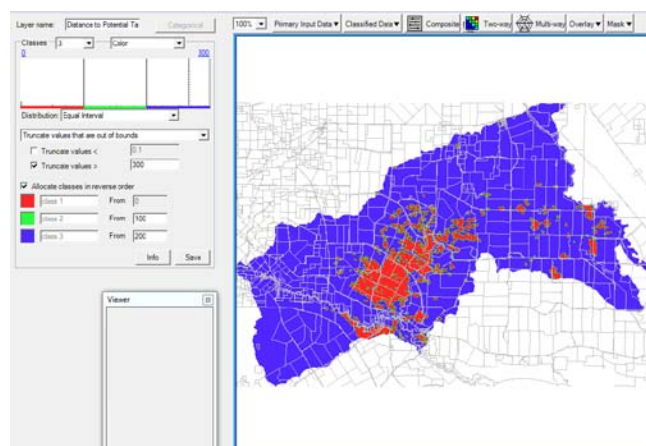


Figure 45 - Distance to Potential Tammar Habitat Layer

Actual Remnant Tammar Habitat

Metadata

Existing Tammar Habitat

Description: Existing tammar habitat (E. Floctonia and E. Platypus)

Custodian: G Link

Currency: n/a

Lineage: Distribution of existing (remnant) Tammar wallaby habitat (E. Floctonia and E. Platypus) from Newby vegetation mapping.

Classification

Classified data with three categories (two types of vegetation class & no data). Highest value given to category 1 & 2 data.

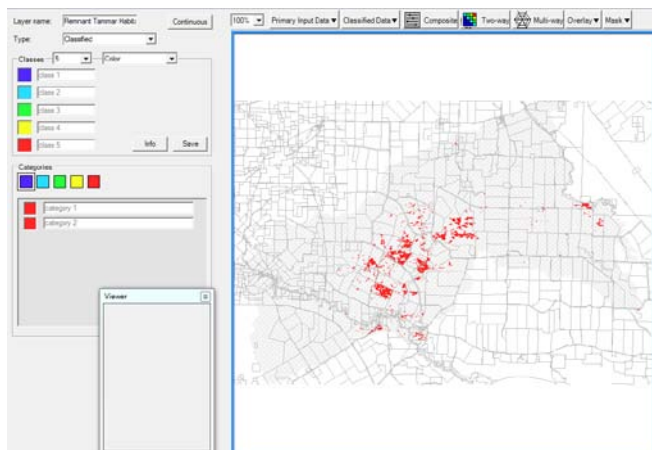


Figure 46 - Actual Remnant Tammar Habitat Layer

4.5.2 Output Layers

Revegetation Priority for Tammar Wallaby

The purpose of this output is to indicate areas that are suitable for revegetation that will provide habitat for Tammar Wallaby. The output combines three input datasets:

- Distance to Potential Tammar Habitat: Weighting is 3 - 50% of the input influence, indicating this is very significant. Intent is to highlight potential Tammar habitat for revegetation.
- Distance to Recordings of Tammar Wallaby: Weighting is 2 – significant, to reflect proximity to known tammar habitat to allow colonisation to revegetation areas.
- Distance to Existing Tammar Habitat: Weighting is 1 – minor importance but still included to pick up areas where Tammar are assumed to be but have not necessarily been sighted.

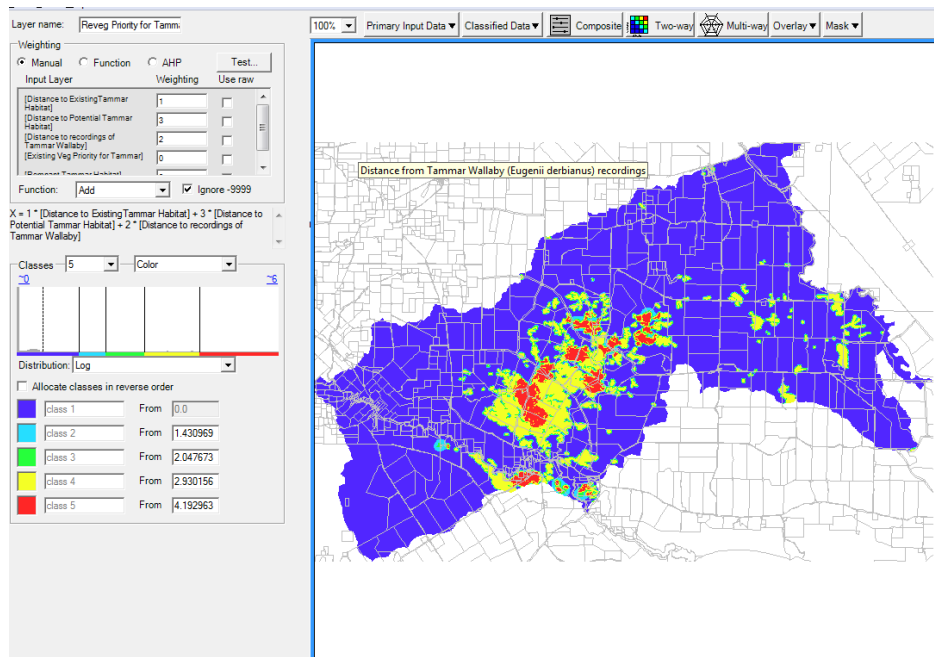


Figure 47 – Tammar Wallaby Component: Revegetation Priority for Tammar Wallaby.

