This handbook forms part of the three products produced during the compilation of the Mpumalanga Biodiversity Conservation Plan (MBCP).

CITATION:

OTHER MBCP PRODUCTS INCLUDE:


Affiliations: 1 Private, 2 MTPA, 3 DALA, 4 SANBI,
ISBN: 978-0-620-38085-0

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The Mpumalanga Tourism and Parks Agency welcomes comment and feedback on the Handbook, in particular the identification of errors and omissions. Provision of new information that should be incorporated into any revised edition of the Biodiversity Plan or this handbook would be particularly appreciated. For this or any other correspondence please contact:

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ACKNOWLEDGMENTS

The MBCP is a truly cooperative effort. Mpumalanga had precious few people with any experience in systematic biodiversity planning at the start of this project. The support provided was such that, in the end, these local shortcomings seemed to be an advantage rather than the opposite. It resulted in many people contributing and a great willingness to listen and learn on the part of the production team. We pay special thanks to the Development Bank of Southern Africa (DBSA) for its generous financial support of this project.

The authors and the MBCP Steering Committee, under the chairmanship of Charles Ngobeni, would like to thank sincerely, all those who participated and generously gave of their time. In particular, the personal drive and strong institutional support from MEC Madala Masuku, was particularly helpful. The long list of supporters includes:

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Forestwoodland is particularly well endowed with living natural resources, collectively referred to as biodiversity. The conservation of this biodiversity and the ecosystem services that it delivers, is recognised as a legitimate and sustainable form of land use.

The Provincial Government is determined to ensure the persistent conservation of this biodiversity for current and future generations. The management and sustainable use of biodiversity contribute to the health of our people, to the growth of the tourism industry and to the delivery of vital ecosystem services such as clean air and fresh water.

In recognising these realities, the Province has developed the Mpumalanga Biodiversity Conservation Plan (MBCP). This plan has been jointly developed by the Mpumalanga Tourism and Parks Agency (MTPA) and the Department of Agriculture and Land Administration (DALA). The MTPA has since moved to the Department of Economic Affairs and Planning (DEDP) and the plan is therefore being supported and implemented by all these agencies. The completion of the MBCP in 2006 provides us with the first comprehensive spatial plan that identifies and maps the biodiversity status of land across the Province.

The plan identifies all remaining natural areas in Mpumalanga that have not been transformed by development. It prioritises these areas, based on their biodiversity importance and sensitivity to degradation. These areas must be managed to protect biodiversity in order to meet our constitutional commitment to sustainable development and a healthy environment for all.

With a view to implementing the plan, and improving land-use planning, the MBCP includes land-use management guidelines to ensure that development is appropriate and compatible with biodiversity. The Mpumalanga Provincial Government is committed to ensuring that the MBCP is implemented by provincial departments and municipalities. We trust that private and corporate landowners will join hands and support this initiative to promote the sustainable development of Mpumalanga.

Signed
Mr S. W. Lubisi (MPL)
MEC Economic Development and Planning
LIST OF ACRONYMS AND ABBREVIATIONS

ARC Agricultural Research Council
CBD Convention on Biological Diversity
CR Critically Endangered conservation status
CSIR Council for Scientific and Industrial Research
DEAT Department of Environment Affairs and Tourism
DEDP Department of Economic Development and Planning
DWAF Department of Water Affairs and Forestry
EIA Environmental impact assessment
EN Endangered conservation status
GIS Geographic information system
GP Gauteng Province
IUCN World Conservation Union
KZN KwaZulu Natal Province
LT Least Threatened conservation status
MBCP Mpumalanga Biodiversity Conservation Plan
MEC Member of the (provincial) Executive Council
MPB Mpumalanga Parks Board
MTPA Mpumalanga Tourism and Parks Agency (formerly MPB)
NEMA National Environmental Management Act
NEPAD New Plan for African Development
NGO Non-government organisation
NP National park
NSBA National Spatial Biodiversity Assessment
PA Protected area
PESC Present ecological status class
SABIF South African Biodiversity Information Forum
SADC Southern African Development Community
SANBI South African National Biodiversity Institute
SANParks South African National Parks
SBP Systematic biodiversity planning
SEA Strategic environmental assessment
TFCA Trans-frontier conservation area
VU Vulnerable conservation status
WWW Working for Water
WHC World Heritage Convention
> Greater than
< Less than
EXECUTIVE SUMMARY

THE MBCP IN CONTEXT

The Mpumalanga Tourism and Parks Agency (MTPA) and the Department of Agriculture and Land Administration (DALA) have jointly developed the Mpumalanga Biodiversity Conservation Plan (MBCP). As the first such plan produced for the Province, it is intended to guide conservation and land-use decisions in support of sustainable development.

The project has been funded by the Development Bank of Southern Africa and widely supported from outside the Province by planners and scientists from the South African National Biodiversity Institute (SANBI), and from other provinces, universities and research institutes.

The MBCP takes its mandate from the South African Constitution, the National Biodiversity Act (10 of 2004) and the MTPA Act 10 of 1998. These and other statutes require the state to provide for a conserved and healthy environment that supports sustainable development and is safe and healthy for all citizens. At national level the first steps in carrying out this mandate have produced the National Spatial Biodiversity Assessment, 2004 (Driver et al. 2005) and National Biodiversity Strategy and Action Plan (DEAT, 2005).

The MBCP builds on these national plans at the provincial level in Mpumalanga. It is intended to be used by all who are involved in land-use and development planning, most particularly those specialists who need a comprehensive source of biodiversity information. It provides a basis for MTPA to review its biodiversity conservation policy and to focus its attention on high value areas for future protection initiatives. The plan, and in particular its land-use guidelines, are intended to supplement other spatial planning tools such as municipal Integrated Development Plans and Spatial Development Frameworks. The MBCP will also be a useful addition to the information disseminated by agricultural extension and environmental education practitioners in Government and the private sector.

The text of this handbook sets the statutory context by outlining the laws which define the state’s mandate to protect and manage biodiversity. It then proceeds to broadly describe the biomes and ecosystems that occur in the Province, treating rivers and wetlands separately and emphasising their importance, both in biodiversity and water conservation. Aspects of ecosystem functioning are also covered in these descriptions, to provide some understanding of how habitats differ and the way they respond to various management activities. The distribution of biomes and vegetation types is displayed in maps. Ecosystem status, a measure of the extent to which each vegetation type has been transformed by loss of natural habitat, is assessed and also mapped.

ANALYSIS

The MBCP is founded on an extensive biodiversity database compiled over the last 21 years by the Province’s conservation biologists. These detailed records, together with the latest mapping and remote sensing data on vegetation, land use and water resources, have been combined and subjected to sophisticated analyses. The science on which MBCP is based is the best available and the data, despite having gaps and limitations, is also the best there is. Nearly 500 biodiversity features were used in the MBCP, 340 terrestrial and 157 aquatic features, covering the entire landscape of the Province.

The MBCP uses the Systematic Biodiversity Planning approach. This involves selecting a range of biodiversity features, the data for which are allocated to 65 000 planning units of 118 hectares each. Quantitative targets are set for each biodiversity feature, indicating how much is needed to ensure their persistence in the landscape. Using sophisticated GIS-based software and the planning program Marxan, the
distribution of these features relative to their targets is analysed, and allocated ‘irreplaceability’ values. The mapped output of this analysis displays the most efficient distribution of planning units that allows the biodiversity feature targets to be met. Marxan was chosen for a variety of technical reasons and because it provides for greater flexibility and innovation in its outputs. Its advantages include: minimising land use conflicts; achieving ‘intelligent clumping’ of planning units of equivalent high value; the use of planning units small enough to allow fine scale as well as provincial scale planning; and the integration of terrestrial and aquatic biodiversity in a single spatial plan. These features have not appeared before in systematic biodiversity plans. As these innovations indicate, the MBCP is among the most advanced local applications of biodiversity planning to date. Several of the advisors to the MBCP are among those South African scientists considered at the forefront of this technology worldwide.

Two principal maps result from these analyses. The first is the main MBCP map which indicates where the overall biodiversity priorities are located. The second is the aquatic biodiversity map (Figure 4.2) which indicates where aquatic biodiversity targets will best be met and at the same time, the location of the most important subcatchments for water production. Figure 4.2 should not be confused with the Aquatic Biodiversity Assessment map on the MBCP poster (see Chapter 5).

RESULTS
The MBCP maps the distribution of the Province’s known biodiversity into six categories. These are ranked according to ecological and biodiversity importance and their contribution to meeting the quantitative targets set for each biodiversity feature. The categories are:

1. Protected areas - already protected and managed for conservation;
2. Irreplaceable areas - no other options available to meet targets—protection crucial;
3. Highly Significant areas - protection needed, very limited choice for meeting targets;
4. Important and Necessary areas - protection needed, greater choice in meeting targets;
5. Ecological Corridors – mixed natural and transformed areas, identified for long term connectivity and biological movement;
6. Areas of Least Concern – natural areas with most choices, including for development;
7. Areas with No Natural Habitat Remaining – transformed areas that make no contribution to meeting targets.

The categories 2, 3, 4 and 6 were determined by analysis in Marxan. No Natural Habitat Remaining was added later. ‘Ecological Corridors’ were then selected along river lines, altitudinal gradients and mountain ranges, based on expert judgement. Selection of corridors was also guided by the need to link important biodiversity areas and promote connectivity. Corridor width was set at 7 km, which allows for the needs of most species to move within habitats that are already fragmented. Due to the existing fragmentation of natural habitat in corridors, this should be treated as a guideline rather than a precise measure.

The pattern of biodiversity distribution shows the high value areas distributed prominently along the north eastern escarpment and in known areas of high plant endemism, such as the Barberton, Sekhukhuneland, Wakkerstroom and Lydenburg/Dullstroom areas. It also clearly shows the lack of protected areas in the grassland biome and the extent of forestry and agricultural transformation in this region. The savanna region of the Province is by far the best conserved, due to the dominant contribution of the southern Kruger National Park to the provincial analysis.

The significance of sustainable freshwater supplies is acknowledged and integrated into the terrestrial analysis. About 50% of aquatic irreplacability values is captured in the overall analysis and incorporated into the terrestrial biodiversity map. The aquatic data are also mapped and presented separately in the 1 503
subcatchment planning units. This allows for specific consideration of water conservation issues in strategic planning.

The MBCP provides a basis for better informed decisions in establishing and managing both existing and future protected areas. It presents clear priorities for locating as well as for scheduling conservation efforts. This is especially important for irreplaceable sites that are under pressure from potentially destructive development. For the first time it empowers biodiversity decision makers to be proactive rather than reactive, as they have had to be in the past. It also provides land-use and development planners with the same proactive capability.

**LAND-USE GUIDELINES**

The MBCP is accompanied by land-use planning guidelines to guide planning and development within each of the biodiversity conservation categories throughout the Province. In each category there are different land-use and development consequences. In time the guidelines need to be formalised as distinct ‘Codes of Best Practice’ and eventually as regulations to achieve sustainable development. The guidelines are arranged to address terrestrial and aquatic biodiversity issues, with the aquatic ones being split into those relating to rivers and to wetlands.

As summarised in Table 6.1, the MBCP identifies 24.2% of the Province, outside of protected areas, that must be managed using biodiversity friendly forms of land use to ensure ‘living landscapes’ into the future. Protected areas account for a further 14.8%, including the southern Kruger NP at 10.4%. The remaining 61% of the Province allows for considerable freedom of choice for development, provided EIA procedures guide all development proposals. The MBCP suggests that ‘Irreplaceable’, ‘Highly Significant’ and ‘Important and Necessary’ areas should remain unaltered and be managed for biodiversity by various means. Other categories incorporate increasing options for different types of land use that should be decided by the application of EIA procedures and negotiation between stakeholders. A land-use suitability matrix presents these relationships at a glance in Table 6.2.

The guidelines relate to 15 different types of land uses, ranked according to their impact on biodiversity:

<table>
<thead>
<tr>
<th>Rural land uses that are more or less biodiversity friendly</th>
<th>Rural land uses that have moderate to high impact on biodiversity</th>
<th>Urban and industrial land uses that are not only destructive of biodiversity but export their negative impacts to rural areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Extensive game farming</td>
<td>6. Dryland crop cultivation</td>
<td>11. Major development projects</td>
</tr>
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<td></td>
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<td>15. Surface mining, dumping, dredging</td>
</tr>
</tbody>
</table>
The guidelines suggest restricting permissible land uses within each biodiversity conservation category as follows:

- **Protected Areas**
  - Land use types 1 and 2 only permitted, type 3 allowed under restriction;

- **Irreplaceable Areas**
  - Land use types 1 to 3 permitted, unavoidable developments require strict controls;

- **Highly Significant Areas**
  - Land use types 1 to 3 permitted, type 4 and unavoidable developments, as above;

- **Important and Necessary Areas**
  - Land use types 1 to 3 recommended, types 4 and 5 allowed under restriction;

- **Ecological Corridors**
  - Land use types 1 to 3 recommended, all other land uses permitted only under restriction; timber production (9) and urban development (10) not permitted in corridors;

- **Areas of Least Concern**
  - All land uses permitted, although several require restrictions (see Table 6.2).

The MBCP also identifies the 35.8% of the Province that has ‘No natural habitat remaining’ and which has very little biodiversity value. The general mechanism of applying these guidelines will rely substantially on reinforcing the use of EIA procedures and regulations by means of specialist biodiversity surveys by locally knowledgeable experts.
The mandate for conserving biodiversity lies with many state agencies at national, provincial and local levels of government. It is part of a wider responsibility for the environment and the sustainable use of natural resources. Constitutional and other national laws require these environmental issues to be dealt with in cooperative, participatory, transparent and integrated ways. With this in mind the Mpumalanga Biodiversity Conservation Plan (MBCP) follows the approach of the National Spatial Biodiversity Assessment (Driver et al, 2005). Both use a scientific analytical approach called Systematic Biodiversity Planning (SBP) and share certain data sources and assessment procedures (Chapters 4 & 5).

This handbook provides an explanation of the MBCP and how to use it. It is a spatial rather than an operational plan and forms part of a wider set of national biodiversity planning initiatives supported by South African National Biodiversity Institute (SANBI). It provides a relatively detailed and quantified provincial contribution to the country-wide biodiversity planning effort that is provided for by both national and international legislation (Chapter 5).

The text provides background to biodiversity and its importance and outlines the biomes and other biodiversity highlights of Mpumalanga (Chapter 3). It discusses how these features are analysed and integrated into the spatial plan. Guidelines are provided, describing the most sustainable land uses suited to areas of different biodiversity value (Chapter 6). Combining the map with the guidelines, via the GIS-based electronic application on CD, enables access to comprehensive biodiversity information at the touch of a button. The ability to display this information at a range of scales, from provincial to local, provides for quick and precise identification of development planning issues related to biodiversity.
PURPOSE OF THE MBCP

The MBCP is the first spatial biodiversity plan for Mpumalanga that is based on scientifically determined and quantified biodiversity objectives. The purpose of the MBCP is to contribute to sustainable development in Mpumalanga.

Its specific objectives are:

1. To guide the MTPA in implementing its biodiversity mandate, including working with landowners to improve the provincial protected area network.
2. To provide biodiversity information that supports land-use planning and helps to streamline and monitor environmental decision-making.

More broadly, the MBCP provides a scientifically based planning and monitoring tool for biodiversity conservation for the Mpumalanga Tourism and Parks Agency (MTPA). For DALA, it serves to encourage environmental regulators to be pro-active in dealing with the competing pressures for economic development and biodiversity conservation. Finding this delicate balance is the ultimate goal of land use planning and sustainable development.

There has never before been spatial biodiversity information readily available in a single comprehensive source. Now that it exists, it is vital for it to be used in development decision making. The biodiversity priority areas identified in MBCP should inform environmental assessment (including SEA and EIA) and development authorisations, and should be incorporated into Spatial Development Frameworks.

BOX 1.1: WHAT IS BIODIVERSITY AND WHY SHOULD WE BE CONCERNED ABOUT IT?  
(Driver et al. 2005)

‘The term biodiversity refers to … plants and animals, ecosystems and landscapes, and the ecological and evolutionary processes that allow these … to persist over time. South Africa’s biodiversity provides an important basis for economic growth and development, in obvious ways such as … rangelands that support commercial and subsistence farming, horticultural and agricultural industry based on indigenous species, the tourism industry… and commercial and non-commercial medicinal applications of indigenous resources. Keeping our biodiversity intact is also vital for ensuring ongoing provision of ecosystem services such as production of clean water through good catchment management, prevention of erosion, carbon storage (to counteract global warming), and clean air. Loss of biodiversity puts aspects of our … life at risk, and reduces socio-economic options for future generations.

People are ultimately dependent on living, functioning ecosystems and the services they provide. Loss of biodiversity leads to ecosystem degradation … which tends to harm the rural poor more directly … while the wealthy are buffered against the loss of ecosystem services by being able to purchase basic necessities and scarce commodities. Our path towards sustainable development, poverty reduction and enhanced human well-being for all, is therefore dependent on how effectively we conserve biodiversity.’
INTENDED USERS
The maps and accompanying text are intended first and foremost for technical users in MTPA and DALA, and for development planners. The target audience includes all stakeholders in the development and environmental planning profession. This is referred to as the ‘primary user group’. It includes:

- MTPA officials and relevant landowners;
- DALA officials, including EIA regulators;
- Planning and environmental assessment specialists;
- Town and regional planners in municipalities and provincial government;
- Biodiversity and conservation scientists in the private and NGO sectors.

For the local conservation agency (MTPA), the MBCP includes a review of the Protected Areas (PA) network, both on public and private land, identifying the relative contribution of each type of PA. The plan also informs land-use and development planning throughout the Province to ensure the persistence of biodiversity and the delivery of vital ecosystem services. This is the responsibility of the provincial environmental authority, which is currently DALA. In spite of the intended users being largely technical people, trouble has been taken to produce products, especially the map, meaningful to the general public. Widespread public understanding of MBCP is vital for its effective implementation in the long run. A separate technical report, with details of all the data layers and analyses, is held by the Scientific Services division of the MTPA (see page iv).

SCOPE OF MBCP
The MBCP covers the whole Province, including all cross-boundary municipalities whose final delimitation is still unresolved. In terms of scale, MBCP uses relatively small, 118 ha hexagonal planning units which provides a scale that can be used at both local municipal and provincial level.

The MBCP planning domain is flanked by two existing provincial biodiversity plans, those for KwaZulu Natal and for Gauteng. The KZN and GP planning teams have been consulted and the data sets harmonised as far as possible. Since inception of this work two additional bioregional planning projects that will overlap with MBCP have been initiated and/or proposed: the National Grassland Biodiversity Programme, which is in the project design phase; and the North Eastern Escarpment Bioregional Plan, which is still in the preliminary discussion phase. MBCP will feed into these two projects as and when required.

A broader aspect of the scope of the MBCP is its intended contribution to public understanding of biodiversity conservation. This assessment and, more importantly, any subsequent ‘Strategy and Action Plan’ that results from Phase 2 need to be widely understood and accepted by decision makers and the public. Public awareness is therefore a focus of both phases. In Phase 1 we target key leaders, decision makers and planners; a limited but very important audience whose support is needed to pave the way for a much wider public education effort in Phase 2.

