Department of Environment and Resource Management

Protected Areas for THE FUTURE

Cornerstones for Terrestrial Biodiversity Conservation

Toward Q2 Tomorrow's Queensland | Queensland Government

Prepared by:

Biodiversity Integration Unit, Natural Resources and Environment Division

Department of Environment and Resource Management

#29301

December 2010

Contents

List of figures, graphs and tables		
Figure 1.	National park area in Queensland from 1900 to 2010.	6
Figure 2.	Growth and projected growth in nature refuge area, 1994 to 2010.	8
Figure 3.	Queensland's protected area selection methodology and the tools, inputs and approaches that underpin this.	22
Table 1.	Level of protection (bioregion area and RE representation) in each of Queensland bioregions.	27
Figure 4.	Target for regional ecosystems as a proportion of pre-clearing extent (in hectares). Note these need to be adjusted when remnant area is limited.	31
Table 2.	Theoretical targets for a range of regional ecosystems.	31
Figure 5.	Number of regional ecosystems in each bioregion achieving different levels of protection in the protected area system (based on the proportional representation method).	32
Table 3.	Broad wetland habitat types in the major drainage basins of Queensland, showing proportion protected in national parks and other protected areas.	33
Table 4.	The proportion of areas with high ecological values (as assessed through the BPA process) that are covered by protected areas in each bioregion.	35
Table 5.	Indicative protected areas priorities for Queensland's bioregions.	40
Figure 6.	The current and projected protected area extent in Queensland.	41

List of maps		
Map 1.	Protected areas and bioregions of Queensland.	7
Map 2.	Proportion of bioregion area conserved in all types of national park, conservation parks and resources reserves (2010).	25
Map 3.	Proportional count of regional ecosystems in each bioregion protected in all types of national park, conservation parks and resources reserves (represented at any level).	26
Map 4.	Proportion of subregion area conserved in national parks and other protected areas, excluding nature refuges.	28
Map 5.	Proportion of regional ecosystems in each subregion protected in national parks and other protected areas, excluding nature refuges (represented at any level).	29
Map 6.	The drainage basins of Queensland.	34

List of GIS data used to compile maps 1 to 5:

- Queensland Bioregions and Subregions Version 5
- DERM Protected Area Estate (June 2010)
- Regional Ecosystem of Queensland Version 6.0b (November 2009) + certified draft mapping (August 2010).

Terrestrial protected area terms used in this document

National park: national park; national park (scientific); national park (Torres Strait Islander land); national park (Cape York Peninsula Aboriginal land).

Protected areas: all categories under the *Nature Conservation Act 1992* (NCA), including all forms of national park (see above), conservation park, resource reserve, nature refuge and coordinated conservation area; plus forest reserve which is a future protected area. Note that for calculations of statistics, nature refuges are not included.

Private protected areas: Private protected areas owned or leased and managed by non-government organisations and included on the Collaborative Australian Protected Area Database (CAPAD).

Indigenous protected areas*:* Areas of Indigenous-owned land or sea where Traditional Owners have entered into an agreement with the Commonwealth Government to promote biodiversity and cultural conservation – included on CAPAD.

Reserves: any land recognised under the National Reserve System – all of the above. This term is used for reserve planning as considerations of other reserve types (e.g. Indigenous protected area or private protected areas) are included.

Spring-fed creek on the edge of the Gulf Plains bioregion. Photo: Gethin Morgan

Executive summary

Protected areas are recognised internationally as the cornerstones of biodiversity conservation and are a key part of an integrated strategy for nature conservation. On this basis, the Queensland Government has announced a Q2 commitment to expand the total protected estate in Queensland from the current 10.3 million hectares to 20 million hectares by 2020. This commitment will include 13 million hectares of national park, which is 7.5 per cent of the state.

New protected areas will bring two kinds of benefits: they will conserve a wider range of biodiversity in one of the most diverse areas on the planet and provide new and exciting opportunities for tourism and recreation across regional and rural Queensland. The government has set an ambitious target to acquire more protected areas, and to encourage and assist other landholders to commit areas of high biodiversity to protection.

Protected Areas for the Future (PAF) is central to Queensland's biodiversity efforts as outlined in Building Nature's Resilience: A Draft Biodiversity Strategy for Queensland (Department of Environment and Resource Management 2010). To complement the Strategy, this document reviews Queensland's current terrestrial protected area system, discussing why these new protected areas are required, where the gaps exist in the current system, and describing a methodology to help fill these gaps. This information will provide the basis for selecting new areas as possible additions to the protected area system. The system for protecting the state's marine and freshwater ecosystems is also being reviewed and a parallel plan is under development.

Protected areas in Queensland currently include national parks and conservation parks which are important for both conservation and public access and presentation, newly created national parks (Cape York Peninsula Aboriginal Land) and nature refuges on private lands. Indigenous protected areas and private protected areas, which are not under state legislation, also play vital roles. All these reserves help to enhance ecosystem resilience to climate change and other threats to nature.

Queensland’s reserve system now has new type of protected area where Aboriginal freehold land in the Cape York Peninsula region can, by agreement, be declared National Park (Cape York Peninsula Aboriginal land) and is then jointly managed by traditional Owners and DERM. Through the Cape York Peninsula Tenure Resolution Program, other Aboriginal lands of high conservation value in the region have become nature refuges through the negotiation of conservation agreements.

Mt Croll Nature Refuge. Photo: DERM

Why protected areas are important

A system of healthy protected areas is seen as a valuable investment that reconnects people with nature and provides many other benefits to the community, including:

- protection for the unique plants, animals and ecosystems that form part of the Queensland identity and culture
- health and wellbeing benefits through recreation and scenic beauty
- ecosystem services for human populations such as fresh air, clean water and productive soils
- large and stable areas for storage of greenhouse gases and the regulation of climate
- a vibrant, growing tourism industry based on national parks
- places where Indigenous culture and links to the land are celebrated
- employment opportunities for local communities, including Indigenous people
- refuges for diverse life forms
- genetic material providing opportunities for 'bioprospecting' for medical cures and other natural chemicals
- protection for cultural heritage
- benchmarks for ecologically sustainable management across all lands.

Protected areas are cornerstones of a broader whole-of-landscape approach to biodiversity conservation. They will continue to be extremely important for biodiversity conservation in light of the growing threats such as climate change, delayed effects of fragmentation, and increased invasive species.

In the coastal regions, which are under pressure from development and increasing populations, protected areas play a very important role in biodiversity conservation, in catchment protection and in providing places for recreation and tourism. In the less fragmented western and northern parts of Queensland, protected areas provide refuges from grazing, mining and other land use, as well as places where the whole community can enjoy nature.

Many significant ecosystems, with their unique plants and animals, are not yet reserved in any protected area, and many other ecosystems have only very small representation in parks. With the opportunity now to almost double the protected area estate, these gaps can now be filled.

The work so far

Over the past 100 years, Queensland's protected area system has made progress towards conserving the state's biodiversity, with an estimated 80 per cent of regional ecosystems represented to some extent. For more than 30 years, planning for Queensland's protected areas has been based on the bioregional framework and our protected area planning has focused on the idea of protecting as many types of plants, animals and landscapes as possible right across the state—from the coast to the desert and from the tropics to the cool southern highlands.

This progress has been underpinned by a 'comprehensive, adequate and representative' protected area system (CAR). It is based on a bioregional focus through which the analysis of the state's 13 terrestrial bioregions has provided a more strategic approach to selection. The bioregions represent the primary level of biodiversity classification in Queensland and are based on broad landscape patterns that reflect the major structural geologies and climate as well as major plant and animal groups.

Comprehensive, adequate and representative (CAR) protected area system

Comprehensive means the reserve system samples the full range of regional ecosystems across the landscape.

Adequate means the reserves are of sufficient size and appropriate shape to enable natural integrity, including species diversity, of the park to be maintained.

Representative means the samples of regional ecosystems include the maximum possible diversity of their plant and animal communities.

Where to from here?

In terms of area alone, Queensland's national parks cover only 4.9 per cent of the state, and even with

all protected areas included only 6.2 per cent of the state is covered. This figure falls well short of the national average of 12 per cent. In addition, while many regional ecosystems are already protected, for most of these the area conserved is well below an adequate level for long-term conservation.

The challenge now is to build a more complete and resilient protected area system by extending existing protected areas and adding new ones to protect biodiversity to the best possible extent. This protected area system will protect Queensland's natural capital in the face of climate change and expanding human settlement, and provide more widespread opportunities for recreation and tourism.

Some of Queensland's bioregions are better conserved than others. There is still important work to be done along the coast as a number of subregions in these bioregions are poorly conserved. In the centre and west of the state, protected area coverage remains limited. A number of priority bioregions are in the semi-arid rangelands where climate change may place further strain on marginally productive lands and could lead to species loss and possible ecosystem collapse. The bioregional approach will ensure some of this country is represented in the protected area system.

How will we do it?

Guided by a whole-of-landscape approach to biodiversity conservation, new areas will now be selected as possible additions to the protected area system through a rigorous process that follows a new set of principles, and is driven by a systematic and information-rich methodology.

To undertake this complex task, a combination of computer-based reserve planning tools, systematic biodiversity assessments and expert opinion is being used. The resultant spatial plan will define a set of potential protected areas of different categories and governance types. Priorities for investment in biodiversity and carbon offsets are also being identified, for example where revegetation can develop buffers to, and linkages between parks. This plan is a dynamic tool for the future, and will be adjusted as priority areas are acquired, and as others are identified.

Queensland will broaden its approach to address complexities such as climate change, through this documented approach and methodology. Still using the CAR principles and bioregional approach as before, but applying a new, broader set of principles, better data and knowledge-base capability, and better planning, PAF can deliver focussed action for biodiversity.

Guiding principles

These principles have been agreed and will aid decision-makers in choosing areas that will deliver the greatest benefit for Queensland's biodiversity.

Build a comprehensive, adequate and representative (CAR) system of selection to:

- maximise biological diversity (using regional ecosystems as a surrogate) in each bioregion and subregion
- build resilience to climate change
- improve the 'adequacy' of the protected area system with large enough areas for species and communities to survive, building on existing protected areas so they are easier to manage and more resilient to threats
- conserve priority ecosystems and species through selection of additional areas, primarily where clusters of priority species occur
- include, where practical, representation of the variety of geological features, freshwater ecosystems and wetlands.

Deliver social, health, educational and economic benefits which:

- identify new tourism and recreation opportunities considering socioeconomic impacts and benefits
- conserve cultural and scenic values, in particular natural sites of high cultural value to the community, recognising the experience and contribution of traditional owners in managing their country.

Consider practicality and urgency to:

- ensure the best areas are selected considering costs of acquisition, availability of properties, practicality and future costs of management
- complement other reserves in the National Reserve System, including Indigenous Protected Areas and Private Protected Areas
- assess the level of threat to defined biodiversity areas in the prioritisation of acquisition and other biodiversity actions.

The planning process for selection has also become more complicated, beyond consideration of

biodiversity alone. Increasing resilience to climate change, recognising Traditional Owners' rights, responding to community needs for recreation and economic benefits, and considering cultural heritage are also important planning considerations. Cost factors, availability of land and future management needs must also be taken into account.

New mechanisms for biodiversity conservation, such as a broader range of protected area types, conservation agreements, co-management agreements, and the carbon economy, provide even greater opportunities and challenges in planning the protected area system.

Protected areas will be established and managed through a number of means. For example, important areas of state forests and other state-owned reserve types can be transitioned into national park tenure. Importantly, community partnerships and Indigenous people will continue to play a significant role in helping protect important parts of our landscapes.

Building on the substantial past efforts, the protected area system can now reflect the best possible protection for biodiversity in protected areas, while increasing resilience to climate change, recognising Traditional Owners' and landholder rights, responding to community needs for recreation and economic benefits, and protecting our cultural heritage.

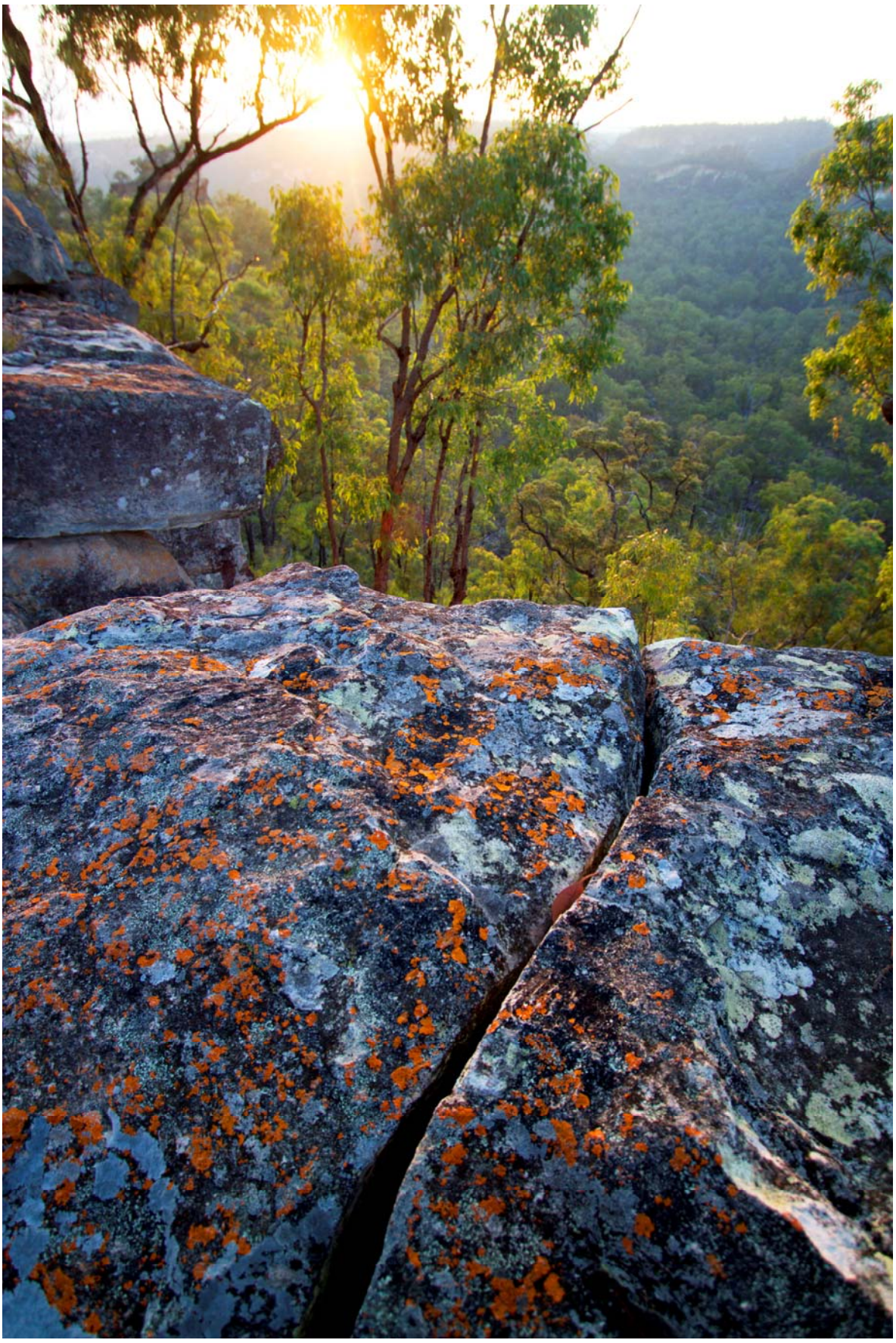
Southern cassowary. Photo: DERM.

Background: why new protected areas are important

Protected areas are recognised internationally as a key strategy in nature conservation. With the threat of climate change, the role of national parks as nature's safety net is even more important. More than 13 per cent of the earth's land is now in national parks or related reserves, and 12 per cent of Australia's land is in reserves recognised in the National Reserve System. In both rich and poor countries, a system of healthy parks is seen as a worthwhile investment that provides a great number of benefits not just to biodiversity, but also to the community. A recent study called The Economics of Ecosystems and Biodiversity estimates that the long-term benefits of protecting land are up to 250 per cent greater than the benefits of converting that land to any other use (The Economics of Ecosystems and Biodiversity 2009). These benefits include:

- Opportunities for local employment and involvement in land management, including potential for a high level of involvement of local Indigenous people.
- Health and wellbeing benefits through recreation and scenic beauty. A 2007 survey found that eight in 10 Queenslanders have visited state national parks, with four in 10 visiting in the year before the survey (The Nielsen Company 2007)**.** International research shows general health benefits for people living in greener environments (Maller et al 2008).
- Ecosystem services for human populations. Catchments protected in national parks provide the cleanest, cheapest and most reliable water supplies for many of our population centres. Other valuable ecosystem services include erosion control, soil formation and nutrient cycling. For example, the total value of ecosystem services (water protection and supply, soil and nutrient services and erosion control) provided by national parks in the Wet Tropics World Heritage Area is more than $35 million a year (Curtis 2004).
- Large and stable areas for storage of greenhouse gases and the regulation of climate. In a world concerned about carbon emissions and storage, natural vegetation has a newly recognised value for community wellbeing and economic investment. The climate regulation value of national parks in the Wet Tropics area is estimated at $4.7 million every year (Curtis 2004). An estimated 15 per cent of the world's carbon is stored in protected areas (Dudley et al 2010).
- A vibrant, growing tourism industry based on national parks, with more than 16 million visitors a year. In Queensland more than 7000 people are employed in this industry and more than $4.4 billion is spent annually by tourists who visit national parks. Spending by people who visit regions specifically to see national parks is estimated at more than $749 million annually and contributes about $345 million to gross state product (Ballantyne et al 2008).
- Places where Indigenous culture and links to the land are celebrated. Many parks have great significance to Aboriginal and Torres Strait Islander people and these areas are increasingly managed in partnership with Traditional Owners.
- Refuges for diverse life forms and genetic material, providing opportunities for future medical cures and other natural chemicals.
- Protection for the unique plants, animals and landscapes that form part of the Queensland identity and culture, from the iconic red dunes of the Simpson Desert to the green rainforests of the Wet Tropics with their myriad life forms.
- Protection for cultural heritage. Cultural heritage places, historical buildings, Aboriginal art and artefacts, archaeological sites and other links with past and current culture are protected in parks.
- Benchmarks for ecologically sustainable management. Where surrounding properties have been used for many years, protected areas are places where the natural diversity of plants and animals can be seen, and as benchmarks against which landscape changes can be measured.

Boronia, Girraween National Park.
Photo: Fiona Leverington



Protected areas conserve biodiversity from tiny lichens growing on the rocks to the tall eucalypts stretching into the distance. Photo: Robert Ashdown

Queensland's protected areas today

Queensland has built a great protected area system over the past 100 years. Protected areas are the cornerstones of an integrated strategy to conserve Queensland's biological diversity.

They help enhance ecosystem resilience to climate change and other threats and connect the Queensland community with nature. For Indigenous people, these places hold special spiritual and custodial significance. Conserving and appropriately managing these places preserves these connections and sense of belonging to the landscape.

Our heritage

Queensland's first national park was created at Mount Tamborine in 1908. The hard work of a number of visionaries, backed by strong public support, resulted in some important national parks being declared in the first half of the twentieth century. Most early national parks included spectacular scenery, but also conserved areas of very high biodiversity. The movement to select national parks on a systematic and scientific basis began as early as 1964, when the Department of Forestry Annual Report stated that 'an important objective of the national parks system must be to reserve permanently examples of all the main environments including the less scenic'.

Visitors to Lamington National Park 1938. Photo: George Gentry

The coordinated effort to establish a representative system of national parks evolved during the late 1960s and 1970s when scientists led the first projects to systematically assess and conserve Australia's biodiversity (Specht et al 1974; Fenner 1975). In 1977, to establish a systematic framework for conservation, a bioregional approach was developed. Thirteen biogeographic regions were identified in Queensland, and key areas for reservation were identified (Stanton & Morgan 1977).

By 1980, many jewels in the crown of scenic beauty and recreation had been reserved in Queensland, including spectacular mountains and rainforests high in biodiversity. In reserving these lands, significant progress towards conservation was also made, as by then an estimated 40 per cent of the state's ecosystem types were to some extent reserved in parks covering 2.5 million hectares (Sattler 1986). However, there was an increasing realisation that few protected areas existed in many bioregions, especially in the western areas.

By 1985, the parks system had been reviewed to determine which natural systems remained unrepresented in each of these bioregions (Sattler 1986). Using new computer-based programs, Queensland Parks and Wildlife Service (QPWS) undertook innovative planning projects to systematically identify conservation priorities in the Channel Country (Wilson & Young n.d.), the Mulga Lands (Purdie 1986a; b) and the southern Brigalow Belt (Young 1990). During this work, the concept of regional ecosystems was developed

Comprehensive, adequate and representative (CAR) protected area system

Comprehensive means the reserve system samples the full range of regional ecosystems across the landscape.

Adequate means the reserves are of sufficient size and appropriate shape to enable natural integrity, including species diversity, of the park to be maintained.

Representative means the samples of regional ecosystems include the maximum possible diversity of their plant and animal communities.

(Morgan 1988). These were defined across the state (Sattler & Williams 1999) and progressively mapped in each bioregion as a basis for detailed reserve planning (Queensland Herbarium 2009).

In the 1990s, recognition of skewed protected area coverage throughout Australia (the vast majority were in coastal areas) led to Commonwealth, state and territory governments committing to the establishment of a comprehensive, adequate and representative (CAR) system of protected areas. Queensland worked towards this commitment by increasing representation of regional ecosystems. Many new protected areas were declared across the state in the 1990s, including large national parks in western bioregions.

Since that time there has been a steady increase in national parks, including those in the high-biodiversity coastal bioregions, resulting from forest transfers and other programs. Detailed planning work has been used to define important forest areas for conservation in the Southeast Queensland and Wet Tropics bioregions and in the western hardwood forests. The increase in national parks since the first park was established in Queensland in 1908 is shown in Figure 1.

