

Prioritising Research on Native Vegetation in Queensland

Report prepared for the Consortium for
Integrated Resource Management

by Jim Tait
with contributions from the CIRM
Native Vegetation Working Group

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BACKGROUND – WHO AND WHAT IS CIRM?

The Consortium for Integrated Resource Management (CIRM) is a partnership established in 1993 to facilitate the planning and coordination of collaborative research and development initiatives in Queensland.

The partner organisations at time of preparation of this report are:

- Department of Natural Resources and Mines
- Environmental Protection Agency
- Department of Primary Industries and Fisheries
- University of Queensland
- Griffith University
- Central Queensland University
- CSIRO.

James Cook University became a member of CIRM from 1 January 2005.

Key research areas

CIRM has recently concentrated on the facilitation of research and development (R&D) for the following six major priority areas in the Queensland arena:

- Social and community dimensions of natural resource management (nrm)
- Aquatic ecosystems
- Dryland salinity risk assessment
- Water use and reuse
- Native vegetation management
- Reef catchment R&D needs.

To help address these issues, the consortium has commissioned a series of position papers to help identify key research topics as well as the research capacity of major science providers. With this background, cross-partner implementation groups have been formed and are working to develop joint projects and to access funding for the projects to address the identified key science needs of each research area.

Modes of operation

CIRM's aims are collaboration, communication and a shared approach to common issues of nrm, and it seeks opportunities to deliver more integrated and holistic outcomes. Because it is a process rather than an entity in its own right, CIRM does not undertake the activities of a centre or other formalised institutional structure.

CIRM is managed by a board, which acts as a reference group for CIRM's activities and is made up of the CEOs (or their nominees) of each of the partner organisations.

Each partner organisation has a senior staff member who represents it in CIRM at the operational level. This group of "CIRM Directors" meets monthly and looks at strategies, linkages and opportunities, funding options, skills and expertise to encourage more integrated and synergistic approaches to identified priority R&D issues.

CIRM undertakes much of its strategic activity through its working groups, which also comprise representatives of the CIRM partners. There are currently working groups for each of the key research areas listed above, namely social and community dimensions, aquatic ecosystems, salinity, water use and reuse, vegetation management, and reef.

Some of the key roles and opportunities for CIRM, both currently and in the future, have been identified by CIRM partners as follows:

- bringing together research providers, policy, management, industry and regional interests to identify strategic nrm science needs for Queensland (e.g. through workshops, review and position papers)
- information brokering on behalf of industry, policy and community stakeholders (provide a service for information and communication sharing among research providers to allow a “one-stop” shop for integrated delivery of research information and research capability to deliver to nrm needs (e.g. as a gateway to research libraries within agencies)
- process for ensuring the nrm science needs of regional community, local government and industry groups become part of both Government and research agencies’ (Government, CSIRO, universities) agendas, with networks to senior policy, planning and research managers
- expansion of the current role of working groups to incorporate active management of projects, including monitoring and evaluation
- bringing together researchers from various agencies to develop a synthesis of the “current state of knowledge” on particular nrm issues, as a basis for future identification of research gaps and needs
- 3-5 year review of CIRM focus areas, or other research initiatives, to identify the successes, weaknesses and relevance of research investment. This could provide input into current needs such as recent CRC re-bid discussions
- supporting the sharing of knowledge and experience among regional communities (including research providers) to reduce duplication of effort and improve application of research outcomes to a broader social and geographic base (e.g. through support for forums, workshops and conferences).

Achievements

CIRM has achieved recognition for its facilitation role in bringing together expertise, scientific knowledge and facilities to address complex issues incorporating social, economic, climatic, biological and physical processes.

Early in 2003, the CIRM Board signed a historic Memorandum of Understanding with Land and Water Australia. This pioneering agreement forges strong state and national linkages and enhances the collaborative and project development capacity of each body.

Future focus

CIRM partners are looking towards expanding CIRM’s area of influence to one of Statewide with national linkages for nrm R&D through:

- development of a broad R&D plan for nrm for Queensland that will provide a basis for nrm R&D priority setting in Queensland
- continuing to develop R&D projects for nrm both in the current priority areas and future key areas for nrm
- facilitating a collaborative R&D approach to CIRM’s input into activities such as CSIRO’s Healthy Country, the Reef Initiative, and Murray-Darling Basin research work
- contributing to the facilitation of a process for nrm priority setting for regional community forums
- expanding CIRM to include other major R&D providers and users across the State and relevant Cooperative Research Centres
- building relationships with national R&D funders and providers.

This report on priority R&D needs for sustainable native vegetation management in Queensland is the fifth position paper developed around CIRM’s agreed key research areas.

PREFACE

This paper has been prepared in response to a request by the Consortium for Integrated Resource Management (CIRM) for a report on the priority research and development needs and issues for the sustainable management of native vegetation in Queensland. It is intended that the document serve as a guide for CIRM partners in making decisions on opportunities for research and development in the native vegetation area, with the potential for later extension to consideration by national natural resource management agencies.

Specific areas that were nominated for consideration in the report included:

- Land management and use
- Intact versus fragmented landscapes
- Biodiversity
- Landscape health
- Social and economic issues¹.

The report expands on research needs identified in a native vegetation management research workshop held in February 2002 (see Wright et al. 2002) and draws national context from the National Land and Water Resources Audit theme reports: *Australian Native Vegetation Assessment 2001* (NLWRA 2001b) and *Rangelands – Tracking Changes* (NLWRA 2001a); and a report to the Prime Minister's Science, Engineering and Innovation Council: *Sustaining our Natural Systems and Biodiversity* (Morton et al. 2002).

The scope of work that guided the initial development of this report was orientated towards treed landscapes and the impacts of clearing. However some researchers and others consulted expressed great interest in aspects that were not directly related to clearing, and/or in rangeland vegetation types not affected by clearing. The recent Queensland Government legislation that will result in the phasing out of broadscale clearing by the end of 2006 is also of great significance in determining current priority research and development directions for native vegetation.

Given the greater relative extent of rangeland landscapes in Queensland it was acknowledged by the steering committee that a report on sustainable native vegetation management research in Queensland must include rangelands. Where possible, existing bodies of work concerning these issues, for example, *Rangelands – Tracking Changes 2001* (NLWRA 2001a), have been referred to.

Research into aquatic and marine vegetation types has not been specifically addressed here. This report is not an in-depth review of *all* current research associated with native vegetation, nor was an extensive literature review undertaken. Rather it is an overview report for the Queensland context, drawn largely from broad consultation with agency and institution researchers, policy-makers, managers, industry representatives and non-government conservation organisations.

1. Social and economic issues are more broadly dealt with in CIRM's paper: *Social and Community Dimensions of Natural Resource Management: a review of issues and related research* (Aitken, 2001) and were therefore not readdressed in this paper.

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Executive Summary

Sustainable management of native vegetation is essential for the conservation of biodiversity, for the socio-economic prosperity associated with activities such as primary industries, mining and tourism, and for the continued provision of a range of ecosystem services that maintain landscape health and serve the whole Queensland community. The sustainable management of native vegetation is complex and challenging for land managers and policy-makers alike. Good science informing sound decision-making can help to avoid potentially costly economic, social and environmental impacts associated with sometimes-irreversible natural resource degradation.

This report, commissioned by the Consortium for Integrated Resource Management (CIRM), will support the prioritisation and implementation of specific native vegetation research and development (R&D) projects among the CIRM partners and other collaborators. The work presents a structured overview of R&D needs along with some of the main contextual considerations associated with sustainable vegetation management. These were identified through consultation with researchers and R&D clients including managers, policy-makers, industry representatives and community organisations.

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Summary of methods

A systematic framework was developed to group issues associated with sustainable native vegetation management and to comprehensively identify R&D needs. Four primary issue areas and their associated secondary subdivisions resulted in ten summary groupings of R&D priorities (below), reflecting the complexity of issues associated with sustainable native vegetation management:

1. Native vegetation inventory and monitoring
2. Vegetation impact and condition drivers
3. Defining sustainable native vegetation management:
 - 3.1. Conservation of biodiversity
 - 3.2. Ecosystem services and processes
 - 3.3. Landscape health
 - 3.4. Sustainable development
4. Delivering sustainable management outcomes:
 - 4.1. Management and planning policy
 - 4.2. Social and economic dimensions
 - 4.3. Information needs and provision
 - 4.4. Active management.

Four criteria were then applied to all potential R&D issues identified within those areas to help determine R&D priorities. The criteria applied were:

- (i) short-term (supporting current Queensland policy and management requirements)
- (ii) longer-term (of strategic significance and contributing to improved scientific capacity)
- (iii) precautionary (based on perceived management risks associated with limited scientific understanding of a particular issue)
- (iv) consensus (agreement among consulted individuals)

The stratification of priorities across all issue areas recognises the integrated management requirements of native vegetation and the need for concurrent R&D progress in all areas.

In defining priority R&D needs it is acknowledged that there is potential for significant differences in applicability between regions, landscapes and land-use settings. For that reason, a structured bioregional review is recommended when seeking to identify region-specific R&D needs.

Response to current (short-term) management needs

Given the immediate needs of current vegetation management decision-makers, refinement and extension of existing research findings is essential. Opportunities for such work are good, as much relevant research on vegetation management issues has yet to be fully developed or applied to different regions.

Priority R&D outputs to support current Queensland vegetation management needs include:

- Definition of land degradation risks and hazards associated with vegetation management
- Definition of native vegetation having high nature conservation value
- Primary production enterprise viability and benefit-cost analyses
- Landscape design and thresholds
- Integrated information systems
- Translation of research findings between regions
- Establishment of monitoring and adaptive management frameworks
- Development of guidelines in relation to: regrowth management, incentive mechanisms, conservation status definitions, and vegetation planning requirements
- Mapping and condition assessment of riparian and wetland vegetation
- Effective, targeted extension.

Strategic (longer-term) R&D priorities

The topics identified as longer-term strategic priorities for sustainable vegetation management R&D are common to most of Australia and have long been recognised in terms of their importance, particularly from a landscape health perspective.

Strategic longer-term R&D priorities include:

- Delivering improved remnant vegetation management, landscape health and biodiversity outcomes by better understanding and management of key impact drivers including:
 - Climate variability and change
 - Total grazing pressure
 - Weeds
 - Fire regimes
 - Vegetation thickening
 - Clearing, fragmentation and land-use intensification
- Improving vegetation assessment, monitoring and reporting capacity on:
 - Condition
 - Structure
 - Biodiversity
 - Landscape health
 - Riparian vegetation
- Improving understanding of the role of native vegetation in ecosystem, landscape and catchment processes and quantifying the ecosystem services it provides, from site to global scales, including its influence on climate

- Development and implementation of adaptive management frameworks for native vegetation management including the integration of incentive mechanisms
- Establishment of longer-term, landscape-scale approaches to native vegetation monitoring and research
- Longer-term benefit-cost analyses that incorporate management and externality costs and examine enterprise viability in relation to biophysical sustainability thresholds (this is an extension of the primary production enterprise viability analyses identified in the priority short-term R&D outputs above)
- Improved understanding of the social, economic, attitudinal and motivational factors underpinning current farming systems and approaches to native vegetation management
- Predictive models and decision support systems for native vegetation management
- Further development of engaged, participatory models of vegetation management extension and policy delivery.

As would be expected, many of the identified R&D priority areas incorporate both short-term and longer-term issues, and many topics overlap between categories. This reinforces the need for research projects that approach issues in an integrated and multidisciplinary manner rather than from single thematic perspectives.

Contextual considerations

Some of the contextual factors identified in this report include the following:

- Use of Regional Vegetation Management Plans (RVMPs) for tactical priority setting (i.e. use of information gaps and research needs identified as part of the RVMP process)
- Management policy opportunities with the leasehold land review (e.g. identifying new management arrangements that could deliver sustainable native vegetation management outcomes is a key and immediate focus for management policy R&D)
- Fragmented versus intact landscapes (recognition of the management contrasts between these two landscape types provides an important context for R&D priority setting and represents an R&D focus area in its own right)
- Basic resource inventory needs (R&D is required here, particularly for the biodiversity and land-capability aspects of sustainable vegetation management)
- The importance of long-term monitoring and research (data is often scarce due to short-term project funding)
- Integrated research (current research involving crossdisciplinary and multi-agency focuses on individual research issues or particular locations is limited).

Recommendations to CIRM

Seven recommendations arise from this report and are discussed in Section 5. They are:

1. Form a native vegetation R&D working group (in keeping with processes applied with previous CIRM priority R&D areas)
2. Undertake gap analysis and integrated information provision (theme-structured research review on a bioregional or regional ecosystem basis)
3. Conduct R&D partner dialogue and priority setting (building on existing CIRM partnership arrangements and activities)
4. Integrate R&D programs (through, for example, joint funding bids and collaborative, landscape-scale projects)
5. Link with existing vegetation R&D programs and regional natural resource management planning processes (strengthening existing links and actively establishing new ones where opportunities arise)
6. Facilitate long-term monitoring and research programs (investigating and identifying how long-term activities can be supported)
7. Form a native vegetation research scientific reference panel (to inform and support activities of working group and other CIRM representative groups).

