State of the catchments 2010

Land management within capability

Hawkesbury–Nepean region

State Plan target

By 2015 there is an increase in the area of land being managed within its capability.

Background

Land 'capability' is the inherent physical capacity of the land to sustain long-term land-uses and management practices without degradation to soil, land, air and water resources (Dent & Young 1981). It is a function of various landscape features and processes, including terrain, soil and climatic attributes, as well as their interactions. Failure to manage land in accordance with its capability may result in degradation of resources both on and off site, leading to a decline in natural ecosystem values, agricultural productivity and infrastructure functionality. The management of land within its inherent physical capability is vital for the sustainable use of soil and land resources.

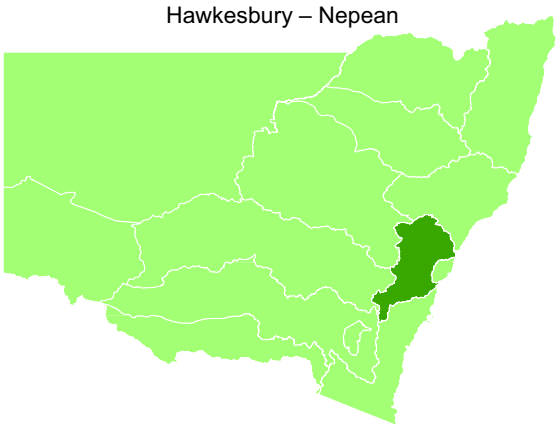
Land management deals with human practices followed during the course of land-use. Management actions, such as the intensity of tillage prior to sowing, length of bare fallow, maintenance of ground cover and the extent of fertiliser application, all impact on the land. Land-uses considered in this report include various forms of cropping, grazing, horticulture, forestry and nature conservation. Current land management practices associated with these land-uses are also considered against land degradation hazards. These hazards include sheet erosion, gully erosion, wind erosion, soil structure decline, organic carbon decline, soil salinity, soil acidification and acid sulfate soils.

A detailed technical report describes the methods used to derive the information contained in this report. At the time of publication of the *State of the catchments 2010* reports, the technical reports were being prepared for public release. When complete, they will be available on the DECCW website: www.environment.nsw.gov.au/publications/reporting.htm.

Note: All data on natural resource condition, pressures and management activity included in this SOC report, as well as the technical report, was collected up to January 2009.

This report outlines the level of sustainable land management across the Hawkesbury–Nepean region. It provides information for setting and adjusting natural resource management (NRM) targets and associated resource allocation. Land management within capability closely relates to soil condition, which is also discussed in this report.

Map of the catchment



The 10 soil monitoring units (SMUs) that were the focus of assessment within the Hawkesbury–Nepean region are shown in Figure 1. An SMU is a large tract of land where changes in soil condition and land management can be periodically observed. SMUs usually have a relatively homogeneous pattern of soils, parent material, geomorphology and climate. The SMUs were selected by DECCW and Hawkesbury–Nepean Catchment Management Authority (CMA) staff on the basis of their area, importance, pressures and vulnerability. They collectively covered 1930 km^2 or approximately nine per cent of the region.