Existing Vegetation Priority for Tammar Wallaby

The purpose of this output is to indicate areas of existing vegetation that should be habitat for Tammar Wallaby. The output combines three input datasets:

- Distance to Potential Tammar Habitat: Weighting is 3 - 50% of the input influence, indicating this is very significant. Intent is to highlight potential Tammar habitat for revegetation.
- Distance to Recordings of Tammar Wallaby: Weighting is 2 – significant, to reflect proximity to known tammar habitat to allow colonisation to as revegetation areas.
- Distance to Existing Tammar Habitat: Weighting is 1 – minor importance but still included to pick up areas where Tammar are assumed to be but have not necessarily been sighted.

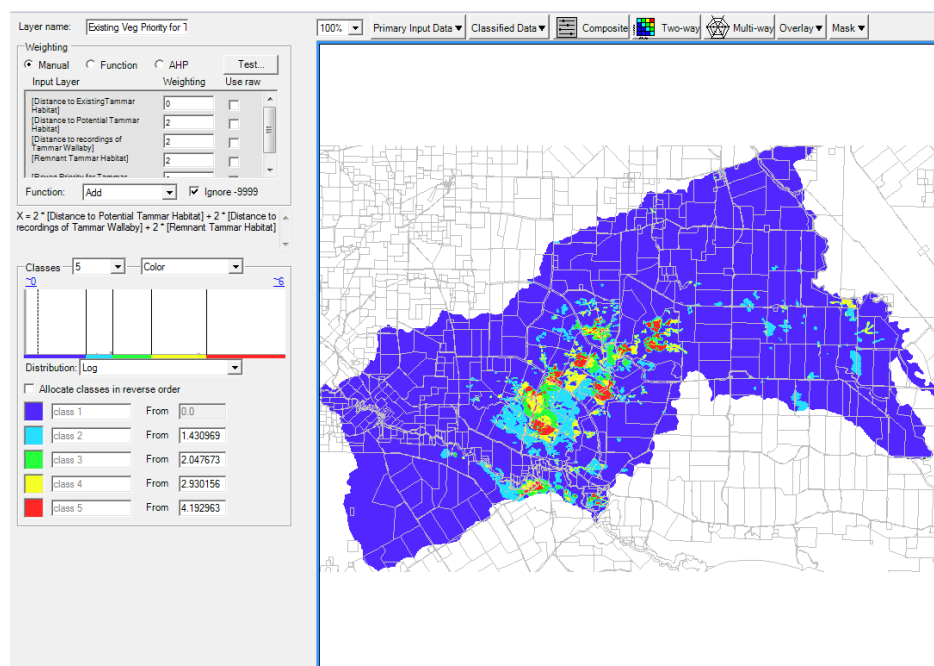


Figure 48 – Tammar Wallaby Component: Existing Vegetation Priority for Tammar Wallaby

4.6 Vegetation Priority

Masking

This component is intended to identify high values in remnant vegetation that is currently not protected, and therefore both vulnerable and potentially available for protection through covenanting, purchase or other mechanisms. All layers in this component are masked to show only areas with unsecure vegetation.

The model has three inputs:

- Conservation Value – value of each area of remnant vegetation for its own sake;
- Connectivity Value – value of remnant vegetation in a regional context; and
- Existing Vegetation Priority for Tammar – value of the remnant vegetation for conservation of a specific endangered species.