1.0

Introduction

The sustainable management of native vegetation is essential for the conservation of biodiversity, the economic wellbeing of primary industries, mining and tourism, and the continued provision of a range of ecosystem services that serve the community. Ecosystem services provided by native vegetation are diverse, and include prevention of soil erosion, maintenance of soil fertility and landscape water balance, climate moderation and protection of water quality. This highlights its multifunctional role and importance in maintaining landscape health, as well as in cultural heritage and the provision of aesthetic amenity. Native vegetation is also one of the main components of Queensland's biodiversity and provides habitat and food resources for most of its terrestrial fauna.

Queensland has retained more of its native vegetation than most other Australian States, with 82 per cent remaining in 1999 (Wilson et al. 2002). Elsewhere in Australia and globally, the cost of not sustainably managing native vegetation resources is being counted in terms of dryland salinity and soil erosion, degraded water quality, reduced soil fertility and agricultural productivity, extinction of wildlife species, changed climate and rainfall patterns and global warming. However, nor has the Queensland landscape escaped unscathed. Native vegetation resources have been, and continue to be, developed and utilised for land uses of varying intensity. Broadscale tree clearing was occurring in Queensland at a rate of about 577 000 hectares per year (1999-2001 figures) (NR&M 2003). However, the State Government placed a moratorium on new clearing applications in May 2003, and recent changes to the legislation are expected to reduce the clearing rate to almost zero by the end of 2006. Grazing occurs on 85 per cent of the total land area in Queensland (Tothill & Gillies 1992). Total grazing pressure is a recognised driver of vegetation condition, biodiversity status and landscape health. Impacts associated with tree clearing and total grazing pressure present considerable challenges for ecologically sustainable management of native vegetation in Queensland.

In some landscapes, management of native vegetation has not been ecologically sustainable as demonstrated by losses of biodiversity and ecosystem services and associated degradation of land, water and pasture resources (Tothill & Gillies 1992). Since the adoption of ecologically sustainable development (COAG 1992) as a guiding principle for Australian and Queensland natural resource management, there has been an increasing move toward policy and legislative initiatives that seeks to deliver sustainable management of natural resources.

In Queensland, the *Vegetation Management Act 1999* (VMA) and more recently the *Vegetation Management and Other Legislation Amendment Bill 2004*, are the legislative tools supporting the management of native vegetation by controlling broadscale clearing, which impacts heavily upon native vegetation condition and landscape health. Other issues affecting the sustainable management of native vegetation including total grazing pressure, fire, weeds, timber harvesting, nature conservation values and development impacts are dealt with by other Acts including the *Environmental Protection Act 1994*, the *Forestry Act 1959*, the *Integrated Planning Act 1997*, *Land Act 1994*, *Nature Conservation Act 1992*, *Rural Lands Protection Act 1985*, *Soil Conservation Act 1986* and the *Water Act 2000*.

One of the key challenges facing policy-makers and managers concerned with the delivery of sustainable vegetation management is the availability of appropriate scientific information to underpin decision making and the development of appropriate management arrangements.

1.1 Purpose

The objective of this report, commissioned by CIRM, was to examine the various aspects of sustainable vegetation management and determine priority research and development (R&D) needs to support the effective management of native vegetation across Queensland's bioregions. The report will be used as a guide by CIRM partners when making decisions on opportunities for R&D in the native vegetation area, and offers the potential for later consideration by national natural resource management (nrm) agencies and funding bodies.

1.2 Background

The report expands on research needs identified in a native vegetation management research workshop held in February 2002 (Wright et al. 2001) and draws national context from the National Land and Water Resources Audit (NLWRA) theme reports: *Australian Native Vegetation Assessment 2001*; *Rangelands – Tracking Changes: Australian Collaborative Rangeland Information System*; and a report to the Prime Minister's Science, Engineering and Innovation Council *Sustaining our Natural Systems and Biodiversity* (Morton et al. 2002).

1.3 Definition of R&D Needs and Contextual Factors

Three areas of support for native vegetation management in Queensland are considered by this report: research needs, development needs and contextual considerations. Although there is some degree of overlap across these three areas, working definitions help distinguish between them.

Research needs: Research needs are identified where scientific information required to address a particular management issue does not exist, and research is required to provide a scientific basis from which to identify potential management implications, solutions and approaches.

Development needs: Development needs have been identified where scientific information relevant to particular management issues already exists, but development is required to turn the scientific information into management tools that can be operationalised.

Contextual factors: Contextual aspects for instance include the social and economic dimensions of sustainable nrm, the availability of information, policy and legislative requirements and institutional arrangements supporting R&D.

2.0

Methods

The primary methods used for the preparation of this report were literature review (guided by steering committee), consultation with nominated contacts, and structured review of identified research needs using developed prioritisation criteria.

2.1 Literature Review

Time and resource constraints have not enabled a full literature review to be undertaken. However a review of more recent publications on native vegetation management in Queensland including from a national perspective, was pursued. These included McAlpine, Fensham and McIntyre (2002), Morton et al. (2002), NLWRA (2001a,b,c), Boulter et al. (2000), and ANZECC (2000). Other literature referred to or sourced during consultation with nominated contacts is listed in the bibliography.

2.2 Consultation

Fifty-five nominated contacts were consulted during the preparation of this report (see Appendix 3). These individuals represented a broad range of organisations associated with or interested in sustainable vegetation management in Queensland. The majority of those consulted were researchers, but policy-makers, managers, industry and representatives of conservation groups were also consulted. Most consultation involved meetings held from September to October 2002. Meetings were supplemented with phone interviews where necessary.

All contacts were provided with a copy of the native vegetation research needs workshop paper (Wright et al. 2002) prior to being interviewed. This document was used as a starting point for discussions. Interviewees were asked to comment on the comprehensiveness and relevance of topics identified within the paper and to identify other R&D priorities that they considered had been overlooked. A conceptual framework for the identification and structuring of sustainable native vegetation management R&D requirements (discussed below) and suggested approaches for their prioritisation was also presented to the interviewees for comment.

2.3 Sustainable Vegetation Management Conceptual Framework

In identifying R&D priorities through a process of consultation with individuals, there is a danger that the priorities and issues identified will mainly reflect the range of people consulted and their areas of interest. A conceptual framework was developed prior to the consultation process to attempt to limit the influences of these biases and to provide a more systematic structure for the identification of R&D needs. The framework grouped issues under four major headings; with two of those headings being further divided into subheadings, while recognising that no structure will ever provide a mutually exclusive listing of topic areas. This structure has been applied in the treatment of individual R&D needs within the report.

The structural framework is:

1. Native vegetation inventory and monitoring
2. Vegetation impact and condition drivers
3. Defining sustainable native vegetation management
 - 3.1 Conservation of biodiversity
 - 3.2 Ecosystem processes and services
 - 3.3 Landscape health
 - 3.4 Sustainable development
4. Delivering sustainable management outcomes
 - 4.1 Management and planning policy
 - 4.2 Social and economic dimensions
 - 4.3 Information needs and provision
 - 4.4 Active management.

2.4 R&D Prioritisation – Criteria and Approaches

Native vegetation management R&D needs and priorities are dynamic and vary temporally and spatially, and between researchers and R&D clients including policy-makers, managers, and industry and community organisations.

Four primary criteria were used to classify the R&D priorities presented within this framework (see Table 1). These were (1) short-term, (2) longer-term, (3) precautionary and (4) consensus priorities.

(1) **Short-term priorities** – Priorities generally needing to be addressed in short- to medium-term timeframes of, say, up to five years (e.g. land degradation hazard and land capability/suitability mapping based on Queensland farming systems).

(2) **Longer-term priorities** – Topic areas of strategic significance and contributing to improved overall scientific capacity (e.g. development of long-term, landscape-scale vegetation monitoring programs; impacts of water use on riparian and wetland vegetation)

(3) **Precautionary priorities** – Issues that could have potentially significant consequences if improved scientific understanding is not progressed. Precautionary priorities may need to be addressed in medium- to longer-term timeframes, dependent upon the dynamic nature of the issue concerned (e.g. the relationship between vegetation management and regional climate patterns).

(4) **Consensus priorities** – This criterion was used to define priority R&D topic areas that were agreed as important by a consensus of those consulted (e.g. vegetation thickening and thinning). Most of these issues need to be addressed in the shorter term, although some priorities related to a longer-term, strategic R&D focus.

Naturally, these criteria are not mutually exclusive. Other considerations including amount of existing R&D, the extensiveness of a particular issue, 'windows of opportunity' and individual regional priorities were also introduced by some of those consulted and are included in the body of the report where relevant.

Table 1 continued: High priority sustainable native vegetation management R&D needs

Priority basis key: S – Short-term (current); L – Longer-term (strategic); P – Precautionary; C – Consensus

4. Delivering sustainable management outcomes			
4.1 Management and planning policy	4.2 Social and economic dimensions	4.3 Information needs and provision	4.4 Active management
<p>1) Incentives and market-based mechanisms including potential role of environmental management systems for the proactive management of remnant vegetation S/L</p>	<p>1) Development of longer term benefit-cost analyses that incorporate management and externality costs S/L</p>	<p>1) Meeting key information needs of native vegetation managers and including:</p> <ul style="list-style-type: none"> – Land resource capability and degradation risks/hazards including land capability and hazard associations of REs S/P – Regionally defined areas of high nature conservation value S/P/C <p>2) Development of integrated biogeographic/catchment regional information systems capable of incorporating informal and formal knowledge systems and translating relevant vegetation management information between regions S/L</p> <p>3) Ecologic and economic vegetation management decision support systems/software L/C</p> <p>4) Resource inventory for land zones and regional ecosystems for use by resource managers S/C</p> <p>5) Regionally based information on the proactive management needs of remnant vegetation L</p>	<p>1) Development and implementation of adaptive management frameworks for native vegetation generally, and specifically for the long-term safe utilisation of grazing lands S/L/C</p> <p>2) Sustainable management methods for vegetation thickening and regrowth S/C</p> <p>3) Implementation of sustainable fire regimes S/C</p> <p>4) Development of integrated, landscape scale methods for environmental weed control L</p> <p>5) Regionally specific approaches for sustainable management and rehabilitation of remnant vegetation specifically addressing</p> <ul style="list-style-type: none"> – Riparian vegetation S/P – The use of natural succession and other broadcast methods for revegetation L

3.0

R&D Needs and Priorities

The sustainable native vegetation management priority R&D needs summarised in Table 1 were grouped according to the conceptual framework described earlier in Section 2.3. Detailed discussion of these R&D needs and priorities is presented below.

3.1 Native Vegetation Inventory and Monitoring

To manage any resources sustainably, we have to be able to measure those resources. Baseline data enables the effectiveness of management approaches in terms of delivering sustainability to be assessed.

Native vegetation resource values may be defined in terms of biodiversity, economic production and ecosystem services. Their description requires survey and assessment techniques that collect data at a range of scales from sites to landscapes, increasingly employing remote sensing techniques and geographic information systems (GIS) mapping applications where suitable. Some inventory methodologies have been well developed in Queensland.

3.1.1 Vegetation Condition, Cover, Extent, Structure, Type and Floristics

Government management arrangements for native vegetation are partly determined by the capacity to monitor the status of the resource and its response to management actions. In Queensland the primary monitoring capacity at a state level is woody land cover and remnant vegetation extent and type as mapped by the Department of Natural Resources and Mines' Statewide Landcover and Trees Study (SLATS) and the Environmental Protection Agency's (Queensland Herbarium) regional ecosystem mapping programs, respectively. These two sources of monitoring data form the basis for defining the conservation status of native vegetation, management objectives and arrangements. Broad-scale vegetation condition indicators have been proposed in the landscape health assessment framework of the Tropical Savannas Cooperative Research Centre (CRC) (Whitehead et al. 2000) and in the Australian Collaborative Rangelands Information System (NLWRA 2001a). This latter initiative has proposed a nested set of condition assessments for rangeland vegetation using NOAA AVHRR (United States National Oceanic and Atmospheric Administration Advanced Very High Resolution Radiometer) data for Australia-wide analysis of vegetation vigour at a landscape scale, Landsat data for property and paddock scale, and quadrat and photo point data for site monitoring.

Vegetation structure is one of the key indicators of vegetation condition that lends itself to remote sensing assessment methods. Current mapping and monitoring methodologies assess canopy and projected foliage cover and derive basal density of woody vegetation (Kuhnell et al. 1998). This technique provides limited information on understorey structure, which may vary widely within mapped regional ecosystem (RE) units or vegetation projected foliage cover classes. This has important applications for management concerned with habitat, biodiversity, landscape health and carbon accounting. The Department of Primary Industries and Fisheries' (DPI&F) TRAPS program currently provides structural change information from 150 field transects established in the early 1980s. Methods for assessing vegetation structural change using historical data and aerial photography records have also been successfully trialled (Fensham 1998), but will need further development to meet state-wide monitoring and management needs.

Weeds are not well quantified by current mapping and monitoring capabilities, except in distributional extent extrapolated from site records (Tait 1994). While remotely sensed mapping methods have been used for some more distinguishable weed invasion patterns such as prickly acacia in native grasslands and introduced pastures in riparian vegetation (Tait 1994), remote sensing and GIS technology offer the prospect of further development of weed mapping and monitoring capacity to serve both weed control and vegetation conservation evaluation management needs.