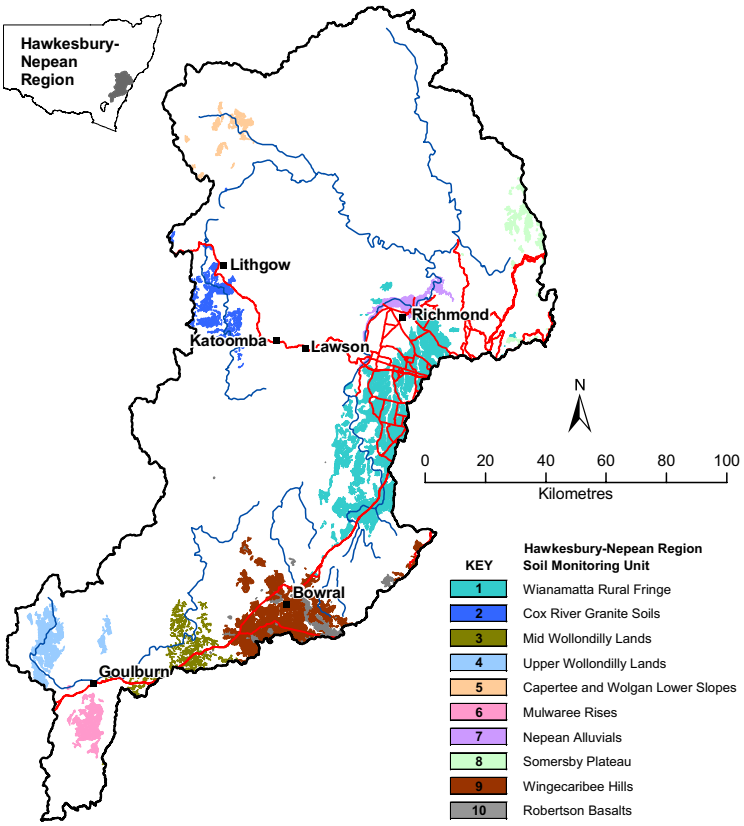


Figure 1 Location and extent of SMUs within the Hawkesbury–Nepean region

Assessment

The project was designed to assess changes in land management, relative to land capability, over time on the most important soils in New South Wales. It involved a comparison of the potential impact of land management actions against soil and land conditions of the sites to derive 'land management within capability' indices. The resulting process is summarised in Figure 2 and briefly described below. It is detailed further in Gray et al. (2008) and the supporting technical report.

