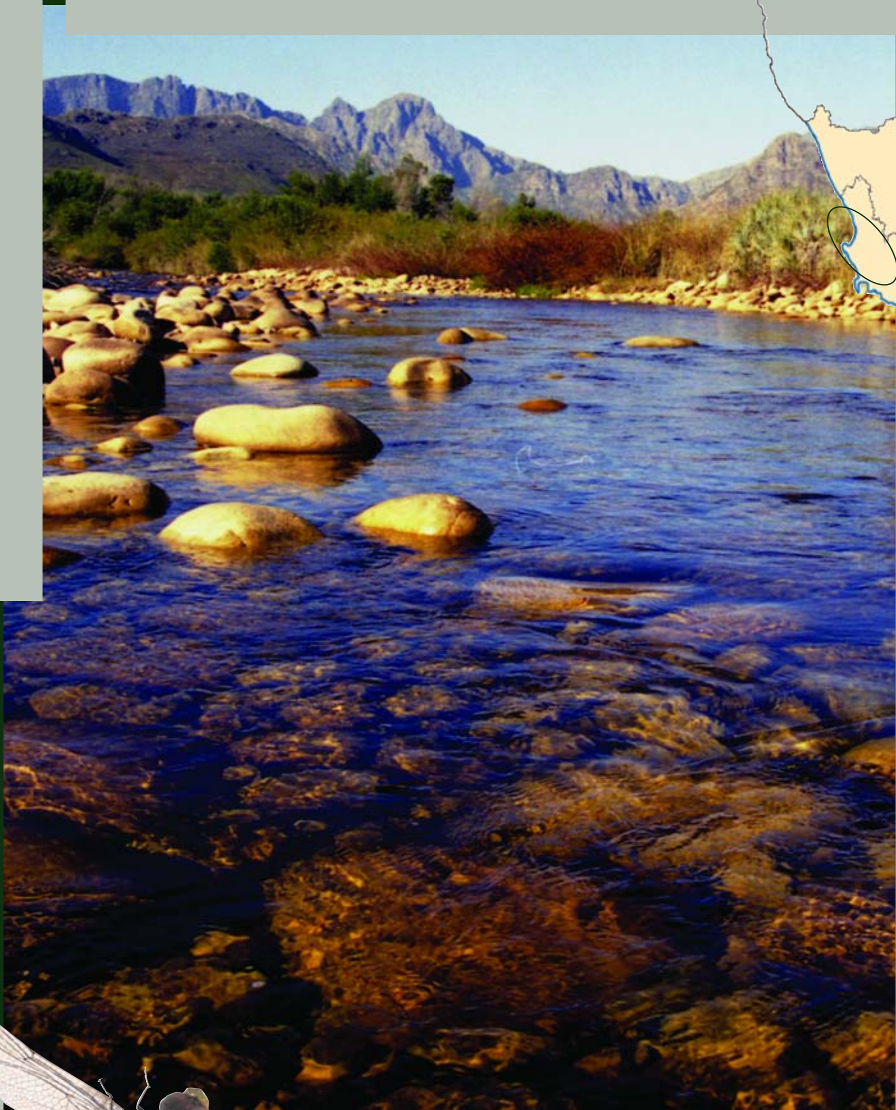
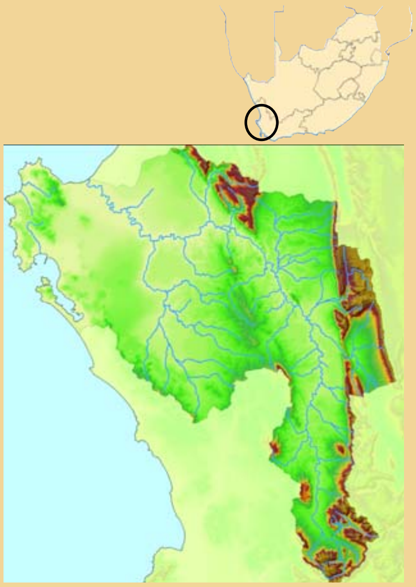
STATE-OF-RIVERS REPORT

