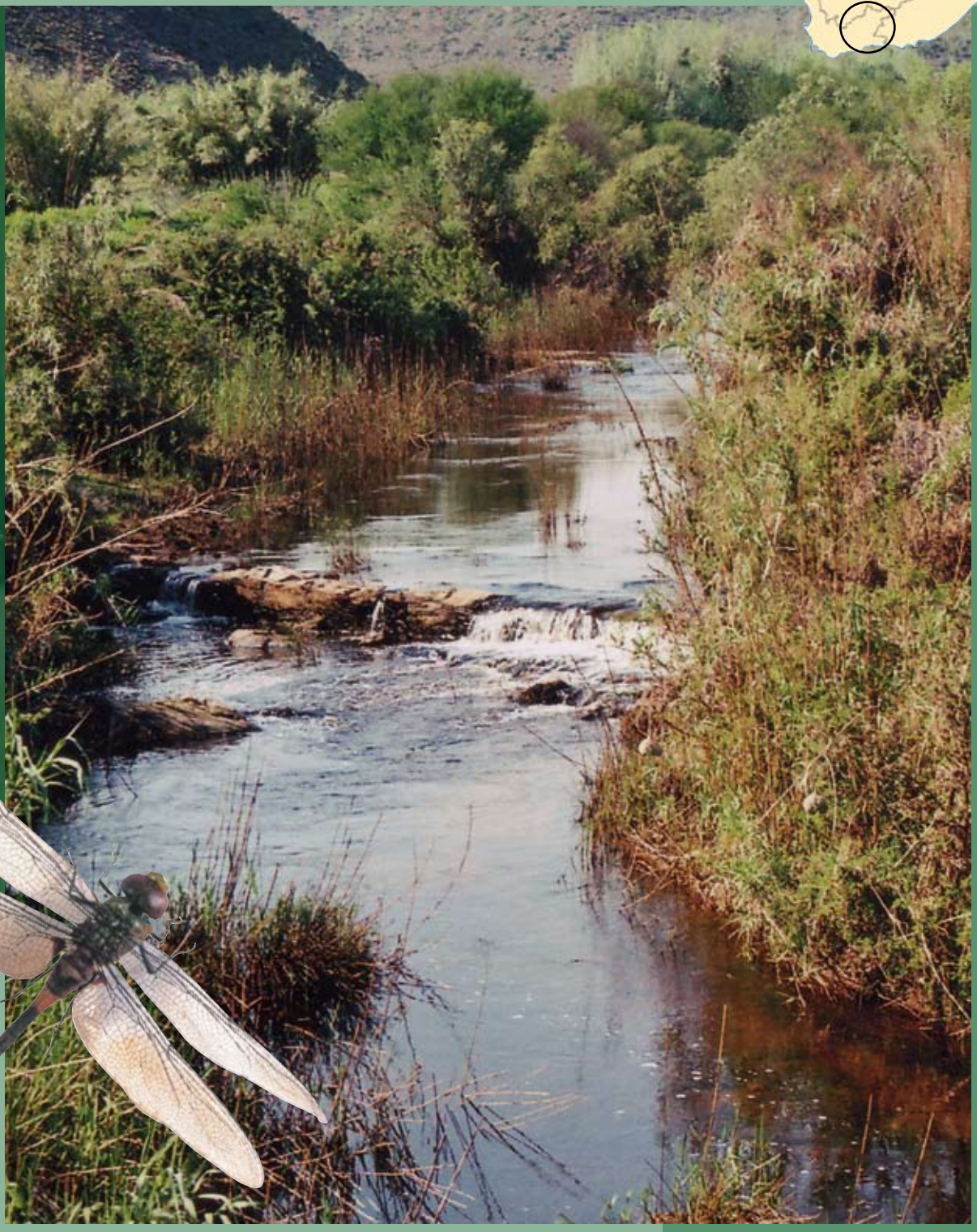
STATE OF RIVERS REPORT

RIVERS OF THE GOURITZ WATER MANAGEMENT AREA 2007

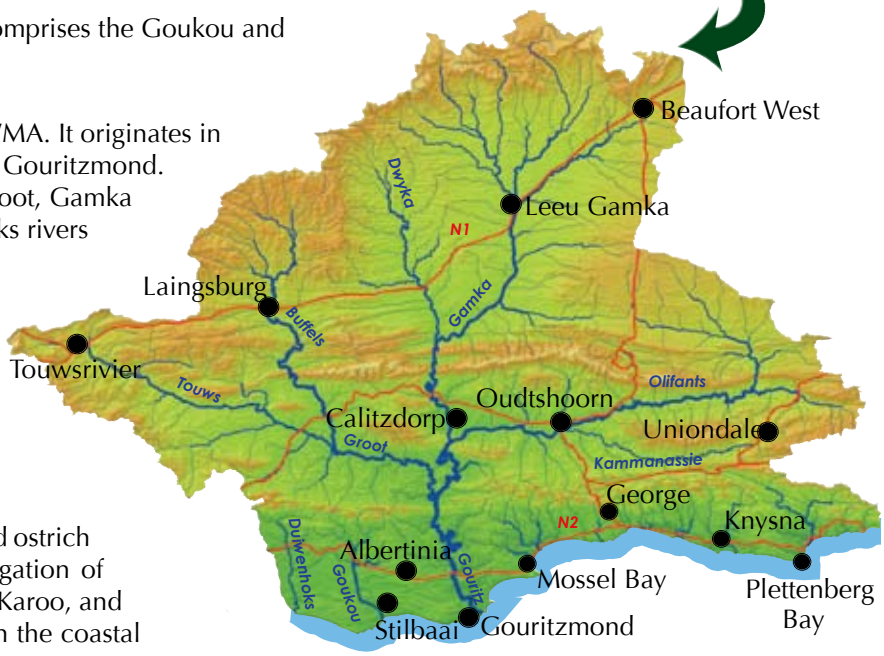


RIVER HEALTH PROGRAMME

Rivers of the Gouritz Water Management Area 2007: Summary

The Gouritz Water Management Area (WMA) comprises the Goukou and Duiwenhoks, Gouritz and Garden Route rivers.

The Gouritz River is the main river within the WMA. It originates in the Great Karoo and enters the Indian Ocean at Gouritzmond. Major tributaries of the Gouritz River are the Groot, Gamka and Olifants rivers. The Goukou and Duiwenhoks rivers are small rivers draining the Langeberg Mountains and flow over the coastal plains, west of Mossel Bay. The main rivers of the Garden Route, east of the Gouritz River, are the Hartenbos, Klein Brak, Groot Brak, Knysna, Bietou, Keurbooms, Groot and Bloukrans.

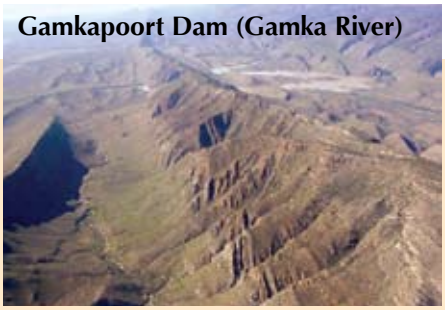


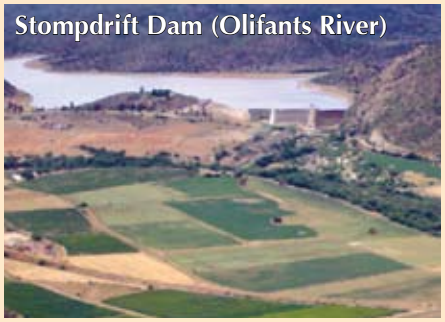
Land-use in the area consists largely of sheep and ostrich farming in the arid Great Karoo, extensive irrigation of lucerne, grapes and deciduous fruit in the Little Karoo, and forestry, tourism and petrochemical industries in the coastal belt. Indigenous forests, wetlands, lakes and estuaries of high conservation status are found in the wetter south eastern portion of the WMA.

Overall State

Generally, only the upper reaches of the coastal rivers and their tributaries in the WMA are still in a natural or good ecological state, while many of the lower reaches are in a good to fair state. Where the lower reaches of some of these rivers are degraded, it is as a result of the cumulative effect of increased development and water abstraction.

The upper reaches of the Gouritz River in the Great Karoo are mostly in a good ecological state, while the middle and lower reaches are in a fair to poor ecological condition as a result of agricultural and urban development. Invasive alien plants and fish have had a major impact on the biodiversity and ecological functioning of rivers in the Gouritz WMA and their existence threatens the status of all endemic species. Portions of the area are protected through conservation initiatives such as the Gouritz Biodiversity Initiative and the Garden Route Initiative and these, in conjunction with conservation projects, have improved the conservation status of the area.

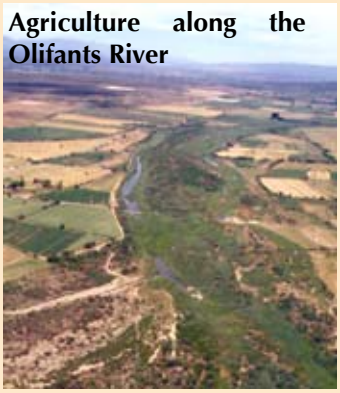

Gamkapoort Dam (Gamka River)


Stompdrift Dam (Olifants River)

Impacts

Flow modification as a result of over-abstraction threatens the ecological functioning of many of the rivers. Extensive abstraction and many off-stream dams for agriculture, domestic use and new developments have had a cumulative negative effect on flow. Extensive alien vegetation encroachment adds to all these impacts on the rivers. This is particularly evident in summer, when some rivers cease to flow. There are a few large instream dams that contribute to flow modification by preventing smaller floods from reaching the estuaries.

Modified flows are negatively impacting on the functioning of the rivers, as well as the overall ecological integrity. This, in turn, affects the ability of the systems to deliver certain goods and services (water supply, breakdown of pollutants).


Agriculture along the Olifants River

Agricultural practices and urban development in floodplains, riparian zones and wetlands have reduced water quality and habitat diversity in the middle to lower reaches of many rivers. These practices have reduced biodiversity and sustainable water resource use in the Gouritz WMA. They have also impacted on wetlands, reducing their ability to act as sponges, attenuating floods and ensuring perennial flows. As a result, rivers remain dry for longer periods and flood damage is more extensive. Alien vegetation encroachment, bulldozing, pastures and developments in riparian zones have further reduced their ability to buffer rivers from surrounding land-use impacts. This has reduced the ability of riparian and wetland vegetation to remove nutrients and stabilise river banks.

The broad distribution of ***alien invasive plants*** pose various threats to rivers in the Gouritz WMA. They reduce riparian habitat diversity, aquatic biodiversity, water availability and destabilize river banks. They also block rivers, resulting in lateral and mid-channel erosion, shade watercourses, can poison the water and create a fire threat.

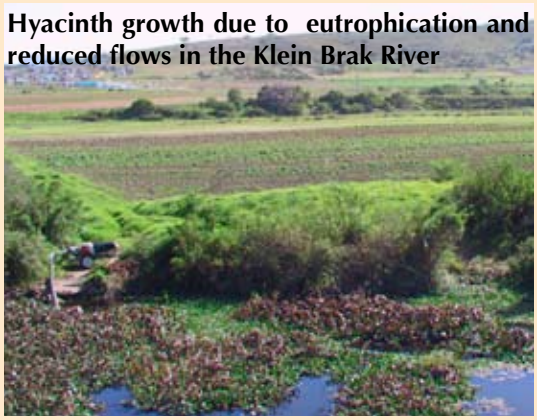
The Garden Route and Goukou/Duiwenhoks rivers and associated wetlands are particularly threatened by the rapid spread of black wattle. Oleander is prevalent on floodplains and perennial water streams of the Gouritz catchment, and is extremely expensive and difficult to eradicate. Pepper trees and Spanish reed are other riverine alien plants in this catchment.


Wattle infestation of the Moordkuil River


Banded tilapia

Introduced and translocated fish such as bass, carp, bluegill sunfish, mosquitofish, tilapia, small-mouth yellowfish and trout pose a major threat to indigenous fish and to river functioning. Alien fish are widespread throughout the middle and lower reaches of many rivers of the Gouritz WMA. Alien fish have caused localised extinctions of indigenous fish populations, many of which are endemic to the area. They predate on indigenous fish, compete for food and alter their habitat. Healthy numbers of indigenous fish now survive only in refuge reaches of rivers that are beyond the reach of alien fish.

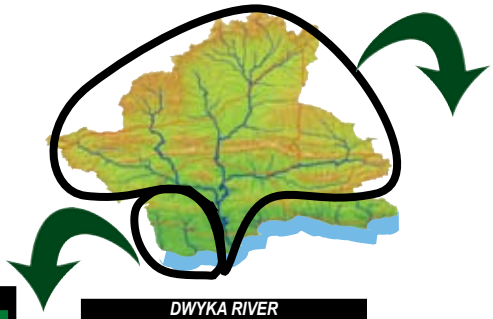
Rivers of the Gouritz WMA generally have good water quality, except in the middle and lower reaches, where water quality is impaired (nutrient enrichment and salinisation) by ***diffuse pollution*** from intensive agricultural activities. Pollution sources include irrigation return flows (fertilisers and insecticides), run-off from feedlots, roads, urban areas and informal settlements adjacent to rivers, as well as discharges from wastewater treatment works. Higher suspended solids occur during times of floods. Microbial contamination from wastewater discharges or the absence of adequate sanitation services pose a high risk to human health, particularly in those river reaches downstream of human settlements. Litter and solid waste dumping also reduce water quality and habitat integrity in some of the rivers.

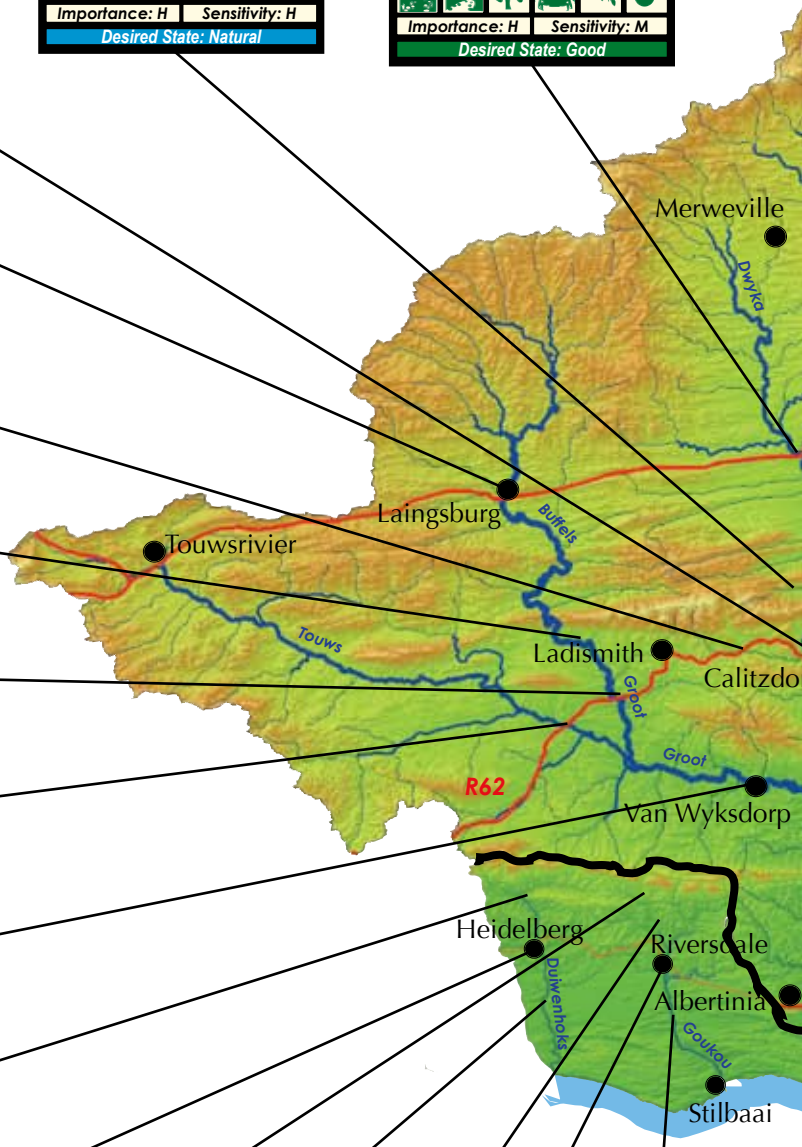

Hyacinth growth due to eutrophication and reduced flows in the Klein Brak River

MANAGEMENT ACTIONS

- **Investigate and ensure environmental flow releases from existing instream dams, where possible**
- **Discourage groundwater abstraction from the riparian zone**
- **Encourage efficient water-use throughout the Water Management Area. Reduce water loss from canals and improve irrigation methods**
- **Encourage environmentally-friendly farming practices (limit farming activities in riparian zones) and maintain a buffer area (10 - 20 m) along river banks**
- **Clear alien vegetation from riparian buffer areas and the surrounding catchment. Rehabilitate cleared areas**
- **Stock dams with indigenous fish rather than alien fish**
- **Control litter and dumping of solid waste near rivers**
- **Improve monitoring and management of stormwater and wastewater from developed areas**

Present State: Goukou/Duiwenhoks & Gouritz Rivers





HUIS RIVER
EcoStatus: Fair
Importance: M | Sensitivity: M
Desired State: Good

GAMKASKLOOF
EcoStatus: Good
Importance: H | Sensitivity: H
Desired State: Natural

DWYKA RIVER
EcoStatus: Good
Importance: H | Sensitivity: M
Desired State: Good

BUFFELS RIVER: LAINGSBURG
EcoStatus: Poor
Importance: L | Sensitivity: L
Desired State: Fair

SEWEWEEKSPOORT
EcoStatus: Good
Importance: H | Sensitivity: H
Desired State: Natural

GROOT RIVER: VAN ZYLS DAM
EcoStatus: Fair
Importance: L | Sensitivity L
Desired State: Fair

GROOT RIVER: R62
EcoStatus: Fair
Importance: M | Sensitivity: M
Desired State: Good

TOUWS RIVER: R62
EcoStatus: Good
Importance: M | Sensitivity: M
Desired State: Good

GROOT RIVER: VAN WYKSDORP
EcoStatus: Fair
Importance: M | Sensitivity: M
Desired State: Good

DUIWENHOKS: DORINGKLOOF
EcoStatus: Fair
Importance: VH | Sensitivity: H
Desired State: Good

DUIWENHOKS: HEIDELBERG
EcoStatus: Poor
Importance: H | Sensitivity: M
Desired State: Fair

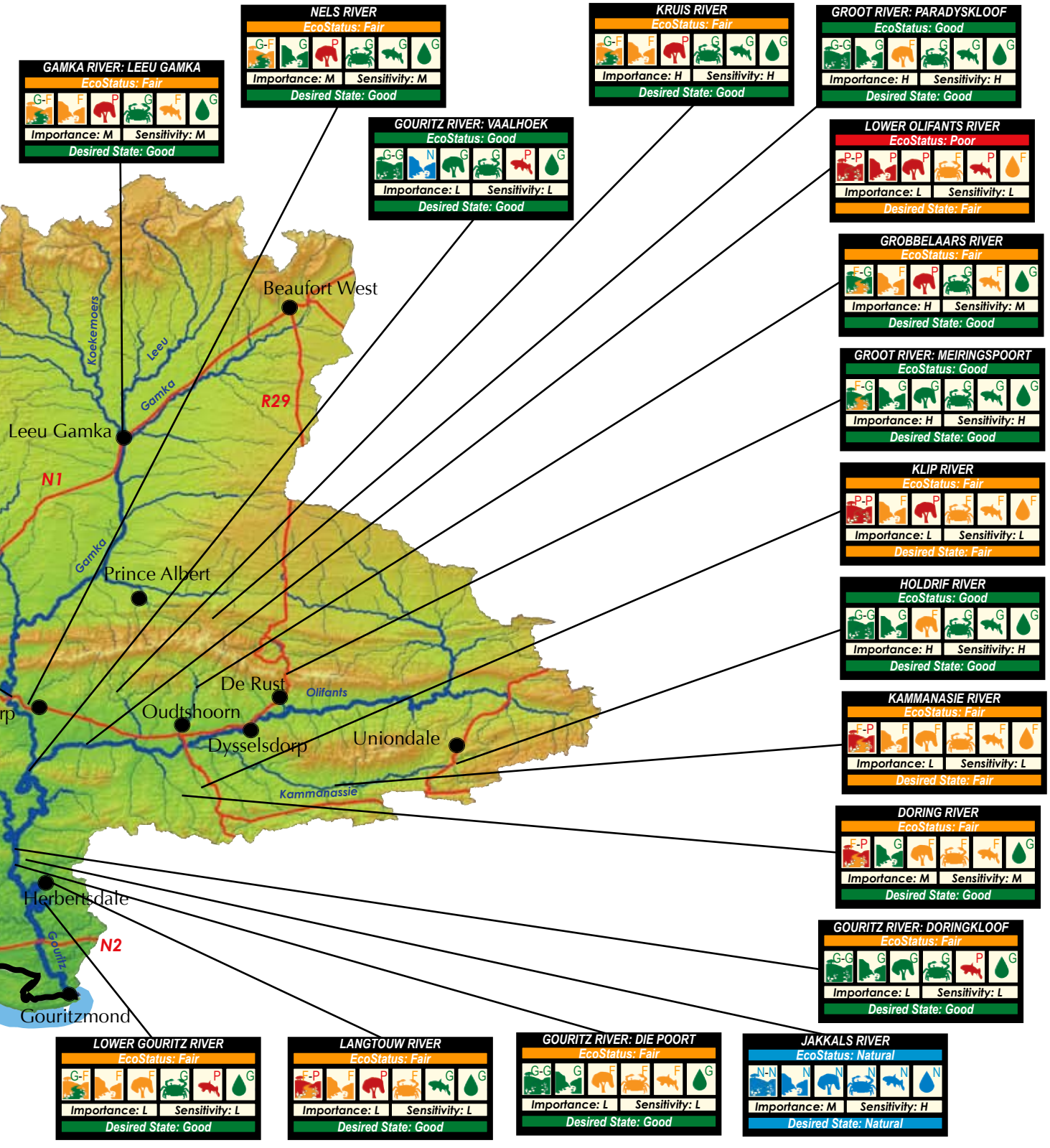
VET RIVER: KOINTEPOORT DAM
EcoStatus: Good
Importance: VH | Sensitivity: VH
Desired State: Natural

DUIWENHOKS: VERMAAKLIKHEID
EcoStatus: Fair
Importance: H | Sensitivity: M
Desired State: Good

VET RIVER: NOVO
EcoStatus: Fair
Importance: VH | Sensitivity: VH
Desired State: Good

GOUKOU: KLIPFONTEIN
EcoStatus: Fair
Importance: H | Sensitivity: M
Desired State: Fair

GOUKOU: RIVERSDAL
EcoStatus: Fair
Importance: H | Sensitivity: M
Desired State: Fair



What is the River Health Programme?

Healthy rivers provide **goods and services** (water supply, natural products, breakdown of pollutants, conservation, flood attenuation, recreation and spiritual value) that contribute to human welfare, economic growth and sustain biodiversity. When people use rivers, they impact on river health. The National River Health Programme assesses the health of rivers by measuring selected ecological indicator groups that represent the condition of the larger aquatic ecosystem. The data are simplified and represented as indices.