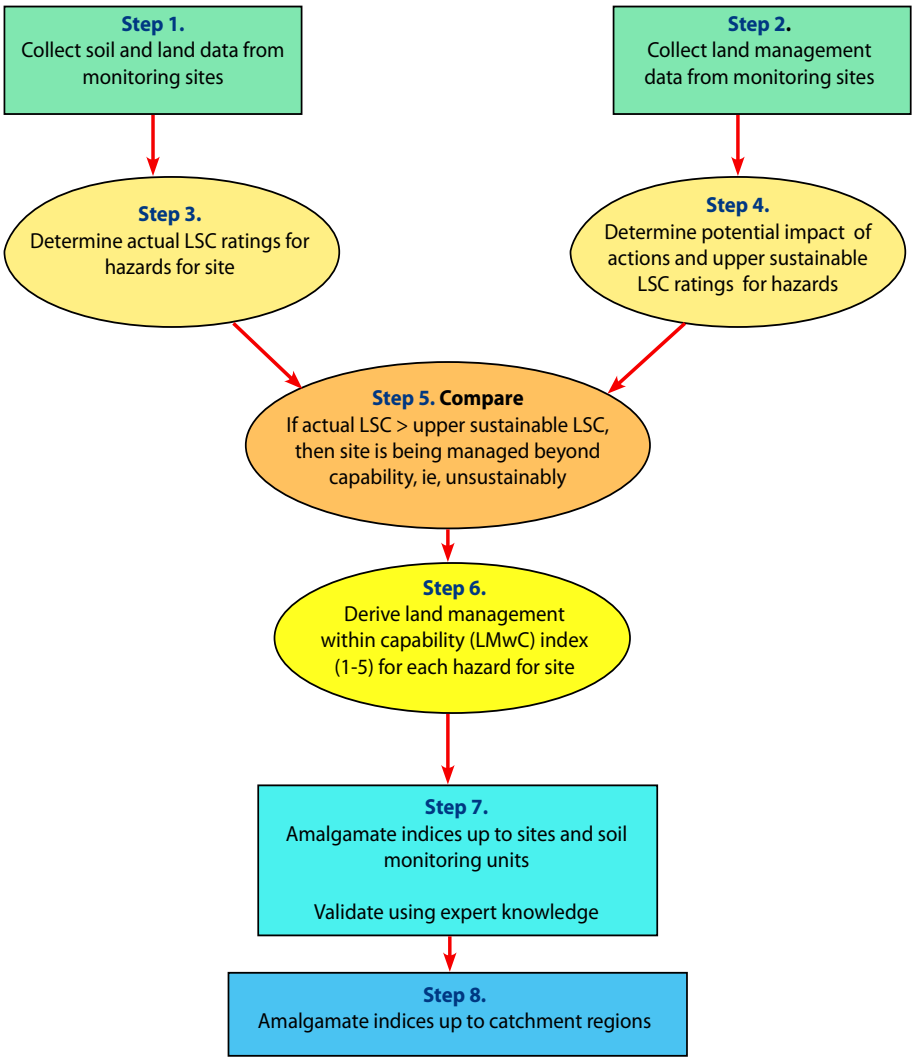


Figure 2 Assessment of land management within capability

Step 1 – the assessment commenced with the collection of soil and land data at each of the permanent soil monitoring sites established within each SMU. This is further described in the protocol document (DECCW 2009).

Step 2 – a questionnaire was used to collect land management data. This was completed by the landholder and detailed precise management actions for each site (DECC 2008). As of March 2009, 47 monitoring sites had been established in the Hawkesbury–Nepean region, 38 of which have had land management surveys returned.

Step 3 – land and soil capability (LSC) of each site was determined using a rule-set, together with the recorded land and soil attributes (Murphy et al. 2008). Ratings ranged from one (most capable) to eight (least capable) for each land degradation hazard.

Step 4 – the potential impact from the combined land management actions was determined, corresponding to an upper allowable LSC for each hazard. This was based on a rule-set prepared with the aid of literature values and expert knowledge and approved by DECCW, CMAs and Industry & Investment NSW (I&I) staff.

Step 5 – the potential impact of the land management actions was evaluated against the actual conditions of the site by comparing the above two derived values (LSC and upper allowable LSC) (see Table 1). Where the potential impact of actions exceeded what could be sustained by the land, the land was rated as being managed beyond its capability.

Step 6 – results were then converted to the 'land management within capability' index, using the rules given in Table 1. The index indicates the degree to which the land is managed in accordance with its natural ability to sustain long-term uses. An index of five indicates very good, highly sustainable land management where the risk of land degradation is very low. An index of one indicates very poor, unsustainable land management, with a very high risk of land degradation.

Step 7 – indices for each hazard at each site were combined for the whole site and combined again to find an average for each SMU. Where significant differences were apparent, expert knowledge gained from DECCW and CMA staff familiar with local land management practices was used to validate the results and modifications made.

Step 8 – the indices were further combined to give an overall index rating of sustainability for the entire Hawkesbury–Nepean region.

Table 1 Comparison of upper allowable LSC with actual LSC

Impact of Land Management Actions	Upper Allowable LSC	LSC Capability Class: Extremely good 1	Very good 2	Good 3	Mod-good 4	Mod-poor 5	Poor 6	Very poor 7	Ext. poor 8
Extremely high (EH)	1								
Very high (VH)	2								
High (H)	3								
Moderate (M)	4								
Moderate to low (M-L)	5								
Low (L)	6								
Very low (VL)	7								
Extremely low (EL)	8								

	Land management within capability index	Managed at:	Sustainability	Risk of land degradation
	5	>=2 within cabability	very good	negligible
	4	1 within capability	good	very low
	3	at capability	fair	low
	2	1 beyond capability	poor	high
	1	>=2 beyond capability	very poor	very high

Current status of land management within capability

Information products relating to the current status of land management within capability in the Hawkesbury–Nepean region are presented in Table 2 by SMU and Table 3 by indicator. Figure 3 provides an overview of these details on a regional map.