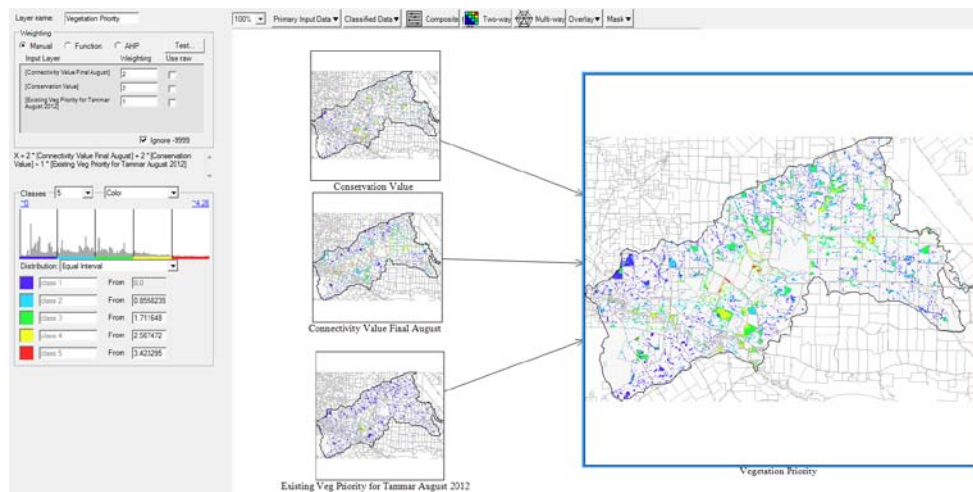


Figure 49 – Vegetation Priority Component Model

4.6.1 Input Layers

Connectivity Value

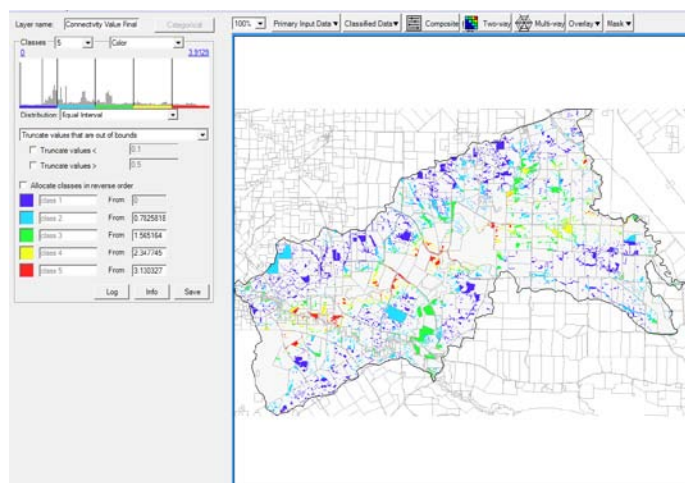


Figure 50 – Connectivity Value Composite Layer

Metadata

Connectivity Value

Description: Connectivity Value – August 2012

Custodian: GLink

Currency: 2012

Lineage: Composite Connectivity Value. Criteria sourced from Gondwana Link & partners as part of the FS Spatial Guide Project 2012.

Classification

Continuous data, classified into five equal interval classes – breaks are 0.78, 1.56, 2.34 and 3.13.

Conservation Value

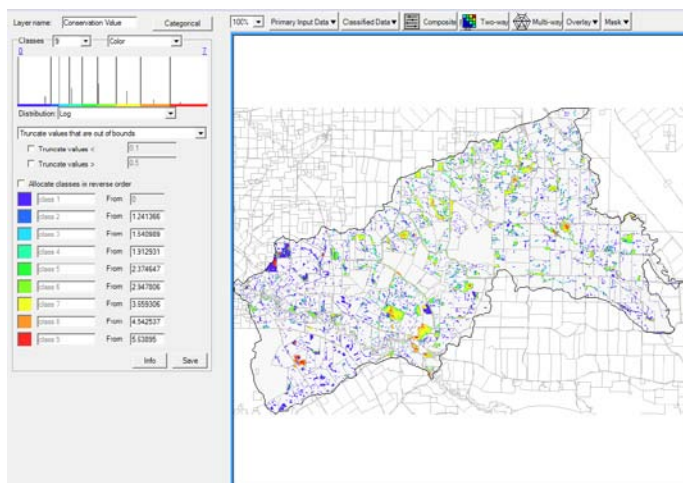


Figure 51 – Conservation Value Composite Layer

Metadata

Modeled Conservation Value

Description: Modeled Conservation Value of existing native vegetation

Custodian: GA

Currency: 2011

Lineage: Conservation Value of existing native vegetation modeled using VegModel2 (Neville 2009). Criteria sourced from GondwanaLink & partners. Note - the western portion of the FS area uses a modified method which lacks detailed veg mapping, although some detail has been added on Target veg species in terms of current proteaceous veg and Moort. This side of the coverage is less accurate and may not be directly comparable to the eastern side.

Classification

Continuous data, classified into 9 log classes.

Existing Vegetation Priority for Tammar

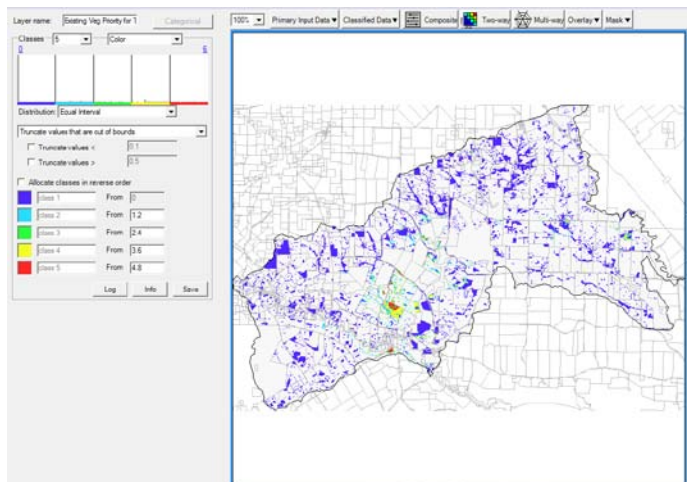


Figure 52 - Existing Vegetation Priority for Tammar Composite Layer

Metadata

Vegetation Priority for Tammar

Description: Vegetation Priority for Tammar – August 2012

Custodian: GLink

Currency: 2012

Lineage: Composite Value of existing native vegetation associations for Tammar Wallaby. Criteria sourced from Gondwana Link & partners.

Classification

Continuous data, classified into five equal interval classes – breaks are 1.2, 2.4, 3.6 and 4.8.

4.6.2 Output Composite - Vegetation Priority

The final output is masked to show only areas with unsecure vegetation, as this is the part of the landscape that this model is aimed at. Inputs are weighted as follows:

- Conservation Value – 2 (40%);
- Connectivity Value – 2 (40%); and
- Existing Vegetation Priority for Tammar – 1 (20%).

In simple terms, the model highlights all areas that have either good connectivity or good conservation value. Peak values are where these two inputs coincide.