The overall ecological status of a river reach is expressed as the EcoStatus, which provides an integrated value of all the ecological indices assessed for that particular reach. The ecological importance and sensitivity rating (EIS) provides an indication of the level of protection that a river should receive.

River Health Indices (p. 4)

- Index of Habitat Integrity
- Geomorphology Index
- Riparian Vegetation Index
- Fish Index
- South African Scoring System
- Water Quality

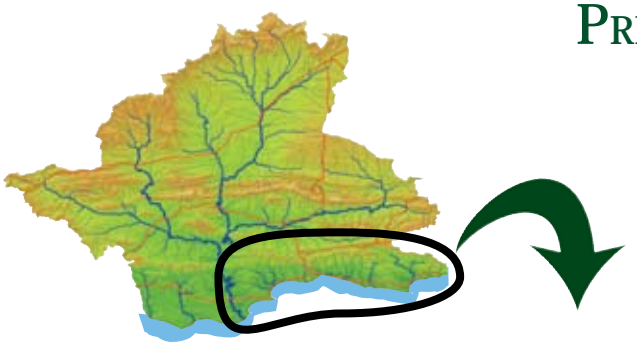
EcoStatus/River Health Categories (p. 5)

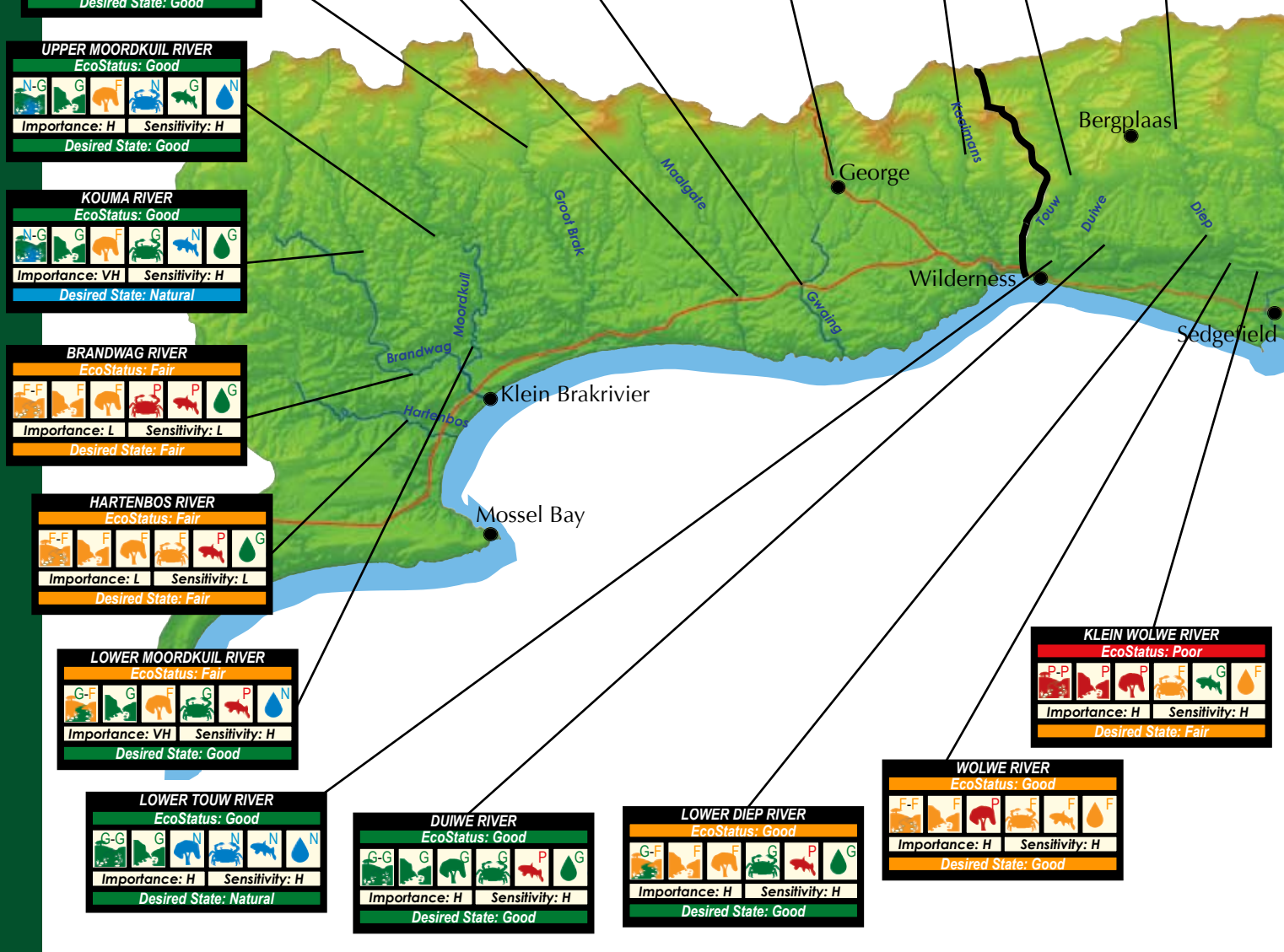
- Natural (N)
- Good (G)
- Fair (F)
- Poor (P)

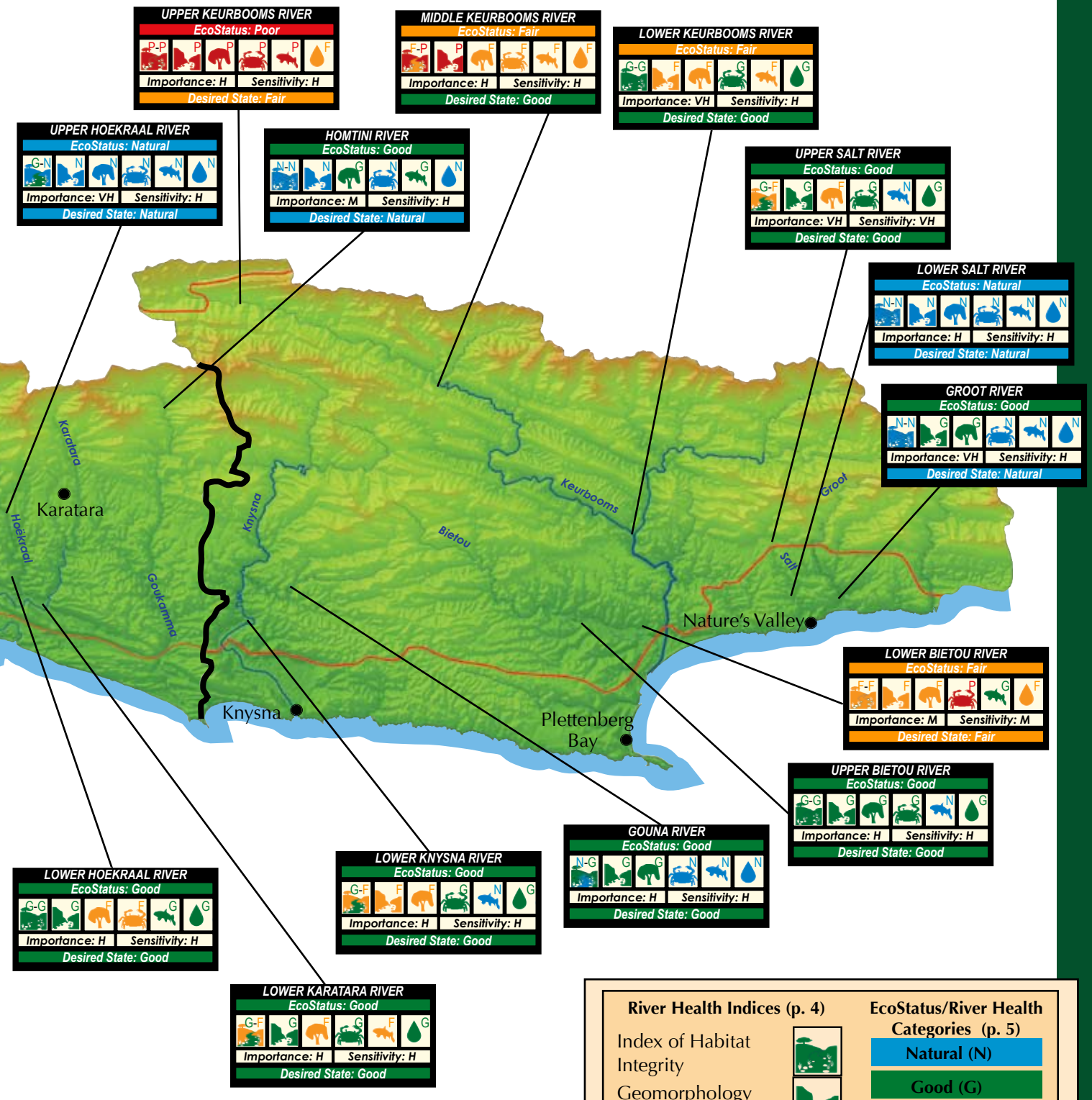
Ecological Importance & Sensitivity Rating (p. 4)

- Very High (VH)
- High (H)
- Moderate (M)
- Low (L)

Present State: Garden Route Rivers






UPPER KEURBOOMS RIVER
EcoStatus: Poor
Importance: H
Sensitivity: H
Desired State: Fair
MIDDLE KEURBOOMS RIVER
EcoStatus: Fair
Importance: H
Sensitivity: H
Desired State: Good
LOWER KEURBOOMS RIVER
EcoStatus: Fair
Importance: VH
Sensitivity: H
Desired State: Good
UPPER HOEKRAAL RIVER
EcoStatus: Natural
Importance: VH
Sensitivity: H
Desired State: Natural
HOMTINI RIVER
EcoStatus: Good
Importance: M
Sensitivity: H
Desired State: Natural
UPPER SALT RIVER
EcoStatus: Good
Importance: VH
Sensitivity: VH
Desired State: Good
LOWER SALT RIVER
EcoStatus: Natural
Importance: H
Sensitivity: H
Desired State: Natural
GROOT RIVER
EcoStatus: Good
Importance: VH
Sensitivity: H
Desired State: Natural
Karatara
Karatara
Hoëkraal
Knysna
Goukamma
Bietou
Keurbooms
Groot
Salt
Nature's Valley
Knysna
Plettenberg Bay
LOWER BIETOU RIVER
EcoStatus: Fair
Importance: M
Sensitivity: M
Desired State: Fair
UPPER BIETOU RIVER
EcoStatus: Good
Importance: H
Sensitivity: H
Desired State: Good
GOUNA RIVER
EcoStatus: Good
Importance: H
Sensitivity: H
Desired State: Good
LOWER KNYSNA RIVER
EcoStatus: Good
Importance: H
Sensitivity: H
Desired State: Good
LOWER HOEKRAAL RIVER
EcoStatus: Good
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Foreword

The Gouritz River is a show case example of how a River System has shaped a defined Water Management Area flowing from the dry lands of the Northern most Region of the Water Management Area through the aptly named Greater Karoo Region to the slightly wetter Little Karoo through to the holiday mecca of the Western Cape Province – the South Cape Coast. About half a million people live in this Water Management Area due exclusively to the life giving force of the Gouritz River System.

The Western Cape Province would be greatly devoid of its inherent quality of beauty of its environmental features and landscapes none so apparent as in the Gouritz WMA. It is unbelievably amazing to see the distinct livelihoods emerging in the area from beachcombers and beach bums at the holiday coastal region to the Forest based activities reliant on the indigenous forests through to the high techno based irrigation farming further north. Livelihoods dependent on stock farming is much better known to many in this country as the high quality Karoo lamb and the graceful ostrich farming practices. We owe unqualified and unequalled allegiance to the Gouritz River for our heritage in this area, which many also best be exemplified by the Cango Caves in the Oudtshoorn area and the effects of water in shaping the landscape even if it is sub surface activities.

In an integrated water resources management sense to achieve sustainable use of water resources, it needs to be monitored, assessed and reported on. The Gouritz WMA State of Rivers Report, the product of a variety of organizations, researchers and scientists, attempts to inform decision makers, interested parties and the public on fundamental issues impacting on rivers in an easy to understand format. It aims to raise awareness and understanding on the current state of our rivers, the impacts on them and what management actions can be taken by all to improve them. As increasing development places pressure on these water resources and it becomes increasingly important that both water resource managers and users of these resources understand the current state of these rivers and their ecological importance.

Through this report, all who live in the Gouritz WMA are encouraged to use these water resources sustainably and where possible restore or conserve the rivers to sustain the life giving force of this River for our children's, children to inherit, nurture as a fundamental part of their better life for all in this Province especially in the Gouritz WMA.

ACTING CHIEF DIRECTOR: WESTERN CAPE
Mr Rashid Khan

Contributing Organisations

Department of Water Affairs and Forestry
Department of Environmental Affairs and Tourism
Water Research Commission
CapeNature
CSIR
SANParks
C.A.P.E.

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State of Rivers Report: Rivers of the Gouritz Water Management Area

Context

The current state of the aquatic ecosystems presented in this report is based on the findings of river surveys that were conducted in the Rivers of the Gouritz Water Management Area as part of the River Health Programme, Western Cape. These surveys took place between 2001 and 2007.

Contents

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ISBN No: 0-620-38676-0

Introduction

Managing Healthy Rivers for People

'River health' refers to the overall condition of a river. The term can be compared to a person or an economy's health. Healthy rivers are essential to our well-being and is central to social and economic development and sustainable utilisation.

People, today, are very aware of the full range of goods and services that water offers. Water is essential to sustainable livelihoods, recreation and has an aesthetic, religious and cultural value. Water affects nearly every aspect of our lives. Although it is the essence of life on earth, people have not adequately taken care of this precious resource.

For centuries, people have had a 'free ride' when it comes to water use. The implications of this are finally dawning on us. Ecosystems are telling us loud and clear that the time has come for us to: i) start repaying our water debts, ii) recognise the goods and services that water provides, and iii) ensure that the goods and services are equitably shared by people and ecosystems alike.

All indications are that South Africa will reach its limits of potentially accessible water supplies between 2020 and 2030. Available water per capita will decline as the population size continues to increase. Unfortunately, the prevailing attitude of those who have access to formal water services, and of many bulk water users in industry and agriculture remains one of viewing water as cheap and plentiful, regardless of the goods and services that the water resources provide.

To continue providing a reliable supply of water for all users, we need to use water more sustainably, and at the same time restore and maintain the health of the environment. This means changing our entire approach and our mind-set to the management of water. We need to build an ethic of water conservation, to cut water use and recycle or reuse water, wherever possible. It is important for us to place a high value on our water resources, and to restore our water resources to safeguard them for present and future generations.

Water Policy, Legislation & Management

The need for sustainable, equitable and efficient water use is central to South Africa's water resource management policy and legislation. The National Water Act (Act 36 of 1998) is the principle legal instrument for the protection, use, development, conservation, management and control of our water resources.

The National Water Resources Strategy (2004) provides a long term plan of how the National Water Act is to be implemented. A protective approach to water resource management has been adopted where water use activities are allowed according to a desired water resource state. This means that water resources are "looked after and used wisely", not "kept separate and preserved".

What Is The River Health Programme?

The River Health Programme assesses the biological and habitat integrity of rivers (through evaluation of, for example, fish, aquatic invertebrates and riparian vegetation). This assessment enables reports on the ecological state of river systems to be produced in an objective and scientifically sound manner. Information from the River Health Programme assists with identification of those areas where unacceptable ecological deterioration is taking place. In addition, this programme reflects the effectiveness of existing river management policies, strategies and actions.

Monitoring aquatic ecosystem health is a requirement in terms of the National Water Act and the results are important for the application of the National Environmental Management Act (1998). This is achieved through State of Environment Reporting.

The River Health Programme is a collaborative venture and partnerships are vital for its success. The national organisations leading the River Health Programme are the Department of Water Affairs and Forestry, Department of Environmental Affairs and Tourism and the Water Research Commission. A variety of organisations within each province implement the River Health Programme at a local level.

The Department of Water Affairs and Forestry, custodian of South Africa's water resources, protects the health of aquatic ecosystems and ensures the sustainable use of water. The River Health Programme, operational since 1994, is a key part of this responsibility. For more information visit www.csir.co.za/rhp.

What Are State Of Rivers Reports?

State of Rivers reporting is complimentary to State of the Environment (SoE) reporting, which has become a recognised form of communication on environmental issues over the past decade. The aim is to provide better information for environmental decision-making. The national SoE uses the Driving Force-Pressure-State-Impact-Response framework to explain what causes environmental change, the wider implication of that change and what we can do to manage the change. State of Rivers reporting uses the same approach, but often with slightly different terminology.

State of Rivers reporting disseminates information on river health to:

- assist in environmentally-sound management of rivers;
- inform and educate people regarding the condition of our rivers; and
- encourage wide participation by all stakeholders.

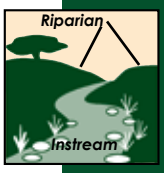
Reports and posters of the River Health Programme will eventually cover all major river systems in South Africa. These will be updated on a regular basis.

How To Read This Report

This introductory section deals with the overall aims of the River Health Programme. The next few pages provide general information on the methods and the study area, followed by three sections dealing with the Goukou/Duiwenhoks, Gouritz and Garden Route rivers in detail. Each section outlines catchment activities, ecological importance and sensitivity, present and desired health, EcoStatus, pressures on the river and key management actions required. The last sections of the report provides an overview of the flora and fauna and conservation initiatives in the Water Management Area.

River Health Monitoring

RIVER HEALTH INDICES



Index of Habitat Integrity

The availability and diversity of habitats are major determinants of aquatic biota that are present. The index assesses the impact of human disturbance on the riparian and instream habitats.

Geomorphological Index

Geomorphological processes determine the size and shape of river channels, which in turn defines the type of habitat. The index reflects the channel condition and channel stability.

Riparian Vegetation Index

Healthy riparian zones help to maintain river channel shape and filter sediment, nutrients and light. Plant material from these zones provides food for aquatic fauna. The index is a measure of riparian vegetation modification from its natural state.

South African Scoring System

Aquatic invertebrates (crabs, insects, snails) require specific habitats and water quality conditions. They are good indicators of recent localised conditions in a river. The index is based on invertebrate families found at a site.

Fish Index

Fish are good indicators of long-term influences on general habitat conditions within a reach. The index is an expression of the degree to which a fish assemblage deviates from its undisturbed condition.

Water Quality

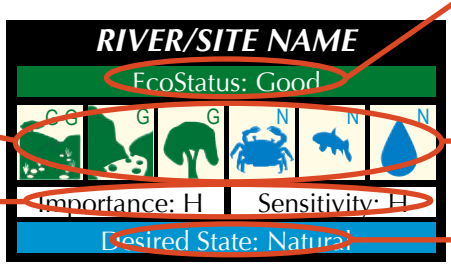
Water quality indicates suitability of water for aquatic ecosystems. This assessment is based on pH, electrical conductivity, total phosphate, total nitrogen, ammonia and dissolved oxygen measured in the rivers.

Measuring River Health

Many physical, chemical and biological factors influence river ecosystem health. The River Health Programme focuses on selected ecological indicator groups that represent the larger ecosystem and are feasible to measure. State of river reporting uses ***RIVER HEALTH INDICES*** to present data in a format that is easy to understand.

The ***ECOLOGICAL IMPORTANCE AND SENSITIVITY*** (EIS) ratings are related to the ecological importance of habitat and biota in a river, as well as how sensitive that aquatic ecosystem is to human modification. This provides an indication of the level of protection that a river should receive. The following EIS categories can be assigned to a river:

EIS Category	Description
Very High (VH)	A very high or high EIS indicates a strong ecological motivation for awarding a high level of protection to the associated river. Such rivers should be maintained in a natural or good river health category.
High (H)	
Moderate (M)	A moderate or low/marginal EIS is representative of a river with a relatively lower conservation value. Such river catchments are more impacted and thus more suited to development.
Low/Marginal (L)	



The outcome of the overall assessment is the ecological status (***ECOSTATUS***), which is an integrated index that indicates the ecological state of a river site or reach in a simple but ecologically-relevant way. The EcoStatus indicates the ability of a river to support an array of indigenous species and provide a variety of goods and services.

The ***PRESENT HEALTH*** of a river is a measure of the present ecological state of the river during the time of the surveys undertaken between 2001 and 2007, and is presented in terms of the ***RIVER HEALTH CATEGORIES*** for the indices described on page 4.

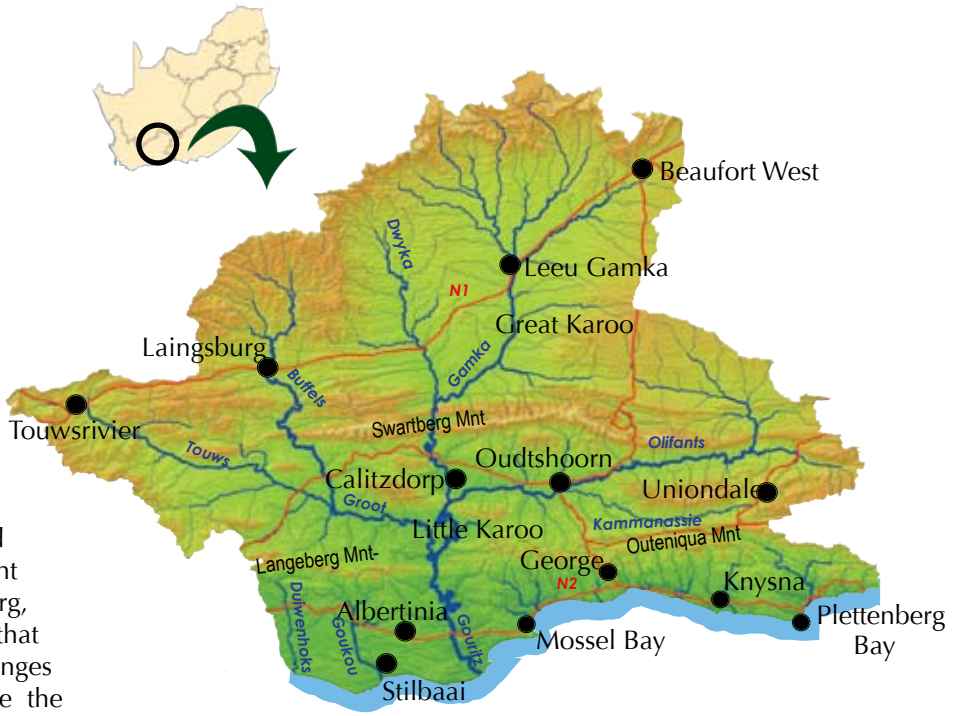
The ***DESIRED HEALTH*** of a river is the envisioned future ecological state of the river. It is based on ecological considerations, the need for sustainable development and management actions (e.g. rehabilitation) concerning the river environment. The desired state for each site has been determined based on the present ecological state, the EIS and the viability of improving the present state.

River Health Category	Ecological Perspective	Management Perspective
Natural N	No or negligible modification from natural	Relatively little human impact
Good G	Biodiversity and integrity largely intact	Some human-related disturbance but ecosystems essentially in good state
Fair F	Sensitive species may be lost; tolerant or opportunistic species dominate	Multiple disturbances associated with the need for socio-economic development
Poor P	Mostly tolerant species; alien invasion, disrupted population dynamics; organisms often diseased	High human densities or extensive resource exploitation

Gouritz WMA Overview

The Gouritz Water Management Area (WMA) is situated along the southern coast of South Africa and extends inland across the Little Karoo and into the Great Karoo. The area covers about 53 140 km^2 and includes the Gouritz River catchment, as well as the catchments of the smaller coastal rivers that lie to the east and west of the Gouritz River mouth. The WMA is divided into three sub-areas for the purpose of this report, viz. Goukou/Duiwenhoks, Gouritz and the Garden Route.