Regional ecosystem mapping at 1:100 000 provides the primary definition of vegetation types for management purposes in Queensland. Floristic information is recorded from sites stratified within defined RE units. In fragmented landscapes a size threshold is used to exclude small (<5 ha) or narrower (< 75 m) (Wilson et al. 2002) remnant vegetation patches from mapping consideration. Although this methodology has been successfully applied to map almost 50 per cent of the state, the mapping resolution and remnant size cut-off means that small but potentially high value remnants in highly fragmented and endangered landscapes (e.g. eastern coastal lowlands) are excluded. While finer 1:25 000 scale mapping is being progressed in some highly fragmented regions in southeast Queensland, the resolution of floristic information elsewhere is not generally suitable for spatially defining the occurrence of threatened ecological communities or species.

Some important flora taxa representing significant biodiversity are not described as part of vegetation mapping or biological surveys due to limited taxonomic information. Although taxonomic research is expensive, some lesser known groups (e.g. macrofungi) may have significant value as indicators of biodiversity and ecosystem services and warrant research.

3.1.2 Faunal Assemblages

Ecologically sustainable native vegetation management entails maintaining native vegetation plant communities and species and also fauna and ecological processes associated with native vegetation ecosystems (Glanzign 1995).

3.1.3 Long-term Monitoring

Many priority native vegetation management research questions require long-term monitoring data (e.g. impacts of practices on soil condition, biodiversity, landscape water balance and vegetation structure). The outcomes of management options can be determined through long-term monitoring data on which models can be validated. Approaches for improving the attractiveness of long-term monitoring programs to funding bodies and agencies include:

- the development of programs that serve multiple agency needs
- the incorporation of automated reporting and adaptive management linkages
- the use of such programs for agency training, academic teaching and post graduate research opportunities.

Monitoring timeframes of 50–100 years are considered necessary to obtain answers to some of the research questions facing vegetation managers.

3.1.4 Soils and Land Capability

The criteria currently used to make decisions on clearing will generally be agricultural suitability, economics and land degradation risks. There is little primary information on landscape function or economics of production. The soils and land use technical bulletins of (then) DPI and (more recently) NR&M, and the CSIRO Land System Reports provide some landscape-scale information.

3.1.5 Riparian and Wetland Vegetation

Riparian and wetland vegetation is important for biodiversity, fisheries production and catchment functional values, and is a major focus for on-ground activities by community groups to manage or rehabilitate key areas. The EPA has compiled wetland aggregation mapping coverages for a number of regions in Queensland and DPI&F has mapped marine coastal wetland vegetation, including mangroves, salt marsh and some seagrass areas for most of the Queensland coast. Further development of these programs would facilitate the assessment and monitoring of wetland condition and the definition of wetland boundaries and drainage relationships at a scale that can serve on-ground management.

3.1.6 Inventory of Private Forests

About 60 per cent of Queensland's native hardwood harvest is sourced from private native forests. However, the location and area of privately owned forests managed for timber production is not well known (DPI 1998). Privately managed forests and farm forestry in southeast Queensland have been documented (Queensland Timber Board representative, pers. comm.), but inventory at a State level is required to serve sustainable management needs including carbon accounting requirements (Henry et al. 2002).

3.1.7 R&D Requirements for Native Vegetation Inventory and Monitoring

Monitoring program development and choice of indicators

- Design of monitoring programs to assess vegetation responses to management
- Adaptive management components included in vegetation monitoring programs for efficient links between changes in resource condition and management practices
- Selection and monitoring of robust, standardised indicators of vegetation condition and trend, for tracking sustainability in relation to social, economic and ecological perspectives and for measuring response to specific management actions
- Development of technical capacity to measure a range of indicators simply and cost-effectively, including by remote sensing means
- Development of technology to scale indicator measurements from site to regional scales
- Further development of existing indicator-based monitoring programs developed by production agencies (e.g. Grass Check) to incorporate landscape function, catchment processes, carbon sink and biodiversity values.

Vegetation condition

- Further development of remote sensing (Landsat, multi spectral scanner, aerial photography) techniques for vegetation condition indicators (e.g. structure, weeds, soils, ground layer)
- Mapping of weed infestation as a key indicator of vegetation condition, and at a scale to serve on-ground management
- Identification of specific condition indicators for specific REs or for key condition drivers
- Inclusion of seasonality and resilience factors in the classification of vegetation condition
- Identification and development of vegetation condition indicators that have surrogate values for biodiversity status
- Further development and implementation of the Queensland component of the Australian Collaborative Rangelands Information System (ACRIS) (NLWRA 2001a).

Vegetation cover/extent

- Development of integrated field and remote sensing applications to assess ground cover status across a range of land types.
- Implementation of recommendations under ACRIS (NLWRA 2001a).

Vegetation structure/physiognomy

- Development of an automated GIS application for regrowth mapping to identify regrowth with significant values and enable its incorporation into planning considerations

- Development of integrated field and remote sensing mapping techniques to define and monitor vegetation structural attributes including understorey features
- Mapping and description of vegetation structural components of fauna habitat importance (hollows, understorey strata), which could be linked to RE mapping
- Long-term monitoring programs to assess structural change.

Vegetation type/regional ecosystem/floristics/taxonomy

- Development of finer RE mapping thresholds in landscapes with higher fragmentation (e.g. as in southeast Queensland and coastal lowlands)
- Extension of finer-scale (1:50 000) mapping to better depict high level of internal variation in RE mapping
- Development of finer-scale mapping and data capture for threatened ecological communities and species
- Methods to quantify and classify weed component of vegetation floristics
- Taxonomic research of lesser known groups with potential indicator values
- Completion of RE mapping in northern and western regions currently lacking (e.g. Gulf Plains and Northwest Highlands).

Vegetation fauna assemblages

- Gap analysis by region and taxa
- Strategic targeting of faunal surveys as part of particular land management activities, and examination of faunal status in relation to landscape metrics
- Inclusion of faunal monitoring as part of long-term monitoring programs
- Identification of surrogacy relationships between vegetation types and fauna and development of a predictive capacity.

Long-term monitoring

- Development of opportunities for the further establishment and support of long-term monitoring programs with consideration of 50-100 year timeframes
- Design of long-term, cost-effective monitoring programs
- Selection of succinct but broadly relevant range of indicators that have application across a range of agency interests for long-term monitoring programs
- Development of automated reporting functions in long-term monitoring programs
- Assessment of the scope of paired site comparisons as an alternative method to long-term monitoring as a means of answering questions associated with the long-term impact of various native vegetation management practices
- Establishment of independent unit/authority for long-term monitoring of natural resource capital, including native vegetation.

Soils and land capability

- Compilation of land capability and degradation hazard data and mapping for REs targeted for development
- Assessment of existing land resource inventory coverage and gaps
- Establishment of land degradation hazard/development constraints associations for mapped REs and land systems
- Development of integrated land system units suited to land resource mapping and management
- Definition and mapping of inherent biophysical hazards of soils/landscapes at a scale suitable to provide context for property management planning
- Development of land capability mapping based on Queensland farming systems.

Riparian and wetland vegetation

- Mapping at range of scales to serve management needs
- Remotely sensed condition and floristics/structural classification
- Development of condition classification benchmarks (e.g. percentage cover of exotics).

Inventory of private forests

- Survey and inventory of privately managed forest resources.

3.2 Vegetation Impact and Condition Drivers

This section examines the biophysical R&D issues associated with identifying, understanding and measuring the impacts and condition drivers of native vegetation. Related socio-economic issues are considered under Section 3.4: 'Delivering sustainable management outcomes'.

3.2.1 The Issues

3.2.1.1 Clearing, thinning and fragmentation

The direct impact of broadscale clearing on native vegetation depends upon the method of clearing employed but is usually apparent in terms of loss of woody vegetation cover and structure and reduced floristic diversity. Thinning of trees is done for pasture improvement, often in conjunction with exotic pasture or forage species establishment, and can involve broadscale (usually mechanical) clearing which tends to remove all vegetation, or chemical clearing which may retain up to 70-80 per cent of ground layer species (J. McIvor pers. comm.).

Thinning is usually but not always done in response to observed thickening trends or where woody vegetation is too dense for good pasture production. Public and private foresters also practise stand thinning to improve the timber production of forests. These practices affect remnant vegetation through changes to competitive interactions and ecosystem processes (A. House, Pers. Com.). Indirect impacts on vegetation from clearing and thinning include reduced and fragmented species populations and changes to microclimate, run-off and groundwater hydrology, soil conditions, nutrient availability and cycling pathways, successional processes, fire regime; and weed dominance (Boulter et al. 2000).

3.2.1.2 Total grazing pressure

In 1992, grazing accounted for 85 per cent of the total land area in Queensland (Tothill & Gillies 1992). Grazing affects native vegetation condition, biodiversity status and landscape health. Its influence on vegetation condition includes trampling, reduced ground cover, increased erosion, altered fire regimes and weed invasion.

3.2.1.3 Fire regime

The majority of Queensland's native vegetation is recognised as a 'fire-mediated mosaic'. Fire regime-comprising frequency, intensity and seasonality-is important for determining the structure of *Eucalyptus* and *Acacia* woodlands, including tree basal area in mulga lands, eucalypt savannas and eucalypt woodlands (Scanlan 2002). It is also associated with maintaining boundaries between gidgee communities and Mitchell grass downs and wet sclerophyll and rainforests. Its reduced frequency is implicated as the primary driver of woodland thickening (see Section 3.3.3 below).

3.2.1.4 Weeds and exotic vegetation

Many researchers and managers suggest that if it were able to be fully quantified, weed infestation would represent the most significant impact affecting remnant native vegetation in Queensland in terms of extent, biodiversity and production impacts. The main target for much weed R&D to date has been those listed as Weeds of National Significance, with a primary focus on impacts on production. In terms of impacts on native vegetation there are a host of significant environmental weeds that require R&D to support decisions on sustainable management.

3.2.1.5 Climate

At least three areas of climate-associated issues are recognised in relation to impacts on native vegetation condition: (1) the influence of climate variability as a key determinant of viable sustainable vegetation management approaches, (2) predicted global climate change as an emerging impact driver of native vegetation and (3) regional, local and micro-climate change resulting from modifications to vegetation cover and structure.

While all three areas are R&D focuses, the influence of climate variability on sustainable vegetation management approaches has received the greater amount of research in Queensland (e.g. McKeon & Hall 2002). Climate variability interacts with processes of vegetation degradation and recovery and is recognised as the most important driver of vegetation condition in Queensland's rangelands (Chilcott et al. in press). Failure to manage for climate variability, particularly the combination of heavy pasture utilisation and drought, has been a major source of reduced vegetation condition and degradation. As climate change simulations indicate enhanced seasonal climate variability and extremes, the potential for existing management patterns to further amplify reductions in resource condition is significant (Chilcott et al. in press).

3.2.1.6 Water resource use

The impacts of water resource use on riparian and floodplain vegetation have previously been identified as a key research priority in a report to CIRM (Choy et al. 2002). The development of water resource planning in Queensland has highlighted the need to better understand the links between water resource use patterns and native vegetation, although impacts such as too much flow have been recognised (Tait 1999). Besides potential impacts associated with flow diversions and groundwater use and recharge, surface pumping from wetlands and drainage infrastructure are also implicated in impacts on native vegetation condition, sometimes via secondary causes involving saltwater intrusion or soil salinity.

3.2.1.7 Dieback, toxins and pathogens

The phenomenon of dieback in native vegetation has been widely reported in many states of Australia, including Queensland. Research on the subject has identified a range of causes including water stress, changed hydrology, salinity, insect and herbivore attack, soil pathogens and eutrophication associated with fertilizer use (Landsberg and Wylie 1983, 1988, 1991, Voller and Eddie 1995). In some regions dieback represents a passive form of clearing that continues to operate after the active process has taken place (S. McIntyre pers. comm.). This issue is often more commonly reported in highly fragmented and intensively used landscapes.

3.2.1.8 Genetic impacts

Maintenance of genetic diversity and gene flow is essential for the viability of biological populations including native plants. Some of the main 'opportunities' for genetic impacts to native plant populations are associated with:

- fragmentation and isolation of populations (e.g. due to clearing and development)
- reduction in population size below viable thresholds (e.g. some endangered species)
- loss of pollination and/or seed dispersal vectors (e.g. cassowaries in tropical rainforests)
- translocation of genetic populations (e.g. use of non-local-providence native species in agroforestry or revegetation).

Due to the long life spans of some native plant species, the implications of genetic impacts may not be realised within human life spans. Hence research on genetic impacts often needs to be approached from a population modelling perspective, although demographic monitoring and molecular genetic analysis of population genotypes is being used in some research projects (A. House pers. comm.).

3.2.2 R&D Requirements for Vegetation Impact and Condition Drivers

Thinning and fragmentation (see also Section 3.3)

- Long-term landscape-scale assessment and monitoring of native vegetation condition when there are changes in ecosystem functioning following clearing and/or stand thinning
- Linking of landscape-scale processes with fragmentation and land-use intensification thresholds
- Fragmentation thresholds for maintenance of remnant vegetation condition and connectivity in fragmented landscapes
- Interaction between vegetation fragmentation thresholds and land-use matrix in maintenance of remnant vegetation condition and connectivity
- Stand thinning thresholds for maintenance of remnant vegetation condition
- Comparisons of remnant vegetation condition impacts of broadscale clearing versus arboricide stand thinning to manage woodland thickening.