BERG RIVER SYSTEM - 2004



RIVER HEALTH PROGRAMME



Summary

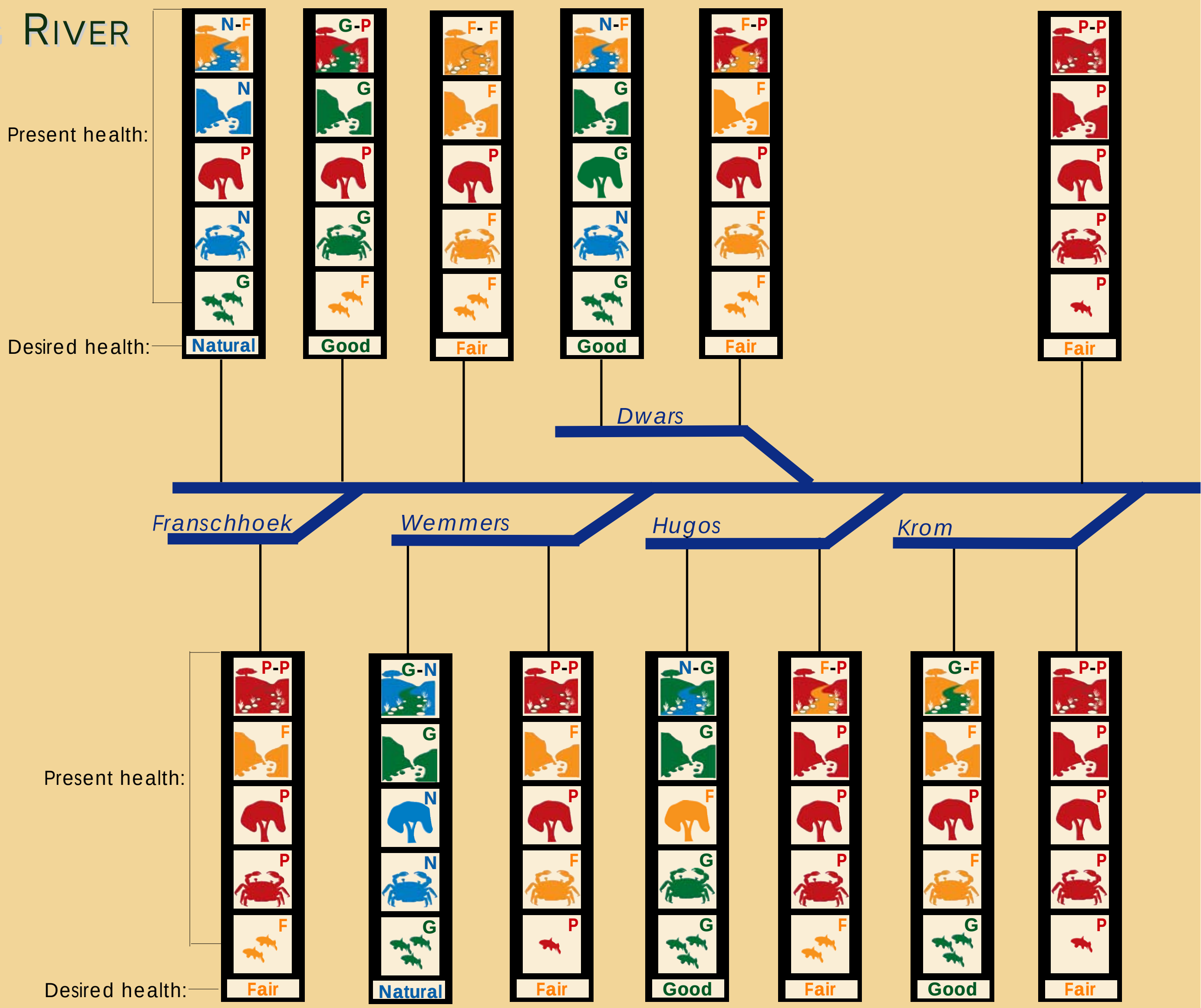
Berg River System - 2004

The Berg River rises in the Franschhoek and Drakenstein mountains. It flows northwards past Paarl, Wellington, Hermon and Gouda, where it is joined by the Klein Berg and Vier-en-Twintig rivers. The Berg River then flows westwards past Porterville, Piketberg, Hopefield and Velddrif to discharge into St. Helena Bay on the west coast.

River health Indices (p. 5):

- Index of Habitat Integrity
- Geomorphological Index
- Riparian Vegetation Index
- South African Scoring System
- Fish Assemblage Integrity Index

Berg River



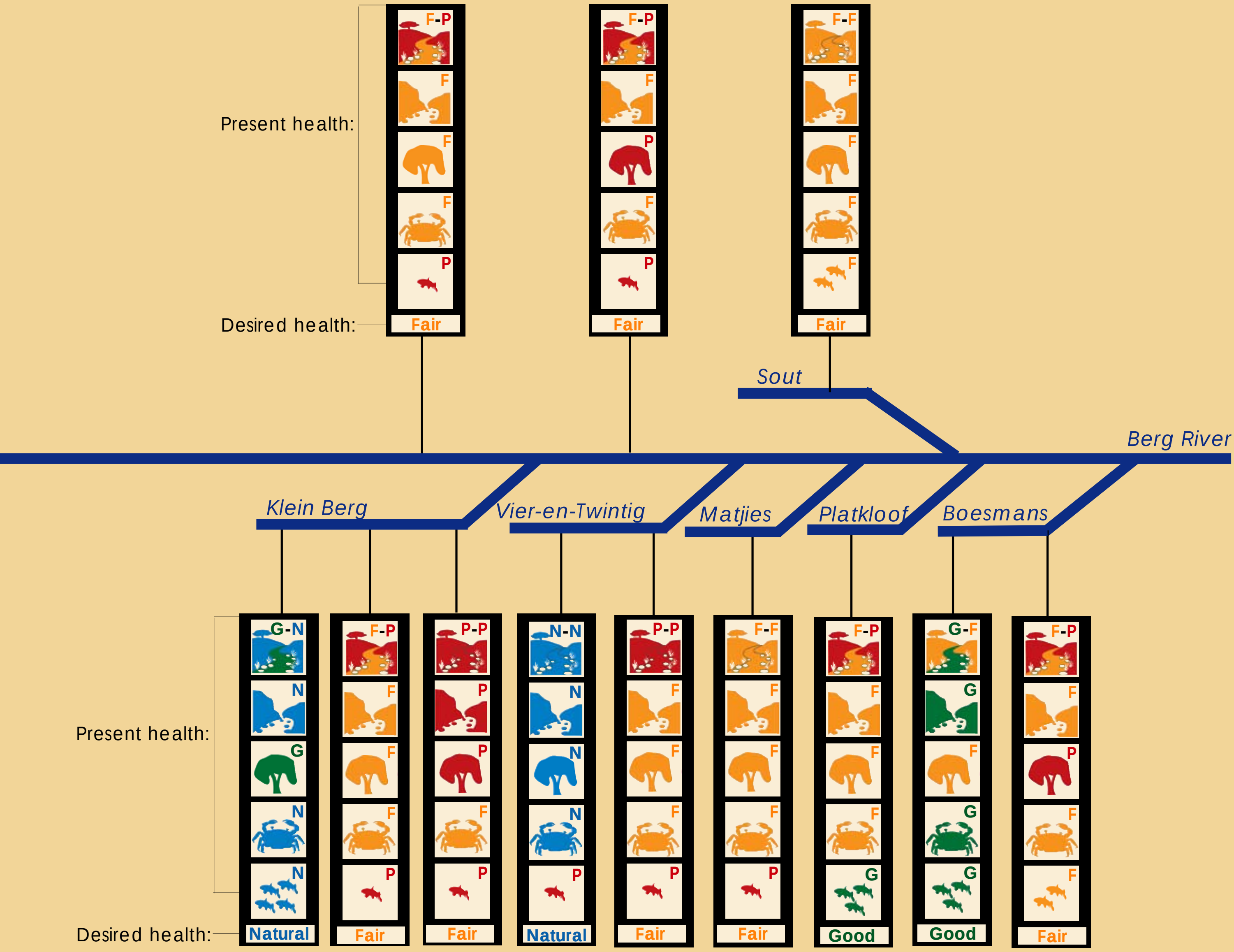
Cultivation of grapes and deciduous fruit is the backbone of the economy in the Berg River catchment. North of Wellington, dryland grain farming and sheep farming predominate. Commercial pine forests occur near the headwaters, around Franschhoek. The major industries in the Berg River basin are agriculturally based and include wineries, canneries and other food processing factories. Only the upper catchment of the Vier-en-Twintig River remains in an essentially natural state.