Much of the area consists of the Gouritz River catchment with its main tributaries, *viz*. Groot, Gamka and Olifants rivers and secondary tributaries, viz. Touws, Buffels and Kammanassie rivers. The shorter Duiwenhoks and Goukou rivers drain the coastal belt, west of the Gouritz River, while the Garden Route consists of several smaller rivers, including the Knysna and Keurbooms rivers. The catchments of the coastal belt also contain a number of important coastal lakes and wetlands.



The topography of the Gouritz WMA is characterised by flat open plains of the semi- arid Great Karoo, Little Karoo and a narrow coastal plain with its deeply incised river valleys. These three distinctly different zones are separated by the steep Swartberg, Langeberg and Outeniqua mountain ranges that lie parallel to the coast. These mountain ranges influence the climate in the region, where the northern and central portions that form part of the Great and Little Karoo are hot and dry, while the southern coastal strip has a more temperate climate with significantly higher rainfall.

The southern Cape rivers, with the exception of the Gouritz River, rise in the Tsitsikamma, Outeniqua or Langkloof mountains. The catchment areas are relatively small and are characterised by high gradient streams that have a rapid response to rainfall events. These coastal rivers are typically peat coloured and humic stained, originating from the indigenous forests and fynbos vegetation. The channel pattern of the rivers and their tributaries differs according to whether they flow across Table Mountain Sandstone or the more easily eroded Cretaceous mudstone.

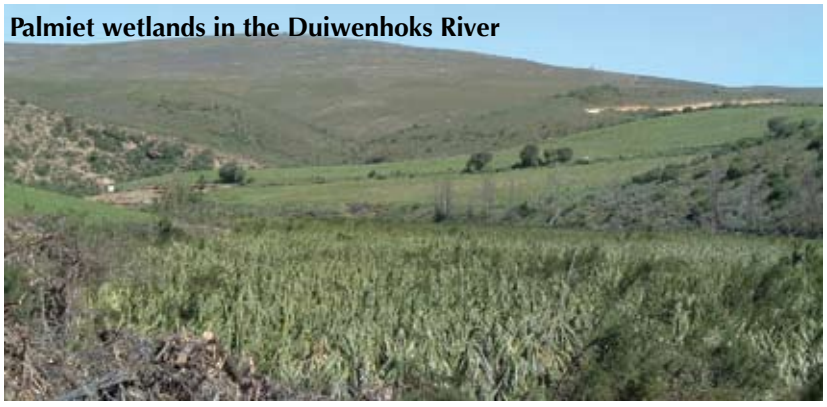
The Touws River

Water flowing from lowland rivers in the Little and Great Karoo (Bokkeveld Shales) brings higher salinity and pH water to the Gouritz River, while water from the mountains (Table Mountain Sandstone) has lower salinity and lower pH. As a result, the lower Gouritz River, which experiences a wide range of salinities and pH. Biota in these reaches are able to tolerate significant variation in water quality. The Gouritz River is therefore a more resilient system than many of the coastal rivers, which are less naturally variable.

Wetlands are associated with the mainstem and tributaries of the Gouritz River, as well as the Garden Route rivers. These wetlands support important aquatic invertebrates, vertebrates (frogs, fish, reptiles, birds and mammals) and aquatic vegetation. In addition, the wetlands form an integral part of river system functioning, and their loss would have a significant negative impact on the health of the rivers in the WMA (see p. 13).

The Wilderness Lake

Palmiet wetlands in the Duiwenhoks River



Importance of Aquatic Habitats for Biota

Rivers provide important habitat for biota. For example:

- ***Phragmites* patches stabilise banks and provide breeding grounds for some bird species;**
- **Rapids are fast flowing, oxygenate the river and provide habitat for many sensitive insect larvae;**
- **Sand banks are important for many invertebrates such as wasps and bees;**
- **Upper reaches of the river provide important habitat for many fish species, many of which are threatened endemics (Cape galaxias and redfin minnows, such as smallscale and slender redfin);**
- **Insect larvae of pollinators (horse flies) develop in stretches of river adjacent to the vegetation type that they pollinate; and**
- **Some frogs such as common platanna (*Xenopus laevis*) and Cape river frog (*Afrana fuscigula*) live in rivers, while most other frogs live in wetlands (in vleis, seasonal pans, foothills, or mountain tops).**

Catchment Characteristics

Ecological characteristics (e.g. climate, geology, vegetation) influence the distribution and diversity of fauna and flora. Areas of similar ecological characteristics are grouped in ecoregions. Rivers in the same ecoregion are ecologically more similar to one another than rivers in a different ecoregion.

Ecoregions

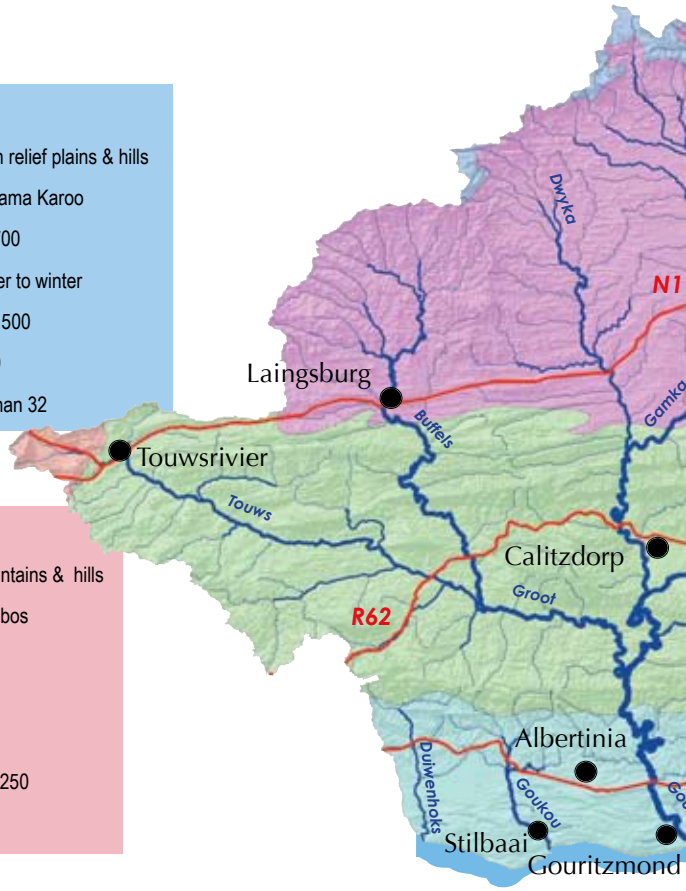
The six ecoregions in the Gouritz WMA are the South Eastern and South-Western Coastal Belts, the Southern and Western Folded Mountains, and the Nama and Great Karoo. The area has two primary climatic regions that display distinctly different characteristics: the large arid inland Karoo area drained by the Gouritz River, and a smaller humid strip of land along the coastal belt to the south of the Outeniqua Mountains, which is drained by several small rivers.

Nama Karoo

Landscape	Lowlands, Moderate/high relief plains & hills
Vegetation	Bushmanland Nama Karoo
Mean Altitude (m)	300 - 1700
Rainfall pattern	Very late summer to winter
Mean Annual Precipitation (mm)	less than 500
Mean Annual Runoff (mm)	5 - 60
Average Daily Temperature (°C)	0 to more than 32

Western Folded Mountains

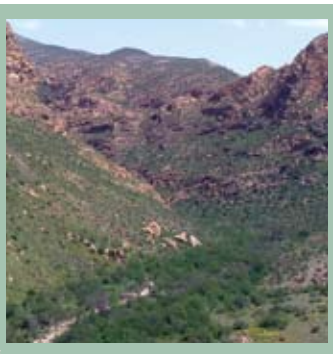
Landscape	Moderate/high relief mountains & hills
Vegetation	Sandstone Fynbos
Mean Altitude (m)	300 - 1700
Rainfall pattern	Winter
Mean Annual Precipitation (mm)	200 - 1500
Mean Annual Runoff (mm)	5 to more than 250
Average Daily Temperature (°C)	0 - 32



Management Area	Goukou/Duiwenhoks	Gouritz	Garden Route
Rivers/main tributaries	Goukou, Duiwenhoks	Gouritz, Groot, Gamka, Olifants, Touws, Buffels, Dwyka, Koekemoers, Leeuw, Kammanassie	Hartenbos, Klein Brak, Groot Brak, Maalgate, Gwaing, Kaaimans, Touw, Diep, Hoëkraal, Karatara, Goukamma, Knysna, Piesangs, Bietou, Keurbooms, Sout, Groot, Bloukrants
Catchment size (km^2)	2 978	45 702	4 459
Geology	Sandstones, shales and tillites of the Cape Supergroup	Karoo sediments and doleritic intrusions; sandstones, quartzite and conglomerates of the Malmesbury Group, overlain in the valley floors by alluvial deposits	Sandstones, shales and tillites of the Cape Supergroup, sandstones, quartzite and conglomerates of the Malmesbury Group
Vegetation	Temperate and Transitional Forest and Scrub, False Sclerophyllous Bush	Temperate and Transitional Forest and Scrub, Karoo and Karroid, False Karoo, Sclerophyllous and False Sclerophyllous Bush	Coastal Topical Forest, Sandstone and Low-land Fynbos, South Coast Renosterveld
Mean Annual Precipitation (mm)	498	262	745
Mean Annual Evaporation (mm)	1404	1985	1450
Mean Annual Runoff (million cubic metres)	212	695	771

Great Karoo

Landscape	Low, moderate and high relief
Vegetation	Central and Great Nama Karoo
Mean Altitude (m)	300 - 1700
Rainfall pattern	Very late summer to winter
Mean Annual Precipitation (mm)	less than 500
Mean Annual Runoff (mm)	5 - 40
Average Daily Temperature (°C)	10 to more than 32



Southern Folded Mountains

Landscape	Moderate/high relief mountains & hills
Vegetation	Sandstone Fynbos, Succulent Karoo
Mean Altitude (m)	300 - 1900
Rainfall pattern	Very late summer to winter, to all year
Mean Annual Precipitation (mm)	200 - 1500
Mean Annual Runoff (mm)	less than 5 to more than 250
Average Daily Temperature (°C)	10 - 32

South Eastern Coastal Belt

Landscape	Moderate/high relief hills & mountains
Vegetation	Afromontane Forest and Lowland Fynbos
Mean Altitude (m)	up to 500
Rainfall pattern	All year
Mean Annual Precipitation (mm)	300 - 1000
Mean Annual Runoff (mm)	more than 250
Average Daily Temperature (°C)	4 - 30

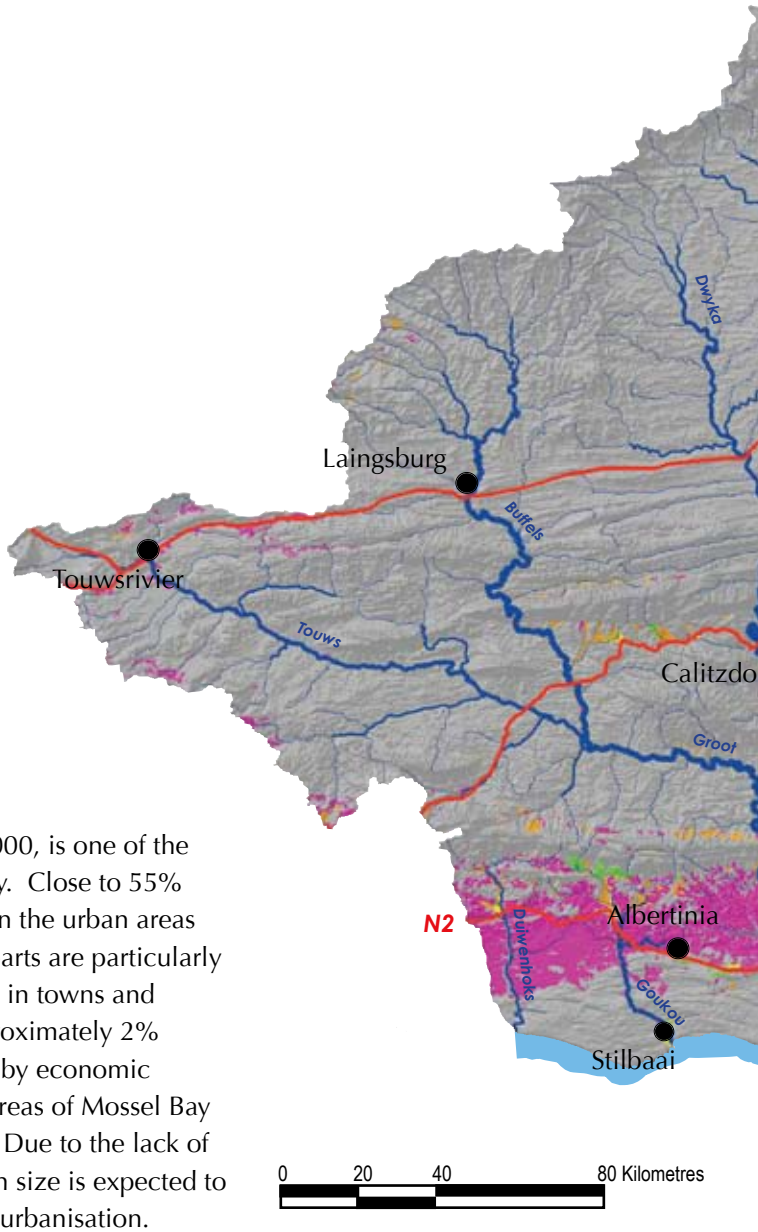
South Western Coastal Belt

Landscape	Moderate relief plains
Vegetation	South Coast Renosterveld, Sandplain Fynbos
Mean Altitude (m)	up to 300
Rainfall pattern	Summer and Winter
Mean Annual Precipitation (mm)	100 - 1000
Mean Annual Runoff (mm)	20 to more than 250
Average Daily Temperature (°C)	4 - 32

Land and Water Use

***Land-use** in the arid areas, consists of mainly sheep and ostrich farming. In the slightly wetter Little Karoo there is extensive irrigation of lucerne, grapes and deciduous fruits. The coastal belt land-use is dominated by forestry, dairy farming and tourism, as well as the petrochemical industry. This area also has numerous indigenous forests, wetlands, lakes and estuaries of high conservation status.*

***Water use** is mainly for agricultural and domestic water supply. Several dams are situated on the Gouritz River and its tributaries, as well as on the coastal rivers. Groundwater is also an important source of water for inhabitants of the area. The potential of utilizing deep groundwater from the Table Mountain Group aquifers is being investigated (see p. 17). A small quantity of water (0.7 million cubic metres per annum) is transferred from the Gouritz River to the Breede WMA for rural water supply.*

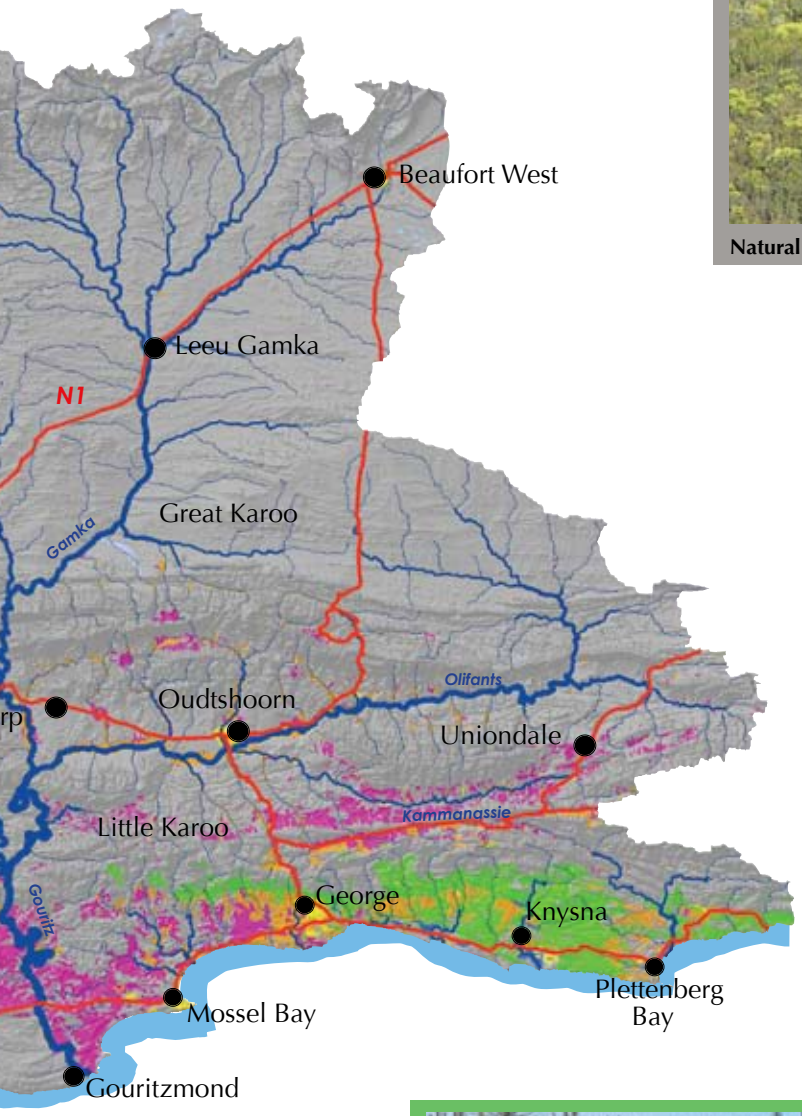


Population

The Gouritz WMA, with an estimated population of about 430 000, is one of the more sparsely populated water management areas in the country. Close to 55% (240 000 people) of the total WMA population is concentrated in the urban areas of the coastal strip from Mossel Bay eastwards. The arid inland parts are particularly sparsely populated, with almost 80% of that population residing in towns and villages. The average population growth rate for the area is approximately 2% per annum. Future population trends are likely to be influenced by economic opportunities and job creation, particularly in the larger urban areas of Mossel Bay and George, and to a lesser extent, Knysna and Plettenberg Bay. Due to the lack of economic stimulant in the Great and Little Karoo, the population size is expected to either remain the same or decline, with a general trend towards urbanisation.

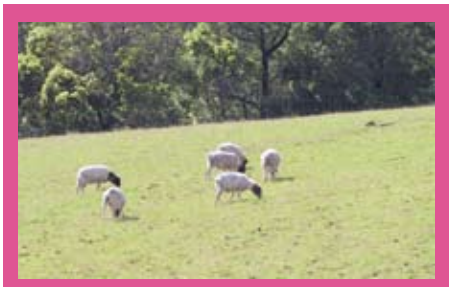
Economy

Economic activities in the Gouritz WMA contribute less than 1% of the gross domestic product of South Africa, with the largest contributions originating from the George and Oudtshoorn areas. Activities include agriculture (fruit, vegetables, grains, dairy, tobacco, sheep, cattle, ostriches, goats and hops), forestry (pine), trade and manufacturing (timber, transport, natural gas refinery and tourism), financial (property) and a wide variety of government, social and financial services. A total labour force of 190 000 was employed in 1994, primarily in the formal economy in government service, agriculture and construction, while 15% were unemployed. A strong potential for growth, related to tourism, eco-tourism and possible further petrochemical developments based on offshore gas-field exploration, exists in the coastal area and is dependant on limited water supplies and the efficient use thereof.



Natural vegetation (90%)

Urban areas (1%)



Dryland crops (5%)

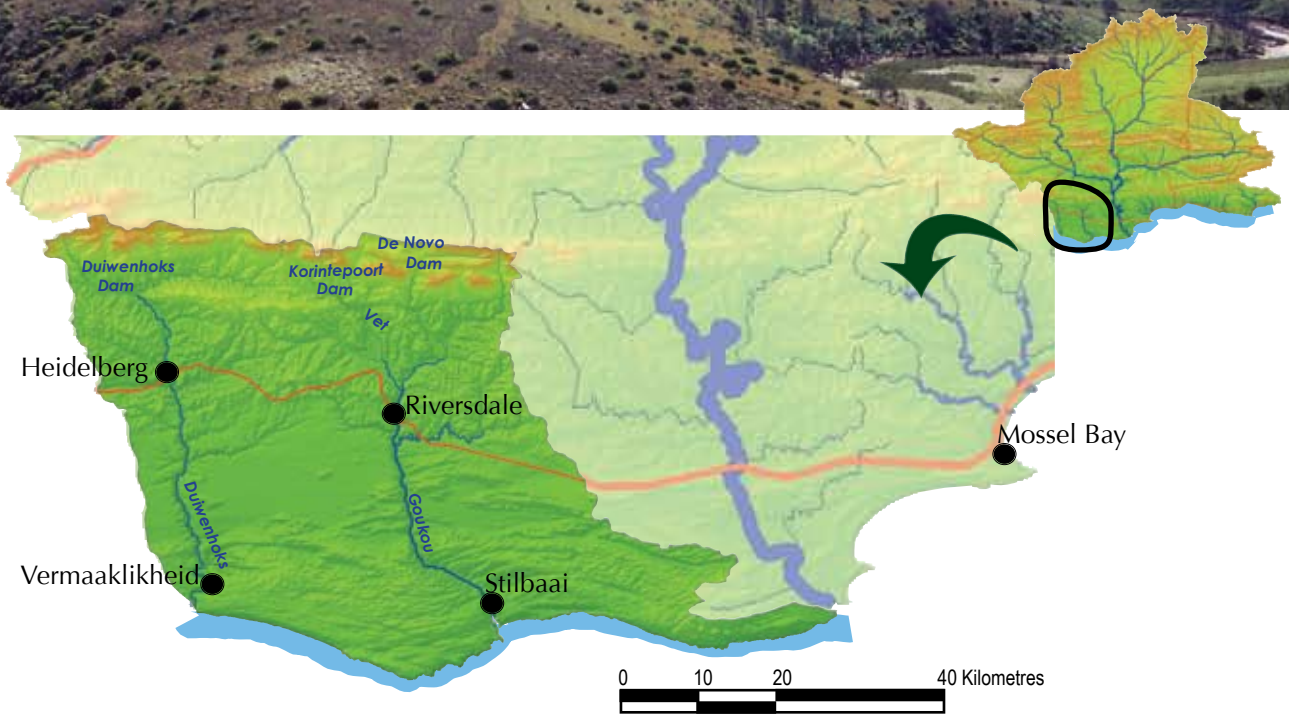
Irrigated crops and pastures (2%)

Forest plantations and indigenous forests (2%)

Management Area	Goukou/Duiwenhoks	Gouritz	Garden Route
Main land-use	Irrigated agriculture (lucerne and pasture)	Irrigated agriculture (lucerne and pasture), livestock (ostriches and sheep)	Irrigated agriculture, afforestation (pine), urban
Population (1995)	28 300	165 795	230 069
Adequate* water supply (%)	99	99	99
Adequate* water sanitation (%)	81	88	93

* According to Reconstruction and Development Programme standards

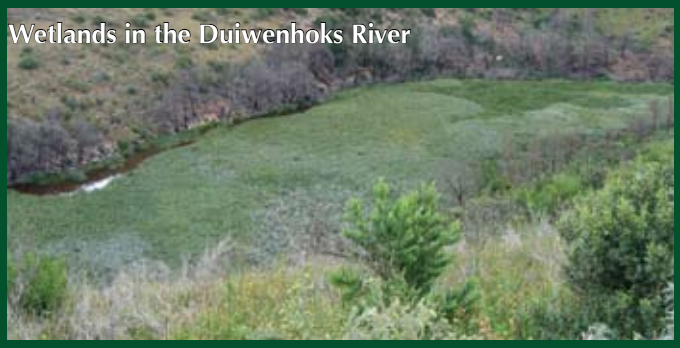
Goukou & Duiwenhoks Rivers



The Goukou and Duiwenhoks rivers drain the Langeberg Mountains and flow south to the coast, and enter the sea west of Mossel Bay in the southern Cape. Natural land-cover consists of mostly Renosterveld shrubland and grassland. The catchments also contain a number of waterbodies and wetlands. Land-use within the catchments comprises mostly dryland and irrigated agriculture and commercial forestry. Urban development is small and comprises mainly residential and industrial developments associated with the coastal settlement of Stilbaai and the inland towns of Riversdale and Heidelberg. The extent of alien plant infestation is significant (covering an area of about 530 km^2) and is estimated to reduce runoff by 43 million cubic metres (20% of natural MAR).

