Reporting on Targets 2009

Native Vegetation Extent and Condition in NSW

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Contents

Glossary of Terms and Abbreviations

ALUM - National Australian Land Use and Management classification system

API – Aerial Photo Interpretation

CMA - Catchment Management Authority

DECCW - Department of Environment, Climate Change and Water

EVI - Enhanced Vegetation Index

FPC - Foliage Projected Cover

HCV - High Conservation Value

Indeterminate Vegetation - Land use mapping has been used to determine if vegetation is native, non-native or indeterminate. Indeterminate vegetation is therefore defined as areas of vegetation cover where the land use could not be used to assign a native or non-native tag (e.g. grazing lands where nativeness is unknown or areas of mixed land use such as schools, universities etc).

MER - Monitoring, Evaluation and Reporting

MODIS - Moderate Resolution Imaging Spectroradiometer

Native Vegetation - Land use mapping has been used to determine if vegetation is native, non-native or indeterminate. Native vegetation is therefore defined as areas of vegetation cover where the land use has been associated with native vegetation (e.g. conservation reserve, woodland and forest areas etc).

NDVI - Normalized Difference Vegetation Index

NLWRA - National Land and Water Resources Audit

Non-native Vegetation - Land use mapping has been used to determine if vegetation is native, non-native or indeterminate. Non-native vegetation is therefore defined as areas of vegetation cover where the land use has been associated with non-native vegetation (e.g. horticulture, orchards and plantation forest etc).

Non-woody Vegetation - All remaining vegetation not identified as woody by the SLATS process (ie less than the pre-defined FPC threshold for woody vegetation- currently <10% FPC).

NRC - Natural Resources Commission

PVP – Property Vegetation Plans

SLATS - State-wide Landcover and Trees Study

VAST - Vegetation Assets, States and Transitions methodology

Vegetation Condition - For this project a vegetation condition surrogate has been developed that aligns with the Vegetation Assets, States and Transitions (VAST) methodology developed by Thackway and Leslie. The VAST method orders vegetation by the degree of anthropogenic modification as a series of states, and was developed by DECCW by combining the National Australian Land Use and Management (ALUM) classification system categories mapped through the NSW Land Use Mapping Program with the extent of structurally intact native vegetation.

Woody Vegetation - Vegetation identified by the SLATS methodology as being woody. The SLATS process calculates the Foliage Projected Cover (FPC) values using several epochs of Landsat satellite imagery. Vegetation is considered woody when the FPC values for a pixel exceed a pre-defined FPC value. As the process is still being refined in NSW, several FPC values have been used to define woody vegetation in the past, including >10% FPC and >25% FPC. The current standard being used is >10% FPC.

Summary of Findings

Below the main findings of the report are summarised.

The following has been reported for the baseline and trend of **native vegetation extent:**

Baseline:

- NSW reported to the National Land and Water Resources Audit that the state, in 2004, contained 87% native vegetation
- The State of the Catchment reporting found that in 2006, NSW vegetation comprised 61% Native Intact Vegetation, 8% Native Derived Vegetation, 20% Native/Non-native Mosaic Vegetation and 11% Non-native/other Vegetation
- The State of the Catchment reporting found that in 2006 native woody vegetation covered 19-23% of the State
- The State of the Catchment reporting found that in 2006 native non-woody vegetation covered 40-64% of the State
- In 2008, an analysis of woody vegetation cover using a newly refined State-wide Landcover and Trees Study (SLATS) methodology found that NSW contained 37% native woody vegetation

Trend:

- The annual clearing of woody vegetation in NSW, measured using the SLATS methodology, has increased in the last four years, from 27,674 hectares in 2004/06 to 40,687 hectares in 2006/07 and 43,841 hectares in 2007/08
- Clearing associated with forestry activities has increased over the period 2004 - 2008, and while the total amount cleared is similar to that associated with cropping, pasture management and thinning over the period, there doesn't seem to be the same annual increase associated with these activities. The contribution of clearing for infrastructure remains relatively small
- Despite this, between 2002-2008 analysis using the SLATS methodology has shown that woody vegetation extent in NSW is stable (i.e. there is no significant increasing or decreasing trend in the extent of native woody vegetation in NSW)
- The ability to report on the trend in the extent of native non-woody vegetation, at the state scale, is not yet available, due to annual and seasonal changes to land use and management practice. The technology and methodology required to accurately map the trend of native non-woody vegetation is still being refined

The following has been reported for the baseline of **native vegetation condition**:

Baseline:

- The State of the Catchment reporting found that in 2006 NSW contained vegetation in the following surrogate 'condition' classes- 9% Residual Vegetation, 52% Modified Vegetation, 7% Transformed Vegetation, 19% Transformed/Replaced-Adventive Mosaic Vegetation, 12% Replaced-Managed Vegetation and 1% Removed

Trend:

- The trend in the state of native vegetation condition, in the defined states above, requires incremental assessment which has not yet been undertaken and therefore the trend in vegetation condition is not yet available

In addition, supporting information obtained from various sources has determined the following:

- That the area cleared under the *Native Vegetation Act 2003, Native Vegetation Conservation Act 1997* and the *Plantations and Reafforestation Act 1999* is significantly less than that conserved, managed or restored over the same period. For instance, in the period between January 2006 and June 2008 from a range of Government initiatives 3,654,264 hectares of vegetation were conserved, managed or restored, while only 8,923 hectares were approved to be cleared
- That analysis of the extent of Forest defined for the purposes of the Kyoto convention in NSW since 1977 shows a +0.05% increase in the extent of Forest in NSW between 2005/06
- That the amount of land held under Government tenure in a region is a strong influence on the potential change in the extent and condition of native vegetation

In general, the methodologies and data required to report on the baseline and trend of native vegetation extent and condition are still being refined. A series of interim data layers have been produced to report on the extent and trend of native vegetation, and this information, which is outlined in this report, represents the best available data at this point. As techniques and methods develop, the information for the baseline and trend of native vegetation extent and condition will continue to be refined for the state.

Executive Summary

The NSW Government has adopted 13 state-wide targets in the following themes; Biodiversity, Water, Land and Community. The targets aim to provide for healthy landscape functions and communities, and are embedded in the NSW State Plan. The Native Vegetation Target is one of the 13 state-wide targets, falling under the Biodiversity theme, and is as follows:

"By 2015 there is an increase in native vegetation extent and an improvement in native vegetation condition"

This report provides details on the state-wide data currently available to report on the baseline and trend of native vegetation extent and condition in NSW. To do this the project team has obtained and utilised existing information from a variety of sources, and verified the data has been created using consistent and valid methods. It is intended that this document will allow an assessment on the progress towards the state-wide native vegetation target using both direct evidence and other lines of evidence, where available. Several limitations were identified for both the project and the information collected, being:

- There is the possibility that the project team has not identified all data sets relevant to native vegetation extent in NSW, although the project team is confident that the data identified is the most accurate, current and highest resolution data available
- The methodologies, techniques and technology available to report on the extent and condition of native vegetation are constantly being refined. It is therefore possible that the results in this document will be updated with future analysis

Significant work has been completed by the Department of Environment, Climate Change and Water (DECCW) to produce the necessary information to assess progress towards the native vegetation target in NSW. While this work is on-going and continually being refined, the information being produced by DECCW is regarded as the best available state-wide data for the measurement of vegetation extent and condition, baseline and trend in NSW.

The analysis of the baseline for vegetation extent and condition has utilised several core data sets, including:

- Information on structurally intact vegetation generated by Keith and Simpson (2006)
- Delineation of woody and non-woody vegetation through an assessment of Foliage Projected Cover (FPC) using Landsat imagery and the State-wide Landcover and Trees Study (SLATS) methodology developed in Queensland
- Land use mapping to determine if vegetation is native, non-native or unknown (indeterminate)

Keith and Simpson (2006) amalgamated 42 existing vegetation survey data layers compiled between 1970-2005, ranking each based on currency and measures of accuracy (method of collection, amount of field verification etc). The layer provides the best information on structurally intact vegetation in NSW.

The SLATS process, developed by the Queensland Department of Natural Resources and Water (DNRW), examines Landsat imagery and calculates FPC values at a grid cell resolution of 25m. Where the FPC values cross a pre-defined threshold the vegetation is defined as woody, with all other vegetation assigned a non-woody classification. Initially the methodology utilised a very high FPC value of 25% to determine woody vegetation, due to only a small number of Landsat epochs being available for analysis. This FPC figure has since been reduced and the Woody Vegetation Change Monitoring Program (described below) now uses a threshold of approximately 10% FPC. The SLATS process does not determine whether the vegetation is native or non-native.

As the SLATS information does not determine vegetation nativeness, each of the 184 primary land use classes mapped by DECCWs Land Use Mapping Program (Emery et al, in prep) were assigned either native, non-native or indeterminate (unknown) categories after interpretation of the land use types. For instance, areas of forest and woodland were classified as native, areas of exotic plantation forest and horticulture were classified as non-native, and areas where nativeness could not be determined, such as grazing of non-woody vegetation, were classified as indeterminate.

These core data layers were utilised by several projects recently undertaken by DECCW to generate baseline information for vegetation extent and condition. The first of these was the Interim Native Vegetation Extent Project (2008- Version 1) (DECC 2008a), which provided information to the National Land and Water Resources Audit (NLWRA) on the amount of native woody and non-woody vegetation in NSW. A subsequent project, completed for the State of the Catchments Project (Dillon 2009) built on this work, generating a state-wide structurally intact native vegetation data layer and a state-wide vegetation condition surrogate data layer.

The extent of native woody and non-woody vegetation was generated using an interim SLATS woody/non-woody layer, produced using the 25% FPC threshold, combined with the nativeness information generated through the manipulation of land use mapping (Figure 1). This work was further refined to generate a structurally intact native vegetation layer by including the structural intact vegetation mapping completed by Keith and Simpson (Figure 2).

Figure 1: Core and derived data sets used to generate native woody/non-woody data layer (DECC 2008a)

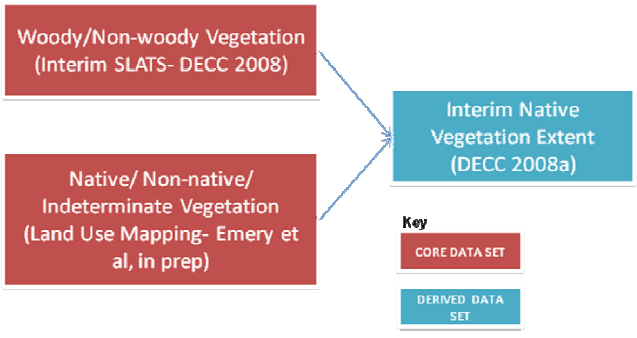
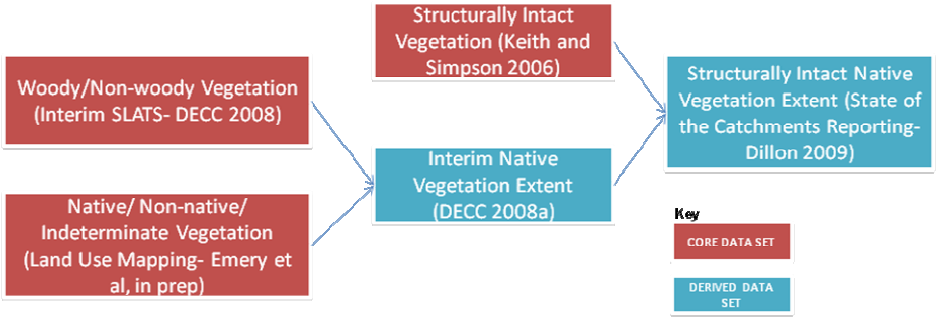


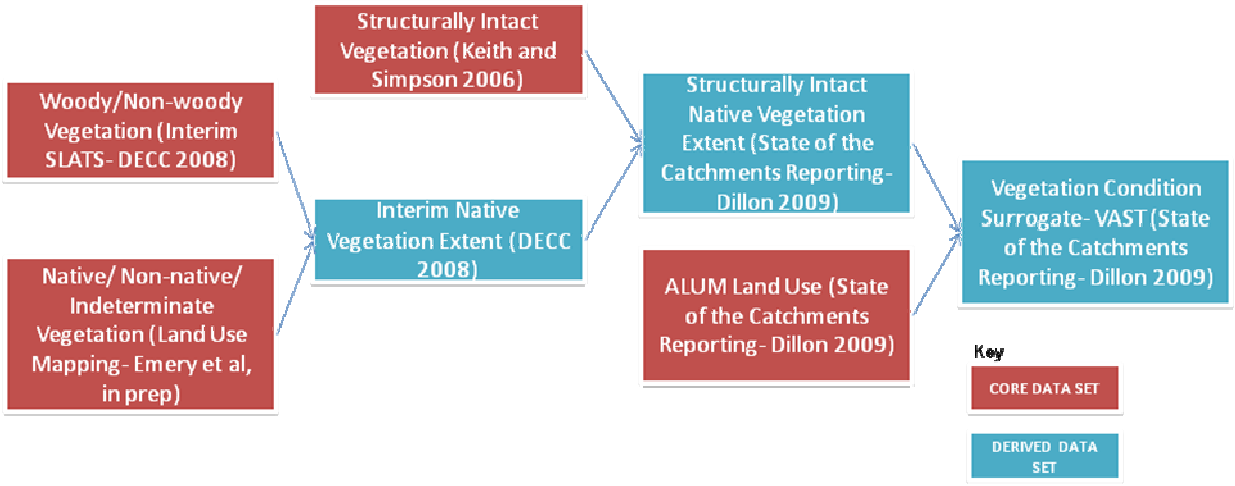
Figure 2: Core and derived data sets used to generate the structurally intact vegetation extent data layer



Due to the inherent difficulties in classifying and mapping vegetation condition across the entire state, the State of the Catchments Project produced a vegetation condition surrogate data layer for NSW. The layer created conforms with the Vegetation Assets, States and Transitions (VAST) methodology (Thackway and Leslie 2005, 2006 and 2008) and assigns a vegetation cover class based on the impacts of human land use and land management practises.

In order to generate this data the structurally intact native vegetation extent data layer described above was combined with the NSW merged land use data layer tagged using National Australian Land Use and Management (ALUM) classification system. Before the land use data layer was utilised it was updated to include more accurate information on NSW National Parks, State Forests and Travelling Stock Reserves (Figure 3). VAST categories were then allocated, based firstly on which vegetation extent category was assigned, and secondly which ALUM category was applied to the area.

Figure 3: Core and derived data sets used to generate the vegetation condition surrogate data layer (VAST)



There are several significant limitations to the creation of the vegetation baseline data layers outlined above. Firstly, several of the input data sets, such as the SLATS and land use data, were not complete or were interim products at the time these projects were completed. As these data sets form the basis of all layers produced, their inherent limitations are carried through the entire data creation process, potentially causing an underestimation of woody vegetation or an error in the allocation of nativeness information. In addition, the land use map generated by the Land Use Mapping Program was not developed specially for the purpose of assigning condition classes, however combined with vegetation extent it provided the best available state-wide data set with which to generate this information.

In order to monitor native vegetation extent trend several programs have been developed by DECCW. These include programs to monitor both woody and non-woody vegetation. Woody vegetation trend is monitored by the Woody Vegetation Change Monitoring Program, which uses the SLATS methodology to detect changes in woody vegetation, above approximately 10% FPC, on an annual basis. The process to monitor non-woody vegetation trend is currently being finalised by DECCW, and utilises Moderate Resolution Imaging Spectroradiometer (MODIS) vegetation indices to generate a 250m resolution layer of native and non-native non-woody vegetation cover which can then be used to monitor change.

The most accurate and up-to-date information available to this report was generated by the Woody Vegetation Change Monitoring Program in 2008. This recent SLATS analysis, using an FPC threshold of approximately 10% to detect woody vegetation, determined that NSW, in 2008, contained 37% native

woody vegetation cover. Although the SLATS analysis, as discussed above, does not identify whether the vegetation is native or non-native, evidence suggests only a very small amount of NSW contains non-native woody vegetation (0.5% of the state) making the figure of 37% produced by the SLATS analysis relatively accurate at the state-wide scale. Direct comparison of this figure with the figures produced as part of the Interim Native Vegetation Extent Project (2008- Version 1) and State of the Catchments Project (Dillon 2009) cannot be made due to the differences in the FPC value utilised (10% versus 25%).

The most accurate vegetation trend information available was also provided by the Woody Vegetation Change Monitoring Program. The program is currently able to calculate the loss of woody vegetation, for each CMA and the state, for the periods 2004-2006, 2006-2007 and 2007-2008 using Landsat imagery and the SLATS methodology. Work is continuing to generate this information back to 1988.

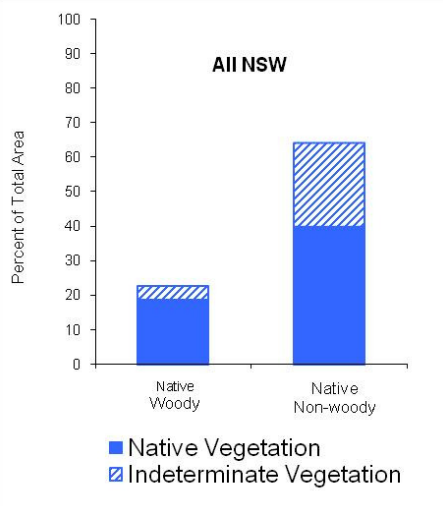
In total 112,175 hectares of woody vegetation were removed between 2004-2008 through a series of changed land uses and management practices including cropping, pasture and thinning, infrastructure and forestry. A further 210,523 hectares were removed through fire. The data produced provides some evidence that the annual clearing of woody vegetation in NSW has increased in the last four years, from 27,674 hectares in 2004/06 to 40,687 hectares in 2006/07 and 43,841 hectares in 2007/08. Despite this, and although DECCW are not able to specifically quantify the amount, or location, of woody vegetation regeneration at this stage, statistical analysis of the FPC data for the period 2002-2008 has determined that, on a state-wide basis, there is no significant increasing or decreasing trend in the extent of native woody vegetation. That is, it appears that although the clearing of woody vegetation has increased, the regeneration of woody vegetation has also increased to match the loss of woody vegetation.

While the information presented above has used a more refined SLATS product than that used by the Interim Native Vegetation Extent and State of the Catchments Projects, the findings of these projects still provide important contextual information for the state. The Department of Environment, Climate Change and Water (DECCW), through work completed by the Interim Native Vegetation Extent Project (2008- Version 1) (DECC 2008a), reported to the NLWRA that NSW contained 69,980,691 hectares of native vegetation, representing 87% of the state. This information was further refined by the State of the Catchments Project which found that, in 2006, NSW contained (Figure 4):

- 19-23% native woody vegetation
- 40-64% native non-woody vegetation

The range of figures presented for both the native woody and native non-woody vegetation (hatched areas in graph) represent the area of indeterminate (unknown nativeness) vegetation mapped in NSW. This indeterminate category was assigned to vegetation where the land use data layer could not be used to determine if vegetation was native or non-native, and demonstrates the difficulty of assigning nativeness from land use mapping across the state.

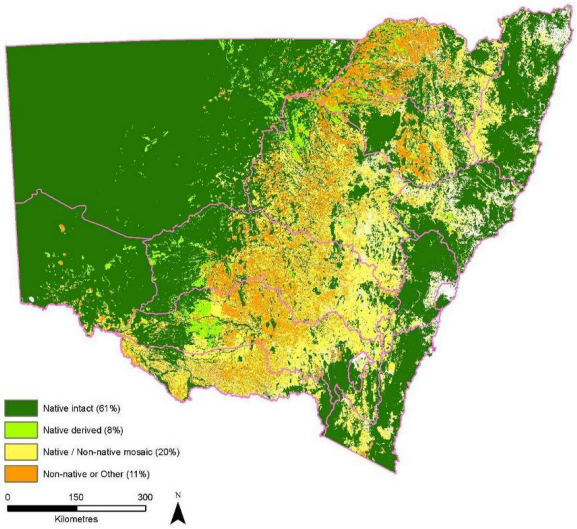
Figure 4: Amount of native woody and non-woody vegetation in NSW in 2006



The measure of structurally intact native vegetation was undertaken through the State of the Catchment Reporting Project and built on work completed by the Interim Vegetation Extent Project. It found that in 2006 NSW contained (Figure 5):

- 61% Native Intact Vegetation
- 8% Native Derived Vegetation
- 20% Native/Non-native Mosaic Vegetation
- 11% Non-native/other Vegetation

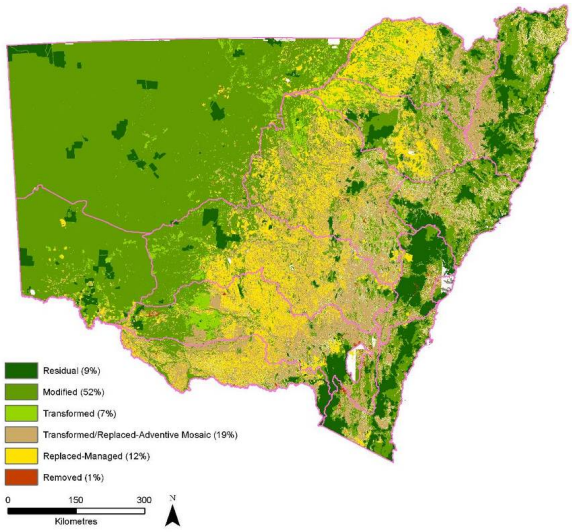
Figure 5: Vegetation extent within NSW and the 13 Catchment Management Authority Regions (From Dillon et al 2009)



The results of the vegetation condition surrogate mapping (VAST), undertaken as part of the State of the Catchments reporting, found that, in 2006, NSW contained (Figure 6):

- 9% Residual Vegetation
- 52% Modified Vegetation
- 7% Transformed Vegetation
- 19% Transformed/Replaced-Adventive Mosaic Vegetation
- 12% Replaced-Managed Vegetation
- 1% Removed.

Figure 6: Vegetation condition states within NSW and the 13 Catchment Management Authority regions (From Dillon et al 2009)



An incremental assessment of vegetation condition trend, using the VAST surrogate described above, would be technically possible however has not yet been completed. Although additional methodologies are also currently being trialled to monitor the trend of vegetation condition at a local and regional level (e.g. site vegetation condition assessments and derived vegetation condition surfaces) these programs are not yet able to report on the trend of vegetation condition at the state scale.

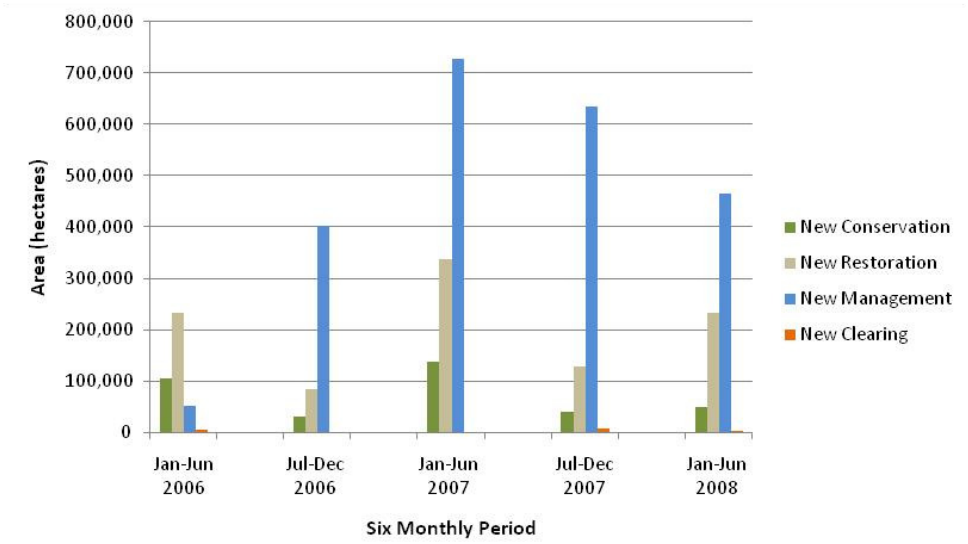
A method to monitor the trend of native non-woody vegetation, using MODIS data, is currently being finalised. Due to the developmental nature of this process, the on-going refinement of the methodology and the dynamic nature of grassland systems (that is the frequent change from native grassland to cropping and return to native vegetation), a state-wide assessment of native non-woody vegetation trend is not possible at this time.

Additional evidence was sought from alternative sources to provide other lines of evidence. The Native Vegetation Report Cards provide a regular reporting framework to outline the conservation, restoration and revegetation, management and clearing of vegetation in NSW. The data contained in the report card provides some evidence that since the introduction of the *Native Vegetation Act 2003*, the amount

of conservation actions being undertaken across the state, such as the dedication of new reserves, Property Vegetation Plan (PVP) incentive payments and other conservation programs, is far greater than the broad scale clearing approved under the *Native Vegetation Act 2003* for the same period (Figure 7). For instance, in the period between January 2006 and June 2008 under various Government initiatives 3,654,264 hectares of vegetation were conserved, managed or restored, while only 8,923 hectares were approved to be cleared under the *Native Vegetation Act 2003, Native Vegetation Conservation Act 1997* and the *Plantations and Reafforestation Act 1999*.

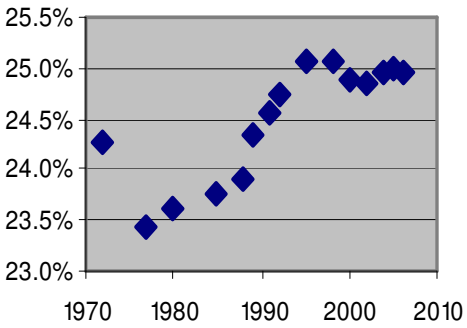
It is important to note that this vegetation clearing figure is significantly less that the amount of woody vegetation clearing identified by the Woody Vegetation Change Monitoring Program. This is due to the Native Vegetation Report Cards only capturing the native vegetation approved to be cleared under the under the three Acts referred to above, whereas the Woody Vegetation Change Monitoring Program captures all woody vegetation clearing. Clearing under the *Native Vegetation Act 2003* in NSW represents only a small proportion of all clearing conducted in the state.

Figure 7: Area of native vegetation that has been conserved, restored/revegetated, managed and approved for clearing in NSW from 1 January 2006 to 30 June 2008. Adapted from DECC 2008b



Forest change estimated by the Australian Government as part of the Greenhouse Gas initiatives also provides additional evidence on the status of vegetation extent and trend in NSW (Figure 8). The change and distribution of 'Kyoto Forest' was examined for NSW between 1972 and 2005-06. It was found that NSW recorded a +0.05% change in Kyoto Forest in the period 2005/06 (i.e. an increase in Kyoto Forest woody vegetation cover). (Work presented to the 2008 Vegetation Futures Conference, by Sue McIntyre and Richard Thackway).

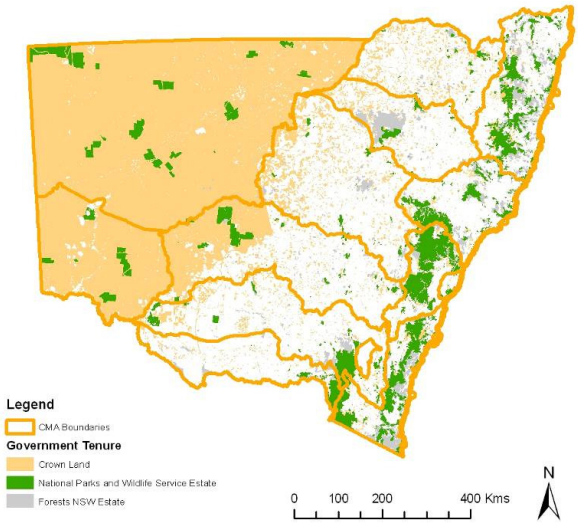
Figure 8: Percentage of NSW with Kyoto forest cover 1972 to 2006 (McIntyre and Thackway 2008)



Finally, the land tenure in NSW, particularly the government land holdings of National Parks and Wildlife Estate, Forests NSW and leasehold Crown lands, were analysed for each CMA and compared

to the vegetation extent and condition results for each CMA (Figure 9). It was found that, in general, CMAs with a high proportion of remaining vegetation extent, and good vegetation condition, contained a higher amount of land held within government tenure. Therefore, in the rangelands where the land tenure is generally leasehold, the dominant land use is not changing and it may be assumed that the extent of native vegetation will also not change. There may be a change in vegetation condition, however, due to changed management practices.

Figure 9: Distribution of government tenure in NSW



Several case studies are also presented to highlight the on-going work within CMA regions that will provide, in the future, more accurate, fine scale data to report on the baseline and trend of native vegetation extent and condition. This fine scale data, which will be used by the CMAs to monitor their performance, may also provide vital information to help improve the accuracy of the state-wide mapping programs. The case studies contain:

- Newly generated data for woody native vegetation clearing demonstrating that woody vegetation clearing within the Border Rivers-Gwydir (BRG) CMA region rose by a very small amount (0.03% to 0.22%) between 2004/06 and 2006/08
- Analysis and assessment of MODIS data, using newly created techniques which are still to be finalised, demonstrating the highly variable nature of the non-woody system, with non-woody cover fluctuating widely through various seasons and years
- A vegetation condition surface layer generated as part of the High Conservation Value Vegetation Project in the BRG CMA region that provides more accurate data on vegetation condition within the CMA than other information currently available at the state-wide scale
- Information on the development of a composite Aerial Photo Interpretation (API) vegetation layer, Conservation Strategy and rapid riverine vegetation condition assessment for the Namoi CMA
- Information on the process to capture and monitor site based vegetation condition information, within the Murray CMA. It is hoped this process will, in time, provide site, local and regional information of vegetation condition trend in the Murray CMA.

In summary, with the information available at this point, it is not possible to report progress towards the whole of the Native Vegetation Extent & Condition target. However, using recent progress made by DECCW and CMAs, it is now possible to report that:

- The most accurate information available has been produced by the Woody Vegetation Monitoring Program in 2008, and includes information on the extent and trend of woody vegetation
- A baseline in 2006 for native woody and non-woody vegetation extent and condition is established
- The Woody Vegetation Monitoring Program has identified an increase in the clearing of woody vegetation between 2004 and 2008
- Statistical analysis undertaken by the Woody Vegetation Monitoring Program indicates native woody vegetation extent has not changed significantly across the state between 2002-2008 (i.e. regeneration of woody vegetation appears to be matching the increased woody vegetation clearing rate)
- The change in non-woody native vegetation extent varies with land use and management practice in many parts of the state and cannot be determined at this time. Advances in remote sensing technology will likely increase the ability to monitor these changes and hence the area of native vegetation with continued investment
- The change in native vegetation condition cannot be determined at this point in time but with continuing work undertaken by DECCW and CMAs the ability should be demonstrated in the near future.

1 Introduction

1.1 STATE-WIDE TARGETS

The NSW Government has adopted 13 state-wide targets in the following themes:

- Biodiversity
- Water
- Land
- Community

The targets, which are contained in a document titled 'The Standard and Targets' (NRC 2005) aim to provide for healthy landscape functions and communities, and are embedded in the NSW State Plan.

The Native Vegetation Target is one of the 13 state-wide targets, falling under the Biodiversity theme. The target is as follows:

"By 2015 there is an increase in native vegetation extent and an improvement in native vegetation condition"

The native vegetation target has been selected as the basis of this report as, in the option of DECCW representatives and the project team, the data available for this target is the most comprehensive and allows the reporting of baseline, and some trend information.

1.2 PROJECT BACKGROUND AND PROCESS

This report represents the first attempt to report on a state-wide target under the NRC's 'Reporting on Targets 2009' Project. The Reporting on Targets 2009 Project forms part of the NRC's Strategic Plan (2009-2012) and feeds into the NRC Mid-term review. The native vegetation state-wide target has been selected as the first target the project will report on.

To report on the native vegetation target the project team has utilised existing information obtained from a variety of sources, and verified that the data has been created using consistent and valid methods. The project has not generated or analysed data layers in its own right, but has relied on building strong and robust relationships with DECCW (NSW), the Native Vegetation Monitoring, Evaluation and Reporting (MER) Theme Team and other state and federal government agencies to collect the required information.

This report outlines the most comprehensive information on the baseline and trend of native vegetation extent and condition in NSW currently available. It is intended that this document will allow an assessment on the progress towards the state-wide native vegetation target for both extent and condition, using direct evidence, and where available, other lines of evidence to support those decisions. Where sufficient data may not be available case studies have also been provided to highlight new and on-going work being undertaken in some parts of the state that will improve the ability to report on the native vegetation target in the future. The methodology used to report on the baseline and trend

of vegetation extent and condition is provided below, along with the results of the analysis and associated references.

This project also provides an example for potential future projects to be undertaken as part of the Reporting on Targets 2009 Project. The following process was used to collect the required information, validate the existence of the information and produce this report:

1. Initial meeting with DECCW to select target for reporting
2. Project team meeting to determine scope of project and project timing
3. Workshop with key agency representatives, including appropriate MER Theme Team members and DECCW staff, to identify key data sets and sources of information
4. Data audit and review of information provided by MER Theme Team and DECCW. Further data search to identify other sources including federal and state government agencies
5. Production of a report documenting data available, analysis undertaken, results of analysis and information on the baseline and trend, data availability and management and access to data
6. Review of collected materials, report and presentation by an Expert Panel. The Expert Panel is to determine the progress towards the Native Vegetation target in NSW
7. Production of a 4 page summary, and 1 page fact sheet, highlighting key points

1.3 DATA MANAGEMENT AND GOVERNANCE

The information and data collected to report on the baseline and trend of native vegetation extent and condition has predominantly been supplied by the NSW Department of Environment, Climate Change and Water (DECCW), particularly the MER Theme Team members. As the reporting process is required to continue at regular intervals in the future, for yearly reporting, State of the Environment reporting and State Plan purposes, it was necessary for the project team to ensure all data and information supplied was collected consistently using repeatable methods, is stored centrally with a regular backup regime, and is accessible (with the appropriate permissions).

The availability of the underlining data and associated management and custodial arrangements were discussed with the relevant DECCW staff in various locations. Appendix 1 provides information for each core data set, including:

- Data set name and project source
- Metadata ANZLIC reference and internet address
- Further reference information
- Contact person
- Corporate management status

1.4 POTENTIAL LIMITATIONS IN THE REPORTING PROCESS

There are several limitations in the reporting of the Native Vegetation state-wide target that are outlined below:

- Although every effort has been made to identify all data sets relevant to the assessment of native vegetation trend and condition, both through DECCW, the MER Theme Team and other state and federal agencies, there is the possibility that some data may not have been identified and considered. The project team is confident, however, that the data that has been identified and reported on below is the most accurate, current and highest resolution data available to report on native vegetation extent and condition baseline as well as trend for the state of NSW.
- The methodologies, techniques and technology available to report on the extent and condition of native vegetation in NSW are constantly changing, as methodologies are adapted and improved and technology, such as satellite imagery and analysis techniques, becomes more sophisticated. This report represents a snapshot in time and documents the data currently available. As work continues, particularly by the Native Vegetation MER Theme Team, data available will be updated and refined. Any results of future analysis will update the figures recorded in this document.
- The ability to report on the native vegetation extent and condition target will depend on receiving up-dated data and information from a variety of sources (and possibly other thematic programs (e.g. land use mapping, land tenure updates)). Therefore the reporting frequency and ability to monitor and report trends from a scientific point of view may not always correspond with legislative and policy reporting timetables. The optimal time to report on each aspect of extent and condition (e.g. native woody vegetation, native non-woody vegetation and vegetation condition) will differ depending on the methodology used and the natural fluctuations in the environment. Appendix 2 outlines a proposed reporting schedule for the native vegetation target.

2 Methods

Significant work has been completed by the Department of Environment, Climate Change and Water (DECCW), and the Native Vegetation Monitoring, Evaluation and Reporting (MER) Theme Team, to measure native vegetation extent and condition in NSW. This work, which is on-going and continually being improved, has produced information regarded as the best available state-wide estimate of native vegetation extent and condition at present, and continued refinement of the methodologies applied is expected to improve the products and outputs over time.

Each of the core programs and data sets, and the derived outputs from analyses undertaken, are described below for the generation of baseline and trend information for native vegetation extent and condition in NSW. The results of the analysis described below are outlined in Section 3.

2.1 NATIVE VEGETATION EXTENT BASELINE

Information on the extent of native vegetation in NSW has been generated through the combination of a variety of core data sets under various programs and projects. The analysis conducted has utilised existing data layers to obtain information on the structural 'intactness' of vegetation in NSW, the woody and non-woody extent of vegetation and the 'nativeness' of vegetation.

2.1.1 Core Data Sets

Several core data sets have been utilised to generate information on native vegetation extent in NSW. These data sets include:

- Information on the structural 'intactness' of vegetation produced by Keith and Simpson
- Delineation of woody and non-woody vegetation through the State-wide Landcover and Trees Study (SLATS) process
- The manipulation of land use mapping to determine if vegetation is native, non-native or unknown (indeterminate)

Each of these core data sets is described below.

NSW Structurally Intact Native Vegetation (Keith and Simpson)

Keith and Simpson amalgamated 42 existing vegetation survey data sets captured between 1970 and 2005, which were merged based on the highest level of currency and reliability (Keith and Simpson 2006, 2008). Complete coverage of NSW and the ACT was achieved with a grid cell size of 250m, with the most accurate data sets replacing less accurate data sets where overlaps between the data sets occurred. The data produced through this project is considered to be the best available mapping of structurally intact native vegetation across NSW, and is considered current till the year 2006 (Figure 10).

Although the best available information of this type, Keith and Simpson do acknowledge that gaps in the coverage exist, particularly for the north coast, northern and central tablelands, and parts of the western slopes and plains. Figure 11 identifies the quality of the input data available.