UPPER BERG RIVER & TRIBUTARIES Habitat integrity and water quality in the Berg River deteriorate downstream as a result of alien vegetation encroachment (*Acacia sp.*), the interbasin transfer of water and river modification. Urban and agricultural development affect the water quality at Franschhoek (municipal and wine farm effluent). The lack of environmental flow releases from Wemmershoek Dam results in a severely altered flow regime and habitat downstream.

UPPER MIDDLE BERG RIVER & TRIBUTARIES River health is reduced in the tributaries as a result of alien vegetation infestation and agricultural development (river modification, water abstraction, runoff). Water quality and habitat integrity in the Berg River and lower reaches of these tributaries are reduced due to urban development.

LOWER MIDDLE BERG RIVER & TRIBUTARIES Diversion weirs in the Klein Berg and Vier-en-Twintig rivers have altered flow patterns. Alien fish (bass and banded tilapia) are widespread and have led to the disappearance of indigenous fish (Berg River redfin and whitefish). River health is also reduced by the effects of agriculture (levees and pesticide residues). Water quality and habitat integrity near Tulbagh are poor.

LOWER BERG RIVER & TRIBUTARIES Farming practices (riparian vegetation removal, bed modification, water abstraction) and alien vegetation (black wattle, river gum) impact on the habitat integrity and flow of the rivers. Flow releases are made from the bottom of Misverstand Dam and reduce water quality. Alien fish (banded tilapia and carp) prey on or compete with indigenous fish.



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Foreword

The River Health Programme (RHP) has been in existence since in 1994. It is therefore by no coincidence that while South Africa celebrates a decade under democratic government, the RHP is also looking back at its humble beginnings. This programme was initiated out of a need to understand the status and trends of our water resources and is very much in support of our Constitution in ensuring our right to a health and safe environment. Government policy has also since 1994 focused strongly on equitable and sustainable social and economic development for the benefit of all. To achieve this, our water resources need to be monitored, assessed and reported on.

A variety of organizations, researchers and scientists have gathered the information presented in this State of Rivers Report to enable the identification of trends and emergent patterns and to assess management responses to change. The value of the report lies in the fact that it informs 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. We are not managing rivers for the rivers sake but to ensure that future generations can continue to enjoy them.

The Berg River is an important contributor to the economic and social well-being of the greater Cape Town area. It provides water to towns, cities, rural communities, farmers and recreational users in the area. A large percentage of the country's wheat and wine farming occurs here and contributes towards the economy of the country. Tourism is a growing industry in the Western Cape, relying heavily on the goods and services that the Berg and other rivers provide. With the construction of the proposed Berg River dam soon to begin, it is important that both water resource managers and the users of the Berg River understand the current state of the river. This report, a joint initiative between the Department of Water Affairs and Forestry, the City of Cape Town, Western Cape Nature Conservation, TCTA and a number of other organizations, thus gives voice to the river and the services that it provides.

Director-General
Department of Water Affairs and Forestry

Suggested Citation:

River Health Programme (2004). State-of-Rivers Report:
Berg River System.
Department of Water Affairs and Forestry
Pretoria
ISBN No: 0-620-32075-3

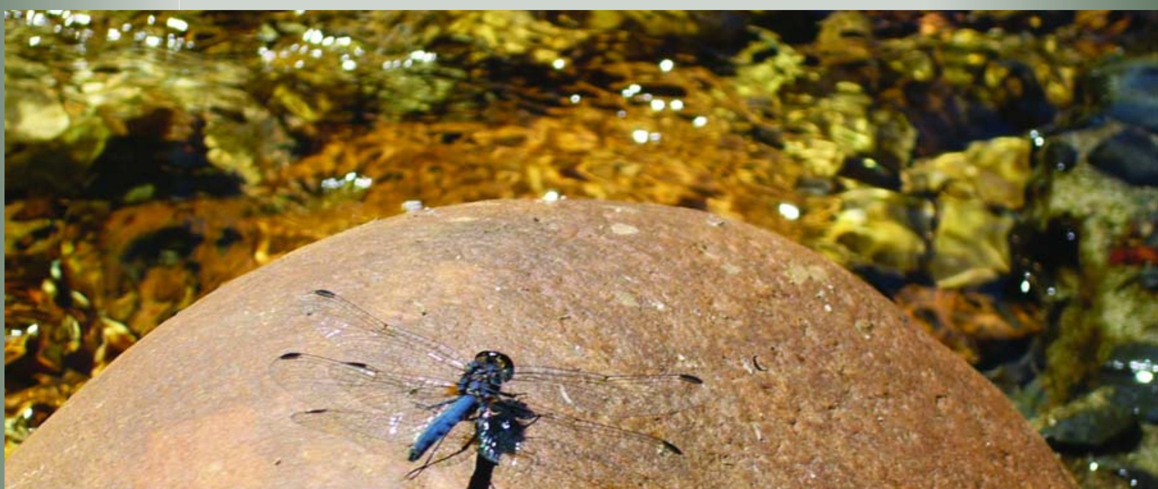
Acknowledgements

Roger Bills (SAIAB), Alan Channing (UWC), B. Cilliё, Margot Collett (SAIAB), A. Fanfoni, Annelise Gerber (DWAF), Martin Hendricks (UWC), Liesl Hill (CSIR), Mike Killick (CCT), Steve Lamberth (MCM), Gareth McConkey (DWAF), MuseumAfrica, State Archives, C. Weatherby (UWC), Wellington Museum, West Coast Fossil Park, U. van Bloemstein (UWC)

CONTENTS

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 BERG RIVER SYSTEM AS PART OF THE RIVER HEALTH PROGRAMME, WESTERN CAPE. THESE SURVEYS TOOK PLACE DURING 2003.