IMPLEMENTATION (PHASE 2)
Phase 1 of the MBCP project has produced this handbook and its accompanying map and CD Rom. Phase 2 will deal with implementation and capacity building. This is often referred to as ‘mainstreaming biodiversity’ - into the main sectors of the economy. Implementation will provide capacity-building for the agencies mainly responsible for MBCP, namely MTPA, DEDP and DALA. This will also be provided more widely to those involved in development planning, especially planners in local government at district and local municipalities. As mentioned above, there will also be a substantial public awareness and education component.
Specifically, Phase 2 will focus on:

- Building the capacity of environmental officials and planners to use MBCP and its land-use guidelines in environmental assessments and development planning;
- Supporting a strategic review of MTPA's biodiversity conservation priorities;
- Developing a conservation stewardship programme working with landowners to conserve priority sites;
- Filling information gaps for future revision and improvement of MBCP.

Implementation will also need to target planners from the private (development) sector and consulting planners who are often the contracted service providers to underskilled municipalities. Direct training and mentoring of primary users of the plan may also be undertaken in situations of most need.

### BOX 1.2: CONSERVATION STEWARDSHIP PROGRAMME

A Conservation Stewardship programme recognises the value of biodiversity on private land and the conservation role that private land owners can play in helping to meet provincial biodiversity targets. Stewardship is defined as ‘…the protection, management and wise use of the natural resources that have been entrusted into your care’.

The programme provides for the legal protection of important biodiversity areas in return for economic, legal and technical support benefits. Stewardship arrangements are innovative and adaptive to the individual needs of the land owner and yet provide binding long-term security for biodiversity assets. Such programmes, which are already well developed in other provinces, are in the earliest stages of development in Mpumalanga and not yet fully operational.

Stewardship offers three tangible products to land owners, each providing different levels of protection and support.

- Contract nature reserves (minimum period of 30 years);
- Protected environments (legal agreements between owners and MTPA);
- Conservancies (land owner cooperative agreements).

The first two options offer legally binding status with contract nature reserves having the added benefit of ‘rates exclusion’ (see page 8). Conservancies provide a softer option that is not legally binding but attracts technical and managerial support from MTPA. It is important to note that the programme is NOT a means to provide the MTPA with uninvited access to private land. Both the conservation initiative and land ownership remain 100% with the land owner.

The process of participating in a Stewardship Programme involves the following steps:

- On-site assessment (the land must qualify as being of high biodiversity value);
- Definition in writing of the level of commitment from the land owner;
- The drafting of management plans jointly by the land owner and MTPA;
- Finalising contractual agreements (signed by MEC and land owner);
- Declaration of protected area status;
- Negotiation with the local municipality to unlock economic benefits.

### THE PROJECT PROCESS

After the publication of the Cape Action Plan for the Environment (a systematic biodiversity plan for the Cape Floristic Region) in 2000, both DALA and the then Mpumalanga Parks Board (MPB) recognised the need for such an assessment in Mpumalanga. Implementing this idea was no simple task as the necessary skills and support in the form of experienced academics and technically skilled NGOs, were almost non-existent in the Province. Those who realised its potential persisted and in early 2004 a joint proposal was forwarded to the Development Bank of Southern Africa to fund the project to the extent of R550 000. Phase 1 was initiated in February 2005 and has been completed in just over 18 months. It has been guided by a combined Steering Committee, comprising representatives from the relevant provincial departments, SANBI and various technical specialists and advisors.
CHAPTER 2 - POLICY & LEGISLATION

POLICY AND LEGISLATION

Systematic Biodiversity Planning (SBP) is an empowering tool for applying aspects of South Africa’s bold new environmental legislation. From the powerful clauses in the Constitution to the yet-to-be written regulations for the Biodiversity Act of 2004, South Africa has never before had such empowering environmental legislation. The creation of SANBI to support this complex cross-sectoral activity is part of the benefit of these far-sighted laws. Together they are a wise investment in a brighter, greener future for all South Africans.

As a provincial biodiversity plan, MBCP is part of the broad intention of the legislation to have biodiversity conservation mainstreamed into all facets of development. The MBCP provides for this to happen with clear priorities in terms of location and in terms of urgency, by means of its assessment of the pressures affecting biodiversity. To work, it must be widely publicised to guide the policies, decisions and actions of many people and agencies.

Globally, there is growing emphasis on biodiversity conservation. This is largely a response to rapidly rising pressure on, and consumption of, the world’s natural resources. In South Africa, loss and degradation of natural habitat are the biggest pressures on biodiversity. They are heightened by the strong and expanding economy and the drive for job creation through growth. The resultant pressure on our globally recognised biodiversity is marked and widespread. South Africa has world class policies and legislative tools for biodiversity conservation – the challenge is to implement them effectively.

Policy and laws operate at many levels. There are four significant levels to be aware of:

1. Global / International / Multinational - including NEPAD
2. National / Regional - including SADC
3. Provincial / Subregional - including good neighbour agreements (TFCAs)
4. Municipal, both Local and District
NATIONAL AND INTERNATIONAL LAWS

At the international level, South Africa is signatory to several conventions and treaties intended to benefit biodiversity and the environment. These include:

- Nine agreements dealing with the use of marine and coastal resources;
- Five dealing with global biodiversity conservation (terrestrial and marine);
- Three agreements dealing with commercial and trade issues;
- Three agreements dealing with aspects of global climate change.

These global agreements are attempts to define international norms and standards for addressing global problems. In effect they represent guidelines for ‘universal best practice’. The agreements rely more on international peer pressure than on legal enforcement to achieve their objectives, although some are ratified in terms of our national laws. However, their direct and indirect influence on South African legislation has been substantial as many were sources of reference for the drafting of our own new and widely acclaimed environmental legislation.

International agreements most relevant to biodiversity in Mpumalanga are: the Convention on Biological Diversity (CBD, 1992); the Convention on International Trade in Endangered Species (1973); the World Heritage Convention (WHC, 1997); and the Kyoto Protocol on World Climate Change (2003). The first two of these agreements are given effect in national legislation. The most directly relevant of these is the CBD which sets out the most succinct and widely applicable objectives for biodiversity conservation. The Convention has three objectives:

- The conservation of biodiversity;
- The sustainable use of biological resources;
- The fair and equitable sharing of benefits from the use of biodiversity.

The CBD, which was signed by 178 governments in Rio de Janeiro in 1992, was formally adopted by South Africa in 1995. At the same time South Africa became a signatory to Agenda 21 and adopted a Local Agenda 21 Action Plan. Agenda 21 is an international programme centred on the realisation that the world cannot continue with present policies that increase poverty, hunger, sickness and illiteracy and cause continuing deterioration of ecosystems on which all life depends. Local Agenda 21 results from South Africa’s obligation to its international Agenda 21 agreement. It is basically a local government-led, community-wide, and participatory effort to adopt a comprehensive and sustainable strategy for environmental protection, economic prosperity and community well-being at the local level (Job, 2006).

At a national level the South African Constitution (Act 108 of 1996) and its Bill of Rights (Section 24) states:

‘Everyone has the right –

a. To an environment that is not harmful to their health or well-being; and
b. To have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that –

i. prevent pollution and ecological degradation;
ii. promote conservation;
iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.’

The Constitution provides for these rights to be balanced with other rights in the fields of social and economic development. The Constitution also allocates mandates and powers to various state agencies and requires them to cooperate at all levels in executing these powers.

Influenced by the Constitution and international norms and agreements, national laws have been passed giving effect to these rights. The most important of these for biodiversity conservation include:

- Conservation of Agricultural Resources Act (43 of 1983)
- Environment Conservation Act (73 of 1989) [partly redundant since the new EIA regulations were published in 2006]
- National Forests Act (84 of 1998)
- National Environmental Management Act (NEMA, 107 of 1998)
- National Water Act (36 of 1998)
- World Heritage Convention Act (49 of 1999)
- The Protected Areas Act (Act 57 of 2003)
- The Biodiversity Act (Act 10 of 2004)

These are the laws most directly relevant for environmental management and, therefore, biodiversity. There are many others that have more indirect relevance. A key element is that all organs of state at all levels are required to contribute to environmental management including biodiversity.
Although South Africa has very little indigenous forest, covering only 0.56% of its land area and only 0.46% of Mpumalanga, the forest is home to a disproportionately high share of biodiversity. In recent years the few patches of indigenous forest we have, have been subjected to clearance, encroachment by plantations, invasion by alien species, cutting of timber for fuel and construction and destruction of trees resulting from the collection of bark used for traditional medicines.

NEMA is central to South Africa’s new approach to managing difficult environmental issues. This is an enabling or framework Act that sets out the overarching principles that guide the formulation of subsequent laws and regulations. NEMA lists nearly thirty principles, intended to define the relationship the law seeks to establish between people and their environment. Much shortened, these principles include:

- The need to balance environmental rights with socio-economic rights;
- Placing people and their needs at the forefront of concern;
- Development must be sustainable, environmentally and socioeconomically;
- Negative impacts, e.g. pollution, waste etc., to be avoided, minimised or remedied;
- The ‘polluter pays’ principle applies to environmental impacts and their costs;
- Environmental management needs to be integrated and participatory;
- Environmental justice and equitability must be observed;
- People should be informed and empowered by environmental information;
- Conflicts of interest must be resolved by negotiation;
- Sensitive ecosystems, such as wetlands, require special measures;

(See also Appendix 1 for NEMA’s relevance to development planning).

**PROVINCIAL LEGISLATION**

Provincial legislation relevant to biodiversity conservation is comprised of two Provincial Acts, the Mpumalanga Nature Conservation Act (Act 10 of 1998) and the Mpumalanga Tourism and Parks Agency Act (Act 5 of 2005). The first sets out how wild species are to be managed in terms of human use, such as collecting, fishing, hunting, capture, transport and trade. It deals with rare and endangered species and the powers needed to protect them, and the protection of sensitive natural sites from damage and exploitation.

The second and most recent Act has created the Mpumalanga Tourism and Parks Agency (MTPA) in 2006, with a specific mandate to

‘Promote and sustainably manage tourism and nature conservation and provide for the sustainable use of natural resources.’

In pursuing its objectives, the MTPA is required to:

- Conserve and manage biodiversity and ecosystems;
- Develop and manage protected areas;
- Promote, develop and market tourism;
- Create growth and transformation within the industry, and thereby economic and employment opportunities for disadvantaged people.

In all that it does, the MTPA is required to liaise and consult with all relevant stakeholders including,

- Owners of existing or potential tourist attractions;
- Owners of natural resources who may benefit from their use.
In addition to the obvious tourism value of biodiversity, it makes economic sense for municipalities to manage their biodiversity sustainably. For example: protecting catchment areas will cost less in the long-term than treating polluted drinking water; retaining natural vegetation buffers along rivers and wetlands will cost less than repairing the damage after flooding. Opportunities exist for municipalities to encourage more sustainable forms of land management through their rates policies. The lost municipal revenue from such 'forfeited' rates are a) likely to be smaller than the long-term financial benefits, and b) may, in future, be recoverable from other sources of environmental support.

Municipalities have several opportunities to encourage sound biodiversity management by including in their rates policies:

- Judicious exemptions for properties with threatened ecosystems (per MBCP Handbook);
- Rebates for property owners that invest in sound land management activities, such as regular clearing of invasive alien plants;
- Penalties for properties not complying with environmental directives;
- Allowing the property rates system to reflect reduced property values if the land has legally binding conservation restrictions.

Formal protected areas, whether state or privately owned, are automatically eligible for rates exclusion in terms of the Municipal Property Rates Act. Either a portion or the entire property may be declared a formal protected area.
An ecosystem is a dynamic complex of plant, animal and microorganism communities and their nonliving environment, interacting as a functional unit (NEMA). Ecosystems operate at various scales; from a single wetland to an entire region such as a range of mountains. Groups of ecosystems with common characteristics at a landscape scale are called biomes. This chapter briefly describes Mpumalanga’s main ecosystems, with some notes on their functioning, diversity and ecological status.

3.1 TERRESTRIAL ECOSYSTEMS

THE BIOMES
Mpumalanga is a warm summer-rainfall province, containing three of South Africa’s nine biomes: grassland (highveld and escarpment hills), savanna (escarpment foothills and lowveld) and forest (south and east facing escarpment valleys). Descriptions of these biomes are useful in understanding the biodiversity and ecological characteristics of the Province (Table 3.1). A map of the biomes is included in Figure 3.1.
TABLE 3.1 Extent of Mpumalanga’s three biomes.

<table>
<thead>
<tr>
<th>BIOME</th>
<th>TOTAL SIZE (km²)</th>
<th>% OF MPUMALANGA</th>
<th>REMAINING NATURAL VEGETATION (km²)</th>
<th>%TRANSFORMED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grassland</td>
<td>531</td>
<td>61%</td>
<td>298</td>
<td>44%</td>
</tr>
<tr>
<td>Savanna</td>
<td>338</td>
<td>39%</td>
<td>255</td>
<td>25%</td>
</tr>
<tr>
<td>Forest</td>
<td>40</td>
<td>0.5%</td>
<td>39</td>
<td>1%</td>
</tr>
<tr>
<td>Total</td>
<td>874</td>
<td>100%</td>
<td>558</td>
<td>36%</td>
</tr>
</tbody>
</table>

TRANSFORMATION

Transformation refers to the removal or radical disturbance of natural vegetation, for example by crop agriculture, plantation forestry, mining or urban development. Transformation mostly results in a serious and permanent loss of biodiversity and fragmentation of ecosystems, which in turn lead to the failure of ecological processes. Remnants of biodiversity may survive in transformed landscapes.

The MBCP transformation layer was created by merging the 1995 and 2000 National Land Cover maps. These maps were created from satellite images that had been classified (by the CSIR and ARC) into various land-use types, using remote sensing techniques. The MBCP transformation layer is the best available representation of lost natural habitat based on composite, six-year-old data. The composite layer was cross-checked against a false-colour satellite image taken in 2000, allowing mis-classified areas to be corrected.

GRASSLAND

Grassland defines itself: landscapes dominated by grass. Although grasses are the most visible plants, grasslands have a higher diversity than other herbaceous species, especially those with below-ground storage organs such as bulbs or tubers. These plants produce many of our spectacular wild flowers and contribute to biodiversity that is second only to the Cape Fynbos in species richness. Grassland species are particularly well adapted to being defoliated, whether by grazing, fire or frost. Repeated defoliation, within reason, does no real harm to such plants nor does it reduce productivity.

African grasslands are particularly old, stable and resilient ecosystems. Most plants are perennials and surprisingly long lived, with very few annual species, which are the pioneer plants needed to repair disturbance. This makes our grasslands vulnerable to destruction by cultivation; once ploughed they are invaded by weedy pioneer plants that are mostly alien. Although many grassland plants do produce seed, very little germinates, most being used as vital food for their rich rodent and insect fauna.

Mpumalanga’s grasslands are mainly found in the highveld above 1000m. These are cool, dry open landscapes, with rainfall of over 500mm/yr. Frost, hail storms and lightning strikes are common. It is the natural occurrence of fire and these other defoliating events that favour grassland plants over woody species and help maintain the open treeless character of grasslands. Grasslands have shallow-rooted vegetation with a growing season limited to about six months of the year. The nongrowing seasons are characterised by cool and dry conditions, during which time most foliage is removed or killed by frost, and dies back to ground level.
Large parts of our grasslands occur on deep fertile soils of high agricultural value. Much of this landscape has already been converted to crops, timber or intensive animal production. The unproductive winter and spring seasons in grassland require agricultural strategies for livestock and cultivation that bridge this gap in economic productivity. Crop rotation, cultivated pastures and fallow intervals, as well as supplementary feeding of livestock, including the use of crop residues, are all part of good farming practice in these regions.

Grasslands originally covered 61% of Mpumalanga, but 44% of this has been transformed by agriculture and other development. This substantial and irreversible reduction of the biome is due mainly to cultivation, especially industrial-scale agriculture and timber growing. These land uses destroy biodiversity but extensive livestock grazing can be reasonably biodiversity-friendly, provided good management and safe stocking rates are applied.

The palatability of grass and its value as food for livestock, increases with decreasing rainfall, which is also correlated with altitude. In grazing terms, this corresponds to sourveld in the moist highveld and sweetveld in the dryer lowveld. This grass palatability gradient extends from grassland into savannas. Although sweetveld grasses produce less biomass than sourveld grasses, they have higher food value and lower fibre. This means the plant nutrients are more available in lower rainfall areas due to less leaching of the soil by high rainfall. The 650mm rainfall isoline approximately separates these two livestock zones.

Fire is a characteristic feature of grassland (and savannas) and is a necessary component of good land management. Grassland plants depend on fire, they resprout annually from their root-stocks. Without frequent fire, grasslands eventually become invaded with woody species and some herbaceous plants die. Regular burning to complement good grazing management helps to prevent the increase of species unpalatable to livestock, including woody species that form bush encroachment. Timber growing is mainly restricted to grasslands but its impact is not limited to the plantation “footprint”. It significantly reduces surface and underground water and causes the spread of some of the most damaging alien species. These effects, along with flammability of its tree species and the fire protection measures required, also substantially change the fire regime in grasslands.

The large number of rare and endangered species in grasslands is a particular problem for environmental impact assessment. They are mostly small, very localised and visible for only a few weeks in the year when they flower. Most surveys will not pick them up and special skills are required to locate and identify them reliably. Highest biodiversity is found in rocky grassland habitats and on sandy soils. Clay soils generally have the lowest biodiversity in grasslands.

SAVANNA

SAvanna is the name for the typically African mixture of trees, shrubs and grass, also referred to as the bushveld, and, at lower altitudes, the lowveld. It varies from tall dense woodland in the warmest, wettest areas, through open woodland, to dense thicket. It includes wooded, shubby hill slopes and grassy plains with scattered trees or bush-clumps. Diversity in savanna is provided by variation in soil-type and topography; koppies, river lines and anthills (termitaria) provide localised changes in soil moisture and nutrients which create different habitats for plants and animals.

Savanna used to cover 39% of Mpumalanga, but 25% of the original area of savanna has been transformed. Savannas are important for livestock, especially cattle and more recently the wildlife and tourism industry. Broad-leaved and woody plants provide a valuable food source for browsers like kudu and giraffe. Grazing quality varies with rainfall: as rainfall increases, the nutritional value of grass decreases although there is more growth; in low rainfall areas there is less grass but it is more nutritious.

Rain is frequently delivered in thunderstorm events with a high proportion of surface runoff. This creates flash flooding and vulnerability to soil erosion. The amount of rain that remains available to plants is reduced by the long, hot dry seasons, creating a strong water deficit where evaporation far exceeds rainfall. This is an important limitation for production land uses for agriculture and livestock. Only the most fertile deeper soils are used for cultivation. Bush encroachment or ‘induced thicket’ can result from overgrazing by livestock. Bush encroachment reduces carrying capacity and is difficult to reverse, reducing the value of the land for livestock.

Savannas are hotter than grasslands and are deciduous, i.e. most plants lose their leaves or die back in the dry season to conserve water. The woody plants are deep rooted, accessing moisture not available to grasses and herbs. The winter and spring seasons (May – October) are dry and have high water stress for plants. This increases the likelihood of bushfires. Savannas are adapted to bushfires; grass and woody plants survive them well, so long as they are not too frequent or too fierce. A good wet season means lots of grass which in turn provides more fuel to burn and raises the risk of damaging wildfires late in the dry season.
FOREST

The term ‘forest’ is used only for indigenous natural forests. In this sense commercial timber plantations are not forests. Indigenous evergreen trees that form a closed canopy are defined as forests. This year-round cover provides so much shade and moisture-conserving leaf litter that it limits the growth of ground-layer plants like grass. Forests have little to offer to livestock and are located mostly on steep slopes with sensitive soils not suited to cultivation.