Figure 10: Keith and Simpson structurally intact native vegetation

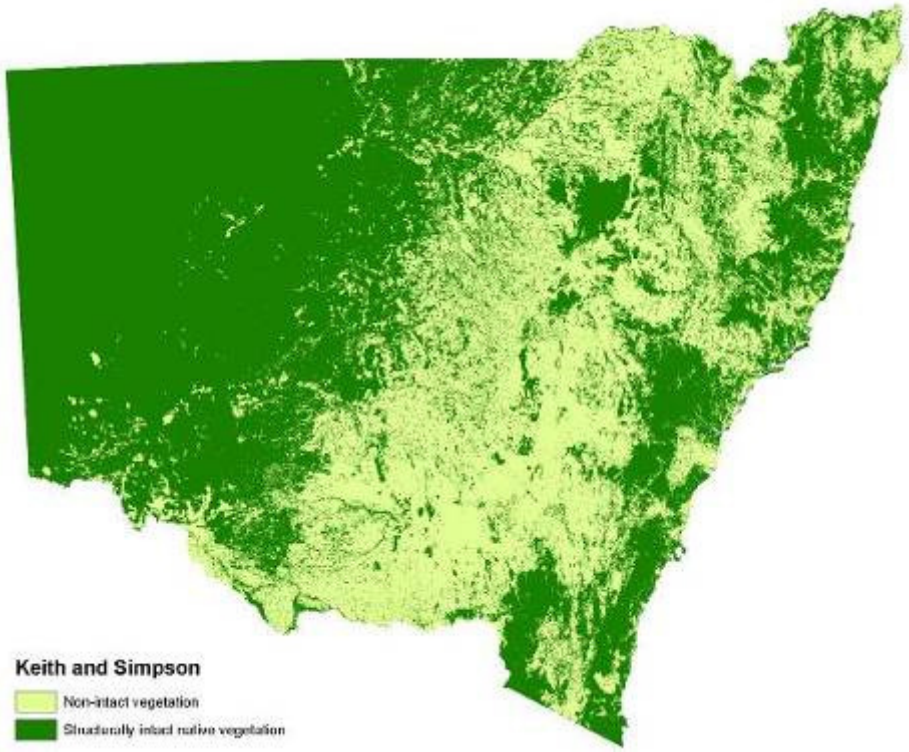
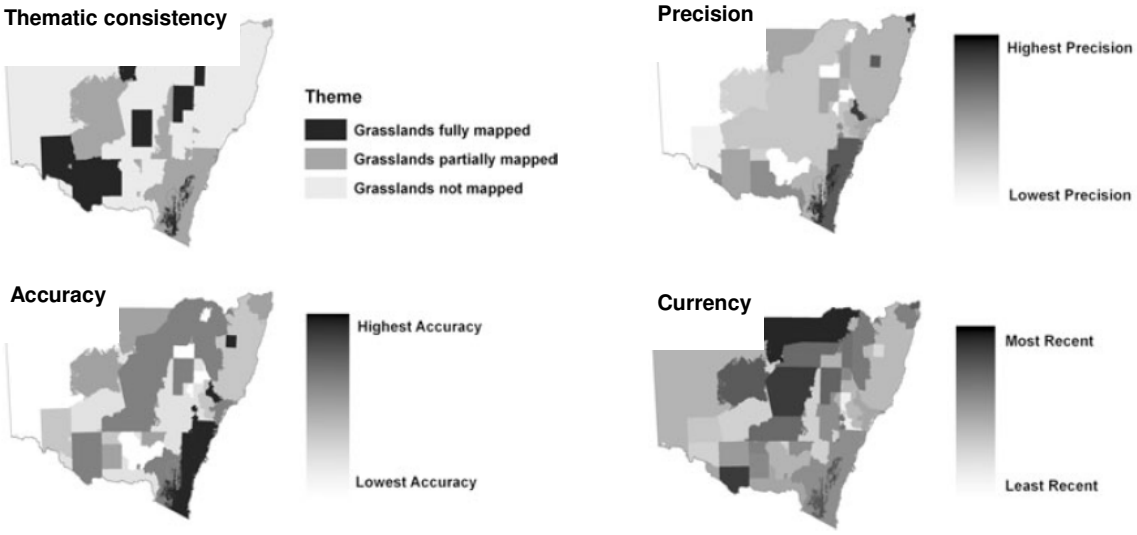


Figure 11: Keith and Simpson accuracy assessment



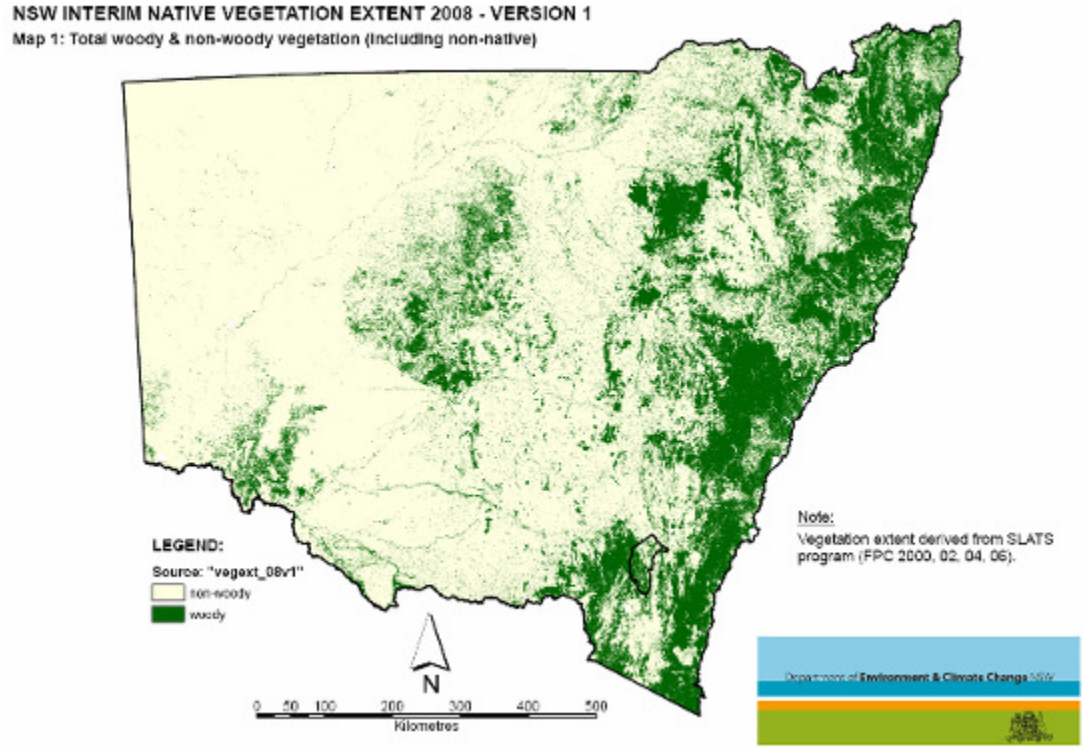
State-wide Landcover and Trees Study (SLATS)

The State-wide Landcover and Trees Study (SLATS) methodology, developed by the Queensland Department of Natural Resources and Water (DNRW, 2007), uses Landsat TM and ETM satellite imagery to determine the extent of woody vegetation. The process calculates Foliage Projected Cover (FPC) values at a grid cell resolution of 25m, with woody vegetation identified where the FPC values for a location cross a pre-defined threshold.

The SLATS method is being continually refined and improved in NSW as part of the Woody Vegetation Change Monitoring Program, and as such several different FPC values have been utilised to define woody and non-woody vegetation across the state at different times. Recent SLATS analysis has used an FPC value of >10% to distinguish between woody and non-woody vegetation. This compares to an earlier interim FPC threshold of >25% (Figure 12) which was used in the development of the Interim Vegetation Extent data layer produced by DECCW in 2008. The SLATS process does not determine whether the vegetation identified is native, with the use of the FPC threshold simply identifying vegetation as woody or non-woody, however the amount of non-native woody vegetation in NSW is estimated to be less than 0.5% of the state, ensuring that most of the woody vegetation identified by the SLATS process is native.

The NSW SLATS process currently relies on Queensland field surveys and desktop analysis to calibrate and validate the results of the analysis. Plans are currently being developed to undertake a comprehensive field validation and calibration exercise for the NSW SLATS program, from which further refinements to the FPC threshold may be applied.

Figure 12: Woody/non-woody vegetation developed through the NSW Interim Native Vegetation Extent 2008 Project (DECC 2008)



Land Use

As the SLATS process does not identify the vegetation as native or non-native, an alternative way to determine vegetation 'nativeness' is utilised by DECCW. The Land Use Mapping Program (Emery et al, in prep) has mapped land use, at varying scales, across NSW. This land use information has been converted to one of three categories, including native, non-native or indeterminate, after interpretation of the 184 primary land use types (DECC 2008a). For instance, areas of forest and woodland were classified as native, areas of exotic plantation forest and horticulture were classified as non-native, and areas where nativeness could not be determined, such as grazing of non-woody vegetation, were classified as indeterminate. Additional information on the categorisation of each land use category is contained in Appendix 3.

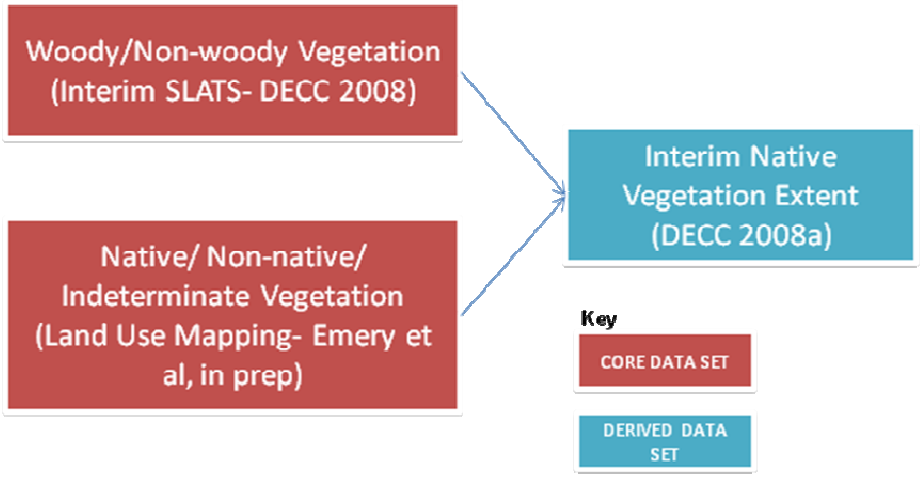
2.1.2 Derived Data Sets

Several projects have been undertaken recently by DECCW to determine the extent of native vegetation in NSW. The first of these, the Interim Native Vegetation Extent Project (2008 - Version 1) was undertaken to report to the National Land and Water Resources Audit (NLWRA) on the extent of native vegetation in NSW. More recently, DECCW has undertaken further work to refine the interim products for the State of the Catchment report cards (Dillon et al 2009). These processes, and the data produced, are described below.

Interim Native Vegetation Extent

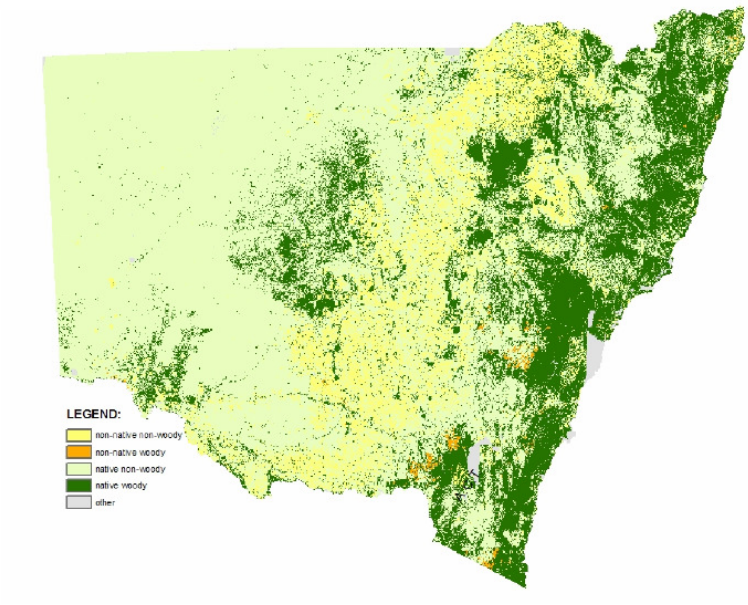
The NSW Interim Native Vegetation Extent Project (2008- Version 1) (DECC 2008a) combined the interim (25% FPC) State-wide Landcover and Trees Study (SLATS) product for woody and non-woody vegetation with the nativeness layer developed through the manipulation of the land use mapping to derive an interim data set (Figure 13). The project used the conservative FPC SLATS threshold of 25% to distinguish between woody and non-woody vegetation, and used 4 Landsat epochs (2000, 02, 04 and 06) in the analysis of FPC. The conservative threshold was applied as the SLATS methodology was still in the process of being refined in NSW, and the 25% figure avoided overestimation of woody vegetation in eastern areas of the state (DECC 2008a). This FPC threshold has since been reduced to 10% for SLATS analysis now conducted.

Figure 13: Core and derived data sets from the Interim Vegetation Extent Project



The output of this process was an interim data set showing the extent of native and non-native woody and non-woody vegetation in 2006 (Figure 14). For this project all areas of indeterminate nativeness were assumed to be native, and the project provided the necessary material to the NLWRA to report on the extent of native vegetation in NSW (Section 3.1.1).

Figure 14: NSW Interim Vegetation Extent (2008- Version 1)



State of the Catchments Reporting

As part of the State of the Catchments reporting process DECCW undertook additional analysis to generate more accurate information on the extent of native vegetation in NSW (Dillon et al 2009). The analysis generated two distinct data layers, including:

1. The extent of native woody and native non-woody vegetation
2. A native vegetation extent layer with information on whether the vegetation is structurally intact.

The data sets utilised, and their source, are outlined in Table 1.

Table 1: GIS data used to derive NSW vegetation extent data layers (From Dillon et al 2009)

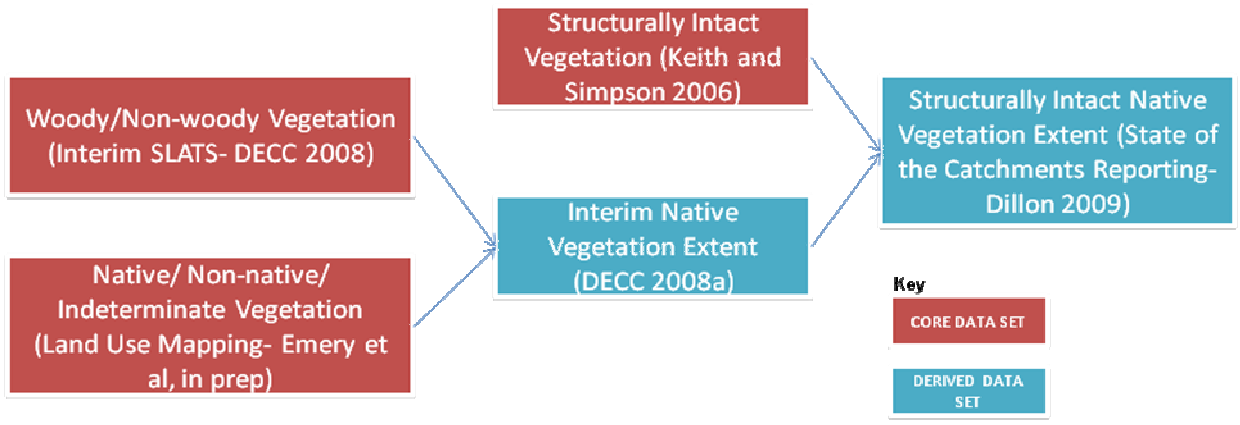
GIS Filename (cell size)	Description	Source
extveg_002 (250m)	Mask of extant remnant structurally intact native vegetation used to assign intactness to cells in other layers. Includes 2 classes: 'structurally intact native vegetation' and 'other'.	Keith & Simpson (2006)
vegtype_08v1 (25m)	Native vegetation extent grid (25m). Extent derived from interim FPC and nativeness (or uncertainty) informed by land use. Includes 5 classes: 'native non-woody', 'native woody', 'exotic non woody', 'exotic woody', and 'other'.	DECC (2008a)
wdy_nat_08v1 (25m)	Mask of nativeness for woody vegetation derived from land use and used to assign nativeness to woody cells in other layers. Includes 3 classes: 'native', 'non-native', and 'indeterminate nativeness'.	DECC (2008a)
nwdy_nat_ind (25m)	Mask of nativeness for non-woody vegetation derived from land use and used to assign nativeness to non-woody cells in other layers. Includes 3 classes: 'native', 'non-native', and 'indeterminate nativeness'.	DECC (2008a)

GIS Filename (cell size)	Description	Source
wd_nonwd_ext (25m)	Native, exotic and indeterminate vegetation layer derived from the above layers. Includes 7 classes: 'native woody', 'native non-woody', 'indeterminate woody', 'indeterminate non-woody', 'exotic woody', 'exotic non-woody' and 'other'. This layer was created by reclassifying "vegtype_08v1" into 2 classes ('woody' and 'non-woody') and applying the Spatial Analyst "plus" operation to "wdy_nat_08v1" and "nwdy_nat_ind".	State of the Catchments Reporting
vegnativeness (25m)	Vegetation extent layer derived by reclassifying "wd_nonwd_ext" into 4 classes: 'native vegetation', 'non-native (exotic) vegetation', 'vegetation with indeterminate nativeness', and 'non-vegetation'.	State of the Catchments Reporting
Veg_ext_nsw_1 (25m)	Vegetation extent layer derived by combining "vegnativeness" and "extveg_002". Includes 5 classes: 'structurally intact native vegetation', 'derived native vegetation', 'vegetation with indeterminate nativeness', 'non-native (exotic) vegetation', and 'non-vegetation'. For mapping purposes the 'non-native (exotic) vegetation', and 'non-vegetation' classes were combined into a category called 'Non-native or Other' (Figure 1).	State of the Catchments Reporting

The extent of native woody/non woody vegetation was created by combining products generated during the Interim Native Vegetation Extent Project (DECC 2008a), including a woody/non woody mask, a woody native, non-native and indeterminate layer and a non-woody native, non-native and indeterminate layer. The layer created contains seven classes (native woody, native non-woody, indeterminate woody, indeterminate non-woody, exotic woody, exotic non-woody and 'other'). The data does not make an assessment of whether the vegetation is structurally intact or derived (Dillon et al 2009), and the indeterminate category (i.e. unknown native or non-native status) reflects areas where the land use categories could not be classified as either native or non-native. The results of this analysis, for the state and each CMA, can be seen in Section 3.1.2.

In order to undertake a state-wide assessment which included information on whether the vegetation was structurally intact or derived, an additional data set of native vegetation extent was created. The layer was developed by combining the Keith and Simpson (2006) structurally intact data with the Interim Vegetation Extent layer derived from the NSW Interim Native Vegetation Extent Project (DECC 2008a) (Figure 15).

Figure 15: Core and derived data sets used to generate the structurally intact vegetation extent information as part of the State of the Catchments Project



This led to the creation of four broad categories depicting the nativeness and structural intactness of the vegetation, including:

- Native-Intact: Native vegetation in which the structure has not been substantially altered by human activities, or has been altered and has since recovered.
- Native-Derived: Vegetation that is predominantly native but has been substantially altered by human activities and is no longer structurally intact.
- Native/Non-Native: Vegetation that cannot readily be classified as either Native or Non-native using current remote sensing methods.
- Non-native or Other: Non-native vegetation including crops, non-native plantations and non-native pastures, or other non-vegetation land cover types, including urban, industrial, infrastructure.

The categories above conformed to the NSW Definitions of Native Vegetation Extent (DECC 2009).

The extent of native woody and non-woody vegetation, and the extent of Native-Intact, Native-Derived, Native/Non-Native and Non-Native/Other, are provided in Section 3.1.2 for the entire state, and by CMA.

2.1.3 Limitations and Possible Improvement

The native vegetation extent data layers have been created by combining several raster base data sets, which themselves have been compiled using a range of base data (Dillon et al 2009). Therefore, both the base data and the resulting data layers from the analysis outlined above contain a number of limitations and caveats (DECC 2008a, Keith and Simpson 2006, 2008, Dillon et al 2009) including:

- The DECCW 2008 vegetation extent data layer was developed as an interim product, and as such the information generated from this layer will be updated with further analysis.
- The processing used to generate the interim FPC layer (DECC 2008a) through the SLATS method used only 4 satellite epochs (2000, 2002, 2004, 2006) while the SLATS methodology recommends a minimum of 8 epochs.
- The 2000-2006 period was drier than average, and this may have led to an underestimation of FPC values for drier areas.
- The FPC values used were calibrated for Queensland conditions and not for NSW. To help counter this, a conservative FPC value of 25% was used.
- A single FPC value was used across the State. There may be some scope to adjust the FPC threshold depending on the location being studied.
- Incomplete land use data was used during the DECCW 2008 mapping process, and further refinements of the land use data will be incorporated into subsequent updates.
- A large proportion of extent non-woody vegetation falls within the Native/Non-native Mosaic Vegetation extent category (indeterminate), leading to some uncertainty regarding the figures for vegetation extent, particularly non-woody vegetation.
- The currency and quality of the data layers used to create the Keith and Simpson (2006) layer varies. Therefore parts of the state contain gaps, particularly for native non-woody vegetation.

DECCW continue to develop and refine the methodology, and final outputs, of the vegetation extent analysis. Continued improvements are planned, and include:

- The use of Landsat and MODIS imagery to identify cropped, recently cropped and pasture improved areas that may be able to be used to more accurately identify non-native non-woody vegetation.
- The use of more imagery epochs to further refine the FPC results obtained from the SLATS analysis. This process has just been completed by DECCW and has improved the reliability of the woody vegetation figure.
- Improvement of the land use mapping available and continual updating of this data.
- Continued CMA programs capturing spatial information, such as the Land Management Database designed to capture information on incentive payments.

It is important that these programs are funded and adequately resourced to ensure the continued improvement in the ability to report on native vegetation extent in NSW.

2.2 NATIVE VEGETATION EXTENT TREND

DECCW are undertaking several processes in order to monitor the trend of native vegetation extent in NSW. These include programs to monitor both woody and non-woody vegetation trend, which are outlined below.

2.2.1 Woody Vegetation

The trend in the extent of woody vegetation is being monitored through the use of multiple Landsat images across the state of NSW through the Woody Vegetation Monitoring Program. The SLATS methodology adopted by DECCW for this process is monitoring the change in woody vegetation above approximately 10% Foliage Projected Cover (20% canopy cover) on a yearly basis (DECC 2007), and is currently able to document the area of loss of woody vegetation extent for 2004-2006, 2006-2007 and 2007-2008. Further work continues to identify the extent of increasing woody vegetation and the woody vegetation trend back to 1988.

The process uses a semi-automated approach with visual editing of change data by regional officers. Figure 16 demonstrates the data output produced by SLATS to identify cleared areas, with the red areas depicting areas of vegetation change identified by a reduction in the FPC values for an area. These areas are then visually checked, using recent imagery, to determine if the change identified by SLATS is correct and clearing has occurred.

Figure 16: Example of woody vegetation change analysis

Several categories of decreasing vegetation change are identified to assess the impact of different clearing types in NSW, with the regional officers also confirming this information through desktop analysis. The categories include:

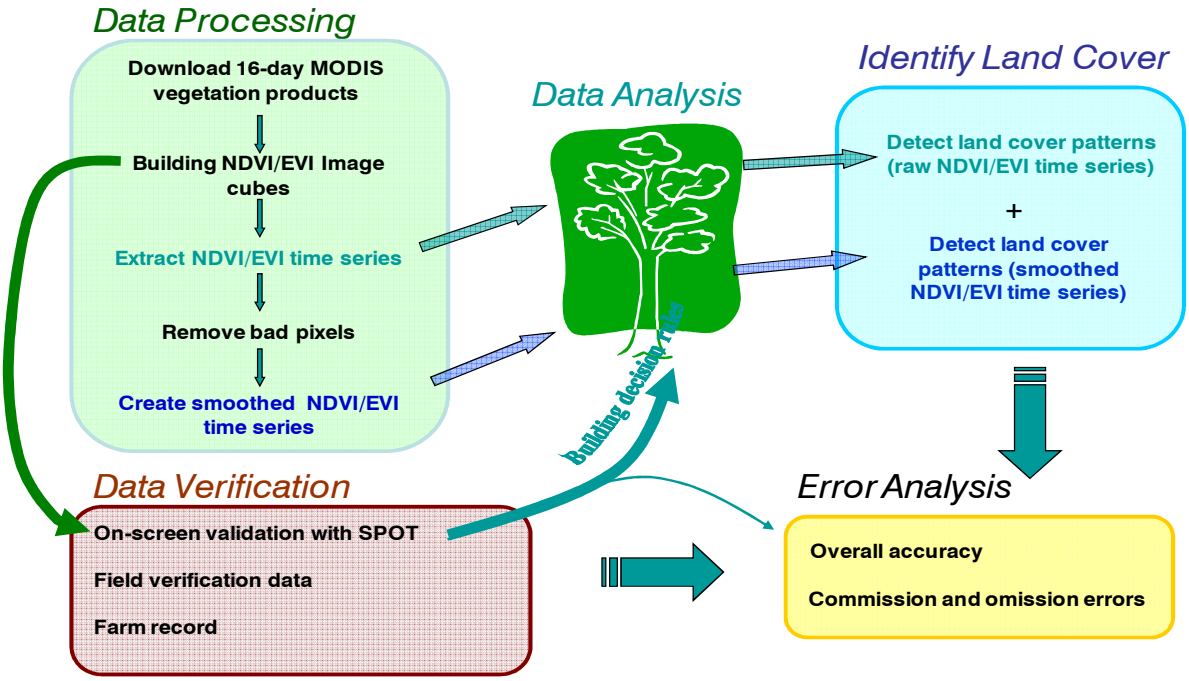
- Cropping, pasture and thinning
- Forestry
- Fire scars
- Rural and major infrastructure.

The area of woody vegetation clearing, for the State and each CMA, are provided in Section 3.2.1.

2.2.2 Non-woody Vegetation

A process to map and monitor the trend of non-woody vegetation is currently being finalised within DECCW. The process currently utilises the two MODIS vegetation indices Enhanced Vegetation Index (EVI) and Normalized Difference Vegetation Index (NDVI) to generate a 250m resolution layer of non-woody vegetation cover. The process is described in Figure 17.

Figure 17: Methodology to map non-woody vegetation using MODIS EVI / NDVI data (From DECCW)



As the methodology and data has not yet been finalised the information was not available for this report. Future reporting on this state-wide target, however, should be able to utilise this information.

2.2.3 Limitations and Possible Improvement

The processes to map woody and non-woody native vegetation, and trend, are still undergoing methodological refinement, and as discussed earlier in this report several of the data layers currently being utilised are interim products which continue to be refined. The following listed improvements will enable a more accurate assessment of native vegetation extent trend in the future:

- Continued refinement of SLATS methodology in NSW will provide more accurate results for woody vegetation.
- Identification of the amount, and location, of increasing woody vegetation cover will be completed in 6-12 months. This will strengthen DECCWs ability to report on the trend of woody vegetation in NSW.
- Continued development of the methodology used to map non-woody vegetation, including the trial of several methods in various CMAs, should improve the ability to map non-woody vegetation in NSW.

2.3 NATIVE VEGETATION CONDITION BASELINE

There are inherent difficulties in classifying, and mapping, vegetation condition across the entire state. The measure of vegetation condition is value laden and differs depending on the condition benchmark that is used, the vegetation type, the regional location and the normal natural state of the vegetation. As a definitive methodology is yet to be developed for mapping vegetation condition across the state, and the use of on-site assessment data is problematic due to the size of NSW, a surrogate for vegetation condition, which conforms to the draft Vegetation Condition Classification methodology- VAST (Vegetation Assets, States and Transitions) (Thackway and Leslie 2005, 2006, 2008) has been developed by DECCW. The methodology assigns a vegetation cover class based on the impacts of human land use and land management practises.

2.3.1 Core Data Sets

The same core data sets have been used for the mapping of condition as those used to map native vegetation extent, being:

- The structurally intact vegetation layer developed by Keith and Simpson (2006)
- The interim woody/non-woody data layer developed through the SLATS process as part of the Interim Vegetation Extent Project (DECC 2008a)
- The vegetation nativeness information developed through the Land Use Mapping Program (Emery et al, in prep)

For more information on these core data sets see Section 2.1.1.

2.3.2 Derived Data Sets

In order to generate the VAST data layer for NSW the derived structurally intact native vegetation data layer (produced as part of the State of the Catchments reporting) was combined with the core data sets above to create the VAST data layer. This process is outlined below.

State of the Catchments Reporting

The surrogate vegetation condition mapping for the entire state of NSW was completed as part of the State of the Catchments Native Vegetation Reporting (Dillon et al 2009). The mapping, which has a cell resolution of 25m, uses a methodology that conforms to the draft VAST methodology, which orders vegetation by degree of anthropogenic modification as a series of states, from a residual or base-line state through to total removal – a non existence state (Thackway and Leslie 2005). More detail on the classes is provided in Figure 18.

Figure 18: Vegetation Assets, States and Transitions (VAST). From Thackway and Leslie 2006

Increasing vegetation modification from left to right

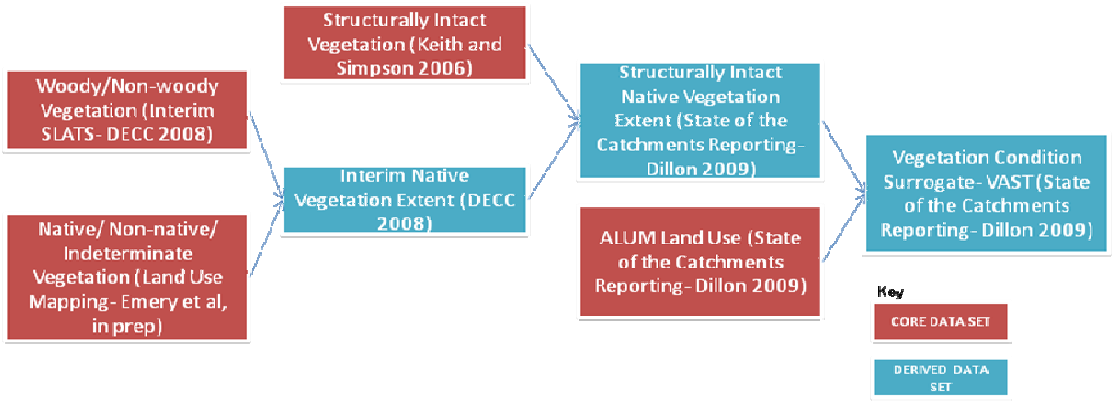
			Native Vegetation Cover Dominant structuring plant species indigenous to the locality and spontaneous in occurrence – i.e. a vegetation community described using definitive vegetation types relative to estimated pre1750 states			**Non-native Vegetation Cover** Dominant structuring plant species indigenous to the locality but cultivated; alien to the locality and cultivated; or alien to the locality and spontaneous		
Vegetation Cover Classes		State 0: NATURALLY BARE areas where native vegetation does not naturally persist and recently naturally disturbed areas where native vegetation has been entirely removed. (i.e. open to primary succession)	State I: RESIDUAL native vegetation community structure, composition, and regenerative capacity intact – no significant perturbation from land use/land management practice	State II: MODIFIED native vegetation community structure, composition and regenerative capacity intact – perturbed by land use/land management practice	State III: TRANSFORMED native vegetation community structure, composition and regenerative capacity significantly altered by land use/land management practice	State IV: REPLACED – *ADVENTIVE* native vegetation replacement – species alien to the locality and spontaneous in occurrence	State V: REPLACED – *MANAGED* native vegetation replacement with cultivated vegetation	State VI: REMOVED vegetation removed – alienation to non-vegetated land cover
Diagnostic criteria	Current regenerative capacity	Complete absence of in-situ regeneration capacity except for ephemerals and lower plants	Natural regenerative capacity unmodified	Natural regeneration capacity persists under past and /or current land management practices	Natural regenerative capacity limited / at risk under past and/or current land use or land management practices. Rehabilitation and restoration possible through modified land management practice	Regeneration potential of native vegetation community has been suppressed and in-situ resilience at least significantly depleted. May still be considerable potential for restoration using assisted natural regeneration approaches	Regeneration potential of native vegetation community likely to be highly depleted by intensive land management. Very limited potential for restoration using assisted natural regeneration approaches	Nil or minimal regeneration potential. Restoration potential dependent on reconstruction approaches
	Vegetation structure	Nil or minimal	Structural integrity of native vegetation community is very high	Structure is predominantly altered but intact e.g. a layer / strata and/or growth forms and/or age classes removed	Dominant structuring species of native vegetation community significantly altered e.g. a layer / strata frequently and repeatedly removed	Dominant structuring species of native vegetation community removed or predominantly cleared or extremely degraded	Dominant structuring species of native vegetation community removed	Vegetation absent or ornamental
	Vegetation composition	Nil or minimal	Compositional integrity of native vegetation community is very high	Composition of native vegetation community is altered but intact	Dominant structuring species present – species dominance significantly altered	Dominant structuring species of native vegetation community removed	Dominant structuring species of native vegetation community removed	Vegetation absent or ornamental
Examples		Bare mud; rock; river and beach sand, salt freshwater lakes, rock slides and lava flows	Old growth forests; Native grasslands that have not been grazed; Wildfire in native forests and woodlands of a natural frequency and/or intensity	Native vegetation types managed using sustainable grazing systems; Selective timber harvesting practices; Severely burnt (wildfire) native forests and woodlands not of a natural frequency and/or intensity	Intensive native forestry practices; Heavily grazed native grasslands and grassy woodlands; Obvious thinning of trees for pasture production; Weedy native remnant patches; Degraded roadside reserves; Degraded coastal dune systems; Heavily grazed riparian vegetation	Severe invasions of introduced weeds; Invasive native woody species found outside their normal range; Isolated native trees/shrubs/grass species in the above examples	Forest plantations; Horticulture; Tree cropping; Orchards; Reclaimed mine sites; Environmental and amenity plantings; Improved pastures. (includes heavy thinning of trees for pasture); Cropping; Isolated native trees/ shrubs/ grass species in the above examples	Water impoundments; Urban and industrial landscapes; quarries and mines; Transport infrastructure; salt scalded areas

The VAST data layer for NSW was developed using two main input layers, including:

1. The structurally intact native vegetation extent data layer produced as part of the State of the Catchments Reporting Project (Dillon et al 2009), identifying areas of Native Intact Vegetation, Native Derived Vegetation, Native/Non-native Mosaic Vegetation and Non-native/other Vegetation.
2. NSW Merged Land Use Data layer created as part of the Interim Native Vegetation Extent Project (2008- Version 1) (DECC 2008a). The layer, which is still in draft form, continues to be refined by the NSW Land Use Mapping Program. The layer uses National Australian Land Use and Management (ALUM) classification categories (Australian Government, 2006) and provided a link between land use potential and vegetation condition. This layer was updated with more accurate NSW National Parks and Wildlife Service Estate, Forest NSW Estate and NSW Travelling Stock Reserves before being utilised for this process.

To create the final VAST condition layer the NSW National Parks, Forest NSW and NSW Travelling Stock Reserves were merged with the NSW Merged Land Use data, with the more accurate and recent data replacing the data held in the NSW Merged Land Use layer. The updated land use was then combined with the structurally intact native vegetation extent data layer, to create a data set with both land use and vegetation extent attributes (Figure 19). VAST categories were then allocated, based firstly on which vegetation extent category was assigned, and secondly on which ALUM category was applied to the area (Dillon et al 2009). The VAST categories applied to different land use and extent vegetation data can be seen in Appendix 4, and the results of the analysis are contained in Section 3.3

Figure 19: Core and derived data sets used to generate the vegetation condition surrogate information as part of the State of the Catchments Project



The following modification states have been used (Dillon et al 2009).

- Residual: Native vegetation community structure, composition and regenerative capacity intact– no significant perturbation from land use or land management practices.
- Modified: Native vegetation community structure, composition and regenerative capacity intact– perturbed by land use or land management practices.
- Transformed: Native vegetation community structure, composition and regenerative capacity significantly altered by land use or land management practices.
- Transformed/Replaced-Adventive Mosaic: Vegetation that cannot readily be classified as either Transformed (native) or Replaced-Adventive (non-native) on the basis of available State-wide data sets.

- Replaced-Managed: Native vegetation replaced with cultivated vegetation.
- Removed: Vegetation removed to leave non-vegetated land cover.

All classes conform to the VAST methodology, except for Transformed/Replaced-Adventive Mosaic which denotes a native/non-native mosaic caused by the incomplete information on vegetation extent (Dillon et al 2009).

2.3.3 Limitations and Possible Improvement

Limitations are acknowledged in the approach to mapping vegetation condition using the methodology outlined above (Dillon et al 2009). The draft land use data layer was not developed for purpose of mapping vegetation condition, however combined with the vegetation extent data layer it provides the best available state-wide data set to measure the state of modification against a benchmark and as a surrogate for vegetation condition. The coarse nature of this approach is recognised.

The VAST method applied also assumes that secure conservation tenure, such as National Parks, are in good condition when compared to the surrounding landscape. It is acknowledged that this may not always be the case, with conservation tenure often under the same pressures as other tenure types. Continued management of conservation tenures should, however, increase the condition of the vegetation over time.

In order to improve the mapping of vegetation condition in NSW DECCW has initiated a state-wide Vegetation Condition MER to collect site based condition data across a range of land cover, land use and management conditions (Dillon et al 2009). The project is currently being carried out in six CMAs, and assuming project funding continues the project will provide the ability to report on vegetation using a finer scale, bottom up approach to modelling and mapping vegetation. It is intended that the data will be used in the 2012 State of the Catchment reports.

2.4 NATIVE VEGETATION CONDITION TREND

As discussed in Section 2.3, the identification of vegetation condition is difficult as the measure of vegetation condition will differ between vegetation types, and in different parts of the State. The same limitations apply to monitoring the trend of vegetation condition at the state-wide level. The work outlined above, where a surrogate for vegetation condition was developed using the VAST methodology, may be utilised in the future to enable a comparative assessment of the extent of different states of vegetation over time at the state-wide and CMA level.

2.4.1 Limitations and Possible Improvement

It is acknowledged that by using the VAST method to monitor vegetation condition trend the loss of vegetation condition (i.e. removal of vegetation or change of land use leading to the potential removal of vegetation) will be relatively easy to identify and map, allowing the decrease in vegetation condition to be identified. However, the improvement of vegetation condition takes considerable time, and may require several decades to move into an increased condition category under the VAST methodology. This may lead to the situation where the condition of vegetation in NSW appears to be deteriorating, where in fact the vegetation may simply be taking a significant period of time to improve.

DECCW are continuing to investigate alternative methods to map vegetation condition and monitor trend on the state-wide scale. Work currently underway in various CMAs (Section 5), such as the generation of condition surfaces and on-site survey, may lead to more accurate measures of condition, and trend, in NSW.

3 Results

3.1 NATIVE VEGETATION EXTENT BASELINE

Below is an explanation of the baseline information collected for Australia, the state of NSW, and for each Catchment Management Authority region within NSW.

3.1.1 Australian Context- Setting the Scene

The extent of native vegetation in NSW, when compared to other states in Australia, was obtained through work completed by the National Land and Water Resources Audit (NLWRA, 2008). Along with the Bureau of Rural Sciences (BRS) the NLWRA worked with the States and Territories to develop a national baseline for native vegetation extent for the year 2004/05. It is intended that this data set be used to measure future trends and the effectiveness of policy and program initiatives.

That study determined that in 2004 there was over 676 million hectares of native vegetation in Australia, covering 88% of the continent. The area of native vegetation ranges quite significantly between the states, with a minimum of 44% native vegetation coverage in Victoria, to a maximum native vegetation cover of 99% in the Northern Territory (Table 2). NSW contains 69,980,691 hectares of native vegetation, covering 87% of the state. This figure was provided to the NLWRA by NSW Department of Environment, Climate Change and Water (DECCW) through work completed by the Interim Native Vegetation Extent Project (2008- Version 1) (DECC 2008a).

Table 2: Extent of native vegetation in Australia (Adapted from NLWRA 2008)

	Extent of Native Vegetation (ha)	Total Area (ha)	%
Australia	676,695,922	768,278,712	88
ACT	127,913	235,726	55
NSW	69,980,691	80,102,152	87
NT	132,421,716	134,313,828	99
QLD	139,819,766	172,939,770	81
SA	84,416,131	98,432,191	86
TAS	5,071,672	6,859,319	74
VIC	10,569,891	22,687,003	47
WA	234,288,141	252,701,298	93

Although this baseline provides for future monitoring and trend evaluation, it is noted that the baseline has been developed for each jurisdiction using definitions of native vegetation relevant to each State or Territory. These definitions are not consistent, and therefore some discrepancies may exist between the information generated for each State and Territory.

3.1.2 Current Vegetation Extent in NSW

SUMMARY OF FINDINGS

1. The State of the Catchment reporting found that in 2006 NSW contained 61% native intact vegetation, 8% native derived vegetation, 20% native/non-native mosaic vegetation and 11% non-native/other vegetation.
2. The State of the Catchment reporting found that in 2006 native woody vegetation covered 19-23% of the state. This analysis used the interim FPC value of 25% to identify woody vegetation.
3. The State of the Catchment reporting found that in 2006 native non-woody vegetation covered 40-64% of the state.
4. Analysis using the refined FPC value of 10% for woody vegetation found that in 2008 NSW contained 37% native woody vegetation.