Total grazing pressure

- Assessments of impact of total grazing pressure on native woodland and grassland floristics and structure from a conservation (rather than pastoral) perspective
- Interaction between total grazing pressure and fire regime (measured in terms of woodland thickening and weed invasion in different land systems and bioregions)
- Impacts of grazing on forest product and conservation values
- Native animal grazing pressure on native vegetation management within variegated and relictual landscapes.

Fire regime

- Long-term monitoring and landscape-scale fire regime research to determine the implications of fire regime and grazing interactions on vegetation structure and condition
- Native vegetation impacts of fire regime where exotic grasses predominate
- Interaction between fire regime and encroachment/management of weeds
- Development and adoption of management methods using existing fire regime research
- Assessment of historical and proxy data to determine pre-settlement fire regime patterns
- Identification of appropriate fire regime strategies in grazed forests that meet the needs of both foresters and graziers.

Thickening

- Impact of thickening on the floristics, ecological functioning and condition of native vegetation communities.

Weeds and exotic vegetation

- Interactions with fire and exotic pasture and forage species on native vegetation
- Predictive capacity for where species could impact
- Optimal quarantine methods.

Climate

- Improved understanding of the interaction between vegetation management, climate variability and landscape function
- Assessment of remnant vegetation impacts associated with projected regional climate change and identifying potential means of impact mitigation
- Identification of zonal successional opportunities and extinction risks in relation to the movement of biota in response to predicted climate change.

Water resource use

- Relationships between in-stream flow regime and riparian and floodplain vegetation condition
- Groundwater use and yield in relation to potential impacts on native vegetation, including secondary interactions with intrusion of coastal saltwater wedges
- Design and operation of drainage infrastructure to minimise hydrological impacts.

Dieback, toxins and pathogens

- Key causes of native vegetation dieback in different regions and vegetation types and relationships to land management practices, fragmentation thresholds and landscape processes.

Genetic impacts

- Quantification genetic, demographic and landscape factors that affect the viability of plant populations in vegetation remnants
- Review of existing and proposed genetically modified organism (GMO) crops in Australia for their potential impacts on native vegetation.

3.3 Defining Sustainable Native Vegetation Management

3.3.1 Conservation of Biodiversity

3.3.1.1 Tree clearing and biodiversity conservation

Reducing land clearance has been one of four areas of investment recommended above all others as likely to yield the greatest return in limiting the diminishing value of Australia's natural systems and biodiversity (Morton et al. 2002, Environment Australia 2001). Under the *Vegetation Management and Other Legislation Amendment Bill 2004*, broadscale clearing of remnant vegetation will be phased out in Queensland by December 2006. There is a transitional clearing cap of 500 000 hectares on broadscale clearing of remnant vegetation during the phase-out period. The cap includes permits issued since 16 May 2003 when the halt on receiving new clearing applications began. The balance of the cap will be allocated in a ballot after the legislation comes into effect, and landholders will be able to apply through the ballot process for broadscale clearing of remnant vegetation. A financial assistance package will be provided to landholders affected by these changes.

Regional ecosystem conservation status: REs form the primary planning framework for the Queensland vegetation management legislation. Remnant vegetation conservation status is defined on the basis of the extent of REs in relation to their pre-European extent. Thresholds of 30 per cent and 10 per cent pre-European extent define 'of concern' and 'endangered' REs respectively. The VMA prohibited broadscale clearing of endangered (<10% remaining) REs on all land tenures and of concern (<30% remaining) REs on leasehold land. They also restrict clearance that would have resulted in an RE moving to a lower conservation status (e.g. 'of concern' to 'endangered'). The *Vegetation Management and Other Legislation Amendment Bill 2004* further restricts broadscale clearing to include 'of concern' REs during the period before broadscale clearing is phased out.

The two major concerns associated with the use of this planning approach to deliver biodiversity conservation outcomes are (1) the surrogacy value of REs for biodiversity and (2) the adequacy of vegetation retention thresholds effected through conservation status definitions.

Regional ecosystem surrogacy: While it is generally accepted that biodiversity conservation entails planning at three levels—ecosystem, species and genotype, REs represent only the first level. There is an urgent need to assess the extent to which mapped REs reflect patterns of biodiversity at the species level for a range of taxa. Opportunities to supplement RE maps with additional linked data sets to better reflect the internal heterogeneity of REs (particularly structural attributes that relate to habitat values), would provide useful information for managing a range of taxa.

Conservation status thresholds: Where no other constraints exist, current management arrangements allow REs to be cleared within a region to retention levels defined by their conservation status, that is, 10 per cent or 30 per cent of pre-European extent. Some research findings indicate that faunal species loss associated with clearing within a landscape is initiated at around 70 per cent vegetation cover and accelerates greatly at levels below 30 per cent retention (McAlpine, Fensham & Temple-Smith 2002, McIntyre et al. 2000, James & Saunders 2001).

Another concern with RE conservation status is that vegetation *condition* is not included in determining RE conservation status. As a result, an RE with an extent of greater than 30 per cent considered 'not of concern' could potentially be in poor condition (e.g. weed-infested), while areas of better condition but less extent could warrant a higher conservation status.

Definition of areas of high nature conservation value: Current approaches for the definition of areas of high nature conservation value (HNCV) are generally restricted to input at the landscape scale. Data and resource constraints also currently limit opportunities to assess for endangered species as part of the property vegetation management planning process. Biodiversity Assessment and Mapping Methodology (BAMM), Marxan and C-plan have been developed by the EPA for defining areas of high nature conservation value (EPA 2002). They depend upon expert opinion, and have limitations in regard to operating in extensive and intact (as opposed to fragmented) landscapes or at individual property scales. There is a need to compare and contrast the results achieved by all methods to improve confidence in the robustness of their outputs.

Currently the BAMM is based on the definition of remnant vegetation under the VMA, which excludes regrowth. Regrowth comprises much of the native vegetation in the landscape in areas with substantial clearing history (Wilson et al. 2002). Identifying valuable regrowth is a priority research area for definitions of HNCV.

BAMM is being used to prepare regional biodiversity planning assessments, but these assessments have not yet been completed for all bioregions. There is a need to develop a definition of HNCV, and create transparent and repeatable implementation protocols.

3.3.1.2 Biodiversity indicators

There is limited survey and ecological data for many flora and fauna species of possible biodiversity conservation value. The National Land and Water Resources Audit's *Australian Terrestrial Biodiversity Assessment 2002* report set a baseline for management-orientated biodiversity information and concluded that "continued collection of data to fill gaps and establish trend in condition is essential" (NLWRA, 2002b, p. ix). There is merit in finding and assessing suitable indicators to track the condition and trend of remnant native vegetation from a biodiversity status perspective.

Potential indicators include attributes such as vegetation structure, floristic composition including indicator species, and landscape functional attributes. This need particularly applies in the extensive areas of uncleared rangeland landscapes, where existing coarse measures of landscape condition are considered poor surrogates for their biodiversity status (J. Woinarski pers. comm.). Currently, there is some evidence that significant declines in rangeland biodiversity are going unnoticed by existing vegetation monitoring programs that are limited in extent and orientated toward production values.

3.3.1.3 Landscape ecology

In the absence of specific ecological information, generic approaches to landscape design and vegetation management are often adopted. Monitoring is needed to assess the success of pursued approaches.

3.3.1.4 Patterns of vegetation retention

The influence of habitat area and fragmentation on wildlife diversity is one of the most well established areas of biogeographic theory. One challenge in applying such theory to the management and retention of remnant vegetation in the landscape is the sometimes-specific nature of regional landscape ecology and species maintenance requirements. While some general principles concerning corridor widths, connectivity requirements and minimum patch size have been developed and trialled within a limited number of bioregional settings, the extent to which this information can be reliably transferred to other regions is often limited.

3.3.1.5 Fire and grazing regimes

Fire and grazing regimes and their interaction are two of the most significant drivers of native vegetation structure, condition and composition. While our understanding of native vegetation responses to various fire and grazing regimes is increasing, the focus of much of the existing research has been from a production perspective (Ensley et al. 2000, Watson 2001).

Total grazing pressure is also an example of where research (MacLeod & McIntyre 1997, McIntyre 2000) has been more orientated toward production persistence of native pastures rather than broader sustainability goals associated with biodiversity conservation. More recent research on sustainable grazing has included landscape scale indicators and thresholds related to fauna as well as native pasture (McIntyre et al. 2000). R&D is still required to assess the sustainability implications for all native biodiversity of various levels of total grazing pressure associated with different patterns and practices of grazing land-use intensification.

3.3.1.6 Change in vegetation structure

A range of management practices including clearing, logging, thinning, 'shrubscaping', burning and grazing all affect native vegetation structure in terms of overstorey height, canopy cover, number and density of understorey strata, ground cover and woody versus non-woody composition. Ecological theory supports the notion that greater vegetation structural complexity provides more niche opportunities and greater biodiversity. Previous research has mostly been associated with assessing the impact of forestry practices, or has been part of developing conservation evaluation criteria for woodland remnants, with the exception of Ludwig and Tongway (2002) who examined the biodiversity responses of a range of woodland structures affected by clearing and post-clearing treatments.

3.3.1.7 Weeds and exotic vegetation

The impacts of weed infestation on biodiversity conservation include changes to vegetation condition, structure and composition. To fully understand and quantify these impacts requires both concerted biological survey effort and good autoecological data for the range of potentially affected species. In some instances, weed infestation impacts on biodiversity indirectly, such as on water quality (from aquatic weeds) or changes to fire regimes.

3.3.1.8 Soil biodiversity

Impacts of vegetation management practices on soil flora, microbial and macroinvertebrate communities are not well known. Although limited taxonomic understanding is often cited as a reason for not researching these poorly described groups, their importance for ecosystem functioning and their potential role as indicators of biodiversity and ecosystem health status underpins an R&D need that belies their inconspicuous nature. Fundamental research regarding the taxonomic description and functioning of soil biological communities is required to support improved management efforts for their conservation. This has been recognised in biodiversity research priorities defined at the Commonwealth level by the Biodiversity Advisory Committee (BDAC 2001). A key conservation R&D priority is the definition of vegetation management thresholds based on ground cover and pasture composition that ensures the maintenance of soil biodiversity.

3.3.1.9 R&D requirements for conservation of biodiversity

Conservation status thresholds

- Assessment of remnant vegetation biodiversity status in range of bioregions and RE settings, stratifying assessments across variable regional vegetation retention levels and variable timeframes since clearing
- Incorporation of condition indicators for species and soil in definition of conservation status
- Effect of remnant vegetation condition on fauna and flora diversity.

Regional ecosystem surrogacy

- Comparisons across taxa to identify where surrogacy does and does not apply, as a means of identifying supplementary fauna survey needs
- Development of habitat mapping to link with RE maps
- Inventory/survey work to further identify fauna associations with REs
- Association of rare and threatened species with REs.

Definition of areas of high nature conservation value

- Improved incorporation of the three levels of biodiversity (landscape, species and genotype) in the definition of areas of HNCV
- Data collection and development of methods to define patterns of species rarity and richness
- Methods for spatial definition and protection of key ecological processes that underpin maintenance of landscape biodiversity
- Incorporation of landscape design and threshold principles in BAMB
- Incorporation of probability of persistence and issues of complementarity
- Strategies for incorporating recognised biodiversity values of regrowth in definition of areas of HNCV and corridors using defensible methods
- Development of effective means to communicate what constitutes areas of HNCV beyond complex sets of rules
- Definition and recognition of landscape elements and biodiversity communities (e.g. mound springs, wetlands, headlands, hill tops) of high nature conservation value within all REs and data linked to RE maps
- Comparison of different GIS based approaches (BAMB, C-Plan, Marxam) to assess concordance in definition of HNCV and deliver greater robustness in methods
- Development of methods to define HNCV in extensive and information-poor landscapes
- Development of communication tools that quantify the biodiversity impact costs of vegetation degradation per RE
- Research into mechanisms (e.g. stewardship) to implement conservation/biodiversity programs.

Rare and threatened species

- Associations of rare and threatened species with REs
- Habitat modelling and prediction
- Incorporation of autoecological information into landscape design principles
- Relationship of native vegetation management and condition to fauna extinctions occurring in tropical savanna landscapes.

Biodiversity indicators

- Methods for evaluation and selecting indicator species/most critical species including those that relate to the persistence of key ecological processes (e.g. seed dispersal in rainforests)
- Identification of what provides the most comprehensive but cost-effective suite of indicators for specific bioregional settings (could be developed relatively rapidly by targeted biodiversity monitoring workshops)
- Assessment of the use of invertebrates as biodiversity and ecosystem process indicators
- Development and implementation of biodiversity indicators recommended in the Queensland section of the Australian Collaborative Rangelands Information System (NLWRA 2001a)
- Development of monitoring programs to provide condition and trend of biodiversity status at property to regional scales.

Landscape ecology

- Dependence of biota in broader landscape on areas of higher productivity (alluvial frontages, fertile soils) and distribution routes of biota, flows of materials and energy
- Potential landscape ecology impacts of developing more productive landscape elements within extensive, relatively infertile and arid landscapes
- Definition of key landscape processes in different bioregions or regional ecosystems
- Translation of spatial and temporal elements of key landscape ecological processes into landscape design/vegetation retention principles
- Assessment of whether retained vegetation corridors are serving intended purposes at a landscape scale.