Forests are normally frost-free. Their dense vegetation and shade allow higher humidity and lower temperatures than surrounding areas. This means forest patches do not normally burn in bush-fires except around the perimeter. Very hot fires can shrink forests by continually eroding their edges. The vulnerability of the forest edge to fire is considerably increased by the presence of alien plants such as wattle, which increases the penetration of fire into forests.

In Mpumalanga, forests occur in small scattered patches, mostly in river valleys in the escarpment region. They require high rainfall (over 725mm/yr) boosted through the dry season by groundwater from associated streams and added precipitation in the form of mist. Their scattered distribution and small patch size means they have rich biodiversity. This is dependent on the connectedness of patches, achieved through riverine linkages and access by specialised forest fauna such as birds and monkeys. Forest patches are vulnerable to many impacts due to their high edge-to-area ratio.

Forests have significant cultural values as sources of traditional medicines and spiritual inspiration. Commercial harvesting of valuable plants and medicinal species, and the need for structural timber, are the main pressures on forest biodiversity. From a scenic and wilderness point of view forests are very popular with visitors. Their location and interplay with rivers and mountains provides the backdrop to much of Mpumalanga’s most popular scenic attractions. Hiking trails are strung with forest patches like beads on a necklace, running through the escarpment region. Indigenous forests protect water sources rather than drying them out, as is the case with timber plantations of pine and gum trees.

Within biomes there are many ecosystems that can be defined at different scales. A useful way of classifying biodiversity within biomes is to use vegetation types as surrogates for ecosystems. Vegetation types work well for terrestrial ecosystems but do not effectively cover the important aquatic or freshwater systems.
FIGURE 3.1: Distribution of three biomes and 68 vegetation types in Mpumalanga.
3.2 VEGETATION TYPES

Vegetation types provide a good representation of terrestrial biodiversity because most animals, birds, insects and other organisms are associated with particular vegetation types (Rouget et al. 2004). In 2005 SANBI produced an extensively revised vegetation map for South Africa, Lesotho and Swaziland (Mucina et al. 2005), with 441 vegetation types. Each vegetation type in the South African vegetation map has a biodiversity target set by the National Spatial Biodiversity Assessment. This vegetation map, with minor refinements, was used to define 68 vegetation types for Mpumalanga, shown in Figure 3.1.

With vegetation types defined and mapped, it is possible to assess their ecosystem status. Ecosystem status reflects the ecosystem's ability to function naturally, at a landscape scale and in the long term. The single biggest cause of loss of biodiversity in South Africa is the loss and degradation of natural habitat. As the natural habitat in an ecosystem is reduced and degraded, its ability to persist is compromised. The degradation process is characterised by: loss of ability to deliver ecosystem services; loss of biodiversity, including local species extinctions; and irreversible damage to ecological processes. All these combine, eventually leading to ecological collapse (Rouget et al. 2004).

The purpose of defining vegetation types in terms of their ecosystem status is to identify ecosystems at risk. The ecosystem status reflects the ecosystem’s ability to function naturally, at a landscape scale and in the long term. The single biggest cause of loss of biodiversity in South Africa is the loss and degradation of natural habitat. As the natural habitat in an ecosystem is reduced and degraded, its ability to persist is compromised. The degradation process is characterised by: loss of ability to deliver ecosystem services; loss of biodiversity, including local species extinctions; and irreversible damage to ecological processes. All these combine, eventually leading to ecological collapse (Rouget et al. 2004).

LISTING OF THREATENED ECOSYSTEMS IN TERMS OF THE BIODIVERSITY ACT

The Biodiversity Act provides for listing threatened and protected ecosystems as follows:

52 (1) (a) The Minister may . . . publish a national list of threatened ecosystems in need of protection.
   (b) An MEC for environmental affairs may . . . similarly publish a provincial list of threatened ecosystems.

52 (2) The following categories of threatened ecosystems may be listed in terms of subsection (1):
   - ‘Critically endangered’ ecosystems – that have undergone severe ecological degradation and are at an extremely high risk of irreversible transformation;
   - ‘Endangered’, or ‘vulnerable’ ecosystems – being categories of reduced degradation and risk, each less than the previous category above;
   - ‘Protected’ ecosystems – being ecosystems that are not threatened but nevertheless are worthy of special protection.

NOTE: DEAT and SANBI are in the process of developing criteria for identifying and listing threatened and protected ecosystems. Systematic biodiversity plans such as the MBCP will provide an important basis for identifying these ecosystems.

The purpose of defining vegetation types in terms of their ecosystem status is to identify ecosystems at risk. The ecosystem status categories are similar to those used by the IUCN for species: Critically Endangered (CR), Endangered (EN), and Vulnerable (VU). These categories are also used in the National Spatial Biodiversity Assessment (Driver et al. 2005). A vegetation type is allocated an ecosystem status based on the proportion of its original natural habitat that remains. The classification system and categories used here are illustrated in Figure 3.2. In the MBCP analysis the endangered category is split in two in order to identify those ecosystems closer to critically endangered status.
FIGURE 3.2: Classification of vegetation types into five ecosystem status categories based on % of natural habitat remaining.

- **LEAST THREATENED (LT)**: 100% of ecosystem intact. Threshold for conserving ecosystem functioning.
- **VULNERABLE (VU)**: If habitat loss continues, ecosystem functioning will be compromised.
- **ENDANGERED: LOW (EN-L)**: A higher degree of ecosystem functioning lost - nearing CR status.
- **ENDANGERED: HIGH (EN-H)**: Point beyond which many species may be lost.
- **CRITICALLY ENDANGERED (CR)**: 19-28% untransformed land.

100% of ecosystem intact
If habitat loss continues, ecosystem functioning will be compromised
Threshold for conserving ecosystem functioning
A higher degree of ecosystem functioning lost - nearing CR status
Point beyond which many species may be lost

FIGURE 3.3: The status of terrestrial ecosystems in Mpumalanga.
Appendix 2 presents the statistical characteristics of each vegetation type in Mpumalanga:

- The names of the 68 vegetation types together with their national biodiversity targets;
- The percentage of natural habitat remaining for each;
- Their ecosystem status;
- The proportion of the biodiversity target protected in formal protected areas;
- Their protection level category;
- The relevant biome and its percentage transformation.

Note that a vegetation type can be well protected (i.e. 100% of its biodiversity target included in formal protected areas) yet still be vulnerable or endangered if a large proportion of natural habitat in that vegetation type has been lost.

3.3 AQUATIC ECOSYSTEMS

Aquatic ecosystems include both rivers and wetlands. These two are inter-related, with most wetlands feeding rivers, thereby extending and stabilising their varied and seasonal flows. Together they function as arteries for the lifeblood of our living landscapes and as kidneys that process much of the waste products of life – and of humanity. These functions are sensitive to disturbance and overload. Successful protection of aquatic biodiversity and water supplies is the foundation stone for sustainable development.

Rivers and wetlands are South Africa’s most important ecosystems. Apart from the vital water they deliver they are also our most impacted and damaged ecosystems. Aquatic biodiversity has its own specifically aquatic characteristics but is strongly influenced by the terrestrial ecosystems within each catchment. Freshwater plants, animals and microorganisms act as useful indicators of the ecological health of aquatic ecosystems, which has the added benefit of reflecting aspects of the health of the entire catchment as well.

Rivers and wetlands are controlled by three basic ‘drivers’ that define their health and ecological characteristics. It is the balance between these drivers that is important.

Aquatic ecosystem drivers may be summarised as:

- **Hydrological** — the presence and the flow of water — which will vary seasonally and after rainfall in terms of speed and volume of flow;
- **Chemical and physical** — water quality — which is a measure of the dissolved chemicals, pollutants and sediment contained in and transported by the water;
- **Geomorphological** — the physical land surface — the types of rock, soil and the slope of the surfaces over which the water flows, both in uplands and in the water-courses of rivers and streams; this includes the plant cover that controls erosion.

Changes in ecosystem health may be measured by changes in river biota, such as fish, aquatic insects and riverine vegetation. Health of a river system, including its wetlands, is usually good in pristine or well protected catchments. This is particularly true in headwater and upper level catchments. However, a section of river does not necessarily reflect the condition of the catchment it flows through. For example, the Olifants River flows through a protected part of its catchment in the Kruger National Park, but the health of the river has already been seriously compromised upstream.

The management and use of water has the most obvious and direct effect on aquatic ecosystems. But their ecosystem status is equally dependent on the irreversible and widespread changes that take place on the land. Cultivation, hard surfacing and polluted return-flows from urban and irrigated land, place pressures on river systems that are permanent and increasingly costly to manage. These impacts affect everyone at the personal level and economically at the regional and national level. Disadvantaged communities are most vulnerable to these impacts.

**RIVER ECOSYSTEMS**

Rivers are much more than channels where rainfall runoff races away to the sea. They provide important ecological goods and services to the landscape and for human use. Providing and purifying water are the most obvious of these but there are many others such as providing fish, aquatic plants and animals and social goods and services. Headwaters, middle reaches and lowland stretches of rivers all perform different environmental functions and need to be managed differently. Mpumalanga has no coastline and no estuaries, but local river management is also required to provide water for downstream users in Swaziland and Mozambique. This responsibility is provided for by international agreements on shared water resources.

Rivers are flow-driven linear systems, which means their biodiversity characteristics are difficult to represent and quantify spatially as we do for terrestrial ecosystems. (Terrestrial biodiversity is inter-connected like the strands in a complex fabric of many threads in many directions. Aquatic biodiversity is more like string, the threads are all bound together and are more vulnerable to an impact that might sever one or more of them, especially those that control the ecosystem drivers.)
Rivers are the sites of important ecological processes, mostly characterised by movement along the river line (water and sediment downstream; aquatic and terrestrial biota in both directions). Selected rivers are used as the basis for many of the ecological corridors identified by MBCP to provide for long-term response to climate change as described elsewhere (see Section 6T.5). There are two special functions of rivers that add to their biodiversity value. One is the ability of river headwaters to provide refugia for species in times of drought. The other is that segments of rivers may be identified as providing important movement linkages in river systems increasingly interrupted by dams and other developments, that need protection in order to maintain connectivity.

The flow-driven nature of rivers results in sediments and pollutants having both local and extended downstream effects which may be cumulative. However, healthy rivers are self-cleansing systems. They are able to trap sediment and stabilise it with plant growth. They also remove dissolved chemicals (nutrients and pollutants) and convert them into useful biological resources. But the cleansing capacity of rivers is limited. They are easily overloaded by soil erosion and polluted runoff and seepage. Extremes of drought and flooding are increasing, due largely to development activities, which reduces the ability of rivers to perform their natural functions. Present trends in global climate change are likely to worsen these extremes.

Both rivers and wetlands can be classified according to their functional and biodiversity attributes. River ecosystems are classified using the ‘ecoregion’ concept, which is an expert-based classification that defines regions according to shared ecological characteristics and in terms of relationships between organisms and their environments (Kleynhans et al. 2005a; see Figure 3.4). Ecoregions are based on the understanding that ecosystems and their biota display regional patterns that mirror causal factors such as climate, soils, geology, physical land surface and vegetation.

The MBCP identifies healthy subcatchments using a combination of Present Ecological State Category (PESC) (Kleynhans, 2000) and loss of natural habitat in each subcatchment, as surrogate measures for healthy rivers, tributaries and wetlands. Heavily transformed subcatchments are expected to have degraded wetlands and tributaries. After determining the health of each subcatchment based on these measures, the proportion of each river type occurring within healthy subcatchments was calculated as a percentage for each river type. Healthy subcatchments are defined as subcatchments with a PESC of A, and B subcatchments that are more than 75% untransformed.
FIGURE 3.4: Rivers and wetlands in Mpumalanga. Rivers are classified into 30 types, based on Level 2 River Ecoregions. Wetlands are classified into four functional types, pans being temporary or perennial. (Note: not all wetlands are visible on the map because of map scale)

In a similar approach to that outlined for terrestrial ecosystem status discussed above (Figure 3.2), the ecosystem status of river types was assessed as the proportion of each type occurring in healthy (natural, unmodified) subcatchments. If a river type has more than 80% of its length running through healthy subcatchments, it was classified as Least Threatened. If 80-60% of its length flowed through healthy subcatchments, it was classified as Vulnerable, if less than 60% but more than its biodiversity target length occurred in healthy subcatchments, it was classified as Endangered. And finally, if less than its target flowed through healthy subcatchments, it was classified as Critically Endangered.

The results are shown in Figure 3.5. Of Mpumalanga’s 30 river types, 83% are threatened. Thirty three percent are Critically Endangered, 40% are Endangered, and 10% are Vulnerable. A Critically Endangered river type is one for which there are few remaining rivers occurring in healthy subcatchments and for which rehabilitation of catchments is required in order to meet biodiversity targets. This puts the biodiversity and ecosystems of these types of river systems at risk.
3.4 WETLAND ECOSYSTEMS

Wetlands are areas that are wet temporarily, seasonally or permanently, including pans of open water. Most wetlands support a vigorous and diverse cover of water-loving plants, due to the high watertable. A distinguishing feature of all wetlands, even when they are dry, is that they occur on hydromorphic soils, i.e. soils that have developed under prolonged periods of water-logging. These living, porous soils provide for water storage and controlled flow of water above and below the surface. Wetland soil types are site-specific, relatively easy to identify, and highly adapted to local climatic conditions. They are also vulnerable to damage and, once damaged or eroded, are very difficult and expensive to restore or replace.

Wetlands are specialised systems that perform ecological functions vital for human welfare and environmental sustainability. They are first and foremost important water management and storage areas - above and below ground. Their vigorous plant
cover slows runoff, filters and purifies water and reduces the impacts of droughts and floods by regulating stream flow. They provide special habitats for many species of plants and animals. Besides these benefits, wetland vegetation also provides economic resources such as grazing, food, medicinal plants and natural fibre for thatch and craft making.

Wetlands are controlled by the same basic ‘drivers’ as rivers. These features define their health and sustainability. A key property of wetlands is that they present a convergence of aquatic and terrestrial biodiversity at important positions in the landscape. It is here, as well as in rivers, where the health of key components of natural ecosystems can best be observed and measured. Our wetlands are typically variable, with over 90 different wetland biodiversity features recognised in the MBCP. These are based on a functional and Ecoregion level 2 classification as a surrogate for wetland biodiversity types. All wetlands may be allocated into four functional categories.

CATEGORIES OF WETLANDS

SEEPAGE WETLANDS – are generally seasonal, small and widely scattered. Often referred to as seeps or sponges, they mostly occur on obvious slopes and in upland areas. They are sometimes linear, across the slope and may be associated with bands of impermeable rock which provide an unexpected ‘perched water-table’. These are the least obvious wetlands as they are the most temporary and not located in obviously wet valley-bottom landscapes.

VALLEY-BOTTOM WETLANDS – occur in bottom-lands and are generally wetter, and wet for longer periods, than seeps. In headwater areas they typically occur as seasonally water-logged, shallow grassy valleys (vleis). In the mid and lower reaches of rivers they are also associated with streams and river banks, especially within the floodline. Valley-bottom wetlands include floodplains of the lower reaches of larger rivers, subjected to high-volume flood events.

PANS – are shallow, usually seasonal bodies of open water; often circular and not directly connected to river systems by surface flow. Essentially they are internally draining systems that may contain either fresh or saline water, depending on local soil conditions. They may be temporary or perennial. Pans on different soils and at varying altitudes have substantially different ecological characteristics.

LAKES AND DAMS – there are no true lakes in Mpumalanga. Strictly speaking, lakes are natural impoundments within the continuous river line. Dams are artificial impoundments that are not considered as wetlands as we have no natural fauna and flora that are adapted specifically to lake-type environments. The small ‘lakes’ in the Chrissiesmeer area are in fact pans, occasionally interconnected by wet-season overflows.
WHAT IS A SPATIAL BIODIVERSITY PLAN?

Biodiversity is not evenly distributed throughout the landscape. Some areas have higher levels of biodiversity than others. These ‘higher levels’ may include both a higher number of species or ecosystems, or a large number of threatened species. A spatial biodiversity plan takes this variability into account by collating and mapping information about:

- Biodiversity features (species, ecosystems, ecological processes);
- Existing protected areas;
- Current patterns of land use;
- Potential and conflicting patterns of land use.

These mapped features can be linked for further analysis using Geographic Information Systems (GIS), to identify areas of high biodiversity and determine priority areas for action.

Spatial planning can occur at a variety of scales. The NSBA (Driver, et al, 2005) was done at a broad scale and does not yield information suitable for land use decisions for a municipality or a specific river or catchment. The finer scale MBCP is suitable for use even at the farm level. This is because the underlying data on biodiversity features in the Province were recorded and mapped at a finer scale than the national data used in the NSBA.
WHAT IS SYSTEMATIC BIODIVERSITY PLANNING?

The process of identifying spatial biodiversity priorities in the MBCP is based on the Systematic Biodiversity Planning approach of Margules and Pressey (2000), also referred to as Systematic Conservation Planning. The underlying principle is to identify representative samples of biodiversity that are located where they can persist over the long term. The amount of biodiversity requiring protection must then be quantified by setting a target for each biodiversity feature. This numerical target tells us how much of the feature needs to be maintained or conserved, in order for it to persist and contribute to ecosystem functioning.

**BOX 4.1: STEPS IN SYSTEMATIC BIODIVERSITY PLANNING**
(Margules & Pressey 2000)

1. Select and collate the biodiversity features and surrogates to be used in the planning area.
2. Formulate explicit conservation goals that can be expressed as quantifiable biodiversity targets.
3. Review the extent to which goals have been met in existing reserves.
4. Use systematic methods to locate and design feasible new reserves that are able to protect the remainder of the biodiversity targets (that are not currently protected).
5. Prioritise and implement conservation actions on the ground.
6. Manage and monitor (adaptive management) within reserves to maintain biodiversity features.

Systematic biodiversity planning is at a more advanced stage for terrestrial than for aquatic ecosystems, usually resulting in such plans being done separately. The MBCP is the first provincial biodiversity plan to successfully integrate the two. Systematic biodiversity planning makes use of sophisticated planning software to calculate the most efficient pattern of planning units required to meet biodiversity targets. The MBCP used a software package called Marxan (Possingham et al. 2000) briefly explained in the box below.

**BOX 4.2: BIODIVERSITY PLANNING SOFTWARE USED IN MBCP — MARXAN AND CLUZ**

Cluz is a user-friendly ArcView GIS interface that allows users to design protected area networks based on the Marxan algorithm. Its efficiency lies in linking the Marxan conservation planning software with ArcView and in importing of data, analysis and exporting of output data.

Marxan is designed to produce very efficient solutions to the problem of selecting planning units that meet a suite of biodiversity targets. Although several other conservation planning packages are available (such as C-plan), Marxan is unique in that it is able to address three important functions. These are:
- Incorporating boundary cost;
- Incorporating planning unit cost;
- Setting clump targets.

Marxan then aims to minimise the cost of the above three functions by adding a cost value to them, and then trying to minimise planning unit portfolio costs.

continued overleaf
The MBCP used relatively small planning units, dividing the Province into a honeycomb of 65 000 hexagons of 118 hectares each. The biodiversity features were then overlaid and the amount of each feature occurring in a planning unit was calculated. The software then identified the required portfolio of planning units that best meets all biodiversity targets in the smallest possible area. Thus each planning unit is assessed in terms of whether it is needed to meet targets and what the likelihood is of other planning units being selected to protect the same biodiversity feature (a measure of irreplaceability). Sites with truly unique biodiversity are crucial in meeting targets. No alternative units will be offered because there are none, i.e. they are irreplaceable. Other sites may offer various alternative planning units to meet a target and thus have a lower irreplaceability value.