Introduction

Water Policy, Legislation and Management

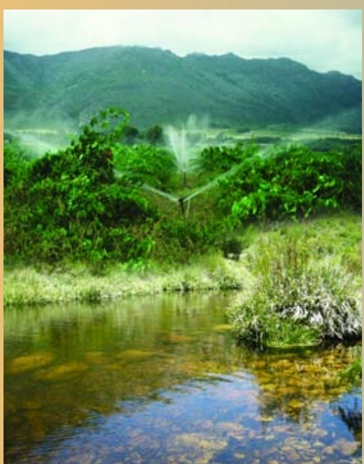
Central to South Africa's water resource management policy and legislation, is the need for equitable and efficient water use on a sustainable basis. The National Water Act (Act 36 of 1998) is the principle legal instrument for the protection, use, development, conservation, management and control of our water resources. The National Water Resources Strategy provides a long term plan of how the Act is to be implemented. To give effect to the inter-related objectives of sustainability and equity, a protective approach to water resources management has been adopted by setting objectives for the desired resource condition and limiting the impact of water use.

How do we protect our water resources?

Water resource protection is closely linked with its use. The National Water Act requires that we protect the water resources (rivers, wetlands, estuaries and aquifers) so that we can benefit from their ecosystem services, now and in the future.

Protection means to "look after and use wisely" and not to "keep separate and not use". We must use water and aquatic ecosystems for social and economic development and for poverty eradication. The amount to which that water resource is used is closely linked to the health of that ecosystem and the services that it provides. People can choose the level to which a resource is used or protected.

Globally the security, stability and environmental sustainability of all nations, particularly those in the developing world are threatened by a water crisis. This issue is highlighted in the following quotes arising from the 2nd World Water Forum in The Hague, 2000:



“Water resources, and the related ecosystems that provide and sustain them, are under threat from pollution, unsustainable use, land-use changes, climate change and many other forces. The link between these threats and poverty is clear, for it is the poor who are hit first and hardest “ (Ministerial Declaration, 2nd World Water Forum).

“On the one hand, the fundamental fear of food shortages encourages ever greater use of water resources for agriculture. On the other, there is a need to divert water from irrigated food production to other uses and to protect the resource and the ecosystem. Many believe this conflict is one of the most critical problems to be tackled in the early 21st century” (Global Water Partnership).

“We need a Blue Revolution in agriculture that focuses on increasing productivity per unit of water – more crop per drop” (Secretary General Kofi Annan, United Nations).”

What goods and services do water resources provide?

All life and all sectors of the economy depend on water. We cannot live without water.

In South Africa most of our freshwater resources are obtained from rivers.

- Rivers supply water to farmers and rural communities for crops and livestock, as well as to support towns, cities, mines, industry and power generation.
- Rivers process and dilute waste.
- People need water for drinking, cooking food, washing and for health.
- Rivers supply natural products such as reeds and fish.
- Rivers provide places for recreation, tourism and religious rituals.
- Rivers sustain plants, animals, habitats and ecosystem processes that are important for nature conservation.

What is Integrated Water Resource Management (IWRM)?

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

IWRM is based on the concept that different water resources (rivers, wetlands, estuaries and ground-water) are all linked by the hydrological cycle to each other, the surrounding environment and human activities that influence them. Thus, in order to ensure sustainable, equitable and efficient water use, water resources need to be managed in an integrated manner that takes into account water availability, quality and use, as well as the environmental and socio-economic issues. IWRM requires co-operation and co-ordination between decision makers from an international to local level. Water users must participate in the management of water resources at all levels.

IWRM is also about providing sufficient information about water resources for informed decision-making. The River Health Programme is one such monitoring programme which provides water resource managers with information on river health and allows them to manage South Africa's water resources in an ecologically sound way.

Introduction (Continued)

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.

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 us to report on the ecological state of our river systems in an objective and scientifically sound manner. Information from the River Health Programme allows for the identification of those areas where unacceptable ecological deterioration is taking place. This programme reflects the effectiveness of existing river management policies, strategies and actions.

The monitoring of aquatic ecosystem health is a legal requirement under the National Water Act of 1998 and the results are important for the application of the National Environmental Management Act (1998). 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.

Why Do We Monitor and Report on River Health?

'River health' is the overall condition of the river. The term can be compared to the health of a person or an economy. Rivers are central to our welfare and economic development. Their health is essential for our well-being.

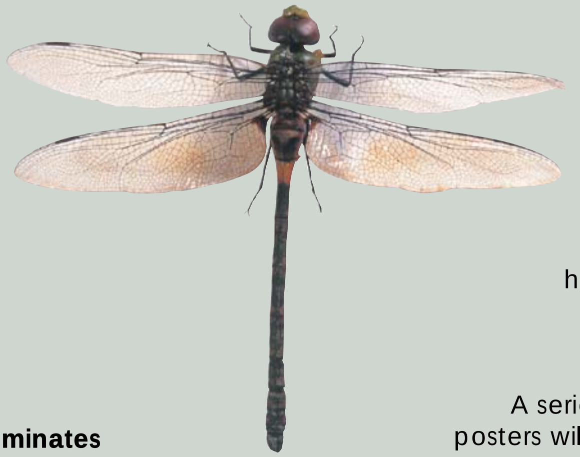
Healthy rivers provide goods and services which contribute to human welfare and economic growth. Knowledge of the impacts on a river provides insight into why the river is in its present health.