Structurally Intact Native Vegetation Extent

The results of the state-wide analysis undertaken as part of the State of the Catchment reporting are displayed in Figure 20 and Figure 21 below. In 2006, NSW contained 61% Native Intact Vegetation, 8% Native Derived Vegetation, 20% Native/Non-native Mosaic Vegetation and 11% Non-native/other Vegetation. The results can be further analysed by each CMA, and are displayed in Table 3. Graphs for each CMA are provided in Appendix 5.

Figure 20: Percent of total NSW land area represented by each of the four vegetation extent categories (From Dillon et al 2009)

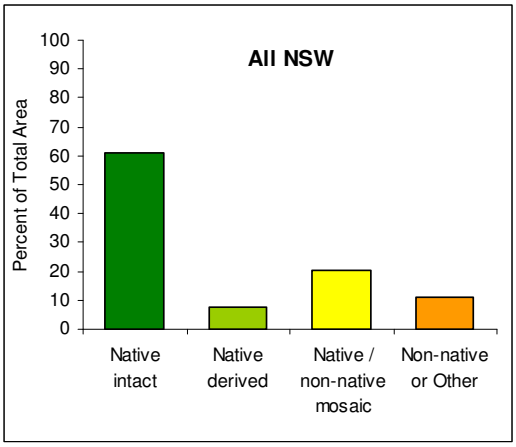


Figure 21: Vegetation extent within NSW and the 13 Catchment Management Authority Regions (From Dillon et al 2009)

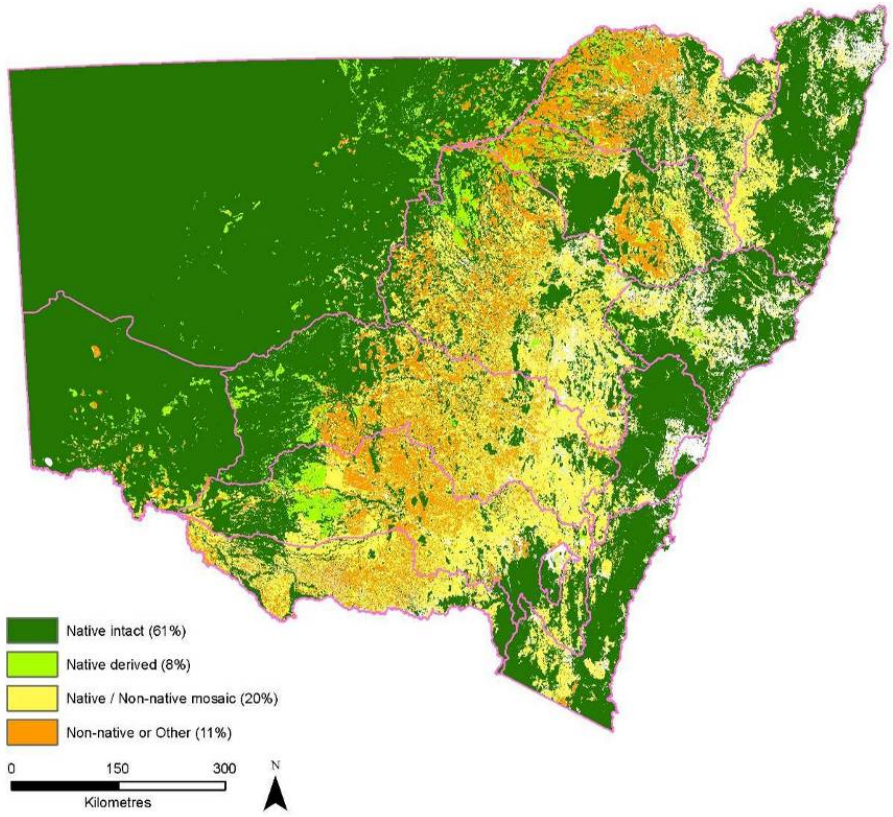


Table 3: Proportion of vegetation extent categories by CMA

	Native intact (%)	Native derived (%)	Native / Non-native Mosaic (%)	Non-native or Other (%)
NSW	61.1	7.5	20.2	11.2
Border Rivers-Gwydir	31.5	13.7	26	28.8
Central West	29.3	11.4	39.6	19.6
Hawkesbury-Nepean	71	5.8	18.2	5
Hunter-Central Rivers	53	16.1	27.9	3
Lachlan	40.5	7.8	31.8	19.9
Lower Murray-Darling	92.4	4.1	1.4	2.2
Murray	25.3	4.8	43.2	26.7
Murrumbidgee	32.1	10.3	36.8	20.8
Namoi	41.1	11.8	26.3	20.7
Northern Rivers	62.7	9.7	25.3	2.3
Southern Rivers	69.9	5.8	20.9	3.4
Sydney Metro	40.4	2	11.5	46.1
Western	95.6	2.9	0.7	0.9

Further analysis was conducted to generate a Vegetation Extent Index for the state and each CMA. The index generated is useful for comparing different regions (such as CMAs) and may provide an additional option for the measurement of the trend of vegetation extent in the future. Each vegetation extent

category was assigned an index based on the relative difference in vegetation integrity between the four categories, as defined by DECCW staff (Dillon et al 2009). These are displayed in Table 4.

Table 4: Vegetation extent category index weighting (from Dillon et al 2009)

Vegetation Extent Category	Index
Native – intact vegetation	1.00
Native – derived vegetation	0.50
Native/Non-native mosaic vegetation	0.25
Non-native or Other	0.00

The overall Vegetation Extent Index was then calculated by multiplying the percentage of each extent category (i.e. Native – intact vegetation, Native – derived vegetation, Native/Non-native mosaic vegetation and Non-native or Other) by its associated index value listed in Table 4. An example of how the calculation was completed for the state is shown in Table 5.

Table 5: Calculation of the vegetation extent index for NSW

Vegetation Extent Category	Index	Percentage of NSW	Component Score
Native – intact vegetation	1.00	61.1	61.10
Native – derived vegetation	0.50	7.5	3.75
Native/Non-native mosaic vegetation	0.25	20.2	5.05
Non-native or Other	0.00	11.2	0.00
Overall Vegetation Extent Index for NSW			69.9

The results are displayed in Table 6, while as assessment of each of the index ranges is contained in Table 7. Overall, NSW scored a 'Good' Vegetation Extent Index with a score of 69.9. The results for CMAs vary, ranging from 38 (Poor) for Murray CMA to 95 (Very Good) for Western and Lower Murray Darling CMAs.

Table 6: Vegetation extent index for NSW and each CMA

	Index	Rating
NSW	70 / 100	Good
Border Rivers-Gwydir	45 / 100	Fair
Central West	45 / 100	Fair
Hawkesbury-Nepean	78 / 100	Good
Hunter-Central Rivers	68 / 100	Good
Lachlan	52 / 100	Fair
Lower Murray-Darling	95 / 100	Very Good
Murray	38 / 100	Poor
Murrumbidgee	46 / 100	Fair
Namoi	54 / 100	Fair
Northern Rivers	74 / 100	Good
Southern Rivers	78 / 100	Good
Sydney Metro	44 / 100	Fair
Western	97 / 100	Very Good

Table 7: Vegetation extent index rating (From Dillon et al 2009)

Extent Index	Extent class
> 80 - 100	very good
> 60 - 80	good
> 40 - 60	fair
> 20 - 40	poor
0 - 20	very poor

Native Woody/Non-woody Extent

Recent SLATS analysis completed for the state using a greater range of Landsat epochs and a refined FPC value of 10% has been conducted by the Woody Vegetation Change Monitoring Program. This work reports that NSW contains approximately 37% native woody vegetation, with an estimate of approximately 50% native non-woody vegetation (Danaher 2009). This updated data will be included in any further analysis and refinement of vegetation extent in NSW in the future, and will update the information contained in the NSW Interim Native Vegetation Extent (2008- Version 1) and the State of the Catchment Reports (Dillon et al 2009). The data produced by this more recent analysis has varied due to:

- A significant change in the FPC value for woody vegetation from 25% to 10%
- An increase in the number of Landsat epochs used during the analysis, providing a more comprehensive data range

Before this new woody data was available, the State of the Catchments reporting process provided an estimate of native woody and native non-woody vegetation extent in NSW. It was reported that in 2006, native vegetation covered between 59-87% of NSW (Figure 22). This figure comprises a range of 19-23% for native woody vegetation, and 40-64% for native non-woody vegetation.

The range of the figures reflects the difficulty of reporting on the nativeness of vegetation at the state-wide scale, particularly as land use has been used as a surrogate for nativeness in this process. The hatched areas in Figure 22 represent the area of indeterminate woody and non-woody vegetation, where the land use data layer could not be used to assign either a native or non-native tag. The problem is more pronounced with non-woody vegetation due to the inherent difficulties of establishing the nativeness of grassland areas through land use (i.e. non-woody grazing areas were assigned the indeterminate category). Although this is the case, due to the conservative definition of native vegetation in NSW the actual cover of native vegetation is likely to be closer to the maximum range presented.

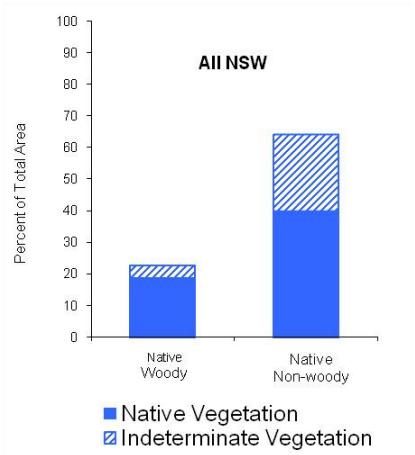


Figure 22: Upper and lower estimates of percent of native woody and native non-woody vegetation in NSW (From Dillon et al 2009)

Figures for each CMA have also been produced, and again highlight the difficulties in accurately mapping the nativeness of vegetation (Table 8). Lower estimates for native woody vegetation range from 6% to 59%, while upper estimates range from 6 to 70%. Lower estimates of native non-woody vegetation range from 0.4% to 91%, while upper estimates range from 4% to 93%. Graphs for each CMA are provided in Appendix 6.

Table 8: Lower and upper range of woody and non-woody native vegetation cover in NSW and by CMA

	Woody Native Vegetation Extent		Non-Woody Native Vegetation Extent		
	Lower Estimate (%)	Upper Estimate (%)	Lower Estimate (%)	Upper Estimate (%)	Native Vegetation Extent Range (%)
NSW	19.0	22.9	40.0	64.4	59-87
Border Rivers-Gwydir	22.8	27.4	12.2	42.0	35-69
Central West	16.1	19.5	11.1	59.2	27-79
Hawkesbury-Nepean	59.2	69.9	1.3	20.1	61-90
Hunter-Central Rivers	52.3	63.1	2.7	32.1	55-95
Lachlan	14.0	15.4	26.0	63.6	40-79
Lower Murray-Darling	10.0	10.2	84.8	87.1	95-97
Murray	12.7	15.8	4.8	55.9	18-72
Murrumbidgee	11.6	14.8	16.0	62.7	28-78
Namoi	24.5	33.4	10.5	44.2	35-78
Northern Rivers	49.0	63.8	4.3	32.8	53-97
Southern Rivers	50.8	65.4	5.7	29.6	57-95
Sydney Metro	17.9	30.7	0.4	3.5	18-34
Western	6.0	6.1	90.6	92.6	97-99

3.2 NATIVE VEGETATION EXTENT TREND

3.2.1 Woody Vegetation Trend

The DECCW Woody Vegetation Monitoring program is using the SLATS methodology, developed in Queensland, to map the change in woody vegetation cover in NSW. As discussed previously, DECCW have completed the analysis to determine the location and amount of woody vegetation clearing across the state. As the SLATS methodology does not differentiate between native and non-native woody vegetation the figures generated for the clearing of woody vegetation will include some non-native areas. The area of non-native woody vegetation, however, is estimated to be less than 0.5% of the state, and therefore the figures presented on the clearing of woody vegetation will, in the main, be related to the clearing of native woody vegetation. DECCW are currently undertaking the work required to identify where the regeneration of woody vegetation is occurring and the amount of increase being recorded.

The results of the woody clearing analysis are presented below, by CMA, for the periods of 2004-2006, 2006-2007 and 2007-2008 (Table 9, Table 10 and Table 11). As fire is generally viewed as a natural event, we have excluded the figures for fire scars from the totals for each CMA, but have provided them separately for information. The allocation of clearing to various categories (Cropping, Pasture and Thinning, Infrastructure and Forestry) was undertaken by DECCW staff. Combined figures for each CMA are presented in Table 12.

Table 9: Woody vegetation change rate by category (ha/year) - 2004-2006

CMA 2004-2006	Cropping, Pasture and Thinning	Infrastructure	Forestry	TOTAL	Fire
Northern Rivers	980	50	390	**1,420**	4
Murray	122	0	317	**439**	175
Central West	4,272	113	1,680	**6,065**	74
Border Rivers	882	28	0	**910**	0
Sydney Metro	0	80	0	**80**	64
Southern Rivers	252	70	1,728	**2,050**	0
Namoi	498	2	778	**1,278**	0
Hawkesbury Nepean	236	54	1,061	**1,351**	433
Murrumbidgee	196	1	2,855	**3,052**	0
Lachlan	2,041	57	630	**2,728**	1,872
Western	4,548	489	0	**5,037**	0
Lower Murray Darling	1,677	247	0	**1,924**	691
Hunter Central Rivers	386	683	244	**1,313**	434
TOTAL	**16,090**	**1,874**	**9,683**	**27,647**	**3,747**

Table 10: Woody vegetation change rate by category (ha/year) - 2006-2007

CMA 2006-2007	Cropping, Pasture and Thinning	Infrastructure	Forestry	TOTAL	Fire
Northern Rivers	4,045	816	4,522	**9,383**	1,395
Murray	183	0	623	**806**	2,796
Central West	1,744	256	1,012	**3,012**	5,178
Border Rivers	1,982	311	194	**2,487**	3,104
Sydney Metro	44	53	30	**127**	293
Southern Rivers	490	108	4,008	**4,606**	49
Namoi	609	89	412	**1,110**	110,397
Hawkesbury Nepean	257	336	1,686	**2,280**	44,161
Murrumbidgee	594	24	2,948	**3,565**	16,032
Lachlan	2,439	174	862	**3,475**	0
Western	3,371	590	0	**3,962**	0
Lower Murray Darling	1,332	133	0	**1,466**	2,942
Hunter Central Rivers	1,826	912	1,669	**4,408**	16,089
TOTAL	**18,916**	**3,803**	**17,968**	**40,687**	**202,437**

Table 11: Woody vegetation change rate by category (ha/year) - 2007-2008

CMA 2007-2008	Cropping, Pasture and Thinning	Infrastructure	Forestry	TOTAL	Fire
Northern Rivers	2,657	856	6,078	**9,591**	173
Murray	63	62	1,776	**1,900**	579
Central West	2,420	229	1,836	**4,485**	1,369
Border Rivers	1,941	100	165	**2,207**	153
Sydney Metro	0	58	0	**58**	32
Southern Rivers	212	207	4,960	**5,379**	42
Namoi	863	246	478	**1,587**	152
Hawkesbury Nepean	107	132	951	**1,191**	160
Murrumbidgee	333	82	6,225	**6,640**	221
Lachlan	1,005	388	1,164	**2,558**	1,427
Western	3,466	545	0	**4,011**	0
Lower Murray Darling	1,655	440	0	**2,094**	0
Hunter Central Rivers	586	615	938	**2,139**	32
TOTAL	**15,308**	**3,962**	**24,572**	**43,841**	**4,340**

Table 12: Combined woody vegetation change rate by category (ha) - 2004-2008

CMA Combined Figures	Cropping, Pasture and Thinning	Infrastructure	Forestry	TOTAL	Fire
Northern Rivers	7,682	1,722	10,990	**20,395**	1,572
Murray	368	62	2,716	**3,145**	3,550
Central West	8,436	598	4,529	**13,563**	6,622
Border Rivers	4,805	439	360	**5,604**	3,257
Sydney Metro	44	192	30	**265**	388
Southern Rivers	954	385	10,695	**12,034**	91
Namoi	1,970	337	1,668	**3,975**	110,549
Hawkesbury Nepean	600	522	3,699	**4,821**	44,754
Murrumbidgee	1,122	107	12,028	**13,258**	16,253
Lachlan	5,485	619	2,656	**8,761**	3,299
Western	11,385	1,624	0	**13,010**	0
Lower Murray Darling	4,664	820	0	**5,484**	3,633
Hunter Central Rivers	2,798	2,211	2,852	**7,860**	16,556
TOTAL	**50,314**	**9,639**	**52,223**	**112,175**	210,523

The total decrease in woody vegetation extent (excluding fire scars) across the three time scales is 112,175 hectares. The maximum yearly decrease is 43,841 hectares for 2007/08, followed by 40,687 hectares for 2006/07 and 27,647 hectares for 2004/06. The data provides evidence that the clearing of

woody vegetation has increased over the period 2004-2008 with the results for 2004-2008 almost 20,000 hectares less than the woody vegetation clearing recorded in 2007-2008.

The CMAs with the greatest total decrease in woody vegetation for the combined reporting periods are Northern Rivers, Central West, Murrumbidgee and Western. The CMAs with the smallest decrease in woody vegetation are Murray, Sydney Metro, Namoi and Hawkesbury Nepean. Excluding fire scars, forestry operations and cropping; pasture and thinning are the main causes of woody vegetation clearing in NSW, with infrastructure contributing only a small proportion of the total amount cleared.

Vegetation change maps have been produced identifying the location of woody vegetation decrease (Figure 23, Figure 24 and Figure 25). Note that the pixels contained in the maps below do not represent the actual area of clearing. The symbols have been exaggerated to enable display of clearing that would otherwise not be visible on a map at this scale. The colours represent the clearing intensity in a particular location, from low (green) to high (red), and exclude the fire scar information.

Figure 23: Woody vegetation clearing in NSW- 2004-2006

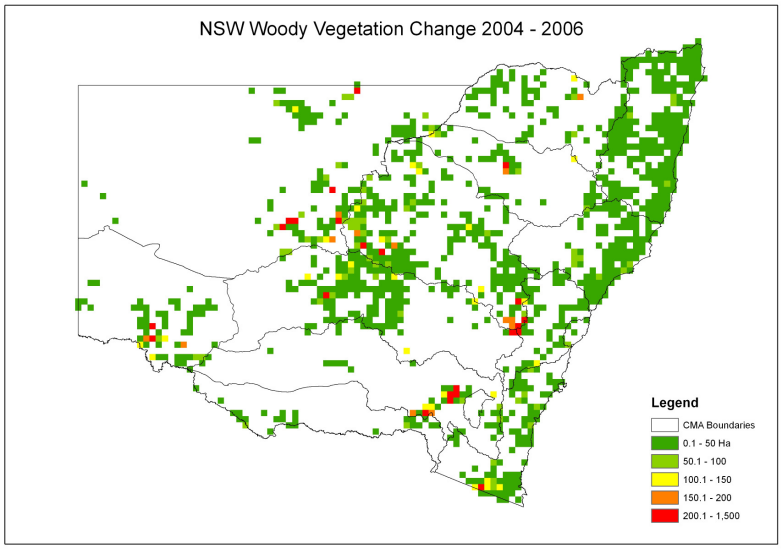


Figure 24: Woody vegetation clearing in NSW- 2006-2007

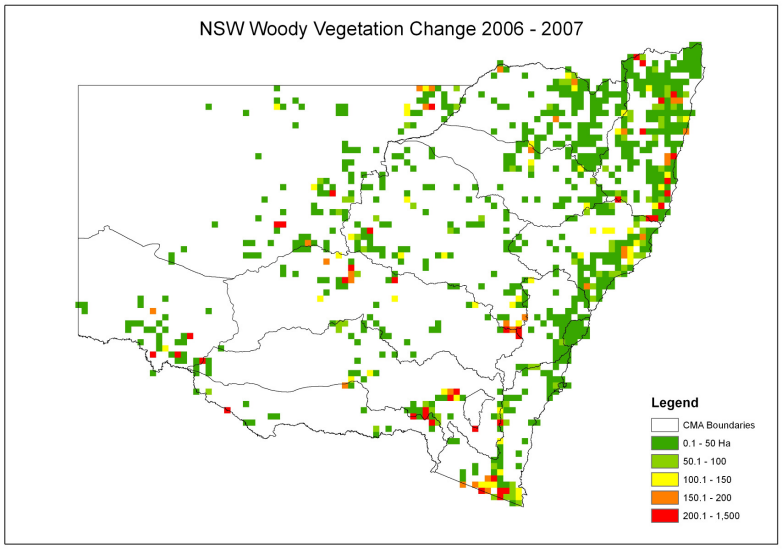
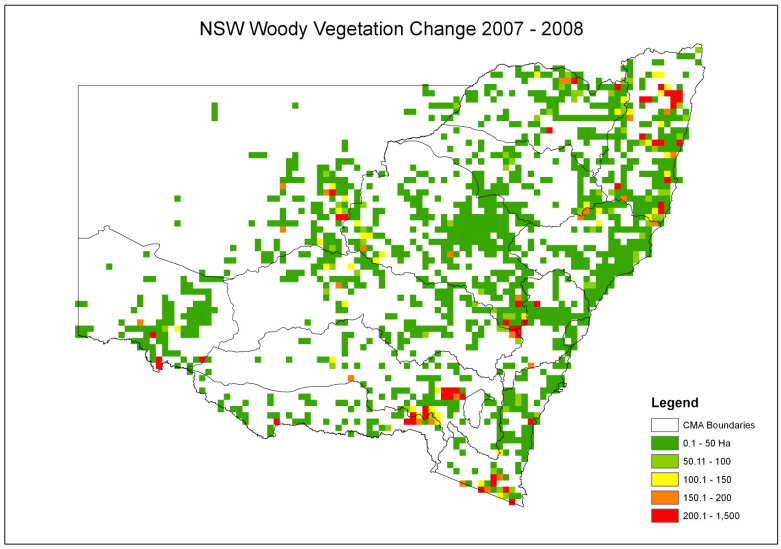


Figure 25: Woody vegetation clearing in NSW- 2007-2008



As can be observed from the figures above, the location of the clearing of woody vegetation shifts in each of the years sampled. These changes in the clearing pattern most likely reflect changes in rainfall or land use changes for the different years.

Woody Vegetation Trend Statement

As documented above, the Woody Vegetation Monitoring Program has performed the analysis to determine the amount of decreasing woody vegetation; however the analysis required to identify areas of woody vegetation increase is on-going, and will be completed within 6-12 months (Tim Danaher, per comm.).

While this fine scale information on increasing woody vegetation is not available, the Woody Vegetation Monitoring Program team has conducted some statistical analysis of the FPC data derived from the SLATS process. This analysis has shown that between 2002 and 2008 there is no significant increasing or decreasing trend in the extent of woody vegetation in NSW. That is, although the amount of woody vegetation being cleared has increased between 2004-2008, the regeneration of woody vegetation has also increased, thus leaving the amount of woody vegetation within the state stable. This information was supplied to the State of the Environment team earlier this year for their use, and is included below.

Information provided to SoE Team

The extent of native vegetation in NSW is estimated at 87% of the state (DECC 2008a).

Data from the DECCW Woody Vegetation Monitoring Program, indicates there was no significant increasing or decreasing trend in the extent of native woody vegetation between 2002 and 2008, with the extent of native woody vegetation estimated to be 37% in 2008. These figures are based on a biennial time-series of Landsat satellite data from 1988 – 2008, analysed to provide estimates of extent for 2002, 2004, 2006 and 2008.

Estimates of the extent of native non-woody vegetation are less well developed, and vary widely due to seasonal climate, rainfall and land management factors. The best current estimate of native non-woody

vegetation is 50% and is based on the analysis of the residual non woody vegetation area using interpretation of land-use patterns.

** Non-native woody vegetation is estimated at less than 0.5% of the State.*

References:

DECC (2008) NSW Interim Native Vegetation Extent (2008-Version 1). Report and data prepared by NSW, Department of Environment and Climate Change for the National Land and Water Resources Audit, Canberra. Project No. DONR 000397. ANZLIC Metadata No. ANZNS0208000244 http://www.nlwra.gov.au/products/pn21468

3.2.2 Non-Woody Vegetation Trend

Due to the developmental nature of the MODIS process, the on-going refinement of the methodology and the dynamic nature of grassland systems, a state-wide assessment of native non-woody vegetation trend is not possible at this time. A case study, looking at the Border Rivers-Gwydir CMA, is presented in Section 5.1.2 to demonstrate DECCWs progress with the MODIS data.

3.3 NATIVE VEGETATION CONDITION BASELINE

SUMMARY OF FINDINGS

1. The State of the Catchment reporting found that in 2006 NSW contained 9% Residual Vegetation, 52% Modified Vegetation, 7% Transformed Vegetation, 19% Transformed/Replaced-Adventive Mosaic Vegetation, 12% Replaced-Managed Vegetation and 1% Removed.

The results of the state-wide analysis are displayed in and below Figure 26 and Figure 27 In 2006, NSW contained 9% Residual Vegetation, 52% Modified Vegetation, 7% Transformed Vegetation, 19% Transformed/Replaced-Adventive Mosaic Vegetation, 12% Replaced-Managed Vegetation and 1% Removed. The results can be further analysed by each CMA, and are displayed in Table 13, graphs are provided in Appendix 7.

Figure 26: Percent of total NSW land area represented by each of the six vegetation condition states (From Dillon et al 2009)

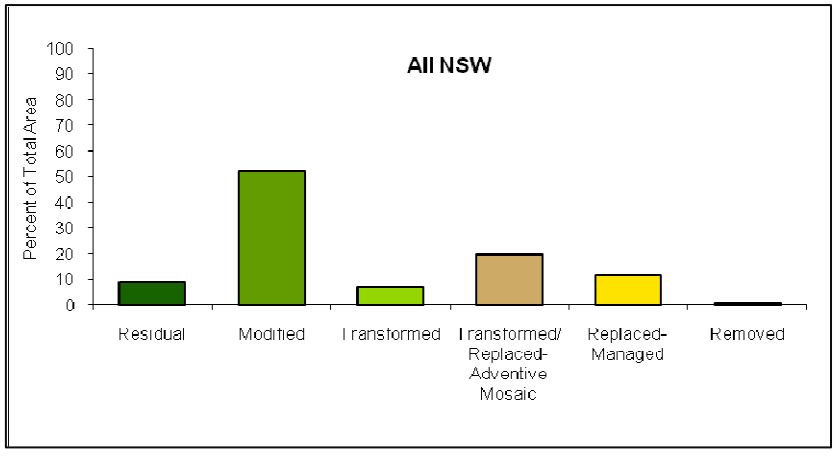


Figure 27: Vegetation condition states within NSW and the 13 Catchment Management Authority regions (From Dillon et al 2009)

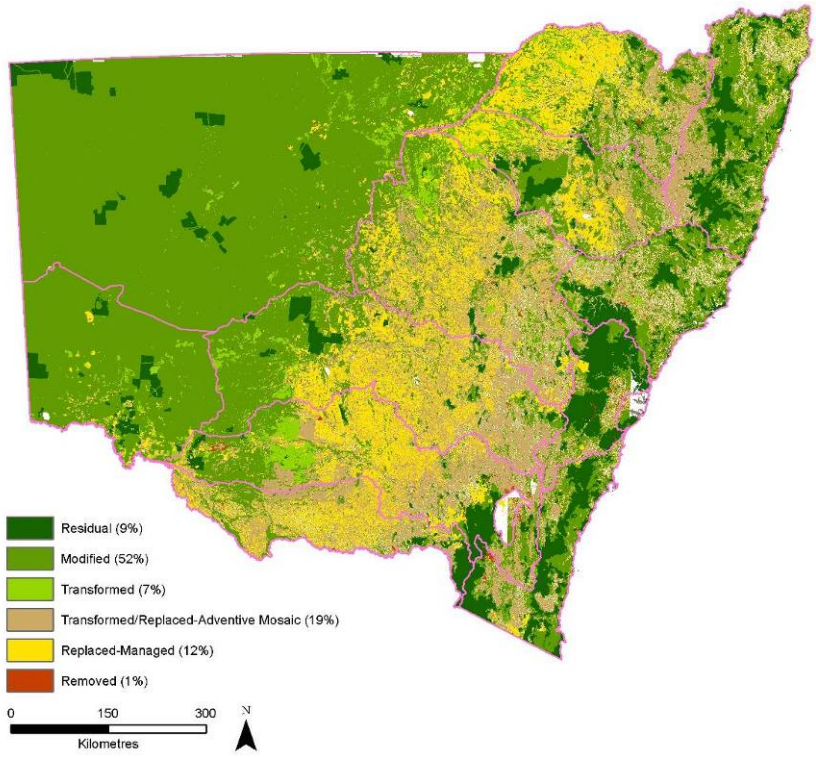


Table 13: Proportion of vegetation condition categories by CMA

	Residual (%)	Modified (%)	Transformed (%)	Transformed-Replaced Mosaic (%)	Replaced-Managed (%)	Removed (%)
NSW	9	52	7	19	12	1
Border Rivers-Gwydir	3.2	26.4	12.9	23.6	32.6	1.4
Central West	2.3	24.8	10.8	38.9	22.1	1.1
Hawkesbury-Nepean	47.4	22.2	5.5	17.8	3.1	4
Hunter-Central Rivers	19.1	33.5	15	27.4	2.8	1.3
Lachlan	4.3	34.9	7.3	31.2	21.6	0.6
Lower Murray-Darling	6.4	85.8	4	1.4	2.3	0.1
Murray	5.9	17.4	3.7	41.1	29.8	2
Murrumbidgee	6.8	23.6	9.4	35.8	22.5	1.9
Namoi	7.7	31.9	11.1	25.4	22.9	1
Northern Rivers	21.8	40.4	8.5	24.5	3.9	0.9
Southern Rivers	35.3	34.2	5	20.5	3.4	1.6
Sydney Metro	33.6	25.6	3.2	19.4	1.8	16.4
Western	3.9	91.7	2.8	0.6	0.9	0.1

Further analysis was conducted to generate a Vegetation Condition Index for the state and each CMA. The index generated is useful for comparing different regions of the state and may provide an additional option for the measurement of vegetation condition trend in the future. Each vegetation condition category was assigned an index based on the relative difference in vegetation condition between the six categories (Dillon et al 2009). These are displayed in Table 14.

Table 14: Vegetation condition category index weighting (From Dillon et al 2009)

Vegetation Condition Category (from VAST)	Index
Residual	80
Modified	60
Transformed	50
Transformed/Replaced-Adventive Mosaic	40
Replaced-Managed	20
Removed	5

The overall Vegetation Condition Index was then calculated by multiplying the percentage of each category by its associated index value. The results are displayed in Table 15, while an assessment of each of the index ranges is contained in Table 16. Overall, NSW scored a 'Fair' Vegetation Condition Index with a score of 51.5. The results for CMAs vary, ranging from 31 (Poor) for Sydney Metro CMA to 62 (Good) for Hawkesbury-Nepean CMA.

Table 15: Vegetation condition index for NSW and each CMA

	Index	Rating
NSW	51 / 100	Fair
Border Rivers-Gwydir	41 / 100	Fair
Central West	42 / 100	Fair
Hawkesbury-Nepean	62 / 100	Good
Hunter-Central Rivers	54 / 100	Fair
Lachlan	45 / 100	Fair
Lower Murray-Darling	60 / 100	Fair
Murray	40 / 100	Poor
Murrumbidgee	43 / 100	Fair
Namoi	46 / 100	Fair
Northern Rivers	57 / 100	Fair
Southern Rivers	61 / 100	Good
Sydney Metro	31 / 100	Poor
Western	60 / 100	Fair

Table 16: Vegetation condition index rating (From Dillon et al 2009)

Extent Index	Extent class
> 80 - 100	very good
> 60 - 80	good
> 40 - 60	fair
> 20 - 40	poor
0 - 20	very poor

3.4 NATIVE VEGETATION CONDITION TREND

The identification of vegetation condition is difficult as the measure of vegetation condition will differ between vegetation types, and in different parts of the State. The same limitations apply to monitoring the trend of vegetation condition at the state-wide level, and at this time the trend of native vegetation condition is not able to be reported directly.

Several other pieces of information are presented that may support an assessment of vegetation condition trend, including the information presented in Section 4 - 'Supporting Information' on the area of new conservation areas, restoration/revegetation of native vegetation and management of native vegetation compared to the areas of new clearing of native vegetation under the *Native Vegetation Act 2003*. This data demonstrates the large areas of conservation/management activities compared to the relatively small amount of clearing. In addition, analysis has been conducted into the amount of Government tenure across the state, and with each CMA region (Section 4.3). This analysis demonstrates that for some areas of the state, where Government tenure is dominant, vegetation extent and condition is relatively intact. Other regions, where Government tenure is not dominant, contain less native vegetation which is generally in 'poorer' condition.

Finally, case studies have been provided in Section 5 to demonstrate that work which is being conducted at finer scales, such as CMAs, that may lead to a more accurate and repeatable assessment of vegetation condition in the future.

4 Supporting Information

Although the information above on the baseline and trend of native vegetation extent and condition represents the best available data at the state-wide scale, additional supporting information is available from other programs and sources that will aid an Expert Panel in determining whether progress is being made towards the native vegetation target. The information is discussed below.

4.1 NATIVE VEGETATION REPORT CARD (1 JANUARY TO 30 JUNE 2008)

The Native Vegetation Report Cards provide a regular reporting framework to outline the conservation, restoration and revegetation, management and clearing of vegetation in NSW (DECC 2008b). The report cards are regularly available from DECCW, and the 1 January to 30 June 2008 version reviewed here is the fifth since the *Native Vegetation Act 2003* commenced and represents the latest information publically available (a more recent Native Vegetation Report Card has been produced, however at the time of completion of this report is not available).

The statistics displayed in the Native Vegetation Report Card, and outlined below, are compiled through a collaborative effort between the Department of Environment, Climate Change and Water (DECCW), Catchment Management Authorities (CMAs), the NSW Department of Primary Industries, the NSW Department of Lands and Forests NSW, with the majority of the information taken from DECCW databases (DECC 2008b). Two limitations are noted when considering this data:

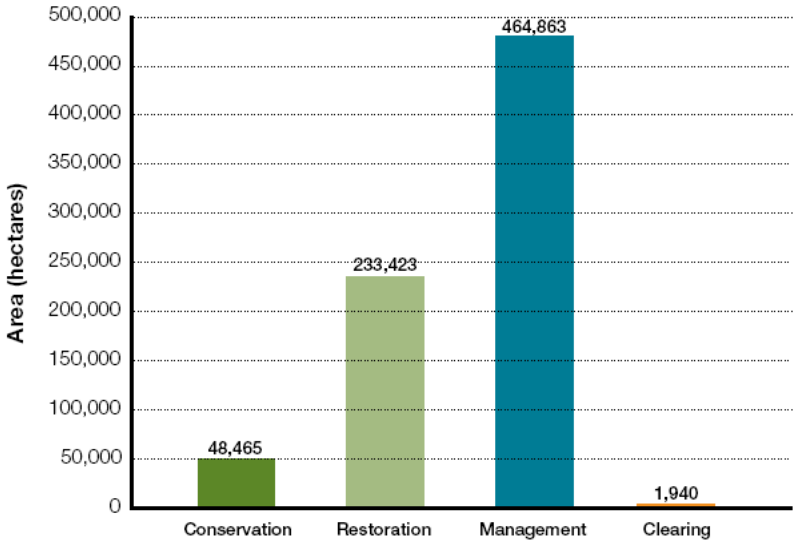
- The compiling of data across all CMAs to produce state-wide figures is difficult to achieve and the figures presented should be considered an estimate.
- The clearing of vegetation under the *Native Vegetation Act 2003* represents only a portion of all native vegetation clearing in NSW.

The figures captured include the following categories:

- New conservation areas (National Parks Estate, Forests NSW Flora Reserves, Voluntary Conservation Agreements, Wildlife Refuges - habitat retained, In Perpetuity PVPs).
- New restoration/revegetation of native vegetation (Incentive PVPs, PVP Offsets, Native Plantations, CMA funded revegetation, natural revegetation, retained as approval to clear area, Wildlife Refuges- habitat restored).
- New management of native vegetation (Invasive scrub PVPs, Thinning to benchmark, Public forest estate, Private native forestry on state protected land, Private native forestry PVPs, Weed removal programs).
- New clearing of native vegetation (clearing PVPs approved where improve or maintain test is met, Isolated paddock tree clearing, Clearing under *Native Vegetation Conservation Act 1997, Clearing under Plantations and Reafforestation Act 1999*).

Figure 28 below, taken from the Native Vegetation Report Card (DECC 2008b), shows the area of native vegetation that has been conserved, restored, managed and approved for clearing between 1 January 2008 to 30 June 2008. As can be observed from the figures, the proportion of vegetation cleared under the *Native Vegetation Act 2003,* the *Native Vegetation Conservation Act 1997*, and the *Plantation and Reafforestation Act 1999* in the six month period, compared to that conserved, restored or managed, is extremely small.

Figure 28: Area of native vegetation that has been conserved, restored/revegetated, managed and approved for clearing from 1 January 2008 to 30 June 2008. Taken from DECC 2008b.



Additional information is supplied on the trend of each of the categories, over 6 month intervals, since January 2006. These are displayed in Figure 29 and Table 16. The trend for all categories vary between each six month interval, with no obvious pattern, however the amount of clearing recorded is consistently considerably less than the amount of conservation, restoration and management recorded. Please note that each graph is plotted on a different scale.

This information has also been charted on the same scale, to enable direct comparison of the conservation, restoration and management of vegetation versus the clearing of vegetation. Figure 30 has been developed by combining the six monthly information contained in the Native Vegetation Report Card (DECC 2008b) and demonstrates the large area of vegetation under some form of management compared to clearing approvals granted.

The total approved clearing figure of 8,923 hectares since January 2006 is significantly less that the amount of woody vegetation clearing identified in Section 3.2.1. This is due to the Native Vegetation Report Cards only capturing the native vegetation approved to be cleared under the *Native Vegetation Act 2003, Native Vegetation Conservation Act 1997* and the *Plantations and Reafforestation Act 1999,* whereas the Woody Vegetation Change Monitoring Program captures all woody vegetation clearing. In total, clearing under the *Native Vegetation Act 2003* in NSW represents only a small proportion of all clearing conducted in NSW.

This data provides some evidence that since the introduction of the *Native Vegetation Act 2003* the amount of broad scale clearing has been far exceeded by the conservation actions being undertaken across the state, such as the dedication of new reserves, PVP incentive payments and other conservation and management programs.

Table 17: Area of clearing (hectares) by six month period. Adapted from DECC 2008b (Clearing approvals are associated with the *Native Vegetation Act 2003, Native Vegetation Conservation Act 1997* and the *Plantations and Reafforestation Act 1999*).