INTEGRATING TERRESTRIAL AND AQUATIC ASSESSMENTS IN A SINGLE BIODIVERSITY PLAN

The MBCP started from the premise of trying to be as inclusive and integrated as possible. This led to the decision to integrate the aquatic and terrestrial analyses into a single biodiversity plan. The general approach that underlies this process may be summarised as:

- Recognising the priority to conserve aquatic biodiversity within healthy subcatchments;
- Assessing the biodiversity importance of high value subcatchment areas and influencing the selection of terrestrial priorities towards these areas;
- Assessing future land-use pressures and influencing the terrestrial assessment to avoid these areas;
- Using spatially intelligent software (Marxan) to combine freshwater and terrestrial assessments in a single biodiversity plan;
- Producing a practical, meaningful output, useful at both provincial and municipal scales;
- Providing land-use guidelines for biodiversity conservation at the strategic or planning level.
Thus the process started with the aquatic analysis, which was then integrated into the terrestrial analysis to produce the final product, using the following steps:

- Aquatic assessment preparation: collate spatial data on biodiversity features, aquatic processes and high water production areas;
- Identify healthy subcatchments;
- Set targets for aquatic biodiversity features (Table 4.1);
- Do aquatic assessment using Marxan and identify priority sites within the healthy subcatchments needed to protect aquatic features;
- Convert the identified priority subcatchments into a GIS layer (cost surface) which will bias the selection of terrestrial planning units towards these important areas;
- Terrestrial assessment preparation: collate spatial data on biodiversity, ecological processes and protected areas;
- Set targets for terrestrial biodiversity features (Table 4.2);
- Develop a GIS-layer for biodiversity/land-use conflict (and convert to cost surface);
- Combine output of the aquatic assessment with the land-use conflict layer;
- Do terrestrial assessment to meet targets for all terrestrial features, while combining cost layers (favouring aquatic priorities and avoiding areas of land-use conflict);
- Sort output into meaningful biodiversity categories;
- Create land-use guidelines applicable to these categories.

Various analyses and trials were conducted to integrate the aquatic and terrestrial assessments to produce the overall biodiversity plan. Through this process, various products were generated, including:

- Assessment of the health and integrity of subcatchments (Figure 4.1);
- Assessment of aquatic biodiversity (Figure 4.2);
- Assessment of future land-use pressures on biodiversity (Figure 4.3);
- Assessment of terrestrial biodiversity (Figure 4.4);
- Guidelines for land-use planning for biodiversity conservation (Chapter 6).
TABLE 4.1: Biodiversity features and processes used in the aquatic biodiversity assessment

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>DESCRIPTION &amp; IMPORTANCE</th>
<th>EXTENT/SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers – biodiversity types</td>
<td>Ecoregion Level 2 types: surrogate for aquatic biodiversity</td>
<td>30 types; 28,666 km of rivers</td>
</tr>
<tr>
<td>Rivers – functional types</td>
<td>River signatures: surrogate for functional types of rivers</td>
<td>24 types; 120,675 km of rivers</td>
</tr>
<tr>
<td>Seepage and valley bottom</td>
<td>Wetlands classified into functional types, then according to Ecoregion Level 2 (for</td>
<td>113,628 wetlands; totalling 312,771 ha; 51 types</td>
</tr>
<tr>
<td>wetlands</td>
<td>biodiversity)</td>
<td></td>
</tr>
<tr>
<td>Pan wetlands</td>
<td>Classified into perennial &amp; non-perennial pans, and Ecoregion Level 2 biodiversity</td>
<td>23,922 ha of pans; 39 pan types</td>
</tr>
<tr>
<td>Peat wetlands</td>
<td>Known peat wetlands</td>
<td>77 point records</td>
</tr>
<tr>
<td>Fish species</td>
<td>Distribution of 4 threatened fish species</td>
<td>908 km of river length</td>
</tr>
<tr>
<td>Important pan clusters</td>
<td>All pans buffered with 1 km, transformed and heavily fragmented areas removed (&gt; 500 ha)</td>
<td>132,611 ha of important clusters</td>
</tr>
<tr>
<td>Important wetland clusters</td>
<td>Wetlands buffered with 1 km, transformed and heavily fragmented areas removed (&gt;1000 ha)</td>
<td>266,820 ha of important clusters</td>
</tr>
<tr>
<td>High water-production areas</td>
<td>Catchments producing 50% of Mpumalanga’s runoff mapped as high water-production areas</td>
<td>High water-production areas equate to 19% of MBCP planning domain</td>
</tr>
<tr>
<td>Aquatic refugia</td>
<td>Refuge areas for maintaining fish populations during times of drought</td>
<td>Selected subcatchments</td>
</tr>
<tr>
<td>Migration areas</td>
<td>Areas important for maintaining fish migration</td>
<td>Selected subcatchments</td>
</tr>
</tbody>
</table>

HEALTHY SUBCATCHMENTS

No direct measure of subcatchment condition was available so we used a combination of PESC and the extent of terrestrial transformation, as measures of subcatchment integrity. Present Ecological State Class (PESC) is the degree to which present ecological conditions of a catchment have been modified from natural (reference) conditions. The measure is based on an assessment of water quality, biotic indicators and habitat information. Results are classified on a 6-point scale, from Category A (largely natural) to Category F (critically modified). A limitation of this data set is that PESC was based only on the main rivers within a quaternary catchment, not the tributaries. Each subcatchment was assigned the PES category of the parent quaternary catchment.

At the subcatchment level, the extent of habitat transformation is a good proxy for riparian integrity. Thus the extent of transformation was used as one of the surrogates for subcatchment integrity because in heavily transformed subcatchments, one can expect to have degraded wetlands and tributaries. So the MBCP used a combination of PESC and habitat transformation for each subcatchment to identify healthy subcatchments. This output was used in Marxan to bias the selection of planning units to meet targets in these healthy subcatchments first.
FIGURE 4.1: Subcatchment health or integrity. The health was determined using a combination of PESC and subcatchment transformation values. The subcatchment health is summarised into 3 broad categories. These are then further displayed using the degree of transformation as shading. The darker the colour, the more transformed the subcatchment.

RESULTS OF THE ASSESSMENT
The smallest and most efficient portfolio of planning units that meets the targets for all aquatic features was determined using Marxan. The selection of these units was biased towards meeting targets in healthy subcatchments. The results show that 28% of Mpumalanga is identified as important for meeting aquatic biodiversity targets (in addition to protected areas). However, not all of this area is in a healthy state. Of the additional required catchments, only 57% are healthy; 30% moderate and 13% modified. This implies that rehabilitation is needed in order to adequately conserve freshwater biodiversity within healthy subcatchments.
Figure 4.2 identifies the most efficient portfolio of planning units able to meet all the aquatic biodiversity targets. These planning units represent the most healthy subcatchments possible to meet aquatic targets. For sustainable water production as well as biodiversity conservation, it is critical that measures are taken to prevent degradation and where possible protect and restore these important catchments.

By comparison, the Aquatic Biodiversity Assessment image, (as displayed on the MBCP Map [Lötter & Ferrar, 2006]) identifies the ‘irreplaceability value’ of each subcatchment. This refers to the likelihood of any subcatchment being required to meet aquatic biodiversity targets and indicates the options for meeting these targets. The most valuable catchments will always be required and this map serves to help prioritise conservation actions.
TERRESTRIAL ANALYSIS
The terrestrial approach incorporates:
- Use of fine-scale planning units able to be used at provincial and local municipal scales;
- Selection of a wide range of species and ecosystem features to define biodiversity;
- Use of cost surfaces to create bias for meeting terrestrial biodiversity targets within important aquatic planning units (subcatchments);
- Avoiding areas of conflict or threats from other priority land uses.

This combination of fine scale, large data sets, use of intelligent clumping of planning units and the integration of aquatic and terrestrial assessments, is also novel.

PLANNING UNITS
The accuracy and fine-scale mapping of biodiversity data has enabled the use of planning units that are small enough to be useful at the provincial and local municipal levels. A total of 65,000 hexagons were used as planning units, each 118 ha in size. Hexagons were chosen as they are well suited to Marxan's ability to cluster planning units and to produce ecologically sensible patterns of related units.

PROTECTED AREAS
The protected area network layer was updated and mapped to show current levels of protection for terrestrial biodiversity features. These protected areas are discussed in more detail in Chapter 5 where both formal and informal protected areas are assessed. Only the formal protected areas, those managed and/or formally proclaimed as nature reserves, are included in the terrestrial analysis. Conservancies and Natural Heritage Sites are legally and administratively weak at present and were not considered as providing effective long-term protection due to their uncertain future. See Appendix 3 for an extended list of all protected areas in the Province.

BIODIVERSITY FEATURES
Terrestrial biodiversity data, or surrogates for biodiversity features, were captured in GIS and allocated to planning units. Data sources included the MTPA's threatened species databases, expert biologists, NGOs (e.g. Highland Crane Working Group), and museum databases. Species were selected based on their conservation importance. This generally included all Red Data Listed or threatened taxa for which sufficiently precise locality data were available. Priority was given to local endemics and the MTPA responsibility for protecting these endemics is reflected in the biodiversity targets for these species. A complete list of species and their individual biodiversity targets is provided in the MBCP Technical Report. Table 4.2 lists the broad types and numbers of terrestrial biodiversity features used. All 340 terrestrial biodiversity features are also listed on the main MBCP Map.

BIODIVERSITY TARGETS
As previously mentioned, systematic biodiversity planning requires the setting of a target (e.g. a population size or area of habitat) for each biodiversity feature (e.g. species, ecosystem, community or process). The target indicates how much of the feature is needed for it to be conserved in the long term.

The MBCP used the NSBA targets for vegetation types, except for forests. The NSBA targets are based on the species diversity within each vegetation type: higher species diversity corresponds to a higher target. For the vegetation types that occur in Mpumalanga, targets range from 19% to 28% of the original area of each vegetation type. Targets for forests are taken from the DWAF national systematic conservation plan for forests. These targets range from 59.5% to 71.7%. Species targets vary widely, up to 100% for Critically Endangered species localities. The terrestrial biodiversity features used in the analysis are summarised in Table 4.2.
### TABLE 4.2: Types of biodiversity features used in the terrestrial assessment

<table>
<thead>
<tr>
<th>BIODIVERSITY FEATURES</th>
<th>DESCRIPTION</th>
<th>EXTENT/SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation Types</td>
<td>68 Vegetation types: National Vegetation Types other than forests (biodiversity surrogates)</td>
<td>68 Types: 9 forest; 28 grassland; 31 savanna</td>
</tr>
<tr>
<td>Amphibians</td>
<td>Modelled distributions of important species</td>
<td>3 species</td>
</tr>
<tr>
<td>Birds</td>
<td>16 threatened species (known, modelled and/or nesting sites – 24 features in total)</td>
<td>Feeding and known sites - 19 spp Nesting sites - 7 species</td>
</tr>
<tr>
<td>Invertebrates</td>
<td>Buffered known localities and point localities</td>
<td>17 species</td>
</tr>
<tr>
<td>Mammals</td>
<td>Modelled distributions, actual distributions and buffered sites</td>
<td>13 species</td>
</tr>
<tr>
<td>Plants</td>
<td>Known point localities</td>
<td>187 species</td>
</tr>
<tr>
<td>Reptiles</td>
<td>Modelled distributions</td>
<td>10 species</td>
</tr>
<tr>
<td>Special features</td>
<td>Selected pans and wetlands with unique biodiversity; all natural caves</td>
<td>Point records identify wetlands and pans with unique features. Caves have 250m buffer</td>
</tr>
<tr>
<td>Processes</td>
<td>Key landscape features maintain ecological and evolutionary processes centred on biological movement and connectivity</td>
<td>Escarpment/summit corridors; Centres of endemism; Montane and highveld grassland patches; Forest patches</td>
</tr>
</tbody>
</table>

### LAND-USE PRESSURES (CURRENT & FUTURE)

In planning for development to avoid areas where biodiversity is threatened, or where there is an anticipated conflict with existing land use, it is important to assess the socioeconomic context and likely future pressures on biodiversity. Three factors that put pressure on natural habitats are included in this assessment: land of high agricultural potential (high capability land); high mining potential; and high urban growth potential. A fourth factor was included, representing areas with a high likelihood of being degraded by alien plant invasions (Fig 4.3). These factors were combined into one GIS layer representing areas of likely conflicts with biodiversity and therefore high risk areas for meeting biodiversity targets. Site selection is made to avoid these areas if options exist for meeting targets elsewhere.
FIGURE 4.3: Maps showing future pressures on terrestrial biodiversity.

RESULTS
Marxan calculates the smallest area required to meet all targets while minimizing land-use conflict and protecting important aquatic areas. It is able to calculate the ‘irreplaceability’ value of a parcel of land. This irreplaceability value is defined as the likelihood of a particular parcel being needed to meet biodiversity targets. The irreplaceability value and the minimum area required were then sorted into meaningful biodiversity assessment categories. These categories are:

- Protected areas: already managed for biodiversity protection;
- Irreplaceable: 100% Irreplaceable - no other options available to meet targets;
- Highly Significant: 50 - 99% Irreplaceable - very limited options available to meet targets;
- Important & Necessary: lower irreplaceability value, less than 50% but still required to meet targets;
- Least Concern: areas of natural habitat that could be used to meet some targets but not needed now, as long as other areas are not lost;
- No natural habitat remaining: virtually all natural habitat has been irreversibly lost as a result of cultivation, timber plantations, mining, urban development.
Brief descriptions of these biodiversity assessment categories are included on the MBCP Map. Further details, in terms of how to respond to the designation of these categories in a particular area of interest, are located at the beginning of Chapter 6.

**FIGURE 4.4:** Percentage of Mpumalanga covered by different biodiversity assessment categories.

**FIGURE 4.5:** Biodiversity assessment categories as a proportion of each district municipality.

Note: Southern Kruger NP falls within the Bohlabela municipal district. This is obviously unusual as protected area land makes up 83% of this district. The Ehlanzeni District has the highest proportion of irreplaceable sites at 6.2%.

*Striped Mouse \( Rhabdomys pumilio \)*

Aside from humans, the striped mouse may be the most common mammal in southern Africa. They live in a wide range of habitats from the dry Kalahari to the grasslands of Mpumalanga where they feed on grass seeds, herbs and berries and play a role in seed dispersal.
FIGURE 4.6: Results of the terrestrial biodiversity assessment. Refer to the MBCP primary map for the aquatic component.
PROTECTED AREAS PAST AND PRESENT
The most widespread method of conserving biodiversity is by establishing a network of formally Protected Areas (PAs) or nature reserves. For such a network to be effective it must be representative of the variety and spread of biodiversity throughout the landscape. Mpumalanga has 45 formal PAs, (Appendix 3 Aix), most of which were not established with the aim of conserving a representative sample of biodiversity. The result is that the Province’s PAs have a strong bias; they more than adequately protect the game-rich savannas but have neglected the heavily transformed grasslands.

Biodiversity conservation is entrenched in national and provincial law and we now have sufficient knowledge of biodiversity to be able to plan systematically for its protection. Although broad-scale analyses have been carried out for specific biodiversity features, the MBCP is the first scientific assessment of Mpumalanga and its PA network, in terms of the distribution of nature reserves across the landscape and their effectiveness in meeting biodiversity conservation objectives.

Many of the Province’s older PAs were created on lands of low economic value (e.g. on poor soil or at high altitude) in scenic or recreationally attractive areas, or for the protection of one or two charismatic species. The result, not only in Mpumalanga but all over the world, is that scarce conservation funds are being spent on conservation areas that are not representative or effective in conserving biodiversity because they were created for other reasons. All state conservation agencies including MTPA now have specific responsibility to conserve biodiversity in terms of the Biodiversity Act. This assessment provides for a comprehensive review of the PA network in terms of this mandate.
To measure the effectiveness of a PA network it is necessary to first determine how biodiversity is distributed across the landscape. Once we know what occurs where, we can analyse how well the current network captures the full range of known biodiversity. However, it is not enough simply to know how much biodiversity is being protected. Questions such as which PAs are contributing the most to conservation and how unprotected areas can contribute to the overall biodiversity protection task, also need to be answered.

TYPES AND GROUPS OF PROTECTED AREAS

Mpumalanga’s 45 formal PAs are state owned and managed. There are 115 additional, informal PAs comprising private land committed in one way or another to conservation. The informal PAs may be further subdivided on the basis of their legal and administrative security (see Groups 1 to 3 below). There are 18 private reserves that are actively managed, relatively secure and formalised. The remaining 97 PAs are informally conserved areas whose current and future status is uncertain. Together this forms an extended PA network of sufficient significance that the full 160 PAs deserve to be assessed for their combined contribution to provincial biodiversity conservation. Details of the extended PA network are provided in Appendix 3 and summarised in Table 5.2. In outline it comprises the following:

**FORMAL / INFORMAL GROUP NO TYPES OF PROTECTED AREA**

<table>
<thead>
<tr>
<th>Formal protected areas</th>
<th>Group 1</th>
<th>45</th>
<th>National Parks; Provincial Parks and Nature Reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private protected areas</td>
<td>Group 2</td>
<td>18</td>
<td>Municipal, Private and leased-land Nature Reserves</td>
</tr>
<tr>
<td>Unsecured protected areas</td>
<td>Group 3</td>
<td>97</td>
<td>SA Natural Heritage Sites; Conservancies on private or state land</td>
</tr>
</tbody>
</table>

**TYPES OF BIODIVERSITY ASSESSMENT**

The MBCP provides for two different types of assessment:

- The main assessment of the MBCP (Chapter 4) examined the protection levels of biodiversity features across the entire Province, together with an analysis of priority biodiversity areas. Protected areas (mainly formal) were included, but only for assessing the amount of each biodiversity feature currently protected. This analysis did not attempt to assess the value within and between protected areas. In effect each PA was treated as a single planning unit for the purpose of the analysis. The focus of this type of assessment is to identify biodiversity outside the PA network for cooperative stewardship programmes or other conservation initiatives, such as ensuring sustainable development.

- The purpose of the PA assessment is to determine the contribution of each PA towards meeting biodiversity targets. However, this assessment first examined at the level of protection that each vegetation type was afforded within the formal PA network. Then the extended network was assessed in terms of each PA’s contribution towards meeting biodiversity targets (as explained in Chapter 4). This provided an assessment of how well the current PA network is doing in meeting biodiversity targets, as well as identifying opportunities outside current PAs, where protection of biodiversity needs strengthening. As a foundation for the PA assessment, the location, extent and status of all formal and informal PAs in the Province were determined (see Appendix 3).
PROTECTION LEVELS OF VEGETATION TYPES (Refer to Appendix 2 for values for each vegetation unit.)
The analysis measures the extent to which the biodiversity targets for each vegetation type have been met within the current formal PA network. The results for the Province are mapped in Figure 5.1 and summarised in Table 5.1 below.

The main source of the savanna bias in the current PA network is obviously the presence of such a large part of the Kruger NP within the Province (it makes up >70% of formal PA total). Protected areas comprise 14.8% of the Province but only 4.4% without the Kruger contribution. Figure 5.1 shows the protection levels for each vegetation type. It is obvious from the map that the savanna vegetation types are well protected while the grassland and highveld vegetation types are very inadequately protected. Overall, only 2.3% of grasslands are protected, while 34.2% of savannas and 35.4% of the forest biome are protected within formal protected areas.