Patterns of vegetation retention

- Improved understanding of species minimum area requirements for viable populations
- Critical wildlife patch size thresholds and corridor widths for range of landscape types
- Definition of attributes that predict transferability of vegetation retention/design principles between regions
- Definition and delivery of effective networks of wildlife habitat beyond the property scale
- Required patterns of habitat connectivity and juxtaposition defined by biota resource use patterns
- Targeted fauna survey and longer-term monitoring programs across a range of landscapes
- Patterns of native vegetation (grassland) retention/grazing exclusion within extensive grazing-dominated landscapes.

Fire and grazing regimes

- Mechanisms of interaction between fire and grazing on the condition and structure of native vegetation and in turn its biodiversity status
- Development of a range of grazing and fire regimes for different land types with outcomes geared towards both sustainable biodiversity and production
- Mechanisms for re-implementation of fire regime mosaics
- Longer-term ecological studies of fire and grazing regime impacts at landscape scales
- Biodiversity costs of using fire as a weed control method
- Biodiversity costs of grazing intensification management practices including smaller paddock size, cell grazing and feed supplementation.

Changes in vegetation structure

- Role of understorey as habitat
- Regrowth biodiversity values
- Impacts on native vegetation thickening and thinning biodiversity
- Impact on biodiversity of understorey modification
- Implication of broader landscape contexts and habitat availability on potential impacts of vegetation thickening and thinning on biodiversity
- Longer-term ecological studies at landscape scales.

Weeds and exotic vegetation

- Interactions of exotic pasture and forage species with fire and impacts on native vegetation and fauna habitat
- Assessment of long-term benefits of proposed exotic pasture and forage species to pastoralists against potential biodiversity impacts and costs to control.

Soil ecology

- Definition of management thresholds based on ground cover and pasture composition that ensure maintenance of soil biodiversity, including microbial and macroinvertebrate organisms essential for soil health.

3.3.2 Ecosystem Services and Processes

3.3.2.1 Ecosystem services

Native vegetation provides diverse and essential ecosystem services including: stabilisation of water catchments, maintenance of landscape water balance, provision of shelter and pasture for stock, carbon sequestration, provision of timber and fuel resources, maintenance of biodiversity, nutrient cycling, maintenance of soil condition and fertility, and climate moderation. Morton et al. (2002) identified that most ecosystem services remain poorly valued economically and most have been unrecognised and unpriced.

3.3.2.2 Ecosystem functioning following clearing

Broad-scale clearing of woody vegetation generates the greatest gross change to ecosystem form and function including: loss of habitat; reduced and fragmented species populations; and changes to microclimate, landscape water balance, carbon sequestration, soil cover, moisture and erosion, nutrient availability and cycling pathways, successional processes, fire regime and behaviour and weed dominance. Research findings from southern Australian landscapes sound a cautionary warning on the potentially devastating consequences of overclearing native vegetation.

Although much R&D from other states and regions can be applied within Queensland, the transferability of information to areas with different climatic and geomorphic settings is limited and needs to be assessed on a case-by-case basis.

Important factors for landscape design R&D include the site and scale factors associated with the impact of vegetation clearing (e.g. what happens when trees are taken out of the landscape?). The long-term nature of clearing impacts on ecosystem processes (e.g. nutrient cycling, soil chemistry, landscape water balance and species decline) makes such issues generally beyond the scope of most R&D programs. Alternative approaches such as paired site comparisons offer useful insights but are affected by the influence of post-clearing management practices. Controlled clearing experiments are seen to have more merit but are cost- and time- prohibitive.

3.3.2.3 Landscape water balance

Native vegetation is highly efficient at using available soil moisture. The interception of water draining through the soil profile by root systems, and groundwater pumping by evapotranspiration is responsible for the maintenance of landscape water balance in naturally vegetated landscapes. Changes to vegetation cover-particularly the replacement of deep-rooted perennial woody vegetation with shallow-rooted pasture or crop species-can alter landscape water balance, affecting catchment run-off hydrology and groundwater levels (Boulter et al. 2000). Where salt stores are present in the soil profile, rises in groundwater levels can lead to the occurrence of secondary dryland salinity.

3.3.2.4 Nutrient cycling and export

Many Australian soils have relatively low levels of available nutrients. Native vegetation has formed complex relationships between woody and herbaceous components, mycorrhiza, termites and microbiotic crusts to access, use and recycle available nutrient sources (Schmidt & Lamble 2002). Management practices that impact upon these relationships may lead to reduced nutrient availability and nutrient loss, resulting in reduced biomass production and associated ecosystem impacts.

Combined with other potential impacts of clearing on microbiotic crusts, termites, soil moisture, water interception and evapotranspiration, there is also a likelihood of increased run-off and nutrient leaching that results in the loss of nutrients from the catchment.

3.3.2.5 Catchment-scale processes

Vegetation management practices are known to affect landscape water-erosion processes (Ludwig & Tongway 2002). Much of this knowledge has been gained through site- and plot-scale studies that have assessed changes in water run-off, infiltration, soil erosion and sediment yield rates in relation to ground cover and vegetation management practices. Although these processes are known to have flow-on effects at catchment scales, site and plot data cannot be readily translated to catchment findings due to within-catchment sediment and water retention and detention processes. Scaling and modelling studies (e.g. Prosser et al. 2002) are required to assess catchment-scale outcomes.

3.3.2.6 Soil condition

Vegetation cover provides soil with its primary protection against erosion processes. It is also responsible for physical and chemical weathering processes and for contributing and cycling key nutrient inputs that lead to soil formation and help maintain its microbial and invertebrate communities, which in turn maintain soil health and fertility. Through its functional role in the maintenance of landscape water balance, vegetation also reduces the prospect of secondary dryland salinity.

Modifying native vegetation through land-use activities can have major impacts on soil condition. Improved understanding of the relationship between vegetation management and soil condition is essential for the maintenance of productive land use within native vegetation ecosystems.

3.3.2.7 Carbon sequestration

R&D issues associated with the management of native vegetation for carbon sequestration are considered a priority.

3.3.2.8 Regional climate interactions

While the impact of global and regional climate change has become an important issue, the impact of vegetation management on local, regional and ultimately global climatic patterns is less well recognised. Native vegetation shades the ground, moderating air and surface temperatures and the reflective capacity (albedo) of the earth to incident sunlight energy. Vegetation also acts as a water pump, transpiring water vapour to the atmosphere. These characteristics form the basis of continental scale processes that help drive climatic patterns. Changes to vegetation cover and structure may affect these functions and climatic patterns at local, regional and global scales.

The impacts of vegetation management at a site scale on attributes such as shade, air temperatures, wind speed and soil moisture have been recognised and incorporated to some degree in landscape design and property planning principles. It is generally accepted that changes to earth surface temperature resulting from vegetation cover change are connected with but of greater magnitude than ocean surface temperature changes and that these changes occur at a continental scale (Bounoua et al. 2002). The implication is that land-cover change may be as important as the greenhouse effect as a driver of climatic change.

3.3.2.9 R&D requirements for ecosystem services and processes

Ecosystem services

- Integrated regional-scale assessment of relationships between ecosystem services and sustainability
- Inventory, quantification and evaluation of ecosystem services
- Improved understanding of key landscape process drivers operating in bioregions
- Greater development of communication programs highlighting private as well as public benefits of ecosystem services provided by native vegetation
- Identification of ecosystem service costs and benefits in replacing processes provided by native ecosystems with production ecosystems including non-native vegetation.

Ecosystem functioning following clearing

- Answer question: what are the implications of taking trees out of the landscape?
- Ecosystem functioning following clearing (effects on soil chemistry and structure, hydrology, salinity, water quality, vegetation, biodiversity, weed invasion, etc.)
- Large-scale, long-term (20 year+) controlled fragmentation experiment to examine faunal relaxation, edge effects, invasions, management regime effects (fire, grazing), and ecosystem processes (soil nutrient loss) issues at catchment scale
- Condition, thresholds and landscape health of fragmented compared to “intact” landscapes.

Landscape water balance

- Effects of native vegetation landscape retention thresholds and patterns on landscape water balance functions
- Assessment of deep drainage profiles of grasslands including exotic pasture species
- Landscape water balance functions of regrowth
- Effect of native vegetation thickening and thinning on landscape water balance functions.

Nutrient cycling and export

- Effect of vegetation management practices on soil organic matter
- Nutrient dynamics in derived and exotic grassland and native woodlands
- Role of trees in cycling nutrients in low nutrient soils
- Improved knowledge of nutrient pathways in native-vegetation-based production systems.

Catchment-scale processes

- Vegetation retention thresholds and patterns required to sustain catchment processes and services (e.g. water quality, landscape water balance and in-stream hydrology)
- Improved quantification of landscape and catchment functional attributes of riparian and wetland vegetation (including nutrient sink functions)
- Comparison of functional attributes for sediment and nutrient retention between trees and grasses
- Functional implications of riparian corridor width and connectivity
- Role of floodplain vegetation for buffering overland flow velocities.

Soil condition

- Soil condition status and long-term trends in managed grasslands compared with uncleared woodlands
- Soil erosion rates in managed grasslands compared to uncleared/thickening woodlands
- Impacts of vegetation thickening and thinning on soil condition
- Definition of management thresholds based on-ground cover and pasture composition for the maintenance of microbial and macroinvertebrate organisms essential for soil health.

Carbon sinks

- Quantification of the contribution of thickening woodlands to carbon sinks
- Comparison of grassland and woodland carbon sequestration potential
- Quantification of carbon sequestration gains possible through management of rangelands
- Potential carbon trading interactions with vegetation management.

Regional climate interactions

- Gaps between paddock-scale to regional- and continental-scale interactions between vegetation retention patterns and influences on climate
- Improved understanding of impact of changes in vegetation cover in regional climate
- Better delineation of recent land cover changes and temporal (interannual) variation to serve vegetation-climate interaction modelling
- Historical dynamics of Australian vegetation to better understand interrelationships with climate (use of proxy data fire, pollen records etc.)

3.3.3 Landscape Health

3.3.3.1 Role of native vegetation in landscape health

Landscape or ecosystem health is a holistic concept that considers the ‘health’ of ecosystems at a landscape scale based on the status of the whole system. Landscape health applies equally to natural ecosystems and human-modified systems. Definitions of landscape health encompass a range of goals from production sustainability to biodiversity conservation.

3.3.3.2 Total grazing pressure

As discussed earlier, total grazing pressure is one the dominant drivers of native vegetation condition and landscape health in most areas in Queensland. The ways total grazing pressure impacts upon processes and functions responsible for maintaining landscape health have not been documented for many Queensland landscapes. This requires an expansion of research objectives from previous assessments with a production perspective.

3.3.3.3 Fire regime

The potential impacts of fire regime changes on vegetation condition were discussed in Section 3.2. In Queensland, vegetation thickening is occurring in landscapes where fire has been largely excluded or regimes highly modified. Less obvious processes such as nutrient cycling, soil formation and erosion, species recruitment/extinction and pathogen population control are also affected by fire regime changes and may be significant in the maintenance of landscape health.

3.3.3.4 Woodland thickening

Many rangeland areas are experiencing vegetation thickening (Henry et al. 2002, Scanlan 2002). Thickening often occurs in response to a disturbance and has also been associated with the decreased incidence of fire in the landscape due to reduced fuel loads associated with grazing pressure or the preferences of land managers. Climatic fluxes and higher carbon dioxide levels have also been cited as possible causes of thickening (Fensham 1998, Henry et al. 2002).

3.3.3.5 R&D requirements for landscape health

Role of vegetation

- Improved understanding of the linkages between native vegetation attributes and integrated measures of landscape health to serve landscape health indicator development
- Definitions of landscape health thresholds based on improved understanding of native vegetation’s role in landscape functions
- Development of integrated land-type mapping units to provide assessment framework
- Development of monitoring programs to provide fundamental data required to assess condition and trend of landscape health status at property to regional scales.

Total grazing pressure

- Adaptive management arrangements for the long-term safe utilisation of grazing lands
- Increased understanding of landscape ecology to contribute to identification of grazing pressure thresholds and underpin vegetation or landscape based indicators of health status for different landscapes
- Definition of sustainable grazing and fire regimes for different rangeland and/or grassland types with a focus on sustainable native grassland outcomes in addition to yield focus of existing work
- Ongoing research into safe carrying capacities for different land-system types
- Measurement of external impacts of grazing intensification practices including smaller paddocks, cell grazing, and feed supplementation.

Fire regime

- Interaction of fire and grazing on the native vegetation condition and ecosystem processes maintaining landscape health
- Economic (pasture production) and biodiversity costs of fire exclusion
- Longer-term ecological study of fire regime impacts at landscape scales
- Comparison of clearing and fire effects on vegetation to assess proposition that clearing is a contemporary disturbance agent replacing fire
- Identification of appropriate fire regime strategies in grazed forests that meet the needs of foresters, graziers and ecosystem health
- Development of improved adaptive management and monitoring systems.

Thickening and thinning

- Thickening and thinning thresholds at which biodiversity, landscape water balance and ecosystem functional values may be affected
- Effectiveness and economic and ecological benefit-cost analysis of various (fire, grazing, mechanical, chemical) thickening and thinning management techniques
- Social and economic impact of thickening on pastoral districts
- Relative merits and value of thinning (versus clearing) for production in different bioregions
- Natural long-term dynamics of vegetation thickening and thinning in response to natural disturbance and stress events (e.g. fires, drought and cyclones).