Six Month Period	New Conservation	New Restoration	New Management	New Clearing
Jan-Jun 2006	103,627	232,767	50,906	2,200
Jul-Dec 2006	30,313	82,615	402,059	860
Jan-Jun 2007	136,844	337,916	727,862	357
Jul-Dec 2007	40,419	127,088	635,457	3,566
Jan-Jun 2008	48,465	233,423	464,863	1,940
Total	**359,668**	**1,013,809**	**2,281,147**	**8,923**

Figure 29: Area of native vegetation that has been (a) conserved (b) restored (c) managed and (d) approved for clearing, from 1 January 2006 to 30 June 2008

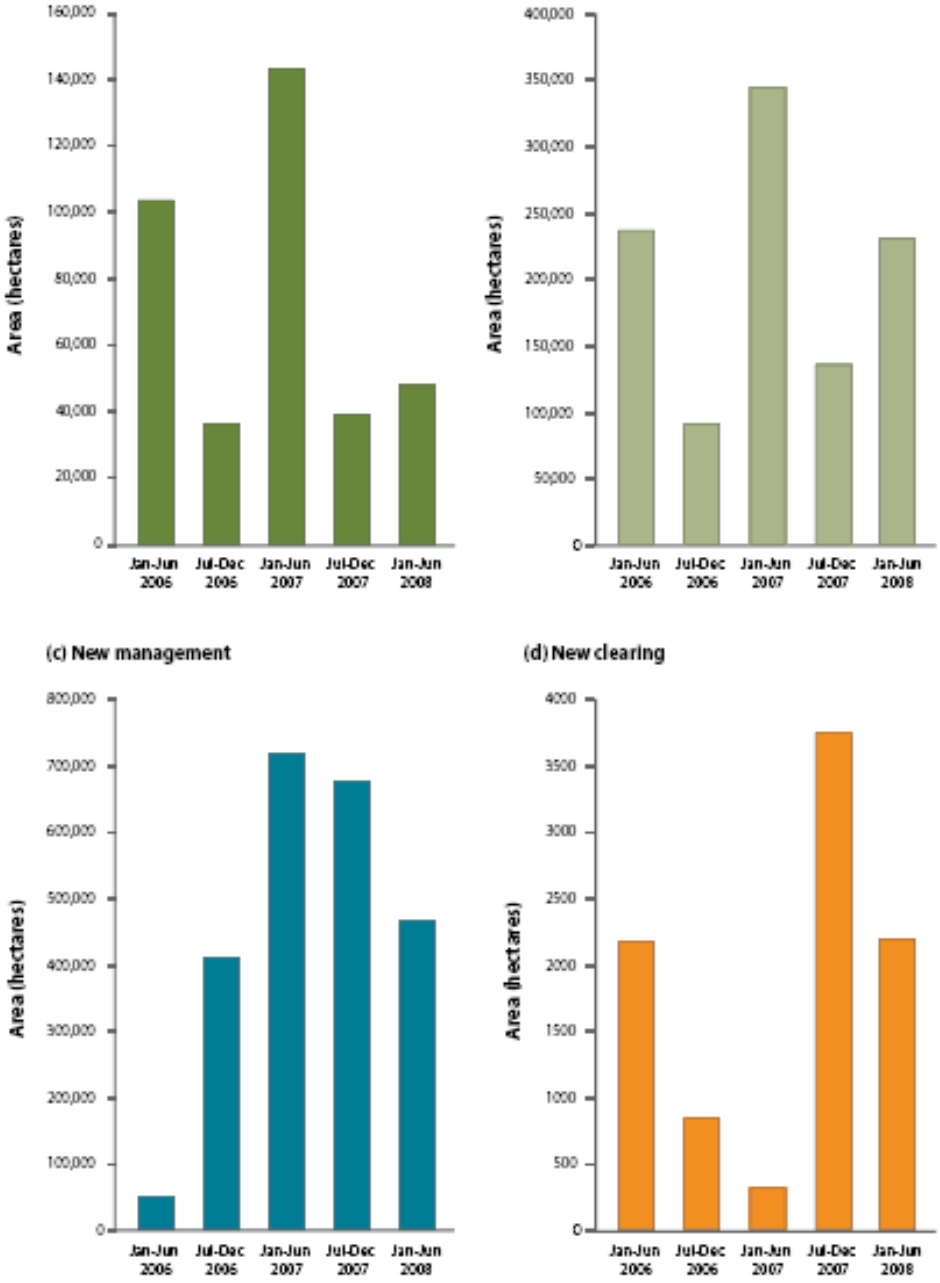
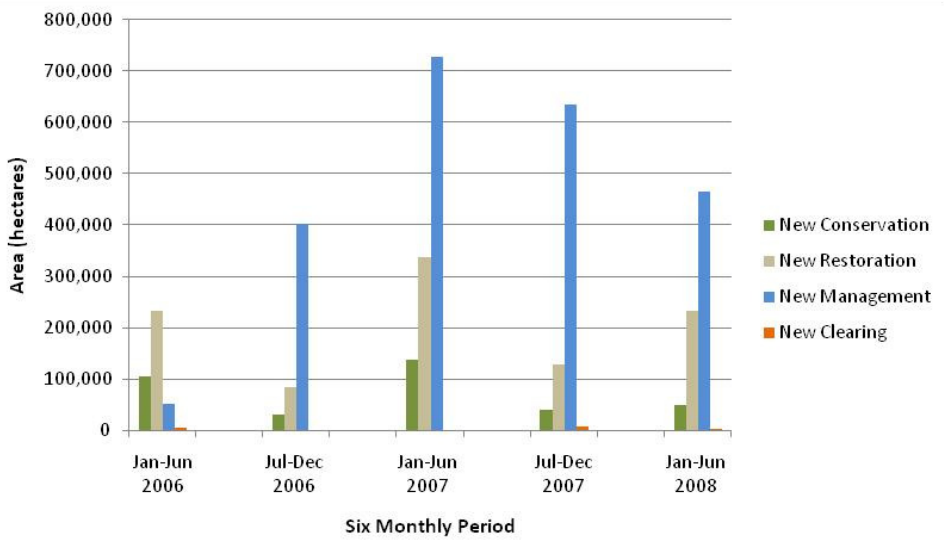


Figure 30: Area of native vegetation that has been conserved, restored/revegetated, managed and approved for clearing in NSW from 1 January 2006 to 30 June 2008. Adapted from DECC 2008b



4.2 STATUS AND TRENDS IN AUSTRALIA'S NATIVE VEGETATION

At the 2008 Vegetation Futures Conference Sue McIntyre and Richard Thackway presented a presentation titled 'Status and Trends in Australia's Native Vegetation' (McIntyre and Thackway 2008). The presentation consisted of two parts:

1. Vegetation clearing status across the states
2. Vegetation condition

The presentation summarised the extent and level of broad-scale clearing on a state-by-state basis, and concludes that broad-scale clearing in Australia has largely ceased due to changes in legislation in many of the states. The presentation initially examined the amount of broad-scale clearing occurring on a yearly basis, at a national scale. In this presentation vegetation cover was defined as Kyoto Forest, that is woody vegetation cover >2m tall and >20% cover defined for the purposes of reporting against the Kyoto initiatives. The national yearly clearing trend (1977-2004) is displayed below in Figure 31, and clearly displays a maximum clearing rate in the early 1980s, with the clearing declining more recently.

The change in the distribution of Kyoto Forest between 1972 and 2005-06 was also examined for each state (Table 17). For most states a negative trend in Kyoto Forest cover was recorded, however for NSW a +0.05% change was observed in the 2005/06 data (i.e. an increase in Kyoto Forest woody vegetation cover). This is further expressed in Figure 32 as a percentage of the state. As can be seen for NSW, there was a general trend up in Kyoto Forest between 1977 and the mid 1990's, with Kyoto Forest relatively static since that time.

Figure 31: National broad scale clearing 1977-2004 (National Carbon Accounting System (1977-2004)

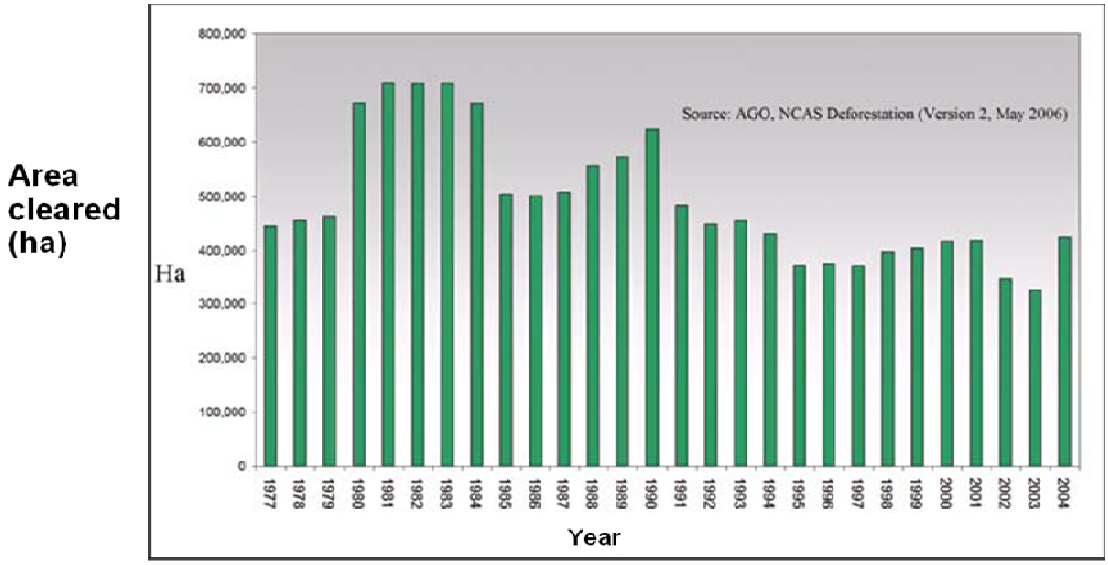
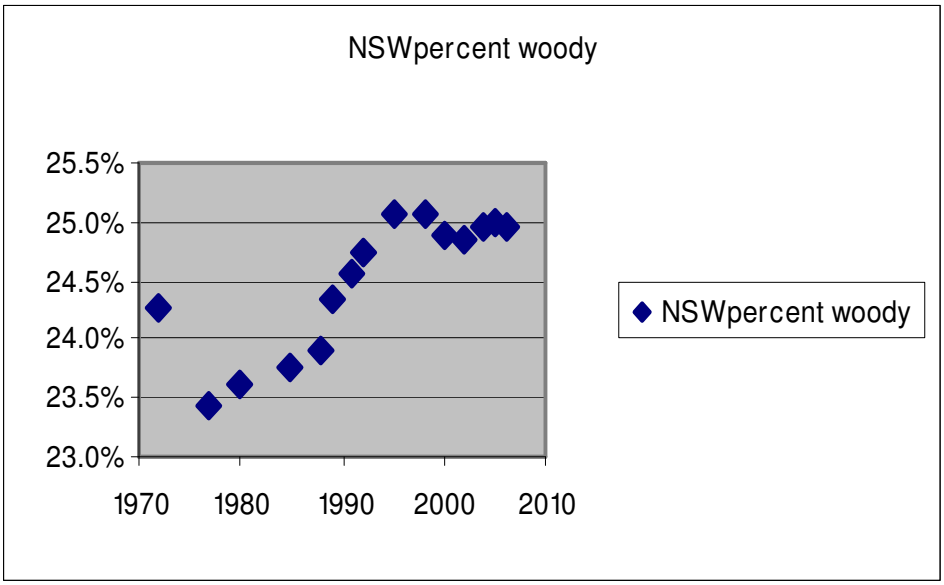


Table 18: 2005-06 change of 'Kyoto Forest' in Australia (Taken from McIntyre and Thackway 2008)

	% change 2005-6
QLD	-0.4
WA	-0.2
NSW	0.05
VIC	-0.9
NT	-2.2
SA	-0.9
TAS	-0.4
ACT	-1.6
Total	-0.47

Figure 32: Kyoto forest cover changes from 1972 to 2006 expressed as percent of total state area (From McIntyre and Thackway 2008)



The assessment of vegetation condition was also examined during the presentation. It was noted that the measuring of condition across large regions was not able to be achieved as the technology has not yet been developed to adequately assess condition remotely, and that appropriate benchmarks do not exist for many vegetation types. It was concluded that there was a need to detect condition change and the clearing of ground layers remotely, as well as for methodologies to continue to be developed for this purpose.

4.3 NSW GOVERNMENT TENURE

The land tenure in NSW, and the resulting underlying land use and land management practises, has played a major role in determining native vegetation extent and condition throughout the state. The extent and condition of the vegetation within National Parks and Wildlife Estate, and to a lesser extent State Forests, in general remains very good, while the far west of the state, which is generally crown land leased by the land holder, remains in relatively good condition due to the land management restrictions on the land holders.

Some analysis has been conducted into the amount of the state, and each CMA, within the main Government tenures of National Parks and Wildlife Estate, State Forests and Crown Lands. The results of the analysis can be seen in Table 19 and Figure 33.

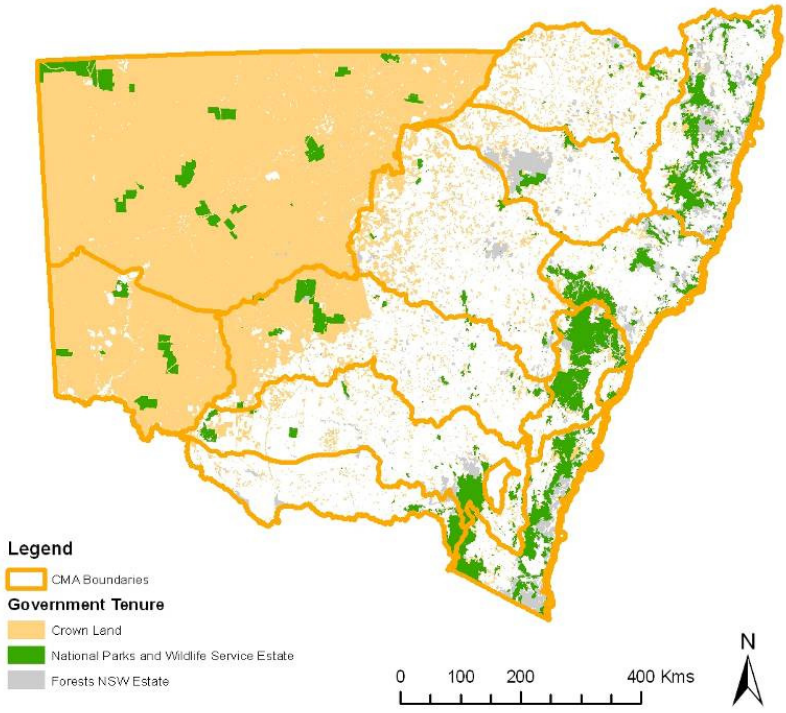
Table 19: Area of different government tenure types in NSW, and each CMA

	Total Area (ha)	Area of Crown Land (ha)	Area of National Parks Estate (ha)	Area of Forests Estate (ha)
NSW	80,121,864	34,605,415 (43.2%)	6,297,354 (7.9%)	2,801,443 (3.5%)
Border Rivers-Gwydir	5,087,880	774,408 (15.2%)	101,681 (2%)	85,041 (1.7%)
Central West	8,484,181	1,526,519 (18%)	117,782 (1.4%)	255,698 (3%)
Hawkesbury-Nepean	2,177,929	120,156 (5.5%)	972,466 (44.7%)	87,474 (4%)
Hunter-Central Rivers	3,587,264	169,877 (4.7%)	647,983 (18.1%)	293,902 (8.2%)
Lachlan	8,609,555	3,018,357 (35.1%)	378,834 (4.4%)	121,514 (1.4%)
Lower Murray-Darling	6,293,533	5,682,354 (90.3%)	253,325 (4%)	28,598 (0.5%)
Murray	3,535,137	181,468 (5.1%)	207,440 (5.9%)	159,323 (4.5%)
Murrumbidgee	6,963,088	680,856 (9.8%)	500,860 (7.2%)	211,302 (3%)
Namoi	4,200,517	443,648 (10.6%)	140,545 (3.3%)	433,181 (10.3%)
Northern Rivers	5,038,559	224,483 (4.5%)	1,027,919 (20.4%)	699,705 (13.9%)
Southern Rivers	2,971,380	148,826 (5%)	1,026,467 (34.5%)	415,175 (14%)
Sydney Metro	202,803	10,499 (5.2%)	31,433 (15.5%)	69 (0%)
Western	22,970,037	21,623,966 (94.1%)	890,618 (3.9%)	10,463 (0%)

Note: Figures calculated using Lamberts Conformal Conic Projection using NPWS Estate layer (2008), Forests NSW layer (2008) and Crown polygon layer (2008).

In general terms, the CMAs that recorded the best vegetation extent and condition results have the highest Government tenure recorded (Western and Lower Murray-Darling CMAs). This is due to the leasehold nature of the land, and the resulting restrictions on land management. Not surprisingly the converse is also true, with the poorest CMAs in terms of vegetation extent and condition containing the least Government tenure, including the Murray, Border Rivers-Gwydir, Murrumbidgee, Sydney Metro and Central West CMAs. This information can be used to help identify those areas in which land use change is causing increased vegetation removal, and priorities for high resolution data capture to monitor such change (such as those outlined in the case studies in Section 5) can be identified.

Figure 33: Distribution of government tenure in NSW



5 CMA Case Studies

To demonstrate the work currently underway in different parts of the state, which will improve the ability in the future to report on native vegetation extent and condition, case studies into work currently being undertaken or recently completed in several CMAs are presented below.

LINKING STATE-WIDE AND REGIONAL TARGET ACTIVITIES

The data collected by the CMAs provides additional detail than that collected by the state-wide programs, namely the information on Regional Vegetation Communities (RVCs) and site based plot data. This data can be used by the state-wide programs to:

- Derive a vegetation condition surface for woody vegetation types through the comparison of RVC benchmarks with FPC values from the SLATS methodology
- Verify the state-wide assessments undertaken by DECC, such as using site based plot data to determine the accuracy of the VAST condition surrogate layer

Such analysis and data verification will lead to continued improvement in the data collected at the state-wide scale.

5.1 BORDER RIVERS - GWYDIR CMA

The materials presented have been provided by the DECCW to demonstrate the progress in mapping, and monitoring, vegetation change at finer scales. Should the resources and funding be available to collect the required data for the remainder of NSW, or priority regions, the information would provide a more accurate assessment of the progress towards the native vegetation target than is currently being achieved. The case studies presented focus on the following:

- Mapping of vegetation extent and condition using fine scale input data (Section 5.1.1)
- Mapping of non-woody vegetation trend using MODIS and NDVI (Section 5.1.2)
- Advancements in the mapping of trends in woody vegetation extent, including the identification of vegetation types and landscapes being targeted by clearing practises, and land uses responsible for the clearing (Section 5.1.3).

5.1.1 Mapping of High Conservation Value (HCV) Vegetation & Areas for Revegetation

The 'Mapping of HCV/Riparian Vegetation and Priority Areas for Revegetation' Project was undertaken by DECCW for the Border Rivers-Gwydir CMA. The total cost was approximately $400,000, and the project term was originally 12 months, which was further extended by 12 months (DECC 2009b).

Although the core information developed for the BRG CMA as part of this project was a series of map products which identified HCV and riparian vegetation, and priority locations for revegetation of HCV

and riparian vegetation, in creating these products DECCW utilised a series of existing data layers to produce additional information which in the future will provide the ability to more accurately report on the baseline and trend of vegetation extent and condition within the Border Rivers-Gwydir (BRG) region. The existing information utilised during the project includes cropping footprint and cropping history mapping, vegetation type mapping and Foliage Projected Cover (FPC) generated from the SLATS project. The new data generated includes digital information on the:

- Extent native woody vegetation
- Current land use
- Regional Vegetation Classes (RVCs)
- Past distribution of RVCs
- Vegetation condition surface.

The project was completed using the following broad tasks (DECC 2009b):

1. Development of a composite Aerial Photograph Interpretation (API) map from existing API within Border Rivers-Gwydir CMA.
2. Infilling the composite API map with new API where vegetation was not mapped.
3. Spatially model Regional Vegetation Classes (RVCs) using Generalised Dissimilarity Modelling approaches to produce a pre-clearing distribution map RVCs.
4. Generation of a map of 2005 native vegetation utilising land use and SLATS data.
5. Generation of catchment wide HCV and revegetation priority maps.

During the project, the annual cropping footprint information available for the BRG region was utilised to identify areas of summer and winter cropping between 1998-2008, within the BRG CMA region. This information, which has been collected for BRG and Namoi CMAs through work carried out by DECCW, captures the number of years since the last crop and the frequency of cropping for the CMA (Figure 34 and Figure 35). The data was acquired through the analysis of Landsat imagery undertaken at the expected maximum winter and summer cropping periods, and represents the best available information of the non-woody landscape.

A current woody vegetation extent map was compiled through FPC data provided by the Woody Change Monitoring Project through the SLATS process; using 12 epochs to improve the accuracy of the layer (DECC 2009b). This is shown in Figure 36. This map was then combined with the RVC modelled vegetation data to compile an extent woody vegetation type map.

Figure 34: Year of last cropping (1998-2008). From DECC 2009b.

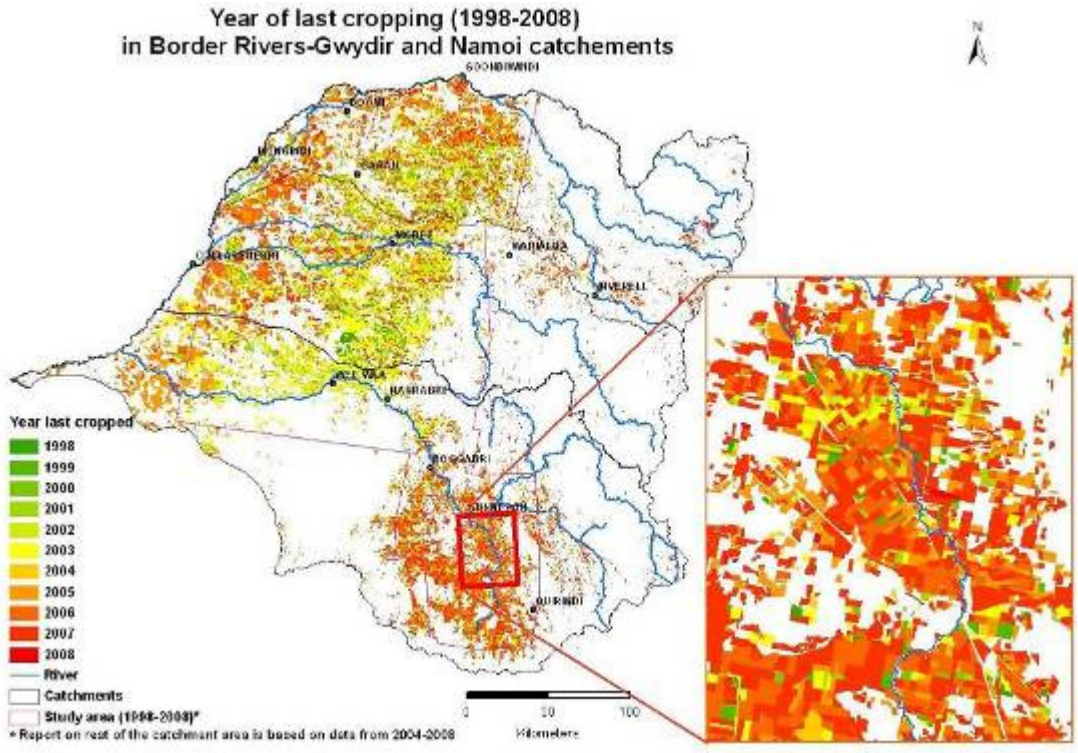


Figure 35: Cropping intensity (number of years cropped during 1998-2008. From DECC 2009b.

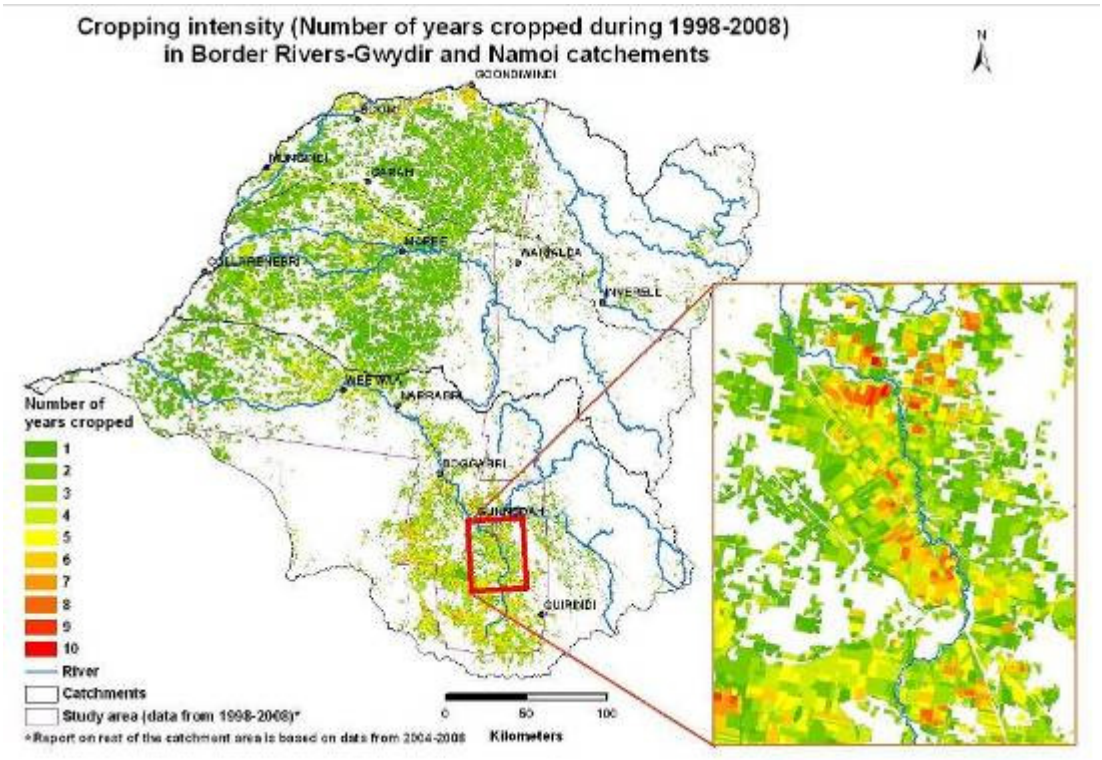
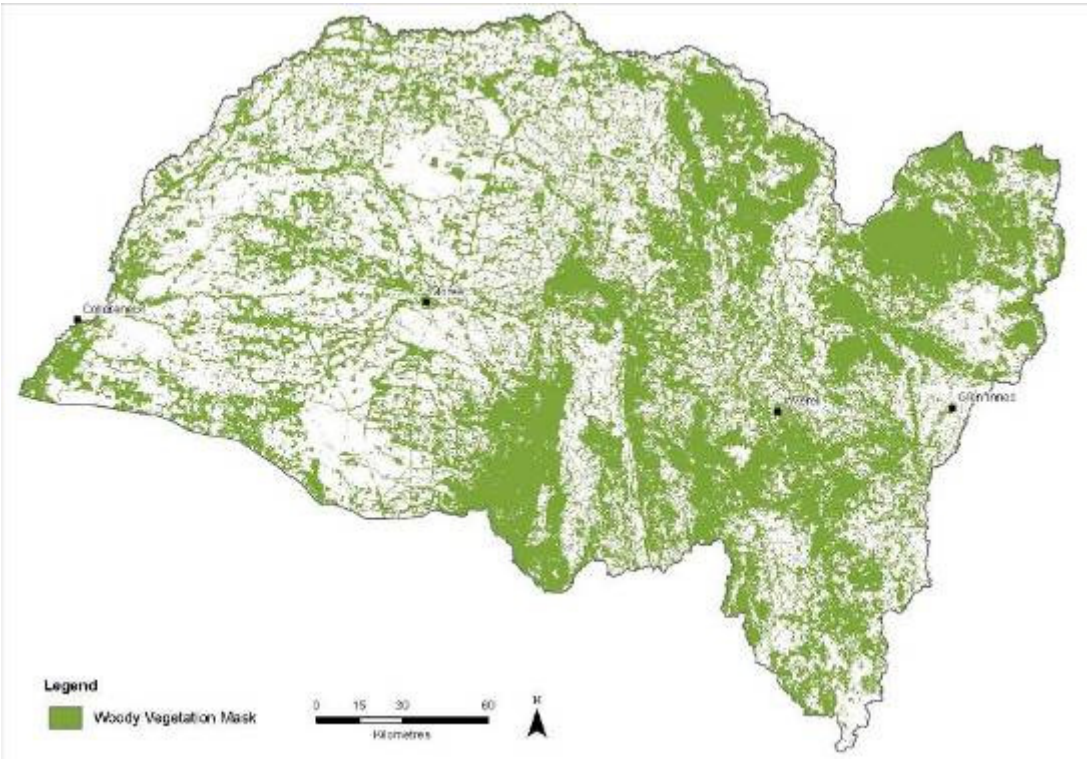


Figure 36: Current extent of woody vegetation. From DECC 2009b.

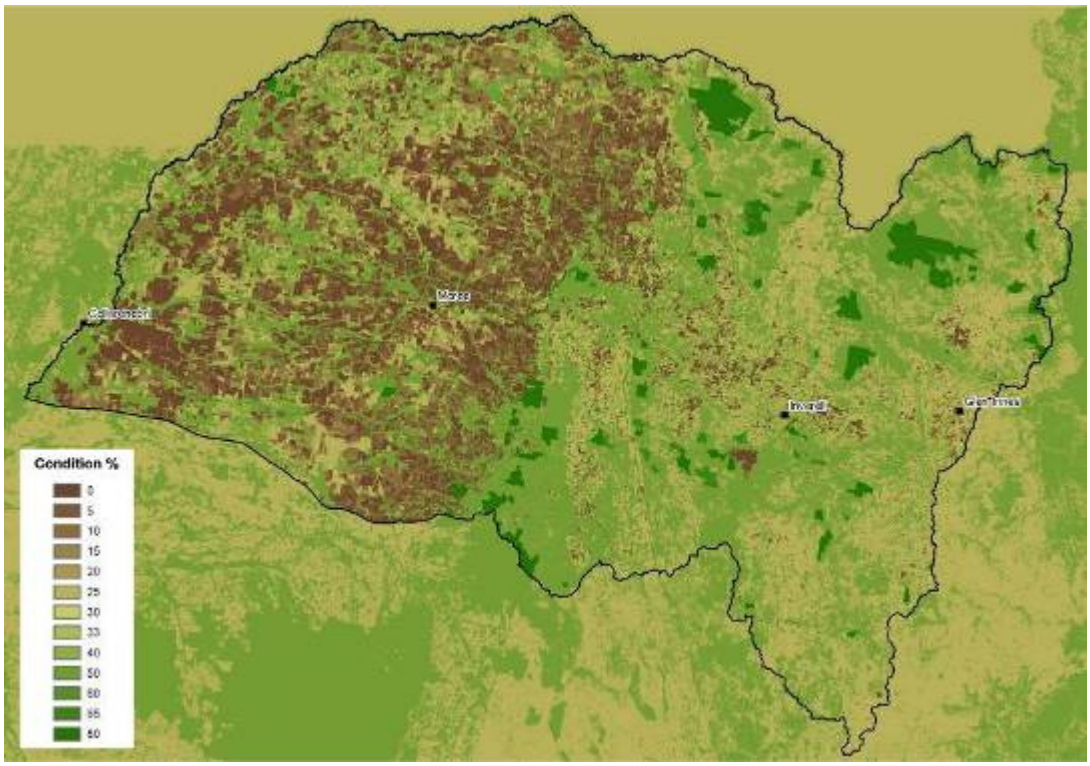


A vegetation condition surface layer (which represents a more refined product than the VAST products completed for the State of the Catchment Reports) was then developed (Figure 37). A score closer to 100 represents better condition vegetation, and the layer was developed using the following inputs;

- Regional Vegetation Class Vegetation map
- SLATS woody extent map
- Cropping history data
- Land tenure (conservation reserves, TSRs, State Forests, private land)
- Land use and land cover expert derived condition scores

The data and information presented demonstrates that the collection of finer scale baseline data for vegetation extent and condition within the BRG CMA region has been completed. Should future iterations of this data be developed using similar methodologies the information collected will enable the monitoring of native vegetation within the region, particularly trend information for native vegetation extent and condition, to a greater accuracy than is available for the majority of the state.

Figure 37: BRG vegetation condition surface



5.1.2 Mapping of Non-Woody Vegetation Trend

The Moderate Resolution Imaging Spectroradiometer (MODIS) offers new possibilities for large-area land cover mapping by providing a near-daily global coverage of science-quality, intermediate resolution (250 m) data since February 2000 at no cost to the end user. At present, a state-wide study is being conducted by DECCW to investigate the applicability of time-series MODIS 250 m Enhanced Vegetation Index (EVI) data for regional-scale, dynamic land cover mapping in the NSW area. A new land cover mapping methodology, which applied a decision tree classification technique to a time series of MODIS 250 m VI data spanning from February 2000 to December 2008, has been tested over the state. A hierarchical decision tree type classification scheme has been implemented, which produced a series of land cover types that progressively summarized into six broad land cover classes, namely: woody, native non-woody, non-native non-woody, crop, bare and water bodies.

The following details apply to the case study:

- Utilised 204 epochs, commencing from 18 February 2000
- Comprised of over 1020 Terra-MODIS VI tiles
- Assessed at a spatial resolution of 250m
- Based on a decision tree based analyses using 8 parameters derived from the MODIS data set, including long-term mean, long-term standard deviation, annual mean, seasonal mean, seasonal min, seasonal max, seasonal standard deviation and any evidence of cropping.

Figure 38 to Figure 41 demonstrate the quality of the data that is now able to be obtained through the use of MODIS data. The variability of the non-woody system is obvious from Figure 28 and Figure 29, where the yearly results fluctuate, particularly for non-native non-woody vegetation. DECCW are currently finalising the methodology and decision tree components of this work and the results of the analysis will be available shortly.

Figure 38: Broad land cover types in Border Rivers-Gwydir and Namoi catchments

Season	Crop	Bare	Water	Woody	Non woody		
					native	non native	Total
2005w	18.8%	0.1%	0.2%	36.0%	21.2%	23.7%	44.9%
2005s	5.7%	0.0%	0.1%	39.1%	17.9%	37.2%	55.1%
2006w	8.4%	0.2%	0.1%	41.6%	15.6%	34.1%	49.7%
2006s	2.8%	0.3%	0.1%	41.4%	15.6%	39.8%	55.3%
2007w	10.8%	0.5%	0.1%	41.9%	14.7%	32.1%	46.7%
2007s	6.2%	0.1%	0.1%	37.1%	19.3%	37.2%	56.5%
2008w	15.8%	0.1%	0.1%	42.4%	14.7%	26.9%	41.7%
Average	9.8%	0.2%	0.1%	39.9%	17.0%	33.0%	50.0%

Figure 39: Broad land cover types of the BRG region

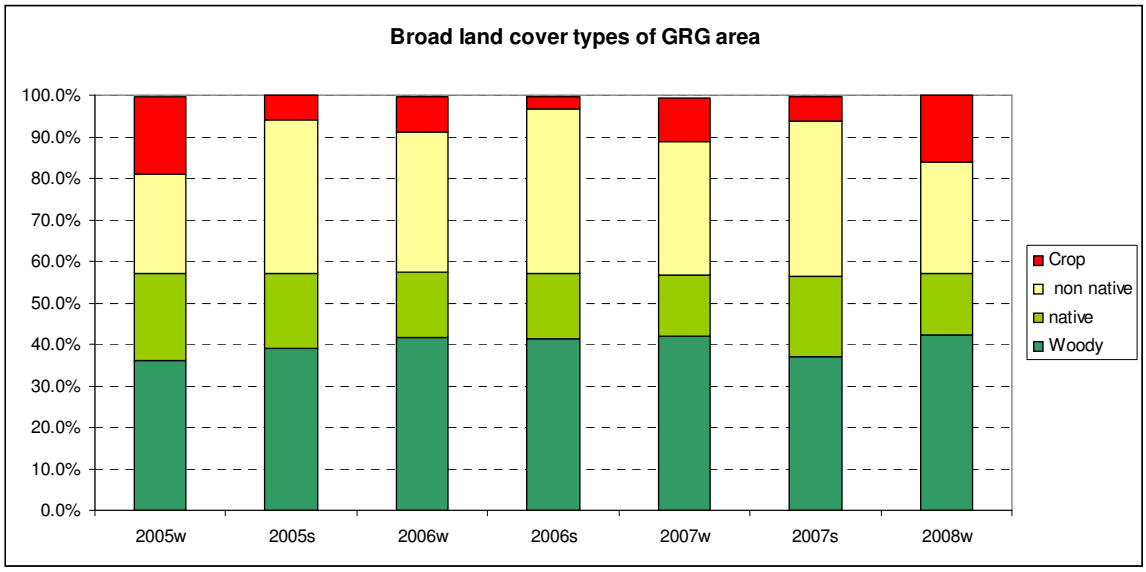


Figure 40: Major land cover types (2008) in the BRG and Namoi CMA regions

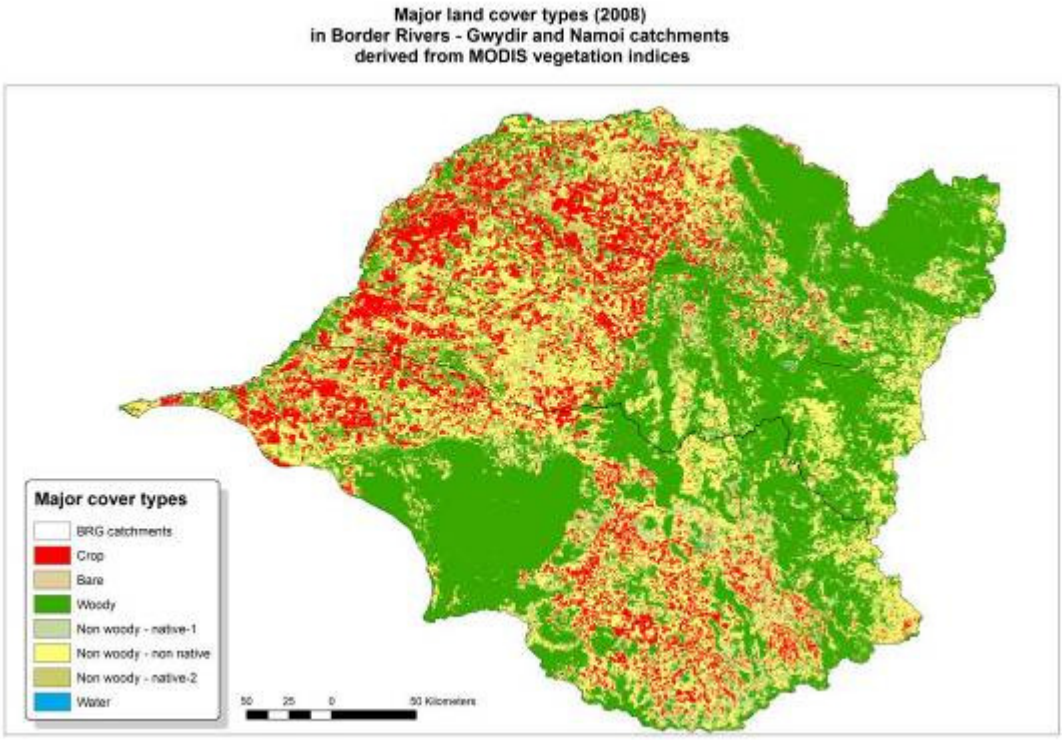
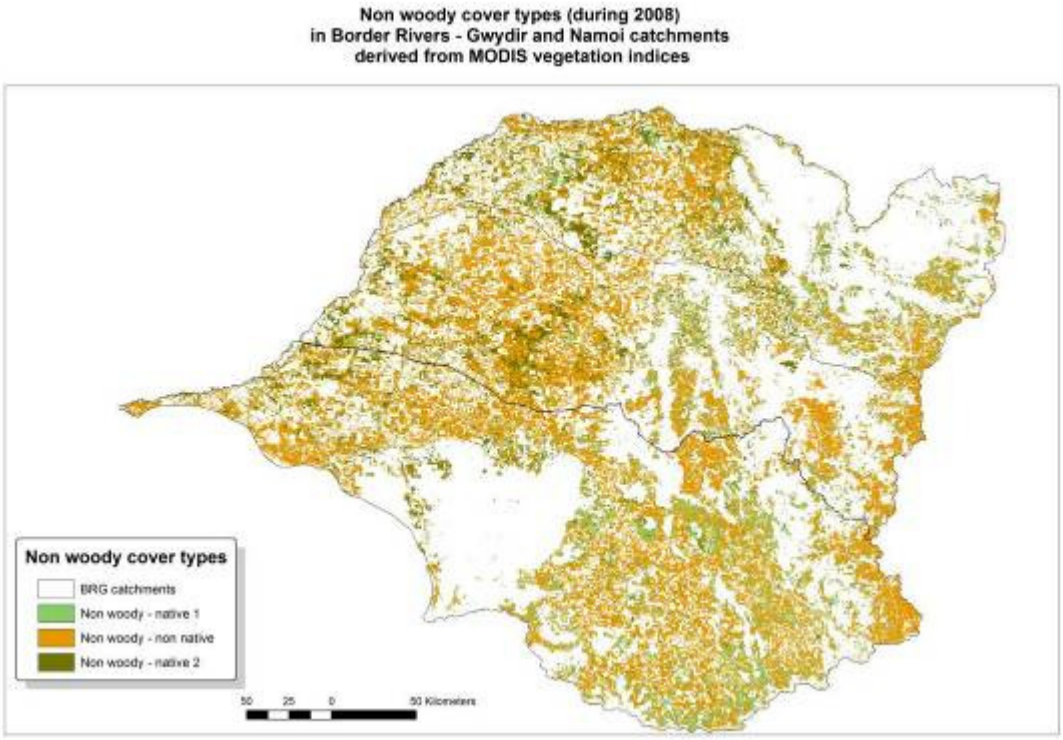


Figure 41: Non woody cover types (during 2008) in BRG and Namoi CMA regions



5.1.3 Quantifying Trends in Woody Vegetation Clearing in the Border Rivers-Gwydir CMA

DECCW have prepared a report for inclusion into this document to demonstrate the recently completed work into the trends in woody vegetation clearing in the Border Rivers-Gwydir CMA. As a summary, the report demonstrates that the area of woody vegetation clearing rose (by a very small amount) between 2004/06 and 2006/08. The report also demonstrates DECCWs ability to now report on woody vegetation clearing to a finer scale, and identify trends within the landscape leading to the clearing of vegetation. This includes the ability to track clearing by:

- Regional Vegetation Class (RVC)
- Land Use
- Mitchell Landscapes
- Cropping History
- Ruggedness.