### TABLE 5.1: Protection levels of vegetation types, based on the proportion of the biodiversity target included in a formal protected area

<table>
<thead>
<tr>
<th>% OF BIODIVERSITY TARGET INCLUDED IN A FORMAL PROTECTED AREA</th>
<th>PROTECTION LEVEL</th>
<th>NUMBER OF VEGETATION TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>zero protected</td>
<td>20</td>
</tr>
<tr>
<td>0-5%</td>
<td>hardly protected</td>
<td>5</td>
</tr>
<tr>
<td>5-50%</td>
<td>poorly protected</td>
<td>15</td>
</tr>
<tr>
<td>50-100%</td>
<td>moderately protected</td>
<td>10</td>
</tr>
<tr>
<td>&gt; 100%</td>
<td>well protected</td>
<td>18</td>
</tr>
</tbody>
</table>

EXPLANATION: Example of vegetation type ‘x’ with a biodiversity target of 22% of its original area. If 22% or more of ‘x’ is protected, the biodiversity target has been met and vegetation type ‘x’ is classified as well protected. If 11% to 21.9% of ‘x’ is protected, then ‘x’ is classified moderately protected. If 1.1% to 10.9% of ‘x’ is protected, it is classified poorly protected. If < 1.1% of ‘x’ is protected, it is hardly protected. If none of ‘x’ is protected, it has zero protection.
FIGURE 5.1: Protection level classes of Mpumalanga’s vegetation types, based on the proportion of the biodiversity target for each vegetation type that is included in formal protected areas.

COMPARATIVE IMPORTANCE OF PROTECTED AREAS

Mpumalanga currently has 160 protected areas (Appendix 3 Aix), classified into three broad groups, based on their legal and administrative status. These groups are subdivided into into 12 types, from state lands and conservancies all the way through to provincial nature reserves and national parks (Table 5.2). This subdivision assists in the finer-scale interpretation of this assessment, as it quantifies the biodiversity or conservation importance of each of these areas. It also enables a template of biodiversity priorities to be created against which the MTPA may then review its short- and longer-term conservation strategy. It is likely that there are areas conserving a great deal of biodiversity but that have uncertain futures due to their informal status. Other studies have identified where gaps exist in PA networks in terms of species diversity or how representative the network is. The exciting aspect of the approach used here, namely measuring each individual PA’s contribution to meeting biodiversity targets, is that it provides a new method of assessing the biodiversity contribution of individual protected areas.
WHO IS THIS ASSESSMENT FOR?
The specific aim of this assessment is to provide insight for MTPA decision makers into how well their current PA network is meeting biodiversity objectives. The assessment is intended to be of value to all current and potential PA owners and managers, and their local stakeholders. In a wider context it is relevant to all members of the public who have an interest in the future of biodiversity, protected areas and tourism in Mpumalanga.

METHODS
The PA assessment methodology is similar to that of the analysis of biodiversity priority areas (Chapter 4). It is based on the same terrestrial database of 340 biodiversity features and their targets. The same 118 ha hexagonal planning units are also used but this time they extend right through all PAs, partitioning the entire Province into planning units regardless of the location of protected areas. The conservation planning software C-Plan (Pressey, 1999) was used to conduct the irreplaceability analysis. C-Plan (which is slightly simpler than Marxan) was used because all that is required is for it to quantify the irreplaceability of each planning unit throughout the Province, based on its contribution to the targets of the 340 biodiversity features. C-Plan was also used because it is able to process a larger number of planning units than Marxan.

Once irreplaceability was calculated for each planning unit and an irreplaceability map produced (Figure 5.2a), a map of the extended PA network was overlaid (Figure 5.2 b,c,d). The Province’s 12 PA types were sorted into three groups based on their legal protection status (taken as a proxy for resource allocation). Group 1 PAs, as listed in Table 5.2, are areas managed by the MTPA or SANParks. Group 2 PAs are privately owned and managed for biodiversity, but are not necessarily proclaimed in the legislation. Group 3 PAs are more informally managed areas with diverse and uncertain futures.

### TABLE 5.2 Summary of the numbers and types of PAs in Mpumalanga and the percentage of the total PA network contained within each category. The size of Kruger NP dominates the Province’s PAs and has a substantial influence on our analysis. As a result, the data are shown both with and without Kruger NP included in the PA network.

<table>
<thead>
<tr>
<th>GROUP</th>
<th>TYPE OF PA</th>
<th>ABBR.</th>
<th>NUMBER</th>
<th>AREA (HA)</th>
<th>% OF PA NETWORK</th>
<th>% MINUS KRUGER NP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>National Park</td>
<td>NP</td>
<td>2</td>
<td>968 643</td>
<td>50.0</td>
<td>5.2</td>
</tr>
<tr>
<td>Provincial Nature Reserve</td>
<td>PNR</td>
<td>25</td>
<td>178 298</td>
<td>9.1</td>
<td>17.4</td>
<td></td>
</tr>
<tr>
<td>MTPA Flora Reserve</td>
<td>MTPA FR</td>
<td>5</td>
<td>95</td>
<td>&lt;0.1</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Indigenous Forest Mountain Catchment Area</td>
<td>IFMCA</td>
<td>10</td>
<td>11 738</td>
<td>0.6</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Joint Management Area</td>
<td>JMA</td>
<td>3</td>
<td>32 771</td>
<td>1.7</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>Municipal Nature Reserve</td>
<td>MNR</td>
<td>3</td>
<td>3 459</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Private Nature/Game Reserve</td>
<td>PR</td>
<td>12</td>
<td>134 173</td>
<td>6.9</td>
<td>13.1</td>
<td></td>
</tr>
<tr>
<td>Leased Area</td>
<td>LA</td>
<td>3</td>
<td>1 417</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>SA Natural Heritage Site</td>
<td>SAHS</td>
<td>41</td>
<td>92 138</td>
<td>4.7</td>
<td>9.0</td>
</tr>
<tr>
<td>Conservancy</td>
<td>C</td>
<td>39</td>
<td>465 415</td>
<td>24.7</td>
<td>46.8</td>
<td></td>
</tr>
<tr>
<td>State land (not protected)</td>
<td>S</td>
<td>16</td>
<td>25 246</td>
<td>1.3</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>De Hoop Potential Reserve</td>
<td>DH</td>
<td>1</td>
<td>12 821</td>
<td>0.7</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td><strong>PA TOTAL</strong></td>
<td></td>
<td></td>
<td>160</td>
<td>1 940 265</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Remaining Unprotected Landscape</td>
<td>-</td>
<td></td>
<td></td>
<td>6 285 745</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GRAND TOTAL</strong></td>
<td></td>
<td></td>
<td>160</td>
<td>8 204 564</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (proposed and not protected)
A measure of the Conservation Importance of each PA was determined by calculating the proportion of all planning units within
the PA with an irreplaceability value of greater than 50%. This provided a simple method for quantifying a PA’s contribution to
meeting biodiversity targets. Conservation Importance was determined for the entire PA network, for Group 1 vs. Group 2 vs.
Group 3 areas, for each of the 12 types of PA, and finally for each individual protected area in the Province (see Appendix 3).

Other information may be obtained, such as a PA’s representativeness and the number of features whose targets are fully
achieved within it. Representativeness indicates the number of biodiversity features found within the PA, while target achieve-
ment indicates the number of known biodiversity features, that have 100% of their targets met within that PA alone. By
compiling all this information, a quantified profile is produced for each of the Province’s 160 protected areas, indicating its size,
status, conservation importance, sum of target achievement as well as other statistics.

FIGURE 5.2: a) C-Plan derived irreplaceability map of Mpumalanga with b) Group 1 conservation areas c) Group 2 conservation areas and d) Group 3 conservation areas overlaid. The red areas indicate those areas that must be
conserved if biodiversity targets are to be met. Any planning unit with an irreplaceability score >0.5 (depicted as orange,
maroon, or red on the map) was deemed an ‘important’ site for meeting biodiversity targets.
RESULTS - WHAT THE ASSESSMENT REVEALED

The assessment revealed that overall Mpumalanga’s PAs are better situated to conserve biodiversity than non-protected areas (Figure 5.2 b). Furthermore, every planning unit within every PA is shown to contribute to meeting the biodiversity targets for one or more biodiversity features, which means that none of the PAs in Mpumalanga is redundant. However, there are still several biodiversity features that are not afforded any protection at all, and there are many features that are inadequately protected with only a portion of their biodiversity target met within the PA network.

A number of PAs contained biodiversity features that were not found anywhere else in the PA network and are hence of particular value. Specifically, Blyde River Canyon NP contained 20 biodiversity features represented nowhere else in the PA network. Moreover, of these 20 biodiversity features, 15 had their targets fully achieved in the Blyde River Canyon NP alone. Kruger National Park contained 15 unique features and fully achieves the targets for all of them.

The study reveals that the highest proportion of important sites (planning units with an irreplaceability value of greater than 50) occurs in the informal Group 3 PAs. Figure 5.3a shows the relative importance of Group 1, 2, and 3 PAs as well as for nonprotected areas. Analysed in more detail, conservation importance scores can be determined for each of the 12 different types of PA. This shows that within each of the three broad PA groups there are large differences between the different types (Figure 5.3b).

Group 1 formal PAs are the most representative, meaning that they contain the highest number of biodiversity features analysed in this assessment (221 of 340). Group 3 PAs contain 181 of the 340 biodiversity features and 42 of these features are unique, meaning they are not found in either Group 1 or 2 PAs. Based on both conservation importance scores and representativeness, Mpumalanga’s top three protected areas for biodiversity are Verloren Valei Provincial Nature Reserve, Mooibron Natural Heritage site and Blyde River Canyon National Park. The analysis calculates detailed conservation importance scores for every PA in the database. A complete list of conservation importance scores and other PA statistics are presented in Appendix 3.

ASSESSMENT IMPLICATIONS

A great deal of useful information was derived from analysing the relative biodiversity importance of protected areas. First, the results showed that the current PA network serves to meet biodiversity targets quite well, although still underprotecting many biodiversity features. The land contained within the PA network is home to a higher proportion of key biodiversity features than the land outside the PA network. This shows that even though in the past the proclamation of PAs may not have been based on biodiversity criteria, they cannot today be considered as arbitrary or redundant; every PA assessed is needed to meet the targets of at least one of the biodiversity features measured.

The formal PA network (Group 1) contributes a great deal towards meeting biodiversity targets. It adequately protects many of the features measured, including a large number found nowhere else (i.e. in Groups 2 or 3). However, a larger proportion of sites rated as important for meeting targets, i.e. planning units with an irreplaceability value of greater than 50%, are found in informal Group 3 PAs. While private lands have long been recognised as potentially important for meeting biodiversity targets, this assessment reveals the extent of their conservation importance. While it is unlikely the MTPA could afford to purchase or otherwise acquire these areas, various stewardship arrangements are well established in other provinces, showing ways that agencies can work with land owners to protect biodiversity (Botha 2001). Currently,

**Hippopotamus**

*Hippopotamus amphibius*

Hippos play a vital role in the ecology of rivers and still water bodies by opening up reed beds and recycling nutrients.

They are widespread in Africa although their numbers are in many places declining as a result of water diversion and extraction, and poaching.

They are said to be Africa’s most dangerous animal (apart from disease carrying insects).

They are still common in the waterways and water bodies of the Lowveld.
MTPA has no stewardship programme and is unable to offer incentives to private land owners for conserving their land (this situation is in the process of being addressed within new MTPA structure). In addition, the SA Natural Heritage Sites, which contain the highest proportion of conservation-important sites in the Group 3 PAs, were registered as part of a long abandoned and rather superficial conservation programme. It is intended to be revitalised but at present the SA Natural Heritage Sites are not formally recognised for their valuable biodiversity. The status of these and other informal PAs are very uncertain in the face of future land-use pressures. Their importance for biodiversity conservation is highlighted in this analysis, clearly indicating that programmes to ensure their future integrity must be implemented if legal mandates are to be fulfilled.

Measuring Conservation Importance, based on a PA's contribution to meeting biodiversity targets, is only one of many ways to determine an area's conservation value. It is particularly important to note here that a reserve like Kruger National Park, which protects a huge range of biodiversity features, including many large mammal populations not included in this assessment, has special attributes that make it important. Size is one; a very important attribute for ensuring the maintenance of functioning ecosystems and the persistence of species into the future.

Every protected area has a role to play in the global contribution to protecting biodiversity, no matter what its legal or ownership status. This assessment does not necessarily detract from the value of areas that do not score highly in our ranking of conservation importance. However, when conservation resources are scarce, methods for allocating those resources must be defensible and effective. Setting biodiversity conservation goals and working towards achieving them is one of the only ways that parks agencies can measure their own effectiveness. This assessment provides a new, quantified and strongly scientific basis for setting those objectives and monitoring progress towards achieving them.

FIGURE 5.3: a) The conservation importance of formal Group 1 PAs, semi-formal Group 2 PAs, and unsecured Group 3 PAs vs. non-conservation lands. The dotted line indicates the provincial average or the proportion of important sites in the entire Province; b) The conservation importance of each of the 12 types of protected areas (IFMCA – Indigenous Forest Mountain Catchment Area).
Purpose

These land-use guidelines are intended to achieve improved conservation of biodiversity and the persistence of ecosystem functioning. They should inform decisions at various levels, from provincial planning forums to individual changes in land use. In covering such a wide range of applications, we make no claim that they are comprehensive or complete. They are intended in the long run to evolve into regulations, and as such will benefit from feedback by users as they apply them to real decision-making situations.

Our readership focus is on planners at all levels, from land owners and buyers to central development planners. The guidelines are intended to inform the decisions of the main provincial environmental and biodiversity agencies, DALA and MTPA. Their most obvious and frequent use is expected to be:

- Informing all parties involved in development applications and their authorisation through the EIA process;
- Informing land-use and development planners in municipalities and the provincial government.

The three ecosystems in this document are identified by a prefix as follows:

- Terrestrial – ‘T’
- Aquatic (rivers, lakes and impoundments) – ‘A’
- Wetlands – ‘W’
The MBCP has created six biodiversity conservation categories for terrestrial ecosystems using systematic biodiversity planning methods (Table 6.1). This chapter sets out broad land-use guidelines applicable to each category and all ecosystems.

The MBCP has also identified the most important water catchments in the Province which are critical for meeting aquatic biodiversity targets (see Figure 4.2). Land-use guidelines for these catchments are provided to safeguard their current good ecosystem status. All land uses involving physical development will have significant impacts on these catchments. It is critical that inappropriate development does not compromise their integrity. Both aquatic biodiversity and water supplies will be jeopardised if this is allowed to happen.

**TERRESTRIAL ECOSYSTEMS**

**TABLE 6.1: Summary of terrestrial biodiversity conservation categories**

<table>
<thead>
<tr>
<th>BIODIVERSITY CONSERVATION CATEGORY</th>
<th>% OF PROVINCE</th>
<th>COMMENT ON LAND USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PAs currently under formal biodiversity protection PAs</td>
<td>14.8%</td>
<td>The higher conservation categories (1 to 4) need to be managed for the conservation of biodiversity.</td>
</tr>
<tr>
<td>2. Irreplaceable, in urgent need of protection and PA status Irrp</td>
<td>2.4%</td>
<td></td>
</tr>
<tr>
<td>3. Highly Significant, protection needed - limited choice for meeting targets H-S</td>
<td>12.3%</td>
<td></td>
</tr>
<tr>
<td>4. Important and Necessary, protection needed - more choices for meeting targets I&amp;N</td>
<td>9.5%</td>
<td></td>
</tr>
<tr>
<td>5. Areas of Least Concern, providing options for development L-C</td>
<td>25.2%</td>
<td>61% of Province available for development via EIA planning procedures.</td>
</tr>
<tr>
<td>6. Areas with No Natural Habitat remaining, providing preferred sites for all forms of development NN</td>
<td>35.8%</td>
<td></td>
</tr>
</tbody>
</table>

(Ecological corridors (6.7%) are not included as they are not part of the spatial analysis.)
T1. PROTECTED AREAS (PAs) - 14.8% of the Province (10.4% in Kruger National Park)

Protected Areas are managed primarily for biodiversity conservation, but also for socioeconomic objectives such as tourism and education. Because PAs are formalised and in most cases managed by state agencies, their management is provided for in laws and regulations at national and provincial level (Chapter 2). These laws are explicit in terms of the purpose, scope and required procedures involved in managing PAs. Broadly they follow norms and standards that are applied widely in other countries. There is no point in providing more than a brief outline here.

In terms of these statutes a formally approved management plan is required for each PA. Such plans must identify allowable activities, uses and developments and allocate them to appropriate zones. The plans are not just spatial, they also deal with policy and implementation issues, with timeframes, staffing, performance criteria and budgets. These plans are also required to consider public participation, capacity building, resource use and other social and economic opportunities, including contractual and co-management arrangements. All operational aspects of managing PAs are subject to their main purpose, being that of protecting and maintaining biodiversity.

Biodiversity issues in the general landscape, outside of Protected Areas, are the particular focus of the land-use planning guidelines below.

T2. IRREPLACEABLE – 2.4% of the Province

IRREPLACEABLE areas are the most important areas of the Province from a biodiversity point of view, outside of the protected area network. Some IRREPLACEABLE sites may already be managed carefully and sustainably by well-informed owners with appropriate resources, but there is currently no compelling legal or public pressure for this to be so.

Ideally, Conservation Management (Land-Use Type 1) should apply to all IRREPLACEABLE areas. In some circumstances, Extensive Game Farming and Livestock Production (Land-Use Types 2 and 3), if well-managed, may also be positive for biodiversity. These two land uses are acceptable so long as they take into account the specific biodiversity values (e.g. rare species or vegetation remnant) and vulnerabilities (e.g. open-cast mining or alien plant invasion) of each site. The most important short-term priority is that the land should be managed in ways that at least have no further negative impact on biodiversity.

Land-use and administrative options for positive biodiversity outcomes include:

- The preferred land use is Conservation Management (Land-Use Type 1) but Types 2 or 3 (extensive game or livestock management) may be acceptable under prescribed conditions;
- Refer all development applications in IRREPLACEABLE land to MTPA and or DALA for evaluation by biodiversity specialists;
- Encourage cooperative conservation arrangements such as Protected Environments, conservancies etc.;
- Where appropriate, incorporate these areas into the formal PA system: by proclamation as a private or contractual nature reserve, stewardship agreement, legally entrenched conservancy agreement or other legal means;
- Restore damaged areas to natural ecosystem functioning where possible (restoration guidelines are required);
- Prepare for and conduct high level public awareness effort on biodiversity values and use of these areas, especially to landowners;
- Priority for MTPA/DALA to carry out regular environmental monitoring and reporting, for biodiversity and/or change of land use, to prevent unauthorised development or degradation by neglect or ignorance (monitoring guidelines are required);
- Prioritise these areas for land care projects: i.e. MTPA, DALA, WiW, Working for Wetlands and NGOs to direct their conservation projects, programmes and activities;
- The option to provide alternative land as a ‘biodiversity offset’ in exchange for biodiversity loss in these areas, should NOT be considered as ALL remaining natural areas are required to meet targets. In exceptional circumstances such offsets of different but comparable value may deserve consideration;
- Devise new financial and other incentives (e.g. resource economic approaches) for achieving sustainable conservation management;
- Develop appropriate legal penalties for non-compliance such as unauthorised development or destruction of natural habitat. These, including environmental auditing procedures, will probably require formal regulations.