Table 2 Land management within capability of SMUs in the Hawkesbury–Nepean region

Soil monitoring unit	Soil monitoring unit name Soil types and monitored land use	Land management within capability index[a]	Range of indices[b]	Worst indicators and index[c]		Data source[d] and confidence[e]
1	**Wianamatta Rural Fringe** Dystrophic Brown Kurosols and Natric Yellow Kurosols. Improved pasture.	3.3		Organic carbon decline	2.5	B and K Medium
2	**Cox River Granite Soils** Red Kandosols and Rudosols. Improved pasture.	3.2		Gully erosion, Acidification, Organic carbon decline, Salinity/waterlog	3.0	B and K Medium
3	**Mid Wollondilly Lands** Yellow and Brown Kurosols and Yellow Kandosols. Improved and native pastures.	2.3		Gully erosion	1.0	B and K Medium
4	**Upper Wollondilly Lands** Yellow Kandosols and Yellow Kurosols. Native and improved pasture.	2.6		Gully erosion, Acidification, Organic carbon decline	2.0	B and K Medium
5	**Capertee and Wolgan Lower Slopes** Brown and Red Chromosols, Kurosols and Kandosols. Improved pastures and woodlands.	3.1		Acidification	2.5	B and K Medium
6	**Mulwaree Rises** Brown and Grey Dermosols and Orthic Tenosols. Cropping and improved pasture.	2.9		Acidification, Organic carbon decline, Salinity/waterlog	2.5	B and K Medium
7	**Nepean Alluvials** Grey Kandosols and Fluvic Rudosols. Vegetable production.	3.4		Organic carbon decline	2.5	B and K Medium
8	**Somersby Plateau** Deep Yellow Kandosols. Vegetable and tree horticulture.	3.4		Organic carbon decline	2.5	B and K Medium
9	**Wingecaribee Hills** Yellow Kandosols and Yellow Kurosols. Native and improved pasture.	3.6		Gully erosion, Acidification, Structure decline	3.0	B and K Medium
10	**Robertson Basalts** Red and Brown Ferrosols and Dermosols. Improved pasture.	3.9		Acidification	2.5	B and K Medium

Legend for Table 2

a Land Management within Capability (LMwC) Index:

4.6 – 5.0	Very good	Managed well within capability, negligible risk of degradation and probable improvement of soil and land resources
3.6 – 4.5	Good	Managed within capability, very low risk of degradation to soil and land resources
2.6 – 3.5	Fair	Managed at capability, low risk of degradation to soil and land resources
1.6 – 2.5	Poor	Managed slightly beyond capability, high risk of degradation to soil and land resources
<1.5	Very poor	Managed well beyond capability, very high risk of degradation to soil and land resources
	No data	Not included for change monitoring. Information may be available in support documents

b Range of indices: pie chart shows variation in LMwC indices for the different hazards in each SMU

c Worst indicators and index: gives the indicators (or hazards) of most concern in the SMU, with the associated LMwC index

d Data source:

B	Baseline data for soil condition – from field and laboratory measurements
L	Landholder survey on land management
K	Expert knowledge – from DECCW and CMA staff

e Data confidence:

High	Derived from numerous landholder surveys and field data from representative sites in the baseline study, and validated using expert knowledge
Medium	Derived from limited landholder surveys and field data from sites in the baseline study or roadside surveys, in conjunction with expert knowledge
Low	Derived from modelling or expert knowledge only

Table 3 Land management within capability indicators in the Hawkesbury–Nepean region