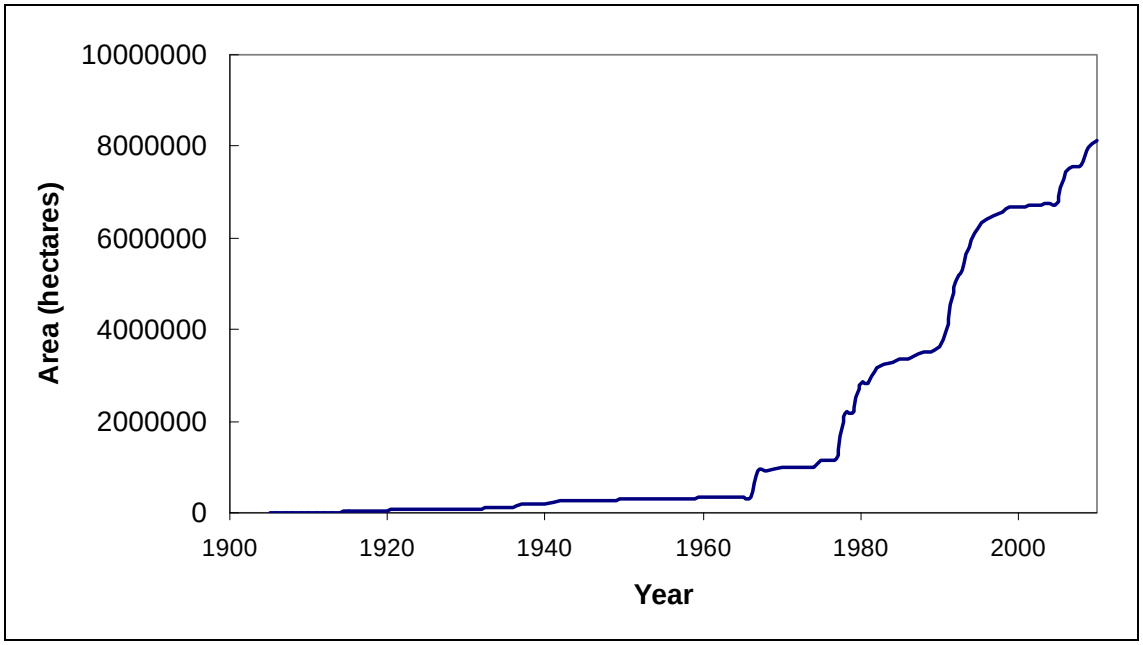


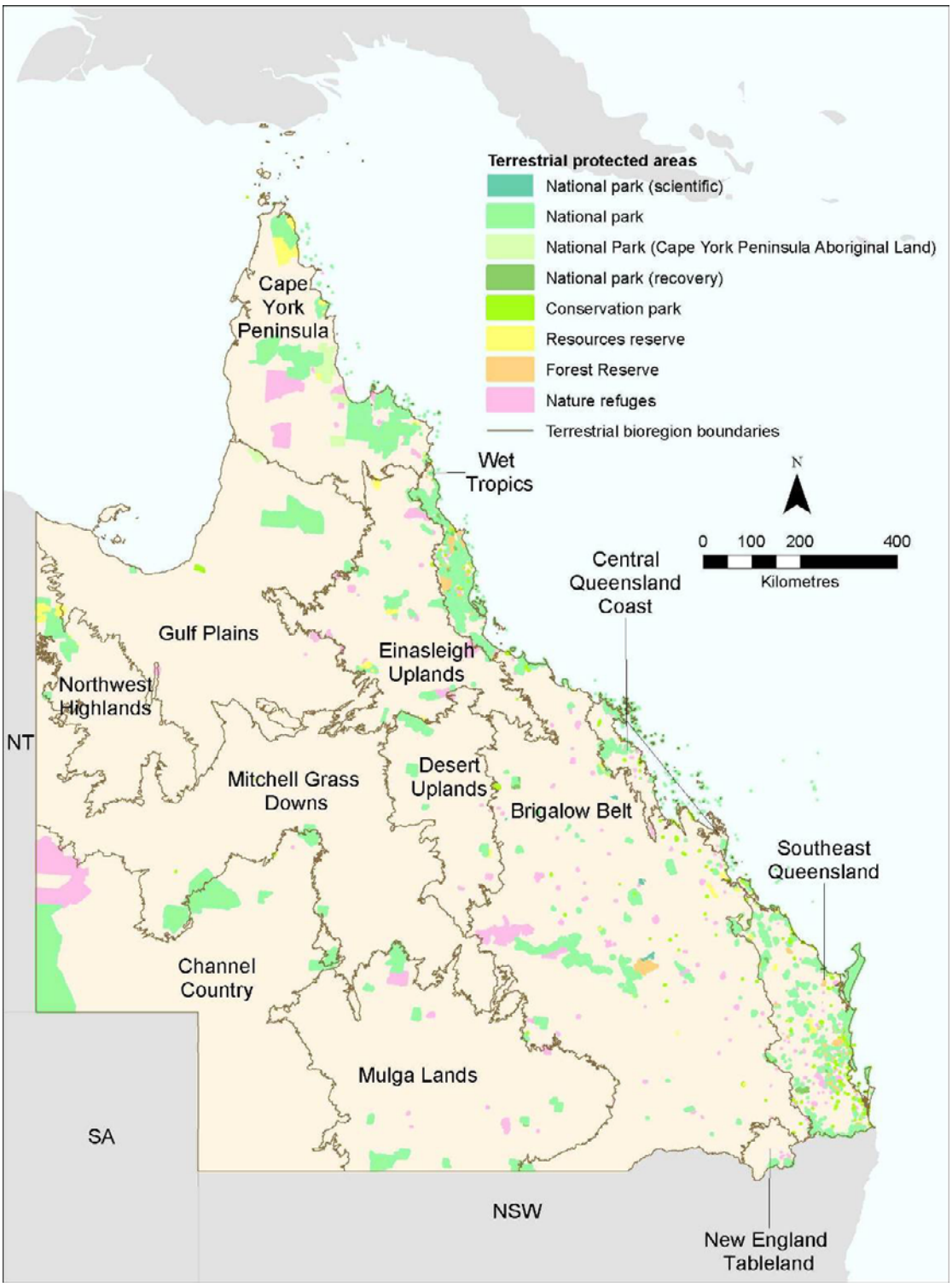
Figure 1. National park area in Queensland from 1900 to 2010.

Protected areas now

Many significant ecosystems, with their unique plants and animals, are not yet reserved in any protected area, and many other ecosystems have only very small areas in parks. Significant challenges are still ahead in establishing a protected area system that truly is a cornerstone of Queensland's draft biodiversity strategy. There are many places too, where access to protected areas for recreation and tourism can be substantially improved.

Queensland's national parks total just 4.9 per cent of the State, and all protected areas 6.3 per cent. This figure falls well short of the national average of 12 per cent in protected areas. The new targets set by the Queensland Government recognise the need to increase the area.

Further detailed analysis of gaps in our protected area system can be found in Methodology later in the document, and the different protected areas and the parts of Queensland that they cover can be seen in Map1.



Map 1. Protected areas and bioregions of Queensland.

Types of protected areas

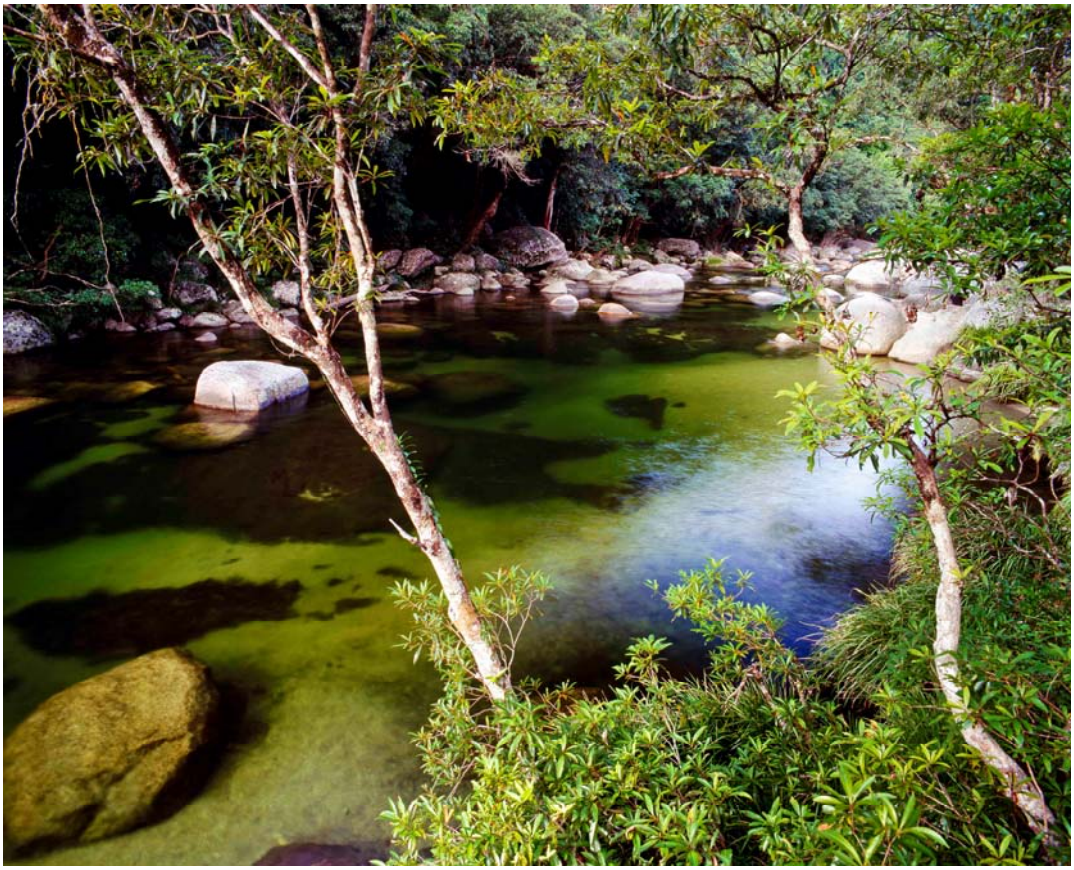
Expanding the types of protected areas available for conservation has also been an important development for Queensland.

In 1992, the Nature Conservation Act was passed, giving protected areas in Queensland up-to-date and innovative legislation with a commitment to community involvement and strong conservation-focussed management. It created new kinds of protected areas including conservation parks, nature refuges and coordinated conservation areas.

This range allows for different kinds of reserves to be declared for different functions, and is consistent with the approach encouraged throughout the world (Dudley 2008). Reserves which are more strictly protected (such as national parks) are managed in a different way from 'multiple use' parks which have both conservation objectives and other uses, such as nature refuges. The more strictly protected areas are the basis for the statistics in this document (unless otherwise specified) as they provide a very high level of long-term protection. All types of reserves have important, but different, roles to play in conservation.

Key protected area types in Queensland include the following:

- **National parks** provide a high level of protection for natural and cultural values and have many important functions. They form the core of the protected area system and will be the first choice of tenure for areas of critical biodiversity importance. National parks are managed to ensure that activities undertaken in these areas are nature-based and ecologically sustainable.
- **National parks (scientific)** are established to protect places or species with exceptional scientific value. This type of protected area gives a high level of protection for nature. Scientific study and monitoring are allowed under strict conditions, and parks can be managed as necessary to control threatening processes. Entry to national parks (scientific) is by special permit.
- **National parks (Cape York Peninsula Aboriginal land)** allow for existing and proposed national parks to become Aboriginal land and to be dedicated and managed as a national park (CYPAL). They are managed under joint agreements by Traditional Owners and Queensland Parks and Wildlife Service.
- **Conservation parks** are also managed primarily for conservation, but allow for a greater range of activities to be undertaken than on national parks. Educational activities and nature-based recreation are encouraged. Conservation parks can be managed or co-managed by trustees, such as local government.
- **National parks (recovery)** are created where an area is intended to become national park, but has been degraded and needs some manipulation of its natural resources to restore its conservation values.
- **Resources reserves** are declared over land that has high conservation value but cannot be reserved as national or conservation park, such as areas subject to fossicking, mining or intensive tourism. Trustees can be appointed to manage a resources reserve.
- **Nature refuges** can be declared over any land, state or freehold, to protect significant natural resources such as wildlife habitat, and to provide for controlled use of those natural resources, taking into account the landholder's interests. This does not change the ownership of the land. Landholders, through nature refuges, can set an example for the community in the management of land which is used for production but also protects key natural or cultural resources such as an endangered animal, a unique habitat or an historic site.
- **Coordinated conservation areas** provide an opportunity for several parties to cooperate in management of adjacent areas of varying tenure (such as national park, council reserve and private lands) to conserve natural and cultural values, and take account of educational, commercial, recreational and other values.



Mossman Gorge, Daintree National Park. Photo: DERM.

In addition, important roles are played by two kinds of reserves that are recognised by the National Reserve System but are not owned or managed by Queensland and do not have protection under the *Nature Conservation Act 1992* (unless they are also declared as nature refuges).

- **Private protected areas** are lands where the title or lease has been acquired by a group specifically dedicated to conservation and in many cases subsidised through the National Reserve System (NRS). Management is undertaken by the landholder in accordance with their responsibilities as part of the NRS. These properties can also be gazetted as nature refuges. Public access is generally not allowed except with permission.
- **Indigenous protected areas** are areas of Indigenous-owned land or sea where Traditional Owners have entered into an agreement with the Australian Government to promote biodiversity and cultural resource conservation. They are declared over Indigenous lands and are part of the National Reserve System.
- **World Heritage Areas** are listed by the United Nations Environmental and Scientific Organisation to protect outstanding examples of the world's natural and cultural heritage for future generations. They can be listed over protected areas or over other lands, including private lands. Queensland has five World Heritage Areas (two of which – the Australian Mammal Fossil Sites and the Gondwana Rainforests of Australia - are joint properties shared with other states).

The type of reserve considered most appropriate for a particular area will depend on a number of factors, including the ecological importance and irreplaceability of the area, the extent to which it could contribute to recreation and tourism opportunities, current land condition, cost and practicality of acquisition and management, current land tenure, willingness of the landholder to sell or enter into a conservation agreement, and the extent to which management for the identified values is compatible with other forms of land use, such as sustainable grazing.

The substantial progress made toward conserving biodiversity through the protected area system forms a sound basis for future action. The bold targets set by the Queensland Government for 2020 can be delivered through the combined efforts of all Queenslanders and with a focus across the range of protected area types.

International, national and state commitments

Queensland's plans for expanding the protected area system complement existing commitments.

At an international level, as well as implementing more general agreements on biodiversity, the Australian Government has given support to the Convention of Biological Diversity (CBD) Program of Work for Protected Areas (Secretariat of the Convention on Biological Diversity 2000).

At a national level, all Australian states and territories—including Queensland—have committed to building a comprehensive, adequate and representative reserve system. The National Reserve System (NRS) is a national network of public, private and Indigenous protected areas and is a cooperative initiative with support from the Australian Government and all states. The revised NRS Directions Statement 2009 (National Reserve System Taskforce 2009) has been adopted by the Australian Government and all state and territory governments. Its goal is 'to develop and effectively manage a comprehensive, adequate and representative national system of protected areas, as the primary means for securing long-term protection for Australia's terrestrial biodiversity. In so doing, the National Reserve System seeks to secure rapid and significant improvements in the reserve system by incorporating examples of the full range of regional ecosystems and other important environmental values across the continent'.

The following targets were agreed upon in the directions statement:

- Comprehensiveness: at least 80 per cent of the number of extant regional ecosystems in each Interim Biogeographic Regionalisation of Australia (IBRA) bioregion is to be represented in the National Reserve System (NRS) by 2015.
- Representativeness: at least 80 per cent of the number of extant regional ecosystems in each IBRA subregion is to be represented in the National Reserve System by 2025.
- Protecting threatened species and ecosystems: Include critical habitats and core areas important for the long-term survival of rare, migratory, threatened or other priority species and ecological communities, including those listed under Australian Government, state or territory legislation in each IBRA bioregion .
- Protecting critical sites for climate change and resilience: Include critical areas to ensure the viability, resilience and integrity of ecosystem function in response to a changing climate, such as large and small refuges, critical habitats, broad landscape-scale corridors, places of species and ecosystem richness, sites of endemism and sites that support threatened species and/or ecological communities, and places important for the stages in the lifecycle of migratory or nomadic species, to act as core lands of a broader whole-of-landscape approach to biodiversity conservation.

Daisies in the Channel Country bioregion. Photo: Fiona Leverington

Growth in nature refuges

Over 350 nature refuges have been gazetted since 1994, establishing a new approach for Queensland where landholders maintain their land management responsibilities and also sign a voluntary conservation agreement with the state government to conserve the property's ecological values.

Over recent years, the main focus of the nature refuge program has shifted from peri-urban to rural landholders. Incentives systems have been introduced, and joint, targeted promotion of nature refuges by the Department of Environment and Resource Management (DERM) and AgForce has significantly increased awareness of nature refuges among rural landholders. This is demonstrated by the significant increase of new nature refuges in more recent years, with 254 new nature refuges between 2004 to mid 2010 alone. The area of nature refuges now totals more than two million hectares (see Figure 2).

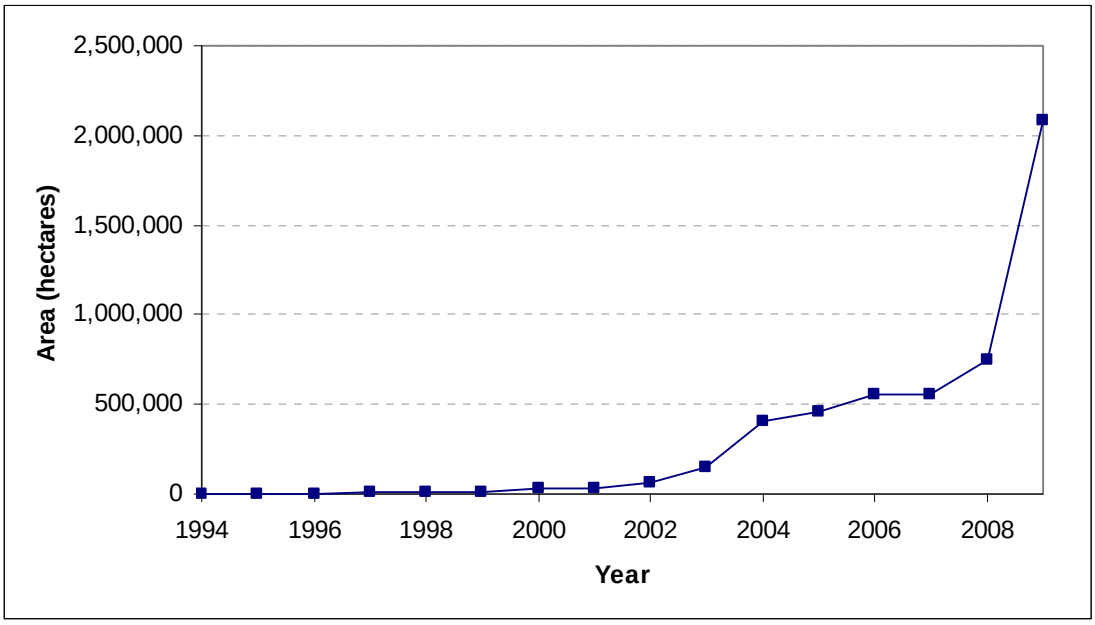


Figure 2. Growth in nature refuge area, 1994 to 2010.

Southern boobook owl in nature refuge, New England Tableland. Photo: Chris Mitchell.

Queensland's protected areas for the future

In March 2008, on the one-hundredth anniversary of national parks in Queensland, the Premier and Minister announced a new commitment to increase the area of national parks by the year 2020 to 13 million hectares, which is 7.5 per cent of the state. The Queensland Government has also announced a target for expanding the protected area estate to 20 million hectares, up from the current figure of 10.3 million hectares.

It is important for Queensland to build on its already impressive protected area system to improve protection of a wider range of biodiversity as well as to provide exciting new opportunities for tourism and recreation. The government has set an ambitious target to acquire more protected areas, and to encourage and assist other landholders to commit areas of high biodiversity to protection.

Building Nature's Resilience: A Draft Biodiversity Strategy for Queensland takes a whole-of-landscape approach to conserving biodiversity throughout the state. The Protected Areas for the Future approach and methodology is central to the strategy.

In this whole-of-landscape model, a well-designed and managed protected area system which provides cornerstones to conservation is central to managing and connecting the landscape. Cornerstones are complemented by sustainable management practices across broad areas of land and sea. This approach recognises the interdependence of the many habitats and ecosystems, while also maximising the conservation of species and habitats at a finer scale.

The identification of new protected areas and the building of a resilient system is being undertaken in an interesting and challenging context. Factors that have changed over the past twenty years include the following:

- Principles of a comprehensive, representative and adequate reserve system, which provide multiple benefits to the community, remain vital and relevant. However, as climate change becomes an accepted reality, protected area selection will focus on future resilience and increase the emphasis on adequacy and connectivity in protected areas. In addition to direct climate change impacts such as temperature increase, climate change is likely to further compound existing threats common to many of the Queensland's ecosystems, such as habitat fragmentation, changed fire regimes and invasive plants and animals. National parks, conservation parks and other protected areas build ecosystem resilience to climate change and other threats.
- A range of protected area types and the development of new strategies and tools for biodiversity conservation means that creative thinking can be adopted to achieve solutions— for example to work towards greater connectivity areas of ‘regrowth’ or cleared land for revegetation can be considered to link a national park and nature refuge. Many partners—from the Commonwealth Government to local landholders—will work with the Department of Environment and Resource Management (DERM) to create an even better protected area system.
- Scientific work on reserve selection has advanced in recent years. Reserve selection tools, including computer programs, can assist to identify the most efficient and comprehensive reserve system. Regional ecosystem mapping is now available for much of the state, giving a high level of confidence in decisions about comprehensive coverage. In addition, Biodiversity Planning Assessments have already been completed for half the bioregions, providing information tools that are critical for planning and representing some of the best information sets in the country.
- There is a high degree of community and scientific scrutiny of the principles, justification and methods used to develop Queensland's protected area system.
- Awareness is high too of the challenges to adequately managing protected areas, especially in remote areas. Partnerships in conservation will be essential, such as with Traditional Owners and landholders through the nature refuge program. Costs of creating and managing the protected area system need to be considered, recognising the balance between costs of protected areas for the community and the economic wellbeing that national parks themselves bring through direct economic benefits.
- The Delbessie program for the management of rural leasehold lands offers an opportunity to negotiate with landholders about conditions on leases, to purchase leases as they expire and to identify future conservation areas (Department of Environment and Resource Management 2010). It also provides incentives to leaseholders to voluntarily offer nature refuges. There are also opportunities to acquire Unallocated State Lands (USL). In addition, non-plantation state forests are being progressively converted to conservation tenures with high priority areas including the Wet Tropics ecotone forests and the Western Hardwoods.