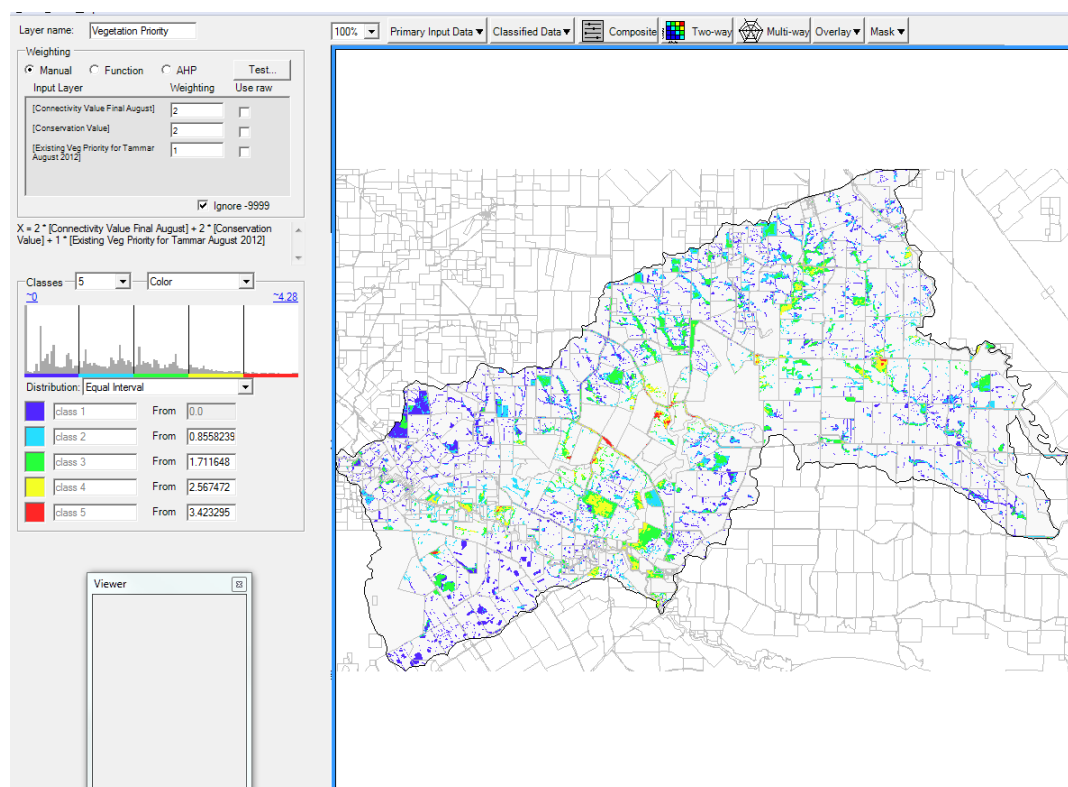


Figure 53 – Vegetation Priority Component: Existing Vegetation Priority

4.7 Revegetation Priority

This component is intended to identify cleared areas with high values for revegetation. All layers in this component are masked to show only areas that are cleared (no vegetation).

The model has four inputs:

- Connectivity Value – value of revegetation in a regional context;
- Past Proteaceous Vegetation – value of the revegetation for re-establishment of priority vegetation associations;
- Existing Vegetation Priority for Tammar – value of revegetation for conservation of a specific endangered species; and
- Riparian Revegetation Priority – value of revegetation for enhancement of ecological values in riparian zones and streams, as well as reduction of erosion and associated damaging impacts (such as nutrient run-off from farms).