Capability hazard	Land management within capability index[a]	Range of indices[b]	Apparent trend[c]	SMUs of concern (index <=2.5)[d]	Data source and confidence[e]
Erosion - sheet Erosion of topsoil by overland flows. Generally a consequence of insufficient ground cover.	3.0			3, 6, 7	B and K Medium
Erosion - gully Erosion of topsoil and subsoils by concentrated overland flows. Generally a consequence of insufficient ground cover and changes to runoff and infiltration patterns.	3.0			6, 7	B and K Medium
Erosion - wind Erosion of soils by the action of wind. Generally a consequence of insufficient ground cover and inappropriate tillage practices.	3.8			-	B and K Medium
Acidification Trend towards increasingly acid soils, leading to reduced chemical health. A consequence of inappropriate management such as over intense use, allowing excessive leaching, over use of nitrogen fertilisers and insufficient use of lime.	3.0			1, 3	B and K Medium
Organic carbon decline The loss of soil organic matter with resulting decline of physical and chemical condition. A consequence of over intense use with insufficient return of biomass to the soil.	3.1			6, 7	B and K Medium
Structure decline Degradation of the physical structure of the soil, reducing the potential for water movement and plant growth. A consequence of practices such as over-cultivation, compaction by heavy vehicles and stock, and insufficient plant root growth.	2.8			5, 9, 10	B and K Medium
Acid sulfate soils Mismanagement can lead to release of highly acid waters into the ecosystem. This can arise from the exposure of buried potential ASS layers to oxygen such as from lowering of watertable by drainage.	3.0			-	B and K Low
Salinity/water logging Build up of salt or saturated soils on ground surface. A consequence of rising groundwater tables following a reduction of deep rooted perennial plants.	2.8			1, 3, 5, 6	B and K Medium
Overall index : Catchment	3.1				
State	3.0				

Legend for Table 3

a Land Management within Capability (LMwC) Index: see Table 2

b Range of indices: pie chart shows variation in LMwC indices for the different SMUs for each hazard (indicator)

c Apparent trend in land management relative to capability as gained from the formal expert knowledge surveys:

- ↑ Improving: there appears to be a steady adoption by landholders of more sustainable land management practices, leading to an improvement in soil and land condition
- ↔ Steady, no change: there is no apparent move towards or away from more sustainable practices
- ↓ Declining: there appears to be a general move away from sustainable practices, leading to a decline in soil and land condition

d SMUs of concern: gives the SMU numbers for which the LMwC index is poor (<=2.5)

e Data source and confidence: see Table 2

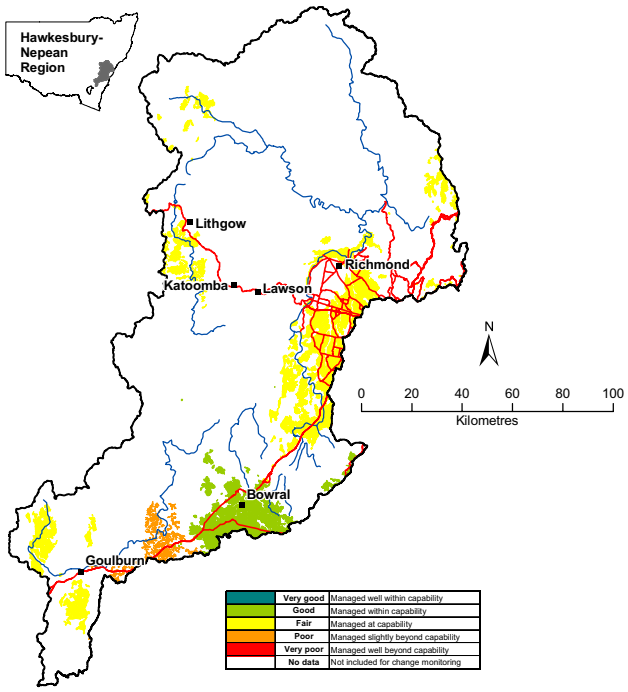


Figure 3 Hawkesbury–Nepean region with average index classes for land management within capability for the SMUs

Pressures

The broad pressures that control the extent of land management within capability in the Hawkesbury–Nepean region are complex and beyond the scope of this project to assess and monitor. They are partly dealt with in the socio-economic monitoring themes and include issues such as:

- financial, technical and managerial capacities of landholders
- knowledge and perceptions of sustainable land management practices by landholders
- market dynamics of agricultural products and production costs
- tax and government financial and legislative settings to promote sustainable land management
- long-term climatic changes, such as increasing severity of droughts.