Undertake specialist studies according to MTPA’s ‘Requirements for Assessing and Mitigating Environmental Impacts of Development Applications’ document.
T3. HIGHLY SIGNIFICANT – 12.3% of the Province

Land in this category should be maintained as natural vegetation cover. Permissible land uses should be limited to those that are least harmful to biodiversity, i.e. Land-Use Types 1 – 4. All cultivation-based agriculture and all urban/industrial development (Land-Use Types 5 – 15) should not be permitted. If development is unavoidable, it must be made sufficiently dispersed (sometimes clumped) and of the right scale to be as biodiversity friendly as possible. Specialist ecological advice will be required in such cases to reinforce standard EIA procedures.

‘Biodiversity reinforced EIA procedures’ require that a specialised biodiversity study be undertaken as part of the EIA. This requires a survey by an experienced and locally knowledgeable biodiversity expert. Destruction of biodiversity on HIGHLY SIGNIFICANT land may result in the area being moved into the IRREPLACEABLE category.

Land-use and administrative options for positive biodiversity outcomes include:

- All land in this category should be maintained as natural vegetation cover;
- Land-use planners to refer all development applications in HIGHLY SIGNIFICANT land to MTPA and or DALA for evaluation by biodiversity specialists;
- Consider economic development only via land use Types 1 – 4 only, and within specified limits, to benefit biodiversity, e.g. extensive livestock management without routine supplementary feeding or pasture enhancement;
- Encourage cooperative conservation arrangements, e.g. Protected Environments or conservancies where appropriate;
- Conduct focused public awareness and/or extension effort on biodiversity values and uses of these areas, especially to land owners;
- Prioritise for MTPA/DALA to carry out environmental monitoring and reporting on biodiversity status and/or change of land use;
- Develop a more detailed list of unsustainable land uses that are site- or area- specific, including relevant aspects of scale and extent;
- Require a biodiversity specialist study as part of the EIA for all development applications;
- Develop best practice guidelines for all permitted land uses;
- Provision for biodiversity offsets being exchanged for biodiversity loss should only be considered at an exchange rate of at least 250%, i.e. more than twice the area or biodiversity value, calculated as a comparable contribution to targets, and only as a last resort;
- Devise new financial and other incentives (e.g. resource economic approaches) for achieving sustainable conservation management;
- Unavoidable development requires special mitigation measures such as dispersed and/or small scale placement of site;
- Consider special projects to develop biodiversity management / sustainable use guidelines and procedures for communal land;
- Develop and apply appropriate legal penalties for non-compliance subject to regulation;
- Prioritise these areas for land care projects: i.e. MTPA, DALA, WiW, Working on Wetlands and NGOs to redirect their conservation projects, programmes and activities.

T4. IMPORTANT AND NECESSARY – 9.5% of the Province

These areas are significantly important areas of natural vegetation that play an important role in meeting biodiversity targets. Their designation as IMPORTANT AND NECESSARY seeks to minimise conflict with competing land uses and represents the most efficient selection of areas to meet biodiversity targets.

No significant increase in the occurrence of Land-Use Types 5 – 9, should be permitted. Every opportunity to revert to economic options using natural land cover should be taken. Some agricultural land uses may be permitted but with best-practice guidelines made conditional and aimed at benefiting the biodiversity assets and reducing the vulnerability of each site.

Land-use and administrative options for positive biodiversity outcomes include:

- Actively encourage economically sustainable land uses that are dependant on natural habitat such as Types 1 – 4;
- Actively discourage intensive land uses which result in biodiversity loss, Types 5 – 9;
- Prioritise the monitoring of changes in land use and loss of natural habitat to guide management response to
T5. ECOLOGICAL CORRIDORS

The purpose of ecological corridors is to provide intact pathways for long-term, large-scale biological movement. They are selected primarily along river lines and altitudinal gradients to provide for the natural retreat and advance of plants and animals in response to environmental change. They are also selected to follow the lines of least transformation (maximum remaining natural habitat) and as links between important biodiversity areas. The mapped width of ecological corridors is 7 km; in practice this may vary to accommodate local features.

Land-use and administrative options for positive biodiversity outcomes in ecological corridors include:

- Corridors need to retain at least existing natural vegetation cover and in some key ‘critical-link’ areas undergo active repair and restoration of ecosystem functioning;
- Land-use planners to refer development applications to MTPA/DALA for all applications involving probable biodiversity impacts, e.g. Land Uses 5 - 15;
- Prioritise the monitoring of changes in land use and loss of natural habitat to protect ecosystem functioning and connectivity;
- Conduct focused public awareness and/or extension efforts on biodiversity values and connectivity to limit natural habitat loss and encourage free movement of plants and animals through biodiversity barriers;
- Identify critical link areas where local sites are protected and promoted to a higher biodiversity conservation category;
- Corridors are pre-disposed towards conservancy-type protection and co-operative management arrangements to provide for cross-barrier movement;
- Treat corridors as priority areas for Working for Water and other alien plant control projects to deny these species the benefits intended for indigenous species;
- Develop activities/procedures for encouraging free movement of indigenous plants and animals across boundaries and barriers in agricultural landscapes;
- EIA applications should assess the impact of the proposed development on the functionality of the ecological corridor;
- Compensatory offsets in corridors can be considered if they result in a net biodiversity gain and improvement in corridor functioning.

T6. LEAST CONCERN – 25.5% of the Province

Biodiversity assets in these landscapes contribute to natural ecosystem functioning, ensure the maintenance of viable species populations and provide essential ecological and...
environmental goods and services across the landscape. Although these areas contribute least to the achievement of biodiversity targets they have significant environmental, aesthetic and social values and should not be viewed as wastelands or carte-blanche development zones.

Development options are widest in these areas. At the broad scale, these areas and those where natural habitat has been lost (see 7, below) serve as preferred sites for all forms of development (Land-Use types 5 – 15). Land-use planners are still required to consider other environmental factors such as socioeconomic efficiency, aesthetics and the sense-of-place in making decisions about development. Prime agricultural land should also be avoided for all nonagricultural land uses.

Land-use and administrative options for positive biodiversity outcomes include:
- Where this category of land occurs close to areas of high biodiversity value, it may provide useful ecological connectivity or ecosystem services functions, e.g. ecological buffer zones and corridors or water production. In these situations encouragement needs to be given to biodiversity-friendly forms of management and even restoration options where appropriate;
- Develop incentives to reverse lost biodiversity for selected parcels of land where buffer zones and connectivity are potentially important;
- Standard application of EIA and other planning procedures required;
- Along with Category T7. below, these areas to serve as preferred sites for all forms of urban and industrial development (Land-Use Types 10 – 15).

T7. NO NATURAL HABITAT REMAINING – 35.8% of the Province

This category has already lost most of its biodiversity and its ecological functioning too. In the remnants of natural habitat that occur between cultivated lands and along riverlines and ridges, residual biodiversity features and ecological processes do survive. But these disconnected remnants are biologically impoverished, highly vulnerable to damage and have limited likelihood of being able to persist. The more transformed a landscape becomes, the more value is placed on these remnants of natural habitat. (In Australia and England rural land authorities are promoting the protection and re-establishment of these remnants in ‘industrialised’ agricultural landscapes, including even hedgerows.)

The most widespread cause for terrestrial biodiversity loss in Mpumalanga is crop and timber cultivation. All forms of production agriculture (Types 5 – 9) will benefit from applying codes of best practice, such as have been developed in the timber growing industry, to reduce impact on biodiversity.

A different set of factors apply to biodiversity losses in aquatic or riverine systems (see Aquatic Ecosystems below). The remedies for riverine impacts need to be considered separately, as the links between cause and effect are not limited to the immediate locality. Both direct and indirect impacts (including dispersed impacts such as acid rain) result from urban-industrial and agricultural sources. Management must be considered on a catchment or subcatchment basis as well as applying common-sense conservation practices in the terrestrial landscape.

Areas with no natural habitat remaining are preferred sites for development, even more so than for 6, above. However, in selecting sites for urban and industrial development, planners need to make a special effort to avoid building on areas of high agricultural potential. Prime agricultural land is coming under the same pressures as land with high biodiversity value and needs to be protected for its ability to produce food and fibre sustainably.
Land-use and administrative options for positive biodiversity outcomes include:

- Where this category of land occurs close to areas of high biodiversity value, and is located to potentially serve useful ecological connectivity functions, such as in ecological corridors, encourage restoration and re-vegetation options;
- For individual parcels of land identified as having specific biodiversity values, actual or potential, develop incentives to restore lost biodiversity and connectivity;
- Consider the negative impacts of land uses on these areas which have off-site impacts, e.g. controlling use of pesticides, on neighbouring areas of natural habitat, especially if they are of high biodiversity value;
- Encourage landowners and developers to use indigenous plants, especially trees, where aesthetic or functional options exist.

**TABLE 6.2: Types of Land-Use suited to each biodiversity conservation category**

<table>
<thead>
<tr>
<th>TYPE OF LAND USE</th>
<th>PA</th>
<th>IRREPLACEABLE</th>
<th>HIGHLY SIGNIFICANT</th>
<th>IMPORTANT &amp; NECESSARY</th>
<th>ECOLOGICAL CORRIDORS</th>
<th>LEAST CONCERN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BIODIVERSITY FRIENDLY LAND USE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Conservation Management</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>2. Extensive Game Farming</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>3. Extensive Livestock Production</td>
<td>R</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>4. Rural Recreational Development</td>
<td>N</td>
<td>N</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td><strong>HIGH IMPACT RURAL LAND USES</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>5. Rural (Communal) Settlement</td>
<td>N</td>
<td>N</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>6. Dryland Crop Cultivation</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>R</td>
<td>Y</td>
</tr>
<tr>
<td>7. Intensive Animal Farming (incl. dairy)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>R</td>
<td>Y</td>
</tr>
<tr>
<td>8. Irrigated Crop Cultivation</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>R</td>
<td>Y</td>
</tr>
<tr>
<td>9. Timber Production</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>R</td>
</tr>
<tr>
<td><strong>URBAN INDUSTRIAL LAND USES</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>10. Urban &amp; Business Development</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>11. Major Development Projects</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>12. Linear Engineering Structures</td>
<td>N</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>13. Water Projects &amp; Transfers</td>
<td>N</td>
<td>N</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>14. Underground Mining</td>
<td>N</td>
<td>N</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>15. Surface Mining, Dumping &amp; Dredging</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>R</td>
<td>R</td>
</tr>
</tbody>
</table>

**LEGEND:**
- **Y** = YES, permitted and actively encouraged activity.
- **N** = NO, not permitted, actively discouraged activity.
- **R** = RESTRICTED, by site-specific conditions and controls when unavoidable; not usually permitted.

**NOTE:** These guidelines apply only to untransformed land with natural vegetation cover.

This table summarises the broad Land-Use Types best suited to each of the biodiversity conservation categories. Application of these guidelines will result in the most ecologically efficient and sustainable pattern of land use throughout the Province.
1 – 4  BIODIVERSITY-FRIENDLY LAND USES

The first four types of land-use activities have least environmental impact, subject to good management. All are more-or-less positive in protecting biodiversity assets and ecosystem functioning, i.e. they have least detrimental effect compared with the conservation ideal or benchmark, Conservation Management. Land-Use Types 2 and 3 represent production-orientated land uses with proven and profitable economies. They provide an economic focus on which to concentrate efforts to improve biodiversity and ecosystem conservation.

Land-Use Type 1. Conservation Management
- Includes: formal and informal Protected Areas managed for biodiversity, wildlife production and recreational and educational tourism, conducted in natural habitats on extensively managed landscapes on public or private land;
- Assumes: specified management objectives to maintain or enhance current biodiversity; controls or guides the use of resources only at sustainable rates (consumptive and non-consumptive); controls all administrative and management developments, including zoning, minimal size, facilities carefully dispersed or clumped to achieve least impact; ecologically and sociologically sensitive practices and processes throughout.

Land-Use Type 2. Extensive Game Farming
- Includes: game production and related tourism activities on extensive land portions of natural land cover; includes sustainable commercial hunting along with other consumptive and non-consumptive use of wild natural resources;
- Assumes: application of similar minimum size criteria for economic sustainability as are applied to rangeland livestock farming; strictly limited development for revenue generating purposes such as intensified tourism or sectional ownership.

Land-Use Type 3. Extensive Livestock Production
- Includes: mainly cattle and sheep production off extensive areas of natural (unimproved) veld; mixed livestock/wildlife options; tourism;
- Assumes: ecologically and economically sustainable management applied to farm portions above a certain minimum size, based on ecological and economic viability.

Land-Use Type 4. Rural Recreational Development
- Includes: development for ‘lifestyle’ or investment-type recreational ownership such as share-block schemes, multi-ownership reserves and eco-estates etc, but only for extensive land portions with limited development (NB: excludes golf estates);
- Assumes: maintenance of a large measure of natural land cover and biodiversity friendly management must be maintained; the development footprint should be limited to <10% of the property and clustered to limit the transformation impact; minimum property size of 250ha.

5 – 9  HIGH IMPACT RURAL LAND USES

The next five categories offer little in support of biodiversity. None of these land uses can make a significant contribution to biodiversity conservation but some may be used tactically to ensure a degree of local connectivity. Variation in impacts on biodiversity can be considerable between crop types but is more than offset by good management practices such as minimal tillage, rotational cropping, soil and water conservation practices etc.
Box 6.1 continued

<table>
<thead>
<tr>
<th>Land-Use Type 5. Rural (Communal) Settlement – subsistence agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes: all communal land used for residential, cultivation and grazing activities;</td>
</tr>
<tr>
<td>Assumes: land use generally does not have (commercial) production orientation due to socioeconomic factors and priority for residential/subsistence needs; communal as opposed to private title forms of ownership.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land-Use Type 6. Dryland Crop Cultivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes: all tillage cultivation of non-irrigated crops, mostly single-season annuals, but including perennial and orchard-type tree crops if cultivated with an indigenous grass layer;</td>
</tr>
<tr>
<td>Assumes: crop production methods that conserve water and protect against soil erosion; more-or-less limited and responsible use of fertilisers, pesticides and other agrochemicals and genetically modified organisms (GMOs).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land-Use Type 7. Intensive Animal Farming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes: all intensive animal production systems, of domestic or ‘wild’ species, that are dependent primarily on imported foodstuffs and confinement; includes dairy farming and all areas in production support for dairy, including pastures, fodder and grain crops, much of which is usually irrigated;</td>
</tr>
<tr>
<td>Assumes: intensive production areas with relatively dense development; not dependent on the use of natural vegetation for production.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land-Use Type 8. Irrigated Crop Cultivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes: all irrigated crops and irrigated tree crops (orchards);</td>
</tr>
<tr>
<td>Assumes: intensive production activity with high nutrient and agro-chemical inputs and often two crops per year. (but even just ploughing, with no chemicals etc., results in irreversible loss of natural habitat)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land-Use Type 9. Timber Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes: all timber plantations, mainly Pinus, Eucalyptus and Acacia spp.;</td>
</tr>
<tr>
<td>Assumes: monoculture of alien timber species with heavy impact on hydrology and soil erosion and for introduction and spread of a variety of the most aggressive alien invasive plants.</td>
</tr>
</tbody>
</table>

10 – 15 URBAN INDUSTRIAL LAND USES
These last six land uses cause the greatest environmental impact and are almost completely destructive of natural vegetation and natural biodiversity. Where biodiversity persists, it is artificially maintained and generally supports only opportunistic assemblages of plants and animals. Ecosystem processes are completely disrupted, heavily impacted or artificially maintained at high cost.

These land uses not only produce the highest local impacts but also dominate the dispersed and cumulative impacts. These are the most destructive and wide ranging, often spreading hundreds of kilometres from their source, especially along river systems. Only ad hoc benefits occur for biodiversity and ecosystem functioning. These land-use types include nonurban developments, e.g. mining and linear engineering structures, requiring special provision in land-use planning, impact assessment and mitigation.

<table>
<thead>
<tr>
<th>Land-Use Type 10. Urban and Business Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes: all physical, residential, industrial and business development – these are the urban or built landscapes. This includes peri-urban development, termed ‘rural residential’ by town planners, prescribed as one dwelling unit per hectare;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land-Use Type 11. Major Development Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes: all nonurban infrastructure development, industrial processing, construction etc, not included in any other category.</td>
</tr>
</tbody>
</table>
Box 6.2: BIODIVERSITY IMPACT OF LAND-USE TYPES

Table 6.2 provides a summary of the permissibility of Land-Use Types within each biodiversity conservation category. Each Land-Use Type includes a variety of potential impacts on biodiversity depending, among other things, on factors like the scale of habitat loss or the style of management. Land-use activities may be grouped and characterised in order to understand why they impact on biodiversity and ecosystem functioning.

Land-Use Type 1. The most biodiversity-compatible land use is Conservation Management (CM). Specifically aimed at maintaining and enhancing biodiversity in Protected Areas, the principles of CM are described briefly at the beginning of these guidelines. Its focus is within PAs and has little to offer in protecting the large-scale ecological processes that allow species and ecosystems to persist. As a form of land use it extends to include production where, for instance, game animals are hunted or captured. CM occurs on private land when legally binding, written formalities are in place, to ensure such management extends beyond the scope of current ownership (see Box 1.2 on Conservation Stewardship).

Land-Use Type 2 and 3 are the next-best land uses for biodiversity, either Game Farming or Extensive Livestock Production. These are similar in their impact in that they both use extensive areas of natural rangeland. Differences in effect between the two are small and strongly influenced by quality of management, i.e. a well-managed cattle ranch may have less negative impact than a badly managed game farm, whereas with good management the reverse would be expected. Any intensification or overdevelopment (e.g. for tourism) of these areas will increase the negative impacts.

Land-Use Type 4. Rural Recreation, is the third-best land use for biodiversity. This category includes: various types of multi-owner game reserves and ‘eco-estates’; share-block and sectional title developments in natural areas provided the density of development is low (<10%); trout fishing properties and other extensive ‘leisure and lifestyle’ developments based on natural landscapes. This land use tends towards urban development as the
density of structures and users increases. Importantly, it excludes intensive recreational developments such as golf and polo estates. These latter involve a high proportion of habitat loss and very high investments in infrastructure. They are in effect urban developments outside the urban edge and fall more appropriately into land-use type 10.

- Land-Use Types 5 – 9 are rural and farming activities that have serious impacts on biodiversity. They are mutually incompatible with biodiversity conservation, often accelerating degradation by causing extensive habitat loss, soil erosion and hydrological changes. Their impacts vary from moderate to severe depletion of natural biota and associated distortions of ecosystem functioning. Irrigated Crops and Timber Production impose particularly heavy impacts on environmental services such as water production. Their actual impact can be considerably reduced by factors such as small scale, dispersed and sensitive placement and general good land husbandry.

- Land-Use Types 10 – 15 comprise urban and industrial developments which pave over and otherwise destroy natural vegetation and soil. In the metros whole landscapes are modified in this way. Where biodiversity exists or is deliberately protected, such as in urban nature reserves, it is distorted by its small scale and ecological isolation. As such, urban biodiversity is largely symbolic, primarily serving social and environmental management needs. An artificial urban biodiversity is created with the planting of ornamental and fruit trees and a large variety of ‘domestic’, mostly alien, garden plants. Although there are attractive aspects of this local abundance of trees and birds (for instance) this should not be confused with natural biodiversity; they can be mutually antagonistic, as when a garden plant becomes an alien invasive, spread by birds. Urban land uses also have important secondary and cumulative negative impacts over the long-term, such as water pollution, acid mine drainage, and increased run-off.
AQUATIC ECOSYSTEMS

These guidelines will assist in planning the location of public sector developments and in granting or withholding planning permission for private sector development applications. They particularly apply to all developments that have consequences for water supply and the generation of effluent and hence the functioning of aquatic ecosystems.