In response to this new context, Protected Areas for the Future will:

- develop a documented process, overseen by leading scientists, to identify key biodiversity areas for an expanded reserve system. Over time, the process will be improved to consider freshwater and marine as well as terrestrial protected areas and to integrate planning for these three 'realms'.
- continue to base the selection process on the widely accepted CAR approach, but also define other principles to complement and expand on this foundation to more strategically focus conservation efforts.
- use the best possible information. Advances in data capture, analysis and storage now allow for the development of a dynamic knowledge database. As new information comes to light it can be added to the existing data and allow adaptive decision-making for identification and selection of the new potential protected areas.
- use protected area system design tools, including computer programs, to identify the most efficient and comprehensive protected area system possible, given certain targets and criteria. These tools will be used in combination with expert opinion and field inspections.

Through this informed and objective process, hundreds of areas of high conservation significance across the state can be identified, prioritised and considered as possible protected areas, subject to practicality and negotiations with landholders.

Queensland's protected area system will contribute to a whole-of-landscape approach in different ways:

Core protected areas will contribute to a more complete and resilient protected area system. These protected areas form core refuges for conservation of plants and animals, a safety net for climate change, and a vital resource for recreation and tourism. Each core area may consist of several kinds of protected area, including national parks, conservation parks, nature refuges, Indigenous protected areas and private protected areas.

Connectivity will be achieved with reserves of all types playing key roles in maintaining connectivity across the landscape. In addition, some protected area types, including nature refuges and national park (recovery) can be important in programs to restore and improve connectivity across fragmented landscapes. New protected areas will also develop links and touring routes for nature-based tourism, bringing economic resilience to rural and remote communities.. This will include capitalising on new and emerging opportunities for 'green markets' to facilitate rehabilitation especially along key corridors and adjacent to natural areas.

Broader landscape areas of freehold or leasehold land can use mechanisms such as nature refuges and Indigenous protected areas for protecting biodiversity and showcasing conservation-friendly management.

Lumholtz's tree-kangaroos rely on protected areas and the links between them for their survival in the high altitude areas of the Wet Tropics. Photo: DERM.

The bioregional approach

Systematic planning for Queensland's protected area system over the past 30 years has been based on the bioregional framework, which was initially devised by Stanton and Morgan (1977), described in Sattler and Williams (1999) and used as the basis of the Interim Biogeographic Regionalisation of Australia (IBRA) and the National Reserve System (Natural Resource Management Ministerial Council 2004). The bioregional framework has been used to develop the concept, used throughout Australia, of the comprehensive, adequate and representative (CAR) protected area system.

Queensland's protected area planning has focused on the idea of protecting as many kinds of plants, animals and landscapes as possible throughout the state—from the coast to the desert, and from the tropics to the cool southern highlands. There is a need to conserve not only the rainforest giants, bright wildflowers, attractive animals and scenic landscapes; but also the more subtle and less impressive places, the rarely seen and less attractive wildlife, and the prickly plants with dull flowers. As it is not possible to list and protect every species in every place, the best way to systematically conserve biodiversity is to group and classify the natural variation across the state, and then to protect samples of these groupings.

In Queensland, three layers of classification are used (Sattler & Williams 1999), which represent different scales of biodiversity:

- bioregions
- subregions
- regional ecosystems.

Classification of Queensland's biodiversity

The **bioregions** represent the primary level of biodiversity classification in Queensland at a scale of 1:1 million–1:2.5 million (see Map 1).These regions are based on broad landscape patterns reflecting major structural geologies and climate zones as well as distinct groups of plants and animals.

Each bioregion contains a number of finer scaled **subregions** (mapped at 1:500 000) These subregions (Morgan & Terrey 1990) delineate significant differences in the finer grain of landscape patterning associated with geology, geomorphology and subtle climatic differences. Subregions have a characteristic pattern of landform and vegetation, which outline major differences in land-forming processes such as water flows, energy availability (for example through soil fertility), and species distributions and patterns of movements.

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. In regional ecosystems three major attributes are combined:

- landscape pattern as described by bioregions and at a finer scale by subregions
- geology, landform and soils (as described by land zones—for details see the DERM website)
- vegetation.

Using bioregions, subregions and regional ecosystems is a more robust approach to planning the conservation of biodiversity than using only one thematic layer, such as vegetation. For example, in south-east Queensland tall open forest dominated by blackbutt (*Eucalyptus pilularis*) grows on a range of different soils in higher rainfall areas. Different regional ecosystems based on this vegetation type occur on high dunes on Fraser Island, on remnant tertiary surfaces on Blackbutt Range, on coarse sedimentary rocks at Helidon Hills, and on volcanic rocks at Mount Mee. A protected area system that samples all of these kinds of forest is much more complete and more resilient to threats than one that samples only one kind of tall blackbutt forest in one location.

From Sattler and Williams (1999)

Scientific underpinnings of protected area selection

A resilient protected area system should be able to cope with threats and to maintain values in spite of climate change. It is more efficient to consider climate change implications now, when the protected area system is being designed, than to consider them later (Hannah et al 2007). Drawing on current literature, including reports on effects of climate change on the National Reserve System (Dunlop & Brown 2008) and Australian biodiversity (Steffen et al 2009), the following broad points have been considered in developing the principles for protected area design.

Change is a reality. The loss of some species and changes in composition and functioning of ecological communities is highly likely. The challenge is to anticipate change and to adapt to it, or to manage it (where appropriate and possible) to minimise biodiversity loss.

The bioregional model used as the foundation of our reserve selection process (discussed above) provides a solid framework for conservation in times of climate change. This model, which involves completion of a comprehensive and representative reserve system, assumes even greater importance in the face of climate change and other threats such as the delayed effects of fragmentation, and increased invasive species (Dunlop & Brown 2008). A protected area system based on the bioregional approach is believed to give much greater resilience to climate change than protected area systems that primarily aim to conserve species or particular habitats (Dunlop & Brown 2008).

This is because, with changing conditions, species and even ecosystem composition are likely to change. Consequently conservation efforts could fail if species and habitats are the sole focus of the state's protected area system. In contrast, bioregions, subregions, and regional ecosystems are based on geological and landscape features as well as plant communities, so even if species and ecosystem composition change, diversity will still be protected to the greatest possible extent. That is, if national parks are created on western claypans and coastal dunes, on the rocky mountain-slopes of the Wet Tropics and the sweeping plains of the Gulf, the full range of biodiversity will be conserved in whatever form it takes it the future.

'… the challenge for a reserve system under climate change is to protect with fixed areas as many species as possible as they change in abundance and distribution. By sampling a diversity of communities (at two scales), the comprehensiveness and representativeness processes of the NRS are also sampling the underlying geographic diversity of the landscape (including soils, geology, topography, microclimate) that largely gives rise to the diversity of ecosystem types within regions. Thus, a set of areas that samples a high diversity of communities now will probably also capture a high diversity of communities under future climates, even if the composition of the communities is different in the future' (Dunlop & Brown 2008).

By including a range of landforms and plant communities, diversity will be conserved even if the climate changes. Daintree National Park, Wet Tropics Bioregion. Photo: DERM.

However, the needs of individual species or groups of species should also be considered, especially where clusters of rare or endemic species rely on specialised habitats, such as mound springs, ephemeral wetlands or serpentenite outcrops, which may be too small in area to be shown in regional ecosystem mapping. These special species and habitats may be overlooked if only an ecosystem-level approach is used.

Increasing connectivity across the landscape is critical. Connectivity is an essential requirement for the long-term viability of ecosystems and their associated species (Soulé et al 2004). To support a protected area system and to maintain ecosystem health in the rest of the landscape, it is important not only to protect remaining landscape connectivity but also to improve it in the more fragmented areas. More detail on connectivity as a whole-of-landscape strategy is provided in the companion document to the biodiversity strategy, Connectivity Conservation in Queensland.

The protection—or in some cases restoration—of vegetation across climatic gradients is recognised as important. It is easier to conserve very short, steep gradients in climatic variability than long, gentle gradients (Pressey et al 2007). This is because short steep gradients can be traversed in a shorter distance. In the Queensland context, gradients in need of protection include:

- Altitudinal gradients in hilly and mountainous areas such as the coastal ranges and the Central Highlands. In some cases quite steep gradients enable protection from lowlands to highlands in relatively small areas. Many of Queensland's protected areas are found on ridges and plateaux, where the addition of foothills and alluvial plains would assist in management as well as in climate change adaptation.
- Latitudinal gradients, where increased connectivity and protected 'stepping stones' may ensure that existing migratory pathways of many bird species are protected. They may also allow long-term distribution shifts by corridor-dependent species.
- Catchment connectivity, where waterways in relatively natural or restored condition are used as natural routes for migration and dispersal across shorter coastal (mountain to sea) gradients, long gentle slopes of rivers through the semi-arid lands, and short flows with extensive wetlands to the Gulf Plains bioregion.
- East-west connectivity from moister to drier climates, allowing seasonal movement of fauna as well as longer-term species adaptation.

Many protected areas in Southeast Queensland bioregion are restricted to higher country and adjoin partly-cleared foothills and sloped, making fire management very difficult. Photo: Robert Ashdown.

Larger size of natural patches is vital. While efficient reserve selection identifies the smallest areas necessary for adequacy and representativeness, it is also well recognised that larger reserves are important for conservation (Lamberson et al 1994; Keddy et al 2009). In the face of climate change and other threats, larger reserves offer better survival opportunities; for example, where rainfall is patchy in both time and space or where there is risk of cyclone or flood affecting part of a protected area.

Although large protected areas are regarded as generally better for conservation, small areas in high biodiversity regions can also play important roles. Some small protected areas can be critical as roosting, feeding and nesting sites: for example small coral cays along the Great Barrier Reef are of vital importance for nesting seabirds and turtles.

Reserve shape is also an important consideration for building a reserve system that is resilient to the effects of climate change. Vegetation edges can be particularly susceptible to weed or pest-animal invasion, cyclone or wind damage and general vegetation degradation (Fischer & Lindenmayer 2007; Laurance & Curran 2008). A protected area with more core area and fewer edge effects is therefore likely to have greater resilience, and will also be cheaper and easier to manage. Protected areas should ideally consist of relatively large areas, with high area to boundary ratios, little internal fragmentation (such as through roads and powerlines), and maximum integrity of catchments.

However, the reality of many protected areas is far from ideal. Acquisitions that make existing protected areas easier to manage and more viable for conservation, for example, adding the catchment to a wetland protected area, or creating a larger continuous area of reserve, will be valuable additions to the system.

In Queensland, there are many opportunities to increase the size and improve the shape of protected areas by adding additional land parcels, including state forests, by linking existing protected areas, and by developing conservation agreements with adjoining landholders. There is potential across the state to establish some substantial, core protected area patches that may consist of different protected area types such a national parks, nature refuges, private protected areas and Indigenous protected areas.

Processes as well as places need protection. Protected areas are spatially defined, but must also protect less easily defined ecological processes such as evolution and adaptation, catchment protection and soil-forming processes, damage and recovery from extreme events (floods, fires, cyclones and drought) and species interactions and movements. These processes take place over different scales of time and space, and where climatic variables are extreme these scales are very large. Climate change has made these processes less predictable than in the past.

'Adequacy' of the reserve system at the broad scale will help ensure each habitat type is well enough conserved to allow for continued survival of its plants and animals. The area needed will vary according to the type of habitat, and may need to be larger where climatic extremes are experienced. For example, areas of semi-arid grassland need to be large enough to support viable breeding populations of seed-eating birds, large macropods and small mammals, and should allow for seasonal movement so animals can survive in dry times. A combination of similar regional ecosystems across land zones in a bioregion might be considered as one unit from the viewpoint of adequacy. The conservation of broad vegetation groups is being considered as a proxy for this broadscale adequacy.

Duplication is useful insurance policy. Duplication of habitats or biodiversity elements in the protected area system, like large patch size, offers opportunity for survival if a catastrophic climatic or disease event affects a core area. With other actions, this will increase the resilience of the protected area system as a whole. Apart from considerations of climate change, duplication needs to be incorporated into design 'to guard against the regional or range-wide extinction of biological features as a result of natural or human-induced changes' (Svancara et al 2005b). Where regional ecosystems occur across several subregions, the principle of representativeness aims to conserve examples across their geographic spread.

In some cases retaining more isolated patches will be advantageous. Although connectivity may be desirable in many cases, it can also increase access for new competitors—herbivores and predators—of both exotic and native species. It is likely that the first species to adapt and migrate could be 'generalists', possibly to the detriment of 'specialists', which might otherwise survive. In addition, connectivity could allow rapid spread of fires and diseases.

In some cases where we wish to give existing species the best possible chance of survival, more isolated areas may be better (Dunlop & Brown 2008). In particular, where it is possible to have a habitat type in more than one protected area, consideration may be given to conserving a duplicate in an isolated protected area.

Conserving climate change refuges will become increasingly important.

Different types of refugia were identified by Moreton et al (1995): *Evolutionary refuges* are areas with concentrations of endemic species where the surrounding environment has become unfavourable through past climate change events (for example, small pockets of species remaining in high altitude forests, isolated mound-spring ecosystems, and rocky outcrops with many endemic species). It is unlikely that many species in evolutionary refugia will shift in range as the climate changes, as the surrounding lands are often inhospitable habitat. The future of some species in evolutionary refugia, such as endemic mammals found only in the cool uplands of the Wet Tropics, may be very difficult to ensure, but their best chance is in protected areas managed to minimise threats such as invasive species and grazing (Winter 2004).

Ecological refuges include drought refuges and other remaining areas of favourable habitat, which in the future could become increasingly isolated and under pressure. These may be short-term or long-term refuges. The bioregional framework has already led to many refuges being included in the protected area system, because they are distinct ecosystems (Dunlop & Brown 2008). At a small scale, refuges from higher temperatures include boulder fields and deep, shaded gorges.

It is suggested that more productive areas for agriculture or other purposes, which are less well represented in the protected area system, may support greater diversity and be more resilient and could be important as future evolutionary source areas (Dunlop & Brown 2008). This will especially be the case where the climate becomes drier and hotter, so areas that include drought and fire refuges will become more important.

Permanent wetlands act as an important refuge for many species in the semi-arid zone, especially during dry seasons. Photo: Chris Mitchell.

Incorporation of wetland areas into the protected area system should be given a higher priority. Nature refuge agreements with actions such as fencing are appropriate in some cases; in others very specific and active management may be required to conserve or restore them. Where there are severe pest-plant infestations, short-term intensive grazing could sometimes be a solution—for a short time the grazing regime may therefore be the opposite of that required for sustainable pastoralism (McCabe pers. comm.).

Since European settlement, *European refugia* have become particularly important for biodiversity in the parts of the landscape that have been transformed by human use. Such refugia include remnant vegetation in cleared landscapes, and areas that have never been grazed. These areas may provide the only remaining habitat for some species, especially rare and specialist species.

In addition, trigger points are important areas where source populations of a species may be concentrated—species and assemblages that could radiate from a localised point in response to changing climate (Young 2007). These may, for example, be patches of sclerophyll vegetation in a rainforest area. These areas will be important if surrounding ecosystems change significantly, as they will provide a source for a new suite of species.

> ‘Many expansions are likely from the boundaries of already well established populations. At a continental scale Soulé et al. (2004) argue that the extensive savannahs and other ecosystems of northern Australia may be important sources of radiating species. Where changes are dominated by landscape drying and increased climatic variation, species from arid regions may become more dominant.’ (Dunlop & Brown 2008).

Areas of high conservation priority other than refugia include centres of endemism, important breeding sites and places with particularly high biodiversity. Many of these areas have already been identified in Queensland by spatial analysis and expert panels through biodiversity planning assessments.

Conservation planning needs to anticipate new threats and new combinations of threats (Pressey et al 2007). New threats include projected sea level rises and increased demands on productive areas. In the Queensland context, implications include concerns about drying or salination of freshwater wetlands (such as those in coastal areas), increased pressure on the more productive seasonal areas of northern Queensland, and the reduction or disappearance of suitable habitat and climatic conditions for species restricted to high altitudes. Existing threats such as inappropriate fire regimes and invasive species will be exacerbated by climate change and may combine to become more serious . Climate change may alter the threats themselves (for example by the introduction of new pests or pathogens) or may alter the sensitivity of species or communities to threats (Dunlop & Brown 2008).

Some habitat and species loss may be inevitable, but the principles outlined above—including completion of the CAR system, duplication and redundancy of habitats (including some connected and some isolated areas), and reservation of refugia—will minimise threats.

When developing plans for the enhanced protected-area system, socioeconomic resilience of the local and regional communities, **including Indigenous communities, should be considered**. Some creative thinking will be required to find ways to maximise the benefits of new protected areas for these communities.

Maximising links and connectivity across the landscape will help retain or restore ecological connectivity and will also develop greater opportunities, especially for tourists and local people looking for outdoor recreational opportunities.

Parks with appropriate facilities can be added at strategic locations to improve the opportunities for people to experience nature, and to bring economic growth to rural and regional communities. For example, for travellers to the remote areas of western and northern Queensland there are wide gaps between the opportunities to visit and camp in national parks. Even on routes such as the Savannah Way, which links Cairns with Broome, there are no parks in Queensland for hundreds of kilometres. Tourist experiences and opportunities could be greatly improved, and local economies strengthened, with the strategic addition of parks across this area.

Climatic refuge, Isla Gorge, Brigalow Belt bioregion. Photo: Robert Ashdown.

Our ten principles

Building on the scientific underpinnings discussed above, the bioregional planning system, national and international commitments and scientific guidelines, a set of 10 principles for future protected area selection have been developed specifically for Queensland.

These principles are the core of Queensland's new approach to building a protected area system that will be resilient to climate change. They will direct efforts toward achieving area targets set by the Queensland Government, and support and expand on the principles of the National Reserve System Strategy (National Reserve System Taskforce 2009) and the Queensland Parks Master Plan.

Our principles fall under three categories: conserving natural landscapes, ecosystems and species; providing social, health, educational and economic benefits to the community; and practicality and urgency of acquisition and management. These principles are summarised below.

Conserving natural landscapes, ecosystems and species

First priority is to develop a comprehensive, adequate and representative (CAR) protected area system, with the primary focus of including as much biological diversity as possible (using regional ecosystems as a surrogate and indicator) in each bioregion and subregion.

Targets for comprehensiveness have been set for each bioregion, and every effort will be made to eventually secure examples of all regional ecosystems. In addition, targets for the area of each regional ecosystem have been set (discussed later in the document).

The National Reserve System target for subregional representativeness (80 per cent of all regional ecosystems conserved in every subregion in which they occur) is challenging as there is little remnant vegetation in a number of subregions in Queensland. For this reason it will be difficult to achieve the 80 per cent target across all areas, so a graded approach will be taken, with different targets for different subregions.

In general, preference will be given to lands in good condition with minimal clearing, pests and other disturbance; however, in some cases lands might be acquired with the intention of restoration, especially of critical links or habitats.

The design of the protected area system will focus on building resilience to climate change by recognising new threats to the system, increasing connectivity at both local and broad scales, and identifying and protecting evolutionary and climate change refugia and trigger points.

Connectivity across the landscape will be increased by protecting or restoring vegetation links between existing national parks and other protected areas— such as nature refuges—and by creating new protected areas with links to each other and to the current protected area system. Vegetation connectivity will be retained or increased along waterways and across gradients of altitude, latitude and climatic zones.

Several types of refugia will be targeted for protection in the new system:

- evolutionary refugia, where many endemic species continue to survive as the surrounding landscape changes
- ecological refugia—that is, places that animals and plants retreat to when, in the short-term, conditions change. This includes, for example, the wettest places in drier landscapes
- European-induced refugia — remaining areas of favourable habitat that still exist in cleared or ungrazed parts of landscapes.

In addition, we will target identified trigger points, where source populations of well-adapted species for changing conditions may be concentrated.

Improved adequacy at system and protected area level will aim to protect ecological processes and improve land and water management.

Broadscale adequacy of the protected area system will ensure large enough areas of a range of habitats are conserved, to allow for ecological viability and resilience and for the survival of plant and animal species.

Adequacy at protected area level will be improved by increasing connectivity with other natural areas, reducing fragmentation, and improving design by including in-holdings and creating ecologically appropriate boundaries.

Conservation of priority ecosystems and species will be increased through the above actions and through selection of additional areas specifically for species conservation, primarily where clusters of priority species occur.

The protection of rare and threatened species and ecosystems in protected areas will be increased. The focus will be on areas known to contain concentrations of rare and threatened species, centres of endemism, and key habitats for priority species.

The protected area system will, as far as practical, include representation of the variety of geological features, freshwater ecosystems and wetlands.

In addition to ecosystems and species, the protected area system will include samples of landscapes including geological features (such as cliffs, sand-dunes, caves, peaks, rock formations and fossils) and of freshwater and wetland systems (such as rivers, lakes, freshwater and saline wetlands, ephemeral swamps and springs).

Providing social, health, educational and economic benefits to the community

Protected area selection will consider socioeconomic impacts and benefits. New tourism opportunities will be identified and protected areas will be selected to enhance recreational opportunities for local residents and interstate and international visitors.

New opportunities will be identified in or near new protected areas. These opportunities will help meet the need for additional places for outdoor recreation in coastal areas, and the need for new tourism opportunities and routes in rural and regional Queensland. Areas of ecological importance that have outstanding tourism and recreational potential will be high priorities for the protected area system.

Cultural and scenic values, in particular natural sites of high cultural value to the community, will be a consideration in allocation of priorities.

Where natural sites are known to contain places of significance to the community—such as rock art sites, places associated with Indigenous stories, or places of historical significance—this will be taken into consideration in designing and managing the protected area system. The importance of connectivity across the landscape and seascape, which includes connectivity between people and the natural or cultural values of the land, will be considered.

Practicality and urgency of acquisition and management

Costs of acquisition and availability will be considered in preliminary protected area selection and then in more detail when priority sites have been identified. Practicality and future costs of management will also be taken into account.

Where there are a number of options to achieve a protected area goal, preference will be given to areas where management is more practical and efficient to implement. For example, proximity to existing QPWS offices, roads and other services will be given consideration.