3.3.4 Sustainable Development

3.3.4.1 Landscape design principles

Landscape design in Australia refers primarily to the patterns of mixed intensity land uses and the retention and establishment of native vegetation within farming landscapes. Native vegetation management is considered one of the most critical components of landscape design, specifically in terms of identifying the extent, type and configuration of vegetation retention (often at a property scale) required to sustain ecosystem processes and biodiversity values at a landscape scale while maximising production outcomes for individual properties.

3.3.4.2 Defining areas vulnerable to land degradation

NR&M has produced salinity hazard mapping for Queensland's portion of the Murray–Darling Basin and for other National Action Plan for Salinity and Water Quality (NAP) priority basins including the Fitzroy, Burnett, Mary, Lockyer, Bremer, upper Brisbane and the Burdekin basins.

NR&M is also developing erosion hazard mapping for Queensland catchments. Other land degradation hazards including soil structural and fertility decline, acidification and woody weed invasion have been defined at coarse scales (EPA 1999), but are not generally available as regionally specific management information or mapped data coverages.

3.3.4.3 Dryland salinity

Salinity hazard mapping has been developed at a catchment and regional scale for many areas of the State. The scale of planning required to manage against the development of dryland salinity is at the subcatchment and property level.

3.3.4.4 Pasture improvement

In contrast to native pasture management, pasture improvement practices actively change the structure and floristic make-up of native vegetation, usually involving the introduction of exotic grass or forage species and the use of inputs such as fertilisers. The intensity of native vegetation pasture improvement practices varies from the sowing of pastures and application of fertilisers, through to broadscale tree clearing followed by burning, raking and exotic pasture cultivation.

3.3.4.5 Water resource use

A range of water resource use practices including water harvesting, drainage, groundwater pumping and irrigation supply flows impact upon native vegetation, but sustainable management requirements are not well recognised.

3.3.4.6 Sustainable forestry practices

About sixty per cent of Queensland's native hardwood harvest is from private native forests (DPI 1998). A range of private forestry practices are accommodated under the vegetation management arrangements, subject to a code of practice, recently released (see www.nrm.qld.gov.au for more details on the code).

3.3.4.7 Urban development

Planning principles for sustainable native vegetation management (e.g. retention patterns and landscape design) could be applied to the management of remnants within a highly fragmented urban landscape. Key distinctions would include: more fragmented, isolated remnant vegetation; smaller and fewer opportunities for patch and corridor retention; a more hostile urban landscape; the absence of pressures such as grazing; limited capacity for some management options (e.g. fire and pest plant and animal control); and highly modified landscape water balance.

3.3.4.8 Alternative industries and land-use practices

The need to 'redesign' Australian agriculture and support the development of new industries more suited to the productive potential, climatic regimes and opportunities of the landscape is an area for national R&D programs and is being pursued by Land and Water Australia and CSIRO (see www.lwrrdc.gov.au and www.clw.csiro.au). This could provide outcomes for long-term economic returns and the provision and maintenance of ecosystem services and biodiversity values associated with sustainable native vegetation management.

3.3.4.9 R&D requirements for sustainable development

Landscape design principles

- Development and communication of existing landscape design research findings to provide tools to support current management arrangements
- Assessment of the capacity of current vegetation management arrangements to support implementation of best practice landscape design
- Appraisal of ability to translate existing research to other bioregions and RE types
- Identification of a comprehensive, cost-effective set of indicators and measurement methods to assess the sustainability of different landscape design elements in specific bioregions
- Development and implementation of an adaptive management/monitoring program incorporating key indicators and a 'built-in' reporting component, for improvement of landscape design outcomes
- Analyses of sites stratified by RE and landscape type comparing landscape functions against benchmarks in landscape design to assess the merits of different design elements
- Greater knowledge of landscape processes in bioregions to underpin landscape design
- Benefit-cost analyses incorporating social, economic and ecological tradeoffs for varying thresholds of intensive versus conservative use of property native vegetation resources
- Testing of the relative merits of generic property scale landscape design thresholds in comparison to specific landscape design requirements
- Development of flexible approaches for defining landscape design requirements for optimising ecological and production benefits
- Development of guidelines to define property thresholds for landscape water balance and salinity management, based on specific property characteristics as compared to regionally established values
- Long-term monitoring of controlled fragmentation experiments.

Defining areas vulnerable to land degradation

- Development of improved predictive capacity for land degradation hazard
- Translation of CSIRO and DPI land system mapping into land suitability classes for definition of development constraints
- Field validation of the erosion hazard index being developed by NR&M
- Development of land degradation (hazards and risks) mapping products equivalent to biodiversity planning assessments produced for regions
- Ability to relate land degradation hazard and development constraints to REs, land systems or other integrated land units.

Dryland salinity

- Development of improved pathways for land managers to access scientific information and expertise regarding dryland salinity hazards
- Development of salinity management guidelines that are based on property scale variations in topography, soils and geology
- Development of integrative predictive models for salinity hazard built upon available core data sets and robust landscape surrogates
- Increased understanding of salinity pathways including greater ability to define recharge and discharge areas based on local landscape characteristics.

Pasture improvement

- Assessment and development of region-specific property planning guidelines for optimal extent and patterns of pasture improvement intensification to meet sustainability outcomes
- Ecologically functional roles including merits and limitations of introduced pasture and forage species in terms of nutrient cycling and other ecosystem processes
- Soil moisture and nutrient dynamics in cleared woodlands
- Long-term assessments of production gains for pasture improvement systems
- Benefit-cost economic analysis of pasture development incorporating continued clearing for regrowth control in REs where it is required
- Development of alternative management practices for the maintenance of pasture productivity in cleared areas
- Establishment of tree-grass density relationships for northern landscapes
- Improved understanding of landscape ecology underpinning landscape management requirements of native biota.

Water resource use

- Improved understanding of water resource use impacts on native vegetation.

Sustainable forest practices

- Range of economic activities available to encourage retention of production forests
- Mechanisms to promote sustainable harvesting and management systems on private land
- Thresholds for ecologically sustainable logging
- Extension program requirements to promote benefits of long-term sustainability measures.

Urban development

- Assessment and planning needs for sustainable native vegetation and biodiversity conservation at urban landscape scales and planning environments.

Alternative industries and land-use practices

- Development of programs to demonstrate alternative industries and/or models of land use
- Economic evaluation of alternative pastoral resource uses
- Development of models of regional scale planning and enterprise management across multiple properties.

3.4 Delivering Sustainable Management Outcomes

Scientific understanding of vegetation impacts and definition of sustainable management practices risk remaining academic if the capacity to deliver desired management outcomes is limited. R&D issues associated with the delivery of sustainable management outcomes are broad and include social and economic dimensions, availability of information, and institutional arrangements. Many of these areas have not previously been identified as research needs in themselves, but rather have been considered more as development needs (translation of research to management). However, due to an increasing recognition of the social and community dimensions of natural resources management (Aitken 2001), they are an important focus for social and economic researchers and provide an essential context for biophysical science. This is partly due to the recognition that natural resource management is often concerned with understanding the motivational drivers of individual resource users and being able to effect behaviour changes in line with broader community expectations.

3.4.1 Management and Planning Policy

The Queensland Government has recently introduced legislation to phase out broadscale clearing of remnant vegetation in Queensland by December 2006 (NR&M 2004).

The *Vegetation Management Act 1999* aims to:

- conserve remnant endangered and 'of concern' regional ecosystems
- prevent land degradation and the loss of biodiversity
- manage the environmental effects of clearing
- reduce greenhouse emissions.

The Department of Natural Resources and Mines website contains further information on legislative changes (www.nrm.qld.gov.au/vegetation).

3.4.1.1 Incentive delivery mechanisms

A range of incentive delivery mechanisms may have application in Australia (ANZECC 2000). These include: tradable clearing; groundwater recharge, harvesting rights and carbon sequestration credits; conservation service auctions or 'bush tenders'; revolving land banks; taxation incentives; differential ratings; offsets and performance bonds; and direct financial payments. Defining the ecosystem services of native vegetation could provide a framework for developing marketplace mechanisms and policies in which ecosystem services are a tradable commodity and a policy end objective.

Incentives and market-based mechanisms

- Assessment of the order of incentives required to provide a catalyst for desired outcomes
- Defining public versus private good components of sustainable native vegetation management, including appropriate 'duty of care' responsibilities
- Defining and quantifying ecosystem services as a framework for the application of incentive mechanisms
- Use of incentives for reducing grazing pressure and other non-clearing elements of vegetation management
- Assessment of native vegetation values that warrant incentive-based management
- Review of incentive mechanisms for use in different regional contexts and landscapes
- Interaction of incentives with other management approaches including environmental management systems and adaptive management frameworks
- Development of pilot projects to examine the effectiveness of different incentive mechanisms
- Potential of market-based mechanisms (e.g. carbon sequestration credits) to act as an incentive for improved vegetation management
- Role of existing markets (e.g. timber and forest products) to provide incentives for appropriate vegetation management.

3.4.2 Social and Economic Dimensions

3.4.2.1 Social dimensions

Social and community involvement and support is a critical though often overlooked factor in the effectiveness of nrm strategies. It is the focus of a paper recently produced by CIRM: *Social and Community Dimensions of Natural Resource Management: A review of issues and related research* (Aitken 2001). A CIRM working group devoted to the topic is currently examining aspects of this important research area. Consequently, this paper will only mention some specific research areas of interest to vegetation management research.

3.4.2.2 Economic dimensions

Given the potentially persuasive nature of economic analyses for both individual managers and political decision-makers, R&D in the use of benefit-cost analyses to assess vegetation management options is a relatively high priority. One of the challenges is to be able to identify externalities to proposed management actions, and to quantify both benefits and costs in a common economic currency. Such externalities include biodiversity, greenhouse gas emissions, land degradation and regional community economic benefits (Rolfe 2002). Other R&D challenges include: linking external costs to specific management actions, reconciling the division of benefits and costs to different groups in society, and comparing benefit-cost analyses for different land systems and vegetation types and at different scales.

Benefit-cost analysis

- Production benefits versus resource conservation costs of vegetation management in development options
- Incorporation of longer-term externalities (e.g. pasture run-down, declining soil fertility and landscape water balance) in benefit-cost assessments of tree clearing and pasture improvement proposals
- Incorporation of a range of future beef industry profitability scenarios in cost-benefit assessments of tree clearing proposals.

3.4.3 Information Needs and Provision

3.4.3.1 Integrated information systems

Planning decisions regarding native vegetation management require information on a range of issues including economic costs and potential benefits, land capability and degradation hazards, biodiversity values and conservation requirements. Such information, where available, resides with multiple agencies, research institutions, community organisations, field officers and land managers in various scales, currencies and formats. There is a need for the development of integrated information systems to make information across a range of issues more readily available to land managers.

3.4.3.2 Decision support systems

Vegetation management policy-makers and land managers are required to make complex native vegetation management planning decisions requiring the input of variably scaled information from a range of sources. R&D that can facilitate robust decision support systems is required to help deliver optimal vegetation management planning outcomes.

Predictive modelling and visualisation tools represent perhaps the ultimate development in decision support systems due to their power as a communication tool for highlighting the potential implications of various management actions. Vegetation management issues that lend themselves to predictive modelling and visualisation approaches include production in terms of pasture, stock carrying capacity, economic returns, land degradation risks, and vegetation structural change including regrowth potential, vegetation responses to fire, climate and policy changes, and biodiversity and habitat values. Several of CIRM's partner agencies

have already progressed predictive modelling in respect to some of these issues, for example definition of areas of HNCV, climate change, dryland salinity hazard and water quality impact drivers.

3.4.3.3 Informal knowledge systems

In addition to formal knowledge systems developed through native vegetation R&D, there are significant informal knowledge systems built on the acquired and collective knowledge of landholders and indigenous people. Recognition of such informal knowledge and integration with more formal scientific knowledge systems could provide benefits in terms of improved acceptance of both sources of knowledge and better definitions of information gaps and key R&D needs.

3.4.3.4 R&D requirements for information needs

Integrated information systems

- Mechanisms for collaboration in knowledge integration and management
- Collation and linking of formal and informal information regarding production economics, sustainability issues and biodiversity values within a hierarchical bioregional and RE database
- Development of vegetation management manuals structured by bioregion and, where appropriate, REs to meet needs of local authorities and land managers
- Development of simple, inexpensive software to assist land managers in collate and collecting information on resource management issues on their properties.

Decision support systems

- Development of guidelines to interpret landscape-based surrogates in the absence of fundamental datasets
- Development of existing landscape design and process research findings towards integrative interpretations of property-scale landscapes, to better define salinity and land degradation hazards, biodiversity values and vegetation retention requirements
- Identification of what aspects of native vegetation management would be best served by decision support underpinned by predictive modelling
- Assessment of the functionality of existing vegetation-related modelling tools at a range of scales to serve decision support systems
- Integration of available modelling tools including the ability to better integrate biophysical, social and economic data
- Improved predictive modelling capacity to support the development of ecological and economic vegetation management decision support systems and software that can assess the ramifications of vegetation management practices
- Development of means of incorporating variable-scaled data within predictive models
- Further data collection to support predictive modelling at finer scales.