Management Area	Duiwenhoks	Goukou
Main land-use	Dryland and irrigated agriculture (vineyards, lucerne and pasture)	Dryland and irrigated agriculture (vineyards, fruit, vegetables, lucerne and pasture), livestock (sheep), commercial forestry (pine)
Main towns	Heidelberg, Vermaaklikheid	Riversdale, Stilbaai
Population (1995)	9 415 (74% in urban areas)	18 886 (70% in urban areas)
Major dams (capacity in million cubic metres)	Duiwenhoks (6.4)	Korintepoort (8.3), De Novo (0.1)
Total dam capacity (including farm dams in million cubic metres)	7.2 (6.8% of MAR)	8.5 (8% of MAR)

Wetlands

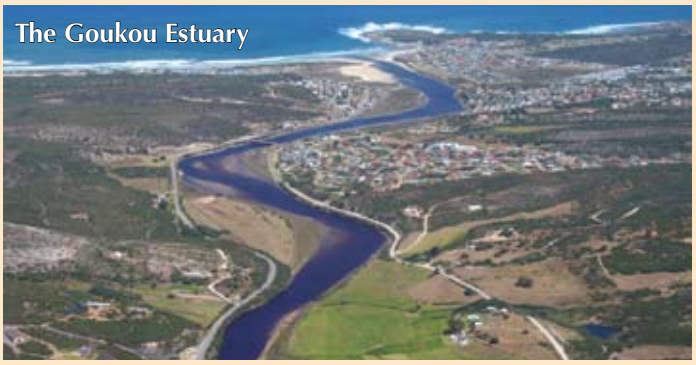

Wetlands in the Duiwenhoks River

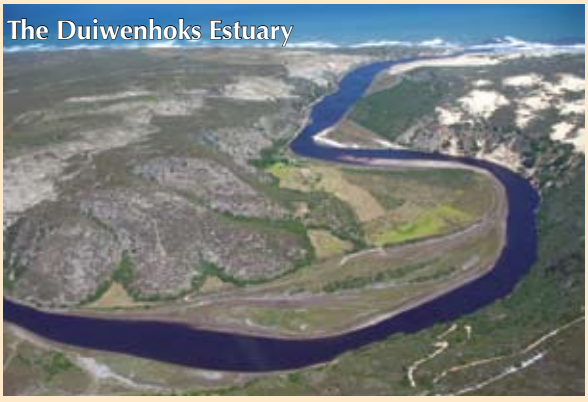
The Goukou and Duiwenhoks catchments are home to several important peat wetland systems that are characteristic of the Langeberg area. Most of the wetlands are dominated by the sedge, palmiet, which form an integral part of the entire river system. Palmiet is important for erosion control, water quality enhancement (sediment trapping), flood attenuation, improved water security for downstream users, biodiversity conservation and carbon sequestration.

These wetlands have been modified by agricultural encroachment, roads, flood-control structures (dykes and drainage ditches) within the wetlands and invasion by alien plants (black wattle). As a result of these modifications, severe floods in 2004 and 2006 caused serious damage to the wetlands, as well as to the rivers below the wetlands.

Goukou and Duiwenhoks Estuaries

The Goukou Estuary covers approximately 108 ha, is 19 km in length, and is embedded in a deep valley. The estuary mouth is permanently open, with a constricted tidal inlet. A large beach lies behind a sandspit on the eastern bank. The sandspit and adjacent beach have been stabilised with port jackson (Acacia saligna) and recreational development. The estuary is ranked 32nd out of 247 South African estuaries, in terms of its conservation importance. Land-use adjacent to the estuary is mostly for holiday accommodation and the estuary is primarily utilised for recreation.


The Goukou Estuary


The Duiwenhoks Estuary

The Duiwenhoks Estuary is also permanently open to the sea, with a constricted tidal inlet and is embedded within a deep valley. The estuary is slightly smaller than the Goukou Estuary, with 72 ha of open water and a tidal reach of 14 km. The tidal basin is dominated by an intertidal sandbank. The estuary is ranked 33rd in terms of its conservation importance. Development next to the estuary is limited, with some farming and holiday accommodation.

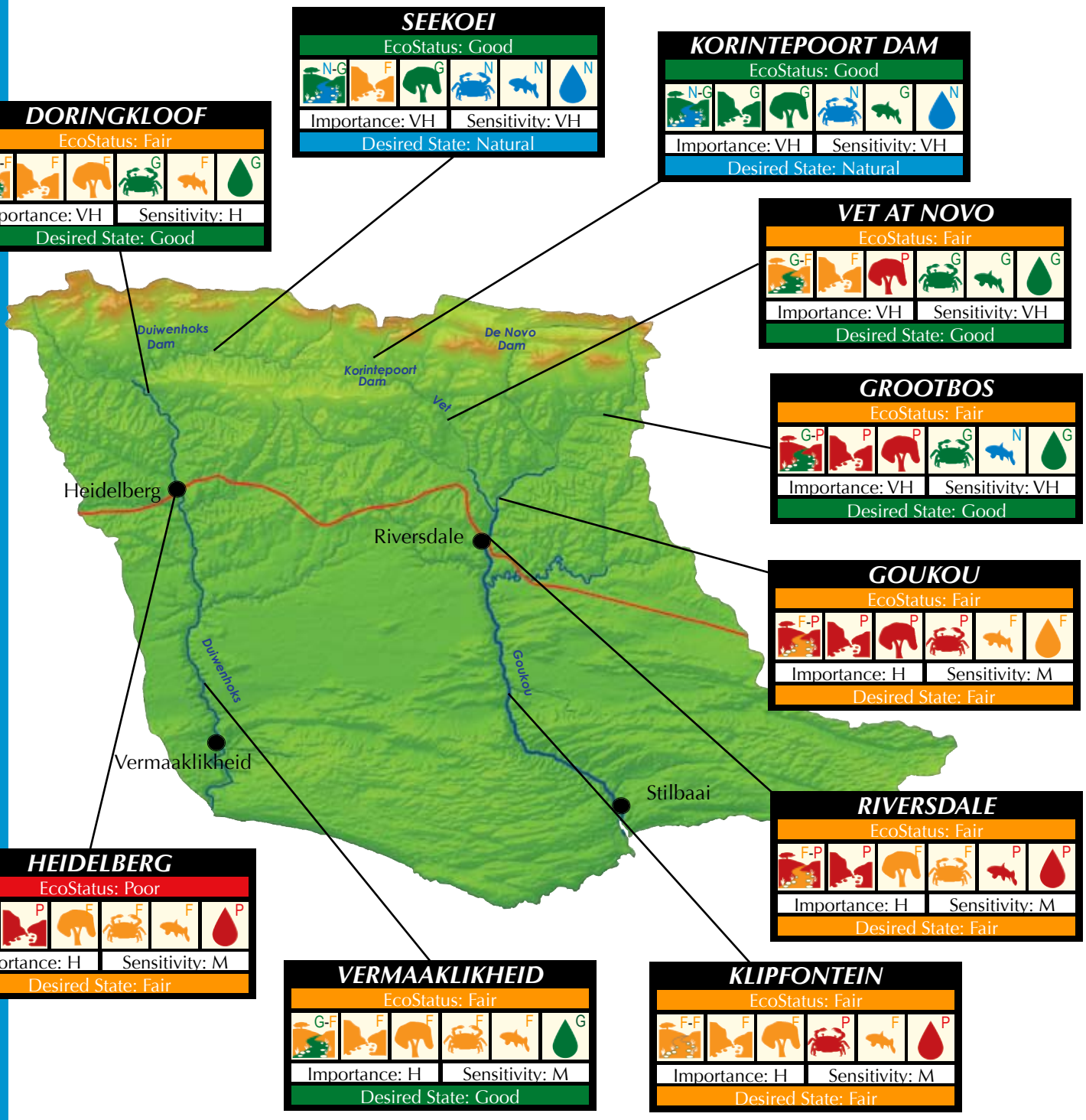
Threats to the health of these estuaries include reduced freshwater inflows in the summer, poor water quality during the peak holiday season, as result of under-capacitated wastewater treatment works' and recreational activities, which disturb habitats and cause bank erosion.

Management Actions

- **Determine the Ecological Reserve for the Goukou and Duiwenhoks estuaries and consider the impact on the Reserve before any further surface water abstractions are approved for these rivers**
- **Upgrade, manage and maintain wastewater treatment works**

Goukou & Duiwenhoks Rivers: Present State

In general, the ecological condition of the Goukou and Duiwenhoks rivers deteriorate rapidly from source to sea, where the main impacts on river health are reduced flows and inadequately treated wastewater. In the Duiwenhoks River, the upper to middle reaches are stressed mostly due to wetland degradation, while the lower reaches have reduced flows during summer. In contrast, the upper reaches of the Goukou River are in a good condition and boast intact wetlands. The middle reaches, however, are heavily infested with black wattle and water hyacinth, while the lower reaches have reduced low flows.



Major Impacts & Management Actions

Flow modification through over-abstraction threatens the ecological functioning of the rivers. Extensive water abstraction and many off-stream dams for irrigated agriculture have had a cumulative effect on flow, particularly in summer when the rivers almost cease to flow. In addition, two major dams (Duiwenhoks River and Korintepoort) prevent smaller floods from reaching the estuary. Black wattle infestation also reduces flow and water availability.

Poor ***agricultural practices*** (draining of wetlands) have impacted on wetlands, reducing their ability to act as sponges, attenuating floods and ensuring perennial flows. As a result, rivers remain dry for longer periods and flood damage is more extensive.

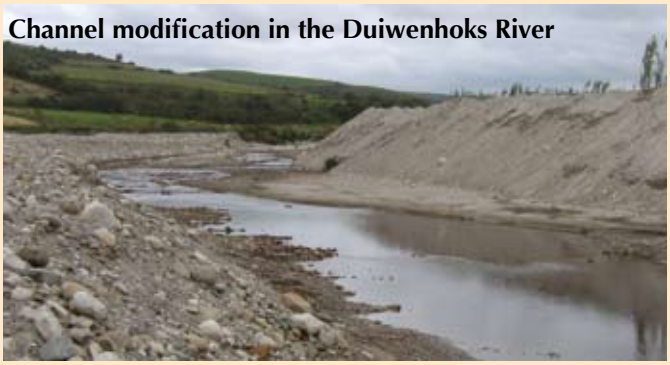
Agricultural activities within the riparian zone

The riparian zones in the middle and lower reaches of the Goukou and Duiwenhoks rivers, tributaries and wetlands are highly impacted by ***invasive alien plants*** (black wattle). This reduces the ability of these zones to act as buffers, reduces habitat availability for aquatic biota and causes deep incising of river channels.

Invasive alien fish in the middle and lower Goukou (largemouth bass, bluegill sunfish) and Duiwenhoks (banded tilapia, mosquitofish) rivers have reduced populations of indigenous Cape kurper, Cape galaxias and Burchell's redfin minnow.

Management Actions

- **Control water abstraction**
- **Encourage efficient water use throughout the catchment**
- **Discourage developments within wetlands**
- **Investigate the possibility of releasing environmental flows from the Korintepoort and Duiwenhoks River dams**
- **Remove alien vegetation from the riparian zone and wetland areas, and rehabilitate cleared areas with indigenous plants**
- **Eradicate alien fish from rivers, where possible**
- **Stock farm dams with indigenous fish**
- **Discourage bulldozing and riverbed modifications**



Channel modification in the Duiwenhoks River

Water quality in sections of the Goukou and Duiwenhoks rivers is comprised as a result of ***non-point source pollution*** from agricultural activities. Irrigation return flows, which contain fertilisers and pesticides, and run-off from feed-lots, which is high in nutrients, impairs water quality. Other less widespread impacts on water quality include run-off from roads and urban areas, including informal settlements and occasional malfunctioning of wastewater treatment plants.

Management Actions

- **Rehabilitate riparian zones to recreate a buffer between farmed areas and the river channel**
- **Collect run-off from feedlots in retention ponds and irrigate where appropriate**
- **Rehabilitate the extensive palmiet wetlands**
- **Monitor and manage stormwater and wastewater**
- **Encourage community awareness and river clean-up initiatives (e.g. Adopt-a-River initiative)**

Gouritz River

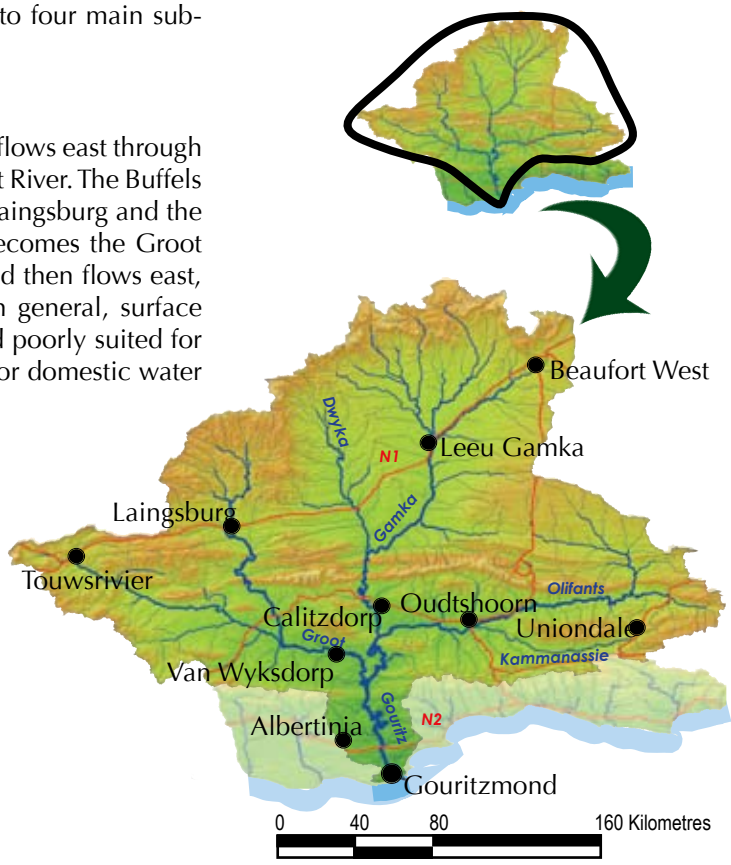
The Gouritz River drains an area of 45 702 km^2 and has a river length of 267 km, from its source in the Greater Karoo to Gouritzmond, where it enters the Indian Ocean. Due to the size of the catchment, it has been divided into four main sub-catchments:

Groot River

The Touws River tributary rises in the Matroosberg Mountains and flows east through Touwsrivier and south into the Little Karoo, where it joins the Groot River. The Buffels River tributary rises in the Great Karoo and flows south through Laingsburg and the Klein Swartberg Mountains into the Little Karoo. It eventually becomes the Groot River about 50 km before its confluence with the Touws River, and then flows east, past Van Wyksdorp, to its confluence with the Gouritz River. In general, surface water quality in this sub-area is naturally saline and is considered poorly suited for use. Groundwater is used extensively for livestock watering and for domestic water supply.

Gamka River

The main tributaries of the Gamka River, *viz*. Dwyka, Koekemoers and Leeuw, rise in the Great Karoo, converge and flow southwards through the Swartberg Mountains. The Olifants River joins the Gamka River south of Calitzdorp. Together these become the Gouritz River. The limited supply and naturally saline nature of surface waters, means that there is a strong reliance on groundwater for domestic and agricultural supply in this area.



Olifants River

The northern tributaries of the Olifants River rise in the Great Karoo to the north of the Swartberg Mountains, while the Olifants River itself rises to the east and flows westwards between the Swartberg and Kammanassie mountains to its confluence with the Gamka River. The southern slopes of the Swartberg Mountains are drained by the perennial Groot, Kango, Grobbelaars, Wynands, Kansa and Vlei tributaries, which flow into the Olifants River. The Kammanassie River rises in the Outeniqua and Kammanassie mountains near Uniondale and joins the Olifants River upstream of Oudshoorn. These tributaries contribute water of low salinity to the Olifants River.

Gouritz River

The Gouritz River flows from the confluence of the Gamka and Olifants rivers and is joined by the Groot River, before flowing through the Langeberg Mountains and coastal plain. It eventually drains into the sea near Gouritzmond.

Management Area	Groot	Gamka	Olifants	Gouritz
Main land-use	Dryland and irrigated agriculture (lucerne, fruit and vineyards), livestock (sheep), conservation areas	Irrigated agriculture (lucerne, pasture, fruit and vineyards), livestock (ostriches and sheep), conservation areas	Dryland and irrigated agriculture (lucerne and pasture), livestock (ostriches and sheep), conservation areas	Dryland and irrigated agriculture (lucerne and pasture), livestock (cattle and sheep)
Main towns	Touwsrivier, Laingsburg, Matjiesfontein, Ladismith, Van Wyksdorp	Beaufort West, Merweville, Leeu-Gamka, Prince Albert Road, Prince Albert, Calitzdorp	Oudtshoorn, Uniondale, De Rust, Dysselsdorp, Klaarstroom	Herbertsdale, Albertinia, Gouritzmond
Population (1995)	21 463 (61% in urban areas)	48 351 (80% in urban areas)	88 533 (77% in urban areas)	7 448 (49% in urban areas)
Major dams (capacity in million cubic metres)	Floriskraal (50.3), Verkeerdevlei (5.5), Bellair (10.1), Miertjieskraal	Doornfontein (4.4), Gamka (1.8), Springfontein, Leeu-Gamka (14.3), Gamkapoort (44.2), Oukloof (4.2), Calitzdorp (4.8), Tierkloof (0.05)	Stompdrift (55.3), Kammanassie (35.8), Koos Raubenheimer (9.2), Melville (0.4)	-
Total dam capacity (million cubic metres)	82.4 (78% of MAR)	80.4 (35% of MAR)	112 (49% of MAR)	0.3 (0.2% of MAR)

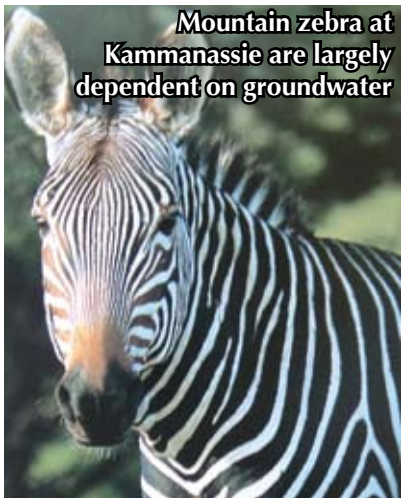
Deep Artesian Groundwater

The geology of the Great and Little Karoo consists of predominantly Table Mountain Group (TMG) sandstone/quartzite and Bokkeveld Group shale and sandstone. These rocks are folded, faulted and overlain by Enon Formation conglomerate. The TMG forms the higher mountains (Swartberg, Kammanassie and Rooiberg mountains) and the Bokkeveld Group and Enon Formation forms the lower areas and hills in the Olifants and Gamka river valleys. Groundwater is abstracted from fractured rock aquifers located in the TMG, which has high yields and good water quality.

The Klein Karoo Rural Water Supply Scheme (KKRWSS) is a large groundwater supply scheme in South Africa that abstracts approximately 1 million cubic metres of water per annum from the TMG aquifer, and has been accused of reducing spring flows, and low flows in rivers downstream. Consequently, the Water Research Commission initiated an innovative study to investigate the effects of large-scale groundwater abstraction of the scheme on the environment. The results indicated that the Kammanassie Mountain groundwater abstraction by the KKRWSS has impacted on the low-flows discharging from the Vermaaks River, and possibly the baseflow in the Huis River. However, the reduction in yield of springs in the area can likely be attributed to the combined effect of declining rain and snowfall, with increased abstraction.

Another study, the Deep Artesian Groundwater Exploration for Oudtshoorn Supply, has been initiated to evaluate the Sustainable Utilisable Potential of the TMG. The purpose of the study is to evaluate the regional flow regime, storage capacity, recharge and discharge patterns of the Peninsula and Skurweberg (Nardouw) aquifers between the Outeniqua and Swartberg ranges in the Olifants River valley.

The Kammanassie Mountains



Mountain zebra at Kammanassie are largely dependent on groundwater

Gouritz Estuary

The Gouritz Estuary is permanently open to the sea, is marine-dominated and extends for about 8 km to the causeway at "Die Eiland". The estuary is at the receiving end of all the activities that take place in the catchment (water abstraction, siltation and infestation by alien plants). Degradation of the physical habitat of the estuary also poses a threat. Activities that degrade the habitat include coastal developments, off-road driving, boat-landing and trampling on salt marshes, livestock grazing and a weir that obstructs river flow to the estuary. These activities damage the salt marshes, destroy riparian vegetation, cause severe bank collapse and erosion, and impact on flow dynamics. The Gouritz Estuary is ranked 50th out of 247 South African estuaries, in terms of its conservation importance.