Protected area selection will take into account the location, biodiversity and management of other protected areas, particularly private protected areas and Indigenous protected areas included in the National Reserve System. Cooperation with managers of these protected areas will be maximised.

Cooperation will be necessary during the acquisition phase to ensure the conservation interests of different groups do not compete with each other. DERM will work strategically with Indigenous communities and other organisations, such as Bush Heritage Australia and the Australian Wildlife Conservancy, so the state protected area system complements and connects with other protected areas as much as possible.

The level of threat to defined biodiversity areas will be considered in the prioritisation of acquisition and other biodiversity actions, once the optimal protected area design has been developed.

Prioritisation of acquisition will recognise the need to protect areas before options for protection are lost if there are potentially threatening processes in the area, for example, if a more intensive land use is likely to occur in the near future.

Methodology and tools for designing the protected area system

Designing a sustainable reserve system to conserve biodiversity and meet community needs across the whole of Queensland is a complex task. The 10 principles are the central feature of the new approach, and a new methodology has been developed and documented to guide selection of potential additions to the protected area system. While efforts in the past used innovative tools and methods, the new approach is:

- more objective and consistent, based on scientific guidelines and latest information
- able to address multiple objectives and current threats and opportunities
- transparent and documented
- applied across the state
- based on a whole-of-landscape approach considering a range of protected area options.

This methodology will help us select an effective protected area system now; and will remain an important tool into the future. We can use the methodology to feed in new information as we learn more about the environment, as well as to adapt our protected area system design to changing goals, targets and threats.

A protected area system is best designed with an integrated approach to the terrestrial, freshwater and marine realms (Beger et al 2010) . The methodology outlined here is being adapted to better incorporate the conservation of freshwater priorities. Marine protected area planning will also be integrated into the process in the near future .

New opportunities for tourism and recreation will be identified across the state. Photo: DERM.

As shown in Figure 3, the protected area selection methodology encompasses six main parts: these are undertaken in a cycle with continual refinement. The process is based on the foundations already discussed in this document: the scientific guidelines, the bioregional planning approach, national and international commitments and the whole-of-landscape approach. Some further detail on different parts of this process is provided in the sections to follow.

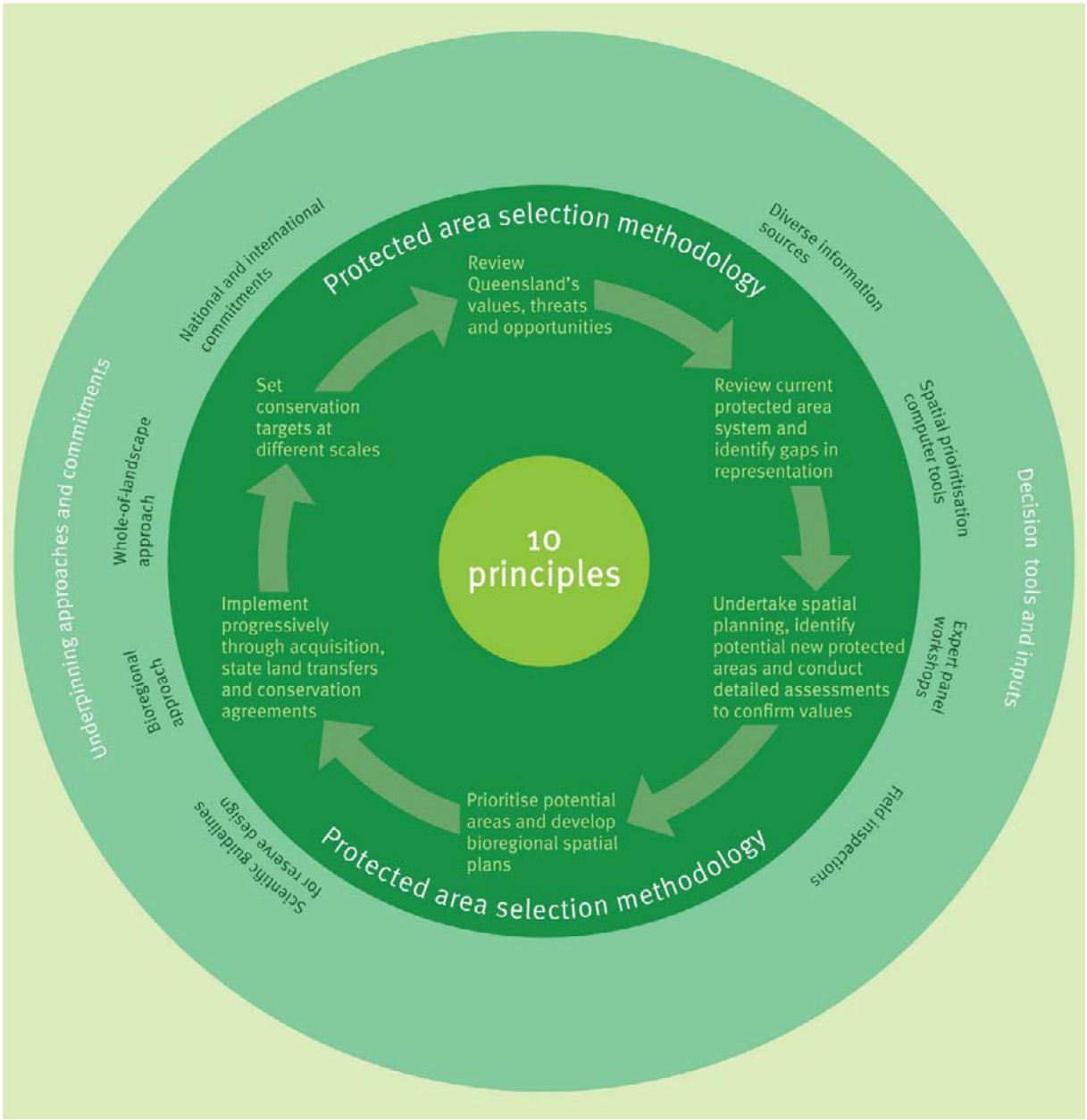


Figure 3. Queensland's protected area selection methodology and the related tools, inputs and approaches.

Analysing information about ecological and other values, and identifying gaps

Though there are gaps in knowledge about plant and animal species (especially in the less populated parts of the state) many sources of information have been drawn on to build an understanding of gaps in the protected area system, values of potential additions, and threats. We already have access to a range of good spatial data sources that can help to identify these gaps, and feed into the protected area system planning process. Some of these information sources are described in the text box below.

At all scales from Statewide to local, gaps and the progress towards the ideal protected area system can be measured in a number of ways:

- the proportion of the area that is protected in national parks and other protected areas
- the proportion of various ecological features which are protected. The most important surrogate for biodiversity is regional ecosystem protection, but other features such as threatened species and wetland conservation will also be considered
- the availability of tourism and recreation opportunities.

At a statewide level, 4.9 per cent of area and about 80 per cent of regional ecosystems are currently in protected areas. This is a great achievement, but is below the desirable goal to conserve all regional ecosystems. In addition, for most of these regional ecosystems the area conserved is well below an adequate level for long-term conservation. Information at the bioregional and subregional scale can help in developing a better understanding of exactly where the gaps exist.

Key information sources include:

- descriptions of bioregions, subregions and regional ecosystems (Sattler & Williams 1999; Queensland Herbarium 2009)
- mapping of regional ecosystems (Queensland Herbarium)
- biodiversity planning assessments for those bioregions where they have been conducted (Southeast Queensland, Brigalow Belt, Desert Uplands, Central Queensland Coast, Mulga Lands, Mitchell Grass Downs, Einasleigh Uplands)
- detailed mapping and descriptions of wetlands (DERM)
- information about rare and threatened species and priority species distribution
- Wildnet data of species records
- specific studies of reserve priorities and conservation potential at bioregional or subregional level including the Channel Country (Wilson & Young n.d.), Desert Uplands (Morgan et al 2002), Mulga Lands (Purdie 1986b; Wilson & Egan 1996), and Brigalow Belt (Young 1990)
- plans and strategies prepared by DERM, natural resource management groups and other agencies
- spatial data showing landforms, elevation, infrastructure and biological features
- other expert and local opinion.

In addition, information on other values is sought wherever possible and includes:

- perspectives of traditional owners
- information about economic and tourism values of parks, and regional tourism strategies
- cultural heritage databases and oral information.

As the state's knowledge base expands in the future, these new knowledge sources can be added to the information inputs in Queensland's protected area design methodology.

Protection of bioregions and subregions

Some bioregions are better conserved through protected areas than others (see Map 2 and Map 3).

Protected area coverage in the bioregions along the east coast (Southeast Queensland, Wet Tropics, Cape York Peninsula and the Central Queensland Coast) is relatively good. The best conserved bioregion is the Wet Tropics, where more than 40 per cent of land and some 96 per cent of regional ecosystems are protected. This level of protection reflects the very high importance of this area for biodiversity. However, there is still important work to be done along the coast to complete the CAR system. A number of subregions within these bioregions are poorly conserved through protected areas. For example, less than 5 per cent of the area of Moreton Basin and South Burnett subregions of Southeast Queensland is in protected areas. Some of the protected areas have poor boundary-to-area ratios, in-holdings, and partially protected catchments for which improvement is required. Some rare and threatened species require further areas and better linkages to ensure their survival.

Climate change will severely affect low-lying coastal areas, and parks will provide vital protection for catchments and areas under greater threat. As many parts of these coastal bioregions are under pressure from development and increasing populations, protected areas play a very important role both for biodiversity conservation and for providing places for recreation and tourism.

In the centre and west of the state, protected area coverage remains poor. Queensland bioregions with lowest representation of regional ecosystems in protected areas include Mitchell Grass Downs, Einasleigh Uplands, Gulf Plains and North West Highlands, while those with the lowest proportion of area include those bioregions as well as the Mulga Lands, Brigalow Belt, Desert Uplands and New England Tableland. Only 1.4 per cent of the Mitchell Grass Downs bioregion is in any form of protected area, and only half of its regional ecosystems are protected. These bioregions are national as well as state priorities for the identification and declaration of new protected areas.

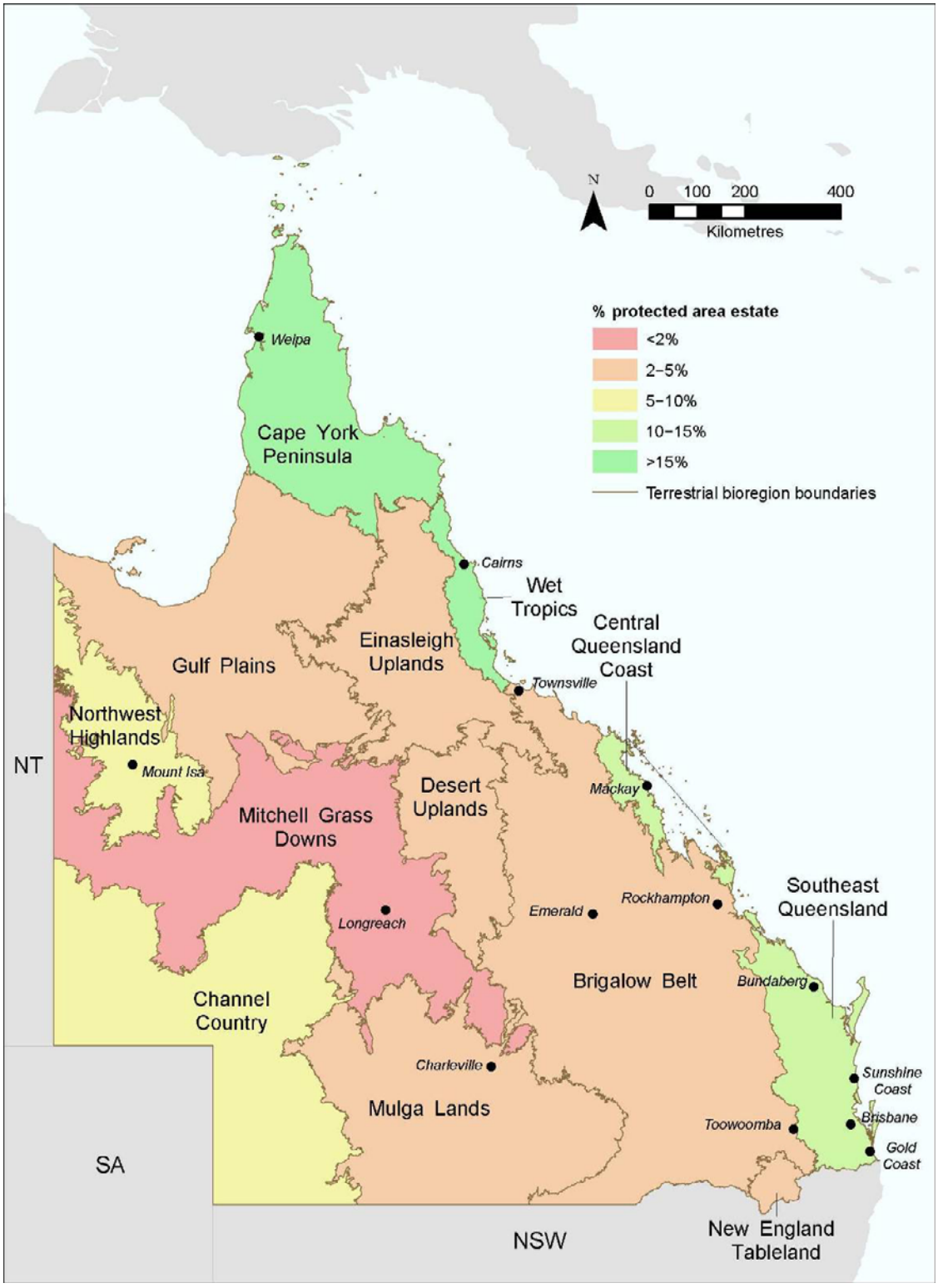
In these areas, especially across the semi-arid rangelands, much of the country is under marginally productive grazing and climate change could result in serious degradation.

There are also significant gaps in the opportunities for tourism and recreation throughout the north and west; for example, across the Gulf of Carpentaria there are few places where tourists can leave the roads to experience the rich natural heritage of the area. National parks can play an important role in providing these publicly accessible natural areas.

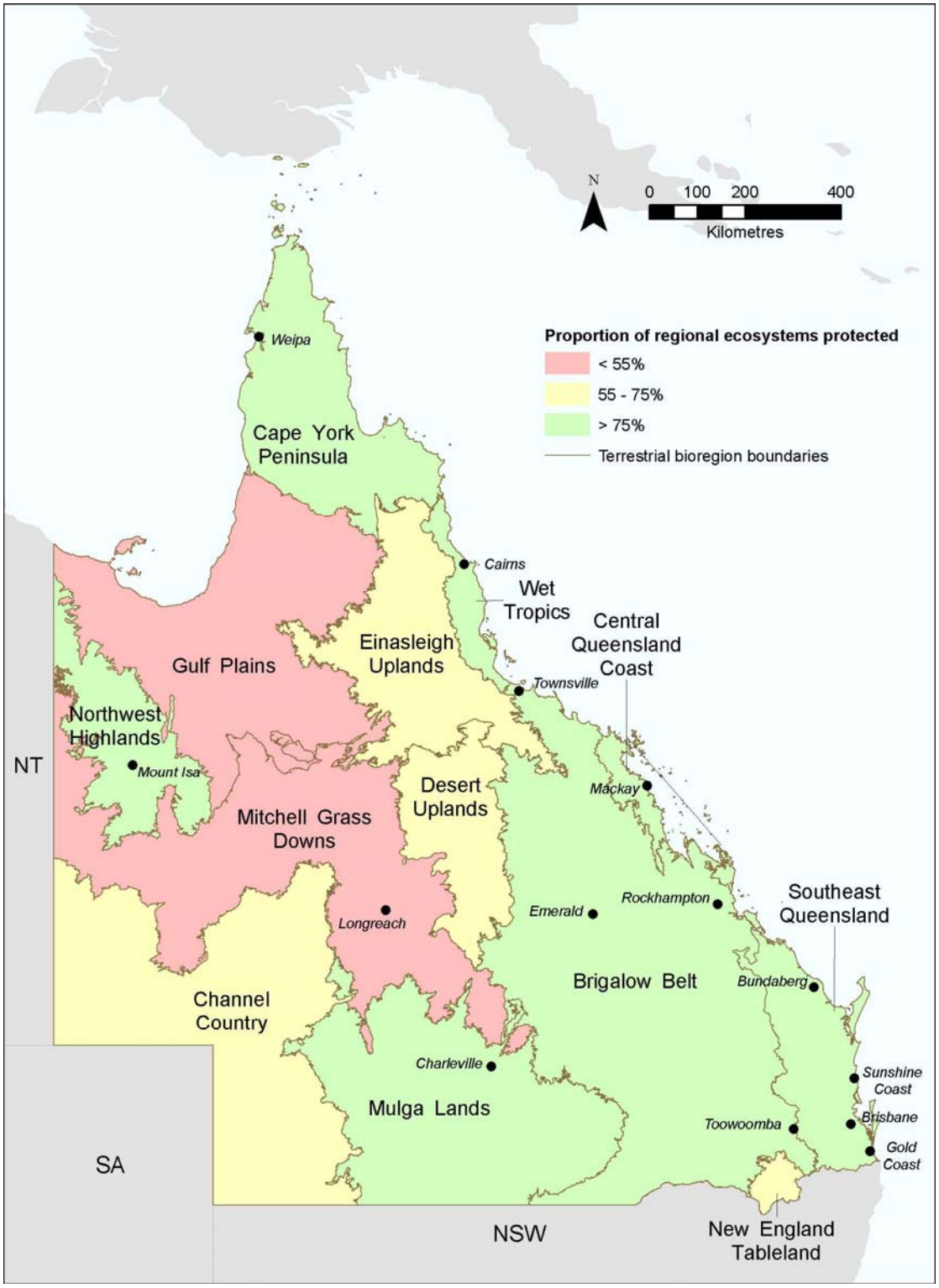
Table 1 provides more detailed statistics about the conservation status of Queensland bioregions including:

- The proportion of each bioregion in national parks. This is a very rough measure of how adequate the protected area system is across the bioregions – that is, across the broad landscapes of similar geomorphology and climate (see also Map 2).
- The proportion of regional ecosystems represented in national parks. This is a measure of comprehensiveness, using regional ecosystems as an indicator of overall biodiversity (see also Map 3).
- The proportion of regional ecosystems conserved at an estimated minimum ‘adequate’ level, considering the overall target of 7.5 per cent of the state.

Protection of catchment values and forest ecosystems in the Wet Tropics Bioregion. Photo: DERM.



Map 2. Proportion of bioregion area conserved in all types of national park, conservation parks and resources reserves (2010).



Map 3. Proportional count of regional ecosystems in each bioregion protected in all types of national park, conservation parks and resources reserves (represented at any level in 2010).

Table 1. Level of protection (bioregion area and RE representation) in each of Queensland bioregions.

Bioregion	Area (ha)^	Current % area in NP§	Number of REs in bioregion†	% REs represented in NP†	% REs represented at target levels**
Northwest Highlands*	7 343 636	5.2 %	43	77 %	5 %
Gulf Plains*	21 910 942	2.6 %	84	51 %	10 %
Cape York Peninsula	12 305 219	16.7 %	233	85 %	37 %
Mitchell Grass Downs	24 162 329	1.4 %	60	53 %	5 %
Channel Country	23 217 288	6.7 %	56	73 %	29 %
Mulga Lands	18 605 811	2.7 %	65	80 %	18 %
Wet Tropics	1 992 899	41.0 %	185	93 %	32 %
Central Queensland Coast	1 484 277	11.1 %	80	95 %	16 %
Einasleigh Uplands	11 625 726	2.5 %	145	62 %	4 %
Desert Uplands	6 941 095	2.7 %	76	67 %	9 %
Brigalow Belt	36 528 106	2.4 %	172	85 %	12 %
Southeast Queensland	6 248 299	13.1 %	151	96 %	35 %
New England Tableland	774 795	3.5 %	25	72 %	12 %
Total	**173 140 423**	**4.9 %**	**1375**	**80 %**	**21 %**

* In these bioregions the mapping is incomplete and therefore the figures are likely to be an underestimation.

^ Bioregions of Queensland Version 5.

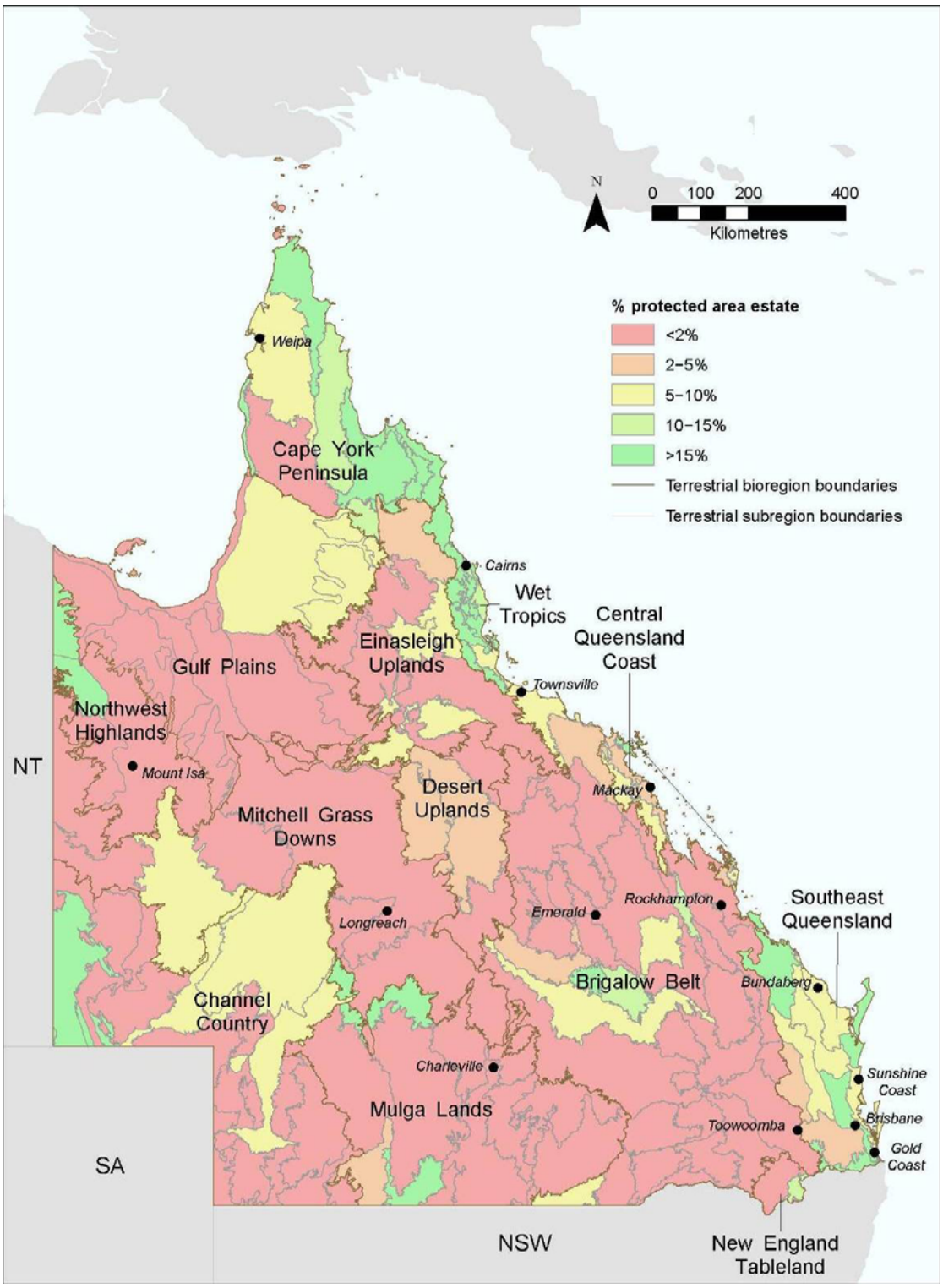
§ Based on national park, conservation parks and resources reserves (DERM Protected Area Estate, July 2010).