Please see below for the report provided by DECCW.

Introduction

The following report presents the results of part of a case study prepared for the Natural Resources Commission by the Department of Environment, Climate Change and Water (DECCW). It was designed to illustrate the potential use of new data sets being developed from remotely sensed imagery by DECCW to quantify trends in vegetation extent.

Method

The following data was used in the case study:

- Negative change in woody extent for the Border Rivers-Gwydir CMA, for 2004-2006 and 2006-2008. Each point in each data set represents clearing of a 25 m by 25 m pixel of woody vegetation between the two years specified. As the acquisition dates of the satellite imagery used to determine vegetation clearing vary, the two year periods are only approximations.
- Draft composite API Regional Vegetation Classes for the Border Rivers-Gwydir CMA.
- Land-use classes for the Border Rivers-Gwydir CMA.
- Mitchell Landscapes of NSW.
- Cropping history for the Border Rivers-Gwydir CMA. This has been quantified as the number of seasons that each paddock has been cropped between 1998 and 2009.
- Ruggedness classes for the Border Rivers-Gwydir CMA, created from the 1 second (25 m) SRTM elevation grid. Ruggedness, defined as the standard deviation of elevation within a 2000 m circular area, was classified from 1 (least rugged) to 10 (most rugged) according to 10 quantiles of mean ruggedness within polygons created from object-oriented segmentation of the ruggedness grid.

All data was reprojected into the same datum and coordinate system (GDA 1994, MGA Zone 55), and clipped to the same extent (Border Rivers-Gwydir CMA boundary). The polygon layers were edited to ensure a complete coverage of the CMA region with no gaps or holes, and to ensure each polygon had been classified and had a unique identification number.

The point data identifying locations of woody clearing were assigned the identification numbers of the polygon in which they were located. This data was summarised, to give a count of points within each polygon, which was converted to an estimate of the area cleared in square metres. The summaries were then used to create histograms and maps of the percentage of woody vegetation cleared within each class for each time period. The maps and histograms were assigned colours by splitting the data into five quantiles (excluding areas of zero clearing).

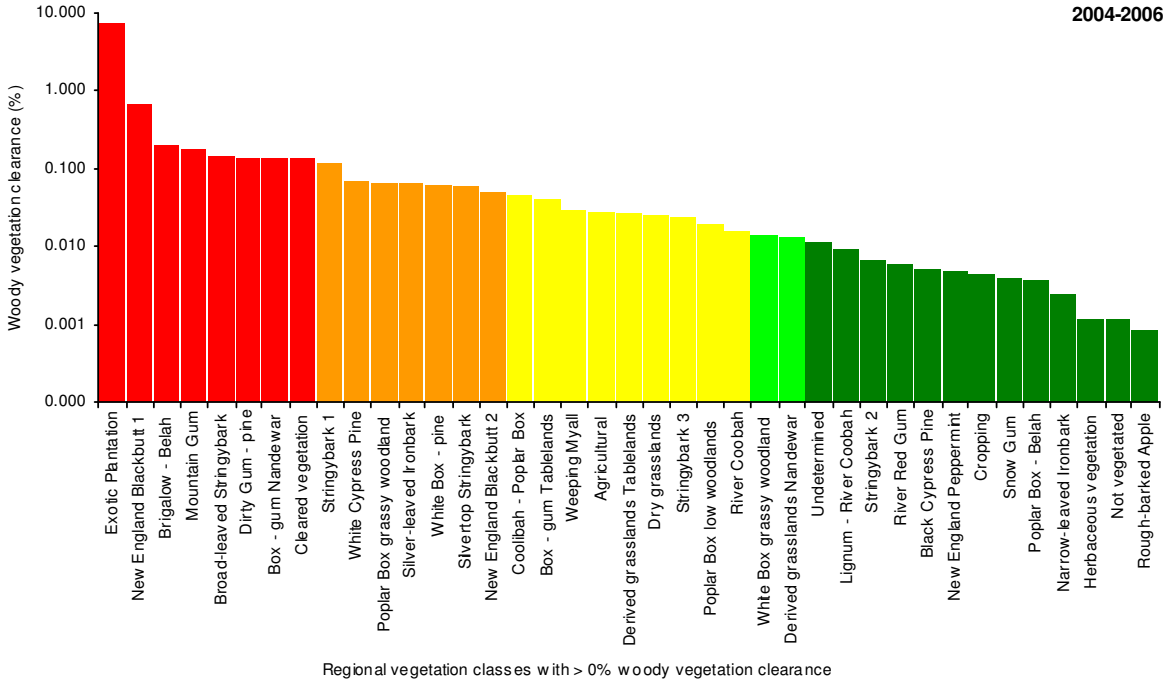
Results

For the whole of the Border Rivers-Gwydir CMA woody clearing percentages increase from 0.03 % in 2004-2006 to 0.22 % in 2006-2008. These low percentages make analysis of the relationships between woody vegetation clearing and land classes difficult, as it is harder to determine whether a trend is significant. Keeping this in mind the results are presented as a series of histograms and maps (Figures 42 – 51). The histograms show which classes were cleared, and how much they were cleared, while the maps give an indication of the location of these classes. Due to the range of data values some of the histograms are presented with a logarithmic scale.

When interpreting the maps it is important to realise that the colours do not indicate that clearing has occurred at any particular location: rather, they indicate that the class mapped at that location has experienced clearing in the CMA as a whole. The histograms and maps were designed to highlight relationships between mapped attributes of the land and the amount of woody vegetation clearance, and show how these relationships change over time. They are not designed to show specific locations of woody vegetation clearing, which would be better visualised through other means.

Figure 42: Histogram (logarithmic scale) and map of woody vegetation clearing within Regional Vegetation Classes, Border Rivers-Gwydir CMA, 2004-2006.

3.1. Regional Vegetation Classes



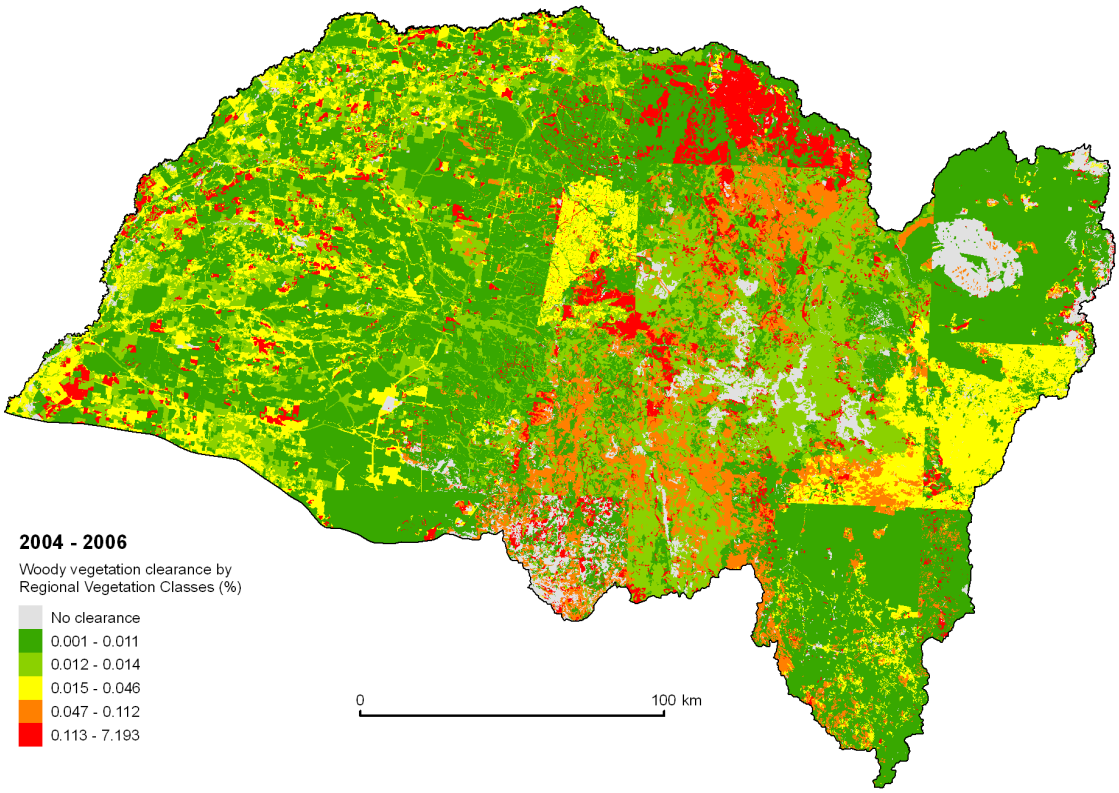
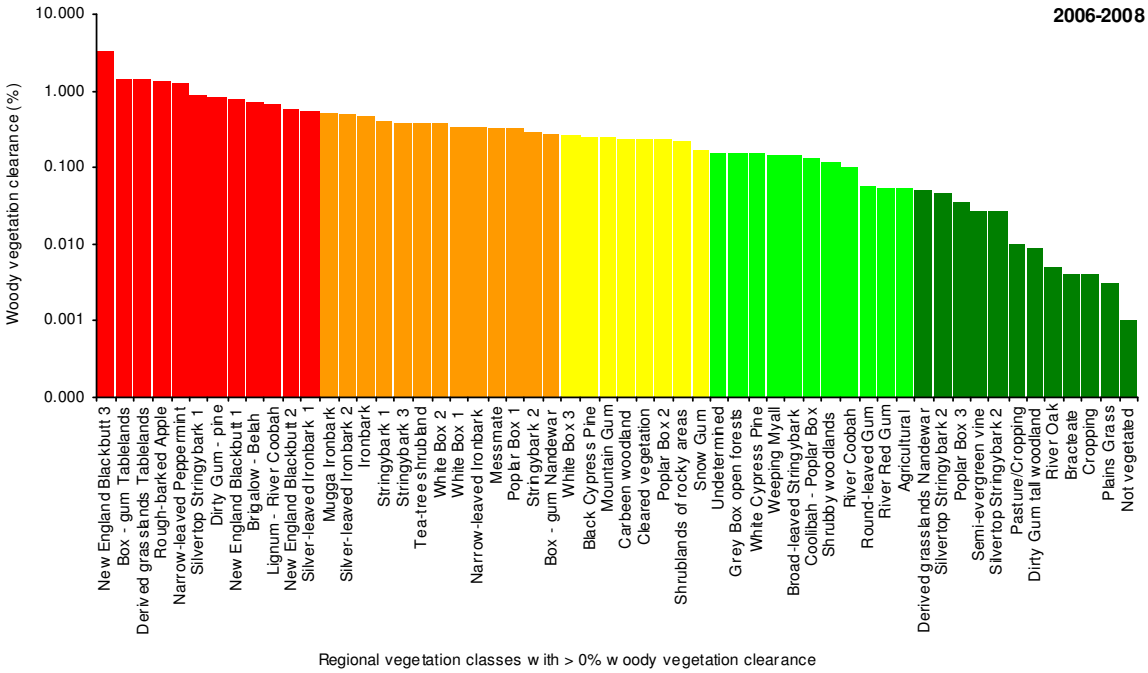


Figure 43: Histogram (logarithmic scale) and map of woody vegetation clearing within Regional Vegetation Classes, Border Rivers-Gwydir CMA, 2006-2008.



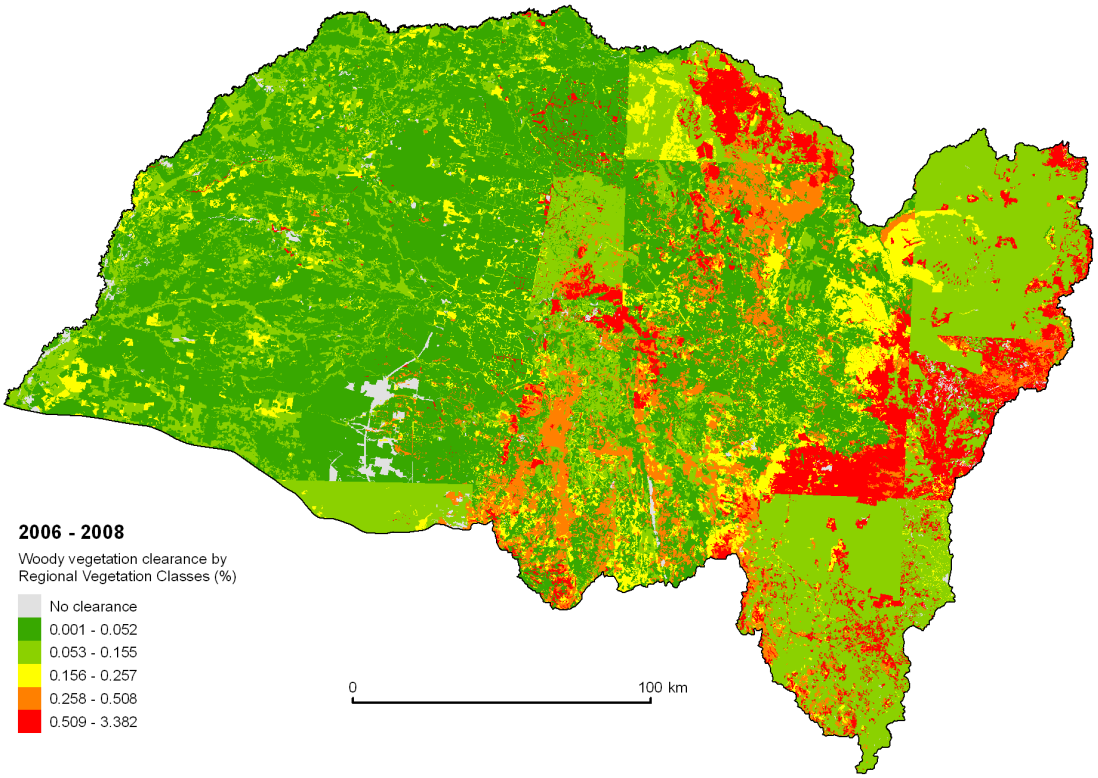


Figure 44: Histogram (logarithmic scale) and map of woody vegetation clearing within land-use classes, Border Rivers-Gwydir CMA, 2004-2006.

3.2 Land-use

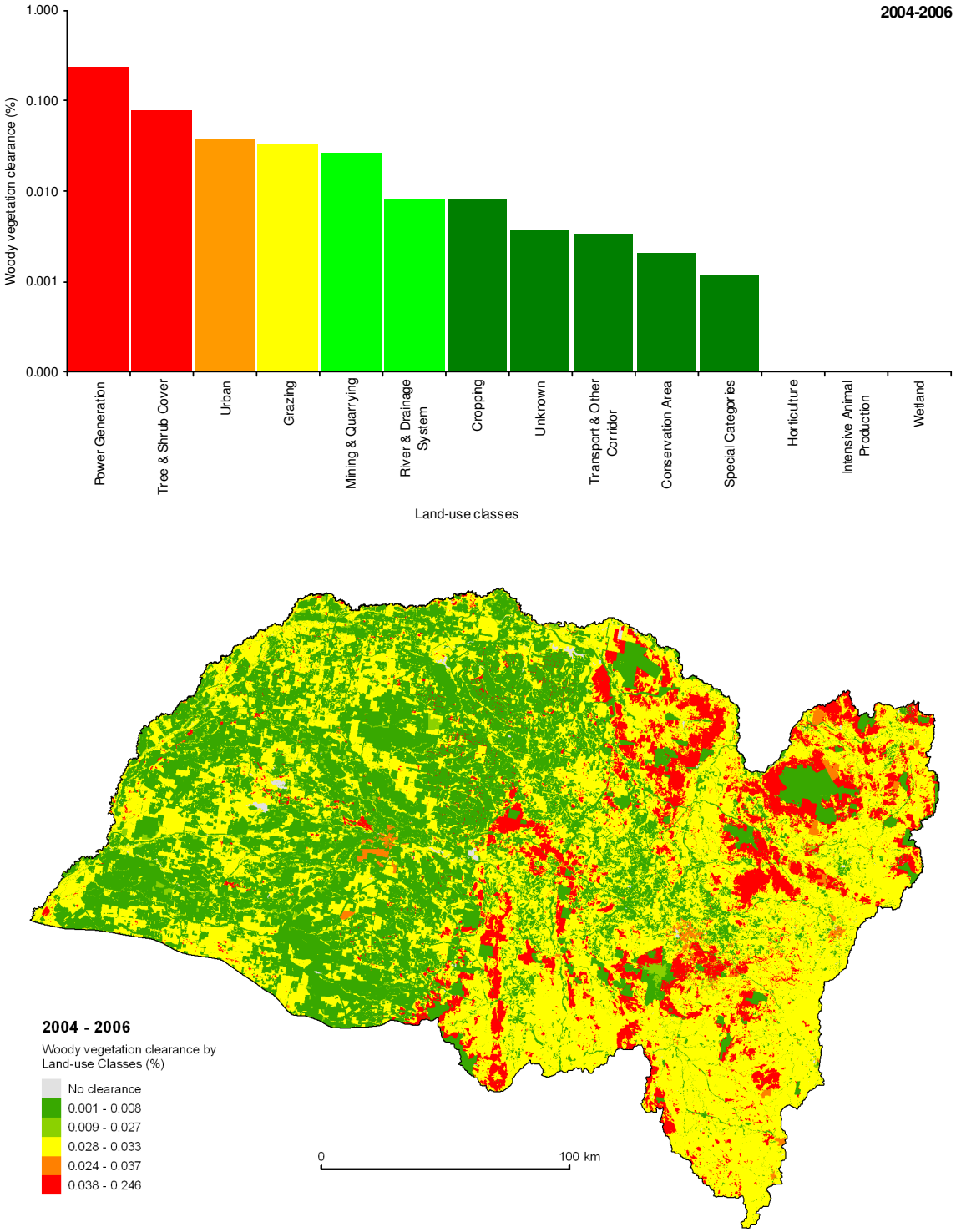
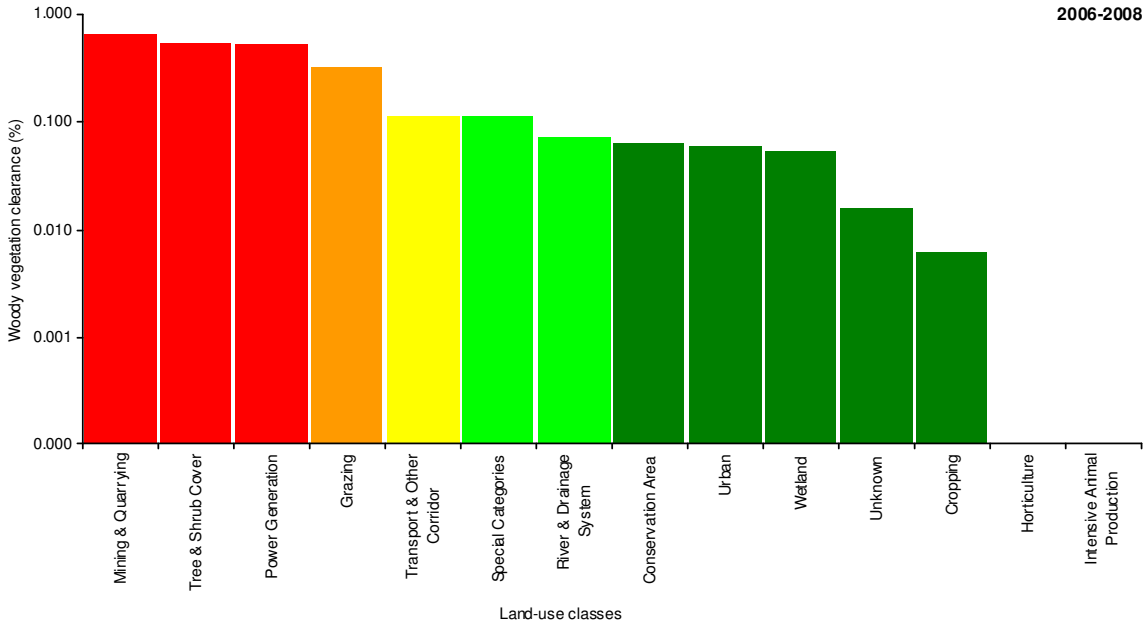


Figure 45: Histogram (logarithmic scale) and map of woody vegetation clearing within land-use classes, Border Rivers-Gwydir CMA, 2006-2008.



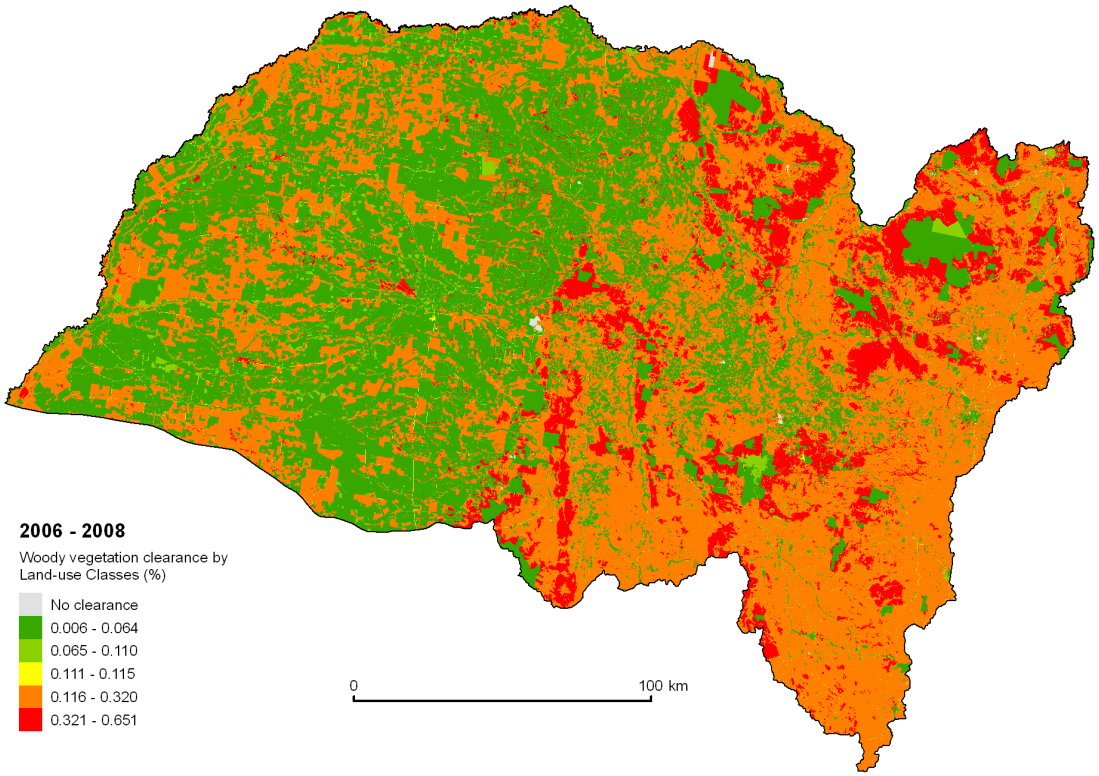
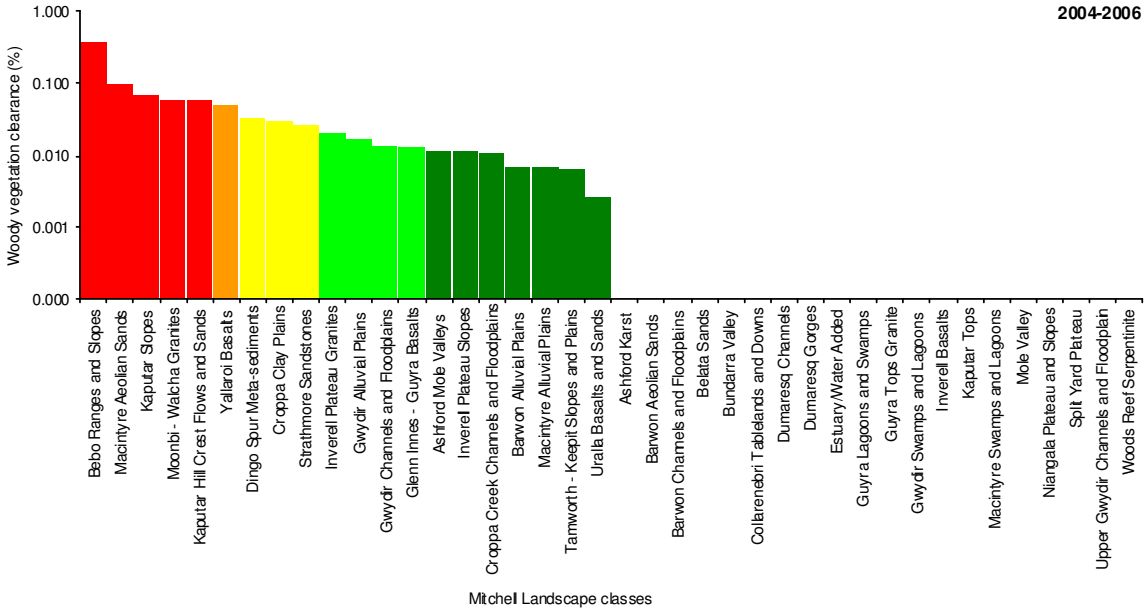


Figure 46: Histogram (logarithmic scale) and map of woody vegetation clearing within Mitchell Landscape classes, Border Rivers-Gwydir CMA, 2004-2006.

3.3 Mitchell landscapes



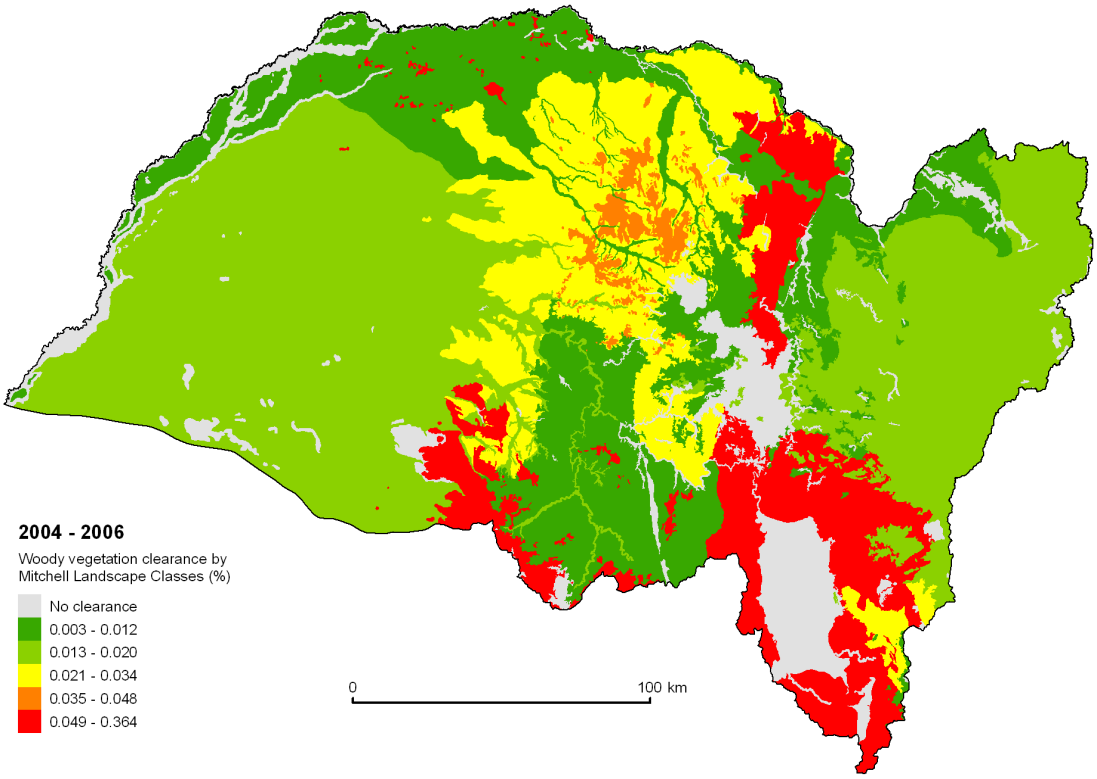


Figure 47: Histogram (logarithmic scale) and map of woody vegetation clearing within Mitchell Landscape classes, Border Rivers-Gwydir CMA, 2006-2008.

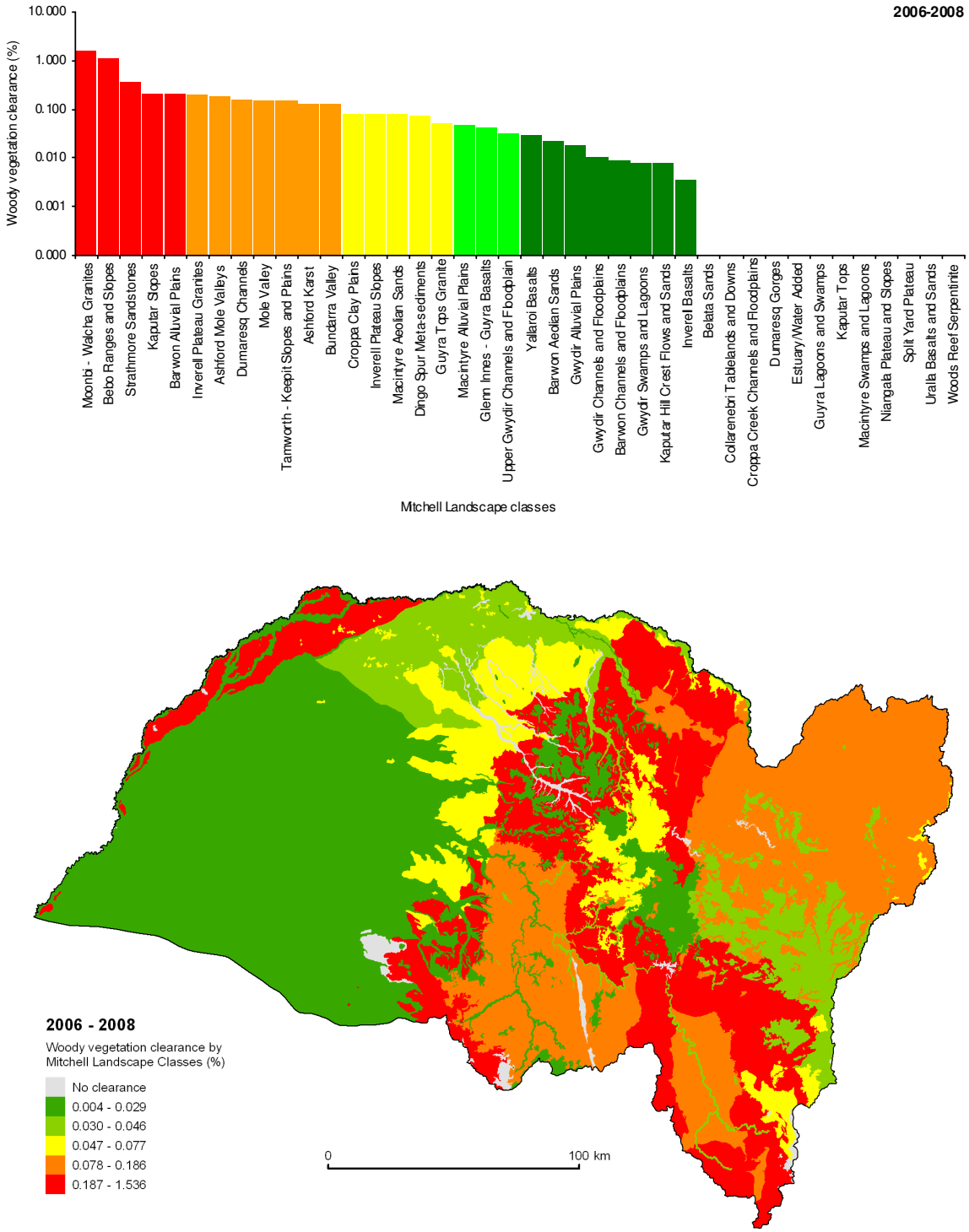
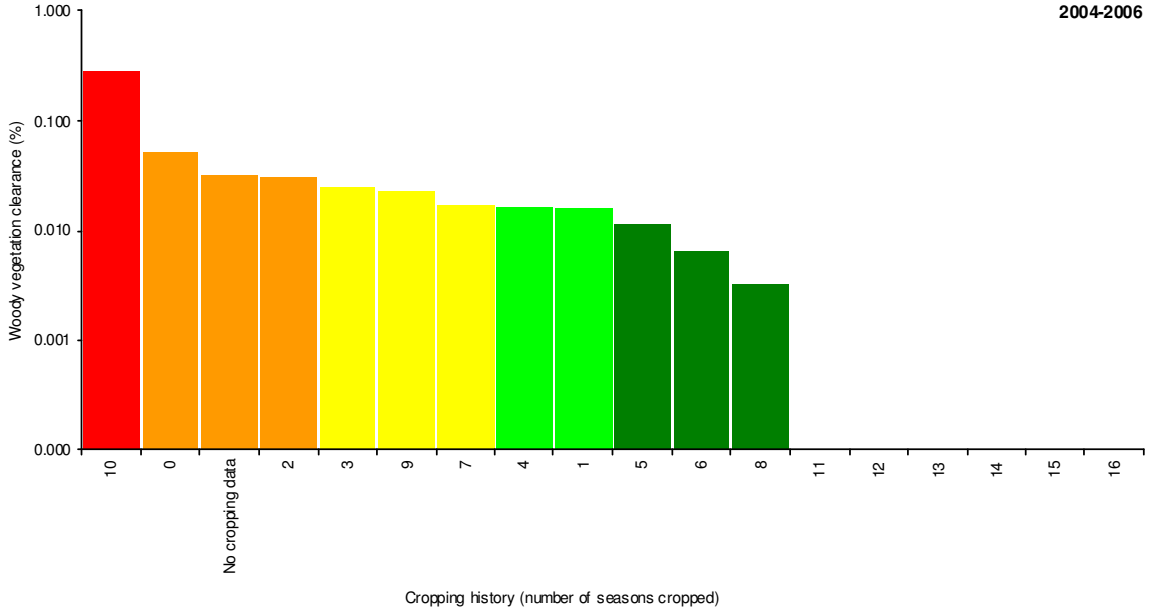


Figure 48: Histogram (logarithmic scale) and map of woody vegetation clearing within Cropping history classes, Border Rivers-Gwydir CMA, 2004-2006.

3.4 Cropping history



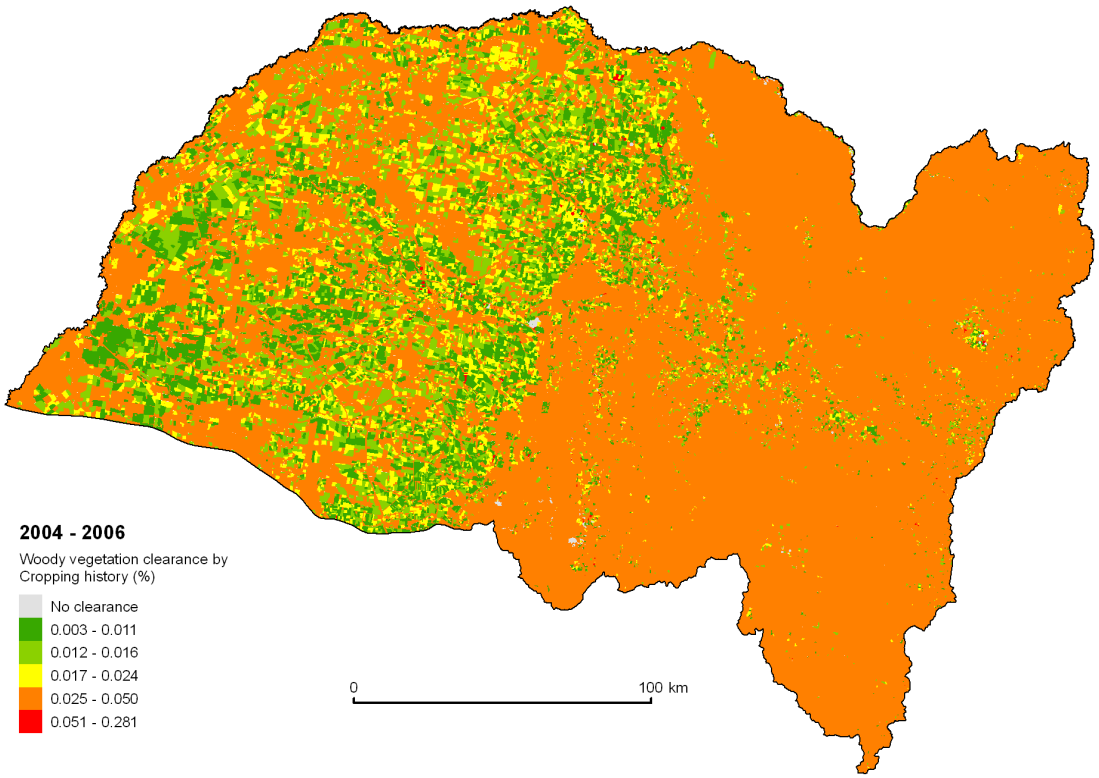


Figure 49: Histogram (logarithmic scale) and map of woody vegetation clearing within Cropping history classes, Border Rivers-Gwydir CMA, 2006-2008.