As land-use guidelines, they are broadly stated and intended to supplement, not replace, the application of normal EIA procedures. They are intended to:

- Help protect aquatic ecosystems;
- Define norms and standards to avoid or minimise the negative impacts of development;
- Support the EIA process in land-use and development planning.

RIVERS AND WATER USE

General description of the nature and sensitivity of river systems is presented in Chapter 3. Protecting river systems and, therefore, water can seldom be achieved by taking action only at a specific site. In deciding on protection measures, it is crucial that we recognise that, without catchment-wide controls, rivers will be exploited to the point where they lose their ability to sustain the quantity and quality of water they deliver. This has already happened to many rivers in Mpumalanga.

Understanding the natural state and functioning of rivers and their response to development impacts and water extraction is essential for wise decision making. The biodiversity of river ecosystems is inseparable from their environmental health and their ability to deliver fresh water. The presence or absence of key indicator species is used to measure river health and therefore environmental impact. The flow-related connectedness of rivers means that the effect of an impact may be felt many kilometres from its source. Being successful in managing rivers and their water is essential for livelihoods and is the foundation stone of sustainable development.

The most common development impacts on river systems include:

- Water extraction: cumulative reduction of river flow;
- Open-cast and strip mining (especially of coal): destruction of water table, acid mine drainage, toxic ground-water discharge;
- Planting high water-demand crops (e.g. timber and sugar cane): lowers water table, stream flow reduction, complex soil changes;
- Industrial-scale agriculture: causes widespread changes to soil and vegetation cover with major impacts on soil erosion, infiltration of rainfall, water-table recharge and sedimentation of rivers;
- Atmospheric pollution: changes the chemistry of rain water (acid rain);
- Hard paving and built structures (urban development): reduced infiltration and water-table recharge, enhanced flooding, erosion and sedimentation of river beds, pollution and changes to overall river ecology;
- Point-source pollution from sewage, industrial and mining discharges: toxic to biodiversity and humans, damages ecosystem health;
- Dams and weirs: change downstream hydrology, flow characteristics, water temperature, turbidity and dissolved nutrients, provide a physical barrier to fish;
- Non-point-source pollution (e.g. groundwater and seepage): from dumps (mine, industrial and rubbish), surface runoff (agricultural, mine, industrial and urban), irrigation seepage;
A2. FLOW-CONTROL OR IMPOUNDMENT STRUCTURES – DAMS AND WEIRS:
Surface water in Mpumalanga is already over-committed to various forms of development and human consumption. All our major rivers are impacted by water extraction and dam construction, leading to severely reduced flows in lower reaches. Because of this, all proposals for dams require detailed planning and strict adherence to formal EIA procedures, including serious consideration of alternatives.

Large public development structures will go through a full EIA process with mandatory public participation. Small farm dams, however, are often thought to be too small to justify impact assessment. Historically farm dams were subsidised by the state, being considered good water conservation practice. Subsequent study has shown their cumulative effect has been to reduce stream-flow dramatically as well as several other negative impacts. In many areas small farm dams are being deliberately breached to correct this error. All farm dams and weirs are subject to EIA legislation.

A2.1 FISH PASSES:
Any structure that obstructs or modifies the flow in a river or creates a sharp increase in water velocity may require a fish pass to allow for upstream (as well as downstream) movement of fish. Fish passes are gently inclined, sometimes stepped, shallow channels that allow fish to swim upstream to breed. Specialised expertise is required to design and build fish passes. These structures should be compulsory wherever movement of fish up or downstream is necessary. This is particularly important in the identified priority sub-catchments, important aquatic corridors and in the lower reaches of rivers. These corridors are identified on the Aquatic Biodiversity Map as critical movement links to retain some connectivity in our fractured river systems.

A3. IN-STREAM ENGINEERING - CHANNEL OR BANK MODIFICATION:
Wherever engineering works will disturb water courses or when structures such as road and rail crossings, have to be built through them, special measures must be taken to ensure minimal disturbance, limiting obstruction to fish movement or restriction of the channel. This provision must take into account a generous assessment of expected flood volumes as there is every indication that flood peaks (and droughts) will become more extreme as global climate change proceeds. Design specifications for such structures must be based on South African conditions and information. Imported specifications may be from less extreme climates and have inadequate margins to accommodate extremes.
A3.1 CANALISATION OF WATER COURSES:
This is often proposed as a means to reduce flooding in built-up areas as a reaction to poor catchment management or a symptom of poorly planned existing development. The hard-surfacing of the land in urban areas with roads, roofs and concrete creates severe flash floods by increasing the speed and volume of water run-off and hence its capacity for erosion and destruction. Flood events are increasing and floodplains and low-lying wetlands near rivers should never be built on. Canalisation to speed up water flow in highly built-up areas may sometimes be necessary, but only as a last resort. Environmentally-friendly planning for these sites should allow for areas to be inundated to delay runoff and keep the water on the land to recharge the water table.

A4. RETURN-WATER AND EFFLUENT WATER QUALITY:
Water that is returned to rivers and wetlands after urban, industrial or agricultural use must adhere to the biological and chemical standards set by DWAF. This is particularly important where discharge water comes from sewage treatment plants and from industries that use water for processing and cleansing. All of this water may be referred to as effluent and considered potentially toxic for people and the environment.

Municipalities and most mining and manufacturing industries produce substantial waste and effluent. This includes solid waste that may convert rainfall into toxic seepage. The liquid and soluble chemical component ends up in rivers. River flow moves the problem to other places, where other people have to bear the cost of upstream pollution. The temptation to simply flush waste down the drain is strong and the level of this sort of illegal toxic waste disposal is high. This is particularly the case with the hundreds of small and medium enterprises in every municipality. The National Environmental Management Act requires the polluter to pay, and provides for very substantial compensation to be recovered through legal action. Continual and widespread water quality monitoring, using reliable and sophisticated technology, is the only defence against this practice.

4.1 RETURN-WATER OUTFLOW STRUCTURES:
Second-hand water, when returned to a river, must achieve DWAF quality standards. Depending on the chemical characteristics of the effluent different disposal strategies may be prescribed. This is a specialised field of expertise and appropriate advice must be obtained. Whether sprayed on the land as irrigation water or channelled directly into a water-course, special precautions must be taken to minimise environmental impact.

A5. AGRICULTURAL LAND USES:
Extraction of irrigation water from rivers and dams is controlled by DWAF in terms of the allocation of water rights. This extraction has obvious consequences in reducing downstream flow. The allocation of water rights is made by calculating the total runoff water available and allocating it equitably between all legitimate users. Because demand is almost always greater than supply, and because more and more legitimate users are being identified, this is an increasingly difficult problem to solve. The use of water pricing to regulate use is almost inevitable in this regard.

A5.1 IRRIGATION SEEPAGE:
In addition to reducing in-stream flow for downstream users, irrigation has other impacts on rivers and water supplies. Irrigated crops are highly productive, they require intensive soil cultivation and high levels of fertiliser and biocides. All these chemicals, as well as those extracted directly from the soil by irrigation water, end up being flushed out into the nearest drainage line. This is agricultural pollution in the form of ‘enriched’ runoff and seepage. These dissolved pollutants enter river systems and change the growing conditions for riverine ecosystems. It is in these disturbed environments that alien plants, particularly water weeds, thrive.

A5.2 LIMITS TO PLANTING OF HIGH WATER-DEMAND CROPS (E.G. TIMBER AND SUGAR CANE):
DWAF and their technical stakeholders (researchers and scientists from the agriculture and timber industries) have been involved in stream flow reduction studies for many decades. This highly technical work has established that timber, certain other crops and alien plant infestations, do substantially lower water-tables and reduce stream flows. These land uses consume large quantities of water potentially available for other uses, including the minimal flow required for ecosystem maintenance - known as the ‘ecological reserve’.

As a result, a complex authorisation protocol is in place to issue water-use licenses to approved land users wanting to grow such crops (see ‘water
The licensing process is based on EIA procedures. It is managed cooperatively through the agricultural and environmental authorities (DWAF, DALA, MTPA) and the forestry industry. The legally required information is processed through the SFRALAAC (Stream Flow Reduction Activity Licensing Assessment Advisory Committee) which makes a recommendation to national DWAF which issues the water-use license.

License applications are complex and take anything from 8 - 15 months to process. The assessment considers catchments as stressed or not, depending on the ratio of water available, over water demand. Water use licensing is intended to limit water use to sustainable levels and distribute water-use rights equitably and transparently to those in most need. Any development that has significant impact on water supply or demand must be processed through the DWAF system. If water use licences are not obtained the development may not proceed.

### A6. GENERAL DEVELOPMENT RESTRICTIONS IN HIGH WATER YIELD SUBCATCHMENTS:

Subcatchments with high biodiversity value and high water yield potential deserve special status and priority conservation management at a landscape scale. One option is to consider various legislative measures for protection. From the wide array of conservation legislation available, there are several choices:

- Proclamation as Protected Mountain Catchment Areas in terms of the Mountain Catchment Areas Act;
- Proclamation as Protected Environments in terms of the Protected Areas Act;
- Proclamation as Specially Protected Ecosystems in terms of the Biodiversity Act;
- Negotiation of Private Nature Reserve or Conservancy agreements.

Additional measures could include:

- Strongly discourage or regulate against development that has high impact on biodiversity or on water resources;
- Apply the land-use guidelines listed under the biodiversity conservation categories Highly Significant and Important and Necessary to these entire catchments;
- Maintain or improve PESC to either A or B. Further degradation of PESC should not be allowed.
- Strongly advocate special water conservation farming methods by agricultural extension services;
- Strict enforcement of wetland and river conservation management practices;
- Negotiate between land-owners and relevant environmental and water authorities to develop land-use ‘best practice’ procedures and later regulate for these.

Blanket coverage with these management constraints, over even a limited number of these subcatchments, would be difficult to implement because of the number of land-owners and land uses involved.
WETLAND ECOSYSTEMS

These guidelines should be read together with the terrestrial guidelines, in particular those applying to the IRREPLACEABLE category, which generally apply to wetlands. Wetlands are special-case patches of landscape where terrestrial and aquatic ecosystem features are most inextricably combined. Because of this and their vulnerability to development, wetlands require special measures to ensure those that are left remain functional and productive.

Wetlands throughout the world, and especially in South Africa, have been widely abused and even destroyed. A combination of agriculture, afforestation and urban/industrial alteration of wetlands has resulted in 50% of them being transformed and rendered dysfunctional. This is mostly an irreversible loss, which contributes significantly to the national water crisis. All wetlands are protected by law (National Water Act, 36 of 1998) because of their importance as water management and storage areas and their vulnerability to damaging impacts.

USE AND SENSITIVITY OF WETLANDS

A general description of the nature and sensitivity of wetlands is presented in Chapter 3. This section highlights some key sensitivities most relevant to the land-use guidelines below.

The value of wetlands is comprehensively recognised by laws and regulations worldwide. In South Africa all wetlands are protected by a number of laws, each with clear penalties for transgressors. No development applications may go ahead within or affecting wetlands without obtaining permits and authorisations from several relevant authorities. The legislation to be complied with includes: the Conservation of Agricultural Resources Act 43 of 1983, the National Environmental Management Act 107 of 1998 and the National Water Act 36 of 1998 (see Appendix 1).

Historically, these laws have not been strictly enforced for a variety of reasons, resulting in their having little positive impact on the rate of wetland destruction. The most widespread damage and destruction of our wetlands stems mainly from various agricultural activities, including cultivation, drainage, damming and the presence of invasive alien plants. The most serious and expensive impacts are those from timber plantations, urban and industrial development and mining.

In particular, open-cast mining of coal is totally destructive of wetlands and all wetland functions. Through acid mine drainage it also pollutes ground water. Deep mining may also penetrate the water table, causing water loss to lower levels in the mine and subsequent pollution. These impacts are not limited to the immediate area of the excavation or waste dump. Acid mine drainage, pollution by heavy metal toxins and major changes in the water-table will all occur at and near the mining site. In most situations these changes will also occur at substantial distances from the mine, especially in the down-slope region. Off-site impacts can affect entire catchments and long stretches of rivers downstream from the origin of the problem. Where mining occurs together with our gigantic coal-burning power stations, high levels of atmospheric pollution, including acid rain, add to the off-site impacts of the coal and energy industry. With the Province’s vast shallow coal deposits these impacts have serious and permanent environmental consequences for Mpumalanga.
All wetlands and all parts of every wetland are important. Their legal protection is extended to include buffer zones to protect them from off-site and up-slope activities that might damage them. A buffer of natural vegetation 20m wide, around the perimeter of all wetlands must be left undisturbed. The purpose of the buffer is to slow potentially erosive run-off, capture sediments, absorb nutrients and provide habitats for wetland-dependant organisms.

The vegetation of wetlands (both live and decomposing) is usually their most important and visible feature. The water-holding and nutrient-trapping functions of this vegetation are particularly important in urban and industrial areas. This is widely recognised, to the extent that artificial wetlands are being marketed to purify waste water as an alternative to mechanical and chemical water-treatment facilities.

Within wetlands the most vital parts are the permanently wet areas and where there is flowing water. These areas are often soft and vulnerable to erosion when disturbed. They include the eye of springs and fountains but are more often located at lower levels in the wetland and at critical outflow points. In floodplains, parallel to the watercourse, the outflows occur at the riverbank or channel, which is subject to high levels of erosion during seasonal high-flow events and floods. In protecting or restoring wetlands, these areas must be the focus of attention. It is critical that natural flows are not interfered with and that no soil disturbance occurs that in any way lowers the base-level of a wetland. This can very easily occur in rural areas along livestock paths, farm roads and trek routes.

DEVELOPMENT GUIDELINES FOR WETLANDS

W1 Map all wetlands within each municipality, according to the wetland inventory guidelines developed by DEAT (at 1:50 000 scale).

W2 Ensure all development applications include an accurate, ground-checked map of all wetlands, as part of the EIA Scoping procedure. The Scoping assessment must include wetlands that fall within the development area and any off-site wetlands that may be affected by the development.

W3 Obtain specialist advice to draw up management and protection guidelines if a wetland is known to contain high value biodiversity or is located in a high value subcatchment. The guidelines should include provision for buffer zones as well as linkages to other natural areas, according to the specific requirements of the biota and the nature and layout of the system.

W4 No excavation, channelling, drainage or in-filling, nor any building or hardened surfaces, may be located in any wetland, or within its buffer zone.

W5 No dumping of wet or dry material and, in particular, no waste disposal of any kind may be permitted in or near a wetland.

W6 No dams or weirs, other than those specifically designed for erosion control, may be constructed in wetlands.

W7 Wetlands should not be cultivated at all. If cultivation is absolutely unavoidable, such as for food gardens or other subsistence agricultural use for which there is no practical alternative, then specialist advice is required to limit its impact. Such advice should specify the types of cultivation and crops allowed and the seasonal and spatial limits for cultivation. Mechanised cultivation (tractors) may not be permitted.

W8 Controls must be established for livestock grazing and any harvesting of wild plants from any wetland.

W9 The presence of alien tree species in wetlands is strictly forbidden, whether deliberately cultivated or spread by natural means.

W10 No roads should be permitted to traverse wetlands. If, no alternative route exists, all aspects of the road, its design, construction, use and maintenance, must ensure minimal environmental impact. Care must be taken not to interfere with the flow of water through the wetland, both above and below ground. (For example: minimise surface disturbance and embankment building; avoid excavation; construct small and dispersed, low-volume, low-velocity road-drains and culverts; use bridges or box culverts rather than pipes.) The base-level of the wetland must not be disturbed or changed. If a flow-channel is present, it must not be disturbed or interfered with in any way, by damming or excavation.

W11 Where a road or other water channelling structure runs alongside or close to a wetland and channels water into it, such water should be dispersed via multiple entry points, with energy-dispersing structures. These drains must be small, dispersed low-volume, low-velocity structures. They must also be set back from the wetland and its buffer zone and be...
designed to spill into undisturbed natural vegetation at ground level. These provisions also apply to all urban storm-water outlets that spill into a wetland or up-slope of a wetland.

W12 Any development that will affect a wetland must comply with the requirements of the National Water Act (1998). Through the concept of the ‘ecological reserve’, this Act seeks to safeguard the production of water of acceptable quantity and quality, for maintaining the well-being of the nation into the future.

W13 In peri-urban areas, wetlands should never be alienated for subdivision and private ownership for any form of use or development that has potentially negative impacts on wetland functions.

W14 Routine wetland management and restoration should include efforts to control all activities that harm wetlands. Avoid disturbing natural vegetation cover; avoid compacting any soil surface; control the spread of alien invasive plants; do nothing that will interfere with water flow, infiltration, or ground-water recharge. Specialist advice will be required to determine best procedures.

**Flesh Fly**
*Sarcophaga haemorrhoidalis*

*Whilst insects are generally seen as pests, they have a vital role to play in maintenance of biodiversity. Many of them are pollinators; sometimes a single species pollinates only a single plant species. Others are active and aggressive hunters of species that are agricultural and human pests. Even the flesh flies have a role to play in that, in many species, their larvae contribute to waste disposal, especially of faeces.*
ENVIRONMENTAL LEGISLATION RELEVANT TO BIODIVERSITY PRIORITY AREAS

There are many environmental and planning laws that require planners and decision-makers to consider the conservation of biodiversity. These apply at all levels of government but are particularly important at the level of the Local Municipality. It is here, and with the provincial environmental authority, which is currently the Department of Agriculture and Land Administration (DALA), where these responsibilities are most obviously and importantly located.

The focus of planning and decision making is necessarily on the future. The future of our natural resources has already been compromised with over 35% of the province’s natural vegetation cover already transformed and its biodiversity substantially destroyed. In this context it must be recognised that any further disturbance of natural habitat has legal implications and in most cases requires a permit from the regulatory authority. A selection of relevant environmental legislation is set out below for quick reference (adapted from Job, 2006).

### CONSERVATION OF AGRICULTURAL RESOURCES ACT (43 OF 1983)
(to be replaced by Sustainable Use of Agricultural Resources Bill)

**Authority:** National Department of Agriculture  
**Commenting authority:** Provincial Department of Agriculture (DALA) and MTPA

**KEY SECTION:** Terrestrial and aquatic invasive alien species

Funding is available from National Department of Agriculture to support clearing of invasive species. Lists of weeds and invader plants are available, (R.280 of March 2001).

**REGULATION 16:** Control of weeds and invader plants:

1. If invasive weeds (as specified in the Act) occur on any area (also specified) the land user shall, by any of the following means, control those weeds effectively:
   - (a) The weeds shall be uprooted, felled or cut off and shall be destroyed by burning or other suitable method.
   - (b) The weeds shall be treated with an appropriately registered weed killer.
   - (c) The measures above shall be applied to the seeds, seedlings or regrowth of the weeds to prevent them from setting seed or propagating vegetatively.

Various categories of invasive alien plant species are listed in different sections of the Act with appropriately strict and specific responses required of any land owner or occupier in respect of each category of invader plant.

**KEY SECTION:** Terrestrial ecosystems

**REGULATION 2:** Cultivation of virgin soil.

No land user shall cultivate any virgin soil except with the authority of a written permit issued by the executive officer. Virgin soil includes land that was cultivated but has lain fallow for more than ten years. Such permission may also be granted in terms of Section 4A of the National Forest Act (68 of 1972).

**REGULATION 3:** Cultivation of land with a slope.

1. Land with a slope of more than 20% may not be cultivated without a permit.
2. Land with a slope of more than 12% may not be cultivated without a permit if certain specified soil types or conditions occur on that land.
3. The above prohibitions do not apply to land that was already cultivated when these regulations came into force, provided such land is already protected effectively against excessive soil erosion.