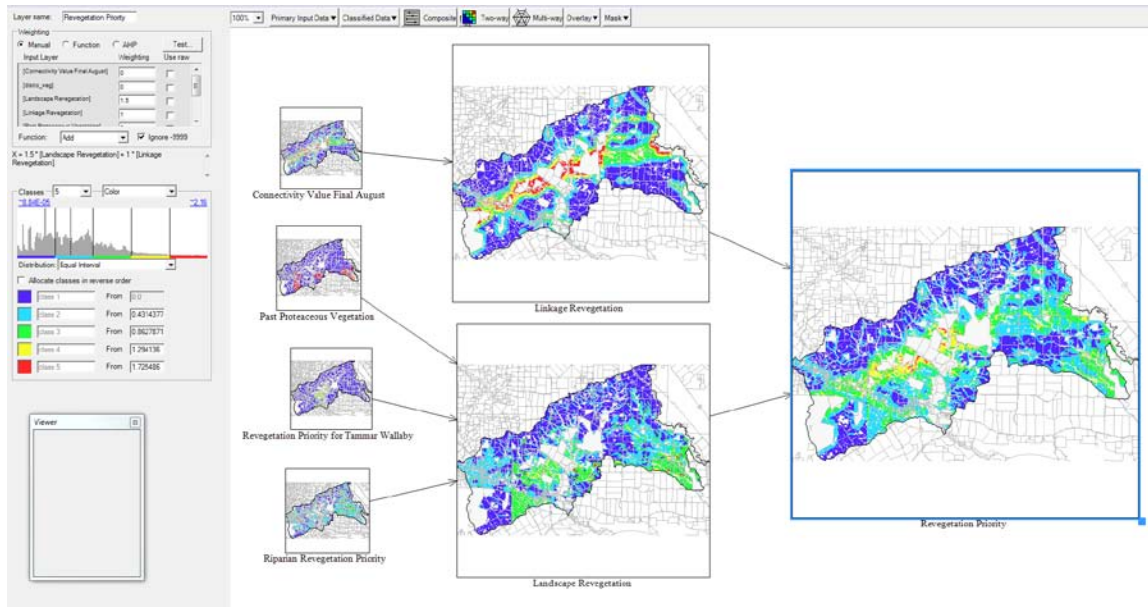


Figure 54 – Revegetation Component Model

4.7.1 Input Layers

Connectivity Value

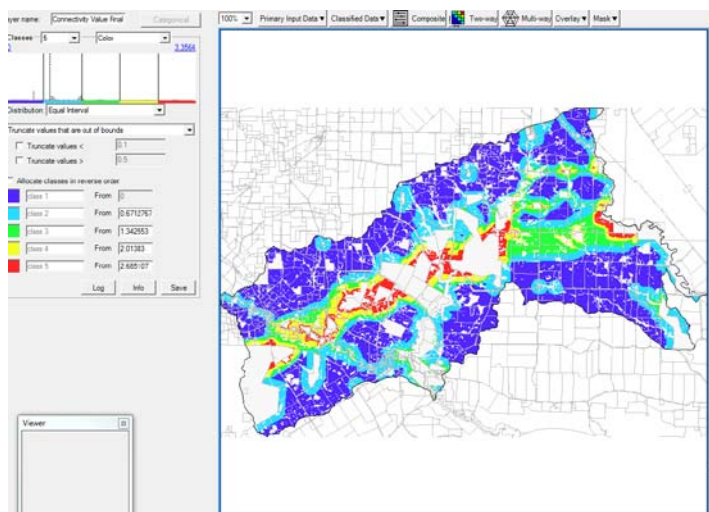


Figure 55 – Connectivity Value Composite Layer

Metadata

Connectivity Value

Description: Connectivity Value – August 2012

Custodian: GLink

Currency: 2012

Lineage: Composite Connectivity Value. Criteria sourced from Gondwana Link & partners as part of the FS Spatial Guide Project 2012.

Classification

Continuous data, classified into five equal interval classes – breaks are 0.67, 1.34, 2.0 and 2.68.

Past Proteaceous Vegetation

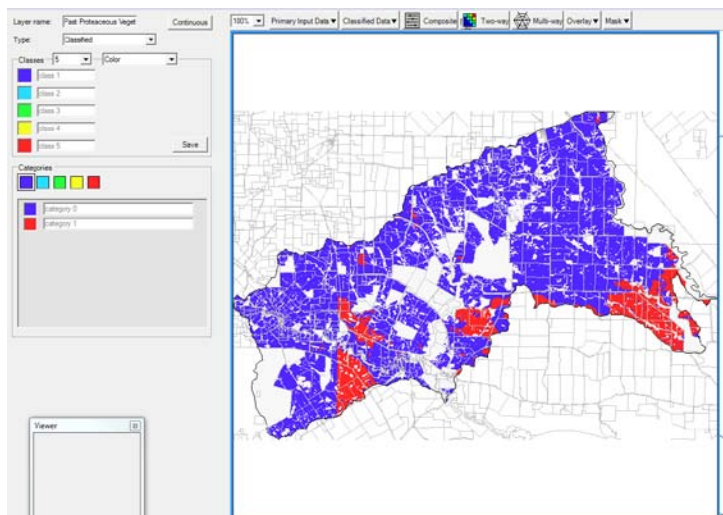


Figure 56 – Past Proteaceous Vegetation Layer

Metadata

Proteaceous Priority Associations

Description: Proteaceous Priority Associations based on Newby Historical Vegetation Mapping

Custodian: GLink

Currency: 2012

Lineage: Newby has mapped historical vegetation associations. This coverage identifies the association codes with proteaceous-rich communities: B. Attenuate, B. Verticillata, Banksia health, E. Phaenophylla & sand. Detailed mapping only covers the eastern 80% of the FS area.

Classification

Classified data with two categories (Proteaceous vegetation associations or no data). A value of 1 is given to Proteaceous vegetation.

Revegetation Priority for Tammar Wallaby

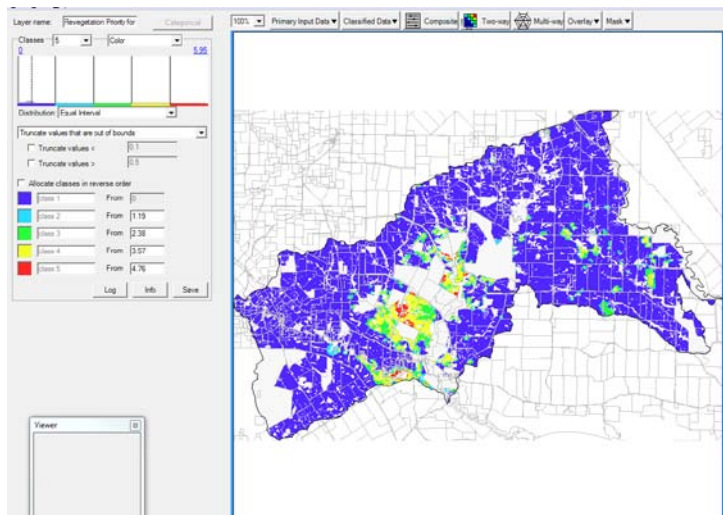


Figure 57 - Revegetation Priority for Tammar Wallaby Composite Layer

Metadata

Revegetation Priority for Tammar Wallaby

Description: Revegetation Priority for Tammar Wallaby

Custodian: Gondwana Link

Currency: 2012

Lineage: Gondwana Link Spatial Plan Component output

Classification

Continuous data, classified into five equal interval classes.