Management activity

The management activity for the soil condition theme and the land management within capability theme are very similar, as both centre on promoting the adoption of sustainable land management practices by landholders.

Increasing the area of land being managed within capability is one of NSW's NRM targets as outlined in the NSW State Plan.

Addressing the target within the Hawkesbury–Nepean region involves initiatives and programs at the state and regional levels that will ultimately bring about the adoption of best land capability-sensitive management practices by landholders.

State level

The NSW Government guides NRM through various legislation, policies, strategies and programs.

Legislation

The *Catchment Management Authorities Act 2003* established the 13 CMAs and continues to outline their broad responsibility for NRM in their regions. The *Soil Conservation Act 1938* provides for the conservation of soil resources; however, its role in effective soil management has diminished over time. Various other Acts provide direct and indirect mechanisms for soil protection and management, including the *Protection of the Environment Operations Act 1997, Environmental Planning and Assessment Act 1979, Native Vegetation Act 2003* and the *Crown Lands Act 1989*.

Policies and strategies

The State Soils Policy (1987) outlines principles for the protection and management of NSW soils. It has recently been reviewed and is undergoing public consultation. Other significant state policies and strategies include:

- Total Catchment Management Policy (1987) – aims to ensure the coordinated use and management of land, water, vegetation and other natural resources on a catchment basis
- Sustainable Agriculture Policy (1998) – aims to facilitate a change in agricultural production in NSW towards ecologically- and economically-sustainable practices and farming systems
- NSW State Salinity Strategy (2000) – aims to slow down the increase in salinity and lay the foundations for future salinity management
- State Environmental Planning Policy (SEPP) Rural Lands (2008) – aims to facilitate the orderly and economic use and development of rural lands for rural and related purposes.

Programs

A number of relevant programs operate at the state level:

- *Monitoring, evaluation and reporting (MER) program* – DECCW is responsible for continuing its MER program and completing a baseline across all CMAs relating to soil condition and land management. The Australian Department of Agriculture, Fisheries and Forestry is funding a pilot program for national monitoring of water erosion, wind erosion, soil acidification and soil carbon. The SoilWatch soil condition performance monitoring kit is being developed to complement and supplement MER surveillance monitoring throughout the state
- *Soil and land-use mapping* – much of eastern and central NSW is covered by soil landscape mapping at 1:100,000 or 1:250,000; this is primarily undertaken by DECCW. 'Soil and Land Resources of the Hawkesbury–Nepean Catchment' is a digital DVD with 21 maps relating to soil landscape information, land capability and hazards for urban and rural land-uses across the region; this was developed by DECCW, in discussion with the Hawkesbury–Nepean CMA, and published in September 2009
- *Assessment systems* – a number of soil and land assessment systems have recently been developed that will ultimately lead to more sustainable land management. These include:

  - a system to assess the impact of various land management actions on soil condition
  - an LSC assessment system, with draft mapping completed across NSW
  - soil and landscape constraint assessment system
  - the Tools2 (SLICK) modelling system which allows for assessment of the impact on soils from different management options
- *Information exchange and advic*e – soil and landscape information and land management advice is provided through various publications, maps and databases (see www.environment.nsw.gov.au/soils/index.htm). The NSW Soil and Land Information System (SALIS) is run by DECCW and is intended as the single soil database for soil information in NSW. The Natural Resource Atlas (www.nratlas.nsw.gov.au) is used to access publicly available soil profile information. The NSW Land Management Database (LMD) is currently being developed and distributed to CMAs throughout the state. Extension services that encourage sustainable land management practices by landholders are undertaken widely by I&I staff throughout the state
- *Research* – research programs aimed at improving soil condition, productivity and sustainable land management practices are carried out by various national and state institutions, including the Commonwealth Scientific and Industrial Research Organisation, universities, I&I, DECCW and rural industry bodies (eg Grains Research Development Corporation).