†Regional ecosystem (RE) counts and representation data derived from the Queensland Herbarium's Regional Ecosystems Description Database (Draft Preclear mapping August 2010). Springs version 5.1

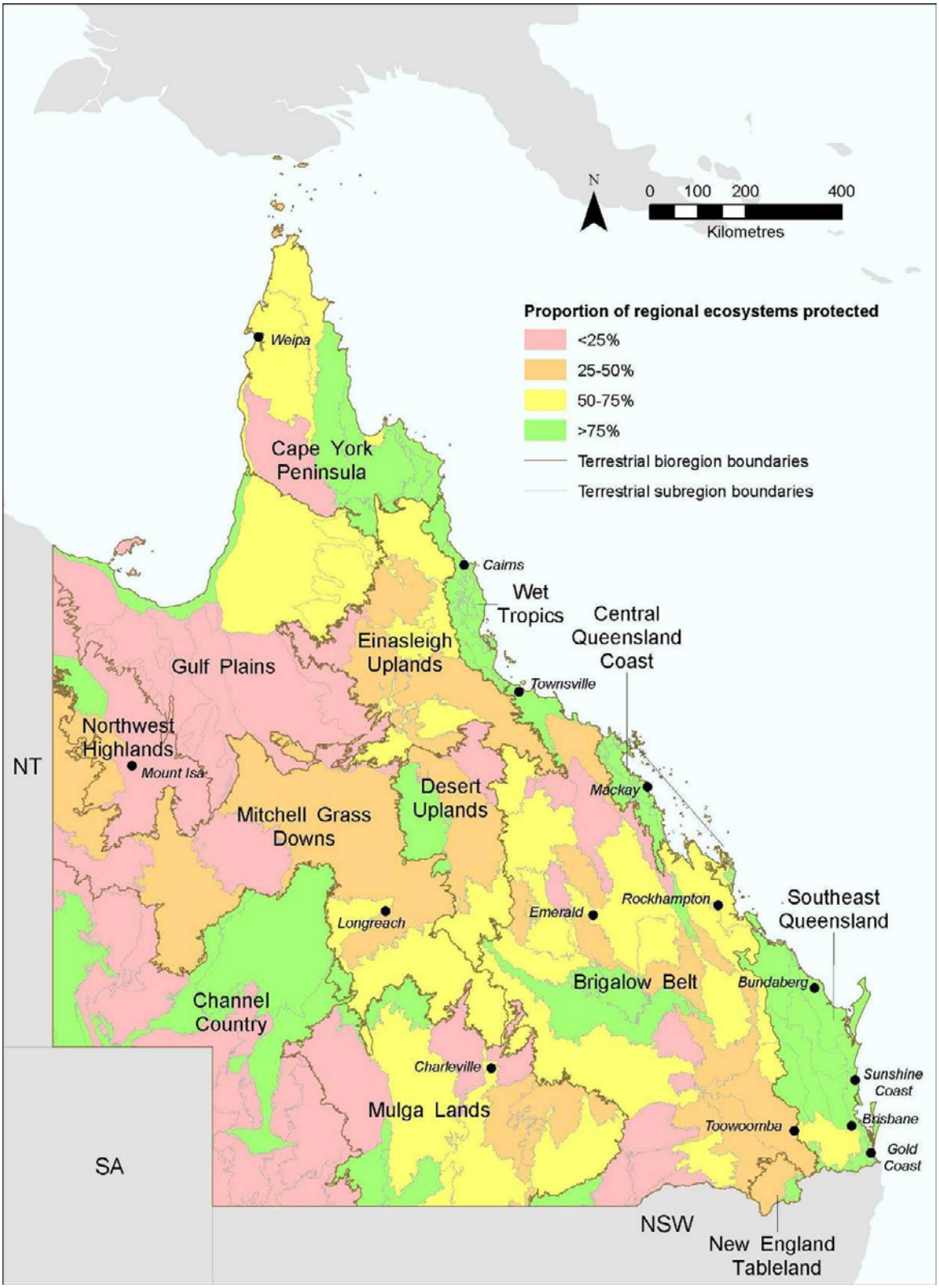
* Bioregion mapping is incomplete and figures are likely to be underestimated.

** The calculation of minimum 'adequate' targets (based on a total national park coverage of 7.5 per cent) is discussed below. (These targets are not necessarily biologically adequate).

We can also look at protected area coverage at the more detailed subregional level. The proportion of land and regional ecosystems represented in protected areas in each subregion are measures of representativeness (see Maps 4 and 5). In 2010, of the 132 subregions in Queensland, 30 have no protected areas at all and a further 42 have less than two per cent of their area in protected areas. However, 30 subregions have more than 10 per cent of their area in protected areas (note that these figures exclude nature refuges). These maps show that for some bioregions, most of the conservation estate is concentrated in only one or two subregions, indicating important gaps in representativeness. In some subregions, this will be difficult to rectify as there are few options for future national parks due to high levels of past clearing.



Map 4. Proportion of subregion area conserved in national parks and other protected areas, excluding nature refuges.



Map 5. Proportion of regional ecosystems in each subregion protected in national parks and other protected areas, excluding nature refuges (represented at any level). Note: REs are only included in a subregion for these calculations if more than 5 per cent of their total area occurs in that subregion.

Representation of aquatic and wetland variation

While many types of wetland are included in the protected area system, analysis to determine gaps in the representation is still continuing. This topic will be addressed further in a future document covering planning for marine and aquatic protected areas. A first step is to decide on the classification system to be used in analysis and planning. Mapping for wetlands in Queensland is well advanced and a review of gaps in the existing system, along with an analysis of the 'incidental inclusion' of wetland values in areas already identified as high priority for protection of biodiversity can then be undertaken quite rapidly.

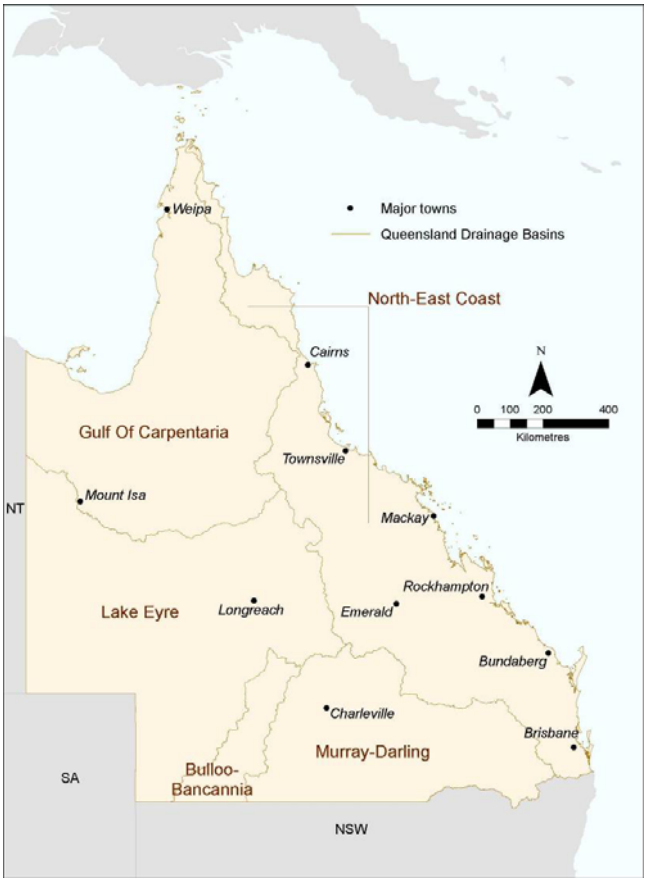
As a first broad view of the level of protection, Table 3 shows the proportion of very broad wetland habitat types protected in each of the major drainage basins. More detailed analysis will include consideration of different riverine and estuarine habitat types, which have been grouped in this table. Locations of the drainage basins (at national level) are shown in Map 6.

Table 3. Proportion of broad wetland types in drainage basins (see Map 6) that are within national parks and other protected areas (excluding nature refuges).

Statistics are calculated using Queensland Wetlands Mapping Version 2 (September 2009), Australia's River Basins layer 1997 as defined by the Australian Water Resources Management Committee.

Wetland habitat type	Bulloo-Bancannia	Gulf Of Carpentaria	Lake Eyre	Murray–Darling	North-east Coast
Arid/semi-arid floodplain grass, sedge, herb swamps	**0 %**	**<1 %**	**<1 %**	**0 %**	**0 %**
Arid/semi-arid floodplain lignum swamps	0 %	0 %	2 %	3 %	n/a
Arid/semi-arid floodplain tree swamps	0 %	2 %	2 %	57 %	<1 %
Arid/semi-arid fresh floodplain lakes	0 %	<1 %	<1 %	0 %	0 %
Arid/semi-arid fresh non-floodplain lakes	0 %	2 %	3 %	35 %	<1 %
Arid/semi-arid fresh non-floodplain lakes – claypans	0 %	n/a	n/a	24 %	n/a
Arid/semi-arid non-floodplain (spring) swamps	n/a	0 %	68 %	77 %	n/a
Arid/semi-arid non-floodplain grass, sedge, herb swamps	0 %	3 %	1 %	5 %	0 %
Arid/semi-arid non-floodplain lignum swamps	0 %	13 %	9 %	<1 %	<1 %
Arid/semi-arid non-floodplain tree swamps	0 %	<1 %	0 %	0 %	<1 %
Arid/semi-arid saline lakes	n/a	n/a	0 %	66 %	n/a
Arid/semi-arid saline swamps	n/a	<1 %	0 %	48 %	0 %
Coastal/sub-coastal floodplain grass, sedge and herb swamps	n/a	2 %	0 %	<1 %	21 %
Coastal/sub-coastal floodplain lakes	n/a	3 %	n/a	0 %	10 %
Coastal/sub-coastal floodplain tree swamps (melaleuca and eucalypt)	n/a	1 %	0 %	2 %	32 %
Coastal/sub-coastal floodplain wet heath swamps	n/a	n/a	n/a	0 %	60 %
Coastal/sub-coastal non-floodplain (spring) swamps	n/a	0 %	n/a	n/a	0 %

Coastal/sub-coastal non-floodplain grass, sedge and herb swamps	n/a	14 %	n/a	100 %	61 %
Coastal/sub-coastal non-floodplain rock lakes	n/a	n/a	n/a	n/a	98 %
Coastal/sub-coastal non-floodplain sand lakes (perched)	n/a	n/a	n/a	n/a	97 %
Coastal/sub-coastal non-floodplain sand lakes (window)	n/a	0 %	n/a	n/a	17 %
Coastal/sub-coastal non-floodplain soil lakes	n/a	0 %	n/a	53 %	7 %
Coastal/sub-coastal non-floodplain tree swamps (melaleuca and eucalypt)	n/a	3 %	n/a	8 %	41 %
Coastal/sub-coastal non-floodplain wet heath swamps	n/a	35 %	n/a	n/a	42 %
Coastal/sub-coastal saline swamps	n/a	<1 %	n/a	n/a	5 %
Coastal/sub-coastal tree swamps (palm)	n/a	93 %	n/a	n/a	48 %
Estuarine – mangroves and related tree communities	n/a	3 %	n/a	n/a	20 %
Estuarine – salt flats and saltmarshes	n/a	1 %	n/a	n/a	22 %
Estuarine – water	n/a	<1 %	n/a	n/a	40 %
Riverine	0 %	2 %	3 %	<1 %	4 %



Map 6. The drainage basins of Queensland.

Representation of refugia, important habitat areas and other priority areas in the protected area system

Biodiversity Planning Assessments (BPAs) have been conducted for most of Queensland's bioregions using a consistent methodology based on both objective data and a standard expert elicitation process, consisting of panels to review data relating to landscapes, flora and fauna (the Biodiversity Assessment and Mapping Methodology; Environmental Protection Agency (2002)). These assessments identify priority areas according to a range of criteria, including:

- centres of endemism
- wildlife refugia
- disjunct population
- geographical limits
- species richness
- relictual populations
- distinct variation in species composition
- hollow bearing trees
- roosting sites

Waterhole, Gulf Plains bioregion. Photo: Gary Wilson.

Analysis of the extent to which these priority areas are included in the protected area system is outlined in Table 4. The extent to which threatened species distributions are included in protected areas will also be further analysed.

Table 4. The proportion of areas with high values (criteria as assessed through the BPA process) that are included in protected areas (excluding nature refuges) in each bioregion (for the nine regions for which these assessments have been done). BPA version is provided in brackets under the bioregion name.

Criteria as classified in the BPA	Brigalow Belt (v1.3)	Channel Country (v1.1)	Central Queensland Coast (v1.3)	Desert Uplands (v1.1)	Einasleigh Uplands (v1.1)	Mitchell Grass Downs (v1.1)	Mulga Lands (v1.4)	New England Tableland (v2.3)	South-east Queensland (v3.5)
Centres of endemism	26 %	17 %	33 %	3 %	6 %	<1 %	22 %	31 %	63 %
Wildlife refugia	10 %	10 %	35 %	6 %	5 %	9 %	9 %	14 %	45 %
Disjunct population	27 %	2 %	24 %	5 %	7 %	10 %	19 %	34 %	42 %
Geographical limits	23 %	13 %	30 %	5 %	6 %	<1 %	13 %	43 %	58 %
Species richness	26 %	11 %	19 %	4 %	6 %	11 %	17 %	33 %	71 %
Relictual populations	29 %	2 %	51 %	n/a	9 %	<1 %	15 %	n/a	46 %
Distinct variation in species composition	7 %	10 %	10 %	21 %	4 %	<1 %	2 %	31 %	45 %
Artificial water bodies	0 %	n/a	0 %	n/a	2 %	0 %	n/a	n/a	21 %
Hollow bearing trees	29 %	4 %	n/a	2 %	5 %	2 %	1 %	<1 %	11 %
Roosting sites	34 %	<1 %	28 %	n/a	5 %	13 %	33 %	0 %	16 %

Setting conservation targets at different scales

Broad area targets for the extent of the future protected area system are included in the Queensland Government's Q2 targets. More detailed targets for the proportion of bioregions, subregions, regional ecosystems, species and other features are being progressively developed as we develop a better understanding of gaps in the existing protected area system. Targets that have already been developed based on knowledge and information in 2010 are presented in the sections that follow—these will continue to be adjusted and developed as more information becomes available in the future.

Targets are important inputs into the protected area design software discussed below. For example, when programming the computer to design a theoretically efficient protected area system, the minimum proportion of each regional ecosystem which should be included in the system is entered into the program..

Targets for representation of other features discussed above have not yet been set.

Protection of regional ecosystems

Minimum targets for regional ecosystem representation have been calculated according to a 'proportional' methodology. In the past, targets and the level of representation of ecosystems in parks have usually been set according to a percentage of their area (e.g. 4 per cent, 10 per cent or 30 per cent), but these targets are not seen as particularly useful by biologists (Pressey et al 2003; Svancara et al 2005a).

To meet biodiversity objectives as well as planning for ecosystem processes, we need to estimate how much of each regional ecosystem is necessary for maintenance of populations, ecosystem health, catchment protection, evolution, and adaptation to climate change. Flat targets do not take into account that some ecosystems and species require more extensive protection than others. The suggestion that percentage targets should be scaled to reflect such differences was put forward by Pressey et al. (2003) who considered that it was necessary to vary targets based on factors such as biophysical variability, rarity, fidelity to a region, and threats.

The area that different regional ecosystems cover in Queensland varies greatly—from nearly six million hectares to as small as four hectares. Regional ecosystems (REs) with total area less than 1000 hectares (or patch size less than 100 hectares and of limited extent) are classified as rare. It makes intuitive sense, and has been confirmed by discussions with scientists, that targets should be higher for REs that are rare, endangered, 'of concern', or under threat.

Targets for riverine ecosystems are often proportionally higher because these systems are restricted in area. Crimson finch, Northwest Highlands bioregion. Photo: Chris Mitchell.

The scaled target means that small REs should be protected to the greatest possible extent, while for the largest RE (nearly six million hectares), the target is just under one per cent. Based on information estimating how much area different species need and the assumption that more heterogeneous areas need higher overall targets (Pressey et al 2003), REs with smaller areas are likely to need a higher proportion in reserves because:

- they will include naturally rare ecosystems, where it is reasonable that we should conserve as much as possible
- heterogeneous broad vegetation types with high diversity, such as the rainforests of the Wet Tropics, have many smaller REs and will thus have a proportionally higher representation in protected areas than large homogenous regions
- large REs have a greater chance of having duplication across the landscape and it is less likely that events such as fires, floods or disease will damage them in their entirety
- naturally small REs often occur in refugia such as mountain-tops, gorges, isolated rocky peaks and geological or edaphic isolates, for reasons related to evolutionary history. As such they often contain high numbers of rare species, including some very resilient to environmental changes (Tim Low pers. com) and may play an especially important role in landscape adaptation to climate change.

For this methodology, minimum target areas for each regional ecosystem (RE) have been based on a scaled proportion of their extent before clearing occurred, so that a higher proportion of endangered and 'of concern' REs will be conserved. Targets are based on pre-clearing extent rather than current remnant. As biodiversity status is calculated on the proportion of the pre-clearing extent which still remains (that is the ratio of remnant area to pre-clearing area), this means that targets are automatically higher in proportion to the remnant vegetation for areas which are endangered or of concern. The use of pre-clearing figures concurs with the premise of Pressey et al. (2003), who argued that this produces larger targets for land units, which have been heavily transformed by land use, and it ensures targets are set based on how much there was in the past not how much remains.

In Queensland, biodiversity classification considers the level of threat from existing land use and condition (for example, invasive plants) in addition to the extent of past clearing. However, these threats do not necessarily raise the extent of land needed; rather they increase the importance of finding high quality samples of the RE. Therefore, it is reasonable that this does not affect the target.

Figure 4 shows the proportionally scaled targets for all REs. These targets are not intended to account for a completely adequate representation of all ecosystems, but rather represent a logical area based method for maximising the conservation of all REs within a total area target of 7.5 per cent of Queensland (Lieberknecht et al 2010). In accounting for the existing extent reserved for REs and including 100 per cent of rare REs (those with a pre-clear extent less than 1000 ha) an approximate square root transformation of the remaining RE area targets provides an optimum trade-off for meeting our area objective, while maintaining sequential continuity as we transition from the lower limit threshold of 1,000 ha to targets of less than 100 per cent.

Table 2 shows the theoretical minimum target areas of a range of REs. In the case of vegetation which has been substantially cleared, such as endangered regional ecosystems, the theoretical target will often be larger than the area of vegetation remaining. The reservation target is then adjusted downwards to be 100 per cent of the remnant vegetation.

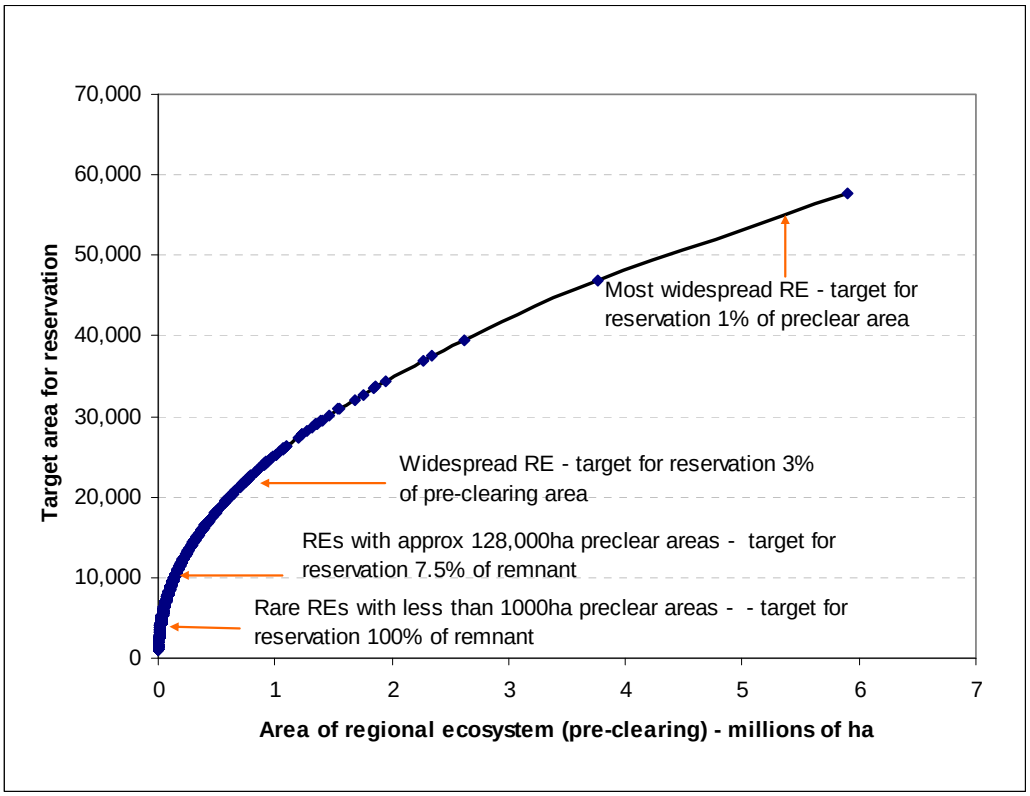


Figure 4. Target for regional ecosystems as a proportion of pre-clearing extent (in hectares). Note these need to be adjusted when remnant area is limited.