Informal knowledge systems

- Development of policy and information system tools to make appropriate use of informal knowledge in decision making
- Methods for overcoming social, institutional and economic barriers for knowledge integration and management
- Development of interactive knowledge systems that integrate the informal knowledge systems of primary producers and indigenous people with formal scientific information
- Mechanisms to assist different stakeholders to enlarge the frameworks within which their knowledge systems operate to accommodate the systems views of other stakeholders in order to achieve better synthesis of goals and greater reservoirs of knowledge
- Development of appropriate methodologies and guidance to fully involve the community in the research process, especially to become knowledge providers and learners through ongoing monitoring and feedback.

3.4.4 Active Management

3.4.4.1 Adaptive management and monitoring frameworks

Many researchers and managers see the development of effective adaptive management and monitoring frameworks as a very high priority need for sustainable native vegetation management. Adaptive approaches help overcome the landscape and long temporal scale challenges associated with doing 'real' research on important vegetation management issues such as grazing and fire.

3.4.4.2 Remnant vegetation management

There is wide consensus that the three key management issues confronting remnant vegetation are grazing, weeds and fire, with weeds posing perhaps the greatest threat to long-term sustainability. The specific management requirements to maintain remnant vegetation condition in different regions and the means by which they can be implemented are a very high priority R&D area.

In some regions, sufficient biophysical research has been conducted to define sustainable grazing and fire regimes but is yet to be broadly implemented within the social and economic framework.

The relative merits of different management approaches (e.g. fire and grazing regime, herbicides, clearing and post-clearing treatments) need to be assessed by reference to an improved understanding of the biodiversity and landscape functional impacts and alternative management methods, as well as the economic benefits and costs. Such management approaches include:

- Clearing as an ecological analogue to the impact of fire
- The ecological sustainability of methods proposed to counter thickening.

3.4.4.3 Riparian vegetation

The important catchment function (see 3.3.2) and biodiversity values of riparian vegetation are undisputed, and recent surveys have indicated that loss of riparian habitat and the impact of exotic weeds in the riparian zone are issues of major concern to community groups (Choy et al. 2002).

In common with most remnant vegetation, the key threats confronting riparian vegetation are weeds, grazing and fire. Given its location in the landscape, erosion and water resource use can also cause degradation. The fertility and development desirability of alluvial soils associated with riparian and floodplain vegetation meant that clearing also posed a significant threat to riparian vegetation.

In addition to the erosion risks caused by cattle access to riparian areas, modified catchment hydrology, boat traffic and high flow impacts on riparian vegetation in poor condition also present significant erosion impact pressures.

3.4.4.4 R&D requirements for active management

Adaptive management

- Design of monitoring programs to assess vegetation responses to management
- Requirements of adaptive management frameworks for sustainable native vegetation landscape management in Queensland.

Catchment- and landscape-based management frameworks

- Use of catchment and landscape functional processes as the context for defining vegetation management requirements.

Remnant vegetation management

- Identification of key proactive management needs for specific RE types within a range of land use settings and for specific management objectives
- Sustainable management guidelines for remnant vegetation in different bioregions and REs
- Development and implementation of sustainable fire regime management in REs already served by appropriate fire regime research
- Development of integrated (biological, chemical, physical) weed management strategies at landscape scales
- Further development of biocontrol methods for environmental as well as production weeds
- Management interventions required to re-establish natural successional processes in disturbed and weed-infested remnant vegetation including regrowth
- Broadacre management of natural successional processes including regrowth.

Regrowth and thickening management

- The landscape and biodiversity values and impacts of vegetation regrowth and thickening within different landscape contexts
- The relative landscape and biodiversity impacts of different thickening and thinning management approaches and economic costs and benefits
- The identification of vegetation thickening thresholds beyond which fire and grazing regimes cannot deliver management control outcomes
- The assessment of clearing as an ecological analogue to fire in the mitigation of vegetation thickening
- The biodiversity, production, economic and policy implications of reduced pasture productivity in protected vegetation areas due to vegetation thickening
- Sustainable patterns of regrowth and thickening control within the landscape, and thinning thresholds
- The role of longer-term climatic impacts on the development and control of vegetation thickening.

Riparian vegetation

- Development of catchment-based integrated (biological, chemical, physical) weed management strategies
- Broadacre (e.g. direct seeding) revegetation methods for riparian vegetation
- The potential roles of grazing and fire regime for riparian vegetation management
- Ecological research to assess importance of riparian corridor functions and implications of breaking connectivity
- Development of integrated hard (e.g. rock placement) and soft (e.g. revegetation) engineering approaches for the protection of riparian vegetation and bank stabilisation.

4.0

R&D Priority Setting – for Whom, Where and When?

A reoccurring question from those consulted for this report concerning the setting of R&D priorities for sustainable native vegetation management is priorities for whom, where and when.

National and State R&D priorities exist, and provide the framework within which agencies and institutions should establish their own R&D priorities. Agency and institutional priorities are dynamic and must respond to changing policy demands, different funding bodies' directions, and new research findings and developments. Aligning R&D priorities with pressing policy needs and available funding streams will always need a practical approach. However, meeting the needs of current policy and management arrangements can often require a tactical response quite distinct from the consideration of more strategic, longer-term R&D needs. R&D priorities can also be regionally constrained, highlighting different levels of available scientific knowledge and development, or regionally specific issues.

Many of the organisations consulted for this report did not have published R&D priorities although they had often been defined within the organisation. Most reviews that seek to identify priority issues obtain input from a range of sources and then define priorities on the basis of dominant views amongst those consulted or criteria considered objective by the reviewer. This report has used elements of both these approaches.

Multi Objective Decision Support System (MODSS) is one process that more transparently defines R&D priorities. Using this framework, which allows for variable weighting of different criteria when choosing between options, the influence of factors such as client values, applied research objectives, cost and time frame on R&D priorities could be examined to support dynamic research programming needs. Without a transparent, structured method such as MODSS, the use of a broad consultative approach to priority setting needs to be employed to ensure that individual R&D clients or researcher interests do not unduly bias priorities.

4.1 R&D Partner Dialogue

To be able to fully respond to the dynamic nature of native vegetation management R&D needs it is important that an ongoing dialogue is maintained between R&D partners. It is also important for managers at the operational level to have access to the R&D program priority setting processes.

4.2 Use of RVMPs for Tactical Priority Setting

The information gaps and research needs identified during the regional vegetation management planning (RVMP) process provide a practical focus for research programs. Research priorities identified in RVMPs include appropriate management of thinning/thickening, and good practice concerning the balance between biodiversity and economic outcomes (Andrea Leverington, pers comm. 2004).

4.3 Basic Resource Inventory

Native vegetation management R&D requires basic resource inventory in order to be effective. This applies particularly to the biodiversity and land capability aspects of sustainable vegetation management. For example, basic fauna inventories for Queensland's native

vegetation ecosystems are required to assess the implications of management practices and to incorporate the needs of biodiversity conservation in landscape design. Similarly soils and land capability inventory are required for many vegetation management regions.

4.4 Delivering the 'D' in R&D

Using available information to 'get on' and manage natural resources as well as possible is often a practical manager's approach in contrast to a researcher's desire to pursue further research to better refine the scientific basis for management. Regardless of one's perspective, it is recognised that at some point, the returns from pursuing additional research are diminished in relation to the cost of delaying management using existing information. Adaptive management, which allows for ongoing incorporation of monitoring or research findings as management is implemented offers the most responsive model but is not widely practised in vegetation management arrangements.

Many consulted individuals stated that, in some instances, sufficient research already exists to serve many sustainable vegetation management needs and that the real issue is one of development. Several factors were cited as relevant to development of research including:

- Need for more basic resource inventory data
- Ongoing dialogue between researchers and resource manager clients leading to identification of development opportunities
- Adaptation of existing information to make it usable within the policy framework
- Improving the recognition of opportunities to translate information between regions and land-use settings
- Pursuit of generic research undertakings
- Recognition of the necessarily limited timeframes for serving current management needs
- Need for a structured review that distinguishes existing research, and development and gaps, to identify new research needs versus outstanding development opportunities
- Identifying where development opportunities lie with other disciplines (e.g. social and economic as compared to biophysical science).

4.5 Biophysical versus Social and Economic Research

Natural resource management is often ultimately about behavioural issues and changing people's attitudes concerning the use of natural resources. The rationalist model that predicts that to effect change all that is required is better scientific understanding and means of communicating it, overlooks the reality that the motivations of individual resource managers and landholders are highly variable, and that to effect changes in behaviour, social research is required to identify these motivational factors (C. Zammit pers comm.). The social and community dimensions of natural resource management and the resulting R&D activity required have been analysed in another CIRM review (Aitken 2001).

4.6 R&D Program Integration

The mechanisms through which CIRM can promote and facilitate more integrated R&D programs need to be identified and progressed as part of any native vegetation management R&D program. Such mechanisms are likely to include: the development of collaborative research funding bids, the focussing of research programs in specific regions or on specific issues; and the use of common biophysical or social economic frameworks for structuring research questions.

Many of the research issues requiring long-term monitoring extend beyond the usual operational horizons of industry R&D corporations and yet are very important for government in terms of developing effective native vegetation and natural resource management policy. Special initiatives may be required to establish and support long-term native vegetation research programs.

5.0

Ways Forward – Recommendations

Seven recommendations arise from the findings of this report, and are discussed below.

Recommendation 1. Formation of a native vegetation R&D program working group

That CIRM, through its partners and in accordance with procedures implemented for other priority R&D areas, establish a Sustainable Native Vegetation Management R&D Program Working Group to take the lead in the further refinement of R&D priorities and the implementation of a prioritised R&D program. Responsibilities should include:

- Facilitation of regional review processes for identification of 'local' R&D priorities
- Establishment of a process for ongoing dialogue between R&D partners and clients
- Implementation of a prioritised native vegetation management R&D program
- Identification of R&D program funding opportunities.

Recommendation 2. Gap analysis and integrated information provision

That the R&D Working Group coordinate a 'theme' structured review of available research and information on a bioregional and regional ecosystem basis, reflecting the planning framework hierarchy used for current policy management arrangements. In progressing R&D information collation and gap analysis, consideration should be given to:

- Potential definition of R&D themes using the summary issue categories of this report
- Utilising the existing data sharing agreements and regional information services as a basis for integrating the information
- Using a distributed database shell to capture the information cost effectively and consistently
- Making a distinction between existing native vegetation management R&D, to enable opportunities for further development of existing research to be defined
- Establishing a process to define similarities between biogeographic regions and REs to aid broader development and use of existing research information between regions.

Recommendation 3. R&D partner dialogue and priority setting

That the Working Group establish a process for ongoing dialogue between R&D partners. As part of this process it is recommended that:

- Partners include managers from the 'coalface', industry and community clients, as well as researchers and policy-makers
- Workshop reviews or other communicative processes be held on at least a biennial frequency
- Working Group members are allocated the task of maintaining communication between State and Commonwealth workers and 'live' lists of R&D priorities for particular themes
- The application of MODSS or similar transparent approaches to R&D priority setting be assessed as part of the review process.

Recommendation 4. Integrated R&D programs

That the Working Group promote and facilitate more integrated vegetation management R&D programs through its links to CIRM member organisations by:

- Developing collaborative bids for research funding for projects with multidisciplinary components and multi-agency interest
- Encouraging development of complimentary research projects on shared sites or within agreed regional settings to allow for better integration of findings
- Promoting the use of biogeographic (i.e. regional ecosystems), land-system and catchment units as a primary framework for the design of research projects and the collation and extension of research findings.

Recommendation 5. Linkage with existing R&D programs and regional nrm planning processes

(a) That the Working Group capitalise on consultative processes and funding opportunities by establishing links with existing vegetation R&D programs and regional nrm planning processes including:

- Land and Water Australia's Native Vegetation and National Rangelands R&D programs
- The National Action Plan for Salinity and Water Quality priority catchment strategies, and the Natural Heritage Trust 2 natural resource management regions
- The Reef Water Quality Protection Plan which is highlighting the importance of water quality ecosystem services provided by native vegetation
- The proposal to develop a Rural Leasehold Land strategy
- The Queensland work plan of the National Framework for the Management and Monitoring of Australia's Native Vegetation (ANZECC 2000)
- The National Land and Water Resources Audit's proposed Australian Collaborative Rangeland Information System
- Cooperative Research Centres (CRCs) that have significant native vegetation management related R&D issues, for example, CRCs for Tropical Savannas, Rainforest, Bushfire, Freshwater Ecology, Coastal Zone and Greenhouse Accounting.

(b) That CIRM partner linkages to these R&D programs and regional planning bodies be used by the Working Group for formal communication canvassing their R&D needs, and that where significant opportunities are identified, CIRM act as broker for the engagement of its members in integrated research projects.

Recommendation 6. Facilitation of long-term monitoring and research programs

That the Working Group identify how the establishment of long-term monitoring and research programs can be supported. Approaches for successful long-term R&D programs are likely to also apply to other research areas and include:

- Delivering cost efficiencies by using student researchers in the analysis of program data and by using such programs as part of the investment in junior agency staff training
- Designing programs that monitor a succinct but broadly relevant range of indicators that have application across a range of agency interests including linkages to State of Environment and Montreal reporting cycles
- Incorporating automated reporting functions so that monitoring programs provide a good return on investment in terms of translating data into information
- Incorporating adaptive management components that provide efficient linkages between resource condition and management practices by engaging researchers, resource managers and policy-makers in their design and implementation
- Identifying and capitalising on existing long-term research programs both within and outside of government agencies.