What are State-of-Rivers Reports?

State-of-Rivers reporting is an offshoot of State of the Environment (SoE) reporting which has become popular over the past decade. The aim is to provide better information for environmental decision-making. The national SoE for South Africa 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-River reporting disseminates information on river health to:

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



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 river in detail.

Each section consists of two double page spreads outlining the catchment area, present and desired health, pressures on the river and key management actions needed.

A series of River Health reports or posters will eventually cover all major river systems in South Africa. These will be regularly updated.

River Health Indices

What are River Health Indices?

Many physical, chemical and biological factors influence river ecosystem health, e.g. geomorphology, hydrological and hydraulic regimes, water quality, instream and riparian habitats and a host of biological processes. The River Health Programme focuses on selected ecological indicator groups that represent the larger ecosystem and are feasible to measure. This report uses river health indices to present data in an easy-to-understand format. The following indices have been used in this report:

Index of Habitat Integrity (IHI)

The availability and diversity of habitats are major determinants of the biota that are present in the river. The IHI assesses the impact of human disturbance on the riparian and in-stream habitats.

Geomorphological Index (GI)

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

South African Scoring System (SASS)

Aquatic invertebrates (e.g. insects) require specific habitats and water quality conditions for at least part of their life cycle. Invertebrates are good indicators of recent localised conditions in a river. SASS is a relatively simple index, based on invertebrate families found at a site.

River Health Categories

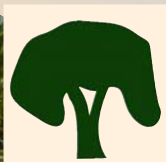
The **present health** of a river is a measure of the present ecological state of the river during the time of the survey and is presented in terms of the river health categories given below.
The **desired health** of a river is the envisioned future ecological state of the river. It is based on ecological considerations, the need for sustainable development and management actions concerning the river environment.

Desired health: Good

River Health Category	Ecological Perspective	Management Perspective
Natural N	No or negligible modification	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, with tolerant or opportunistic species dominating	Multiple disturbances associated with the need for socio-economic development
Poor P	Mostly only tolerant species present; alien species invasion; disrupted population dynamics; species are often diseased	High human densities or extensive resource exploitation

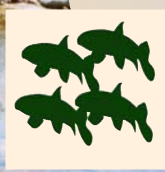
Riparian Vegetation Index (RVI)

Healthy riparian zones help to maintain the form of the river channel and serve as filters for sediment, nutrients and light. Plant material from the riparian zone is an important source of food for aquatic fauna. RVI is a measure of the degree of modification of the riparian zone from its natural state.



Fish Assemblage Integrity Index (FAII)

Fish are good indicators of long-term influences on general habitat conditions within a reach. The FAII is an expression of the degree to which a fish assemblage deviates from its undisturbed condition. The FAII was adapted to make it applicable to rivers with low fish diversities.



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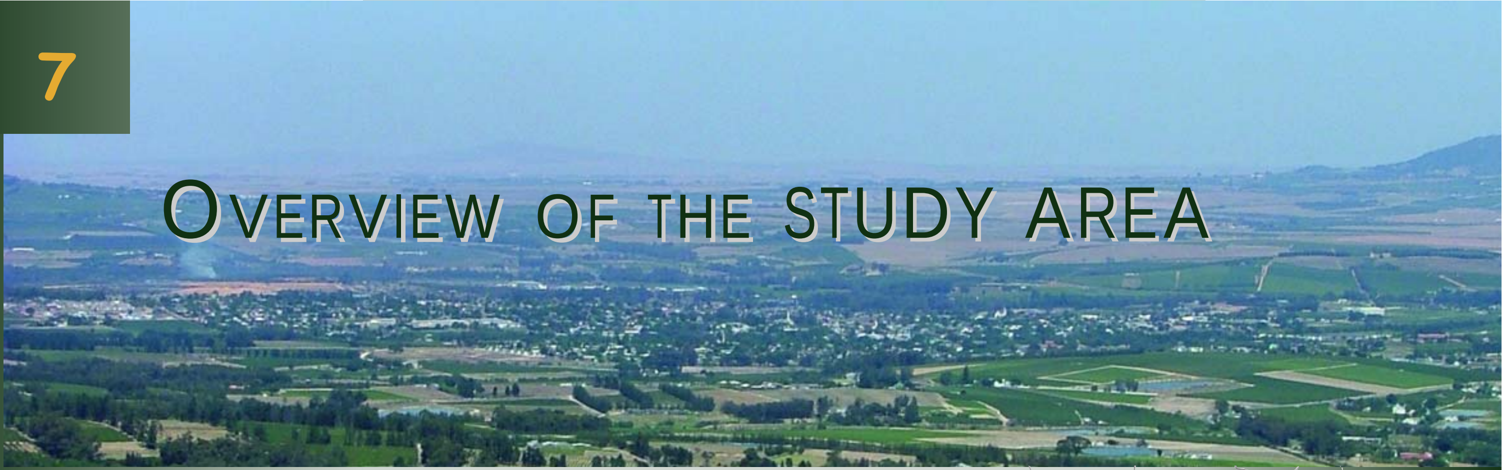


OVERVIEW OF THE STUDY AREA

The Berg River drains an area of approximately 8 980 km^2 and has a total length of about 285 km. It has nine major and seven minor tributaries, six of which were naturally perennial, namely the Franschhoek, Wemmershoek, Dwars, Klein Berg, Vier-en-Twintig and Matjies rivers.

The Berg River rises in the Franschhoek and Drakenstein mountains at an altitude of 1500 m. It flows northwards past Paarl, Wellington, Hermon and Gouda, where it is joined by the Klein Berg and Vier-en-Twintig rivers. The river then flows westwards past Porterville, Piketberg and Velddrif where it finally discharges into St. Helena Bay on the west coast.