Funding is available from National Department of Agriculture for measures to prevent soil erosion, the restoration of eroded land or degraded veld.
NATIONAL FORESTS ACT (84 OF 1998)
Authority: Department of Water Affairs and Forestry,
HYPERLINK "http://www.dwaf.gov.za"

CHAPTER 3 PART 1 Prohibits the destruction of indigenous trees in any natural forest without a licence.

SUBDIVISION OF AGRICULTURAL LAND ACT (70 OF 1970)
Authority: National Department of Agriculture
Commenting authority: Provincial Department of Agriculture (DALA) and MTPA

KEY SECTION A permit is required to subdivide or encumber with restrictions any agricultural land.

MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT (50 OF 1991)
Authority: National Department of Minerals and Energy
HYPERLINK "http://www.dme.gov.za"

KEY SECTION: A permit is required from the Department of Minerals and Energy for any mining, quarrying or other extractive activities. This is in addition to any permits required under any other legislation such as the National Water Act or NEMA.

NATIONAL ENVIRONMENTAL MANAGEMENT ACT (107 OF 1998)
- see Ch 2, MBCP Handbook
Authority: Department of Agriculture and Land Administration (DALA) www.deat.gov.za

KEY SECTIONS: The National Environmental Management Act (NEMA) is the first step in giving legal effect to the environmental rights in the Constitution (Section 24).

THE ACT:
- Establishes principles to guide the decisions and actions of all organs of state (NEMA Principles);
- Establishes procedures for co-operative governance;
- Promotes integrated environmental management by establishing procedures for environmental impact assessments and enabling any national or provincial permitting authority to prescribe environmental impact assessment regulations

Of key importance is Section 5, which deals with Environmental Impact Assessment (EIA) and Environmental Management Frameworks (EMFs). EIA regulations have been promulgated in terms of Section 5 of NEMA. Development activities must have environmental authorisation from the relevant environmental authority (namely DALA) before commencement. In addition, the Province can compile information and maps in the form of EMFs which will inform the EIA process by identifying environmental attributes (such as environmental sensitivity, biodiversity, etc.) for a specific geographic area. The EMFs will also guide spatial planning for the affected geographic area. EMFs can be compiled for a local municipal area.
### DEFINITION OF TERMS

‘water resource’ includes a watercourse, surface water, wetland or aquifer;

‘watercourse’ means -

(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows.

(Reference to a watercourse includes, where relevant, its bed and banks)

‘riparian habitat’ includes the physical structure and associated vegetation of the area associated with a watercourse. These consist of alluvial soils, sometimes periodically flooded, supporting characteristic riverine vegetation with species and appearance distinct from adjacent upland areas;

‘wetland’ means land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

‘aquifer’ means a geological formation which has structures or textures that hold water or permit appreciable water movement through them.

### KEY SECTIONS: Water use

**SECTION 21:** Lists eleven water uses that must be authorised by DWAF.

For the purposes of Section 21 of this Act, water use includes:

(a) taking water from a water resource;
(b) storing water;
(c) impeding or diverting the flow of water in a watercourse;
(d) engaging in a stream flow reduction activity;
(e) engaging in a ‘controlled activity’ as identified in Sects 37(1) or 38(1);
(f) discharging waste or any water containing waste into a water resource;
(g) disposing of waste in ways that may have detrimental impact on a water resource;
(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
(i) altering the bed, banks, course or characteristics of a watercourse;
(j) removing or discharging water found underground, necessary for the efficient continuation of an activity or for the safety of people;
(k) using water for recreational purposes.

**SECTION 22:** According to Section 22 of the Act, a person may only use water –

(a) without a licence:
1. If that water use is permissible under Schedule 1(reasonable domestic use)
2. If that water use is permissible as a continuation of an existing lawful use (section 32); or
3. if that water use is permissible in terms of a general authorisation issued under section 39;
(b) if the water use is authorised by a licence under this Act; or
(c) if the responsible authority has dispensed with a licence requirement (Subsect, 3).

A responsible authority may dispense with the requirement for a licence for water use if it is satisfied that the purpose of this Act will be met by the grant of a licence, permit or other authorisation under any other law.

**SECTION 144:** States DWAF’s view on development surrounding water resources: For the purposes of ensuring that all persons who might be affected have access to information regarding potential flood hazards, no person may establish a township, unless the layout plan shows, in a form acceptable to the local authority, lines indicating the 100 year flood line.

*continued overleaf*
PART 4: Part 4 of the Act lays down clear responsibilities regarding preventing and remedying the effect of pollution of water resources. The Act also provides for an ecological reserve to be determined for every river in South Africa, limiting the amount of water that can be abstracted from the river. The ecological reserve is the portion of the river’s streamflow that needs to remain in the river to ensure the sustainable healthy functioning of aquatic ecosystems. Only water over and above the ecological reserve may be used.

The Act defines the ecological reserve as the quantity and quality of water required:
(a) to satisfy basic human needs by securing a basic water supply, as prescribed under the Water Services Act (108 of 1997), for people who are or who will in the near future, be:
   (i) relying upon;
   (ii) taking water from; or
   (iii) being supplied from, the relevant water resource; and
(b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource.

DWAF may require that an environmental impact assessment (EIA) be undertaken in support of a licence application. An EIA in terms of the National Water Act would entail an assessment by a competent person of the likely environmental effects of the proposed licence on the resource.

KEY SECTIONS: Aquatic ecosystems

REGULATION 7: Use and protection of wetlands and watercourses
1. Wetlands and watercourses may not be used in any way that causes or may cause deterioration of or damage to the natural agricultural resources of the site. This includes all areas within the flood zone of a watercourse or within 10 meters horizontally outside the flood zone.
2. No land user shall drain or cultivate any wetland or area within the flood zone of any watercourse (including its 10 metre buffer) except in terms of a written permit.
3. The above prohibitions do not apply to land that was already cultivated when these regulations came into force, provided such land is already protected effectively against excessive soil erosion.

REGULATION 8: Regulating the flow pattern of run-off water
1. No water from any watercourse may be diverted to any other watercourse without written permit.

No obstruction, dam nor any disturbance of the flow pattern of run-off water may be made on any land, without: provision being made for the collection, passing through and flowing away of run-off water, around or along the said obstruction, in a way that ensures it will not cause excessive soil erosion or the deterioration of natural agricultural resources.
**NEM PROTECTED AREAS ACT (57 OF 2003)**

**Authority:** Department of Environmental Affairs and Tourism (DEAT)  
**HYPERLINK** "http://www.deat.gov.za"

**KEY SECTIONS:**

**CHAPTER 2:** Outlines a system of protected areas in South Africa consisting of the following:
(a) special nature reserves, nature reserves (including wilderness areas) and protected environments;
(b) national parks and world heritage sites;
(c) forest nature reserves and forest wilderness areas, declared in terms of the National Forests Act, 84 of 1998;
(d) mountain catchment areas declared into the Mountain Catchment Areas Act, 63 of 1970.

**CHAPTER 4:** Provides for management authority for protected areas to be identified and requires such authority to manage each reserve in terms of a specified management plan. Management plans are required to set down the policy and purpose of reserve management, implementation, zoning and performance criteria and costing of the plan.

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**NEM BIODIVERSITY ACT (10 OF 2004)**

**Authority:** Department of Environmental Affairs and Tourism (DEAT)  
 www.deat.gov.za

**KEY SECTIONS:**

**CHAPTER 4:** Provides for listing of threatened and protected ecosystems by the Minister or MEC. Once listed, these ecosystems will have to be taken into account in IDPs, and will be considered special areas in terms of NEMA.

**CHAPTER 5:** Provides for invasive alien species control.

- “All organs of state in all spheres of government must prepare invasive species monitoring, control and eradication plans for land under their control, as part of their environmental plans in accordance with Section 11 of the National Environmental Management Act.”
- “Invasive species monitoring, control and eradication plans of municipalities must be part of their Integrated Development Plans”
### APPENDIX 2

#### STATUS OF THE 68 VEGETATION TYPES FOUND IN MPUMALANGA PLANNING REGION

<table>
<thead>
<tr>
<th>VEGETATION TYPE NAME</th>
<th>% TARGET</th>
<th>ORIGINAL AREA HA</th>
<th>% NATURAL</th>
<th>ECOSYSTEM STATUS</th>
<th>% OF TARGET PROTECTED</th>
<th>PROTECTION STATUS (BASED ON TARGET)</th>
<th>BIOME</th>
<th>BIOME NATURAL %</th>
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*continued overleaf*
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<th>% NATURAL</th>
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STATUS OF THE 68 VEGETATION TYPES FOUND IN MPUMALANGA PLANNING REGION

continued overleaf
## Status of the 68 Vegetation Types Found in Mpumalanga Planning Region

<table>
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<tr>
<th>Vegetation Type Name</th>
<th>% Target</th>
<th>Original Area HA</th>
<th>% Natural</th>
<th>Ecosystem Status</th>
<th>% of Target Protected</th>
<th>Protection Status (Based on Target)</th>
<th>Biome</th>
<th>Biome Natural %</th>
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## Data Summary of Formal and Informal Protected Areas

### Understanding the Data in This Table

**Type of PA**

A protected area may be known as more than one ‘type’ because some PAs are located within others.

Types of PA are further classified into three groups, based on land ownership and level of protection. While some of these classifications may be debated, they are based on informed MTPA opinion as to: level of security, ownership and staff attention (a proxy for resource allocation). Group allocation is color-coded in the table.

**Conservation Importance (CI)**

This is a score between 0 and 1 calculated for each PA, based on C-Plan’s irreplaceability analysis. It represents an irreplaceability value of >0.5 (50%) expressed as a proportion of total area. Conservation Importance, measures a PA’s total contribution to the 340 biodiversity feature targets measured.

**Rank**

This is the rank of each PA based on its Conservation Importance. Many PAs have identical ranks because they achieved the same CI scores.

**# BD Features**

The number of biodiversity features found per protected area is based on the mapped distributions of all 340 biodiversity features.

**# Unique Features**

The number of biodiversity features within a PA that are found in NO other PAs.

**Sum of Percentage Contributions**

Each biodiversity feature found within a PA makes a percentage contribution to its target (e.g. 100% means a target is fully achieved within a PA). The figure in this column is the SUM of the contributions of all features to their collective targets within the PA. If this number is a small number (e.g. <10%) then it means the PA is not contributing much to ANY targets and therefore has little biodiversity significance in terms of the features measured.

<table>
<thead>
<tr>
<th>Protected Area Name</th>
<th>Type of Protected Area</th>
<th>Size in Hectares</th>
<th>Conservation Importance</th>
<th>Rank</th>
<th>BD Features</th>
<th>Unique Features</th>
<th>Sum of Percentage Contributions</th>
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*IFMCA – Indigenous forest mountain catchment area (formerly DWAF managed)
## DATA SUMMARY OF FORMAL AND INFORMAL PROTECTED AREAS

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<th>PROTECTED AREA NAME</th>
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<th>RANK</th>
<th>RED FEATURES</th>
<th>UNIQUE FEATURES</th>
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### DATA SUMMARY OF FORMAL AND INFORMAL PROTECTED AREAS

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ALIEN INVASIVE SPECIES
Any plant or animal species that has been introduced into South Africa and which has become naturalised, i.e. capable of reproducing and spreading without human assistance. In the case of plants, such species may establish in natural vegetation to the point of replacing it and destroying biodiversity and ecological functioning. The worst invader plants are required by law to be controlled on both private and state land.

BIODIVERSITY
The variability among all types of living organisms (animals, plants and microbes) including those from terrestrial, aquatic and marine ecosystems. The term is shorthand for biological diversity and includes diversity within species, between species and of ecosystems and other ecological complexes, of which all organisms are a part. It includes the full diversity of all genes, species and ecological communities and the ecological and evolutionary processes that sustain them.

BIODIVERSITY FEATURE
An element or unit of biodiversity, for which it is possible to set a quantitative target for active protection (or conservation or sustainable use) for example, a vegetation type, a rare species, or the spatial component of an ecological process.

BIODIVERSITY ASSESSMENT
The activity of analysing spatial data layers (geographic, biological and ecological) to identify options for meeting conservation targets for a range of biodiversity features. Biodiversity assessment should include the interpretation of the results of such analyses for a wide range of stakeholders.

BIODIVERSITY OFFSET
An area legally set aside or acquired for conservation purposes, in exchange for the permitted destruction (by development) of a separate area of biodiversity of recognized value. If possible, the biodiversity value of the offset should be at least greater than that of the area destroyed and as similar as possible to it.

BIODIVERSITY PLANNING
Planning at various spatial scales to identify priority areas for biodiversity conservation, taking into account patterns of biodiversity (the principle of representation) and the ecological and evolutionary processes that sustain them (the principle of persistence). Biodiversity planning includes biodiversity assessment and the subsequent production of an implementation strategy and action plan.

BIODIVERSITY TARGET
The quantity of a biodiversity feature, based on the best scientific knowledge available, that is an estimate of the amount of the feature needed to ensure its vitality and survival in the long term. This applies to both ‘pattern’ features (e.g. species) and ‘process’ features (e.g. movement) at various scales. Targets are expressed as, for example, an area of land or a number of breeding individuals of a threatened species.

BIOME
A major ecological community of organisms (species) usually characterised by a dominant vegetation type with which they are associated. National scale ecological assessment has led to the classification of eleven biomes in southern Africa: desert, succulent Karoo, fynbos, Nama-Karoo, grassland, savanna, Indian Ocean coastal belt, Albany thicket, forest, and the two island biomes of sub-Antarctic tundra and polar desert.

BIOREGION
The Biodiversity Act defines a bioregion as a region that ‘contains whole or several nested ecosystems and is characterised by its landforms, vegetation cover, human culture and history’. The Act further provides for the publication of Bioregional Plans for such areas. These Plans should be spatially delimited to match the nearest local or district municipal boundaries, or to provincial boundaries.

BIOREGIONAL PLAN
A bioregional plan should be seen primarily as a tool for guiding land and resource-use planning and decision-making by the full range of sectors whose policies and decisions impact on biodiversity, so that biodiversity priorities and sustainable management of natural resources are taken into account in medium- to long-term planning, and in day-to-day decision-making in all of these sectors.

BIOTA
A general collective term for all living things in a specific region.

CONNECTIVITY
The ecological connectedness of the pattern of habitats and distribution of species within a particular area. High connectivity facilitates the free movement of individuals and species. Habitats that are fragmented by development, present obstacles to biological movement and reduced connectivity in proportion to the intensity and type of development.

CONSERVATION AREA
A defined area where conservation of important biodiversity is needed in
order to ensure sustainable benefits. In this handbook this refers to areas outside the formal protected area network.

**CONSERVANCY**
A usually contiguous, privately owned land area (including water) linked by voluntary agreement between participating owners, to cooperate in protecting aspects of their shared natural resources, including wildlife, biodiversity and landscapes.

**DEFOLIATION**
The periodic loss of most of the leaves from a live plant, which are normally replaced through seasonal regrowth. Many plant species, especially shrubs, grasses and herbaceous plants, are well adapted to regular defoliation, total or partial. Defoliation takes place by means of grazing, fire, frost, hail, drought and human harvesting.

**ECOLOGICAL RESERVE**
*(water flow in rivers)*
The quality and quantity of water flow required in a river to allow it to function ecologically and its aquatic biodiversity to persist. This minimum flow must also be sufficient to meet basic human needs and to secure ecologically sustainable development in terms of the National Water Act.

**ECOLOGICAL** *(and evolutionary) processes*
These are the processes that operate to generate and maintain biodiversity. Ecological drivers of change operate over relatively short time scales, while evolutionary processes operate over much longer time scales. Biodiversity assessment includes mapping and setting targets for the spatial components of these processes, namely the areas of land or water required to ensure the processes continue to function. For examples see Box on page 17.

**ECOREGION LEVEL 2**
A river classification that is based on the premise that ecosystems and their components display repeating regional patterns. These exist in varied combinations of causal factors such as climate, mineral availability (soils and geology), vegetation and physiography. This classification is expert based and the purpose is to identify regions of relative homogeneity in ecological characteristics or in relationships between organisms and their environments.

**ECOSYSTEM**
A dynamic complex of plant, animal and microorganism communities and their nonliving environment, interacting as a functional unit.

**ECOSYSTEM SERVICES**
The goods and services provided to society by well functioning ecosystems, such as food, clean water, carbon storage, climate regulation, disease management, spiritual fulfillment and aesthetic enjoyment.

**ENDEMIC SPECIES**
A plant or animal species, naturally confined to or exclusive to, a specified habitat or geographic area.

**HABITAT LOSS**
Loss of natural habitat occurs with most forms of development. It is sometimes referred to as habitat transformation. Habitat loss may be irreversible, meaning that biodiversity patterns and processes can never be restored, such as with urban development, crop agriculture and most forms of mining. In other cases, habitat loss is more-or-less reversible, meaning that local biodiversity features may be restored to some extent. For example, overgrazed veld in some ecosystems can recover if the grazers are reduced and managed. Habitat loss in South Africa, as well as world-wide, is the single biggest cause of biodiversity loss. Halting biodiversity loss depends on avoiding habitat loss in areas that are important for achieving biodiversity targets and slowing the rate of loss in all other areas.

**INTEGRITY** *(ecological)*
The integrity of an ecosystem refers to its functional completeness, including its components (species) its patterns (distribution) and its processes (see above).

**LANDSCAPE SCALE**
Large scale applications of a concept or a characteristic at the level of geographic landscape units, such as a mountain range, a valley, foothill formations or a plateau.

**MAINSTREAMING**
The integration of an understanding of biodiversity and the functioning of ecosystems into all human activities at all levels of organization in society. In particular the integration of biodiversity values into land-use planning and decision making within structures of Local Government at all levels.

**PROTECTED AREA**
The IUCN defines a protected area as an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources, and managed through legal or other effective means. This implies an area of natural or semi-natural habitat with some form of conservation management that is secure for the foreseeable future. A protected area does not need to be owned by the state.

**QUATERNARY CATCHMENT**
A subdivision of a broader catchment classification system. A catchment includes all the land area from mountain top to seashore which is drained by a single river and its tributaries. Each catchment is then subdivided into secondary catch-
ments, which, in turn, have been divided into tertiary catchments. Finally, all tertiary catchments have been divided into quaternary catchments. A total of 1,946 quaternary catchments have been identified for South Africa. These quaternary catchments are the finest unit used by DWAF in its ecological studies.

**REFUGIA**
Localities or habitat patches that become isolated by natural or man-induced processes and provide, (usually temporary), refuges for one or more threatened species.

**STEWARDSHIP**
A formalised programme of land care, usually between a State agency for conserving biodiversity and/or the environment, and private landowners. The programme usually involves mutual incentives to achieve conservation of natural resources, often including economic benefits derived from the use of natural habitats for their material resources and for tourism.

**SUBCATCHMENT**
A subdivision of a quaternary catchment based on GIS modelling procedures, using runoff and digital elevation models to derive these as planning units for aquatic assessment. It is at a finer scale than, and nested within quaternary catchments.

**SUSTAINABLE DEVELOPMENT**
Integration of social, economic and environmental factors into planning, decision making and implementation, to ensure that development is balanced to serve the needs of present and future generations.

**THREATENED**
(biodiversity features)
Threatened biodiversity features are those considered to be ‘critically endangered’, ‘endangered’ or ‘vulnerable’ in terms of standard IUCN definitions of conservation status. Such species, ecosystems or ecological processes are referred to collectively and individually as ‘threatened’.
REFERENCES AND FURTHER READING