Recommendation 7. Formation of native vegetation research scientific panel

That CIRM establish a scientific panel to strategically oversee the implementation of the native vegetation management R&D program consisting of experienced researchers from government, CSIRO and universities. The panel would have responsibility for planning and reviewing strategies and directions, developing and prioritising research programs and coordinating applications to external funding bodies such as CRCs, Land and Water Australia and the Australian Research Council. It should also play a major integrating role in coordinating existing and proposed vegetation management R&D within Queensland Government agencies.

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Appendix 1 – National Strategies, Assessments and R&D Programs

National strategies and Commonwealth legislation are important for setting R&D priorities due to a need to develop Queensland's R&D capacity to meet national commitments and legal responsibilities, and the potential alignment of Commonwealth R&D funding with these initiatives. National assessments and reports on native vegetation management also influence Commonwealth policy and R&D program priorities, and provide further context for state priority setting. Some of the significant national (and broader) strategy, policy and nrm program initiatives are listed below.

International and National Policy and Program Initiatives

1. Montreal Process: <http://www.mpci.org/>
2. National Strategy for Ecologically Sustainable Development (COAG 1992):
<http://www.ea.gov.au/esd/national/nsesd/index.html>
3. National Forest Policy Statement (Commonwealth 1995): <http://www.rfa.gov.au/>
4. National Strategy for the Conservation of Australia's Biological Diversity (ANZECC 1996):
<http://www.ea.gov.au/biodiversity/publications/strategy/>
5. National Greenhouse Strategy (Commonwealth 1998): <http://ngs.greenhouse.gov.au/>
Queensland (1999) Implementation Plan: <http://www.epa.qld.gov.au/publications?id=542>
6. Environment Protection and Biodiversity Conservation Act 1999. (Commonwealth 1999)
<http://www.ea.gov.au/epbc/index.html>
7. National Framework for the Management and Monitoring of Australia's Native Vegetation (ANZECC 2000) <http://www.deh.gov.au/land/publications/nvf/>
8. National Action Plan for Salinity and Water Quality (Commonwealth 2001):
<http://www.napswq.gov.au/index.html>
9. Natural Heritage Trust 2/Bushcare (Commonwealth 2002)
<http://www.nht.gov.au/extension/framework/bushcare.html>

Common themes

Common themes and key commitments with R&D implications for the above initiatives include:

Sustainability

- Assessment and protection of natural resources including: biodiversity, threatened species, critical habitat, ecological communities, soil and water resources, hydrology, land productivity, protected areas natural and cultural heritage, traditional owner interests, and climate change mitigation
- Ecologically sustainable native vegetation management (including forestry and rangelands)
- Effective incentives for ecologically sustainable native vegetation management
- Codes of Practice for sustainable forestry operations
- R&D on indicators of sustainability, compilation of species inventories of flora, climate variability impacts and ecosystem based knowledge
- Development of monitoring frameworks and regional/subregional sustainability indicators.

HNCV/Biodiversity

- Biodiversity monitoring and inventory including vegetation inventory, data and mapping
- Compilation and application of ethno biological knowledge
- Comprehensive regional assessments
- Comprehensive, adequate and representative (CAR) reserve system.

Native vegetation management

- Reverse decline in extent and quality of native vegetation (including clearing control mechanisms and conservation and enhancement of remnant native vegetation)
- Encourage farm management practices promoting revegetation, protection and enhancement of remnant vegetation and biodiversity, and improved native vegetation management to achieve ESD, planning certainty, prevention of land degradation
- Development of state-based work plans for implementing best management practices.

Threatening processes

- Listing and mitigation of key threatening processes including land clearance and emissions of greenhouse gases
- Rehabilitation of threatened species and communities
- Identification of land vulnerable to land degradation
- Improve quarantine and control pests, feral animals and weeds
- Prevent, stabilise and reverse trends in dryland salinity
- Define salinity hazard areas
- Improve water quality
- Strategic planning for threatening processes.
- Promote sustainable management practices and technologies effective in reducing greenhouse gas emissions from the agriculture sector.

Policy, planning and social issues

- Development and implementation of vegetation management frameworks (including bioregional and regional vegetation management planning)
- Promote knowledge and skills to increase the appreciation of the role of biodiversity in the landscape
- Provide incentives and market based mechanisms for nature conservation
- Establish baselines and indicators for monitoring and evaluation and maintain current information on land clearing
- Commit to adaptive management
- Protection and management planning for old growth forests
- Communication and capacity building.

National Native Vegetation Assessments and Reports

1. Managing the Bush: Recent Research Findings from the EA/LWRRDC National Remnant Vegetation R&D Program (Williams 2000)
2. Australian Native Vegetation Assessment 2001 (NLWRA 2001b)
3. Landscape Health in Australia (NLWRA 2001c)
4. Rangelands – Tracking Changes: Australian Collaborative Rangeland Information System (NLWRA 2001a)
5. Australia State of the Environment 2001 (Commonwealth of Australia 2001)

Common themes

Common themes and commitments with R&D implications for the above initiatives include:

Sustainability

- Improved knowledge of vegetation in landscape function
- Ecological basis for identifying thresholds for long-term ecological changes to landscape
- Combination of indicator attributes and weighting to define landscape stress
- Long-term ecological monitoring
- Development of remote sensing for assessing landscape change at local to regional scales.

HNCV/Biodiversity

- Appropriate indicators and monitoring frameworks
- Role of biodiversity in ecological processes
- Value and use of biodiversity surrogates
- Invertebrate and non-vascular plant biodiversity (including taxonomy of poorly known groups).

Native vegetation management

- Quantifying the direct and indirect benefits of native vegetation (including role of remnant vegetation in landscape health)
- Monitoring and assessment condition impacts associated with fire, pests, weeds, soil degradation, nutrient cycling and changed hydrology
- Methods for defining significance, status, trends and priorities for native vegetation restoration and management
- Restoration methods for fragmented landscapes
- Disturbance regimes required for sustainable native vegetation management
- Role of native vegetation in landscape water balance, and sediment and nutrient management
- Catchment based management approaches for native vegetation.

Threatening processes

- Methods to assess and rank threatening processes
- Practical management techniques to mitigate threatening processes
- Extent and impact of disease, weeds and pests
- Potential impacts of GMOs on native vegetation
- Increased knowledge at continental scales of carbon sequestration systems
- Cumulative impact processes.

Policy, planning and social issues

- Skills and capacity for designing sustainable landscapes integrating sustainable agriculture
- Integrated property management planning integrating native vegetations management
- Best management practices and accreditation
- Closer integration of researchers, agencies and managers to deliver adaptive management and knowledge transfer (including appropriate models for communication)
- Refining national carbon accrediting
- Socio-economic profiling of land managers
- Information needs to support indigenous land managers.

Land and Water Australia's Vegetation Arena

Land and Water Australia's Vegetation R&D Program is Australia's leading research broker into the social, economic and ecological aspects of native vegetation management in rural landscapes. The mission of Land and Water Australia's vegetation R&D arena is:

To encourage more sustainable and integrated management of vegetation in rural Australia that recognises the social, economic, cultural and production elements of our landscapes and fully incorporates biodiversity at the gene, species and ecosystem level.

There are four programs within the vegetation arena, with two specifically concerned with sustainable native vegetation management. These are:

1. The Native Vegetation R&D Program and
2. National Rangelands R&D Program

Native Vegetation R&D Program

Research in this phase of the program has a strong emphasis on practical outcomes, focusing on:

- Developing practical methods that allow native vegetation managers to quickly assess status and condition and action priorities; to identify threatening or degrading processes; and to formulate effective, long-term management responses
- Exploring the relative effectiveness and benefits of a wide range of approaches to promoting integrated management of native vegetation by landholders, including the use of a small number of case study projects to refine and demonstrate cost-effective methods
- Assessing the contribution to biodiversity conservation of different approaches to the design of landscapes for vegetation retention and revegetation
- Establishing innovative means of publicising the values of native vegetation, practical management strategies and methods and other R&D findings, that meet the defined needs of the different audiences involved
- Being a national point of contact and focus for R&D on native vegetation not managed for intensive commercial use throughout Australia, and foster improved links between research and practice and the use by managers of an adaptive management approach.

A number of Queensland-based projects are included in this program:

- Applying management principles in variegated landscapes: identifying production: conservation tradeoffs (CSIRO CSE)
- Ecological thresholds for native vegetation management in southern Queensland, (DPI&F)
- Improved vegetation planning for rural landscapes (CSIRO CSE)
- Landscape design principles for native vegetation management: addressing multiple scales (CSIRO CSE)
- A national framework for landscape classification (CSIRO CSE).

National Rangelands R&D Program

Researchers are assessing economic and ecological impacts of different land uses so that options at all levels can be explored. Current projects are focussing on:

- Developing decision rules for different land classes to identify opportunities for sharing resources and management between sectors
- Looking at institutional structures in regions so that shared visions and priorities can be used to implement resource use and management change.
- Capacity building in the regions, and building structures that will support local negotiation and decision making between different sectors.
- Examining the spatial and economic impacts of turning off remote waters as a means of reducing grazing and maintaining biodiversity.

The Queensland-based projects included in the research portfolio under this program include:

- Producing native pasture seed for Mulga lands (DPI&F)
- Regional resource use planning in rangelands: a central Queensland pilot study (CSIRO CSE)
- Research and development for sustainable use and management of Queensland rangelands: scoping study (CSIRO CSE).

Appendix 2 – Acronyms Used

The following acronyms have been used in this report:

ACRIS	Australian Collaborative Rangelands Information System
BAMM	Biodiversity Assessment and Mapping Methodology
CIRM	Consortium for Integrated Resource Management
COAG	Council of Australian Governments
CRC	Cooperative Research Centre
CSIRO CSE	CSIRO Centre for Sustainable Ecosystems
DNR	Department of Natural Resources (now NR&M)
DPI	Department of Primary Industries (now Department of Primary Industries and Fisheries, DPI&F)
EPA	Environmental Protection Agency
ESD	ecologically sustainable development
GIS	geographic information system
GMO	genetically modified organism
HNCV	high nature conservation value
MODSS	multi objective decision support system
NAP	National Action Plan for Salinity and Water Quality
NLWRA	National Land and Water Resources Audit
NR&M	Department of Natural Resources & Mines
NRM&E	Department of Natural Resources, Mines & Energy (now NR&M)
nrm	natural resource management
R&D	research and development
RE	regional ecosystem
RVMP	regional vegetation management plan
VMA	(Queensland) <i>Vegetation Management Act 1999</i>

Appendix 3 – Contacts Consulted

The following officers were consulted during the preparation of this report:

Person	Agency
Andrew Ash	CSIRO
Joe Baker	Department of Primary Industries and Fisheries (DPI&F) / Tropical Queensland Vegetation Management Committee (TQVMAC)
Paul Barrett	Natural Resources and Mines (NR&M)
Don Begbie	NR&M
Mike Berwick	Ministerial Advisory Committee on Vegetation Management (MACVM) / TQVMAC
Paul Bidwell	Agforce
Des Boyland	Wildlife Protection Society Queensland (WPSQ)
Jim Burgess	Queensland Timber Board
Bill Burrows	DPI&F
Chris Chilcott	NR&M
Colin Creighton	MACVM / NLWRA
Steve Crimp	NR&M
Luke Croton	NR&M / North RVMPC
Hans Dillewaard	Environmental Protection Agency, Queensland Parks and Wildlife Service (EPA, QPWS) (Northern region)
Andrew Drysdale	Queensland Murray–Darling Commission
Rod Fensham	EPA
Andrew Grodecki	NR&M
Gordon Guymer	EPA
Paul Harris	NR&M / SE QLD RVMPC
Rod Hewitt	NR&M / Central RVMPC
Melva Hobson	NR&M
Alan House	DPI&F / Queensland Forestry Research Institute

Adrian Jeffreys	Premiers Dept
Peter Latch	EPA, QPWS (Northern region)
Peter Laurence	University of Queensland (UQ) / Queensland Centre for Climate Applications
Greg Leach	NR&M
Andrea Leverington	NR&M
John Ludwig	CSIRO
Jennifer Marahasy	MACVM / Canegrowers
Chris Margules	CSIRO
Clive McAlpine	University of Queensland (UQ)
Juliana McCosker	EPA
Michael McDougall	NR&M / Far North RVMPC
Gus McGowan	MACVM / Agforce
Sue McIntyre	CSIRO
John McIvor	CSIRO
Gethin Morgan	EPA
John Nelder	EPA
Phil Norman	EPA (now NSW Department of Infrastructure, Planning and Natural Resources)
Jan Oliver	Wildlife Preservation Society of Queensland
Julia Playford	EPA
Hugh Possingham	MACVM / UQ
John Rolfe	Central Queensland University (CQU)
Paul Sattler	EPA / Murray Darling Basic Committee
Joe Scanlan	DPI&F
Richard Silcock	DPI&F
Tania Simmons	EPA Queensland Parks and Wildlife Service (QPWS)
Scott Smith	NR&M
Jeremy Thompson	EPA
Peter Voller	NR&M / South West RVMPC
Mary Jane Weld	NR&M
Bruce Wilson	EPA
Felicity Wishart	Queensland Conservation Council, WWF, Australian Conservation Foundation
John Woinarski	Tropical Savannas CRC
Charlie Zammitt	University of Southern Queensland