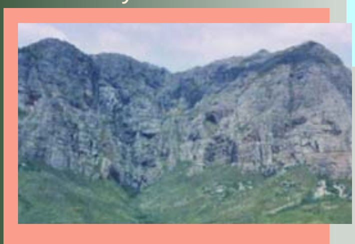
The Berg River catchment falls within the winter rainfall region of the south-western Cape. Rainfall in the catchment increases from west to east. Most of the original vegetation has been replaced by agricultural and urban development, with the last remnants of natural vegetation found on the higher lying areas where steep slopes are not conducive to development.

	Upper Berg River & Tributaries	**Upper Middle Berg River & Tributaries**	**Lower Middle Berg River & Tributaries**	**Lower Berg River & Tributaries**	**Floodplain & Estuary**
Main Tributaries	Franschhoek, Wemmershoek	Dwars, Hugos, Krom, Kompanjes, Bot, Doring, Sand	Klein Berg, Vier-en-Twintig, Drieheuwels	Matjies, Boesmans, Platkloof, Sout	
Catchment size (km^2)	298	1 016	1 987	3 606	2 005
Geology	Table Mountain Group (quartzitic sandstone), Sandy sediments	Table Mountain Group (quartzitic sandstone), Malmesbury Group (shale), Cape Granite Suite, Sandy sediments	Table Mountain Group (quartzitic sandstone), Malmesbury Group (shale), Klipheuwel Group, Sandy sediments	Table Mountain Group (quartzitic sandstone), Malmesbury Group (shale), Cape Granite Suite, Sandy sediments	Cape Granite Suite, Sandy sediments
Vegetation	Fynbos (Sandstone, Alluvium, Afromontane Mires)	Fynbos (Alluvium, Afromontane Mires, Sand, Sandstone), Renosterveld (Shale, Granite)	Fynbos (Sandstone, Shale, Alluvium), Shale Renosterveld	Fynbos (Sand, Sandstone, Alluvium), Renosterveld (Shale, Granite, Silcrete, Alluvium)	Fynbos (Sand, Shale) Strandveld (Calcareous, Dune, Granite, Limestone)
Mean annual precipitation (mm)	1 412	817	722	394	300
Mean annual evaporation (mm)	1 495	1 548	1 624	1 540	1 460
Mean annual runoff (m^3)	277 X 10^6	263 X 10^6	288 X 10^6	97 X 10^6	17 X 10^6

The main ecoregion in the Berg catchment is the South Western Coastal Belt. Small areas of the Southern Folded Mountains and the Western Folded Mountains regions occur in the south and in the west.

The **South Western Coastal Belt** is typified by renosterveld-covered plains.

The **Western Folded Mountains** are typically moderate to high mountains covered with Mountain Fynbos.



The **Southern Folded Mountains** consist of moderate to high mountains covered by Grassy and Mountain Fynbos and Little Succulent Karoo.

Ecoregions and Geomorphological Zones

Ecoregions and geomorphological zones are a way of grouping areas of similar ecological characteristics (e.g. climate, geology and vegetation) and geomorphological features (e.g. slope). These features are important factors influencing the distribution of biota associated with different zones.

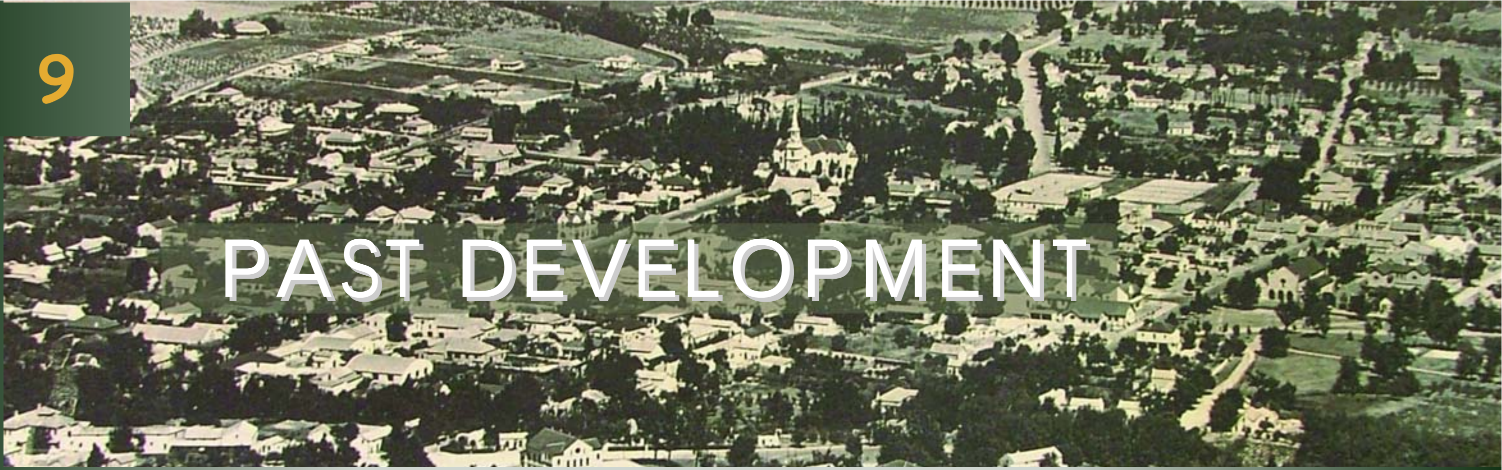
Mountain Stream Zone

Upper Foothill Zone

Rejuvenated Foothill Zone

Lowland River Zone

Lower Foothill Zone



PAST DEVELOPMENT

The San, people whose genetic origins can be traced back to the beginning of modern humanity, were the first known indigenous inhabitants of the Berg Catchment. They were widely dispersed, occurring mostly in the lowlands, and subsisted by hunting game with bows and arrows and gathering edible plants and honey. The distribution of the San across the region varied according to the availability of food and water and required these hunter-gatherers to alter their kinship group sizes from time to time.