Regional level

The Hawkesbury–Nepean Catchment Action Plan (CAP) is the key document that coordinates and drives the effort to improve natural resources across the region. It describes the whole-of-Government approach to soil condition and sustainable land management targets and provides direction for investment in NRM over the next 10 years. The Hawkesbury–Nepean CAP can be found at www.hn.cma.nsw.gov.au/topics/2181.html.

The CAP includes specific targets, with specific areas (hectares), that will address the broader state targets. These targets are achieved through the following:

Data collection

This involves developing a baseline of soil information, eg involvement with the development and promotion of the 'Soil and Land Resources of the Hawkesbury–Nepean Catchment' digital DVD.

Land management data will be collected over individual properties and entered in the NSW LMD.

Planning

Priority issues are identified, as well as locations for improved land management and associated investment.

Collaboration

Partnerships are formed with farming organisations, industry groups, relevant government agencies (particularly DECCW, I&I, the Land and Property Management Authority (LPMA)), tertiary institutions, Landcare and similar community groups and individuals. Collaborative activities include:

- targeting severely degraded land to rehabilitate and protect soil resources –this was conducted in partnership with the LPMA, Sydney Catchment Authority and catchment landholders. In 2007–08 these activities stabilised 25 kilometres of streambank/bed, protected 1500 hectares (ha) of land from soil erosion, established 16,000 plants, and fenced and rehabilitated 17 ha of saline discharge
- increasing the adoption of current recommended practices for the application of composted organics to degraded landscapes, including saline discharge sites to improve soil condition and catchment health – this was conducted with project partners, including DECCW and I&I and included the development of 'Guidelines for Using Compost in Land Rehabilitation and Catchment Management' published by DECCW
- management of acid soils through adoption of improved land management practices (I&I and catchment landholders).

Awareness and skills-raising

A total of 276 landholders were trained in programs such as Prograze and LANDSCAN, and attended courses that focused on the application of current recommended practices.

Farmers and landholder groups were trained in plant/weed recognition, drought management, sustainable grazing and land management practices.

Various guidelines and information sheets were produced, eg Implementing Best Management Practices (BMP) for Sustainable Grazing Management and BMP for Graziers in the Tablelands of NSW (I&I).

Soil and land extension services are also provided to promote the benefits of managing land to its capability.

Contracts and programs with landholders

Contracts have been developed with landholders to modify and improve land management practices.

Incentive programs, aimed at improving land management practices, have also been implemented.

Property-scale plans that focus on the delivery of on-ground actions, and promote the adoption and implementation of land management activities according to land capability, have been developed.

Continued monitoring and evaluation

Monitoring programs to assess progress towards the targets will continue under CMA and DECCW programs. These include:

- treatment of severe gully and in-stream bed and bank erosion in priority subcatchments, as identified by land degradation mapping
- hydro-geological process investigations, including mapping of groundwater flow systems, to better identify recharge/discharge sites and key areas of focus to manage dryland salinity.

Further details and examples of many of these activities are reported in the CMA's recent annual reports.

Other regional or local based bodies and programs that aid in improved land management include:

- local councils, through their compliance with the *Local Government Act 1993* and local or regional planning instruments such as local environmental plans and regional environmental plans
- Landcare and Bushcare groups that facilitate improved landholder knowledge and on-ground works
- universities that undertake research programs in the region, especially University of Western Sydney.

Further reading

DECC 2008, *NSW Monitoring, Evaluation and Reporting Project, Land Management Survey 2008,* Gray J, Chapman G, Murphy B & Jenkins B (eds), Department of Environment and Climate Change, Sydney.

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