Table 2. Theoretical minimum targets for a range of regional ecosystems.

Pre-clearing area (ha)	Target for reservation (ha)	Target as proportion of pre-clearing area
5 907 822	57 767	0.98 %
5 000 000	53 437	1.07 %
1 000 000	25 202	2.52 %
750 000	22 034	2.9 %
500 000	18 233	3.6 %
250 000	13 191	5.3 %
100 000	8599	8.6 %
75 000	7518	10.0 %
50 000	6221	12.4 %
25 000	4501	18.0 %
10 000	2934	29.3 %
5000	2123	42.5 %
1002	1002	100 %

A number of REs for each bioregion have already reached the minimum targets for reservation, and those that have achieved various proportions of the set target (Figure 5). As discussed, these are based only on the RE targets according to the calculations above. However, a greater area of the RE might be required for other reasons such as the presence of rare and threatened species. The REs marked 'special category' are rare ecosystems that have almost reached their target but require special consideration for any remaining areas.

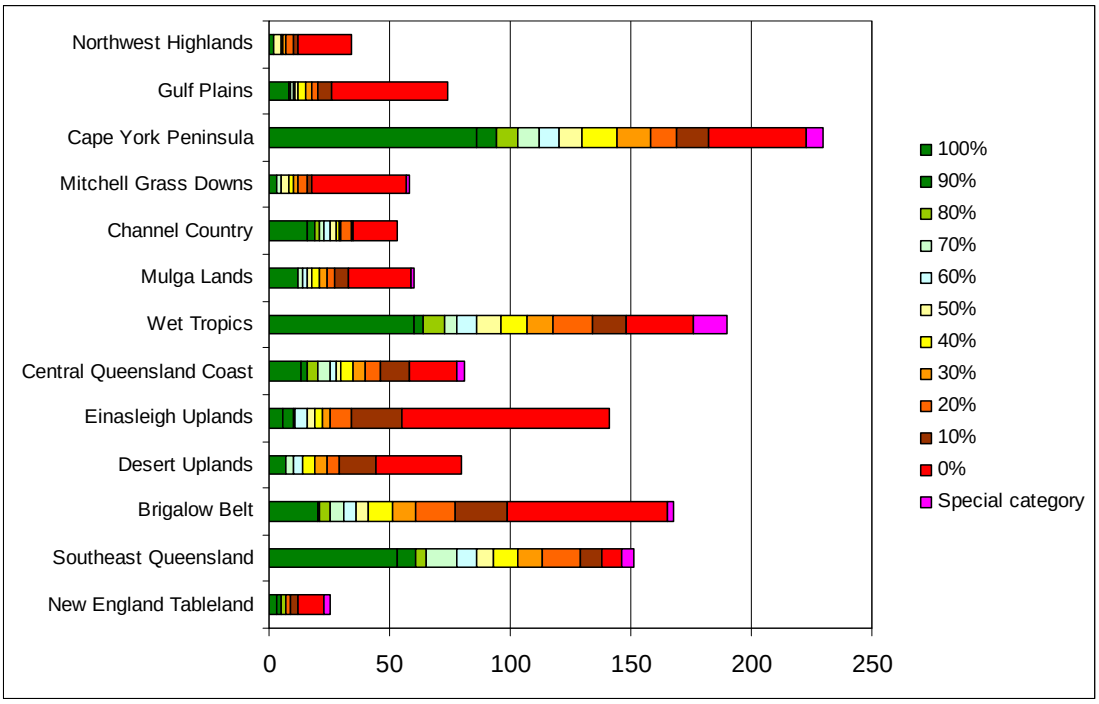


Figure 5. Number of regional ecosystems in each bioregion achieving different levels of protection in the protected area system (based on the proportional representation method).

Shades of green indicate the RE is approaching or exceeding the target area, while shades of red mean that the regional ecosystem has poor representation. 'Special category' refers to rare ecosystems that have almost reached their target but require special consideration for any remaining areas.

Identifying potential new protected areas

Potential new protected areas are being identified through a combination of methods: protected area selection tools, expert panel workshops, literature and file searches, evaluation of properties through the Delbessie process, review of unallocated state lands, and review of previous national park proposals.

To complete the CAR system and address the 10 principles described already, a first step has been to identify properties in priority bioregions and subregions with a diversity of unrepresented or poorly represented regional ecosystems.

Spatial prioritisation tools (discussed on the right) highlight potential areas which will help most efficiently reach the targets for regional ecosystems and other features. Expert knowledge and other data sources are also important in understanding patterns in the landscape, the range of other values being sought, and the likely condition of the land. For example, good wetland mapping enables the identification of important habitat areas for aquatic species and catchment protection. By analysing remote sensing images and topographic data, areas which could play an important conservation role in climate change scenarios can also be pinpointed.

Many potentially important areas are identified through the tenure-blind, 'top-down' process which looks first at a bioregional or subregional scale A great deal of further consideration is made before any approaches would be made to the landholder to gauge interest in selling the land, entering into a conservation agreement or considering some other conservation option.

A 'bottom-up' approach is also used in some cases, where parcels of land are identified as potential protected areas by looking first at a property scale with individual assessments of their biodiversity and related values. This process applies, for example, to leasehold lands when reviewed through the Delbessie process, to areas of unallocated state land, to state forests and to other state lands which are intended for sale. In the case of state lands, the decision to declare them as protected areas may be made on the basis of regional planning – that is, this being the best use of the land, even if the regional ecosystems are well represented. Examples of this kind of decision could be where there are clear benefits, such as inclusion of off-shore coral islands, coastal wetlands or catchment areas in the protected area system.

In all cases, potential protected areas are then compared to existing protected areas and to other land parcels in the bioregion to ensure that the best combination of values will be conserved in the total protected area system.

Key habitats in western Queensland include wetland areas and springs which are habitat for many species including the orange chat. Photo: Chris Mitchell.

Tools for protected area system design

A range of conservation planning tools—software to aid protected area system design—have been developed, trialled and applied over the past 15 years and are now used throughout the world.

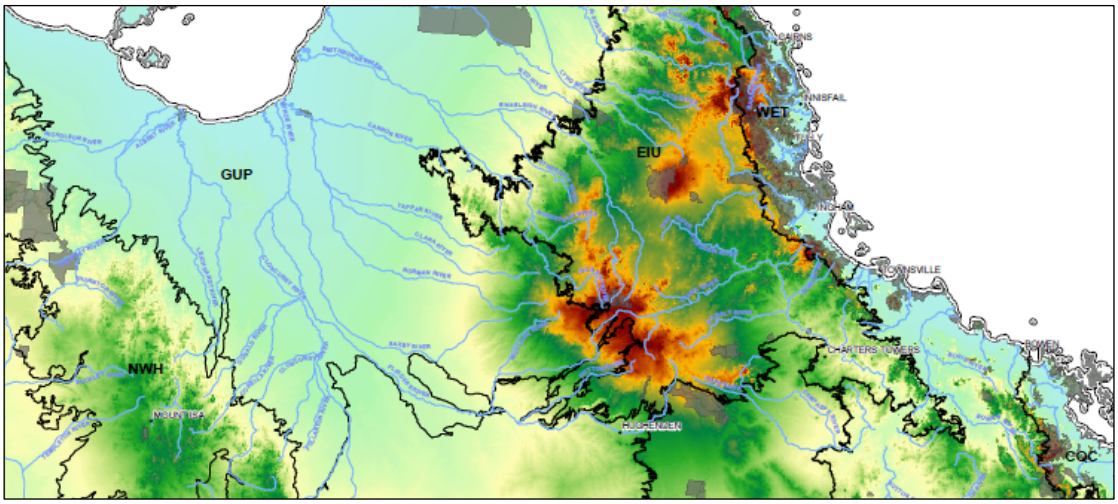
These tools aid conservation planning for protected area systems by helping to manage one of two problems: a 'minimum-set problem', which minimises resources or costs while meeting conservation objectives; or a 'maximal-coverage problem', which maximises level of protection for a fixed cost (Possingham et al 2006). The planning tools rate and combine many different criteria (including ecological values and threats) to prioritise the different areas being considered for a reserve system.

Such tools contrast with simple scoring systems that cannot deal with the synergy of multiple areas, and that lead to inefficient and unrepresentative protected area systems (Possingham et al 2006). With these scoring systems we could select two or more areas with very similar values, without taking into account the overlaps in the values being conserved, and without being able to account for desirable spatial configurations of total networks. While very simple systems can be designed manually, the complexity involved in conservation planning over wide areas soon introduces a great number of permutations of values and potential reserve sites (Possingham et al 2000). This complexity is difficult to manage without the power of sophisticated software. Queensland is attempting to conserve more than 1300 different regional ecosystems in different combinations over 172 million ha.

Two of the most commonly used tools are Marxan (Ball & Possingham 2000; Possingham et al 2000) and C-Plan (New South Wales National Parks and Wildlife Service 1999). In this protected area design methodology, Marxan is used to identify an efficient spatial network of reserves to meet selected targets derived from the principles in this document. A number of different scenarios can be explored using Marxan, based on different levels of representation of regional ecosystems and inclusion of infrastructure costs.

In addition, C-Plan is used to investigate the contribution of specific parcels of land to the CAR protected area system, and to progressively build up a protected area system for each subregion and bioregion. It is particularly useful in identifying the most irreplaceable areas and can be interrogated to understand what values contribute to this identification.

Conservation planning tools do, however, need to be used in conjunction with expert opinion and consideration of other values. For example, even complex planning tools may still be unable to address Aboriginal and Torres Strait Islander's natural and cultural heritage. Such values need to be considered in addition to the computer based planning process, and this needs to be done in partnership with relevant communities.



Elevation map, northern bioregions. Expert panel workshops consider, among other aspects, the elevation and catchment status of land parcels and how these might contribute to climate change resilience. These factors are considered at a range of scales when designing an effective protected areas system.

Expert panel workshops

Expert elicitation processes are a key part of the methodology for designing Queensland's protected area system. Workshop groups viewing remote sensing imagery consider in a consistent manner a wide range of factors including:

- which areas are highlighted by Marxan and C-Plan as being of strategic importance
- location of existing proposals
- location of areas such as state forest that will become part of the conservation estate in time, and of unallocated state land that could be acquired for minimal cost
- biodiversity planning assessments (where available), which have spatial representation of a wide range of biodiversity values
- wetland mapping and information
- location and size of unrepresented, endangered and of concern regional ecosystems
- potential for improving connectivity, catchment protection and patch size
- possible contribution of areas to climate change resilience
- location of any other known areas with significant habitat or conservation value
- possibilities for high-value offset and revegetation areas, such as where endangered ecosystems could be restored or regrowth protected
- cultural importance where known
- tourism or recreation potential of particular relevance in the local setting.

In the expert panel workshops, areas of potential conservation importance are identified and their complementary values discussed. For each area nominated, the panel assigns a possible conservation option (protected area type or action such as rehabilitation), a nominal priority (low to very high), and known values. Key values and other comments on each area systematically recorded.

In addition, C-Plan is used by expert panels to review the contribution of different areas to the targets and goals set for the protected area system.

In addition to the areas highlighted during workshops, other areas may also be of interest for the protected area system. These include pre-existing high priority reserve proposals, state forests where these have been identified for transfer to national park in the short-to-medium term, and areas offered to DERM for sale.

Detailed assessment and prioritisation

All areas that are considered possible additions to the protected area system are further researched through desktop assessments of values that can be identified with spatial tools and databases, including information about regional ecosystems and species records. Before final decisions can be made it is essential that field inspections are conducted to confirm the values, check condition and assess other contributions to the protected area system, such as for tourism and recreation.

Far more land is identified as high priority for conservation than is required or could be managed as protected area. To allocate acquisition priorities, an additional tool has been developed that assesses and rates each area of interest for its contribution to the targets and principles for the enhanced reserve system (see the text box on the next page). For example, as one of its selection criteria this tool prioritises proposals that have a larger number of unrepresented or poorly represented regional ecosystems. If proposals are being considered as nature refuges or revegetation areas, the tool can be adapted to give more weight to other criteria such as connectivity.

Detailed proposals will be developed only for the highest-scoring areas, and the acquisition of these areas will then be considered in the light of available funding, practicality of management, level of threat to the values, and willingness of landholders to sell. In the case of nature refuges, the initiative to request a conservation agreement must come from the landholder, though advice can be given that the property would be highly regarded if such a request were made.

Field inspections have verified the biodiversity values of this Gulf Plains property. Photos: Gary Wilson.

Summary of the factors considered in the assessment and prioritisation of potential protected areas

1. How will the property contribute to a CAR protected area system?

- Is the proposal in a priority bioregion and subregion (i.e. those with low area coverage and RE representation in protected areas)?
- Number and proportional area of unrepresented and poorly represented ('priority') REs, and number and area of endangered and of concern REs. Contribution to conservation of broad vegetation types (a much broader classification of vegetation) in the bioregion.
- Is the proposal of a viable size (or part of a larger tract)?

2. Is the property in a suitable condition for the protected area type (comparative to other properties in the area)? (may also indicate suitability for offset potential)

- Proportion of remnant vegetation, proportion of 'high quality regrowth'
- Condition of the vegetation and landscape and extent of significant degradation (e.g. erosion, invasive plants)
- Revegetation potential.

3. Does the property have special species and habitat values?

- Known or very likely habitat for endangered, vulnerable or near threatened flora or fauna
- A high rating through a biodiversity planning assessment (BAMM Criteria A)
- Contains a centre of endemism (BAMM criteria I) or wildlife refuge (BAMM criteria I)
- Has other wildlife values (BAMM criteria 1c,d,e,g,I,j)
- Other high species or habitat values known by expert panel or reported in literature – may include value to common species.

4. Does the property provide important ecosystem services and include wetland and geological features?

- Patch connectivity or a biodiversity corridor (at the statewide, bioregional or subregional scale)
- Major catchment values
- Resilience to climate change (e.g. altitudinal variation),
- Important geological formations/ landforms
- Representation of freshwater systems or wetlands.

5. Does the property have important cultural and social values?

- Significance to Indigenous peoples
- Non-Indigenous cultural heritage
- Scenic amenity/ importance to local people, tourism potential or existing interest.

6. Does the property have management or operational suitability?

- Is the proposal connected to or an extension of an existing protected area? Whether the property makes a significant contribution to management of existing protected area
- Accessible for management
- Presence of existing infrastructure (useful and non-useful)
- Ease/cost/practicality of management
- Extent of pest issues requiring intervention.

7. What is the threat to this area if it is not converted to protected area?

- Likelihood of major changes in land use or other threats.

8. What is the cost and availability of this area?

- Availability if known
- Impediments to gazettal
- Mining/exploration permits.

Implementation of the protected area system: acquisition, land transfers and conservation agreements

New protected areas will be established through transfers of state forests and other state lands, resolution of tenure in Cape York Peninsula, acquisition of leasehold lands through the Delbessie process, and other purchases of freehold and leasehold lands. Nature refuges will be increased through voluntary agreements with landholders. Figure 6 shows the projected increase in Queensland's protected areas.

As discussed earlier in this report, there is a wide variation in bioregional conservation status from bioregions and subregions in coastal and sub-coastal areas, which are largely cleared and fragmented, to the rangeland and savannah bioregions which are relatively intact though they suffer a range of impacts from grazing, inappropriate fire management and invasive species. The approach to protected area selection and the importance of other measures, such as restoration and conservation agreements, will be quite different in the various bioregions. These approaches are summarised in Table 5.

In the coastal bioregions, the focus is on creating new protected areas in under-represented subregions, improving the adequacy and management of existing protected areas, maintaining or rebuilding connectivity, wetland and catchment protection, protecting coastal values, and enhancing tourism and recreation opportunities. Many opportunities are being created by the transfer of state forests to national park, and by the reservation of unallocated State lands. In the more densely populated areas, creation of new protected areas may sometimes be desirable as a part of local planning processes where conservation is the most beneficial land use, even where it is not a priority for statewide acquisition.

In the under-represented central and western bioregions, there is still much work to be done in creating new core protected areas, with links and improved sustainable management across the wider landscape.

Table 5. Indicative protected area priorities for Queensland's bioregions.

Key: ● primary strategy component – critical importance

▲ secondary strategy component – very high importance

○ tertiary strategy component – high importance but fewer proposals or medium importance

	Brigalow Belt	Cape York Peninsula	Central Queensland Coast	Channel Country	Desert Uplands	Einasleigh Uplands	Gulf Plains	Mitchell Grass Downs	Mulga Lands	Northwest Highlands	New England Tableland	South-east Queensland	Wet Tropics
New, large protected areas	●	●	○	●	●	●	●	●	●	●			
New, smaller protected areas	●		●								●	●	●
Amalgamations and extensions	▲		▲	○	○	●			○				○
Adequacy extensions	▲		○					○		▲	○	▲	▲
Large-scale corridors	▲	○	▲	○	▲	●	▲	▲	○	○	▲	▲	▲
Small-scale connectivity	○		▲								▲	●	●
'Living landscape' partnerships	○	●	▲	●	●	○	●	●	●	▲	▲	▲	▲
Revegetation/restoration/regrowth	▲		▲		○				○		▲	▲	▲

Acquiring new protected areas

A range of mechanisms (see Figure 6) will be used to acquire additional protected areas that are highlighted as important through the protected area design methodology. Some of these involve the transfer of existing state lands, which will minimise purchase costs. Others involve buying leases or freehold title.

The support of the Australian Government through the National Reserve System and Caring for our Country funding will continue to be critical in enabling the purchase of lands in priority bioregions and subregions.

Ecofund will play a major role in providing a continuing source of funding for protected area acquisition and establishment. As well as receiving money from organisations undertaking certain development activities, Ecofund can also use public and corporate donations, including voluntary offset contributions, to buy land for protected areas.

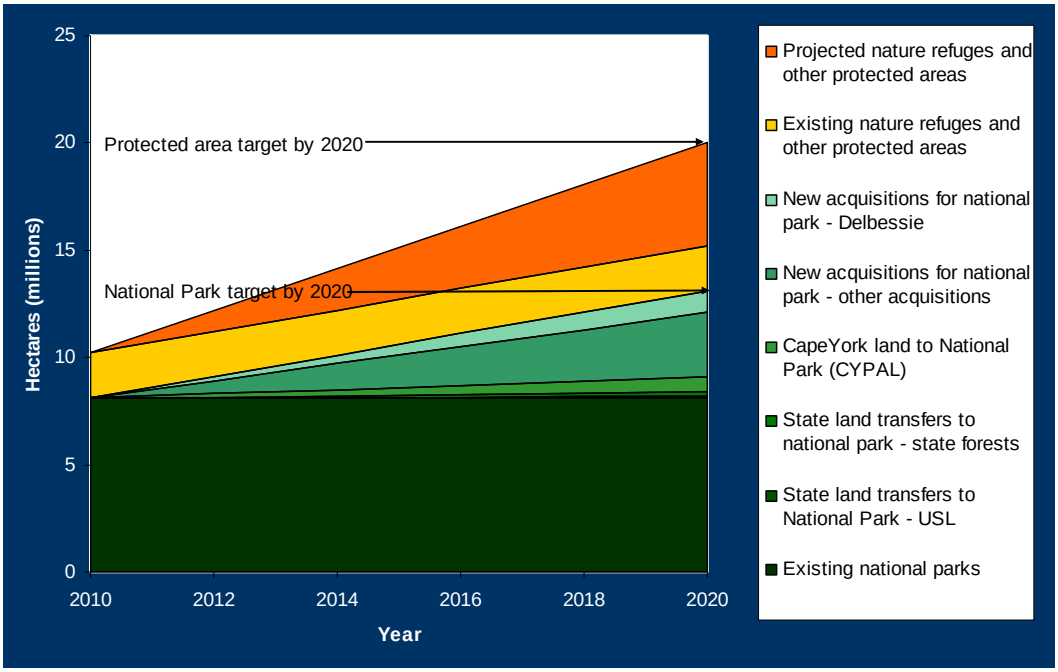


Figure 6. The current and projected protected area extent in Queensland.

The state-wide forests process

This process is progressively organising the transfer of State forests to protected areas. It has determined a preferred long-term forest management solution for critical forests in south-east Queensland, the Brigalow Bioregion and New England Tableland Bioregion (referred to as the western hardwoods region), Rockhampton, Mackay and Proserpine areas and north Queensland. New protected areas achieved through the forest agreement process include the following:

- To conserve south-east Queensland's outstanding biodiversity values and avoid local extinctions of plants and animals, large areas of forest needed to be conserved. The South East Queensland Forests Agreement was a significant milestone towards the protection of biodiversity in Queensland. It led to the reservation of 406 000 hectares of forest and the progressive addition of a further 375 000 hectares (approximately) of publicly owned native forest. Under the agreement, there is a 25-year period for this change to take place. By 2025, there will be no further harvesting of State-owned native forests in south-east Queensland.
- About 400 000 hectares of high-conservation-value forest areas in the Wet Tropics (mostly in the Wet Tropics World Heritage Area) have been reserved, with a further 80 000 hectares (approximately) to be gazetted in the near future.
- The outcome for the western hardwoods region of the statewide forests process provides for the protection of some of the most significant remnant areas in this region. Key elements of the state forest plan include adding more than one million hectares of western hardwood native forest to the conservation estate.

- State forests in the Mackay–Proserpine region are being progressively added to the protected area estate with 14 000 ha transferred by 2010.
- The ecotonal forests of north Queensland are highly valuable from a biodiversity perspective and are important in adaptation to climate change because they are on the boundary of the Wet Tropics and drier areas. . Some 92 000 ha of state forest will be transferred into protected areas.
- The future for the cypress region, which is intermixed with the western hardwoods region, in the statewide forests process is expected to be determined by late 2010.