Approximately 2000 years ago, Khoekhoe pastoralists moved into the area and started competing with the San for game. Evidence shows that these first farmers were sheep herders, with cattle being introduced some 500 years later. Due to the low nutritional value of the fynbos, the Khoekhoe groups were forced to follow a nomadic lifestyle. A Khoekhoe group, the Cochoqua, followed set grazing routes between Saldanha Bay and the Swartland throughout the year.

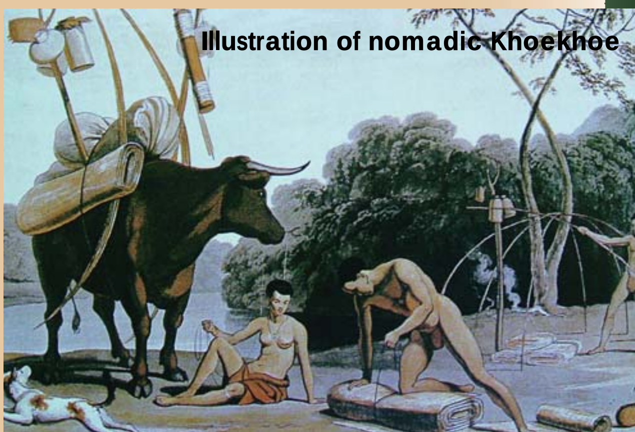
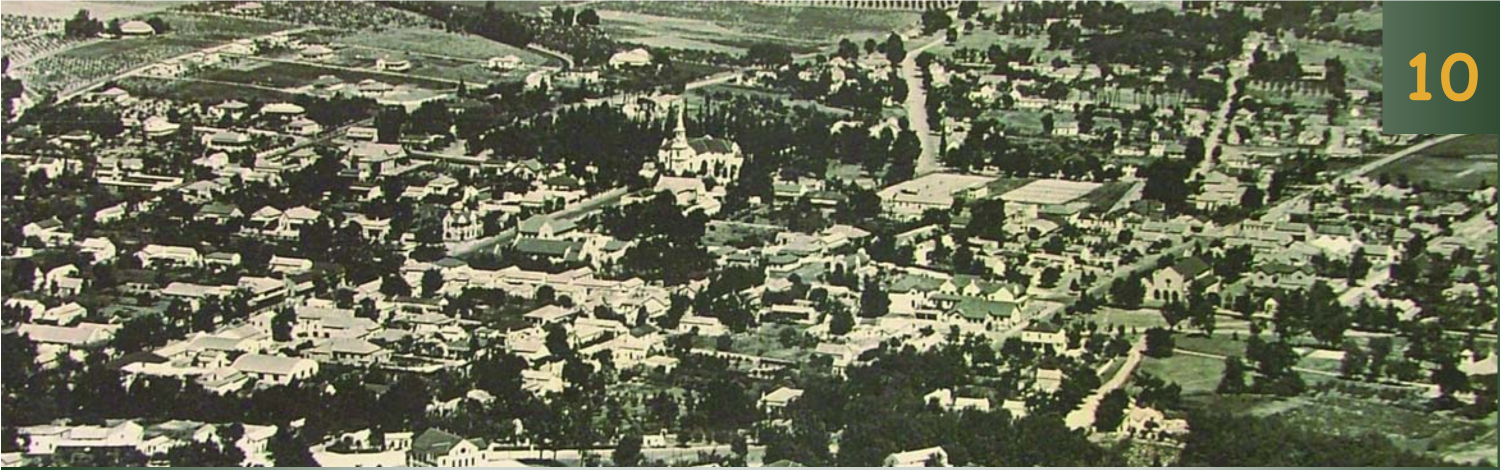


Illustration of nomadic Khoekhoe

Although the Khoekhoe were herders, they relied on the same water resource for crop-growing and on game to supplement their diet. This led to conflict between the two groups but due to the vastness of land in relation to their low numbers, co-existence was possible and their impact on the surrounding environment was small. It was not until the arrival of the first Europians in the seventeenth century that the way of life and existance of both the San and the Khoekhoe was seriously threatened. Conflict with the colonists resulted in the virtual disappearance of the San while the Khoekhoe continued to trade with the Dutch. Conflict over land, disease and enslavement resulted in the Khoekhoe living a precarious existance, where much of their language, religion and cultural heritage was lost.

Rock painting, with eland a common image in rock art of the Western Cape



The first known European record of the Berg River was made by bailiff Abraham Gabbema in 1657 when Dutch Governor Jan van Riebeeck sent him to trade with the Khoekhoe for meat for the settlement at the Cape. Gabbema named the river the 'Groot Berg Rivier'. In years to follow many of van Riebeeck's men relied on the river waters and followed its winding course as they ventured northwards. Despite Gabbema's visit, the Berg Catchment was not developed until Governor Simon van der Stel's time (1679 – 1699), prior to which settlement was limited to the Peninsula. Governor van der Stel visited the area with the first free burghers, and prompted by the Berg River's fertility and beauty, he established the first European settlements at Paarl and the Drakenstein valley in 1687.

The first pontoon across the Berg River was established in 1732 at Kalkoentjies Drift

Wellington, Franschhoek and Tulbagh were established shortly after this as the farmlands expanded. These towns became home to the Huguenots who brought with them an intellectual property that was to transform the Cape: wine-making skills. Although fruit grew in abundance, it was considered of little value and much of it was left to rot. In 1886 several boxes of grapes were transported to London and sold for 15 shillings per pound compared to a penny per pound in Cape Town. This was the birth of the fruit export industry.

Huguenot Bridge, Paarl

In 1699, Governor Willem van der Stel granted licences to stock farmers to graze stock in the Swartland to the north of Cape Town, as far as Riebeek-Kasteel. Later, during the nineteenth century, the towns of Hopefield, Moorreesburg, Darling, Porterville and Piketberg were established and grain farmers joined the stock farmers.