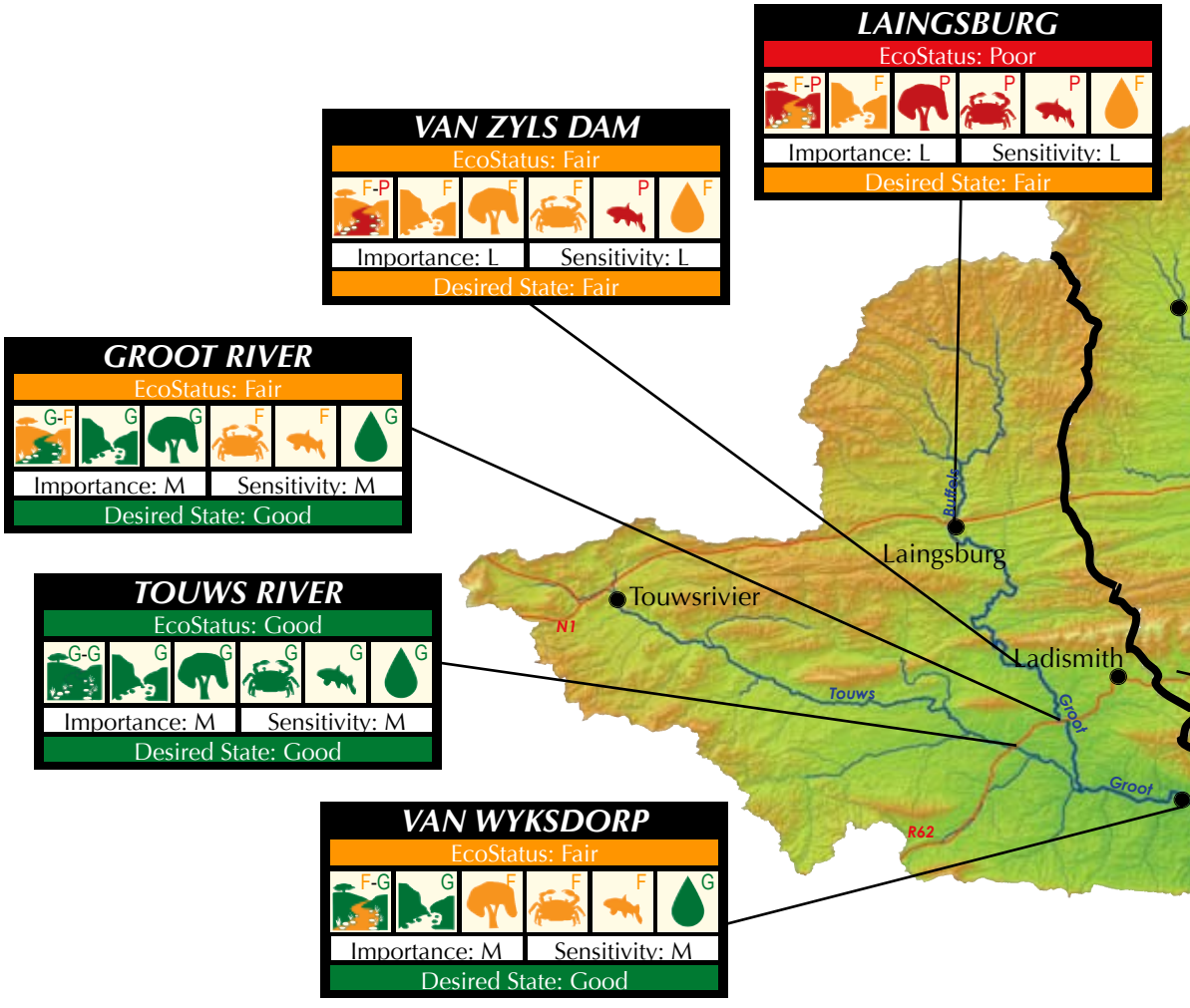
The Gouritz Estuary

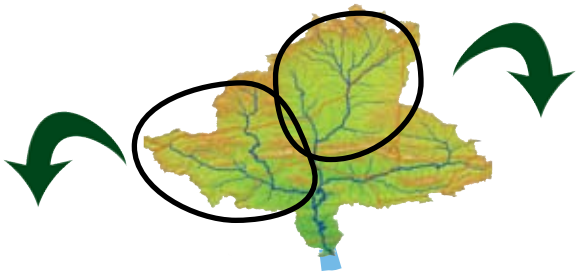
Management Actions

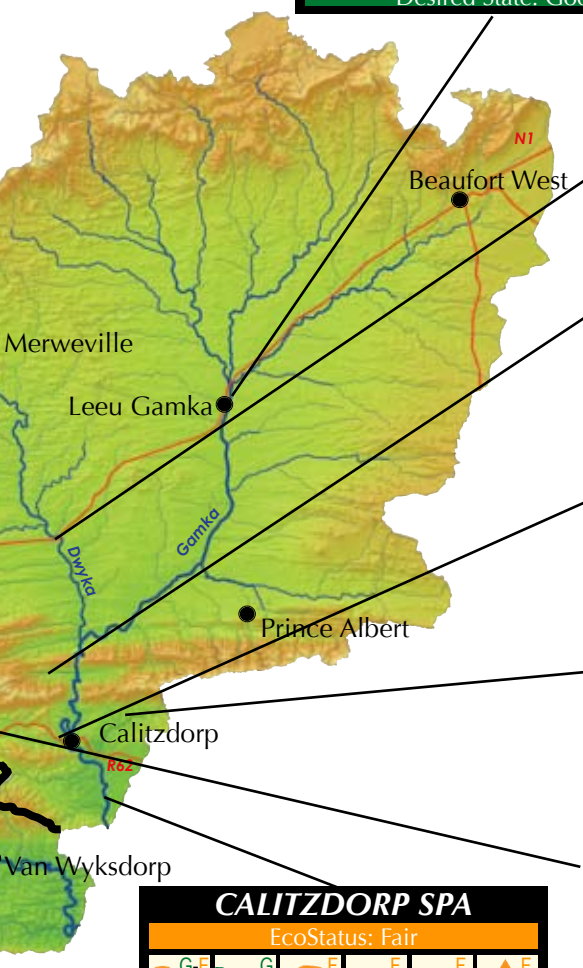
- **Determine and implement the environmental water requirements for the Gouritz Estuary before any further major surface water abstractions are approved for the river**

Touws, Buffels, Groot and Gamka Tributaries of the Gouritz River: Present State

In general, these rivers are relatively unimpacted and in a good ecological state. Localised impacts near the major towns (Laingsburg, Calitzdorp and Van Wyksdorp) have reduced the ecological integrity of some river reaches. These include illegal bulldozing, straightening of rivers, construction of levees and weirs, which causes sedimentation and reduced water flow. General water use authorisations in these rivers have a cumulative impact on river flow. In some rivers, such as the Groot River, banded tilapia and bass compete and predate on indigenous fish, threatening their existence. See pages 22 and 23.







LEEU GAMKA
EcoStatus: Fair
G-F | F | P | G | F | G
Importance: M | Sensitivity: L
Desired State: Good

DWYKA
EcoStatus: Good
G-G | G | G | G | G | G
Importance: H | Sensitivity: M
Desired State: Good

GAMKASKLOOF
EcoStatus: Good
N-G | G | G | G | G | N
Importance: H | Sensitivity: VH
Desired State: Natural

HUIS RIVER
EcoStatus: Fair
F-G | G | F | G | G | G
Importance: M | Sensitivity: M
Desired State: Good

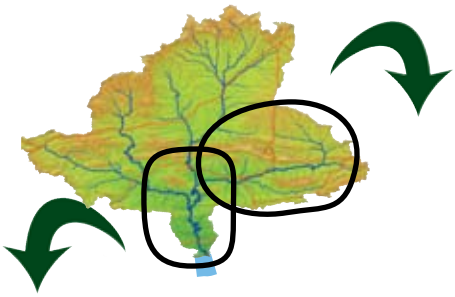
NELS RIVER
EcoStatus: Fair
G-F | G | P | G | G | G
Importance: M | Sensitivity: M
Desired State: Good

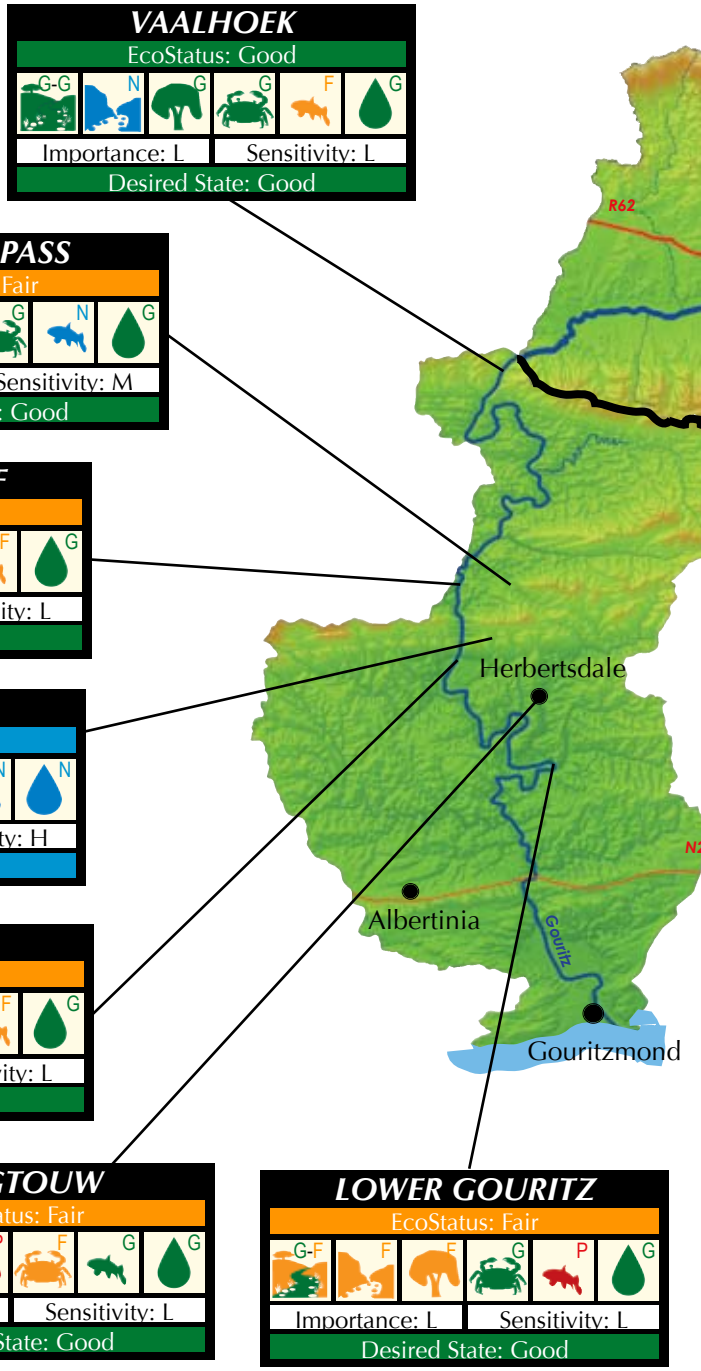
SEWEWEEKSPOORT
EcoStatus: Good
N-G | G | G | G | N | G
Importance: H | Sensitivity: H
Desired State: Natural

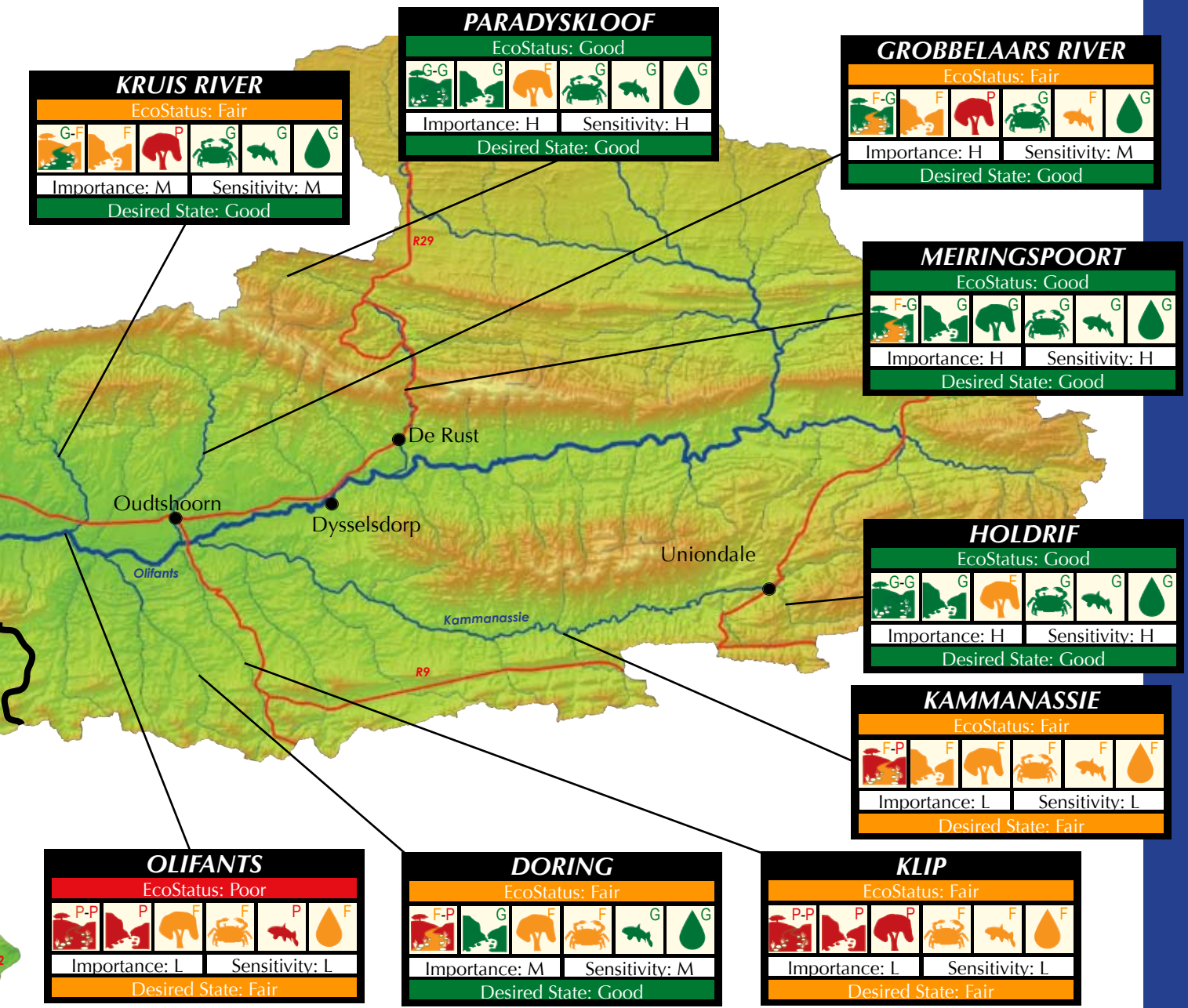
CALITZDORP SPA
EcoStatus: Fair
G-F | G | F | F | F | F
Importance: M | Sensitivity: M
Desired State: Fair

Olifants Tributary and Lower Gouritz River: Present State

Most rivers assessed in this area are in a good to fair ecological state. Impacts include flow modification in the lower Kammanassie and Olifants rivers, and reduced water quality near major towns. Agricultural activities have further reduced habitat integrity and water quality (eutrophication and salinisation). These cumulative effects have reduced the goods and services provided by the rivers and associated floodplains. See pages 22 and 23.



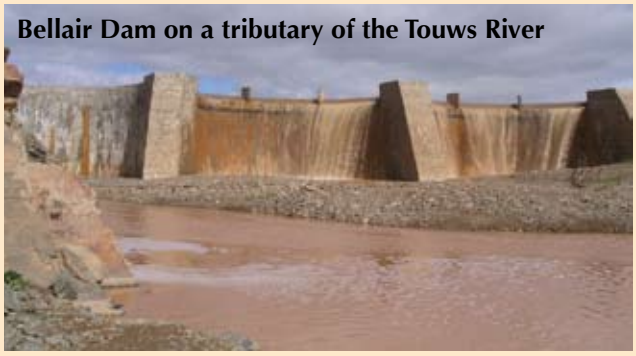



PARADYSKLOOF
EcoStatus: Good
G-G G G F G G G
Importance: H
Sensitivity: H
Desired State: Good
KRUIS RIVER
EcoStatus: Fair
G-F F P G G G
Importance: M
Sensitivity: M
Desired State: Good
GROBBELAARS RIVER
EcoStatus: Fair
F-G F P G F G
Importance: H
Sensitivity: M
Desired State: Good
MEIRINGSPOORT
EcoStatus: Good
F-G G G G G G
Importance: H
Sensitivity: H
Desired State: Good
HOLDRIF
EcoStatus: Good
G-G G F G G G
Importance: H
Sensitivity: H
Desired State: Good
KAMMANASSIE
EcoStatus: Fair
F-P F F F F F
Importance: L
Sensitivity: L
Desired State: Fair
OLIFANTS
EcoStatus: Poor
P-P P F F P F
Importance: L
Sensitivity: L
Desired State: Fair
DORING
EcoStatus: Fair
F-P G F F G G
Importance: M
Sensitivity: M
Desired State: Good
KLIP
EcoStatus: Fair
P-P P P F F F
Importance: L
Sensitivity: L
Desired State: Fair
R29
R9
De Rust
Oudtshoorn
Dysselsdorp
Uniondale
Olifants
Kammanassie

Major Impacts & Management Actions

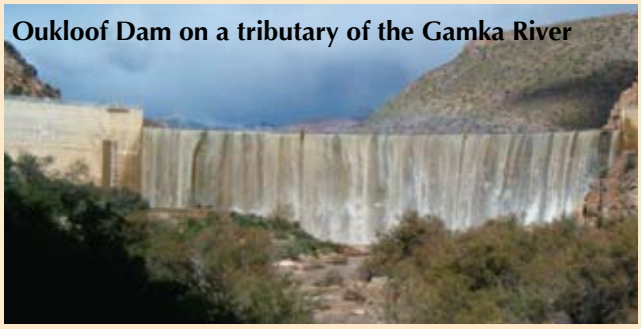
Agricultural practices impacts on biodiversity and sustainable water resource use in the Gouritz catchment. Most of the Little Karoo is subjected to overgrazing by small stock and ostriches. The area near Oudtshoorn and Calitzdorp has many ostrich camps, where the original vegetation has been destroyed. Similarly, the recent introduction of large numbers of ostriches north of the Swartberg Mountains has resulted in irreversible impacts to the landscape. Many of these impacts arise from soil compaction as a result of trampling, which destroys the vegetation and reduces water infiltration. This means that, when it rains, water flows off the camps rapidly, often forming channels, which erode the topsoil and increase the silt loads and peak flood volumes in the rivers. Regrowth of vegetation is slow, and even once farms are abandoned, the knock-on impacts on rivers continue.

Ostrich feedlots near Oudtshoorn



Bellair Dam on a tributary of the Touws River

Low rainfall, particularly in the northern parts of the catchment, means that ***water abstraction*** has taken place mostly in perennial rivers that drain the Swartberg Mountains. The naturally saline water in these rivers during low flows is poorly suited for most uses, and water abstraction has tended to target the flood waters. This has resulted in a proliferation of large in-channel dams (often with a storage capacity exceeding the annual runoff of the river), which store flood flows. Low flows and floods, which are vital for maintaining the downstream river ecosystems, are reduced.



Oukloof Dam on a tributary of the Gamka River

As groundwater is an important water source to the area, the Klein Karoo Rural Water Supply Scheme abstracts groundwater from the TMG aquifers (see p. 17) to supply the Dysselsdorp/ Calitzdorp area. Plans are to extend this to the Klein and Groot Swartberg, by abstracting deep aquifer water for socio-economic development. When considering future groundwater use, an understanding of the link between groundwater and surface water is extremely important.

Agricultural practices and alien vegetation have ***modified the bed and banks*** of many of the rivers in the Gouritz catchment, resulting in ***flow modification*** in these rivers. Rivers that were previously slow-flowing are now often faster flowing. Flows are altered by land-use change, which leads to soil erosion, donga formation and increased siltation of the rivers. Alien vegetation in and along rivers also alters river flow and channels. A large number of low water bridges, weirs, instream dams and some channelisation have further reduced the health of these rivers. Braided river systems, with extensive flood plains, are forced into single channels, resulting in increased flow rates and flood damage.

Diversion weir in the Grobbelaars River


Fluitjiesriet in the Olifants River

Nutrient enrichment from agricultural practices has impaired water quality in many rivers, resulting in prolific growth of fluitjiesriet (*Phragmites australis*) and algae. Nutrient sources include wastewater discharges (industrial or sewage) and agricultural runoff (livestock feedlots or fertiliser use). Prolific growth of aquatic and riparian plants reduces habitat integrity and provision of goods and services.

Reduced flow and agricultural runoff result in elevated salinities in many tributaries of the Gouritz River, particularly the Olifants River. Litter and solid waste dumping within the riparian zones also reduces water quality and habitat integrity.

The broad distribution of ***invasive alien plants*** pose various threats to rivers (blocking of rivers, reducing biodiversity, fire threat, invasion of floodplains, shading of watercourses, toxicity and water use). Invasive alien plants such as pines and *Hakea spp*. were cleared during the late 1980's and early 1990's in the Swartberg Mountains, but regrowth of dense stands of *Hakea* and pines reduce water and displace indigenous fynbos.

Oleander (*Nerium oleander*) is prevalent to floodplains and perennial water streams, and is extremely expensive and difficult to eradicate. Other invasive alien plants within the riparian zone include pepper trees (*Schinus molle*) and Spanish reed (*Arundo donax)*. Black wattle (*Acacia mearnsii*) occurs along many tributaries of the Gouritz River and is extensive in coastal areas, particularly downstream of dams and roads where building sand is often a seed source. Invasive alien plants alter flood patterns, block the river, cause incised channels and divert floodwater to surrounding land (see p. 40).


Oleander

Invasive alien fish pose a major threat to indigenous fish and to river functioning. Problem species include bass, carp, bluegill sunfish, tilapia, small-mouth yellowfish and trout. They have caused localised extinctions of indigenous fish populations, many of which are endemic to the area. Healthy numbers of indigenous fish now survive only in refuge reaches of rivers that are beyond the reach of alien fish (see p. 41).

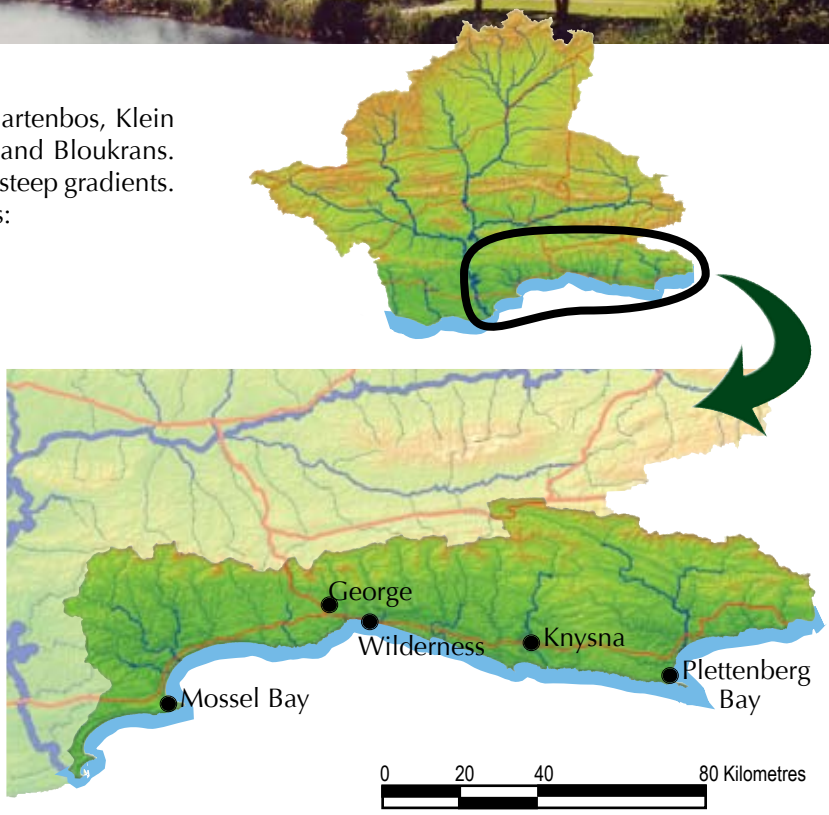

Bluegill sunfish

Management Actions

- **Determine the environmental water requirements below large instream dams and release flows from existing dams to meet the requirements. Reinstate floodflows in the braided river channels on the floodplain**
- **Determine the potential impact of deep water aquifer abstraction on groundwater dependent ecosystems**
- **Discourage groundwater abstraction in close proximity to rivers, particularly in areas where groundwater contribution to surface water is high**
- **Establish and implement environmentally-friendly buffer areas for riparian zones**
- **Rehabilitate riparian zones in order to reduce the high silt loads into the river systems**
- **Encourage improved farming practices to reduce water quality problems**
- **Establish erosion control programmes in the Great Karoo**
- **Develop a systematic alien vegetation clearing programme for the entire catchment**
- **Encourage efficient water use throughout the catchment**
- **Control litter and dumping of solid waste near the Olifants River**
- **Stock dams with indigenous fish in consultation with CapeNature**

Garden Route Rivers

The main rivers in of the Garden Route include the Hartenbos, Klein Brak, Groot Brak, Knysna, Bietou, Keurbooms, Groot and Bloukrans. These rivers are characterised by being short, with fairly steep gradients. They have been divided into the following three groups:



Mossel Bay to George

The Hartenbos River rises in the coastal plain near Mossel Bay and flows into the Indian Ocean at Hartenbos. The Klein Brak, Groot Brak, Maalgate and Gwaing rivers rise in the Outeniqua Mountains east of George. These rivers flow across the narrow coastal plain to the sea at the resort towns of Klein-Brakrivier, Groot-Brakrivier and Herolds Bay, respectively. The Kaaimans River rises in the Outeniqua Mountains at George and enters the sea to the west of Wilderness.