Many opportunities are being created through the transfer of State forests to national park, and through the reservation of unallocated state lands. In the more densely populated areas, creation of new protected areas may sometimes be desirable as a result of good local planning processes, where conservation is the most beneficial land use, even where this is not a strategic priority for statewide acquisition.

Unallocated state land

The biological diversity values, natural features and management challenges of unallocated state land will be reviewed to assess which parcels of this land will be suitable for national park gazettal.

Delbessie process for leasehold lands

The Delbessie Agreement (also known as the State Rural Leasehold Land Strategy) is a framework of legislation, policies and guidelines developed to support the environmentally sustainable productive use of rural leasehold land for agribusiness. Under this agreement, lands identified as of high strategic importance will be considered as additions to the protected area system. In this case, negotiations may be conducted to buy leases for national park at market price, or a further lease can be granted, to be acquired when it expires for the cost only of improvements.

Landholders who enter into a nature refuge agreement may be granted a longer lease than the usual period, so there is also an incentive to create this class of protected area where conditions are met.

Purchase of other leasehold and freehold areas

Where other lands have been identified as high priority for conservation acquisition, funding needs to be secured, including co-funding from the Australian Government where available, and negotiations then conducted with landholders to determine their willingness to sell and to agree on the land price and other details.

Before any lands can be gazetted as protected area, other negotiations also need to be undertaken in relation to interests, such as mining and exploration. Discussions are also held with native title holders where appropriate.

Cape York Peninsula agreement

The acquisition program on Cape York Peninsula delivers significant social and economic outcome to Indigenous people and contributes to a number of key national and state objectives, including Closing the Gap. Land acquired under the Cape York Peninsula acquisition program is considered for both its environmental and its socioeconomic values. A tenure resolution model is used to allocate part as national park (Cape York Peninsula Aboriginal land) and part as Aboriginal land held under an inalienable freehold grant to the Traditional Owners represented by a land trust. This process ensures all native title issues are considered and agreed to ensure an effective long-term management arrangement.

Key benefits for Traditional Owners include the return of traditional land and the capacity not only to reaffirm land management responsibility and cultural practices but also to establish sustainable residential and commercial arrangements. In national park (CYPAL) areas, Traditional Owners receive appropriate recognition and are directly involved in park management decision making. They are also able to benefit from DERM commitments to employment and training, long-term contractual work and improved opportunities to participate in associated businesses including tourism.

Managing protected areas

We have a responsibility to ensure that values of protected areas are conserved into the future. As there are a variety of ways in which land can be protected, there are also a number of ways that different groups protect environmental values of our important places. This includes through national parks, community-based conservation, joint management and Indigenous Protected Areas. These management regimes are outlined below.

Indigenous management and partnerships

Indigenous people in Queensland have a very long history of custodianship over Queensland's lands and waters, and over both their natural and cultural heritage. DERM has a strong commitment to Indigenous partnerships and cooperation across all types of protected areas.

Over the last decade, two different kinds of reserves have been developed where Traditional Owners play a key role.

Rangers and Traditional Owners work together to defeat the lantana menace on Lama Lama Land Trust nature refuge (Lilyvale Nature Refuge). Photo: DERM.

National parks (Cape York Peninsula Aboriginal Land)

Cape York Peninsula has moved into a new era of joint management for national parks. In 2007, the Queensland Government created a new class of protected area, called national park (Cape York Peninsula Aboriginal land) or NP(CYPAL). This initiative allows existing and future national parks in the Cape York Peninsula region to become Aboriginal land and also be dedicated as NP(CYPAL). It provides a framework for joint management of national parks by Traditional Owners (represented by a land trust) and DERM.

The legal basis for NP(CYPAL) is significantly different from that for national parks on Aboriginal land in other jurisdictions in Australia. The underlying tenure is inalienable Aboriginal freehold land, but the land is not leased to the State to be dedicated as a national park. Instead, a land trust and the State enter into an Indigenous Management Agreement (IMA). The IMA must state that the land will be managed as NP(CYPAL) in perpetuity.

As joint managers of the land, Traditional Owners are involved in all levels of management. They work together with DERM to develop policies for resource and visitor management, and procedures for day-to-day management activities, such as pest animal and pest plant control, fire management, permits, visitor relations and facilities. Traditional Owners can also benefit from contract work, commercial tourism, and Indigenous ranger employment and training.

This initiative has been a significant achievement, and early indications are that it is a workable model that will provide meaningful joint management of protected areas for the long term. Joint management agreements outside Cape York are likely to generate similar benefits for the land and people.

Indigenous Protected Areas (IPAs)

Indigenous Protected Areas are areas of land or sea where Traditional Owners have entered into an agreement with the Australian Government to promote biodiversity and cultural resource conservation. Indigenous Protected Areas are considered part of the National Reserve System, but they are not covered by Queensland legislation and are neither owned nor managed by the state government.

Indigenous Protected Areas make a significant contribution to Australian biodiversity conservation, comprising more than 23 per cent of Australia's reserve system (see <www.environment.gov.au/indigenous/ipa/background.html>). In Queensland there are three IPAs, the largest of which is nearly 200 000 ha. Negotiations are in progress for a number of other areas.

Managing these areas helps Indigenous communities protect significant cultural values for future generations. The IPA program also yields health, education, economic and social benefits (Gilligan 2006).

Management of State-owned protected areas

When new State-owned protected areas are gazetted it can take some time for their management to be fully implemented. QPWS takes on the duties and responsibilities of a landholder as well as conservation management and visitor obligations.

Natural and cultural values, threats, and Indigenous and other community interests need to be understood, assets and management needs reviewed, and the first stages of planning undertaken. Decisions need to be made about interim and longer-term staffing, management approaches, pest control, fire management, and visitor facilities and services. Existing assets, such as roads, houses, sheds and equipment may need to be repaired or closed to ensure public safety standards are met.

Resourcing new protected areas

Protected areas are resourced so QPWS can carry out the two primary park management functions of conservation, which includes management of its natural and cultural resources, and presentation, which relates to visitor management and community engagement.

Factors influencing the cost of and approach to managing a protected area include:

- Traditional Owner involvement in management and related issues
- size and configuration of the protected area
- landscape, cadastral and land-use context
- biophysical environment and threats, such as susceptibility to fire and invasive weeds
- geographical location (proximity to existing management base and population centres)
- type of protected area
- visitor use and infrastructure
- non-extractive uses, such as leases, occupational permits
- historical and political factors, for example, elite status as World Heritage
- public concern, interest and expectations
- special features of concern such as risks to staff and visitor safety.

The resources needed to manage a new protected area will vary according to a number of factors. After the establishment phase, and once the area has been assessed, it will be assigned to a category according to its values, threats and visitor use potential and character. This categorisation will determine the resources needed for its continual management to accepted standards. The following classes indicate a potential hierarchy for resourcing.

Establishment phase

Parks for which QPWS has newly assumed management generally fall into this class. Activities during the establishment phase will maintain the condition until management directions have been determined. At this time assessment of the reserve's values and potential and the first stage of strategic planning is undertaken. For example, it will be decided whether visitors will be encouraged in the short term and whether urgent action is needed to manage fire or pests. Basic signs will be installed and the safety of visitors and staff will be given priority. Some reserves may not require any further investment; establishment funding will be adequate for the ongoing management of the estate area.

Management phase

Investment at this stage offers a higher degree of planned management, including active application of management principles, protection of natural and cultural values and promotion of tourism and commercial activities where appropriate. Costs will vary depending on the kind of protected area and specific management requirements; for example, small reserves close to urban centres are very expensive to manage.

Three distinct kinds of protected areas can be recognised in the management phase—explorer, popular and iconic reserves.

Explorer: funding will focus on immediate urgent issues and the development of a forward program to manage for stability. Capital investment at this level will enable adequate firebreaks, road access, signs and some fencing to be provided.

Boodjamulla National Park, Queensland. Photo: Fiona Leverington.

Popular: funding will support management of all priority issues and the development of a forward work program, and a strategic investment and asset management plan. Capital investment will provide for firebreaks, road access, signs and boundary fencing in most cases. It will provide management infrastructure to support an enhanced ranger presence.

Iconic: funding will allow a comprehensive management program enabling a program of continuous improvement to facilities, managed work programs and outputs. There will be increased opportunities managed under a rigorous planning framework. Capital investment at this level will provide firebreaks, road access, signs and boundary fencing. It may provide management infrastructure to support a permanent ranger presence.

Many of our magnificent grasslands still need protection. Photo: DERM.

Nature refuges

Queensland's commitment to a comprehensive, adequate and representative protected area system embraces a major community-based component. This component runs parallel with the publicly owned and managed protected area estate and seeks to achieve complementary conservation outcomes.

Nature refuges provide the opportunity for landholders—individuals, families, trusts, trustees, companies and corporations—to become directly involved in Queensland's protected area system. The growth in nature refuges is shown in Figure 2.

The nature refuges program increasingly contributes to maintaining and rebuilding the state's natural capital by protecting biodiversity, and maintaining healthy ecosystems and ecosystem services. Nature refuges focus on sustainable land management. They are created by targeting particular species and ecosystems for protection (and in some cases enhancement) in a voluntary conservation agreement between a landholder and the Queensland Government.

Nature refuges are not acquired in the same way as national parks, and the landholder retains the same ownership and responsibility for the land as before a nature refuge was declared. Public access to and use of a nature refuge is at the discretion of the landholder within the rights they hold over the land and the terms of the agreement they make with the State of Queensland.

Nature refuges are formally recognised and protected areas gazetted under legislation, and not all private or leasehold land can qualify. A nature refuge must be able to make a clear and substantial contribution to conservation in Queensland. In addition, the values for which the nature refuge was declared must be assessed as being viable into the future.

Nature refuges provide a highly flexible mechanism that is adaptable to the individual needs of landholders, their needs and aspirations for their property, and specific conservation needs. This includes:

- securing and improving landscape-level conservation corridors
- threatened species habitat preservation and restoration
- protecting and re-establishing threatened species
- private conservation areas
- balancing effective conservation with production
- protecting localised and often isolated areas of endangered and of-concern regional ecosystems.

Once a nature refuge is agreed and declared, it is a legally binding, secure instrument that survives subsequent changes of ownership and generations. This means that the landholder who entered into the agreement with the State of Queensland is a partner in ensuring the conservation management of that land will continue as the original landholder wished.

Positive outcomes for biodiversity can also be achieved through sustainable land management and nature refuge agreements. Photo: DERM.

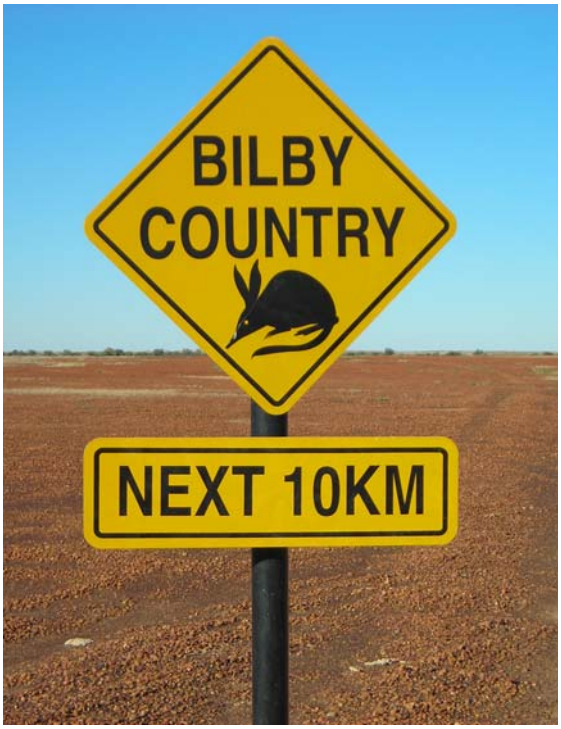
.

Increasing tourism and recreation opportunities

Queensland's protected areas provide some of the most spectacular natural attractions in Australia. Not only is the expansion of the protected estate important from a biodiversity and resilience perspective, but it is also increasingly recognised that Queensland's natural areas provide a vital resource for its people for recreation and environmental education. In addition, they offer a competitive edge in the international and domestic tourism markets. The protected estate as it expands in the future will play a critical role in developing a robust and sustainable tourism industry.

The tourism and recreation value of enhancing the protected area estate lies in providing opportunities for people to enjoy the natural values and attractions of the areas, for nature-based recreational activities and for commercial tourism ventures in response to market demand. Visitors to protected areas include local people, who enjoy regular activities ranging from walking for health reasons to bird-watching, domestic tourists (from within Queensland), interstate visitors and international tourists. Tourists may visit a protected area as an incidental part of a trip to an area, or they may be primarily attracted to the area because of its protected areas. For example, many visitors to far north Queensland come to experience the Great Barrier Reef and rainforests.

Many tourists travel around the state and visit a number of national parks as a key focus of their journey. As the protected area estate is increased, it will be possible to create more opportunities for people to travel in this way, knowing that they will be able to visit, picnic in or camp at a protected area in any part of the state. The variety of routes with interesting and attractive nature-based opportunities will increase, and tourists will also be likely to spend longer in areas which have great potential but where there is currently little open access to natural sites away from the main highway.



Tourism has become a major industry for western Queensland shires. Photo: Rob Brodribb.

Tourism industry representatives have stressed that in many cases, especially away from the most highly visited sites, the main value of national park tourism will come not from tourist operations but in the benefits for local communities of having tourists stay in an area for an extra day or two. New protected areas will in this way assist in the economic welfare of rural and regional communities.

Trends indicate that traditional nature-based activities, such as bushwalking, are declining, while demand for activities, such as mountain biking and other adventure activities, is increasing. It will be important to create opportunities for appropriate and sustainable nature-based adventure tourism and recreation.

The tourism sector has an established a strategic-planning framework, based on market research and forecast trends, which informs planning and guides decisions and investments to build a robust and holistic tourism industry. The Queensland Tourism Strategy provides the 10-year vision for the Queensland tourism industry; protected areas are a fundamental part of this plan. As part of this framework, destination management plans (DMPs) and Tourism Opportunity Plans (TOPs) provide base information that indicates the opportunities that protected areas provide. In addition, some regions have undertaken nature-based tourism planning which also provides guidance.

Although expanding the protected estate is an important part of ensuring the long-term future for tourism in Queensland, it must be supported by substantial investment in visitor and resource management. This will ensure Queensland's natural attractions retain their unique values and are accessible in ways that remain competitive in the international and domestic tourism markets. Creating a diverse range of low-impact ways to experience Queensland's parks and forests is critical to underpinning the tourism value of these areas.

In many cases, providing basic access and minimum facilities in new protected areas will be the most appropriate approach. However, in other cases more sophisticated facilities will be constructed. MaMu Rainforest Canopy Walkway in Wooroonooran National Park in the Wet Tropics is an example of a facility which provides a unique experience of a natural area for visitors and an additional tourism product for the industry. As part of the Queensland Tourism Strategy, DERM, in collaboration with tourism and conservation stakeholders, has identified a range of tourism infrastructure opportunities that will expand the base product and create unique experiences in Queensland's natural areas. Identified opportunities range from semi-permanent luxury safari-style tents on Cape York in north Queensland and Lamington National Park in the south, to a visitor hub and interpretive centre at Natural Bridge, Springbrook National Park in the Gold Coast hinterland . Fostering innovative tourism and recreation product development is important in ensuring Queensland remains competitive in the nature-based tourism market.

Hikers, Southeast Queensland bioregion.
Photo: DERM.

Opportunities offered by new protected areas can be considered in a number of categories:

- increased recreational opportunities for local and regional communities, especially in the expanding South-east Queensland and other coastal areas
- potential for larger-scale intensive tourism use in the coastal areas
- opportunities to boost drive-based tourism, which can be of immense importance to rural and regional communities.

More strategic planning for increase protected area tourism and recreation opportunities will be conducted. Opportunities identified to date include:

South East Queensland Country

'South East Queensland Country' is a tourism-destination project in one of Australia's fastest growing population areas. Expansion of the protected area estate in this region will be critical to supporting the growing population base and demand for diverse 'soft' adventure recreational activities, such as mountain biking, rock-climbing and orienteering. Many scenic and interesting areas have been converted from State forest to national park in recent years. Other potential opportunities include:

- Proposals in the New England Tableland: new protected areas here will support the off-park accommodation identified as a need through the TOP and will also provide for the identified increasing recreational demands of a range of user groups.
- Areas around Nanango would support the existing Country Way touring route and may provide opportunities for adventure activities such as mountain biking, flagged as being a need across the South Burnett region. In the western part of this area, new and proposed protected areas added to existing parks could greatly boost road tourism and recreation opportunities along a fascinating adventure circuit. Over a few days or longer, people can visit parks with a feeling of remoteness and ruggedness only a few hours from Brisbane. This route will lead to a network of proposed parks north and then north-east from Dalby. This route could include a number of new parks acquired through the South East Queensland Forests Agreement (SEQFA) and Western Hardwoods processes.
- A number of areas identified for expansion in the South East Queensland Country region will support the extension to the Brisbane Valley Rail Trail with the possibility to provide multi-user opportunities, camping and day-use facilities.

- Protected areas around the Scenic Rim are recognised tourism attractions in close proximity to Brisbane providing short-drive opportunities, camping, and bush trekking or hiking. Proposed expansions in this area will not only improve management of existing protected areas, but will underpin opportunities for tourism.

Central Queensland region

Although tourism in this resource-rich region is still a developing industry, there is recognition that the challenge for this area is to diversify activities to ensure long-term economic and regional sustainability (Central Queensland Tourism Opportunity Plan 2009-2019). Tourism planning identifies that the unique natural assets of the area will be fundamental in developing new attractions; national parks are recognised as being a major opportunity.

The creation of a more national park areas on the coast between Bundaberg and Gladstone will secure some of the few prime undisturbed coastal areas. This will provide significant increased recreation opportunities for people from Gladstone to Brisbane.

The Gulf and Savannah Way

Tourist routes across the north are growing in popularity but could be better developed with strategically placed park facilities. This will provide much-needed economic boosts to northern towns and support the key tourism drive The Savannah Way, linking Cairns and Broome.

Opportunities for tourists to get off road and experience nature, or camp in natural surroundings, are very limited. New protected areas will enhance and develop The Savannah Way.

Proposed protected areas in the Gulf Plains are believed to rival Kakadu in their tourism potential. Opportunities will include viewing of birds and wetlands, and remote camping and picnic sites, which will attract some of the numerous visitors to the Karumba area whose experiences of the area's natural values is currently restricted. The critical involvement of Traditional Owners in this region provides opportunities for Indigenous tourism ventures.

Mackay region

The Eungella escarpment and Pioneer Valley are identified as unique elements of the Mackay region that are critical to the tourism sector. Existing parks will be complemented by State forest conversion and proposed acquisitions. This will create many opportunities in the form of increased natural attractions and nature-based recreation opportunities to support the development of a tourism node at Eungella (Mackay Whitsunday Regional Tourism Investment and Infrastructure Plan 2006-2016).

Townsville region

The Pinnacles provides important scenic attractions and nature-based recreation opportunities close to Townsville. This area could provide excellent environmental education opportunities given its location next to a regional centre. Other opportunities include rainforest close to Townsville, which has significant natural attractions in steep slopes, rocky outcrops, and great views to the coast and offshore islands.

Cape York

Nature-based tourism has been identified as a growth sector in the Cape York Peninsula region. Tourism is generally based on the Cape's natural assets, specifically its unspoilt remoteness and open spaces, as well as its challenging terrain and the lack of commercialisation in the region. Visitor research has identified that the adventurous journey to Cape York is as much a motivation to travel there as the destination itself (Tourism Queensland 2003). The proposal for nature-based tourism to play a role in the future of the region is based on the flow of tourists along the Peninsula Development Road, which provides access to the peninsula and its unique natural assets. Proposed additions to protected area estate in the form of national park (CYPAL) will extend tourism opportunities to benefit local Indigenous communities.

Big Sky Country—the Outback

There is potential to provide more bush-based camping opportunities along the main western road-trip route from Brisbane to Longreach, where there are vast gaps between national parks. Areas of high significance for cultural heritage will also be conserved. Additional protected areas in the Channel Country would increase the few opportunities for visitors to experience the natural environment within easy reach of the region's towns, either on day trips or camping. This area could increase the number of visitors and their length of stay in the area and cater for a range of visitor types. Partnership in tourism with Traditional Owners is a very good option. Other areas identified in the south-west include a large park with major wetlands on the route from New South Wales.

Most new national parks will provide only basic facilities, but will allow better access for campers to remote parts of Queensland. Photo: Rob Brodribb.

A Longreach to Julia Creek 'ring of green' has been proposed, where new protected areas could expand on existing opportunities for people undertaking long road trips as well as day tours from Longreach, complementing existing protected areas on the edge of the Mitchell Grass region

Mt Isa and the Northwest Highlands

For biodiversity purposes, acquisition in this area is a high priority. Major new park proposals here will also provide much-needed recreational opportunities for Mt Isa residents and visitors and link northwards to the Savannah Way.

The Einasleigh Uplands

An important hub for protected areas will be created across the Einasleigh Uplands, where there are a number of proposals with good camping areas, springs, wetlands, attractive scenery and wildlife in a rugged landscape.

The Wet Tropics

An area important for guided tourism particularly the World Heritage renowned rainforests and in the wider Tablelands area. Nature-based tourism is well documented to provide economic sustenance for this North Queensland area and the natural features of the area are the primary attractions. Indigenous tourism is being supported to also be a primary attraction.

The Cairns area is internationally renowned as a quality mountain biking destination. Proposals are well developed for a significant mountain bike attraction in the Atherton Tablelands.

It is important to consider the tourism and recreation values of any areas being considered for inclusion in the protected area estate.