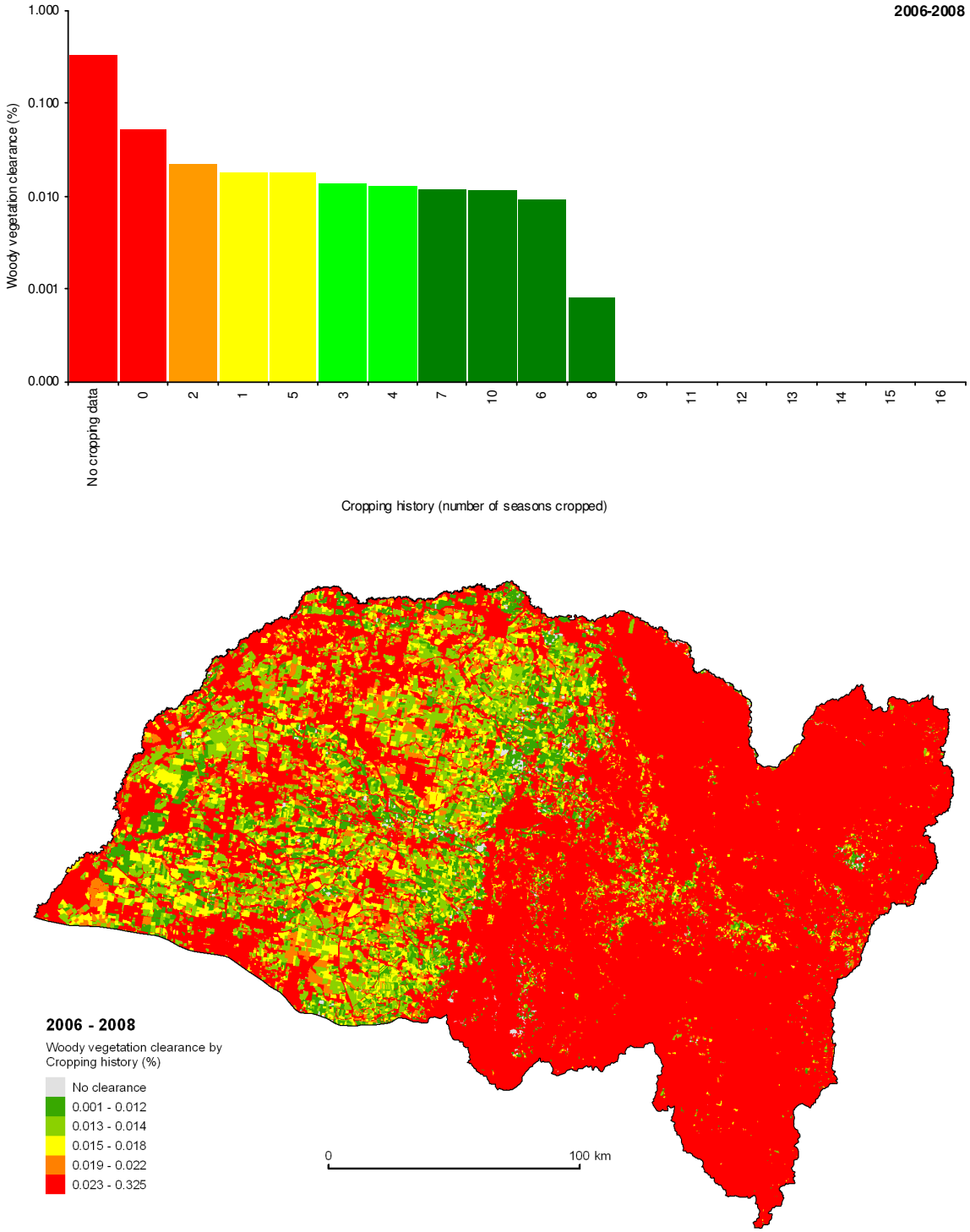


Figure 50: Histogram (linear scale) and map of woody vegetation clearing within ruggedness classes, Border Rivers-Gwydir CMA, 2004-2006.

3.4 Ruggedness

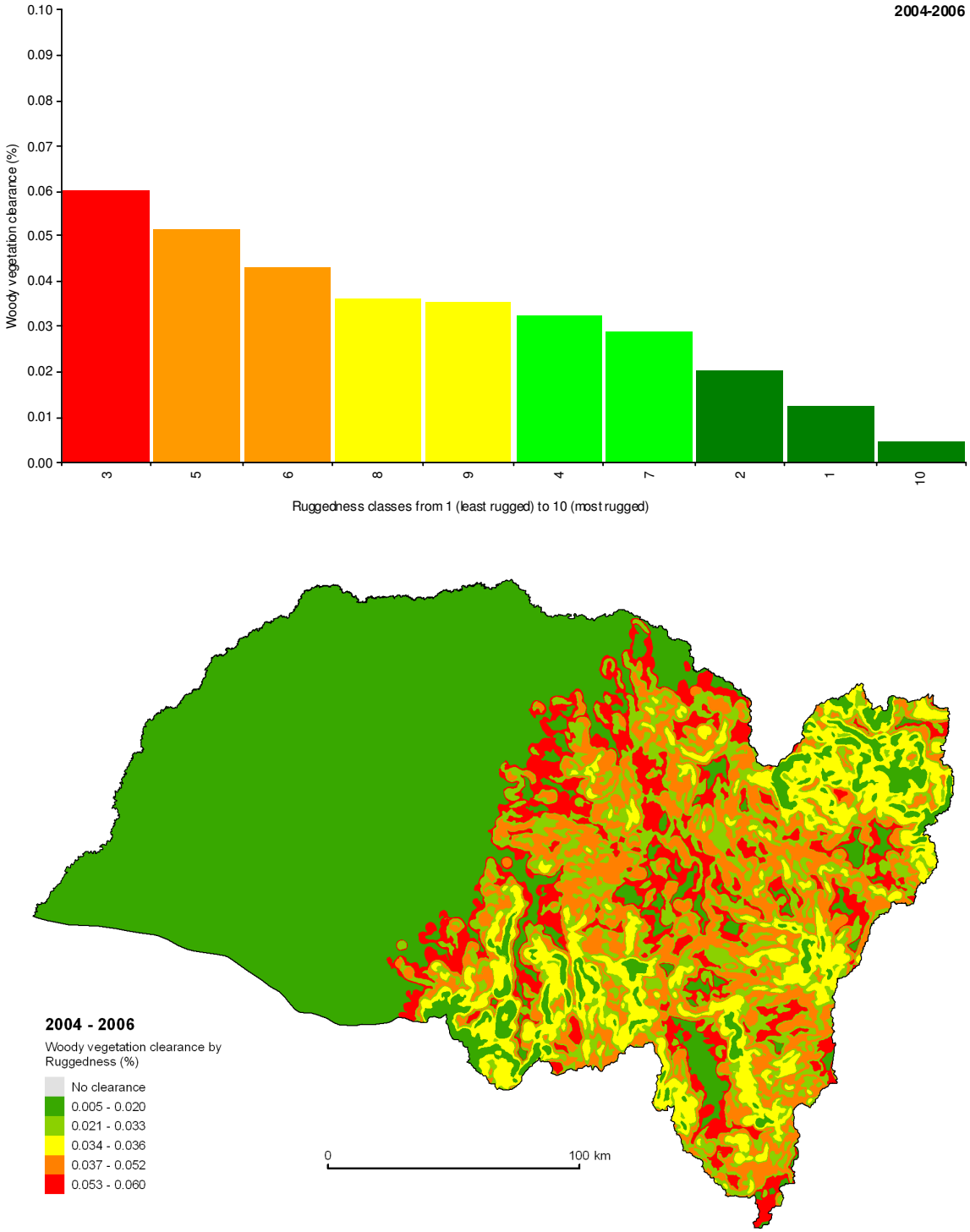
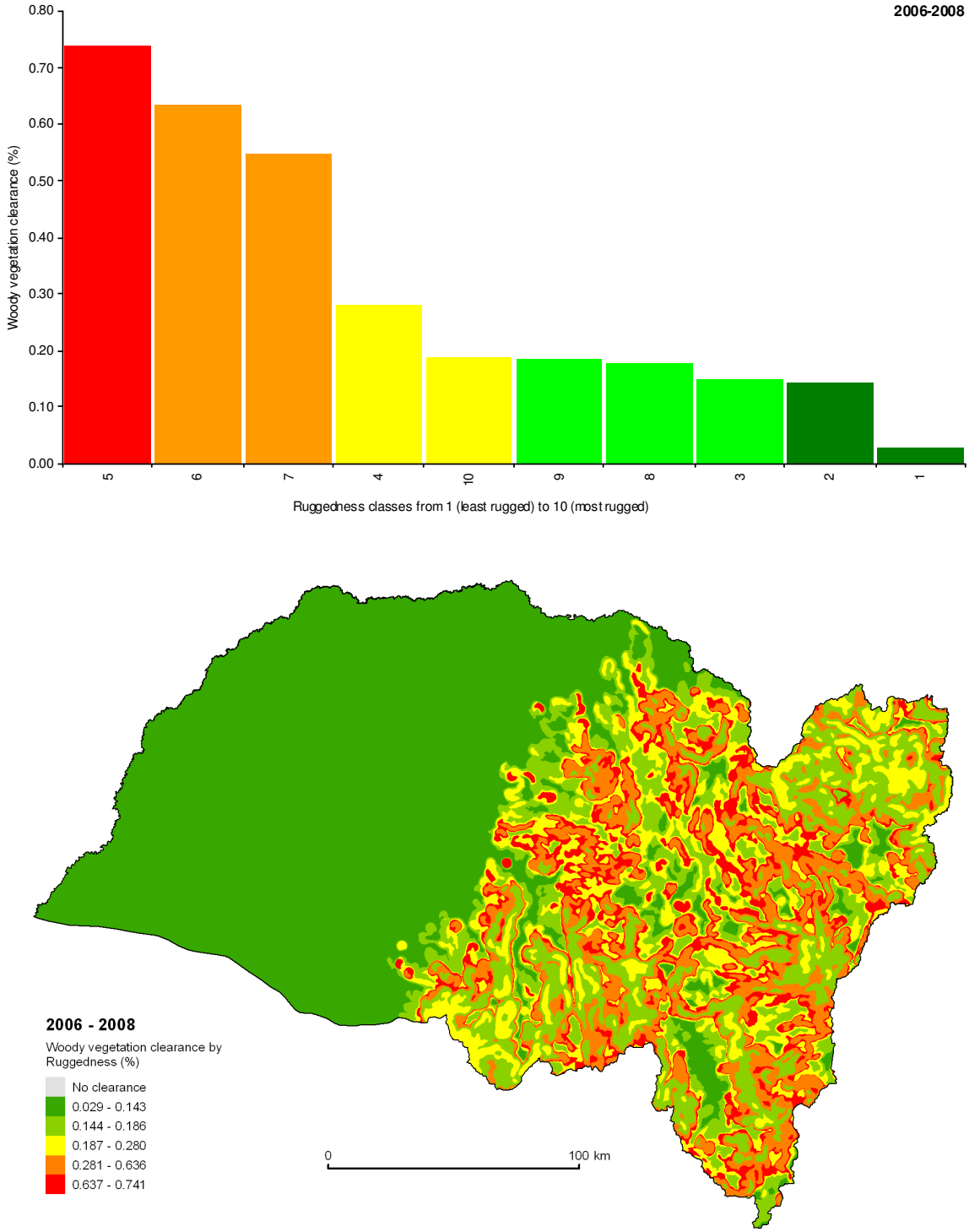


Figure 51: Histogram (logarithmic scale) and map of woody vegetation clearing within ruggedness classes, Border Rivers-Gwydir CMA, 2006-2008.



5.2 NAMOI CMA

The information presented demonstrates a series of projects within the Namoi CMA region that have been undertaken to assist in the identification of high priority vegetation, the preparation of regional conservation strategies and prioritisation of funding opportunities. It does not represent all work being completed by the Namoi CMA, but provides a good overview of the finer scale information that is now being generated by the CMA. A number of products have been created to assist the CMA in completing the conservation and funding prioritisation functions required of the CMA, including;

- Development of a composite Aerial Photo Interpretation (API) vegetation layer
- Drafting of the Namoi Conservation Strategy (NCS), providing guidance on conservation, restoration and corridor priorities, woody vegetation condition and a map of landscape degradation risk factors
- Development of a rapid riverine vegetation condition assessment

The Namoi CMA is also currently preparing a pre-European vegetation layer which will be used throughout the region to further refine conservation and funding prioritisation. At this point in time, this layer is being developed and is not yet available for input into this report.

Each of the identified products is briefly described below. The Namoi CMA considers the data being collected to be a highly accurate baseline from which they will monitor native vegetation extent and condition trend in coming years. Although future projects have not yet been designed or funded, the Namoi CMA feels that future monitoring, particularly of site based condition, should occur within an approximately 5 year period. This timeline will provide a measurable change in vegetation condition and allow a reliable trend to be measured (Bronwyn Witts, per comm.).

5.2.1 Namoi Composite API Layer

The identification of areas of High Conservation Value (HCV) is an essential component in conservation planning management in NSW (ELA 2008). In order to identify areas of HCV, an accurate representation of the spatial distribution of native vegetation types is required.

Construction of the spatial vegetation data layer for Namoi CMA involved the compilation of various local and regional data sets produced as part of other projects. A total of 12 data sets were sourced and integrated, with gaps filled by on-screen digitising using the SPOT5 imagery available (Figure 52).

In total over 94,000 polygons were mapped across the study area, and assigned with the newly developed Regional Vegetation Community (RVC) attribute. A total of 65 RVCs were mapped (ELA 2008) which were then further grouped into Keith Vegetation Classes as shown in Figure 53. The area of each of the vegetation type within the CMA region was calculated, and is shown below in Table 1.

The methodology used to compile the map included both a spatial component, to compile the existing API data layers, and a field component combined with expert analysis to determine the distribution of RVCs. This process included a number of cross checks, such as a comparison with woody/non-woody mapping produced by the SLATS process, in order to develop a robust map product.

Figure 52: Source datasets in the composite vegetation mapping layer

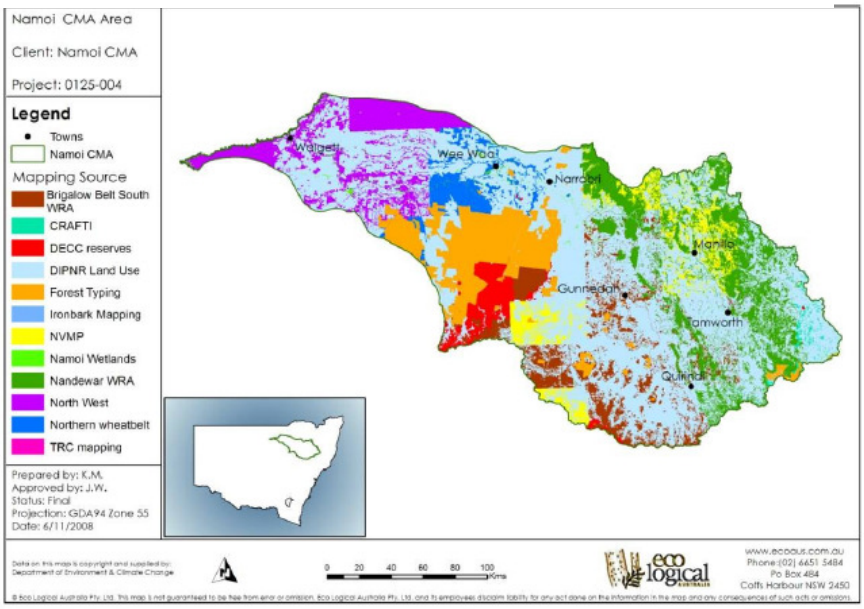


Figure 53: Distribution of Keith vegetation classes

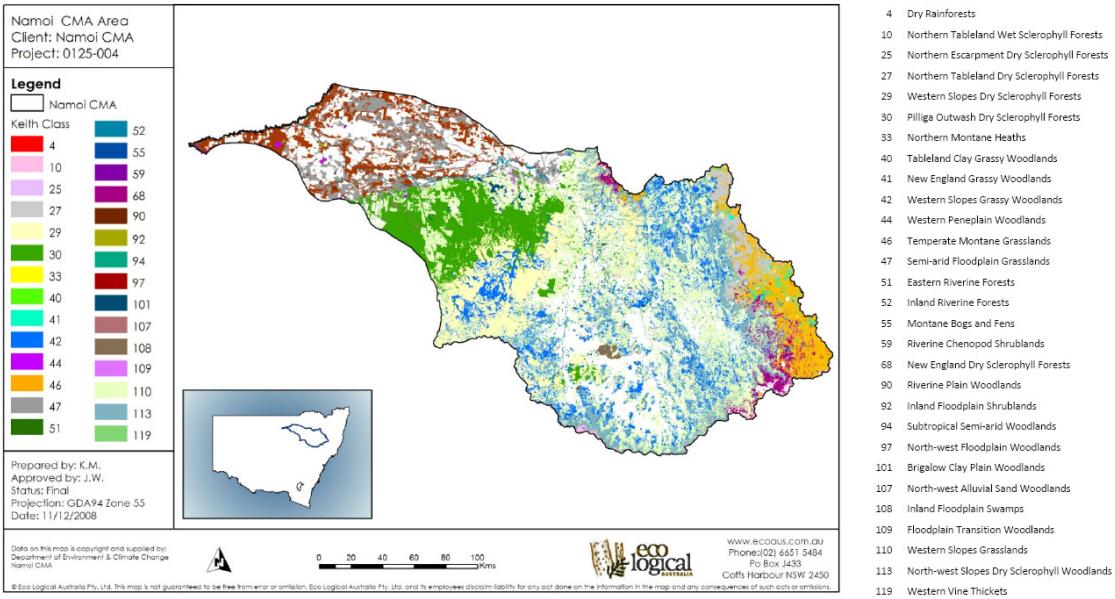


Table 20: RVC area within Namoi CMA. From ELA 2008.

KCNo	Keith Name	RVCNo	RVC	Area (km2)	%Area
		0	Cropping and other non-native vegetation, or no vegetation	9408.06	22.4
1	Subtropical Rainforests	1	Giant Stinging Tree - Fig dry subtropical rainforest, mainly NSW North Coast	-	-
4	Dry Rainforests	2	Rusty Fig - Wild Quince - Native Olive dry rainforest of rocky areas, Nandewar and New England Tablelands	10.34	0.0
		3	Shatterwood - Giant Stinging Tree - Yellow Tulipwood dry rainforest, mainly NSW North Coast	-	-

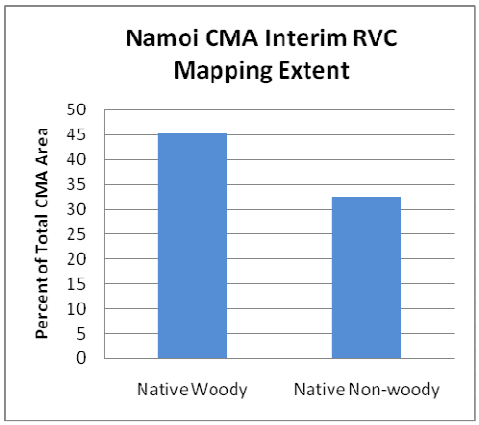
KCNo	Keith Name	RVCNo	RVC	Area (km2)	%Area
44	Western Peneplain Woodlands	4	Wilga - Western Rosewood shrubland, Darling Riverine Plains and Brigalow Belt South	35.00	0.1
		81	Leopardwood woodland of alluvial plains, Darling Riverine Plains and Brigalow Belt South	0.74	0.0
119	Western Vine Thickets	5	Ooline forests, Brigalow Belt South and Nandewar	3.19	0.0
		6	Semi-evergreen vine thicket of basalt hills, Brigalow Belt South and Nandewar	0.25	0.0
10	Northern Tableland Wet Sclerophyll Forests	9	Messmate - gum moist forests of the escarpment ranges, eastern New England Tablelands and NSW North Coast	48.14	0.1
		35	Mountain Gum - Snow Gum open forests, New England Tablelands and NSW North Coast	45.13	0.1
		38	Silvertop Stringybark - gum open forest on basalts of the Liverpool Range, Brigalow Belt South and Nandewar	80.00	0.2
68	New England Dry Sclerophyll Forests	11	Silvertop Stringybark - Nandewar Box open forests in the Kaputar area, Nandewar	84.00	0.2
		36	Stringybark - gum - peppermint open forests, eastern New England Tablelands	176.61	0.4
		39	Silvertop Stringybark grassy open forests, eastern Nandewar and New England Tablelands	413.25	1.0
		52	Broad-leaved Stringybark - gum grassy open forests, central and eastern New England Tablelands	2.48	0.0
40	Tableland Clay Grassy Woodlands	12	Snow Gum - Black Sallee grassy woodlands, New England Tablelands	7.58	0.0
		13	Gum grassy open forests, New England Tablelands	1.18	0.0
		14	New England Peppermint grassy woodlands, New England Tablelands	1.94	0.0
41	New England Grassy Woodlands	15	Bendemeer White Gum grassy woodland, southern New England Tablelands	21.0	0.0
		16	Box - gum grassy woodlands, New England Tablelands	146.54	0.3
		40	Stringybark - Blakely's Red Gum open forests, New England Tablelands	27.24	0.1
42	Western Slopes Grassy Woodlands	17	Box - gum grassy woodlands, Brigalow Belt South and Nandewar	464.08	1.1
		18	White Box grassy woodland, Brigalow Belt South and Nandewar	2367.72	5.6
		19	White Cypress Pine - Silver-leaved Ironbark grassy woodland, Nandewar	46.83	0.1
		20	Rough-barked Apple - Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar	671.53	1.6
109	Floodplain Transition Woodlands	21	Inland Grey Box tall grassy woodland on clay soils, Brigalow Belt South and Nandewar	21.05	0.1
		22	Poplar Box - Belah woodlands, mainly Darling Riverine Plains and Brigalow Belt South	17.84	0.0
		60	White Cypress Pine woodland on sandy loams of the wheatbelt plains, central NSW	-	-
46	Temperate Montane Grasslands	23	Wet tussock grasslands of cold air drainage areas, New England Tablelands	-	-
		27	Derived grasslands, New England Tablelands	1853.95	4.4
47	Semi-arid Floodplain Grasslands	24	Grasslands on river banks and floodplains of inland river systems, mainly Darling Riverine Plains	-	-
		25	Mitchell Grass grassland of alluvial floodplains, mainly Darling Riverine Plains	-	-
		26	Dry grasslands of alluvial plains, Darling Riverine Plains and Brigalow Belt South	2154.09	5.1

KCNo	Keith Name	RVCNo	RVC	Area (km2)	%Area
110	Western Slopes Grasslands	28	Derived grasslands, Brigalow Belt South and Nandewar	9642.02	22.9
		29	Plains Grass - Blue Grass grasslands, Brigalow Belt South and Nandewar	30.52	0.1
		30	Slender Bamboo Grass - Spiny Saltbush grassland, Brigalow Belt South	-	-
30	Pilliga Outwash Dry Sclerophyll Forests	31	Broombush shrubland of the sand plains of the Pilliga region, Brigalow Belt South	177.99	0.4
		32	Pilliga Box - Poplar Box- White Cypress Pine grassy open woodland on alluvial loams, Darling Riverine Plains and Brigalow Belt South	987.27	2.3
		33	Ironbark shrubby woodlands of the Pilliga area, Brigalow Belt South	2512.96	6.0
		96	Blakely's red gum riparian woodland of the Pilliga	105.27	0.3
113	North-west Slopes Dry Sclerophyll Woodlands	41	White Box - stringybark shrubby woodlands, Brigalow Belt South and Nandewar	918.28	2.2
		44	White Box - pine - Silver-leaved Ironbark shrubby open forests, Nandewar	1719.39	4.1
		45	Stringybark - spinifex woodland, Nandewar	11.35	0.0
		92	Mugga Ironbark shrubby open forests, Nandewar and western New England Tablelands	71.43	0.2
33	Northern Montane Heaths	46	Mallee shrublands on granite and acid volcanic outcrops, eastern New England Tablelands	-	-
		62	Shrublands of rocky areas, Brigalow Belt South, Nandewar and western New England Tablelands	27.62	0.1
		63	Tea-tree shrubland in drainage lines, Nandewar and New England Tablelands	1.32	0.0
25	Northern Escarpment Dry Sclerophyll Forests	47	Narrow-leaved Peppermint - Wattle-leaved Peppermint open forest, eastern New England Tablelands	1.31	0.0
27	Northern Tableland Dry Sclerophyll Forests	49	Black Cypress Pine - Orange Gum - Tumbledown Red Gum shrubby woodlands, Nandewar and western New England Tablelands	177.65	0.4
		50	Stringybark - Blakely's Red Gum - Rough-barked Apple open forests, Nandewar and western New England Tablelands	418.66	1.0
		51	New England Blackbutt - stringybark open forests, Nandewar and western New England Tablelands	324.57	0.8
29	Western Slopes Dry Sclerophyll Forests	54	Black Cypress Pine shrubby woodlands, Brigalow Belt South	57.07	0.1
		55	Black Cypress Pine - Narrow-leaved Stringybark heathy woodland, southern Brigalow Belt South	-	-
		56	Ironbark - Brown Bloodwood - Black Cypress Pine heathy woodlands, Brigalow Belt South	2629.56	6.3
106	Yetman Dry Sclerophyll Forests	57	Narrow-leaved Ironbark - pine - Brown Bloodwood shrub/grass open forest, Brigalow Belt South and Nandewar	-	-
		61	Dirty Gum - pine - Smooth-barked Apple open forests, northern Brigalow Belt South and Nandewar	-	-
29	Western Slopes Dry Sclerophyll Forests	58	Shrubby woodlands or mallee woodlands on stoney soils, Brigalow Belt South and Nandewar	14.01	0.0
		59	Narrow-leaved Ironbark - pine - box woodlands and open forests, Brigalow Belt South and Nandewar	966.09	2.3
55	Montane Bogs and Fens	64	Fens and wet heaths, Nandewar and New England Tablelands	16.03	0.0

KCNo	Keith Name	RVCNo	RVC	Area (km2)	%Area
92	Inland Floodplain Shrublands	66	Canegrass swamp of drainage depressions, playa lakes and pans of the inland plains, western NSW	-	-
		67	Eurah shrubland of inland floodplains, Darling Riverine Plains	1.88	0.0
		68	Lignum - River Coobah shrublands on floodplains, Darling Riverine Plains and Brigalow Belt South	6.60	0.0
108	Inland Floodplain Swamps	70	Wetlands and marshes, inland NSW		
		95	Tall rushlands, reedlands or sedgelands of inland river systems, inland NSW	259.13	0.6
51	Eastern Riverine Forests	71	River Oak riparian woodland, eastern NSW	65.35	0.2
52	Inland Riverine Forests	72	Bracteate Honey Myrtle riparian low forest/shrubland, Brigalow Belt South and Nandewar	3.04	0.0
		73	River Red Gum riverine woodlands and forests, Darling Riverine Plains, Brigalow Belt South and Nandewar	301.74	0.7
53	Inland Floodplain Woodlands	74	Yellow Box woodland on alluvial plains, mainly Darling Riverine Plains	-	-
90	Riverine Plain Woodlands	75	Weeping Myall open woodland, Darling Riverine Plains, Brigalow Belt South and Nandewar	50.66	0.1
97	North-west Floodplain Woodlands	76	Coolibah - Poplar Box - Belah woodlands on floodplains, mainly Darling Riverine Plains and Brigalow Belt South	1152.82	2.7
		77	Black Box woodland on floodplains, mainly Darling Riverine Plains	912.21	2.2
		78	Coolibah - River Coobah - Lignum woodland of frequently flooded channels, mainly Darling Riverine Plains.	29.67	0.1
		82	Poplar Box low woodlands, western NSW	53.74	0.1
101	Brigalow Clay Plain Woodlands	79	Brigalow - Belah woodland on alluvial clay soil, mainly Brigalow Belt South	100.98	0.2
		80	Poplar Box grassy woodland on alluvial clay soils, Brigalow Belt South and Nandewar	150.07	0.4
94	Subtropical Semi-arid Woodlands	84	Whitewood open woodland, mainly eastern Darling Riverine Plains	1.74	0.0
107	North-west Alluvial Sand Woodlands	85	Carbeen woodland on alluvial soils, Darling Riverine Plains and Brigalow Belt South	10.19	0.0
		86	Dirty Gum tall woodland on sand monkeys, Darling Riverine Plains and Brigalow Belt South	29.07	0.1
		87	Silver-leaved Ironbark - White Cypress Pine on alluvial sandy loam, Darling Riverine Plains	6.37	0.0
59	Riverine Chenopod Shrublands	88	Saltbush chenopod shrublands, mainly Darling Riverine Plains	-	-
		89	Copperburr chenopod shrubland, Darling Riverine Plains and Brigalow Belt South	3.27	0.0
		90	Ephemeral forblands on playas and scalds, Darling Riverine Plains and Cobar Peneplain	-	-
		94	Old Man Saltbush shrublands, mainly Murray-Darling Depression, Riverina and Channel Country	-	-

In total 32,651km^2 (77.6% of the CMA) of native vegetation was mapped within the CMA, with a further 9,408km^2 (22.4% of the CMA) identified as cropped, cleared or other non-native vegetation. On further analysis the amount of woody and non-woody vegetation was calculated (Figure 54). In total, the CMA contains 45.1% native woody vegetation and 32.5% native non-woody vegetation. The mapping has been compiled through a series of other mapping products captured between 1980 and 2007. It is therefore difficult to determine the currency of these figures at this time, however as work continues on the data layer, and as areas of clearing or regeneration are identified through recent satellite imagery, the ability to determine the precise currency of the layer will be improved.

Figure 54: Native woody and non-woody vegetation extent in Namoi CMA



Limitations are noted for the mapping and figures outlined above, including an acknowledgement that some of the spatial data sets used to compile the RVC mapping contained spatial errors of up to 200m, mapping is incomplete for restricted EECs and other restricted RVCs, floristic data is missing in some areas and land use changes have occurred since several of the input maps were created.

In saying this, however, the information presented represents a baseline for regional vegetation communities in the Namoi CMA which is not available through the state-wide data sets. The layer is currently being updated with additional vegetation type data from recent field work which is likely to adjust these results above, particularly for non-woody vegetation. The information will enable the CMA to identify the status of vegetation extent and conservation priorities to the regional vegetation community level across the region and will provide the Namoi CMA with the improved ability to monitor the extent of vegetation within the CMA on a regular basis.

5.2.2 Namoi Conservation Strategy

The Namoi Conservation Strategy (NCS) provides a long term plan identifying clear priorities to guide future natural resource management and conservation efforts (EAS 2008). It presents a strategic approach to protecting and managing the regions important environmental attributes by identifying key on-ground management requirements and threat abatement opportunities.

The project was completed by collecting and analysing the best available spatial data for the region, and produced several products (EAS 2008):

1. Conservation Priority Layer (areas that would contribute most to the positive biodiversity outcomes within the CMA region) (Figure 55)

2. Restoration Priority Layer (areas most likely to benefit from investment in restoration)
3. Corridor Priority Layer (identifies areas where existing or potential corridors can be created or improved)
4. Landscape Degradation Risk Layer (identifies areas at greatest risk of degradation, identified by assessing risk factors from multiple threats)
5. Woody Vegetation Condition Layer (derived by comparing the mapped Foliage Projected Cover (FPC) derived through the DECCW SLATS program against the over-storey benchmarks expected for each regional vegetation community) (Figure 56)

These products provide the necessary information to allow the Namoi CMA to make decisions with clear environmental benefits. The project and GIS mapping has been designed to allow continual updating of the input data as more fine scale, accurate information becomes available, or as legislation and threats change over time.

Figure 55: Conservation priority layer. From EAS 2008.

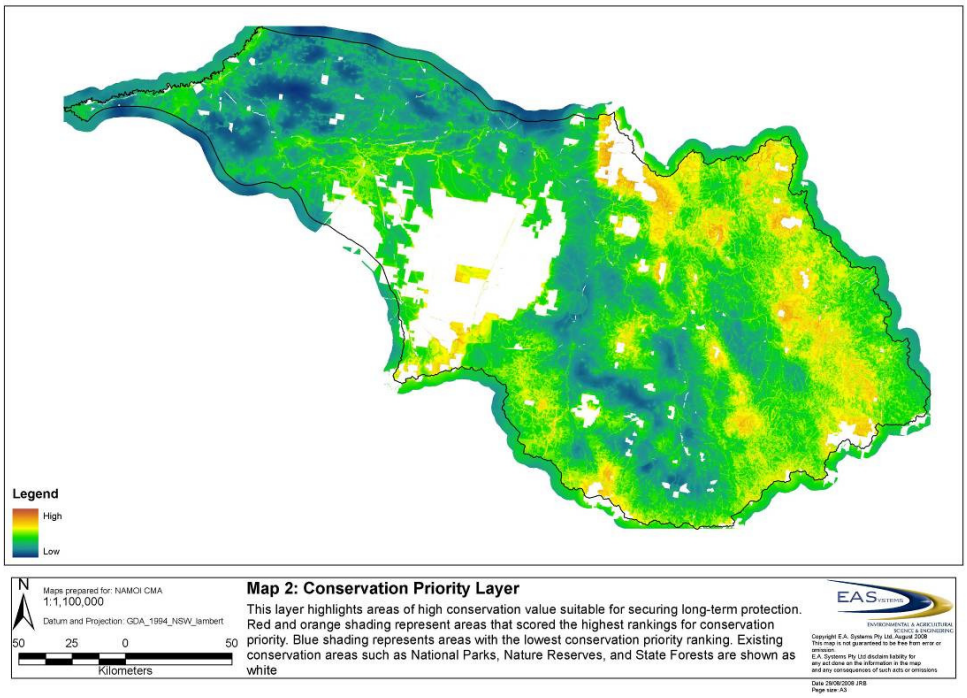
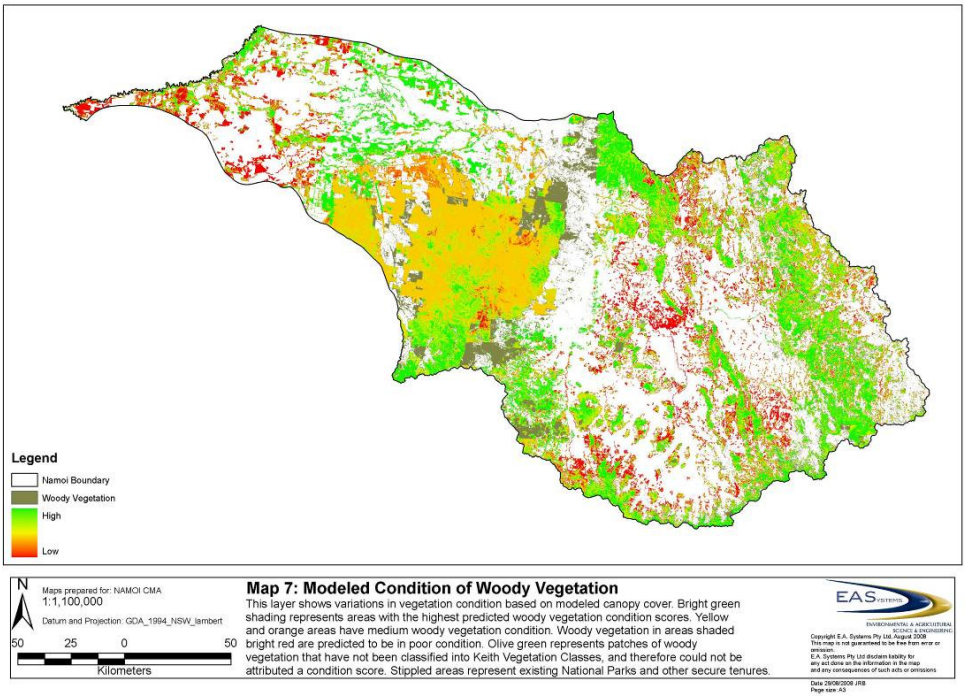


Figure 56: Modelled condition of woody vegetation



5.2.3 Rapid Riverine Assessment

A study into riverine vegetation condition was completed for the Namoi CMA to develop and apply a framework for evaluating and mapping the condition of native riparian and floodplain riverine vegetation in the catchment (ELA 2009). To do this a framework was developed using landscape metrics derived from remotely sensed data and a rapid plot-based sampling technique designed to capture ecological data and score them against appropriate benchmarks.

The landscape condition assessment applied metrics such as % woody cover, % non-native vegetation, continuity of vegetation along rivers and connectivity (ELA 2009). The plot based assessment of vegetation condition utilised a newly developed rapid assessment technique and captured the attributes identified in Figure 57. In total 329 plots were sampled, including 91 on the floodplain and 238 along major channels. Several attributes were collected including % cover and species richness, number of large trees and length of fallen dead timber.

The plots data, which was measured out of a total of 100, was assessed for each of the 329 sites. A range of scores from poorest condition (2/100) to best condition (98/100) was recorded, with the average plot score being 55/100. The following was observed (ELA 2009):

- Remnant floodplain vegetation appears to be in better condition that riparian vegetation
- Riparian vegetation of upland areas associated with pastoral activities was in poorer condition than in lowland channels associated with cropping
- The condition of native vegetation within cotton growing areas was almost identical to that outside cotton growing areas

The Namoi CMA intends to utilise rapid assessment field methodology developed as part of this project across all of the CMAs on-ground assessment works, and intends to return to the 329 sites already surveyed to monitor the vegetation condition at these reference sites. Namoi CMA staff have been trained in the collection of the data, and this methodology will provide the CMA an ability to report on the change in vegetation condition across the region using a repeatable, consistent and scientifically based field methodology.

Figure 57: Field survey method. From ELA 2009.

Attribute	Sampling Unit	Sampling Method
Species richness (canopy)	50 x 20m baseplot	Count of native species in the canopy. Canopy species are tree (including tall Acacias) and tree mallee species that form the tallest layer of the vegetation. This layer is usually taller than 6m.
Species richness (midstorey)	20 x 20m subplot	Count of native shrub and small tree species in the midstorey (≥ 1m height). This can include immature specimens of potential canopy species.
Species richness (groundcover)	20 x 20m subplot	Count of native species in the understorey (< 1m height, including grasses, forbs, herbs, sedges, rushes and small shrubs). If a species occurs in more than one layer it should only be counted once.
Native canopy cover	10 points along 50m	Measured as projected foliage cover (including trunks and branches) of native canopy species expressed as a %. Estimated visually, with or without assistance of reference cover images, by looking at the canopy within a 2.5m radius of the point.
Canopy health	50 x 20m baseplot	Estimated to the nearest 10% as the proportion of the expected healthy canopy cover that is present (i.e. not missing due to tree death or decline, or mistletoe infestation)
Native midstorey (shrub) cover	10 points along 50m	Measured as projected foliage cover (expressed as a %) of native midstorey shrub and small tree species. Estimated visually within a 2.5m radius of the point. This can include immature native canopy species.
Weed canopy and midstorey cover	10 points along 50m	Measured as projected foliage cover (expressed as a %) of weed shrub and tree species. Estimated visually within a 2.5m radius of the point.
Groundcover	1 x 1m plots	Measured as projected foliage cover (expressed as a %) of native understorey vegetation (< 1m height. Visually estimated as the proportion of each quadrat occupied by understorey plants. This includes grasses, forbs, herbs, sedges, rushes and small shrubs. Species can contribute to cover scores in more than one layer.
Bryophyte cover	1 x 1m plots	Estimated as cover of bryophytes (mosses and lichens) in the ground layer.
Weeds	1 x 1m plots	Estimated visually as total projected foliage cover (expressed as a %) of weeds in the ground layer.
Organic litter	1 x 1m plots	Estimated as %cover of all organic litter (including standing dead plant material and sticks <10cm diameter).
Rock/bare ground	1 x 1m plots	Estimated as % of rock and/or bare ground.