Wilderness Rivers

The river ecosystems around Wilderness are characterised by the important coastal lake systems of Wilderness, Groenvlei and Swartvlei. The Touw River flows into the Wilderness Estuary, while the Serpentine River connects the estuary to Eilandvlei. Groenvlei receives water via run-off and seepage from surrounding dunes (see p. 33). The Diep, Hoëkraal and Karatara rivers drain into Swartvlei Lake, which enters the sea close to the town of Sedgefield. The Goukamma River enters the sea near the holiday resort town of Buffelsbaai, west of Knysna.

Knysna to Bloukrans

There are several main rivers in this area. The Knysna and Piesang rivers drain into the Knysna Estuary and Plettenberg Bay, respectively, while the Bietou and Keurbooms rivers flow into the bay via the Keurbooms Estuary. Other rivers such as the Sout and Groot rivers enter the sea near Nature's Valley, while the Bloukrans River enters the sea in the Tsitsikamma National Park.

Management Area	Mossel Bay - George	Wilderness	Knysna - Bloukrans
Main land-use	Natural forests and conservation areas, afforestation (pine), dryland and irrigated agriculture (lucerne and pasture), urban, livestock (sheep)	Natural forests and conservation areas, afforestation (pine), irrigated agriculture (lucerne and pasture), urban	Natural forests and conservation areas, afforestation (pine), irrigated agriculture, urban, livestock (sheep)
Main towns	Mossel Bay, Hartenbos, George	Wilderness, Karatara, Sedgefield	Knysna, Plettenberg Bay, Nature's Valley
Population (1995)	164 388 (93% in urban areas)	13 330 (59% in urban areas)	52 351 (88% in urban areas)
Major dams (capacity in million cubic metres)	Hartebeeskuil (7.2), Klipheuwel (4.2), Ernest Robertson (0.4), Wolwedans (24), Garden Route (8)	-	Roodefontein (1.4)
Total dam capacity (million cubic metres)	51.1 (18% of MAR)	0.4 (0.2% of MAR)	4.8 (1.5% of MAR)

Balancing Water Demand and Supply

Water resources in the Garden Route are under severe threat and indications are that water demand is unsustainable and poses a risk to the integrity of this sensitive coastal ecosystem. DWAF's Internal Strategic Perspective for the Gouritz WMA indicates a shortfall of 43 million cubic metres per annum for the Garden Route when water requirements and water availability are reconciled. A significant proportion of this shortfall is attributed to the impact of the ecological Reserve on yield (34 million cubic metres per annum), but does not account for the estuarine Reserve requirements, which are expected to be far higher. Individual shortfalls in each of the sub-areas are:

- Mossel Bay to George (14 million cubic metres per annum);
- Wilderness Rivers (19 million cubic metres per annum); and
- Knysna to Bloukrans (10 million cubic metres per annum).

Golf course development at Knysna

Current climate change predictions suggest a change in rainfall patterns for the area, with more intense rainfall events and increased runoff, reducing TMG recharge and water available for run-of-river abstraction. Excessive water abstraction (for residential estates and other developments), however, continues unabated despite frequent water shortages and restrictions. During December 2005, water supplies to Sedgefield, George and Plettenberg Bay reached critically low levels. Environmental and social lobby groups resist rapid residential developments.

Reconciliation interventions such as Water Conservation and Demand Management need to be effectively implemented and adhered to if the use of water resources is to be sustainable. The Western Cape Guidelines for Golf Courses, Golf Estates, Polo Fields and Polo Estates also suggests that meeting water demands from sources other than natural systems (i.e. rivers, streams, wetlands, and groundwater) must be considered as a first option, particularly for irrigation purposes. Alternative water sources include desalinisation and water re-use options.

Saving the Unique Invertebrates of the Salt River

Recent surveys on the diversity and uniqueness of the macro-invertebrates of the Salt River and its tributaries in the southern Cape revealed that the river contains a rich diversity of aquatic insect species. Sixteen new species and three new genera of insects were discovered. The river also produced the richest known mayfly species (*Teloganodidae*) diversity in Africa. The Salt River serves as an important refuge for those macro-invertebrate species that have evolved in unique conditions, i.e. in a nutrient-deficient and strongly acidic river in the absence of fish. To survive in such an environment, biota have certain unique characteristics. These include being 'naïve' to fish predation, while they have special adaptations (energy-saving strategies and specialist food-collecting techniques) that enable them to survive in nutrient-poor environments. Such species are, however, vulnerable to any major changes (e.g. introduction of fish or changes to physico-chemical conditions).

The uniqueness of this river's fauna, together with the threats posed by development in the catchment, suggests that many of the macro-invertebrate species found in the Salt River, particularly the endemics, should be classified as 'vulnerable'. As such, the Salt River invertebrates deserve special conservation protection.

The pristine Salt River

Floods: A Force of Nature

South Africa's Garden Route is regarded as a prime holiday destination in the country. Annually, thousands of tourists visit the region for its coastal landscapes and holiday resorts, and impressive coastal lakes, indigenous forests and mountains. The recent flood damage to this area has disrupted tourism services and required significant funds for repair to infrastructure, diverting several local and district municipalities' resources from service delivery. In the last two years, unusual weather patterns have resulted in severe droughts and floods in the region. Climate change will probably increase the frequency of flood events. The flood damage is intensified by the loss of wetlands, floodplains and natural watercourses that can cope with severe flooding.

The August 2006 floods followed closely on two extreme floods (December 2004 and January 2005). The entire southern Cape experienced torrential rains, with most of the region registering approximately 300 mm of rain within 48 hours. These floods caused significant damage to local infrastructure (undermined railway lines, exposed or burst water supply pipes in certain areas, burst dams, overflowed septic tanks, collapsed stormwater pipes, collapsed bridges, scoured and widened river beds and roads that were washed away or pitted with potholes and deep gullies). In addition, water resources in rural areas were contaminated during the floods. The most notable damage occurred on the N2 near Kaaimans River. Estimated costs of the August 2006 flood damage were R350 million.

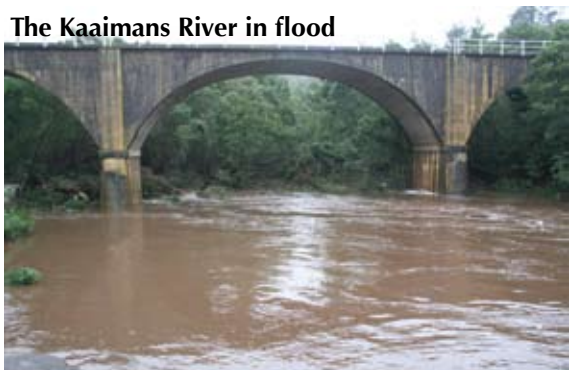
Much of the damage caused by floods has been more severe as a result of land-use practices where developments have altered runoff characteristics for a catchment or where they have been poorly sited and below the 1-in-50 year flood lines. Revegetation and rehabilitation of areas where alien vegetation has been removed from riparian zones is often slow and causes further erosion and runoff. In addition, where alien trees had been felled, the trunks are often not cleared from the area, and result in debris being swept down rivers, often causing destruction to infrastructure downstream. To prevent such extensive damage in the future, more attention should be paid to aspects such as planning and construction of new developments, and in particular their stormwater management.

Flood damage at Glentana

Flood damage at Glentana

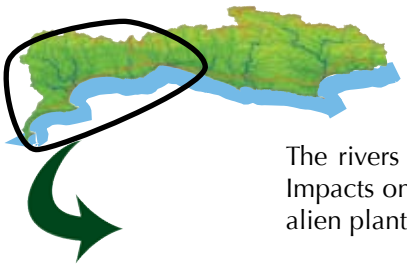
Flood damage at Glentana

The Kaaimans River in flood



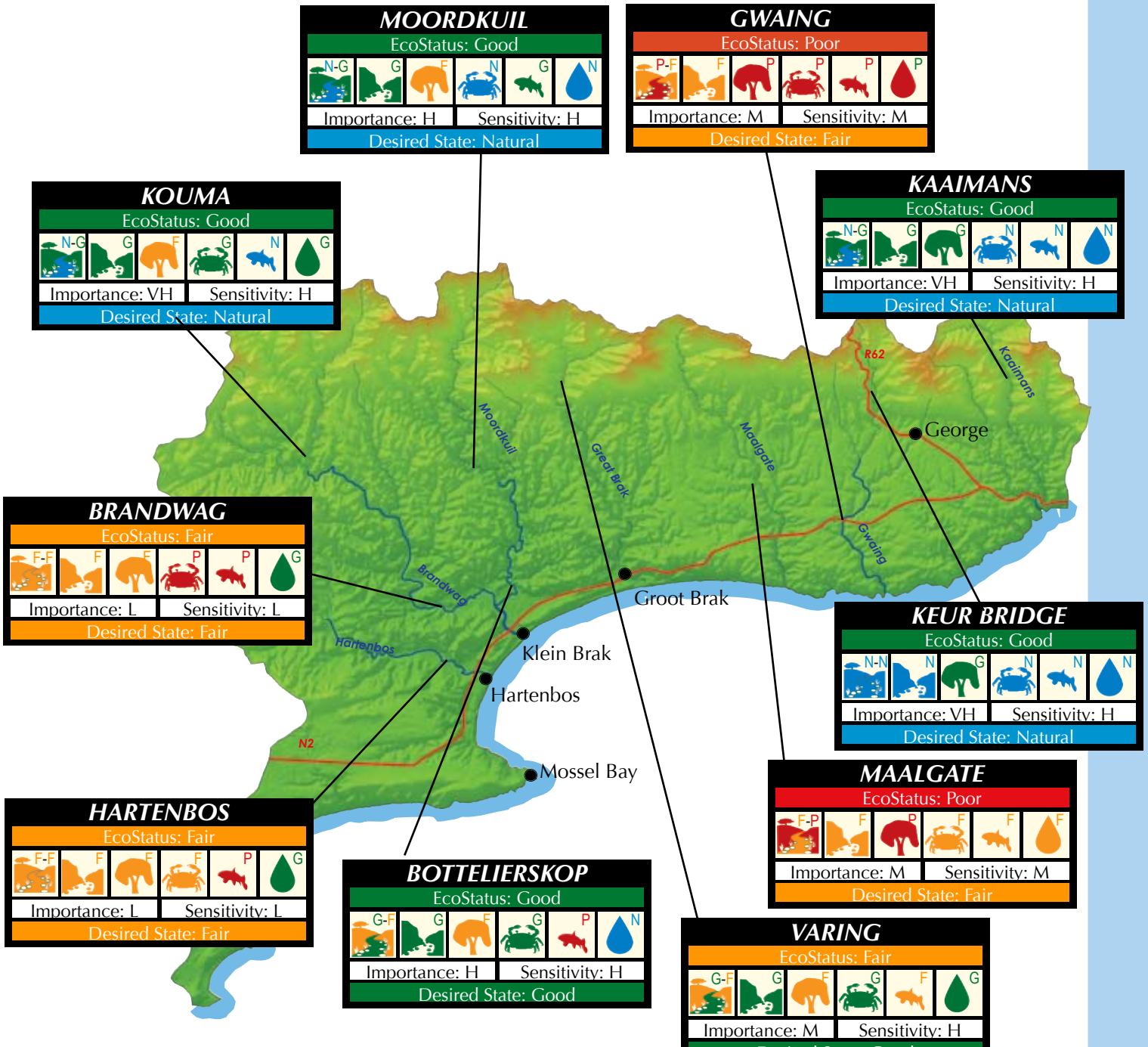
Flooding at Groot Brak

The Silver River in flood



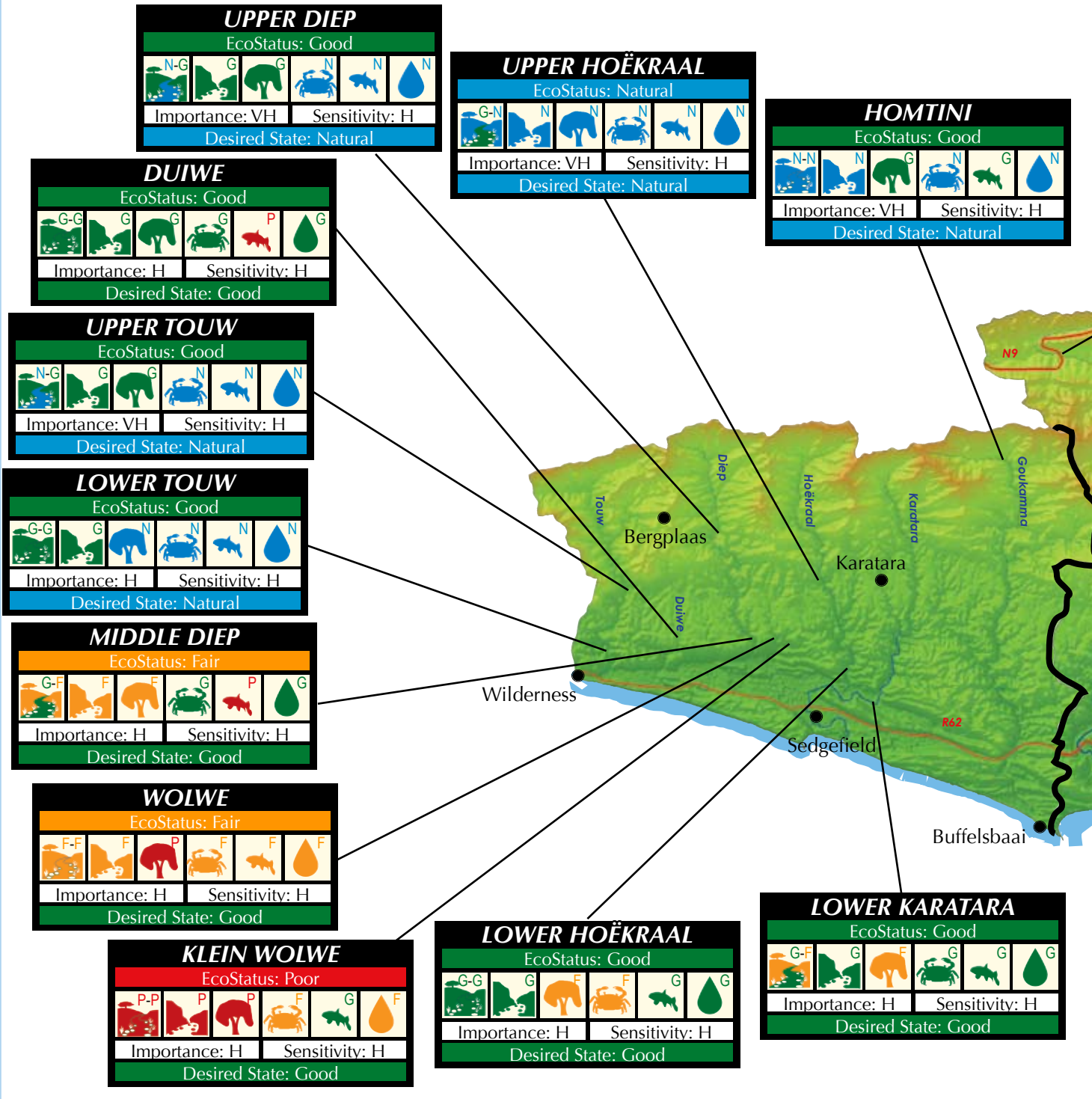
Mossel Bay to George Rivers: Present State

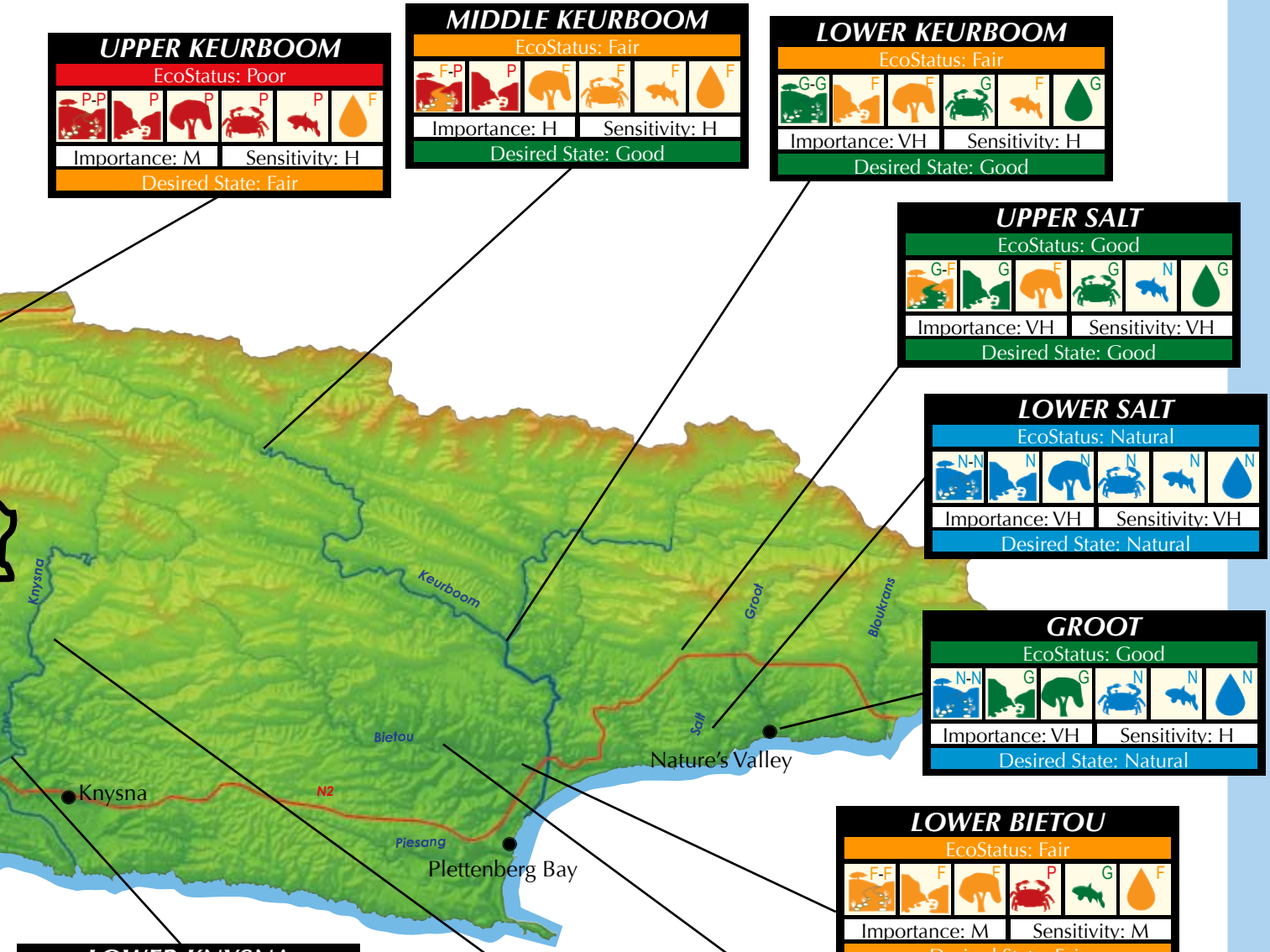
The rivers of the Mossel Bay to George area are in a good to fair ecological condition. Impacts on these rivers include farm dams, afforestation (pine), water abstraction, invasive alien plants and pollution. See page 30 and 31.



Wilderness to Bloukrans Rivers: Present State

The upper reaches of most of the rivers in this area, except the Keurbooms River, are in a natural to good ecological condition. The ecological condition of the Keurbooms River, and the lower reaches of many of these rivers (Diep, Wolwe, Klein Wolwe and Bietou) has been reduced by agricultural practices, urban development and invasive alien plants and fish. Water abstraction has severely impacted on low flows, with some rivers ceasing to flow. See page 30 and 31.





UPPER KEURBOOM
EcoStatus: Poor
P-P | P | P | P | P | F
Importance: M | Sensitivity: H
Desired State: Fair

MIDDLE KEURBOOM
EcoStatus: Fair
F-P | P | F | F | F | F
Importance: H | Sensitivity: H
Desired State: Good

LOWER KEURBOOM
EcoStatus: Fair
G-G | F | F | G | F | G
Importance: VH | Sensitivity: H
Desired State: Good

UPPER SALT
EcoStatus: Good
G-F | G | F | G | N | G
Importance: VH | Sensitivity: VH
Desired State: Good

LOWER SALT
EcoStatus: Natural
N-N | N | N | N | N | N
Importance: VH | Sensitivity: VH
Desired State: Natural

GROOT
EcoStatus: Good
N-N | G | G | N | N | N
Importance: VH | Sensitivity: H
Desired State: Natural

LOWER BIETOU
EcoStatus: Fair
F-F | F | F | P | G | F
Importance: M | Sensitivity: M
Desired State: Fair

LOWER KNYSNA
EcoStatus: Good
G-F | F | F | G | N | G
Importance: H | Sensitivity: H
Desired State: Good

GOUNA
EcoStatus: Good
N-G | G | G | N | N | N
Importance: H | Sensitivity: H
Desired State: Good

UPPER BIETOU
EcoStatus: Good
G-G | G | G | G | N | G
Importance: H | Sensitivity: H
Desired State: Good

Major Impacts & Management Actions

The rapid spread of ***invasive alien plants***, mainly black wattle, shades the river and reduces the sunlight available for maintaining aquatic biodiversity (e.g. indigenous plants, invertebrates and fish). Tannins released from black wattle alters the water quality of many rivers. Invasive alien vegetation also reduces water availability in this water stressed area, reduces riparian habitat diversity, destabilizes river banks and causes incised river channels that reduces channel carrying capacity and increases water flow rates.