Glossary

Agribusiness	The various businesses collectively that process, distribute, and support farm products.
Algorithms	A set of instructions or mathematical equations for solving a problem.
Assemblage	The group of species that have assembled and live in an area.
Biodiversity	The variety of all life forms on earth, the different plants, animals and micro-organisms, their genes, and the terrestrial, marine and freshwater ecosystems of which they are a part.
Biophysical	The study of living things and the physical environment in which they live.
Bioprospecting	Searching for plant or animal species for use as a source of commercially exploitable products, such as pharmaceuticals.
Bioregion	Large, geographically distinct areas of land or sea with common characteristics, such as geology, landform patterns, climate, ecological features, and plant and animal communities.
Catchment	The area drained by a river or body of water.
Corridors	Continuous remnant vegetation or patches of vegetation in the landscape that, if managed for conservation values, provide connectivity benefits. This will help ensure that connected ecological processes can continue. Corridors can be mapped at any scale, from the statewide to local scale.
C-plan	A software tool used to investigate the contribution of specific parcels of land to a comprehensive, adequate and representative protected area system. Particularly useful in helping identify areas that best meet specific conservation targets.
Custodianship	A person entrusted with guarding or maintaining a property.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
Ecotone	A transitional zone between two ecological communities, as between a forest and grassland or a river and its estuary.
Endemic	Native to a particular area and found (naturally) nowhere else.
Endemism	Confined in occurrence to a local region.
Ephemeral	Lasting a very short time; transitory.
Escarpment	A long, more or less continuous cliff or relatively steep slope facing in one general direction, produced by erosion or faulting.
Fragmentation or fragmented landscapes	The process whereby patches of similar habitat, such as forests, are split or isolated, often occurring as a result of human activities such as clearing and logging. Fragmentation results in a loss in the amount and quality of habitat, it isolates species and limits genetic flow.
Gazetted	Officially declared.
Geomorphology	The study of the origin and evolution of the earth's landforms, both on the continents and within the ocean basins. It is concerned with the internal geologic processes of the earth's crust, such as tectonic activity and volcanism, that constructs new landforms as well as externally driven forces of wind, water, waves, and glacial ice that modify such landforms.

Habitat	The place where a population (e.g. human, animal, plant, microorganism) lives and its surroundings, both living and non-living.
Hydrological	The branch of geology that studies water on the earth and in the atmosphere, including its distribution, uses and conservation.
In perpetuity	The condition of an estate that is limited so as to be inalienable either perpetually or longer than the period determined by law.
Inalienable	Not able to be transferred to another.
Indigenous	Originating in and characteristic of a particular region or country; native.
Landforms	A recognisable, naturally formed feature on the Earth's surface.
Leasehold land	Land that is administered by the State under the *Land Act 1994*. Leases and licences are granted over State land for activities, such as grazing, agriculture, industry and tourism.
Macropod	Marsupials belonging to the family *Macropodidae*, which includes kangaroos, wallabies, tree-kangaroos, pademelons and several others.
Marxan	A software program that can be used to identify an efficient spatial network of protected areas to meet selected targets. A number of different scenarios can be explored using Marxan, based on different levels of representation of regional ecosystems and inclusion of infrastructure costs.
Micro-climate	The climate of a small, specific place within a larger area.
National Reserve System	The National Reserve System is Australia's network of protected areas, conserving examples of natural landscapes and native plants and animals for future generations. It is made up of protected areas under commonwealth, state and territory legislation, Indigenous Protected Areas and private protected areas.
Queensland Herbarium	The Queensland Herbarium is the Department of Environment and Resource Management centre for research and information on the Queensland flora, vegetation and plant communities and provides a wide range of botanical information including information on poisonous plants, weeds and regional ecosystems. The Queensland Herbarium houses a world-class specimen collection built on a long history devoted to discovering, describing and documenting the Queensland flora. New native species are being discovered and documented each year, including plants, algae, lichens and fungi.
Queensland Parks Master Plan	2001 Master Plan for Queensland's Parks System outlines the direction for the management of Queensland's protected areas.
Rangelands	Areas that extend across low-rainfall and variable climates, including arid, semiarid and some seasonally high-rainfall areas. The term includes a diverse group of relatively undisturbed ecosystems such as tropical savannahs, woodlands, shrublands and grasslands.
Refugia	An area where special environmental circumstances have enabled a species or a community of species to survive after extinction in surrounding areas.
Regional ecosystems	Regional ecosystems (REs) are communities of vegetation that are consistently associated with a particular combination of geology, land form and soil in a bioregion. The Queensland Herbarium has mapped the remnant extent of regional ecosystems for much of the state using a combination of satellite imagery, aerial photography and on-ground studies. Each regional ecosystem has been assigned a conservation status, which is based on its current remnant extent (how much of it remains) in a bioregion. Regional ecosystems are declared in the Vegetation Management Regulation 2000.
Resilience	An ecosystem's ability to recover and retain its structure and function following a temporary, external shock event.

Revegetation	The planting of native species in areas that have been cleared or highly modified. The mix of species may not be the same as originally occurring in that patch of vegetation.
Savannah	A plain characterised by coarse grasses and scattered tree growth, especially on the margins of the tropics where the rainfall is seasonal.
Sclerophyllous	Leaves which are hard and thickened, characteristic of many Australian native plants, in particular *Eucalyptus* species.
Serpentinite	A metamorphic rock consisting almost entirely of minerals in the serpentine group. Serpentinite forms from the alteration of ferromagnesian silicate materials, such as olivine and pyroxene, during metamorphism.
Socioeconomic	The combination or interaction of social and economic factors.
Spatial	Of or pertaining to space.
Stepping stone corridors	Where core areas are connected via a number of small habitat patches in close proximity to each other.
Stepping stones	See 'stepping stone corridors'.
Subregion	Major landscapes within each bioregion, each having a distinctive pattern of landform and soils.
Substrates	The surface on or in which plants, algae, or certain animals, such as barnacles or clams, live or grow. A substrate may serve as a source of food for an organism or simply provide support.
Surrogate	A person or thing acting as a substitute.
Synthesis	The process of combining objects or ideas into a complex whole.
Terrestrial	Of or belonging to the land as opposed to the sea or air.
Topography	the relief features or surface configuration of an area.
Wetlands	A lowland area, such as a marsh or swamp that is saturated with moisture, especially when regarded as the natural habitat of wildlife.
Whole-of-landscape	Holistic approach, looking not just at biodiversity issues in all parts of the landscape and seascape, but also issues such as local economies, agriculture, eco-tourism, and the health and social benefits for communities.
WildNet	A computerised information database on Queensland's wildlife.

References

Ball I & Possingham H 2000, *MARXAN (V1.8.2): Marine Reserve Design Using Spatially Explicit Annealing, a Manual*

Ballantyne R, Brown R, Pegg S & Scott N 2008, *Valuing tourism spend arising from visitation to Queensland national parks*, CRC for Sustainable Tourism.

Beger M, Grantham HS, Pressey RL, Wilson KA, Peterson EL, Dorfman D, Mumby PJ, Lourival R, Brumbaugh DR & Possingham HP 2010, 'Conservation planning for connectivity across marine, freshwater, and terrestrial realms', *Biological conservation*, vol. 143, pp. 565-575.

Curtis IA 2004, 'Valuing ecosystem goods and services: a new approach using a surrogate market and the combination of a multiple criteria analysis and a Delphi panel to assign weights to the attributes', *Ecological Economics*, vol. 50, pp. 163-194.

Department of Environment and Resource Management 2010, 'Delbessie Agreement', Queensland Government, Brisbane, www.nrw.qld.gov.au/land/state/rural_leasehold/strategy.html

Dudley N 2008, *Guidelines for Applying Protected Area Management Categories,* IUCN, Gland, Switzerland.

Dudley N, Parrish JD, Redford KH & Stolton S 2010, 'The revised IUCN protected area management categories: the debate and ways forward', *Oryx*, vol. 44, pp. 485-490.

Dunlop M & Brown PR 2008, *Implications of Climate Change for Australia's National Reserve System - A Preliminary Assessment. Report to the Department of Climate Change, February 2008*, Department of Climate Change, Canberra, Australia.

Environmental Protection Agency 2002, *Biodiversity Assessment and Mapping Methodology Version 2.1*, Queensland Government, Brisbane.

Fenner F (Ed.) 1975, *A national system of ecological reserves in Australia,* Australian Academy of science Canberra.

Fischer J & Lindenmayer DB 2007, 'Landscape modification and habitat fragmentation: a synthesis', *Global Ecology and Biogeography*, vol. 16, pp. 265-280.

Gilligan B 2006, *The Indigenous Protected Areas Programme 2006 Evaluation* Department of the Environment and Heritage, www.deh.gov.au/indigenous/publications/ipa-evaluation.html, Canberra.

Hannah L, Midgley G, Andelman S, Araújo M, Hughes G, Martinez-Meyer E, Pearson R & Williams P 2007, 'Protected area needs in a changing climate', *Frontiers in Ecology and Environment*, vol. 5, pp. 131-138.

Keddy PA, Fraser LH, Solomeshch AI, Junk WJ, Campbell DR, M.T.K. A & Alho CJR 2009, 'Wet and wonderful: the world's largest wetlands are conservation priorities', *BioScience*, vol. 59, pp. 39-51.

Lamberson RH, Noon BR, Voss C & McKelvey KS 1994, ' Reserve Design for Territorial Species: the effects of patch size and spacing on the viability of the Northern Spotted Owl', *Conservation Biology*, vol. 8, pp. 185-195.

Laurance WF & Curran TJ 2008, 'Impacts of wind disturbance on fragmented tropical forests: a review and synthesis', *Austral Ecology*, vol. 33, pp. 399-408.

Lieberknecht L, Ardron JA, Wells R, Ban NC, Lotter M, Gerhartz JL & D.J. N 2010, 'Addressing Ecological Objectives through the settting of targets. ', In *Marxan Good Practices Handbook, Version 2.*, (Ed. JA Ardron, Possingham, H.P., and Klein, C.J.), Pacific Marine Analysis and Research Association, Victoria, BC.

Maller C, Townsend M, St Leger L, Henderson-Wilson C, Pryor A, Porosser L & Moore M 2008, *Healthy parks, healthy people: The health benefits of contact with nature in a park context. A review of relevant literature. 2nd edition*, Deakin University and Parks Victoria, Melbourne.

Morgan G 1988, *Provinces of the Brigalow Belt.* , Report prepared by QNPWS, Brisbane.

Morgan G, Lorimer M, Morrison A & Kutt A 2002, *The conservation of biodiversity in the Desert Uplands*, Nothern regional Office, Environmental Protection Agency, Townsville.

Morgan G & Terrey J 1990, 'Natural Regions of Western New South Wales and their use for Environmental Management', *Proceedings Ecological Society Australia*, vol. 16, pp. 467-473.

Morton SR, Short J & Barker RD 1995, *Refugia for biological diversity in arid and semi-arid Australia. Biodiversity Series Paper No 4.*, Department of the Environment, Sport and Territories, Commonwealth of Australia, Canberra.

National Reserve System Taskforce 2009, *Australia's Strategy for the National Reserve System2009–2030*, The Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Natural Resource Management Ministerial Council 2004, *Directions for the National Reserve System - A Partnership Approach*, Australian Government, Department of the Environment and Heritage, Canberra, ACT.

New South Wales National Parks and Wildlife Service 1999, 'The Conservation Planning System (C-Plan) version 3.11. '.

Possingham HP, Ball IR & Andelman S 2000, 'Mathematical methods for identifying representative reserve networks', In *Quantitative methods for conservation biology*, (Ed. SFaM Burgman), pp. 291-305, Springer-Verlag, New York.

Possingham HP, Wilson KA, Andelman SJ & Vynne CH 2006, 'Protected areas: goals, limitations and design', In *Principles of Conservation Biology*, (Eds MJ Groom, GJ Meffe & CR Carroll), pp. 509-533, Sinauer Associates, Inc, Sunderland, MA.

Pressey RL, Cabeza M, Watts ME, Cowling RM & Wilson KA 2007, 'Conservation planning in a changing world ', *Trends in ecology and evolution*, vol. 22, pp. 583-592

Pressey RL, Cowling RM & Rouget M 2003, 'Formulating conservation targets for biodiversity pattern and process in the Cape Floristic Region, South Africa', *Biological Conservation*, vol. 112, pp. 99-127.

Purdie R 1986a, 'The development of a national park system for Queensland's mulga region', In *The Mulga Lands*, (Eds D McKenzie & PS Sattler), The Royal Society, Brisbane.

Purdie R 1986b, *Nature Conservation Strategy - Mulga Lands (WWF Project 63)*, Queensland National Parks and Wildlife Service

Queensland Herbarium 2009, *Regional Ecosystem Description Database (REDD). Version 6.0b Updated November 2009, (November 2009)*, Department of Environment and Resource Management, Brisbane.

Sattler P 1986, 'Nature conservation in Queensland: Planning the matrix', *Proceedings of the Royal Society of Queensland*, vol. 97.

Sattler P & Williams R (Eds) 1999, *The Conservation Status of Queensland's Bioregional Ecosystems,* Environmental Protection Agency, Brisbane.

Secretariat of the Convention on Biological Diversity 2000, 'Decisions adopted by the Conference of the Parties to The Convention on Biological Diversity at its Fifth Meeting', In *Conference of the Parties to the Convention on Biological Diversity*, United Nations Environment Programme, Nairobi, Kenya.

Soulé ME, Mackey BG, Recher HF, Williams JE, Woinarski JCZ, Driscoll D, Dennison WC & Jones ME 2004, 'The role of connectivity in Australian conservation', *Pacific Conservation Biology*, vol. 10, pp. 266-279.

Specht R, Roe EM & Boughton VH 1974, 'Conservation of major plant communities in Australia and Papua-New Guinea', *Australian Journal of Botany supplementary series*, vol. 7.

Stanton JP & Morgan MG 1977, *The rapid appraisal of key and endangered sites. Report to the Department of Environment, Housing and Community Development* University of New England, Armidale.

Steffen W, Burbidge A, Hughes L, Kitching R, Lindenmayer D, Musgrave W, Stafford Smith M & Werner P 2009, *Australia's biodiversity and climate change: A strategic assessment of the vulnerability of Australia's biodiversity to climate change: A report to the Natural Resource Management Ministerial Council commissioned by the Australian Government,* CSIRO Publishing, Collingwood.

Svancara LK, Brannon R, Scott JM, Groves CR, Noss RF & Pressey RL 2005a, 'Policy-Driven versus Evidence-Based Conservation: A Review of Political Targets and Biological Needs', *Bioscience*, vol. 55, pp. 989-995.

Svancara LK, Brannon R, Scott JM, Groves CR, Noss RF & Pressey RL 2005b, 'Policy-driven versus evidence-based conservation: a review of political targets and biological needs.(Forum)', *BioScience*, vol. 55, p. 989(987).

The Economics of Ecosystems and Biodiversity 2009, *The Economics of Ecosystems and Biodiversity for National and International Policy Makers. Summary: Responding to the Value of Nature*, United Nations Environment Programme.

The Nielsen Company 2007, *Community Survey: Queensland Parks and Wildlife Service Final Report*, Queensland Parks and Wildlife Service, Brisbane.

Wilson B & Egan S 1996, *Model for bioregional management Mulgalands South West Queensland. Final report to the Australian Nature Conservation Agency for Phase 1 of the National Reserve System Cooperative Program Project N302*, Department of Environment, Brisbane.

Wilson B & Young P n.d., *Conservation Strategy: Channel Country Biogeographic Region Queensland. Report submitted to Australian National Parks and Wildlife Service Endangered Species Program Project no 14.*, Conservation Strategy Branch, Conservation Division, Department of Environment and Heritage.

Winter J 2004, 'Forest mammals of Northern Queensland', In *Conservation of Australia's forest fauna (second edition)*, (Ed. D Lunney), Royal Zoological Society of New South Wales, Mossman.

Young P 1990, *Brigalow Lands Study, report on Stage One*, Q.NPWS, Birsbane.

Young P 2007, 'The CAR principle of adequacy of the National Reserve System in the context of climate change', In *Protected Areas: buffering nature against climate change. Proceedings of a WWF and IUCN World Commission on Protected Areas Symposium, 18-19 June 2007, Canberra*, (Eds M Taylor & P Figgis), pp. 100-116, WWF-Australia, Sydney.

Appendix 1: Protected area types

The protected area system in Queensland includes a range of different types or classes (see Table 1 and Table 2) declared under the *Nature Conservation Act 1992*. This range allows for different kinds of protected areas to be declared for different functions. Some are very strictly protected, while others are multi-use reserves allowing for both conservation and production, and may be declared by agreement over private land to protect specific values.

Table 1. Protected area types.

Note: these are the categories of protected area most likely to be suitable for Queensland—for a complete description of categories see the *Nature Conservation Act 1992*.

Protected area category	Criteria for selection of this category
National parks Most protected areas in Queensland are national parks. The management principles for national parks are: • as the cardinal principle, to provide, to the greatest possible extent, for the preservation of the natural condition and the protection of cultural resources • present the area's cultural and natural resources, and their values; and ensure that the only use of the area is nature-based and ecologically sustainable.	Areas that: • contribute to the CAR system of reserves • may be suitable for public access and recreation • may have cultural values • are in generally good condition • generally are substantial enough to be considered ecologically self-sustaining and manageable land parcels (or may adjoin and complement existing protected areas).
National parks (scientific) These are established to protect places or species with exceptional scientific value. This type of protected area gives a high level of protection for nature. Scientific study and monitoring are allowed under strict conditions, and parks can be managed as necessary to control threatening processes. Entry to national parks (scientific) is by special permit and there is no provision for recreational use. Epping Forest, the site of the last remaining colony of the endangered northern hairy-nosed wombat, is a national park (scientific).	Areas that: • have exceptional scientific value or containing species of exceptional value • may require active management.
National parks (Cape York Peninsula Aboriginal land) This new class allows for existing and proposed national parks to become Aboriginal land and to be dedicated and managed as a national park (CYPAL). It allows for joint management of national park land by Traditional Owners (represented by a land trust) and the Department of Environment and Resource Management (DERM) and is to be managed, as far as practicable, in a way that is consistent with any Aboriginal tradition applicable to the area, including any tradition relating to activities in the area.	Areas that are created under the provisions of the *Cape York Peninsula Heritage Act 2007*.
Conservation parks Like national parks, conservation parks are managed to: • conserve and present the area's cultural and natural resources and their values • permanently conserve the area's natural condition. Although the primary purpose is still conservation, a greater range of activities can be undertaken in conservation parks than in national parks. Any commercial use of the area's natural resources, such as fishing and grazing, must be ecologically sustainable. Educational activities and nature-based recreation are encouraged. Conservation parks can be managed or co-managed by trustees, such as local government.	Areas that: • will contribute to the CAR system but may require a level of management support to ensure the long-term ecological sustainability of the area • may be suitable for joint management or devolved management to trustee, such as local government • may be suitable for continued sustainable use such as grazing • may be suitable for horse-riding, fishing or other uses.

National parks (recovery) Where an area is intended to become national park, but has been degraded and needs some manipulation of its natural resources to restore its conservation values, it can be declared a national park (recovery)—in effect, a 'national park in waiting'. On this kind of park, for example, native vegetation might have been cleared in the past and replaced with a plantation of exotic trees. The restoration activity might be removing the unwanted plantation timber, followed by planting or passive regeneration of the damaged land. As well as the restoration activities, the management principles require that the park is managed to protect or restore its natural condition and to protect its cultural values so it can be declared a national park. Any commercial or other use of the park's natural resources to restore its conservation values must be consistent with an approved regeneration plan, and other uses of the park must be nature-based.	Areas that: • will contribute to the CAR system or be a link between existing or proposed protected areas, but are currently in poor condition or require restoration or revegetation • will meet the national park criteria once the natural values have recovered either naturally or with management support.
Resources reserves Resources reserves are declared over land that has high conservation value but cannot be reserved as national or conservation park, for example, areas subject to fossicking, mining or intensive tourism. Sometimes resources reserves might protect land that will eventually be converted to national park but need to be rehabilitated first. Resources reserves are managed to: • recognise and protect the area's cultural and natural resources • provide for the controlled use of those resources • ensure the area is kept mainly in a natural condition. Trustees can be appointed to manage a resources reserve. An example of this type of protected area is Palmer River Goldfields Resources Reserve in north Queensland.	Areas that would otherwise meet the criteria for national park or conservation park, and are managed accordingly, but where there is currently an impediment to the declaration of the area as the preferred tenure, such as mining potential.
Nature refuges Landholders can help protect native wildlife and wildlife habitat by having their property declared a nature refuge. A nature refuge can be declared over any land, State or freehold, to protect significant natural resources, such as wildlife habitat, and to provide for controlled use of those natural resources, taking into account the landholder's interests. This does not change the ownership of the land. Once a property, or part of a property, becomes a nature refuge, a voluntary conservation agreement is developed to protect the land's conservation value and to guide the way the property is managed. This agreement is between the State of Queensland and the landholder and may be binding on future landholders. Activities and management arrangements are detailed in the conservation agreement. The property can still be used for agriculture, grazing, timber production and tourism, provided those activities are ecologically sustainable.	Areas that have been assessed of significant value for conservation and where landholders are willing to enter into a conservation agreement: • are suitable to remain in private ownership as freehold or leasehold tenure • may be used for continuing sustainable management as defined in the conservation agreement • will be managed by the landholder. Nature refuges may be part of core conservation areas, important conservation corridors, or the broader landscape. Except at the discretion of the landholder, public access is not allowed.
Coordinated conservation areas A coordinated conservation area provides for consistent management of adjacent areas of varying tenure to conserve the area's natural and cultural values, and take account of educational, commercial, recreational and other values. Landholder interests must be maintained.	This category can be placed over a number of different protected area types, as well as other lands such as local government reserves, to provide for a coordinated approach to management. CCAs have great potential for the establishment of multi-tenure core protected areas.

In addition, the National Reserve System recognises and provides support for two kinds of protected areas that are not owned or managed by Queensland and do not have protection under the *Nature Conservation Act 1992* unless they are also declared as nature refuges.

Table 2. Other categories not under the *Nature Conservation Act 1992*.

Protected area category	Criteria for selection of this category
Private protected areas These are lands where the title or lease has been acquired by a group specifically dedicated to conservation and in many cases subsidised through the National Reserve System. Management is undertaken by the landholder in accordance with their responsibilities as part of the NRS. These properties should also be gazetted as nature refuges. Public access is generally not allowed except with permission.	Lands that are assessed by the conservation NGOs as of high significance and in keeping with their strategic planning Discussions between DERM and these groups will ensure that a complementary approach is taken In some cases landholders have preferences to deal with NGOs Public access is by permission of the landholder.
Indigenous protected areas IPAs are declared over Indigenous lands and are part of the National Reserve System, where an agreement between the NRS and Indigenous owners has been reached.	Indigenous lands of conservation value where landholders have decided to enter into an agreement and manage their lands as IPAs. To date the State has not been involved in the selection or declaration of these areas.