Riparian Revegetation Priority

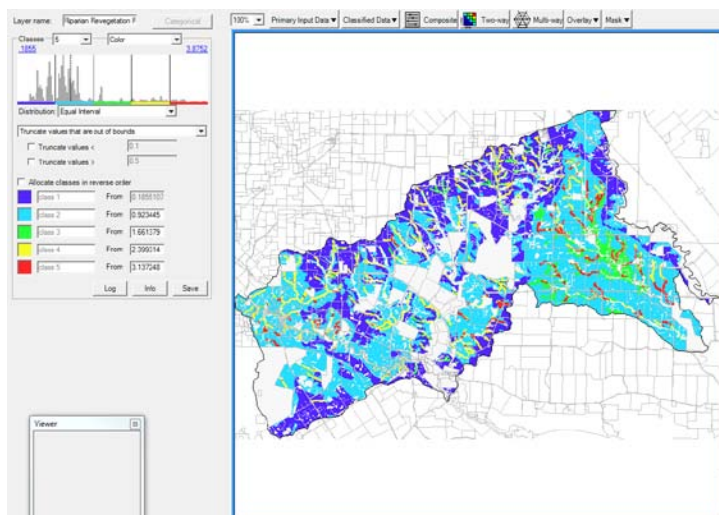


Figure 58 – Riparian Revegetation Priority Composite Layer

Metadata

Riparian Revegetation Priority
 Description: Riparian Revegetation Priority
 Custodian: Gondwana Link
 Currency: 2012
 Lineage: Gondwana Link Spatial Plan Component output

Classification

Continuous data, classified into five equal interval classes.

4.7.2 Interim Composite Layers

Linkage Revegetation

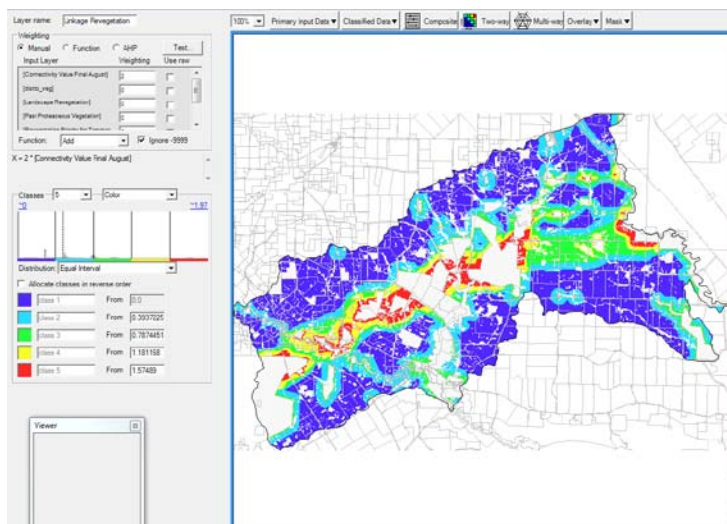


Figure 59 – Linkage Revegetation Composite Layer

Metadata

Linkage revegetation composite (derived directly from Connectivity Value layer).

Classification

Continuous data, classified into five equal interval classes.

Landscape Revegetation

Inputs are weighted as follows:

- Prior Proteaceous – 1 (33%);
- Revegetation Priority for Tammar – 1 (33%); and
- Riparian Revegetation Priority – 1 (33%).

All three of these inputs represent specific landscape-scale restoration objectives. The model highlights all areas that score well for each input, and peak values are where these objectives overlap.

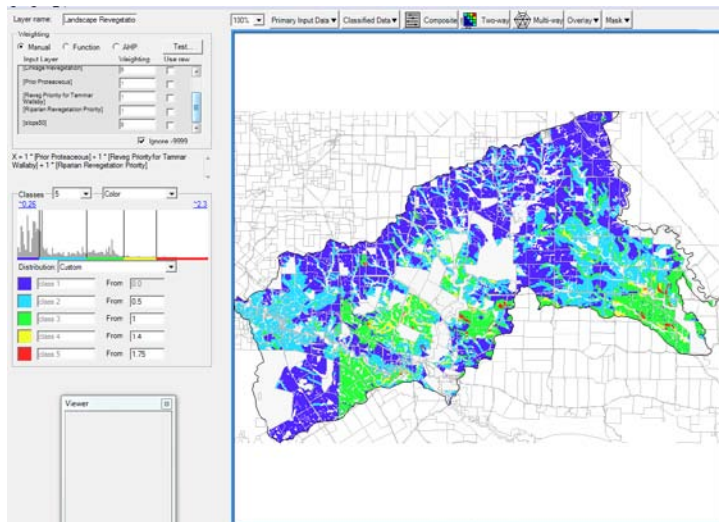


Figure 60– Landscape Revegetation Composite Layer

Metadata

Landscape Revegetation
Description: Landscape Revegetation Priority
Custodian: Gondwana Link
Currency: 2012
Lineage: Gondwana Link Spatial Plan Composite Layer

Classification

Continuous data, classified into five custom classes.