Spanish reed and black wattle along riverbanks

Black wattle on the Maalgate River

Wolwedans Dam

Water abstraction and flow modification (new developments, golf courses and polofields, irrigated agriculture and extensive alien vegetation encroachment) is a major threat to the health of these rivers. Water is abstracted from rivers in the Garden Route for a variety of uses. There are a large number of farm dams, particularly in the George area, while water for domestic purposes are largely run-of-river abstractions with off-channel storage. The only large instream dams are the Wolwedans and Roodefontein. The cumulative effect of these water abstractions has modified flow. The impact on low flow is more severe, with some rivers (Duiwe River) ceasing to flow throughout the year. This results in water quality problems and fragmentation of habitat, which reduce the goods and services of these rivers.

Alien fish such as small- and largemouth bass were introduced widely into rivers of the Garden Route (see p. 44). Indigenous fish lack natural defenses against the large specialised predators, while the predators themselves have no natural controls. Consequently the indigenous fish were quickly eliminated from many areas and now survive only in refuge reaches of rivers that are beyond the reach of introduced predators.

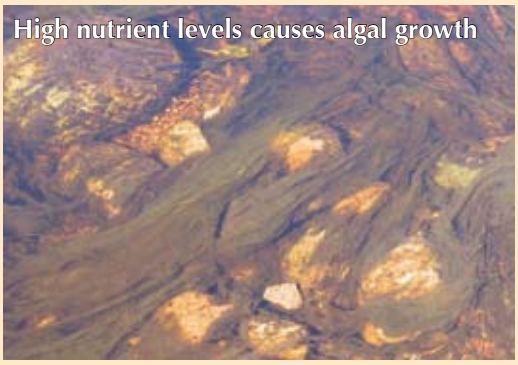
Other introduced species such as mosquitofish compete with indigenous fish for food and space, as well as prey on their larvae. The cumulative impact of alien fish, together with habitat destruction, is likely to place the indigenous populations into an extremely vulnerable position. See page 41.

Smallmouth bass

Agricultural practices and urban development into floodplains and wetlands have reduced water quality and habitat diversity in the lower reaches of many rivers. Alien vegetation encroachment, bulldozing, pastures and developments in riparian zones have reduced the riparian zone's buffering function from surrounding land-use impacts, thus reducing its ability to remove nutrients and stabilise riverbanks. The recent flooding caused significant damage where the riparian habitat had been degraded.

Construction within the Keurbooms River

Typical agricultural impacts



High nutrient levels causes algal growth

Water quality in the lakes and rivers of the Garden Route is generally good. Exceptions relate to higher suspended solids during times of floods (see p. 26) and elevated nutrient levels. There is some concern that ongoing forestry, agriculture and urbanisation (silt and suspended solids, run-off of fertilisers and pesticides, stormwater discharges, septic tanks, sewage treatment plant releases and general littering), together with a reduced surface water flow, could result in a deterioration of water quality. Microbial contamination from wastewater discharges or the absence of adequate sanitation services pose a high risk to human health, particularly in those river reaches downstream of human settlements.

Management Actions

- **Implement a systematic alien vegetation eradication programme**
- **Remove invasive alien plants where necessary to improve biodiversity and water supply**
- **Improve regulation of abstractions from these rivers**
- **Encourage efficient water use throughout the area**
- **Remove alien fish where possible to allow for natural recovery of indigenous fish**
- **Stock dams with indigenous fish in consultation with CapeNature**
- **Rehabilitate riparian zones to act as a buffer between the river and surrounding agricultural areas**
- **Improve wastewater and stormwater management from developed areas**
- **Ensure integrated stormwater planning in urban areas**
- **Re-evaluate floodlines to cater for the impact of climate change and reduce flood damage on new developments**
- **Motivate for higher conservation status of the Salt River at national and international level**

Estuaries of the Garden Route


Great Brak Estuary

Estuaries occur where seawater and river water mix in the lower sections of a river. They are important nursery and feeding areas for fish and provide many goods and services. A diversity of estuarine types occur along the Garden Route, including: small temporarily open/closed systems (Groot Brak, Hartenbos) with little river inflow; large permanently open estuaries (Keurbooms) with significant river inflow; large permanently open estuarine bays (Knysna); and estuarine lakes (Swartvlei) that are at times closed off from the sea.

The Groot Brak Estuary is influenced by storm tides, littoral sand movement, floods and catchment activities. The estuary widens into a basin behind the periodically open mouth and supports a rich diversity of estuarine fauna. Limited refuge areas, particularly at high tide, and heavy recreational pressure in summer are a limiting factor on bird numbers within the estuary. The permanent sandy island, "The Island" is a residential area located within the basin. A retaining wall around the island protects houses from erosion by floods and channel modification. The Wolwedans Dam in the upper reaches of the river reduces freshwater flow into the estuary, but water releases are made from the dam as a mitigation measure.

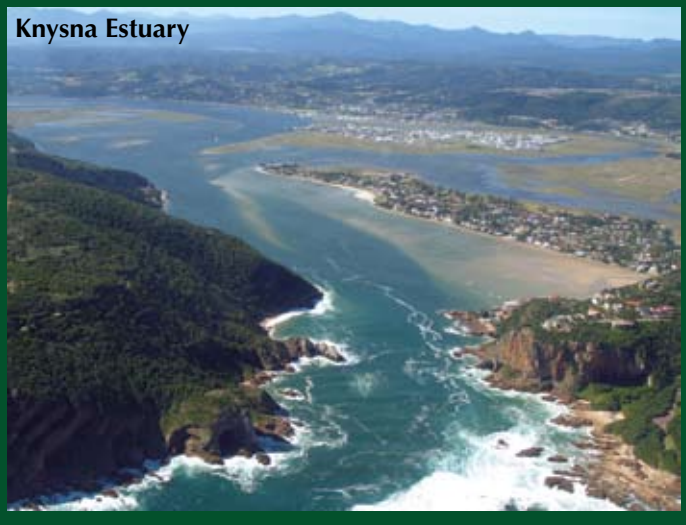
The Klein Brak Estuary is less vulnerable to impact from human activities due to open mouth conditions and limited development activities in the catchment. Deposition of marine sediments is, however, increasing as a result of reduced riverine inflows. Floods are thus important in flushing out sediments from the estuary, with the probability of a major flood event being approximately 1 in 12 years, with the most recent one being experienced during August 2006 (see p. 26).

The Keurbooms Estuary lies in the sheltered Plettenberg Bay on the southern Cape coast. A coastal barrier separates the lower estuary reaches from the sea, and a tidal inlet through the barrier provides tidal connections between the estuary and the sea. The Keurbooms Estuary and its Bietou tributary occupy two drowned river valleys. A road bridge at Wittedrift and a causeway over the Bitou River act as obstructions to water flow and form the upper limit of tidal exchange. Sedimentation as a result of a reduction in floods and saline intrusion upstream are two threats to the estuary, as mouth closure would mean an unacceptable ecological change for the estuary. A permanently open mouth is vitally important in this species rich estuary, with the middle and lower reaches being important nursery areas for fish.

Estuary Conservation Importance

The Garden Route estuaries have been ranked in terms of their conservation importance out of 247 estuaries in South Africa. This ranking, based on estuary size, habitat, zonal type rarity and biodiversity importance, is as follows:

Estuary	Rank	Estuary	Rank
Knysna	1	Sout (Oos)	83
Swartvlei	6	Klein Brak	96
Keurboom	16	Bloukrans	102
Wilderness	24	Kaaimans	199
Groot Brak	49	Maalgate	201
Piesang	57	Maatjies/Bietou	212
Goukamma	68	Noetsie	223
Hartenbos	74	Gwaing	240


Knysna Estuary

The coastal lakes of the Garden Route are small and shallow and are ideal for recreational activities. The Wilderness, Swartvlei and Groenvlei lakes are three separate and distinctly different systems.

The Wilderness Lakes, classified as a Ramsar site, were formed by the natural damming of water between two dune ridges. These lakes include Island Lake, Langvlei and Rondevlei and are connected to each other by small shallow channels, as well as to the Touw River Estuary. They receive freshwater via the Touw and Duiwe rivers and underground seepage, as well as seawater from the Touw Estuary and possibly seepage through the barrier dunes. As a result, the lakes have salinities that vary and an estuary mouth that is open for about 30% of the time.

Groenvlei is a freshwater coastal lake that has been separated from the sea for 4000 to 7000 years. It is an endorheic system that is completely dependant on groundwater. The lake still harbours some relic estuarine species, such as estuarine roundherring, which contribute to its unique character.

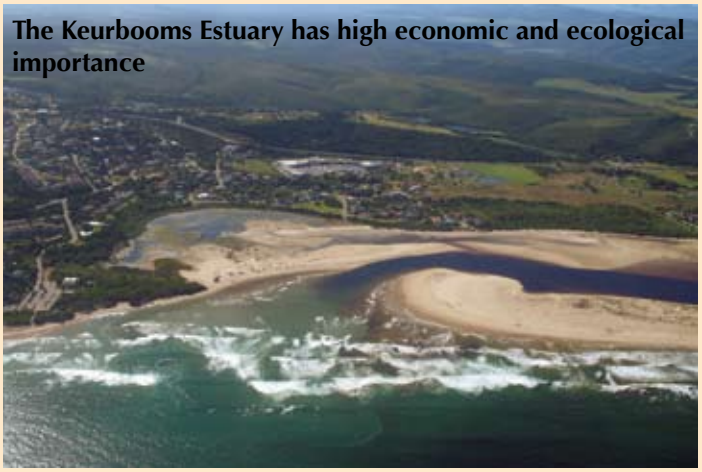
Swartvlei is the largest and deepest of the estuarine lakes in the southern Cape. It consists of a lake and estuary, and has four inflowing rivers, viz. Diep, Klein-Wolwe, Hoëkraal and Karatara. Its major characteristic is that it is usually stratified into different densities caused by tidal water exchange and river inflow, and has an estuary mouth that is open about 55% of the time. Inflow from the catchment is far greater than Swartvlei's volume and future water abstraction in the catchment is an important consideration in the management of this lake.

Swartvlei

The Knysna Estuary sustains the richest estuarine biodiversity in the Cape. Salinity in the estuary is similar to that of seawater since the mouth is permanently open and there is reduced freshwater inflow from the catchment due to land-use activities. There are three islands in the lagoon, *viz*. Leisure Isle, Thesen's Island and Rex Island. The overall habitat accounts for the remarkable diversity of species. If left unchecked, residential and recreational development and the associated effects and by-products will change the natural and rural character of this estuary. This poses a threat to many of the more sensitive estuarine biota such as the Knysna seahorse (see p. 39). Due to the fact that the Knysna Estuary has a high biodiversity value and a high development potential, the estuary was selected as one of the six priority estuaries of the C.A.P.E. Estuaries Programme. The aim of the programme will be to develop an Estuary Management Plan, that is implemented locally. Building local managerial capacity is seen as being paramount to the effective conservation and management of this natural resource.

Estuarine Goods and Services

Estuaries provide many goods and services to society. This includes food and bait collection, nurseries and refuges for birds, fish and crustaceans, tourism and recreation, cultural and spiritual activities and craft materials. Human activities such as wastewater discharges, water abstraction and storage, over-exploitation of fish, and the destruction of estuarine habitat impact on estuaries and influence their ability to provide these goods and services. Developments in the catchment of these estuaries and lakes reduce the freshwater contributions to these unique systems and increase the sediment and nutrient loads to the systems.



The Keurbooms Estuary has high economic and ecological importance

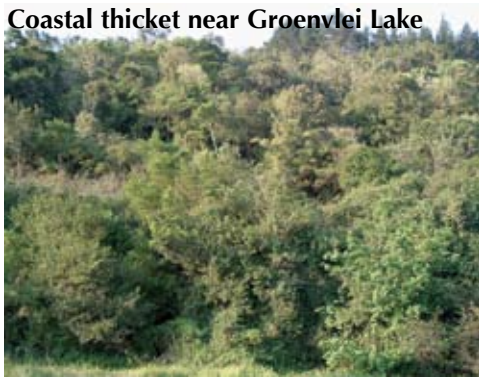
Flora and Fauna

The Gouritz WMA incorporates three important biomes that have been identified by the Gouritz Initiative as hotspots for the Global Biodiversity Conservation Project, *viz*. Fynbos, Thicket and Succulent Karoo. Fynbos is a shrubland, comprising hard-leafed, evergreen, fire-prone shrubs, and is characterised by four major plant types: restioids (elegant restio), ericoids (common heath, vlakte heath), proteoids (king protea, sugarbush) and bulbs (watsonia, cluster disa). Thicket vegetation often only occurs as bush-clumps in a matrix of different vegetation types (aloe, cotyledon, euphorbia, spekboom, gasteria, haworthia, rhus and strelitzia).

The typical vegetation of the Succulent Karoo is a dwarf shrubland comprising mostly of leaf succulents (Mesembryanthemaceae, Crassulaceae, Asteraceae and Asphodelaceae). The dominance of leaf succulents (some 1 700 species) in this biome is unique among the deserts of the world. Stem succulents, comprising about 130 species, include species of euphorbia, tylecodon, othonna and numerous stapeliads. Seasonal bulbs appear in the open spaces between the shrubs and provide magnificent spring displays. The hilly areas of the Little Karoo have abundant evergreen shrubs and tall aloes.

The indigenous forests of the southern Cape are the largest stretch of natural forests in South Africa. Forests along the coast have a drier shrub-like appearance and have vegetation that is able to survive coastal salt sprays. Further inland, rainfall increases and moist forest types occur, typically with high canopies. Wet forest, characterised by ferns, moss and fungi, grows on some slopes and damp ravines. The major conservation areas which include fynbos are home to 526 of the world's erica species, 96 varieties of gladioli and 69 of the world's 112 protea species.


Fynbos shrubland


Coastal thicket near Groenvlei Lake

Dune Slack Rush *(Juncus kraussii)*
This perennial sedge of about 1.5 m grows in large colonies in the Western Cape. It dominates salt marshes with low salinities and can be seen along the banks of Swartvlei at Sedgefield. Purplish brown flowers appear between October and February. In parts of South Africa, this sedge is harvested for use in weaving of traditional sleeping mats, baskets, beer strainers, conference bags and numerous other craftwork products.


Dune slack rush

The Importance of Healthy Riparian Vegetation

Indigenous riparian vegetation performs the following important functions:

- Binds riverbanks with their roots and prevents erosion;
- Traps sediment and pollutants, and helps protect water quality;
- Provides habitat and food for animals, fish and aquatic insects;
- Reduces the effects of floodwaters;
- Provides cover to rivers thus influencing water temperatures;
- Slows runoff in the groundcover, increasing bank storage and the absorption of water, particularly during flood conditions;
- Maintains elevated flows after floodflows have receded;
- Provides an aesthetically pleasing environment; and
- Contributes to species richness and biodiversity.


Riparian vegetation in the Hoëkraal River

Generally, only perennial and seasonal streams have sufficient water to support riparian vegetation, where a natural and variable flow regime is necessary to maintain the vegetation zonation and diversity in the riparian zones that provide these vital functions.

Ephemeral streams in the Great and Little Karoo do not have a water table sufficiently close to the soil surface to provide for typical water-loving riparian vegetation. Vegetation growing along these streams may occur in greater densities or grow more vigorously than the surrounding terrestrial vegetation, and the plant composition is generally different to that in the surrounding areas. Examples of such vegetation include the keurboom in the Garden Route and the sweet thorn in the Great and Little Karoo (see below).

Western Keurboom *(Virgilia oroboides)*

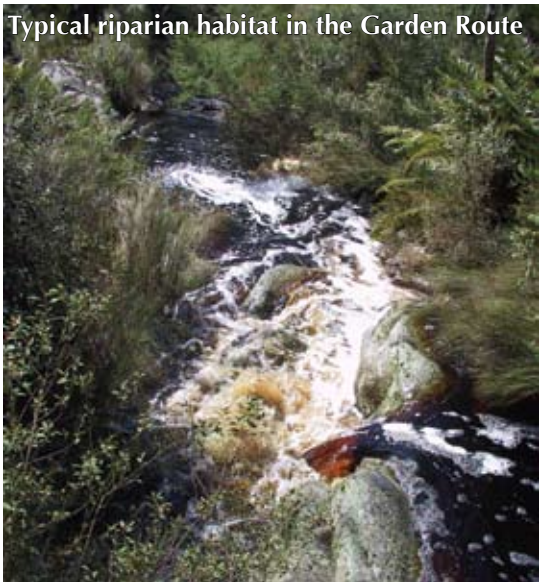
The keurboom is a deciduous tree that grows in coastal forest edges and river valleys of the Garden Route. The tree is abundant in the Plettenberg Bay area, along the Keurbooms River, hence its name. It is believed that the tree protects indigenous forests and vegetation from veld fires. Sprays of pink-mauve flowers change to long, flat, brown, velvety pods from August to September, and also between December and January.


Keurboom flowers


Sweet thorn flowers

Sweet Thorn *(Acacia karroo)*

These trees are widespread throughout southern Africa, occurring in bushveld, grassland and in coastal dune forest. They are particularly abundant along river beds and often occur in dense stands. Some forms of this tree are spectacularly lovely after good rains, with their crowns concealed under a froth of yellow fragrant flowers. The tree is browsed by game, while the bark is used for tanning, yielding rope, producing edible gum and for traditional medicine, together with the root. The wood is hard and heavy, while the seeds can be used as a coffee substitute. The trees often proliferate in overgrazed areas.


Typical riparian habitat in the Garden Route

The Importance of Riparian Habitat for Wildlife

Rivers and riparian vegetation provide important habitat for many plants and animals. These areas occupy only a small percentage of the catchment but contain a high diversity of living organisms, and play a crucial role as a corridor for the movement of animals.

For some species this habitat is critical. Some animals rely on riparian habitats for their entire lifetime, whereas others may only need them at particular times during the day, in certain seasons, or during specific life stages. This habitat is important for providing food, water, shelter from predators and from harsh physical conditions, and provide sites for nesting and roosting.

Aquatic Insects

The Western Cape supports a unique variety of aquatic insects, many of which do not occur elsewhere in Africa. In many cases, their closest relatives are in New Zealand, Australia, South America or Madagascar. Many of the rivers in the region are characterised by clear, nutrient-poor, acidic waters, which are often stained brown by humic compounds that are leached from the surrounding vegetation. This water is the preferred habitat of many invertebrates, including the water beetle and stonefly (see below).


Larvae (left) and adult (right) water beetle

Predaceous Water Beetle *(Dytiscidae)*

Predaceous water beetles occur in freshwater rivers and lakes, like Groenvlei (see p. 33). The adults are strong fliers, often attracted to lights at night. Underwater, they use their oar-like back legs to swim, where they trap fresh air in the space between their wings and abdomen, which acts as a water lung. The beetle is carnivorous, capturing and devouring insects, small worms, tadpoles and other small water creatures. Their lifespan is generally more than one year. The larvae are completely aquatic but are air-breathing and carnivorous like the adults. Pupation occurs on land close to water.

Stoneflies *(Plecoptera)*

Stoneflies are restricted to unpolluted, well-oxygenated rivers where the nymphs occur under stones and the adults can be spotted as they climb on the rocks. The larval stage lasts from a few months to years in water, while the adults are short-lived.

These small aquatic insects belong to an extremely isolated group of insects that has branched out on their own evolutionary limb at an early stage. Few species occur in Africa, compared to the temperate regions of the world. There are two families in South Africa and both occur in the southern Cape rivers. *Perlidae* are confined to rivers in the eastern half of the country and are voracious predators of blackfly larvae and mayfly nymphs. *Notonemouridae* are found in coastal and mountain streams of the southwestern Cape and are benthic shredders of plant material. Stonefly nymphs are vulnerable to predation by introduced trout and bass (see p. 41).


Stonefly larvae: *Notonemouridae* (left) and *Perlidae* (right)

Indigenous Fauna of Interest

The Gouritz WMA has a high diversity and abundance of animal species that decreases from the coast inland. This diversity and abundance can be attributed to changes in vegetation and availability of suitable habitats, which in turn are largely dependant on water availability. The many dams, pans and vleis of the area provide ideal habitat for a variety of animals such as the Cape clawless otter, the African Fish Eagle, the Knysna Lourie (see below) and many endemic fish (see p. 38).


Cape clawless otter

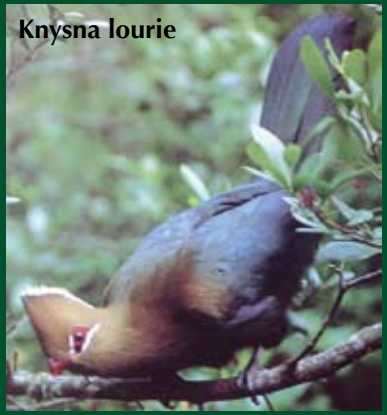
Cape Clawless Otter *(Aonyx capensis)*

Cape clawless otters occur from South Africa northwards to Ethiopia and Senegal, but are absent from the central rainforest areas. Their numbers are high in Tsitsikamma, where as many as one otter per two kilometres of coastline occur. They are frequently found in and along rivers, small streams and coastal rock pools where they forage for octopus, frogs, crabs, crayfish, or even insects, birds, bird's eggs and reptiles. Otters are mostly active during late afternoon and early evening and shelter during the day under rocks, holes in the ground and in vegetation. Their endangered status is 'low', although increasing human population, farming and overgrazing are threatening their habitat.

African Fish Eagle *(Haliaeetus vocifer)*

The African fish eagle is the quintessential ambassador of aquatic ecosystems in Africa, where its habitat is usually larger rivers, lakes, pans, dams, coastal lagoons and estuaries. Their diet consists mostly of fish, and in some areas it also includes flamingos and other water birds. In rare circumstances they feed on dassies, monkeys, monitor lizards, frogs, terrapins and insects. The eagle often steals prey from other birds, and also raid colonies of nesting water birds for their young and eggs. The eagle is usually seen in pairs, and has a breeding season between March and September.


African fish eagle


Knysna lourie

Knysna Tauraco/Lourie *(Tauraco corythaix)*

The Knysna lourie is fairly common in the Afromontane, riverine and coastal forests between Mossel Bay and KwaZulu-Natal. The lourie reaches a length of about 45-47 cm, and has red feathers that are most noticeable in flight. They use the canopies of the forest to feed on fruit and nest, occasionally descending to feed on invertebrates and fallen fruit. Threats to their numbers are from forest destruction and exploitation of forest patches for medicinal plants.

Indigenous fish of the Gouritz WMA

This WMA falls within the Cape Floristic Region, a unique freshwater fish ecoregion in South Africa, characterized by a low overall indigenous fish diversity (19 species), but a very high endemicity (16 species). The WMA has nine indigenous fish species, two of which are candidates for becoming new species (e.g. *Pseudobarbus cf afer sp.*).

The richest river system for fish diversity in the WMA is, not surprisingly, the very large Gouritz system which has six of the nine species. The smaller coastal systems usually have three species, *viz*. a redfin species, Cape kurper and Cape galaxias. All indigenous fish are primarily river dwellers and many are habitat specialists, preferring either large deep pools (moggel), riffle areas (slender redfin) or vegetated backwaters (Cape kurper). Nearly all species require permanent flow, good habitat and water quality. Fish surveys show that the healthiest fish populations are found in undisturbed rivers that are free of invasive alien fish.