Attribute	Sampling Unit	Sampling Method
Number of large trees	50 x 20m baseplot	Count of the number of living trees greater or equal to the benchmark diameter at breast height (dbh) (see Appendix 1).
Number of trees with hollows	50 x 20m baseplot	Count of the number of living and dead trees which possess at least one hollow, where the hollow entrance clearly possesses depth into the tree, is estimated to be ≥5cm diameter, and occurs as part of the main trunk or limbs, at least 1m above the ground. (Note: the base of tree needs to be in the plot, but the hollow does not)
Number of canopy species regenerating	50 x 20m baseplot	Count of the number of canopy or potential canopy species observed to be regenerating (dbh ≤5cm). There can be more species in this category than the number of native canopy species.
Coarse woody debris	50 x 20 m baseplot	Measured as the total combined length of dead fallen timber (diameter ≥ 10 cm; length ≥ 50cm). Estimated to the nearest metre using a tape or by pacing.

5.3 MURRAY CMA

The Murray CMA has provided details of their Vegetation Condition Monitoring Project through the following report- Willinck, E (2008) Vegetation Condition Monitoring in the Murray Catchment. Background and Current Situation. Murray Catchment Management Authority. Deniliquin.

The Murray CMA is currently conducting a vegetation condition assessment using site bases analysis to determine the improvement, or otherwise, of vegetation condition over time. Through MER workshops held in 2006 and 2007 the monitoring of native vegetation was identified as a very high priority. The objectives of the monitoring relevant to vegetation extent and condition were to:

- Determine whether plots, sites, broad vegetation types (BVTs), management units and the catchment were improving, being maintained or deteriorating, particularly where incentives were being provided
- Guide more effective site management
- Guide incentive delivery.

The Biometric field methodology, current used to assess Property Vegetation Plans (PVPs) and Biobanking applications, was selected as the field methodology to be applied because;

- It provided for consistency with the PVP methodology, and potentially between CMAs
- Training had already been provided to CMA staff
- The methodology is scientifically rigorous and has been thoroughly reviewed
- Benchmarks for vegetation classes and types have been compiled.

The monitoring program intends to assess a site every two years. The first site visit, which has been completed, intends to collect the baseline data. Subsequent visits will provide information on the trend of vegetation condition. A soon to be finalised MS Access database will store, analyse and report on the information collected, and allow assessment of vegetation condition on a site by site or broader basis, such as by Broad Vegetation Type. Figure 58 provides an example of the sort of data that may be able to be generated by the monitoring project in the coming years for specific sites. Figure 59 presents information on the type of data that may be available at a more regional scale, such as by Broad Vegetation Types and Figure 60 presents potential catchment scale information.

Figure 58: Example of site scale data that will be available through this project. From Willinck, E (2008)

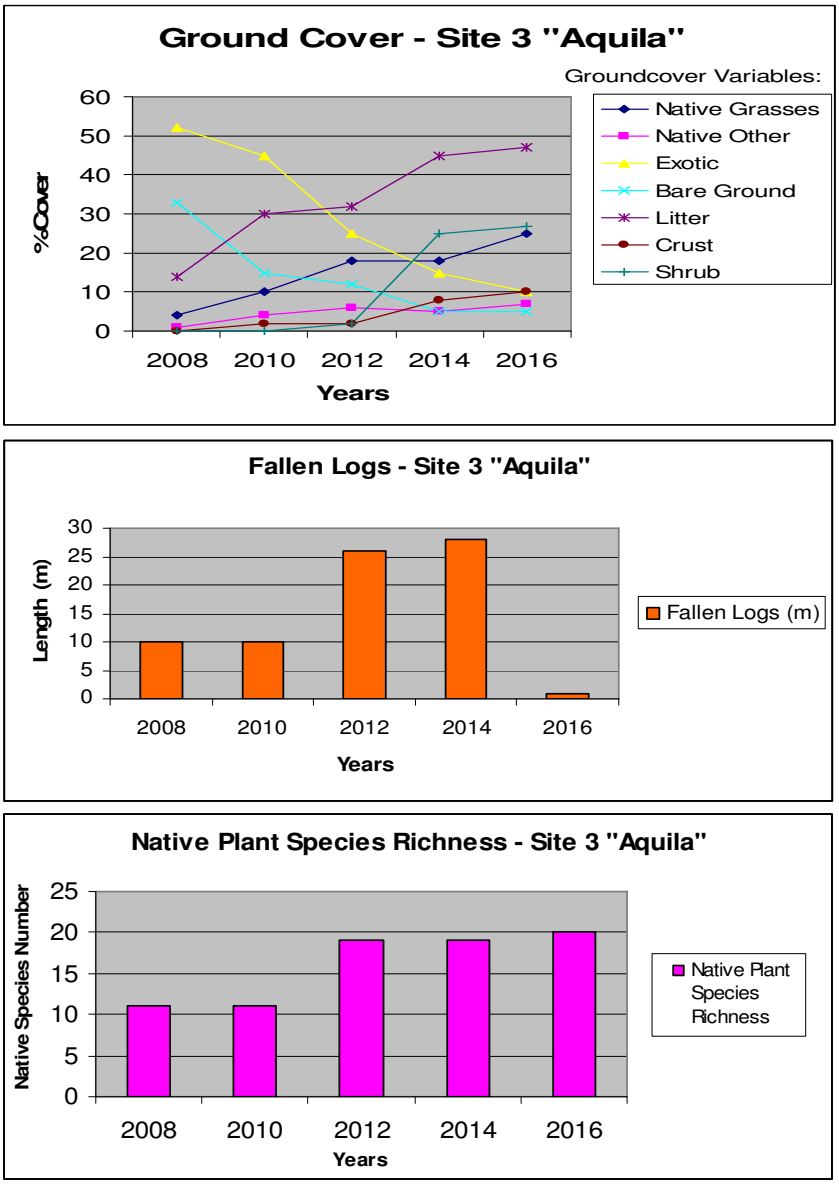


Figure 59: Example of regional scale data that will be available through this project. From Willinck, E (2008)

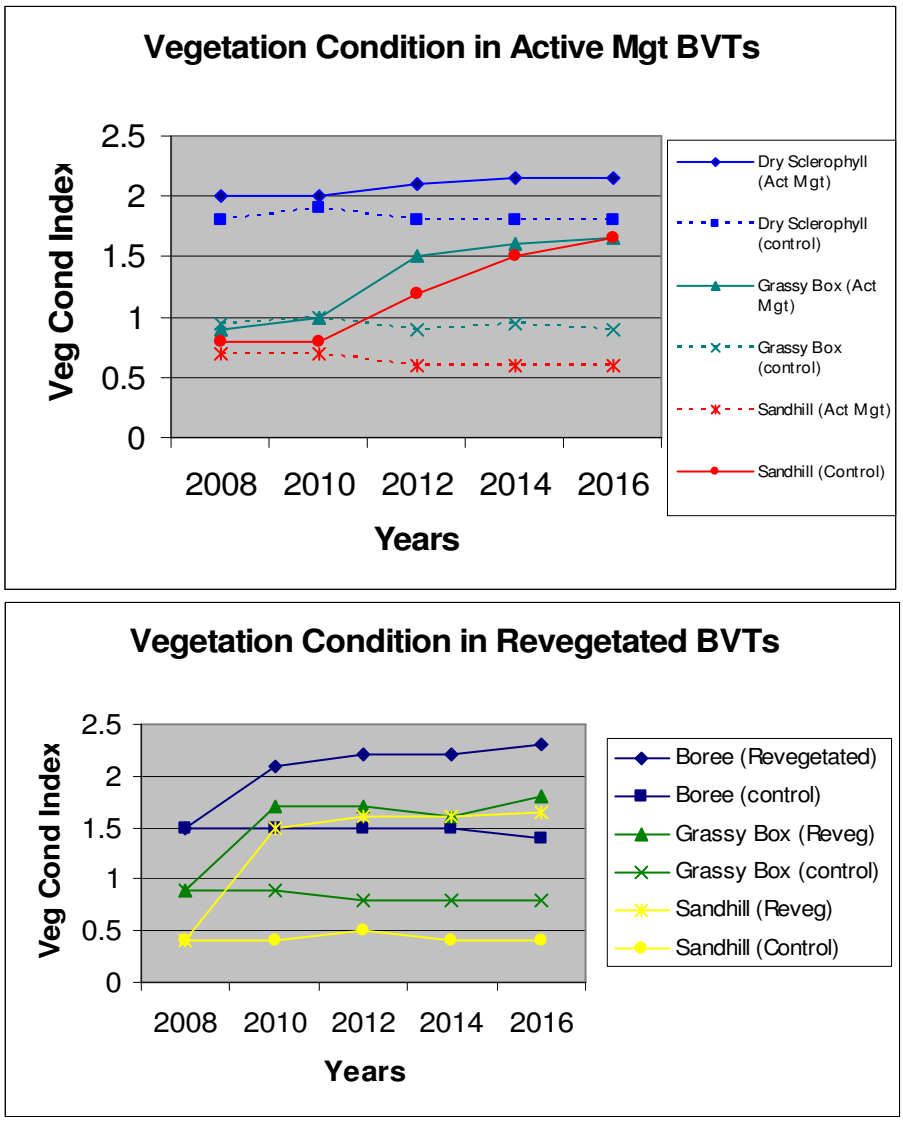
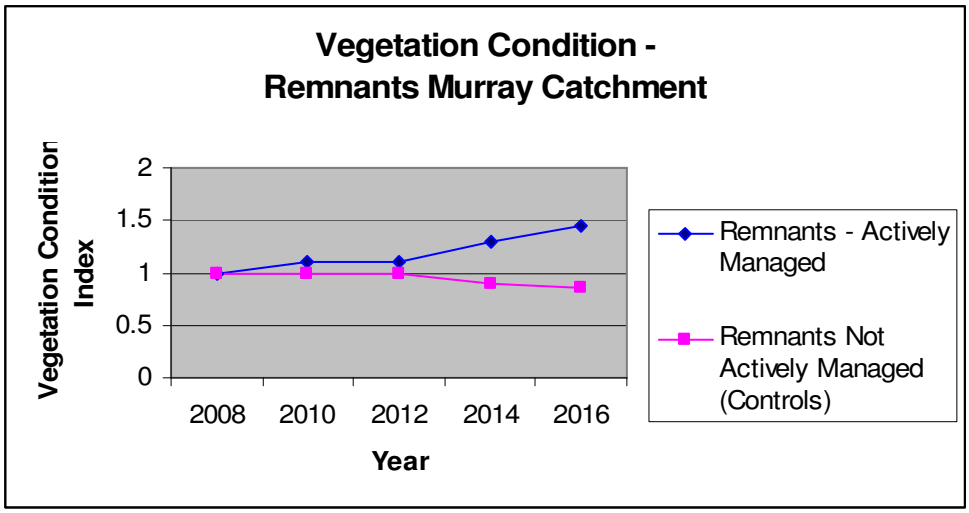


Figure 60: Example of catchment scale data that will be available through this project. From Willinck, E (2008)



6 Conclusion

This document provides a comprehensive review of the data available to report on the Native Vegetation Extent and Condition target. The information presented has been obtained from a variety of sources, and the ability of the methods to be repeated verified. The project did not create or interrogate data in its own right, but relied on existing strong relationships with the relevant knowledge holders to gain access to the information required. Where data was not available to report on the target, case studies have been provided to demonstrate the data being collected at the CMA scale.

The project found that although it is not possible to report on the entire Native Vegetation Extent and Condition target at this time, recent DECCW programs and analysis has made it possible to report that:

- The most accurate information available has been produced by the Woody Vegetation Monitoring Program in 2008, and includes information on the extent and trend of woody vegetation
- A baseline in 2006 for native woody and non-woody vegetation extent and condition is established
- The Woody Vegetation Monitoring Program has identified an increase in the clearing of woody vegetation between 2004 and 2008
- Statistical analysis undertaken by the Woody Vegetation Monitoring Program indicates native woody vegetation extent has not changed significantly across the state between 2002-2008 (i.e. regeneration of woody vegetation appears to be matching the increased woody vegetation clearing rate)
- The change in non-woody native vegetation extent varies with land use and management practice in many parts of the state and cannot be determined at this time. Advances in remote sensing technology will likely increase the ability to monitor these changes and hence the area of native vegetation with continued investment
- The change in native vegetation condition cannot be determined at this point in time but with continuing work undertaken by DECCW and CMAs the ability should be demonstrated in the near future.

DECCW are continuing to refine and develop the methodologies utilised to report on the Native Vegetation Extent and Condition target in NSW. This on-going development will improve the ability to report on this target in the future.

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Appendix 1- Custodial Arrangements for Key Data Sets

Data Set	Metadata Reference	Additional References	Contact Person	Corporate Management Status
Native Vegetation Extent (Keith and Simpson)	ANZNS0208000230 (http://canri.nsw.gov.au/nrdd/records/ANZNS0208000230.html)	Keith DA and Simpson CC. (2006) Keith DA and Simpson CC. (2008)	David Keith Chris Simpson	Yes (DECCW CorpData)
Foliage Projected Cover- Woody Vegetation Monitoring Program	Under Development	http://www.nrw.qld.gov.au/slats/index.html	Richard Hicks Tim Danaher	Planned
Non-woody Vegetation Mapping Program (MODIS analysis)	Under Development	Under Development	Ron Avery	Planned
Land Use Mapping	ANZNS0359100121 (to be updated)	Emery et al (In prep)	Keith Emery	In progress (to be loaded to DECCW CorpData)
Interim Vegetation Extent (2008)	ANZNS0208000244 (http://canri.nsw.gov.au/nrdd/records/ANZNS0208000244.html)	DECC 2008	Ron Avery	Yes (DECCW CorpData)
NSW State of the Catchments 2008: Native Vegetation Theme (Vegetation extent and condition)	ANZNS0208000241	Dillon 2009	Ian Oliver	Planned
Vegetation Information System (VIS)- Catalogue of vegetation type maps	Metadata relates to each map, of which there are approx. 260. Database of map and metadata sources held centrally in DECCW.	Various – each map may have a number of separate references.	Ron Avery	Yes

Appendix 2- Reporting Matrix

Reporting Subject	Six Monthly	Annual Reporting	State of the Environment Reporting (every 3 years)	NRC 2015 Target Review
Native Vegetation Report Card	✓	✓	✓	✓
Vegetation Extent Baseline	×	×	✓	✓
Vegetation Condition Baseline	×	×	✓	✓
Vegetation Extent Trend (native woody vegetation)	×	✓	✓	✓
Vegetation Extent Trend (native non-woody vegetation)	×	×	✓	✓
Vegetation Condition Trend	×	×	✓	✓

Appendix 3- Classification of Land Use Mapping Categories

From DECC 2008a

0= Not classified
11 = Native woody; native non-woody
21 = Native woody; exotic non-woody
31 = Native woody; indeterminate non-woody
12 = Exotic woody; native non-woody
22 = Exotic woody; exotic non-woody
32 = Exotic woody; indeterminate non-woody
13 = Indeterminate woody; native non-woody
23 = indeterminate woody; exotic non-woody
33 = Indeterminate woody; indeterminate non-woody

		WOODY				NON-WOODY					
Primary Code	Land Use Class	Significantly Native / Natural 1=Yes; 0=No	significantly non-native/ Exotic 2=Yes; 0=No	Class 1=native; 2=non-native; 3=indeterminate	Binary (3 Class re-assigned) 1=native; 2=non-native	Significantly Native / Natural 10=Yes; 0=No	Significantly non-native/ Exotic 20=Yes; 0=No	Class 10=native; 20=non-native; 30=indeterminate	Binary (30 Class re-assigned) 10=native; 20=non-native	Candidate Composite 9 Class (Confidence margins with 'Indeterminate')	Composite 4 Class (Binary) - Confidence compromised - no indeterminate classes!
1	cropping – continuous or rotation	1	2	3	1	0	20	20	20	23	21
2	horticulture – orchard	0	2	2	2	0	20	20	20	22	22
3	horticulture – vineyard	0	2	2	2	0	20	20	20	22	22
4	grazing – volunteer, naturalised or improved pasture	1	0	1	1	10	20	30	10	31	11
5	grazing – improved perennial pasture	1	0	1	1	10	20	30	10	31	11
6	grazing – irrigated pasture	1	0	1	1	0	20	20	20	21	21
7	quarry	1	0	1	1	10	20	30	20	31	21
8	farm dam	1	0	1	1	10	20	30	10	31	11
9	native forest - State Forest	1	0	1	1	10	0	10	10	11	11
10	native forest - logged - State Forest	1	0	1	1	10	0	10	10	11	11
11	native forest – regeneration - State Forest	1	0	1	1	10	0	10	10	11	11
12	river, creek or other incised drainage feature. Includes the bed and bank of a river system and any adjoining riparian vegetation that overhangs the drainage feature or grows on the bank of the channel. Also includes vegetation growing on sand, gravel or clay deposits within the river channel	1	0	1	1	10	0	10	10	11	11
13	native forest – filter strips in softwood plantation - State Forest	1	0	1	1	10	0	10	10	11	11
14	softwood plantation - State Forest	0	2	2	2	10	0	10	10	12	12
15	softwood plantation – nursery - State Forest	0	2	2	2	10	0	10	10	12	12
16	urban – industrial/commercial	1	2	3	1	0	20	20	20	23	21
17	urban – residential	1	2	3	1	0	20	20	20	23	21
18	urban – rural residential	1	2	3	1	0	20	20	20	23	21
19	road/road reserve	1	2	3	1	10	20	30	10	33	11
20	railway	1	2	3	1	10	20	30	20	33	21
21	floodplain swamp – backswamp	1	0	1	1	10	0	10	10	11	11
22	floodplain swamp – billabong	1	0	1	1	10	0	10	10	11	11
23	swamp	1	0	1	1	10	0	10	10	11	11
24	Linear feature, usually residual stands of native species found along Crown roads or road reserves.	1	0	1	1	10	0	10	10	11	11

25	Planted stands or corridors of native or exotic species. Mostly linear features along fence lines, but can include areas planted for gully stabilisation. May be of varying ages from recently established to mature	1	2	3	2	10	20	30	20	33	22
26	intensive animal production	1	2	3	1	0	20	20	20	23	21
27	private conservation agreement	1	0	1	1	10	0	10	10	11	11
29	sewage disposal ponds	1	0	1	1	0	20	20	20	21	21
30	riparian vegetation – exotic species(principally willows)	0	2	2	2	10	20	30	10	32	12
31	urban - recreation	1	2	3	1	0	20	20	20	23	21
32	defence facility	1	0	1	1	10	20	30	10	31	11
33	landfill	1	2	3	1	0	20	20	20	23	21
34	fish, prawn farm	1	0	1	1	10	20	30	20	31	21
35	horticulture – eucalypts & other Australian native species for cut flower arrangements	0	2	2	2	10	20	30	20	32	22
36	aerodrome/airport	1	2	3	1	10	20	30	20	33	21
37	horticulture – seed production, including clover seed	0	2	2	2	0	20	20	20	22	22
38	olives	0	2	2	2	10	20	30	20	32	22
39	vegetables	0	2	2	2	0	20	20	20	22	22
40	rice	1	2	3	1	0	20	20	20	23	21
41	hardwood plantation - State Forest	1	0	1	1	10	0	10	10	11	11
42	nursery	0	2	2	2	10	20	30	20	32	22
43	derelict mining land	1		1	1	10	20	30	20	31	21
44	mining site	1	0	1	1	10	20	30	20	31	21
45	airstrip (local/farmer, not sealed)	1	2	3	1	10	20	30	20	33	21
46	reservoir	1	0	1	1	10	20	30	10	31	11
47	energy corridor	1	0	1	1	10	0	10	10	11	11
48	lantana infestations; total surface area of ground cover by lantana	1	0	1	1	0	20	20	20	21	21
49	restored mining lands, both open cut and pit operations	1	0	1	1	10	20	30	10	31	11
50	cemetery	1	2	3	1	10	20	30	20	33	21
51	river training work	1	0	1	1	10	20	30	10	31	11
52	poplar plantation	0	2	2	2	10	20	30	20	32	22
53	building associated with horticultural industry (winery, packing shed)	1	0	1	1	10	20	30	20	31	21
54	mangrove	1	0	1	1	10	0	10	10	11	11
55	mudflat	1	0	1	1	10	0	10	10	11	11
56	coastal marsh/estuarine swamp	1	0	1	1	10	0	10	10	11	11
57	drainage channel	1	0	1	1	10	20	30	10	31	11
58	foreshore land to DLWC dam	1	2	3	1	10	0	10	10	13	11
59	foreshore or reserved land to water supply dam (Sydney Water, Hunter Water, SMHEA or Public Works Dam)	1	2	3	1	10	20	30	10	33	11
60	abattoir	1	2	3	1	10	20	30	20	33	21
61	research facility	1	2	3	1	10	20	30	20	33	21
62	irrigation from abattoir & other industries	1	2	3	1	10	20	30	20	33	21
63	river navigation structure	1	0	1	1	10	20	30	10	31	11
64	beach	1	2	3	1	10	20	30	10	33	11
65	river gravel deposit	1	0	1	1	10	0	10	10	11	11
66	recently burnt areas (of woody vegetation)	1	0	1	1	10	0	10	10	11	11
67	native woody shrub	1	0	1	1	10	0	10	10	11	11
68	recently cleared land (cleared of forest vegetation, as yet not covered by crop or pasture	1	0	1	1	10	20	30	10	31	11
69	native shrub plantation (eg tea tree)	0	2	2	2	10	20	30	20	32	22
70	woodland	1	0	1	1	10	0	10	10	11	11
71	flood or irrigation structure	1	0	1	1	10	20	30	10	31	11
72	trig station or beacon	1	0	1	1	10	20	30	10	31	11

73	wetland – dunal swamp	1	0	1	1	10	0	10	10	11	11
74	floodplain swamp	1	0	1	1	10	0	10	10	11	11
75	tourist development, convention site	1	2	3	1	10	20	30	20	33	21
76	lagoon, inland lake (not saline), open depression or playa	1	0	1	1	10	0	10	10	11	11
77	university & other tertiary institutions	1	2	3	1	10	20	30	20	33	21
78	fly ash dam/spoil dump	1	0	1	1	10	20	30	20	31	21
79	drain	1	0	1	1	10	20	30	10	31	11
80	water supply pressure reservoir including water filtration plant	1	0	1	1	10	20	30	10	31	11
81	shade house (includes hydroponic use)	0	2	2	2	0	20	20	20	22	22
82	grassland within mining lease	1	0	1	1	10	0	10	10	11	11
83	degraded land (salt site, eroded area)	1	0	1	1	10	20	30	10	31	11
84	fodder cropping such as oats	1	2	3	1	0	20	20	20	23	21
85	temporary water storage area (eg rice farming –opportunistic storage of water	1	0	1	1	10	20	30	20	31	21
86	inland salt lake	1	0	1	1	10	0	10	10	11	11
87	abandoned orchard and vine lands; trees/vines not maintained and may be dying; regrowth of native shrubs and trees is occurring	1	2	3	1	10	20	30	10	33	11
88	turf farming	1	2	3	1	0	20	20	20	23	21
89	bulb production for flower trade	1	2	3	1	0	20	20	20	23	21
90	horse stud and/or horse breeding facility	1	2	3	1	10	20	30	20	33	21
91	evaporation basin	1	0	1	1	10	20	30	10	31	11
92	government and private facilities – gaol, training centre, school, religious institutions & training centres, religious retreats	1	2	3	1	10	20	30	20	33	21
93	electricity substation	1	0	1	1	10	20	30	20	31	21
94	caravan park, mobile home village	1	2	3	1	0	20	20	20	23	21
95	restored sand mining area	1	0	1	1	10	20	30	10	31	11
96	sand spit/estuarine sand island	1	0	1	1	10	0	10	10	11	11
97	No identified use	1	0	1	1	10	20	30	10	31	11
98	aquaculture – oyster spoil & sheds, but not actual submerged lease	1	0	1	1	10	20	30	20	31	21
99	foreshore protection – vegetated foredune	1	2	3	1	10	20	30	10	33	11
100	marina	1	2	3	1	10	20	30	20	33	21
101	secondary grassland. This is a combined land use/land cover feature to describe clearing of an isolated area or woody vegetation in a forest with little or no further activity such as grazing or logging. Woody regeneration is not evident and grasses herbs or forbs dominate the site.	1	0	1	1	10	20	30	10	31	11
102	bananas	1	2	3	1	0	20	20	20	23	21
103	communications facility	1	2	3	1	10	20	30	20	33	21
104	pecan, macadamia and other nuts	0	2	2	2	0	20	20	20	22	22
105	coastal lake	1	0	1	1	10	0	10	10	11	11
106	estuarine waters	1	0	1	1	10	0	10	10	11	11
107	canal (eg canal estate, navigation canal)	1	2	3	1	10	20	30	20	33	21
108	river and riparian zone, where the river channel is filled by more than 50% of cumbungi or phragmites vegetation	1	0	1	1	10	0	10	10	11	11
109	cliff/rock outcrop	1	0	1	1	10	0	10	10	11	11
110	forest dominated by camphor laurel	1	2	3	2	10	0	10	10	13	12
111	grassed area(eg mown/slashed grass area) within a vineyard	1	2	3	1	0	20	20	20	23	21
112	electricity generation (power station and associated stockpiles, hydro-electric plants)	1	0	1	1	10	20	30	20	31	21
113	land controlled a power company, currently unused or lightly grazed	1	0	1	1	10	0	10	10	11	11
114	conveyor belt	1	2	3	1	10	20	30	20	33	21
115	urban –rural residential within vineyard	1	2	3	1	0	20	20	20	23	21
116	cut flowers and herbs	0	2	2	2	0	20	20	20	22	22

117	wide road reserve (excluding road pavement) or TSR with some grazing	1	2	3	1	10	0	10	10	13	11
118	vineyard with residential facilities scattered amongst plantings (hobby, retreat or tourist feature)	1	2	3	1	10	20	30	20	33	21
119	constructed grass waterway for water disposal. Part of a soil erosion control system carrying run-off from graded banks	1	2	3	1	10	20	30	20	33	21
120	eucalyptus oil plantation	0	2	2	2	10	20	30	20	32	22
121	drainage depression in cropping paddock	1	0	1	1	10	20	30	20	31	21
122	constructed wetland for conservation or water quality improvement	1	2	3	1	10	20	30	20	33	21
123	ancillary (saddle) wall to reservoir (constructed separate to main wall and used to impound surcharge waters)	1	2	3	1	10	20	30	20	33	21
124	effluent pond(s) from intensive animal industries	1	2	3	1	0	20	20	20	23	21
125	Salt treatment or salt demonstration site (discharge & recharge sites)	1	2	3	1	10	20	30	10	33	11
126	Truffle production	0	2	2	2	0	20	20	20	22	22
127	green power site (eg wind turbines)	1	0	1	1	10	20	30	10	31	11
128	water supply channel (non irrigation system eg Sydney water supply channel)	1	2	3	1	10	20	30	20	33	21
129	cotton	1	2	3	1	0	20	20	20	23	21
130	rural recreation - blocks are isolated and not associated with an urban area	1	0	1	1	10	20	30	20	31	21
131	flood chute (flood runner that is filled with water during and after a flood)	1	0	1	1	10	20	30	10	31	11
132	irrigation dam	1	0	1	1	10	20	30	20	31	21
133	stock pile of material located remotely from a mine site. Often situated next to a railway line or at a port	1	2	3	1	10	20	30	20	33	21
134	flood refuge (constructed feature located within a flood prone area)	1	0	1	1	10	20	30	10	31	11
135	saleyard	1	2	3	1	0	20	20	20	23	21
136	irrigation supply channel	1	2	3	1	10	20	30	20	33	21
137	firebreak	1		1	1	10	20	30	10	31	11
138	prior stream	1	0	1	1	10	0	10	10	11	11
139	farm infrastructure - house, machinery & storage sheds and garden areas	1	0	1	1	0	20	20	20	21	21
140	cropping of legumes for seed - chickpeas, lupins, vetches, field beans	1	2	3	1	0	20	20	20	23	21
141	rural quarantine site	1	2	3	1	10	20	30	10	33	11
142	pine planting interspersed amongst eucalypt/shrub forest and/or areas with poor to nil establishment	1	2	3	2	10	0	10	10	13	12
143	regeneration area in reference to Section 47 notice of the NVC Act	1	0	1	1	10	0	10	10	11	11
144	agro-forestry	0	2	2	2	10	20	30	10	32	12
145	land fenced and treated for land degradation problems (other than salt affected land; see Class 125)	1	2	3	1	10	20	30	10	33	11
146	land fenced for riparian management	1	2	3	1	10	20	30	10	33	11
147	abandoned urban or industrial area and site is locked up (eg Glen Alice)	1	2	3	1	10	20	30	20	33	21
148	Sydney Catchment Authority unused land	1	2	3	1	10	0	10	10	13	11
149	resort style private land use	1	2	3	2	0	20	20	20	23	22
150	training facility for marine pilots	1	0	1	1	10	20	30	20	31	21
151	hobby farm	1	2	3	1	10	20	30	10	33	11
152	small to medium forested blocks with isolated residential buildings. Rural residential but the forested feature of the block is worth noting	1	0	1	1	10	20	30	10	31	11
153	disused power station	1	2	3	1	10	20	30	10	33	11
154	Jojoba plantation	0	2	2	2	0	20	20	20	22	22
155	surf club and/or coastal car parking facilities	1	2	3	1	10	20	30	20	33	21
156	glider field for recreational activities	1	2	3	1	10	20	30	20	33	21

157	cultural heritage site - aboriginal or european	1	2	3	1	10	20	30	10	33	11
158	submerged oyster lease	1	0	1	1	10	20	30	10	31	11
159	dog kennel or dog run for greyhounds	1	2	3	1	0	20	20	20	23	21
160	area recently under development for urban, commercial and/or industrial uses - infrastructure in place but no building activity at the time of site inspection	1	2	3	1	0	20	20	20	23	21
161	sugar cane	1	2	3	1	0	20	20	20	23	21
162	Dense shrub growth over previously cleared land	1	0	1	1	10	0	10	10	11	11
163	gas supply facility	1	0	1	1	10	20	30	20	31	21
164	saltbush planting - for grazing purposes and not as part of a salinity control program	1	0	1	1	10	0	10	10	11	11
165	sawmill	1	0	1	1	10	20	30	20	31	21
166	illegal recreation	1	2	3	1	10	20	30	20	33	21
167	crown reserve	1	0	1	1	10	0	10	10	11	11
168	grazing of natural vegetation - grazing of domestic stock on essentially unmodified native vegetation	1	0	1	1	10	0	10	10	11	11
169	protected area managed for conservation of specific natural features	1	0	1	1	10	0	10	10	11	11
170	Grazing - Residual strips (block or linear feature) of native grassland within cultivated paddock - with a woody vegetation cover of open forest	1	0	1	1	10	20	30	10	31	11
171	Alternate life style community under multiple occupancy	1	0	1	1	10	20	30	20	31	21
173	Tea and Coffee plantation	0	2	2	2	0	20	20	20	22	22
174	Bamboo plantation (for food)	0	2	2	2	0	20	20	20	22	22
175	Grazing of riparian land	1	0	1	1	10	0	10	10	11	11
176	Tea Tree Plantation - irrigated	0	2	2	2	0	20	20	20	22	22
177	Rainforest plantation	0	2	2	2	0	20	20	20	22	22
178	Lemon Myrtle plantation	0	2	2	2	0	20	20	20	22	22
179	Levee bank for urban area	1	0	1	1	10	20	30	20	31	21
180	Bore drain (active)	1	0	1	1	10	20	30	10	31	11
181	Bore drain (not longer used)	1	0	1	1	10	0	10	10	11	11
182	grazing within the bed of an ephemeral lake; lake is not regulated or above r	1	0	1	1	10	0	10	10	11	11
183	range land grazing	1	0	1	1	10	0	10	10	11	11
184	grazing within a controlled flood system; prohibition on the construction of barriers to the movement of water	1	0	1	1	10	0	10	10	11	11
185	waterway associated with controlled flooding or opportunistic cropping systems	1	0	1	1	10	20	30	20	31	21
186	cropping - irrigated within a controlled flood system; prohibition on the construction of barriers to the movement of water	1	2	3	1	0	20	20	20	23	21
187	cropping (irrigated) within the bed of an ephemeral lake; lake is regulated	1	2	3	1	0	20	20	20	23	21
188	cropping within the bed of an ephemeral lake; lake is not regulated or above regulation level	1	2	3	1	0	20	20	20	23	21
189	grazing within the bed of an ephemeral lake; lake is regulated	1	0	1	1	10	0	10	10	11	11
190	Pump site, urban or irrigation supply	1	0	1	1	10	20	30	20	31	21
191	Riparian strip in urban and other developed areas but with minimal use	1	0	1	1	10	20	30	10	31	11
192	Roadside rest area	1	0	1	1	10	20	30	20	31	21
193	Disposal site for horticultural waste	1	2	3	1	0	20	20	20	23	21
194	Salt interception pump site	1	2	3	1	10	20	30	10	33	11
195	Pump out site for house boat effluent	1	0	1	1	10	20	30	20	31	21
196	Mooring or jetty for house boat	1	0	1	1	10	20	30	10	31	11
197	Boat ramp	1	0	1	1	10	20	30	10	31	11
198	Crown reserve with public access	1	0	1	1	10	0	10	10	11	11
199				0	1			0	10	0	11
200	Irrigation farm infrastructure; miscellaneous lands within farms including access roads, bund walls, buildings and services	1	0	1	1	10	20	30	10	31	11

201	Low intensity grazing (of native pastures) and low intensity forestry combined	1	0	1	1	10	0	10	10	11	11
202	Grazing within controlled flood management systems	1	0	1	1	10	0	10	10	11	11
203	Perennial horticulture - eg asparagus - irrigated	1	2	3	1	0	20	20	20	23	21
204	Grazing of salt affected land	1	0	1	1	10	0	10	10	11	11
206				0	1			0	10	0	11
207	Disposal dam, depression or lake bed for irrigation tail water	1	0	1	1	10	20	30	10	31	11
208				0	1			0	10	0	11
209	Gypsum mine and associated processing	1	0	1	1	10	20	30	20	31	21
210	Land vested with an aboriginal land council	1	0	1	1	10	0	10	10	11	11
211	Grazing of areas with water ponding treatments	1	0	1	1	10	20	30	10	31	11
212				0	1			0	10	0	11
213				0	1			0	10	0	11
214				0	1			0	10	0	11
215	Regeneration within sites cleared under a 'window-pane' pattern	1	0	1	1	10	20	30	10	31	11
216	Flood runners in western NSW. (Vegetation is indicative of a more prolonged period of inundation or wetness.)	1	0	1	1	10	0	10	10	11	11
217	Grazing pastures within the Macquarie Marshes landscape	1	0	1	1	10	0	10	10	11	11
218				0	1			0	10	0	11
219	River diversion work (inland, not coastal)	1	0	1	1	10	0	10	10	11	11
220	Grazing within bed of an ephemeral lake or watercourse; lake or watercourse are not regulated or above regulation level with a dense shrub or tree cover	1	0	1	1	10	0	10	10	11	11
221				0	1			0	10	0	11
222				0	1			0	10	0	11
223				0	1			0	10	0	11
224				0	1			0	10	0	11
226				0	1			0	10	0	11
231	Areas of dense standing dead trees with the ground cover consisting of volunteer species such as bracken, blady grass and tea tree.	1	0	1	1	10	20	30	10	31	11
232	Cropping within an ephemeral wetland (does not include cropping within an ephemeral lake - see classes 186 & 187)	1	0	1	1	10	20	30	20	31	21
233	Grazing within an ephemeral wetland (does not include cropping within an ephemeral lake - see classes 182 & 189)	1	0	1	1	10	0	10	10	11	11
234	Storage site for agricultural chemicals and products (eg fertiliser dumps, cotton bunkers and temporary grain storages)	1	0	1	1	10	20	30	20	31	21
235	Agricultural industry in a rural location eg cotton gin (See also class 53.)	1	0	1	1	10	20	30	20	31	21
236	Levee for flood protection around house and farm infrastructure	1	0	1	1	10	20	30	10	31	11
237	Waste dump from sawmill site	1	0	1	1	10	20	30	20	31	21
238				0	1			0	10	0	11
239				0	1			0	10	0	11
240	Land primarily used for opal mining operations including shafts, spoil dumps, spoil dumps, residences , community and commercial facilities	1	0	1	1	10	20	30	20	31	21
241	Swampy and/or more moist landscapes within the western drainage system	1	0	1	1	10	0	10	10	11	11
242	Grazing of areas with chequer-board treatment for scald reclamation	1	0	1	1	10	0	10	10	11	11
243	Weir	1	0	1	1	10	0	10	10	11	11
244	Rangeland grazing within western river outflows (eg Paroo & Warrego Rivers)	1	0	1	1	10	0	10	10	11	11
245				0	1			0	10	0	11
255				0	1			0	10	0	11
266				0	1			0	10	0	11

269				0	1			0	10	0	11
302				0	1			0	10	0	11
303				0	1			0	10	0	11
304				0	1			0	10	0	11
305				0	1			0	10	0	11
306				0	1			0	10	0	11
307				0	1			0	10	0	11
308				0	1			0	10	0	11
309				0	1			0	10	0	11
310				0	1			0	10	0	11
311				0	1			0	10	0	11
312				0	1			0	10	0	11
313				0	1			0	10	0	11
314				0	1			0	10	0	11
315				0	1			0	10	0	11
316				0	1			0	10	0	11
317				0	1			0	10	0	11
318				0	1			0	10	0	11
319				0	1			0	10	0	11
320				0	1			0	10	0	11
321				0	1			0	10	0	11
322				0	1			0	10	0	11
323				0	1			0	10	0	11
325				0	1			0	10	0	11
327				0	1			0	10	0	11
328				0	1			0	10	0	11
329				0	1			0	10	0	11
330				0	1			0	10	0	11
331				0	1			0	10	0	11
332				0	1			0	10	0	11
333				0	1			0	10	0	11
334				0	1			0	10	0	11
335				0	1			0	10	0	11
336				0	1			0	10	0	11
337				0	1			0	10	0	11
338				0	1			0	10	0	11
339				0	1			0	10	0	11
340				0	1			0	10	0	11
341				0	1			0	10	0	11
342				0	1			0	10	0	11
343				0	1			0	10	0	11
344				0	1			0	10	0	11
345				0	1			0	10	0	11
346				0	1			0	10	0	11
348				0	1			0	10	0	11
349				0	1			0	10	0	11
350				0	1			0	10	0	11
351				0	1			0	10	0	11
352				0	1			0	10	0	11
353				0	1			0	10	0	11
354				0	1			0	10	0	11
355				0	1			0	10	0	11
356				0	1			0	10	0	11