4.7.3 Output Composite – Revegetation Priority

The final output is masked to show only cleared land. Inputs are weighted as follows:

- Landscape Revegetation – 1.5 (60%); and
- Linkage Revegetation – 1 (40%);

The output highlights all areas that have either high restoration values, or will provide good connectivity. Peak values are where these two inputs coincide.

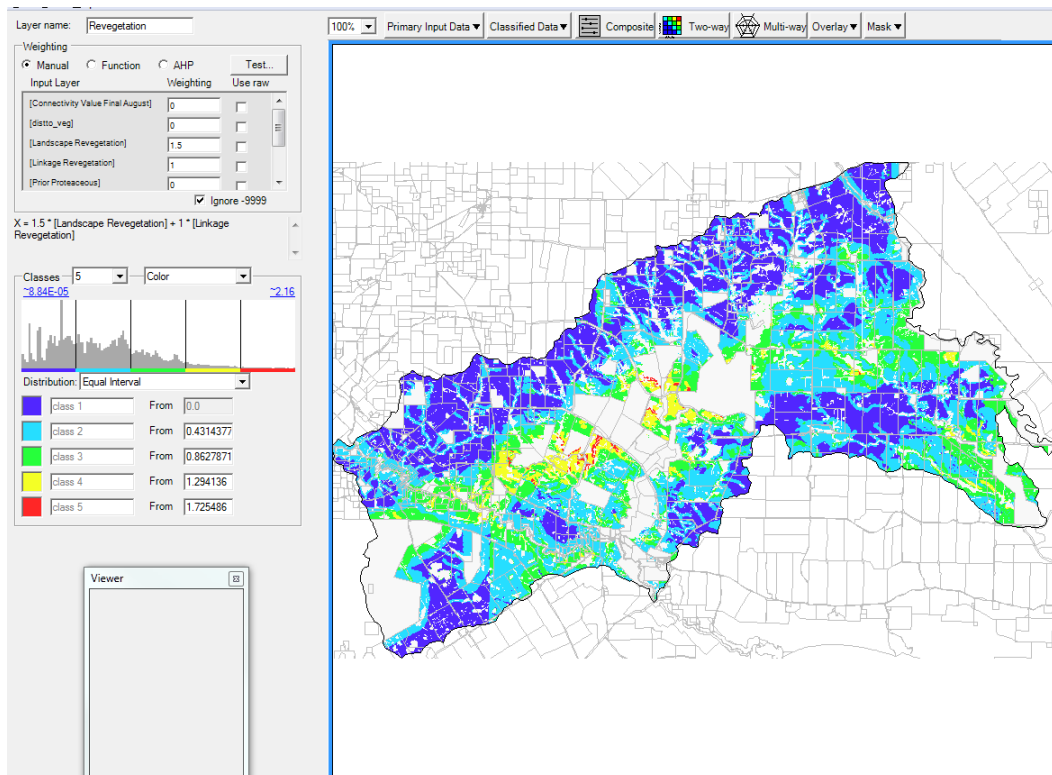


Figure 61 – Revegetation Priority Component: Revegetation Priority

5 Spatial Guide

The Spatial Guide map has been produced by combining the Vegetation & Revegetation priorities output, and overlaying shading to indicate the key areas for Proteaceous vegetation, Tammar Wallaby and riparian restoration. The map is shown in Figure 62 on the following page.

An ArcView map document was set up and the following layers added:

Spatial Plan MCAS Modeling Component Outputs:

- Vegetation Priority
- Revegetation Priority

Shapefiles showing Restoration Plan Priority Areas:

- Proteaceous Vegetation Priority vegetation types
- Tammar Wallaby Priority vegetation types
- Riparian Revegetation Zones – variable width buffers along streams.

Shapefiles of existing components of landscape conservation:

- Covenanted reserves (GLink)
- Vacant Crown Land
- Crown Reserves
- Existing Revegetation