The following indigenous fish species are commonly found in rivers and streams of the Gouritz WMA:

Species	Scientific name	Distribution in WMA	Proposed conservation status
Cape galaxies	*Galaxias zebratus*	Most rivers	Data deficient
Cape kurper	*Sandelia capensis*	Most rivers	Data deficient
Chubbyhead barb	*Barbus anoplus*	Gouritz system	Least concern
Forest redfin#	*Pseudobarbus cf afer sp.*	Coastal rivers: Klein Brak eastwards	Near threatened
Keurbooms redfin#	*Pseudobarbus cf tenius sp.*	Keurbooms system	Endangered
Breede River redfin	*Pseudobarbus burchelli*	Goukou, Duiwenhoks	Near threatened
Smallscale redfin	*Pseudobarbus asper*	Gouritz system	Endangered
Slender redfin	*Pseudobarbus tenuis*	Gouritz system	Near threatened
Moggel	*Labeo umbratus*	Gouritz system	Least concern
Longfin eel*	*Anguilla mossambica*	Most rivers	Least concern
Shortfin eel*	*A. bicolor bicolor*	Most rivers	Least concern
Giant mottled eel*	*A. marmorata*	Most rivers	Least concern

*migrates to coastal zones to breed
#proposed separate species


East Cape redfin (Forest redfin)


Chubbyhead barb


Breede River redfin


Moggel


Giant mottled eel

Genetic diversity of fish

A major research project on the genetic diversity of the redfin group, Cape kurper and Cape galaxias has recently been completed at the University of Pretoria. This work has shown that the Cape Floristic Region is home to several new species of fish, some of which are restricted to a single catchment. Two redfin species that occur in the Gouritz WMA may be listed as new species, viz. Forest redfin which is widespread in coastal rivers of the southern Cape, and Keurbooms redfin. The Cape galaxias is now recognized as a species complex. Fish taxonomists in New Zealand and Grahamstown (South African Institute for Aquatic Biodiversity and Albany Museum) are currently describing new fish species, some of which may occur in the WMA.


Cape kurper


Cape galaxias - Klein Brak River

Threats to indigenous freshwater fish of the Gouritz WMA

Freshwater fish in the Gouritz WMA are threatened by habitat degradation and invasive alien fish and plants. Intensive agriculture has had severe impacts on many rivers through over-abstraction of water, destruction of riparian vegetation, channelisation of rivers for flood control and the incorrect use of pesticides and fertilizers. Rivers damaged by removal of riparian vegetation and eutrophication are usually then invaded by alien plants. These alien plants negatively affect fish in the following ways. Acacias (black wattle) reduce water flow and diversities of aquatic insects, whereas aquatic plants like water lettuce and water hyacinth cover rivers and dams and reduce water temperatures and can also reduce dissolved oxygen concentrations to levels that are lethal to fish.

Invasive and alien fish are also a serious threat as many are widespread in rivers and dams of the WMA. They prey on indigenous fish, compete for food sources such as aquatic insects, and degrade habitat quality by making clear waters turbid. The species of alien fish present in the WMA are described on page 41.

Estuarine fish

Estuarine fish are typically tolerant of a wide range of salinities that occur in estuaries and usually include freshwater species as well as specialised estuarine and marine species. Many of these fish only spend parts of their life cycle in estuaries during their migration from and to rivers or the sea. Estuaries often provide important nursery and feeding grounds for the fish, support near shore fisheries and during the rainy season act as an important source of nutrients for the marine environment. Human impacts such as the construction of barriers to fish migration, significant water quality impairment, and severe reductions of freshwater inflow into the estuary, with a subsequent estuary mouth closure, are common impacts on these fish.

Several estuarine fish were found in the lower reaches of the rivers in the Gouritz WMA, including:

Species	Scientific name	Species	Scientific name
Estuarine roundherring	*Gilchristella aestuaria*	Cape moony	*Monodactylus falciformis*
Flathead mullet	*Mugil cephalus*	Blackhard sole	*Solea bleekeri*
Freshwater mullet	*Myxus capensis*	Leervis	*Lichia amia*
Southern mullet	*Liza richardsoni*	Knysna sandgoby	*Psammogobius holubi*
Groovy mullet	*Liza dumerili*	White steenbras	*Lithognathus lithognathus*
Cape silverside	*Atherina breviceps*		


Flathead mullet


Cape moony


Estuarine roundherring

Knysna Seahorse *(Hippocampus capensis)*

The rare Knysna seahorse has the most limited distribution of all seahorse species, and is the world's only known estuarine seahorse species. They are currently limited to two estuaries in South Africa, *viz*. Swartvlei and Knysna (see p. 32 -33). These small fish reach an average length of about 7cm, and are found in quiet waters among eelgrass that grow along the length of the estuaries. Threats to the seahorse include crabs, larger fish and humans. Because they tend to live at shallow depths, storms can also contribute to their mortality. The Knysna seahorse has been formally recognized as 'endangered' by the World Conservation Union.


Knysna seahorse

Alien Flora and Fauna

Invasive alien plants threaten the indigenous biota and water supply in the Gouritz WMA. The consequences of not controlling these alien plants create enormous problems such as a dwindling water supply, the danger of run-away fires and the destruction of natural habitat that is of value to tourism.

The Working for Water Programme of DWAF is currently clearing invasive alien plants in many of the catchments. This initiative creates employment for previously disadvantaged communities as part of the Expanded Public Works Programme. The Western Cape focus is on removing invasive alien plants from riparian zones and mountain catchments. The Programme also assists land-users with an initial clearing of invasive alien plants, as well as two follow-up treatments. Subsequent to this, the land-user is responsible for keeping cleared areas free from invasive alien plants in terms of the Conservation of Agricultural Resources Act (Act 43 of 1983). Attempts have been made to remove invasive aquatic weeds (e.g. Kariba weed and red water fern) that are problematic in rivers of the Gouritz WMA (see below).

Biological Control of Invasive Aquatic Plants

Kariba Weed (*Salvinia molesta*), a native of Brazil, was first recorded in Africa in 1948. Introduced as ornamental plants, its rapid growth, particularly during favourable conditions, has resulted in it becoming a problem species in South Africa. Mats of Kariba weed of up to one metre thick, can clog water intakes and interfere with agricultural infrastructure, and provide ideal habitat for mosquitoes and other vectors of human disease, posing serious socio-economic impacts. The dense mats also have a wide variety of negative impacts on the aquatic environment causing a decline in water quality and a reduction in biodiversity, as they:

- out-compete indigenous species (crowd out floating weeds and reduce light availability to submerged plants);
- prevent oxygen from entering the water; and
- deplete oxygen levels in the water, creating unsuitable conditions for invertebrates and fish.

Control of Kariba weed by physical removal, herbicides and biological agents has proved to be difficult as the weed either outgrows most efforts, or the control agents pose a risk to other species as they are non-selective, or they have to be reapplied on an ongoing basis. Biological control, using the host-specific weevil *Cyrtobagous salviniae*, introduced to Africa in 1983, is the most sustainable control option. Adult weevils (about 2mm long) feed on leaf buds and young terminal leaves, while the larvae enter the rhizome, causing the plants to be waterlogged and eventually sink.

Kariba weed

Red Water Fern (*Azolla filiculoida*), a native of South America, was introduced as an ornamental plant, where they thrived in the absence of natural enemies. This species too, has been controlled by biological control agents, and the prospects of bringing the weed under control are very favourable, with control initiatives being put in place.

Red water fern

Spanish reed

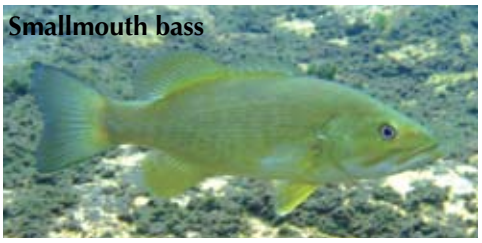
Spanish Reed *(Arundo donax)*

Spanish reed, **a native of India, was introduced to South Africa as early as the 18th century. This weed is now widespread throughout the country, and is potentially one of the most serious invasive alien species. In the past, Spanish reed was used in ceilings, and today it is cultivated by local farmers for basket weaving, traditional reed ceilings, fencing and shed construction. Its superficial similarity to the indigenous local reed *Phragmites*, together with its large scale use has allowed its invasiveness to be overlooked and / or tolerated. Control of Spanish reed will not be easy and its cultivation will need to be balanced with its implication for instream flow reduction and any costs associated with increased risks of flooding of riverside properties.**

Invasive and Alien Fish

The Gouritz WMA has no indigenous freshwater fish of angling value. For this reason, dams and rivers have historically been stocked with alien fish for recreation and as a source of food. Most fish were stocked prior to 1970, by the Cape Department of Nature and Environmental Conservation. The main species stocked were rainbow trout (into mountainous areas), largemouth bass and Mozambique tilapia (into warmer lowland areas), and smallmouth yellowfish (into the Gouritz River). Stocking of alien fish by Nature Conservation was stopped for ecological reasons in 1990. There are also several other alien fish species present (see Table below). All species have a negative impact on the ecology of rivers. Where high numbers of alien fish are present, indigenous fish are usually absent. Alien fish prey on indigenous fish (e.g. bass), compete with them (e.g. smallmouth yellowfish) or degrade habitat (e.g. carp).

CapeNature has proposed a zoning system to better regulate the management of alien fish in the Western Cape. The proposal will involve designating beneficial use zones for most invasive alien fish. Outside of these zones, alien species may not be stocked and when caught should be killed. Alien and invasive fish found in rivers of the Gouritz WMA include:


Smallmouth bass


Banded tilapia


Carp

Species	Scientific name	Impact on indigenous biota
Banded tilapia	*Tilapia sparrmani*	primarily competitor
Bluegill sunfish	*Lepomis macrochirus*	predator and competitor
Carp	*Cyprinus carpio*	competitor, degrades habitat
Largemouth bass	*Micropterus salmoides*	predator
Mosquitofish	*Gambusia affinis*	competitor
Mozambique tilapia	*Oreochromis mossambicus*	primarily competitor
Rainbow trout	*Oncorhynchus mykiss*	predator
Brown trout	*Salmo trutta*	predator
Sharptooth catfish	*Clarias gariepinus*	predator and competitor
Smallmouth bass	*Micropterus dolomieu*	predator
Vaal-Orange Smallmouth yellowfish	*Labeobarbus aeneus*	predator and competitor


Mosquitofish

Mosquitofish were introduced into the Cape in the early 20th century as forage for bass and to control mosquitoes in rivers. Their adaptability and hardiness, and their ability to produce large numbers of young in a short time have resulted in them being a pest in our rivers. They are aggressive competitors and predate on smaller indigenous fish and larvae, leading to reduced numbers or even extinction.

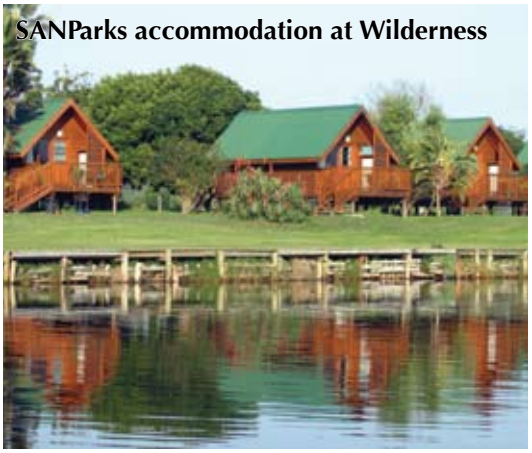
Sharptooth catfish are indigenous to most provinces of South Africa, excluding the Western Cape. This large, prolific and adaptable fish is illegally being spread across the Western Cape. Introduced for angling and as a food source, its preferred habitat is large sluggish rivers, lakes and dams and can endure harsh conditions, with high turbidity and low flows. It is a very successful predator, eating a range of aquatic, amphibian and avian biota. The impact of this should not be underestimated and urgently requires study. Ironically, the illegal introduction of catfish into some dams has impacted on sport fisheries for another alien fish, namely bass. There is also a serious potential impact from alien catfish on freshwater eels. Anglers and farmers need to be educated about the adverse consequences of introducing catfish and the transfer of biota by interbasin transfer schemes require urgent attention.


Sharptooth catfish

Conserving our Resources

A number of initiatives, with the primary aim of conserving biodiversity and promoting sustainable development, have been established in the South Western Cape. The Gouritz WMA is a focus area of many of these initiatives as it is home to three hotspots of the Global Biodiversity Conservation Project, *viz*. Fynbos, Succulent Karoo and Thicket Biomes. As a result, the C.A.P.E., SKEP and STEP bioregional programmes were initiated in the area. In addition, the Garden Route and Gouritz initiatives (see p. 43) were established to sustain biodiversity processes in the Gouritz WMA. The Biomes and the bioregional initiatives in the Gouritz WMA are:

Biome	Typical plants	Bioregional Initiative
Fynbos / Cape Floristic Region	ericas, proteas, restio's	C.A.P.E. (Cape Action for People and the Environment)
Succulent Karoo	crassulas, "plakkies", "vygies"	SKEP (Succulent Karoo Ecosystem Programme)
Subtropical Thicket	aloes, "spekboom", "noem-noem"	STEP (Subtropical Ecosystem Programme)


SANParks accommodation at Wilderness

C.A.P.E. is a programme of the South African Government, with support from international donors, which aims to protect the rich biological heritage of the Fynbos Biome / Cape Floristic Region. The programme seeks to unleash the economic potential of the region's resources through focused investment in sustainable development, while conserving nature and ensuring that all people benefit. A broad-scale spatial plan targets over 60% of the remaining natural vegetation of the region for conservation.

SKEP, funded by the Critical Ecosystem Partnership Fund, was initiated to collect information and generate consensus among stakeholders for a holistic conservation and sustainable land-use plan for the Succulent Karoo Biome. SKEP, which means "to serve" or "to create" in Afrikaans, involves more than 60 scientific experts and 400 local stakeholders representing government, academia, non-governmental organisations, private sector interests and local communities in a unique approach to conservation planning.

STEP, funded by the Global Environment Facility, aims to promote biodiversity conservation in the Thicket Biome. Its vision is to empower people of the Biome to take custodianship of this unique landscape and to work together to conserve, enhance and use the natural resources sustainably.

C.A.P.E. Biodiversity Initiatives in the Gouritz WMA

Gouritz Initiative


Gouritz River at 'Die Poort"

The north-south corridor of the Gouritz River provides a link from the Great and Little Karoo to the sea, thereby providing opportunities for movement and migration of fauna and flora with climate change. This corridor tracks the river and its associated aquatic processes and patterns. For example, predators such as honey badgers, otters, leopards, caracal and genet often walk along rivers.

There are two large west-east corridors, *viz*. the Swartberg and associated mountains in the north (boundary between Little and Great Karoo), and the Langeberg/Outeniqua mountains in the south (boundary between the coast and Little Karoo). These corridors provide opportunities for correct fire management, and migration of birds (Cape sugarbirds) and large predators (leopards). The coastal corridor is severely threatened by invasive alien plants (black wattle) and coastal developments that are transforming the last remaining natural vegetation.

The Gouritz Initiative involves private landowners and civil society. The initiative's primary aim is to promote responsible and sustainable use of the natural environment. Turning planning and strategising into implementation will only become a reality through cooperation and teamwork amongst role-players. As such, the initiative aims to foster cooperation and a good working relationship between various local and national Departments to ensure a more focussed allocation of resources, and greater equity, efficiency and productivity in the region.

Immediate threats to the region are invasive alien plants, indiscriminate destruction of the remaining natural habitats, over-abstraction of water and private developments. Several initiatives in the area have gone a long way towards conserving and protecting their environment, and reducing the threats to the region. The Fransmanshoek conservancy, together with Kanon Private Nature Reserve and other neighbouring coastal properties east of the Gouritz Estuary established a privately funded initiative aimed at improving marine awareness, compliance and law enforcement. The initiative has since employed two environmental officers to work in the area and carry out the functions of the conservancy as laid down in the conservation management plan. This, together with conservation projects, has greatly increased the conservation status of the area.

Garden Route Initiative

A Garden Route Initiative was established to advise on applying more sustainable approaches to future development in the Garden Route. This initiative covers areas of high ecological importance and sensitivity, and areas experiencing very rapid urbanisation. The Garden Route region has experienced growing resistance from a strong environmental lobby sector to the number of affluent developments that are occurring in this famous holiday destination.


Increasing residential developments in the sensitive Garden Route region

The water resources in this area are already stressed and over-allocation of water during the drier periods is threatening the sustained functioning of sensitive ecosystems along the Garden Route. The initiative is aimed at improving communication between all levels of government, as well as the NGO community, to bring about more proactive planning and better coordination of conservation activities in the Garden Route. Fine-scale biodiversity plans are also being developed to guide planners on where development can take place without compromising biodiversity.

Environmental Education Initiatives

Environmental education is critical to instill an appreciation for the environment within the Gouritz WMA. The following are some of the capacity building initiatives:

Nature's Valley Trust

The Nature's Valley Trust promotes appropriate and sustainable development and attempts to minimise the negative impacts of development in the area. They also create awareness and appreciation for the diversity of natural ecosystems. Activities such as outdoor classrooms, with resource booklets, have been developed for learners.

Garden Route Environmental Education Network (GREEN)

GREEN is an environmental education initiative funded by WESSA in schools in the southern Cape. Teachers and learners from schools of the Mossel Bay/Plettenberg Bay/Oudtshoorn area take part in a range of environmental education activities. These include Eco-Schools, Adopt-a-Beach, workshops and events such as the annual Schools Environmental Expo in George.

Adopt-A-River Initiatives in the Eden District

During 2005/6 Eden District Municipality launched an "Adopt-a-River" project in Riversdale. The main focus of the project is to provide learners and teachers with skills to monitor the health of the local Goukou River system. The overall aim of the project is to instill an understanding and appreciation of the environment in learners and teachers, and transfer knowledge to the greater community.

Adopt-a-River school activities

Adopt-a-River teachers and participants

Environmental Water Requirements (The Reserve)

It is important for water resource managers in the Gouritz WMA to give effect to the environmental water requirements in order to maintain healthy aquatic ecosystems. Environmental water requirements are the water quality and quantity that needs remain in a river, or be released into it, to manage aspects of aquatic ecosystem health. Past water abstractions, or flow manipulations, made without considering the impacts on the ecosystem or on people dependant on that ecosystem, have resulted in many socio-economic and ecological repercussions. Water shortages are a major and growing threat to national and global security. If developments included informed management of river flows and water quality, then water resource use could continue, while achieving conservation aims, ensuring continued subsistence use of rivers, and ensuring better functioning ecosystems.

The National Water Act affords the highest priority to provision of water for the Reserve. The first objective is to ensure that sufficient quantities of water of appropriate quality are reliably available for basic human needs. In terms of current policy, a quantity of 25 litres per person per day has been incorporated for this purpose. The second priority is the provision of water for safeguarding and sustaining healthy ecosystems, including fauna and flora. Currently, only provisional estimates of the ecological water requirements exist for many water resources.

Integrated Water Resource Management

Rivers, wetlands, estuaries and groundwater are all linked within the water cycle. They are also linked to the surrounding land and the human activities that impact on them. To address the inter-related nature of water resources and ensure sustainable, equitable and efficient water use, these water bodies need to be managed in an integrated manner. This means that water availability, quality and use, as well as environmental and socio-economic issues must be taken into account. Coordination and cooperation between decision-makers and water users should take place at all levels.

Informed decision-making that is critical to integrated water resource management, relies on reliable data and information. The River Health Programme (see p. 4) is one of many national monitoring programmes of the Department of Water Affairs and Forestry and provides information on the ecological status and trends of water resources.

Integrated water resource management "promotes the coordinated development and management of water, land and related resources order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of ecosystems" (Global Water Partnership, 2000).

Catchment Management Agencies

The National Water Act (Act 36 of 1998) provides for formal structures and processes for integrated water resource management at a catchment and local level, through the establishment of catchment management agencies, with strong user representation. These agencies provide a forum for government authorities and stakeholders to work towards a consensus on the management and development objectives for a catchment, which plays an important role in integrating land-use and water management.

Fourteen catchment forums were established in the Gouritz WMA, *viz*. the Buffels River, Calitzdorp, Groot Karoo, Prince Albert, Klein Karoo, Plettenberg Bay, Knysna, Wilderness Great Lakes, George, Great Brak River, Hartenbos, Klein Gouritz, Goukou and Duiwenhoks. Forum representatives were elected onto a Gouritz WMA Reference Group, which assisted with the proposal for the establishment of a catchment management agency in the Gouritz WMA. This proposal was submitted to the Department of Water Affairs and Forestry for approval. Once approval has been given, the process of establishing a catchment management agency will be initiated, starting with the appointment of the Governing Board and a chairperson.

Partnerships and community involvement are of utmost importance in maintaining a healthy environment.

Glossary

Alien species are fauna and flora introduced intentionally or by accident from other countries.

Aquatic biota is the community of plants and animals that live in rivers and wetlands.

Biodiversity is the variety and variability of living organisms and their ecological complexes.

Buffer zone is a strip on the outer edge of the riparian zone, which is required to protect the habitat and the water resource.

Ecological importance is the diversity, rarity or uniqueness of habitats and biota and the importance of protecting these ecological attributes.

Ecological sensitivity is to the ability of a specific ecosystem to tolerate disturbances and to recover from certain impacts.

Ecological water requirements the quality and quantity of water needed to maintain a river in a pre-determined state of health.

Endemic species is a species which is only found in a given region or location and nowhere else in the world.

Endorheic systems are inward-draining draining systems in arid areas.

Environmental flow releases are the quantity and variability of water released from impoundments to ensure long-term maintenance and conservation of riparian vegetation and to ensure sustainable resource utilisation.

Ephemeral rivers have intermittent or periodic flow.

Fauna is the collective term for animals living in a particular area.

Flora is the collective term for plants growing in a particular area.

Goods and services refer to the conditions and processes
through which natural ecosystems, and the species that make them up, sustain and fulfil human life.

Gross Domestic Product is the total market value of all final goods and services produced in a country for a given period.

Indigenous species are the fauna and flora occurring naturally in an area.

Instream refers to “within the river channel”.

Mean Annual Evaporation is the average evaporation over a year.

Mean Annual Precipitation is the average rainfall (including snow, hail and fog condensation) over a year.

Mean Annual Runoff is the average yearly available stream flow at a point in the river which has been calculated over a long period of time (usually 50 years or more), assuming a constant level of development.

Ramsar sites are wetlands of international importance. The Ramsar Convention on Wetlands provides a framework for national action and international co-operation for the conservation and wise use of wetlands and their resources.

Recharge is the process where water is added to an aquifer, for example, from rainfall.

Red Data species are plants or animals that are under threat. The Red Data categorisation of species helps to determine their conservation status. The categorisation follows IUCN guidelines and includes categories such as extinct, endangered, vulnerable, near threatened and rare.

Reserve is the quality and quantity of water that is required to provide for basic humans needs and to protect the aquatic ecosystems of a water resource, to ensure sustainable utilisation.

Riparian habitat refers to the habitat on the river bank.

Riparian zone is the area adjacent to a river or water body that forms part of the river ecosystem.

Runoff is water that is not absorbed by the soil and flows to lower part of an area, eventually draining into a stream, river or other water body.

Further Reading

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Web pages to explore are:

C.A.P.E.: www.capeaction.org.za
CapeNature: www.capenature.org.za
Department of Environmental Affairs and Tourism: www.deat.gov.za
Department of Water Affairs and Forestry: www.dwaf.gov.za
Garden Route Initiative: www.gardenroute.com/waleaf/projects.htm
Gouritz Initiative: www.gouritz.com
South African National Parks: www.sanparks.org
Water Research Commission: www.wrc.org.za
Working for Water: www.dwaf.gov.za/wfw
River Health Programme: www.csir.co.za/rhp

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