357				0	1			0	10	0	11
358				0	1			0	10	0	11
359				0	1			0	10	0	11
360				0	1			0	10	0	11
361				0	1			0	10	0	11
362				0	1			0	10	0	11
363				0	1			0	10	0	11
364				0	1			0	10	0	11
365				0	1			0	10	0	11
366				0	1			0	10	0	11
367				0	1			0	10	0	11
368				0	1			0	10	0	11
369				0	1			0	10	0	11
370				0	1			0	10	0	11
371				0	1			0	10	0	11
372				0	1			0	10	0	11
373				0	1			0	10	0	11
374				0	1			0	10	0	11
375				0	1			0	10	0	11
376				0	1			0	10	0	11
377				0	1			0	10	0	11
379				0	1			0	10	0	11
380				0	1			0	10	0	11
381				0	1			0	10	0	11
382				0	1			0	10	0	11
383				0	1			0	10	0	11
384				0	1			0	10	0	11
385				0	1			0	10	0	11
386				0	1			0	10	0	11
387				0	1			0	10	0	11
388				0	1			0	10	0	11
389				0	1			0	10	0	11
390				0	1			0	10	0	11
391				0	1			0	10	0	11
413				0	1			0	10	0	11
1000	NP	1	0	1	1	10	0	10	10	11	11
1001	SRA	1	0	1	1	10	0	10	10	11	11
1002	SCA	1	0	1	1	10	0	10	10	11	11
1003	NR	1	0	1	1	10	0	10	10	11	11
1004	HISTORICAL SITE	1	2	3	1	10	20	30	10	33	11
1005	SF	1	2	3	1	10	0	10	10	13	11
1006	MP	1	0	1	1	10	0	10	10	11	11
1393				0	1			0	10	0	11
4443				0	1			0	10	0	11
1111168				0	1			0	10	0	11

Appendix 4- VAST Categories Generated from Vegetation Extent and Land Use Tags

From Dillon et al 2009

Vegetation Extent	ALUM Primary	ALUM Major Category	ALUM Code	VAST Code	VAST State
Native Intact	Conservation and Natural Environments	Nature conservation	1.1.3	1	Residual
			1.1.7	1	Residual
		Managed resource protection	1.2.0	1	Residual
			1.2.2	1	Residual
			1.2.4	1	Residual
		Other minimal use	1.3.0	2	Modified
			1.3.2	2	Modified
			1.3.3	2	Modified
			1.3.4	2	Modified
	Production from Relatively Natural Environments	Grazing natural vegetation	2.1.0	2	Modified
		Production forestry	2.2.0	2	Modified
			2.2.1	2	Modified
	Production from Dryland Agriculture and Plantations	Dryland Agriculture and Plantations	3.0.0	2	Modified
		Plantation forestry	3.1.0	5	Replaced – Managed
			3.1.1	5	Replaced – Managed
			3.1.2	5	Replaced – Managed
			3.1.4	2	Modified
		Grazing modified pastures	3.2.0	2	Modified
			3.2.1	2	Modified
			3.2.2	5	Replaced – Managed
		Cropping	3.3.0	5	Replaced – Managed
			3.3.2	5	Replaced – Managed
			3.3.3	5	Replaced – Managed
			3.3.5	5	Replaced – Managed
			3.3.6	5	Replaced – Managed
			3.3.8	5	Replaced – Managed
		Perennial horticulture	3.4.0	5	Replaced – Managed
			3.4.1	5	Replaced – Managed
			3.4.2	5	Replaced – Managed
			3.4.3	5	Replaced – Managed
			3.4.4	5	Replaced – Managed
		Seasonal horticulture	3.5.0	5	Replaced – Managed
			3.5.3	5	Replaced – Managed
			3.5.4	5	Replaced – Managed
		Land in Transition	3.6.1	4	Replaced – Adventive

		3.6.2	4	Replaced – Adventive
		3.6.3	4	Replaced – Adventive
		3.6.4	4	Replaced – Adventive
Production from Irrigated Agriculture and Plantations	Irrigated plantation forestry	4.1.1	5	Replaced – Managed
		4.1.2	5	Replaced – Managed
		4.1.4	5	Replaced – Managed
	Grazing modified pastures	4.2.1	5	Replaced – Managed
	Irrigated modified pastures	4.2.0	5	Replaced – Managed
	Irrigated cropping	4.3.0	5	Replaced – Managed
		4.3.1	5	Replaced – Managed
		4.3.2	5	Replaced – Managed
		4.3.3	5	Replaced – Managed
		4.3.6	5	Replaced – Managed
		4.3.8	5	Replaced – Managed
	Irrigated perennial horticulture	4.4.0	5	Replaced – Managed
		4.4.1	5	Replaced – Managed
		4.4.2	5	Replaced – Managed
		4.4.3	5	Replaced – Managed
		4.4.4	5	Replaced – Managed
		4.4.7	5	Replaced – Managed
	Irrigated seasonal horticulture	4.5.3	5	Replaced – Managed
		4.5.4	5	Replaced – Managed
	Irrigated land in transition	4.6.2	5	Replaced – Managed
Intensive Uses	Intensive Uses	5.0.0	6	Removed
	Intensive horticulture	5.1.0	6	Removed
		5.1.1	6	Removed
	Intensive animal production	5.2.0	6	Removed
		5.2.1	6	Removed
		5.2.2	6	Removed
		5.2.3	6	Removed
		5.2.4	6	Removed
		5.2.5	6	Removed
		5.2.6	6	Removed
	Manufacturing and industrial	5.3.0	6	Removed
	Residential	5.4.0	2	Modified
		5.4.1	2	Modified
		5.4.2	2	Modified
		5.4.3	2	Modified
	Services	5.5.0	2	Modified
		5.5.1	2	Modified
		5.5.2	2	Modified
		5.5.3	2	Modified
		5.5.4	2	Modified
		5.5.5	2	Modified
	Utilities	5.6.0	2	Modified
		5.6.1	2	Modified
		5.6.2	2	Modified
	Transport and communication	5.7.0	2	Modified
		5.7.1	2	Modified
		5.7.2	2	Modified

			5.7.3	2	Modified
			5.7.4	2	Modified
			5.7.5	2	Modified
		Mining	5.8.0	2	Modified
			5.8.1	2	Modified
			5.8.2	2	Modified
			5.8.3	2	Modified
		Waste treatment and disposal	5.9.0	2	Modified
			5.9.1	2	Modified
			5.9.2	2	Modified
			5.9.5	2	Modified
	Water	Lake	6.1.0	6	Removed
			6.1.1	6	Removed
		Reservoir or dam	6.2.0	6	Removed
			6.2.1	2	Modified
			6.2.3	2	Modified
			6.2.4	2	Modified
		River	6.3.0	2	Modified
			6.3.3	2	Modified
		Channel/aqueduct	6.4.0	2	Modified
			6.4.1	6	Removed
			6.4.2	6	Removed
		Marsh/wetland	6.5.0	6	Removed
		Estuary/coastal waters	6.6.0	6	Removed
			6.6.2	2	Modified
			6.6.3	2	Modified
	Unknown	Unknown	9.9.9	9	Unknown
Native Derived	Conservation and Natural Environments	Nature conservation	1.1.3	3	Transformed
			1.1.7	3	Transformed
		Managed resource protection	1.2.0	3	Transformed
			1.2.2	3	Transformed
			1.2.4	3	Transformed
		Other minimal use	1.3.0	3	Transformed
			1.3.2	3	Transformed
			1.3.3	3	Transformed
			1.3.4	3	Transformed
	Relatively Natural Environments	Grazing natural vegetation	2.1.0	3	Transformed
		Production forestry	2.2.0	3	Transformed
			2.2.1	3	Transformed
	Dryland Agriculture and Plantations	Dryland Agriculture and Plantations	3.0.0	3	Transformed
		Plantation forestry	3.1.0	5	Replaced – Managed
			3.1.1	5	Replaced – Managed
			3.1.2	5	Replaced – Managed
			3.1.4	3	Transformed
		Grazing modified pastures	3.2.0	3	Transformed
			3.2.1	3	Transformed
			3.2.2	5	Replaced – Managed
		Cropping	3.3.0	5	Replaced – Managed
			3.3.2	5	Replaced – Managed

			3.3.3	5	Replaced – Managed
			3.3.5	5	Replaced – Managed
			3.3.6	5	Replaced – Managed
			3.3.8	5	Replaced – Managed
		Perennial horticulture	3.4.0	5	Replaced – Managed
			3.4.1	5	Replaced – Managed
			3.4.2	5	Replaced – Managed
			3.4.3	5	Replaced – Managed
			3.4.4	5	Replaced – Managed
		Seasonal horticulture	3.5.3	5	Replaced – Managed
			3.5.4	5	Replaced – Managed
		Land in Transition	3.6.1	4	Replaced – Adventive
			3.6.2	4	Replaced – Adventive
			3.6.3	4	Replaced – Adventive
			3.6.4	4	Replaced – Adventive
	Irrigated Agriculture and Plantations	Irrigated plantation forestry	4.1.0	5	Replaced – Managed
			4.1.1	5	Replaced – Managed
			4.1.2	5	Replaced – Managed
			4.1.4	5	Replaced – Managed
		Grazing modified pastures	4.2.1	5	Replaced – Managed
		Irrigated modified pastures	4.2.0	5	Replaced – Managed
		Irrigated cropping	4.3.0	5	Replaced – Managed
			4.3.1	5	Replaced – Managed
			4.3.3	5	Replaced – Managed
			4.3.6	5	Replaced – Managed
		Irrigated perennial horticulture	4.4.0	5	Replaced – Managed
			4.4.1	5	Replaced – Managed
			4.4.2	5	Replaced – Managed
			4.4.3	5	Replaced – Managed
			4.4.4	5	Replaced – Managed
			4.4.7	5	Replaced – Managed
		Irrigated seasonal horticulture	4.5.3	5	Replaced – Managed
			4.5.4	5	Replaced – Managed
		Irrigated land in transition	4.6.2	5	Replaced – Managed
	Intensive Uses	Intensive Uses	5.0.0	6	Removed
		Intensive horticulture	5.1.0	6	Removed
			5.1.1	6	Removed
		Intensive animal production	5.2.0	6	Removed
			5.2.1	6	Removed
			5.2.4	6	Removed
			5.2.5	6	Removed
			5.2.6	6	Removed
		Manufacturing and industrial	5.3.0	6	Removed
		Residential	5.4.0	3	Transformed
			5.4.1	3	Transformed
			5.4.2	3	Transformed
			5.4.3	3	Transformed
		Services	5.5.0	3	Transformed
			5.5.1	3	Transformed
			5.5.2	3	Transformed

			5.5.3	3	Transformed
			5.5.4	3	Transformed
			5.5.5	3	Transformed
		Utilities	5.6.0	3	Transformed
			5.6.1	3	Transformed
			5.6.2	3	Transformed
		Transport and communication	5.7.0	3	Transformed
			5.7.1	3	Transformed
			5.7.2	3	Transformed
			5.7.3	3	Transformed
			5.7.4	3	Transformed
			5.7.5	3	Transformed
		Mining	5.8.0	3	Transformed
			5.8.1	3	Transformed
			5.8.2	3	Transformed
			5.8.3	3	Transformed
		Waste treatment and disposal	5.9.0	3	Transformed
			5.9.1	3	Transformed
			5.9.2	3	Transformed
			5.9.5	3	Transformed
	Water	Lake	6.1.0	0	Naturally Bare
			6.1.1	0	Naturally Bare
		Reservoir or dam	6.2.0	6	Removed
			6.2.1	6	Removed
			6.2.3	6	Removed
			6.2.4	6	Removed
		River	6.3.0	0	Naturally Bare
			6.3.3	0	Naturally Bare
		Channel/aqueduct	6.4.0	6	Removed
			6.4.1	6	Removed
			6.4.2	6	Removed
		Marsh/wetland	6.5.0	3	Transformed
		Estuary/coastal waters	6.6.0	0	Naturally Bare
			6.6.2	0	Naturally Bare
			6.6.3	0	Naturally Bare
	Unknown	Unknown	9.9.9	9	Unknown
Native / Non-native mosaic	Conservation and Natural Environments	Nature conservation	1.1.3	3-4	Mosaic
			1.1.7	3-4	Mosaic
		Managed resource protection	1.2.2	3-4	Mosaic
			1.2.4	3-4	Mosaic
		Other minimal use	1.3.0	3-4	Mosaic
			1.3.2	3-4	Mosaic
			1.3.3	3-4	Mosaic
			1.3.4	3-4	Mosaic
	Relatively Natural Environments	Grazing natural vegetation	2.1.0	3-4	Mosaic
		Production forestry	2.2.0	3-4	Mosaic
			2.2.1	3-4	Mosaic
	Dryland Agriculture and Plantations	Dryland Agriculture and Plantations	3.0.0	3-4	Mosaic
		Plantation forestry	3.1.0	3-4	Mosaic

			3.1.1	3-4	Mosaic
			3.1.2	3-4	Mosaic
			3.1.3	3-4	Mosaic
			3.1.4	3-4	Mosaic
		Grazing modified pastures	3.2.0	3-4	Mosaic
			3.2.1	3-4	Mosaic
			3.2.2	3-4	Mosaic
		Cropping	3.3.0	5	Replaced – Managed
			3.3.2	5	Replaced – Managed
			3.3.3	5	Replaced – Managed
			3.3.5	5	Replaced – Managed
			3.3.6	5	Replaced – Managed
			3.3.8	5	Replaced – Managed
		Perennial horticulture	3.4.0	5	Replaced – Managed
			3.4.1	5	Replaced – Managed
			3.4.2	5	Replaced – Managed
			3.4.3	5	Replaced – Managed
			3.4.4	5	Replaced – Managed
		Seasonal horticulture	3.5.3	5	Replaced – Managed
			3.5.4	5	Replaced – Managed
		Land in Transition	3.6.1	3-4	Mosaic
			3.6.2	3-4	Mosaic
			3.6.3	3-4	Mosaic
			3.6.4	3-4	Mosaic
	Irrigated Agriculture and Plantations	Irrigated plantation forestry	4.1.0	5	Replaced –Managed
			4.1.1	5	Replaced – Managed
			4.1.4	5	Replaced – Managed
		Irrigated modified pastures	4.2.0	5	Replaced – Managed
		Irrigated cropping	4.3.0	5	Replaced – Managed
			4.3.1	5	Replaced – Managed
			4.3.2	5	Replaced – Managed
			4.3.3	5	Replaced – Managed
			4.3.6	5	Replaced – Managed
			4.3.8	5	Replaced – Managed
		Irrigated perennial horticulture	4.4.0	5	Replaced – Managed
			4.4.1	5	Replaced – Managed
			4.4.2	5	Replaced – Managed
			4.4.3	5	Replaced – Managed
			4.4.4	5	Replaced – Managed
			4.4.7	5	Replaced – Managed
		Irrigated seasonal horticulture	4.5.3	5	Replaced – Managed
			4.5.4	5	Replaced – Managed
		Irrigated land in transition	4.6.2	5	Replaced – Managed
	Intensive Uses	Intensive Uses	5.0.0	6	Removed
		Intensive horticulture	5.1.0	6	Removed
			5.1.1	6	Removed
		Intensive animal production	5.2.0	6	Removed
			5.2.1	6	Removed
			5.2.2	6	Removed
			5.2.4	6	Removed

			5.2.5	6	Removed
			5.2.6	6	Removed
		Manufacturing and industrial	5.3.0	6	Removed
		Residential	5.4.0	3-4	Mosaic
			5.4.1	3-4	Mosaic
			5.4.2	3-4	Mosaic
			5.4.3	3-4	Mosaic
		Services	5.5.0	3-4	Mosaic
			5.5.1	3-4	Mosaic
			5.5.2	3-4	Mosaic
			5.5.3	3-4	Mosaic
			5.5.4	3-4	Mosaic
			5.5.5	3-4	Mosaic
		Utilities	5.6.0	3-4	Mosaic
			5.6.1	3-4	Mosaic
			5.6.2	3-4	Mosaic
		Transport and communication	5.7.0	3-4	Mosaic
			5.7.1	3-4	Mosaic
			5.7.2	3-4	Mosaic
			5.7.3	3-4	Mosaic
			5.7.4	3-4	Mosaic
			5.7.5	3-4	Mosaic
		Mining	5.8.0	3-4	Mosaic
			5.8.1	3-4	Mosaic
			5.8.2	3-4	Mosaic
			5.8.3	3-4	Mosaic
		Waste treatment and disposal	5.9.0	3-4	Mosaic
			5.9.1	3-4	Mosaic
			5.9.2	3-4	Mosaic
			5.9.5	3-4	Mosaic
	Water	Lake	6.1.0	0	Naturally Bare
		Reservoir or dam	6.2.0	6	Removed
			6.2.1	6	Removed
			6.2.3	6	Removed
			6.2.4	6	Removed
		River	6.3.0	0	Naturally Bare
			6.3.3	0	Naturally Bare
		Channel/aqueduct	6.4.0	6	Removed
			6.4.1	6	Removed
			6.4.2	6	Removed
		Marsh/wetland	6.5.0	3-4	Mosaic
		Estuary/coastal waters	6.6.0	0	Naturally Bare
			6.6.2	0	Naturally Bare
			6.6.3	0	Naturally Bare
	Unknown	Unknown	9.9.9	9	Unknown
Non-vegetation	Conservation and Natural Environments	Nature conservation	1.1.3	5	Managed - Replaced
			1.1.7	5	Managed – Replaced
		Managed resource protection	1.2.0	5	Managed – Replaced
			1.2.2	5	Managed – Replaced
			1.2.4	5	Managed – Replaced

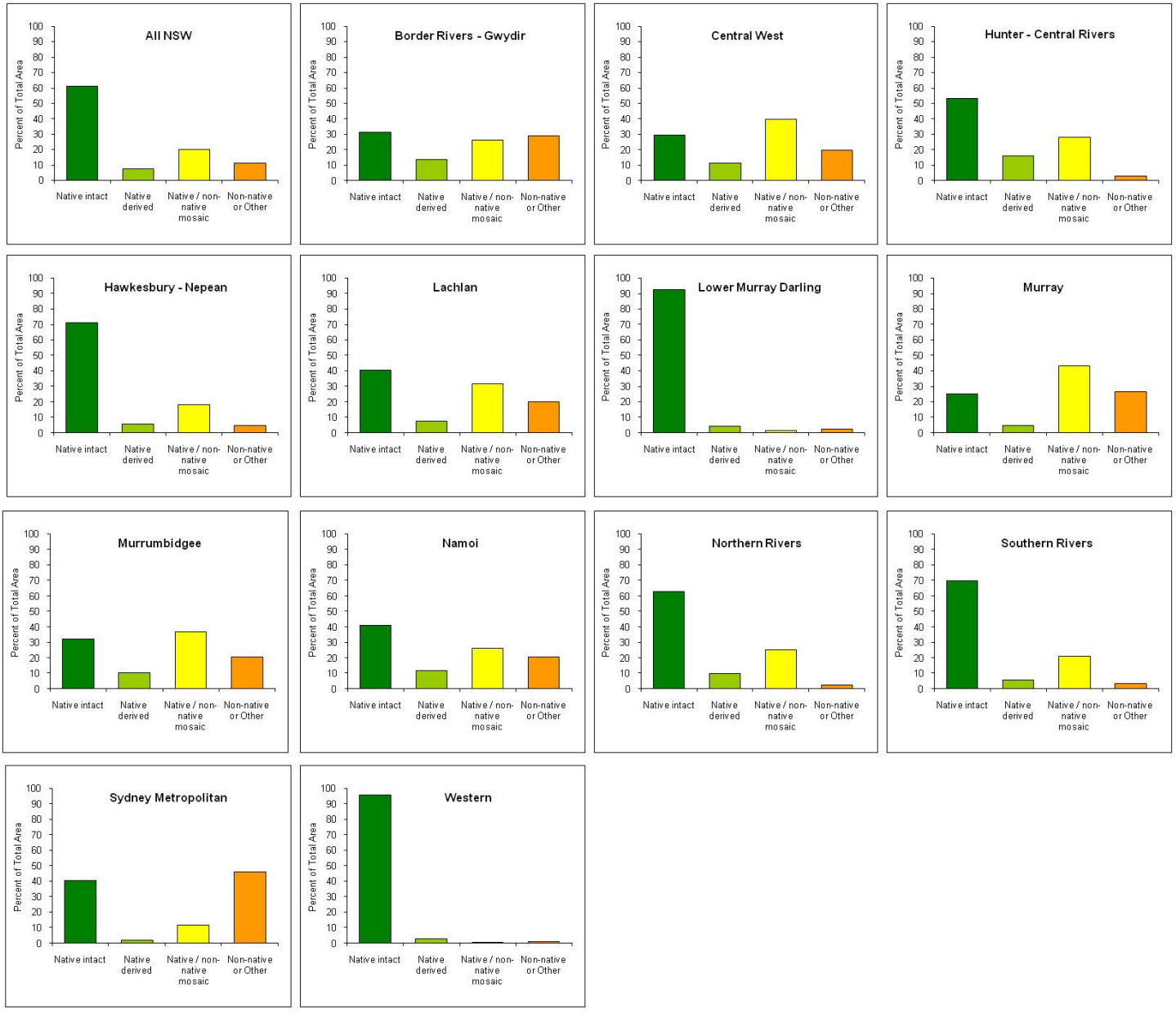
	Other minimal use	1.3.0	5	Managed – Replaced
		1.3.2	5	Managed – Replaced
		1.3.3	5	Managed – Replaced
		1.3.4	5	Managed – Replaced
Relatively Natural Environments	Grazing natural vegetation	2.1.0	5	Managed – Replaced
	Production forestry	2.2.0	5	Managed – Replaced
		2.2.1	5	Managed – Replaced
Dryland Agriculture and Plantations	Dryland Agriculture and Plantations	3.0.0	5	Managed – Replaced
	Plantation forestry	3.1.0	5	Managed – Replaced
		3.1.1	5	Managed – Replaced
		3.1.2	5	Managed – Replaced
		3.1.4	5	Managed – Replaced
	Grazing modified pastures	3.2.0	5	Managed – Replaced
		3.2.1	5	Managed – Replaced
	Cropping	3.3.0	5	Managed – Replaced
		3.3.2	5	Managed – Replaced
		3.3.3	5	Managed – Replaced
		3.3.5	5	Managed – Replaced
		3.3.6	5	Managed – Replaced
	Perennial horticulture	3.4.0	5	Managed – Replaced
		3.4.1	5	Managed – Replaced
		3.4.3	5	Managed – Replaced
		3.4.4	5	Managed – Replaced
	Seasonal horticulture	3.5.4	5	Managed – Replaced
	Land in Transition	3.6.1	5	Managed – Replaced
		3.6.2	5	Managed – Replaced
		3.6.3	5	Managed – Replaced
		3.6.4	5	Managed – Replaced
Irrigated Agriculture and Plantations	Irrigated plantation forestry	4.1.2	6	Removed
		4.1.4	6	Removed
	Irrigated modified pastures	4.2.0	6	Removed
	Irrigated cropping	4.3.0	6	Removed
		4.3.1	6	Removed
		4.3.2	6	Removed
		4.3.3	6	Removed
		4.3.6	6	Removed
	Irrigated perennial horticulture	4.4.0	6	Removed
		4.4.1	6	Removed
		4.4.2	6	Removed
		4.4.3	6	Removed
		4.4.4	6	Removed
	Irrigated seasonal horticulture	4.5.4	6	Removed
	Irrigated land in transition	4.6.2	6	Removed
Intensive Uses	Intensive Uses	5.0.0	6	Removed
	Intensive horticulture	5.1.0	6	Removed
		5.1.1	6	Removed
	Intensive animal production	5.2.0	6	Removed
		5.2.1	6	Removed
		5.2.2	6	Removed

			5.2.4	6	Removed
			5.2.6	6	Removed
		Manufacturing and industrial	5.3.0	6	Removed
		Residential	5.4.0	6	Removed
			5.4.1	6	Removed
			5.4.2	6	Removed
			5.4.3	6	Removed
		Services	5.5.0	6	Removed
			5.5.1	6	Removed
			5.5.2	6	Removed
			5.5.3	6	Removed
			5.5.4	6	Removed
			5.5.5	6	Removed
		Utilities	5.6.0	6	Removed
			5.6.1	6	Removed
		Transport and communication	5.7.0	6	Removed
			5.7.1	6	Removed
			5.7.2	6	Removed
			5.7.3	6	Removed
			5.7.4	6	Removed
			5.7.5	6	Removed
		Mining	5.8.0	6	Removed
			5.8.1	6	Removed
			5.8.2	6	Removed
			5.8.3	6	Removed
		Waste treatment and disposal	5.9.0	6	Removed
			5.9.1	6	Removed
			5.9.2	6	Removed
			5.9.5	6	Removed
	Water	Lake	6.1.0	0	Naturally Bare
			6.1.1	0	Naturally Bare
		Reservoir or dam	6.2.0	6	Removed
			6.2.1	6	Removed
			6.2.3	6	Removed
			6.2.4	6	Removed
		River	6.3.0	0	Naturally Bare
			6.3.3	0	Naturally Bare
		Channel/aqueduct	6.4.0	6	Removed
			6.4.1	6	Removed
			6.4.2	6	Removed
		Marsh/wetland	6.5.0	0	Naturally Bare
		Estuary/coastal waters	6.6.0	0	Naturally Bare
			6.6.2	0	Naturally Bare
			6.6.3	0	Naturally Bare
	Unknown	Unknown	9.9.9	9	Unknown
Exotic Vegetation	Conservation and Natural Environments	Nature conservation	1.1.3	5	Replaced – Managed
			1.1.7	5	Replaced – Managed
		Managed resource protection	1.2.2	5	Replaced – Managed
			1.2.4	5	Replaced – Managed
		Other minimal use	1.3.0	5	Replaced – Managed

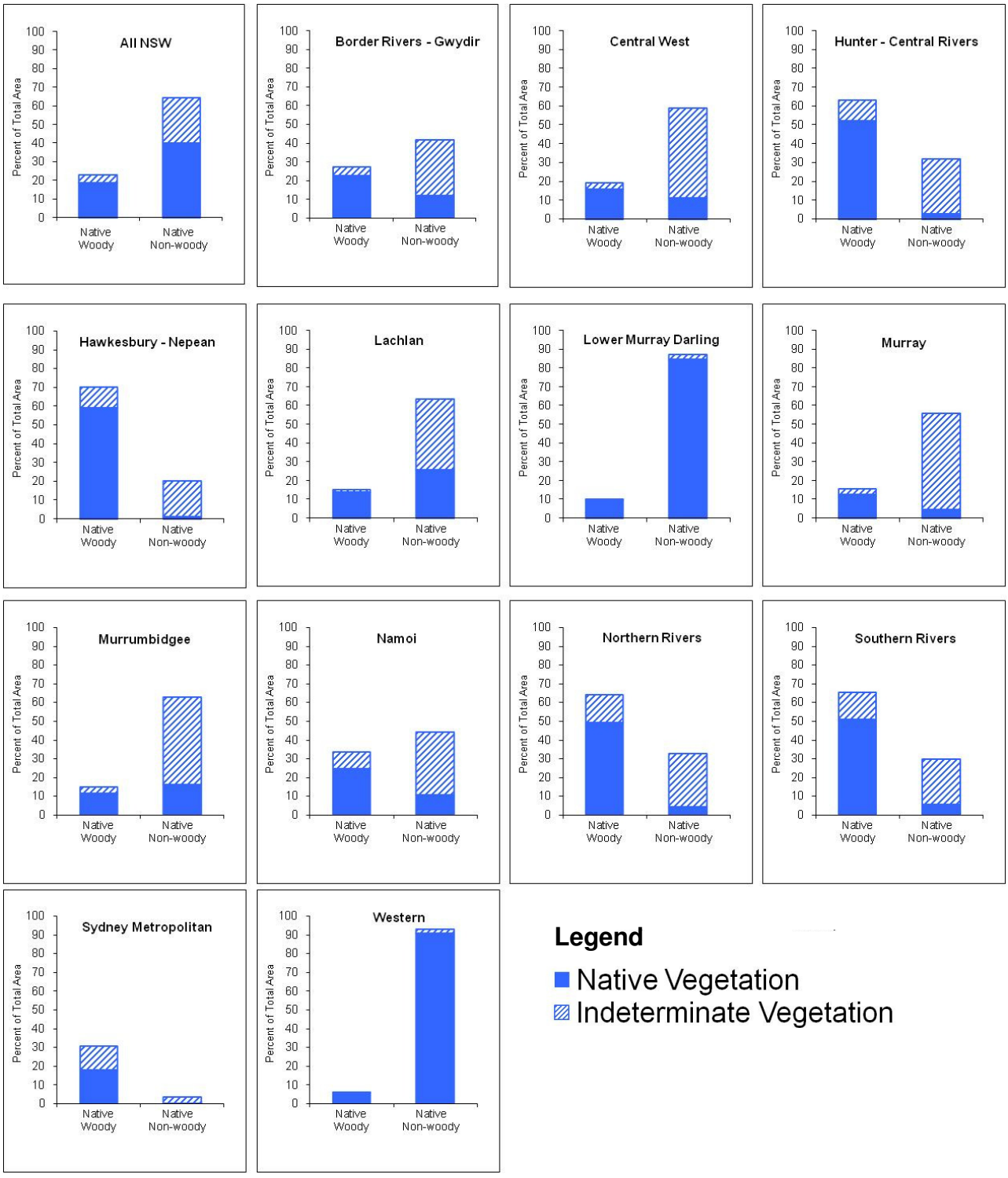
		1.3.2	5	Replaced – Managed
		1.3.3	5	Replaced – Managed
		1.3.4	5	Replaced – Managed
Relatively Natural Environments	Grazing natural vegetation	2.1.0	5	Replaced – Managed
	Production forestry	2.2.0	5	Replaced – Managed
		2.2.1	5	Replaced – Managed
Dryland Agriculture and Plantations	Production from Dryland Agriculture and Plantations	3.0.0	5	Replaced – Managed
	Plantation forestry	3.1.0	5	Replaced – Managed
		3.1.1	5	Replaced – Managed
		3.1.2	5	Replaced – Managed
		3.1.3	5	Replaced – Managed
		3.1.4	5	Replaced – Managed
	Grazing modified pastures	3.2.0	5	Replaced – Managed
		3.2.1	5	Replaced – Managed
		3.2.2	5	Replaced – Managed
	Cropping	3.3.0	5	Replaced – Managed
		3.3.2	5	Replaced – Managed
		3.3.3	5	Replaced – Managed
		3.3.5	5	Replaced – Managed
		3.3.6	5	Replaced – Managed
		3.3.8	5	Replaced – Managed
	Perennial horticulture	3.4.0	5	Replaced – Managed
		3.4.1	5	Replaced – Managed
		3.4.2	5	Replaced – Managed
		3.4.3	5	Replaced – Managed
		3.4.4	5	Replaced – Managed
	Seasonal horticulture	3.5.0	5	Replaced – Managed
		3.5.3	5	Replaced – Managed
		3.5.4	5	Replaced – Managed
	Land in Transition	3.6.1	5	Replaced – Managed
		3.6.2	5	Replaced – Managed
		3.6.3	5	Replaced – Managed
		3.6.4	5	Replaced – Managed
Irrigated Agriculture and Plantations	Irrigated plantation forestry	4.1.0	5	Replaced – Managed
		4.1.1	5	Replaced – Managed
		4.1.2	5	Replaced – Managed
	Irrigated modified pastures	4.2.0	5	Replaced – Managed
	Irrigated cropping	4.3.0	5	Replaced – Managed
		4.3.1	5	Replaced – Managed
		4.3.2	5	Replaced – Managed
		4.3.3	5	Replaced – Managed
		4.3.6	5	Replaced – Managed
		4.3.8	5	Replaced – Managed
	Irrigated perennial horticulture	4.4.0	5	Replaced – Managed
		4.4.1	5	Replaced – Managed
		4.4.2	5	Replaced – Managed
		4.4.3	5	Replaced – Managed
		4.4.4	5	Replaced – Managed
		4.4.7	5	Replaced – Managed

		Irrigated seasonal horticulture	4.5.3	5	Replaced – Managed
			4.5.4	5	Replaced – Managed
		Irrigated land in transition	4.6.2	5	Replaced – Managed
	Intensive Uses	Intensive Uses	5.0.0	6	Removed
		Intensive horticulture	5.1.0	6	Removed
			5.1.1	6	Removed
		Intensive animal production	5.2.0	6	Removed
			5.2.1	6	Removed
			5.2.2	6	Removed
			5.2.3	6	Removed
			5.2.4	6	Removed
			5.2.5	6	Removed
			5.2.6	6	Removed
		Manufacturing and industrial	5.3.0	6	Removed
		Residential	5.4.0	6	Removed
			5.4.1	6	Removed
			5.4.2	6	Removed
			5.4.3	6	Removed
		Services	5.5.0	6	Removed
			5.5.1	6	Removed
			5.5.2	6	Removed
			5.5.3	6	Removed
			5.5.4	6	Removed
			5.5.5	6	Removed
		Utilities	5.6.0	6	Removed
			5.6.1	6	Removed
		Transport and communication	5.7.0	6	Removed
			5.7.1	6	Removed
			5.7.2	6	Removed
			5.7.3	6	Removed
		Mining	5.8.0	6	Removed
			5.8.1	6	Removed
			5.8.2	6	Removed
			5.8.3	6	Removed
		Waste treatment and disposal	5.9.0	6	Removed
			5.9.1	6	Removed
			5.9.2	6	Removed
			5.9.5	6	Removed
	Water	Lake	6.1.0	0	Naturally Bare
		Reservoir or dam	6.2.0	6	Removed
			6.2.1	6	Removed
			6.2.3	6	Removed
			6.2.4	6	Removed
		River	6.3.0	0	Naturally Bare
			6.3.3	0	Naturally Bare
		Channel/aqueduct	6.4.0	6	Removed
			6.4.1	6	Removed
			6.4.2	6	Removed
		Marsh/wetland	6.5.0	0	Naturally Bare
		Estuary/coastal waters	6.6.0	0	Naturally Bare
	Unknown	Unknown	9.9.9	9	Unknown

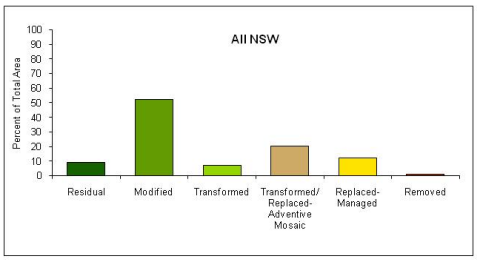
Appendix 5- CMA Graphs of 2006 Vegetation Extent

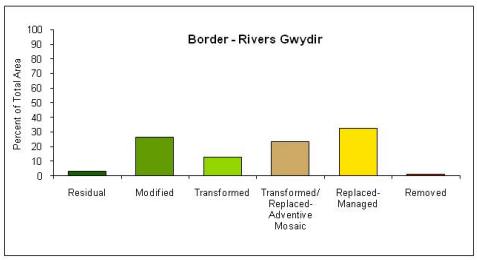


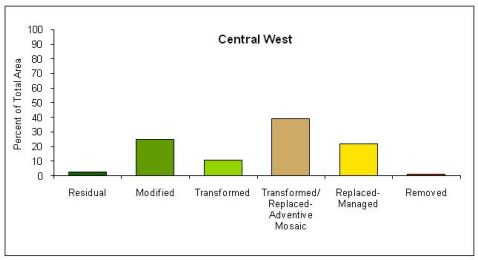
Appendix 6- CMA Graphs of 2006 Native Woody/Non-Woody Extent

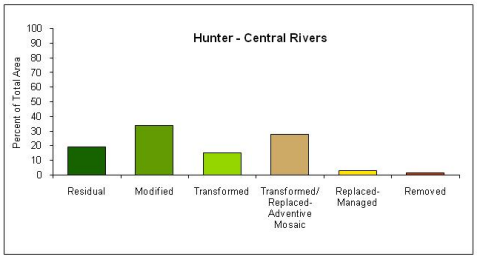


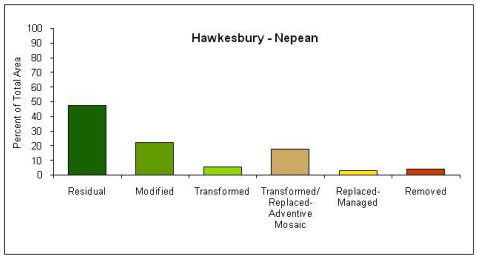
Appendix 7- CMA Graphs of 2006 Native Vegetation Condition

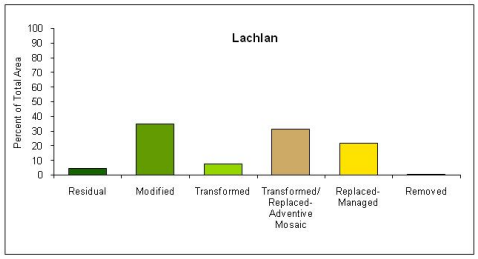


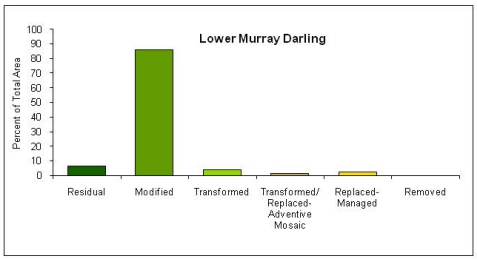


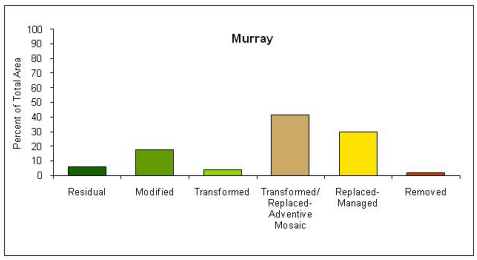


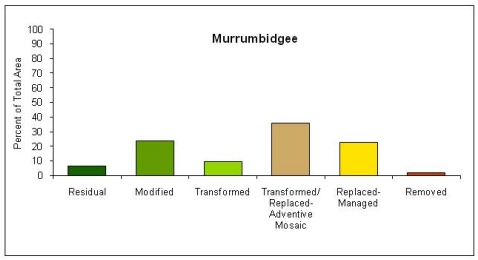


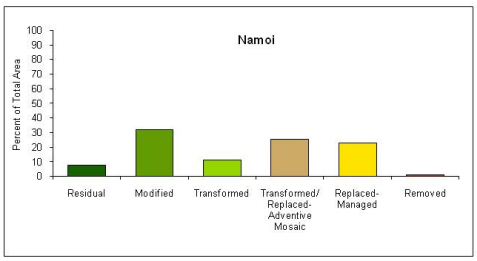


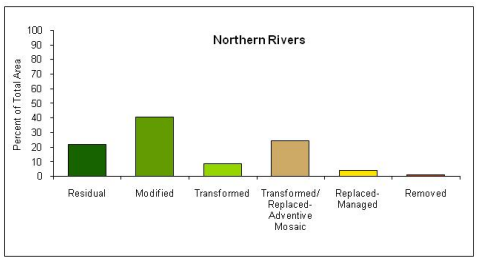


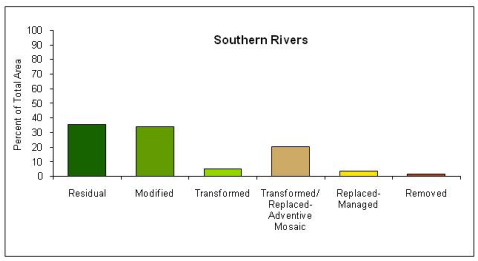


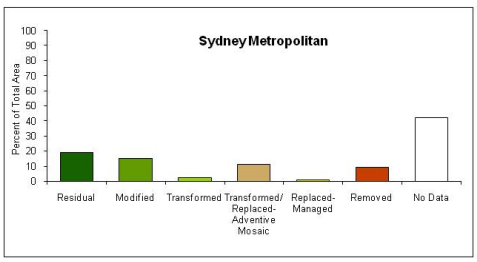


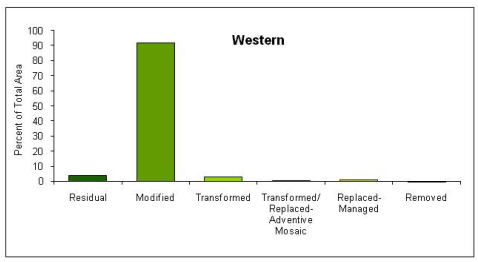












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