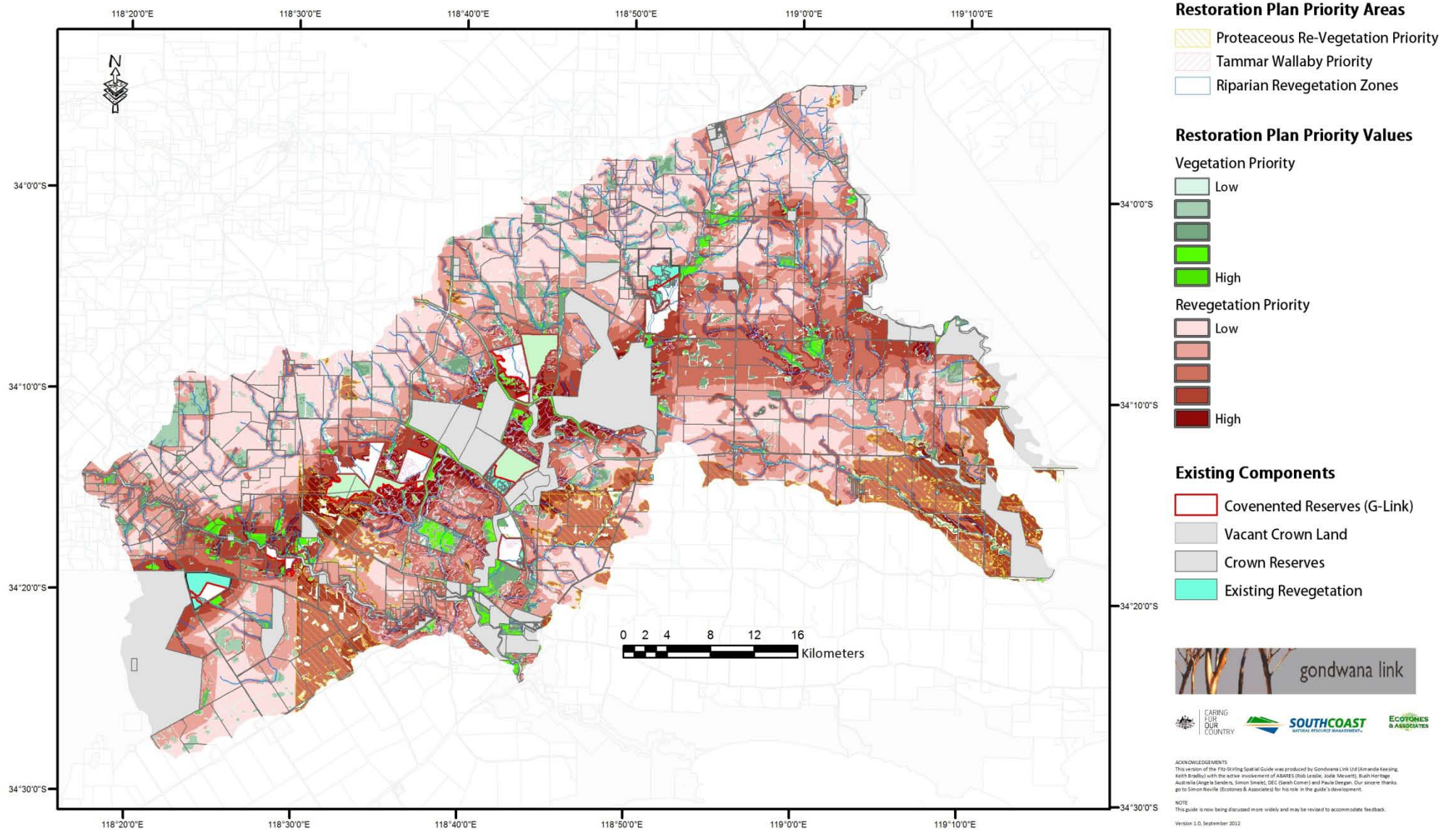
The two main model outputs – vegetation priority & revegetation priority – have been shaded to represent increasing priority with darker shades. The purpose of the plan is to aid – rather than direct – work in the areas of vegetation conservation (either through management or acquisition) and revegetation of cleared land. The map is designed to provide information that is simple and robust enough to give good direction on priorities, but still offer options if high priority targets (eg individual properties) are not available for works.

It should be noted that the map reflects the outcomes of the modeling carried out to date, and that changes to the models (in terms of input rating & weighting) are likely to shift the indicated priorities. This is possible if groups wish to re-cast priorities to better reflect their own priorities or understanding of the FS situation. The models used are completely transparent to allow such modification to be made if required.

Fitz-Stirling Section of Gondwana Link

Spatial Guide for the Functional Landscape Plan

Figure 62 – Spatial Guide for the Functional Landscape Plan



6 References

- ABARES (2011). Multi-Criteria Analysis Shell for Spatial Decision Support (MCAS-S): User Guide. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. www.abares.gov.au
- Austin, M.P.,(1983), Problems of Vegetation Analysis for Nature Conservation, in Myers, K., Margules, C.R. & Musto, I. (eds) Survey Methods for Nature Conservation, Proceedings of a Workshop, Adelaide, 1983
- Boteva, D., Griffith, G. and Dimopoulos, P. (2004). Evaluation and mapping of the conservation significance of habitats using GIS: an example from Crete, Greece. *Journal for Nature Conservation* 12 (2004) 237—250
- Margules, C. (1989) Introduction to some Australian developments in Conservation Evaluation. *Biological Conservation* **50** 1-11.
- Margules, C. and Usher, M.B. (1981) Criteria used in assessing wildlife conservation potential: A Review. *Biological Conservation* **21** 79-109.
- Margules, C.R. and Nicholls, A.O. (1988) Selecting Networks of Reserves to Maximise Biological Diversity. *Biological Conservation* **43** 63-76.
- Margules, C.R., Higgs, A.J. and Rafe, R.W. (1982). Modern Biogeographic Theory: Are there any Lessons for Nature reserve Design? *Biological Conservation* **24** 115-128
- Neville, S.D. (2009). Assessment of Conservation Value, Fitz-Stirling Area: Modeling report. Ecotones & Associates, William Bay WA.
- Panitsa. M, Koutsias, N, Tsiripidis, I, Zotos A. & , Dimopoulos, P. (2011). Species-based versus habitat-based evaluation for conservation status assessment of habitat types in the East Aegean islands (Greece). *Journal for Nature Conservation* 19 (2011) 269– 275
- Van Gool, D., Tille, P. and Moore, G. (2005). Land evaluation standards for land resource mapping: Guidelines for assessing land qualities and determining land capability in south-western Australia. Third edition. Resource Management Technical Report 29X, Department of Agriculture, Western Australia.