EARLY SCIENTIFIC ENDEAVOURS

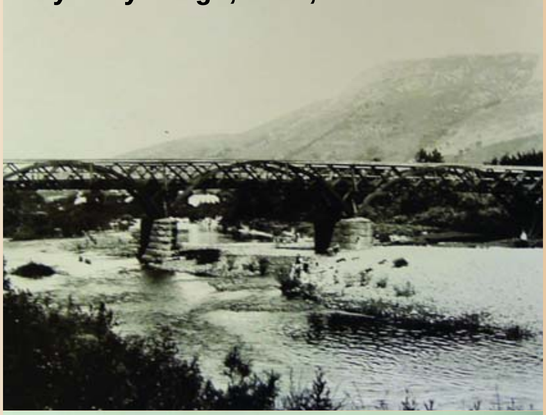
The Berg River was the first river in South Africa on which a detailed limnological and chemical study was conducted. A.D. Harrison and J.F. Elsworth undertook the study and sampling spanned a period of 3 years, beginning in May 1950. Although initially intending to determine the biological effects and indicators of pollution, the objectives of the study shifted to assessing the biota and conditions of life in an unpolluted South African river. The data obtained from the study provides a firm basis for the historical faunal communities and zonation patterns occurring along the river course. This study was not only the first of its kind in South Africa, but aided in the development of methods and provided fundamental concepts for South African river biology.

PAST DEVELOPMENT (CONTINUED)

Various manipulations of the Berg River over the past three hundred years have provided water for surrounding agriculture. In 1852, Sir Thomas Bain, a prominent engineer at the time, and Gawie Retief, constructed one of the first major water diversion schemes in South Africa at a cost of R2 800. Water from the Witte River (a tributary of the Breede River) was diverted via a furrow to the Krom River, a tributary of the upper Berg River. This became known as 'Gawie se Water'.

In 1886, Bain suggested that the Klein Berg River be dammed and that surplus water be stored in 'a small periodical lake named Vogel Vley'. Bain's advice was taken and expanded upon. Today the Voëlvlei Dam can be found a few kilometres south of Gouda. This led to the loss of a rare and valuable wetland.

Lady Grey Bridge, Paarl, 1853

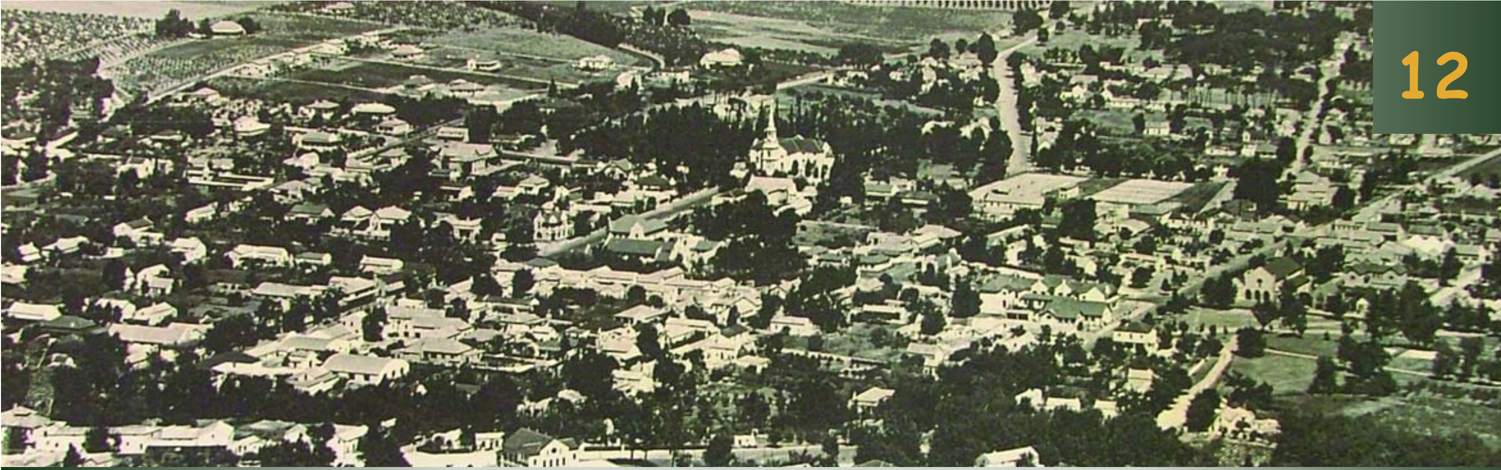


Pont crossing the estuary at Velddrif

One of the first bridges across the Berg River was the Lady Grey Bridge, opened in 1853 and formed the first uninterrupted connection between Paarl and Wellington.

In 1850, a bridge was constructed at "de Brug" on the middle Berg River, just upstream of the present day N7 bridge. The bridge, constructed in England, was originally bound for Australia, but the ship transporting it needed to stop in Cape Town for repairs. In order to do the repairs, the bridge was offloaded, but could not be reloaded. Subsequently, a section of the Berg River, narrow enough to accommodate the bridge was selected, and the bridge found a new home over the Berg River.

The coastal route from the Sandveld, originally forded the river at Velddrif, but was also later moved to a concrete bridge about 5 km upstream of the river mouth.



Although not a navigable river in its upper reaches, the lower reaches of the Berg River were used for many years as a means of transport. The sand bar at the mouth of the Berg River proved a major problem for navigation as it could not be crossed by large boats except at high tide, and could never be crossed during bad weather. Laaiplek (the loading place) served as a shipping point for wheat and other goods transported down the Berg River.

The idea of cutting a path through the sandbar was first mooted in 1786. Almost 200 years later, in 1966, a deeper, artificial channel was finally blasted, linking the river and St. Helena Bay, and bypassing the silting estuary. Breakwaters were built and the fishing harbour was finally completed. The remains of the former mouth channel which lay approximately one kilometer south of the present mouth now form a 'blind arm'.

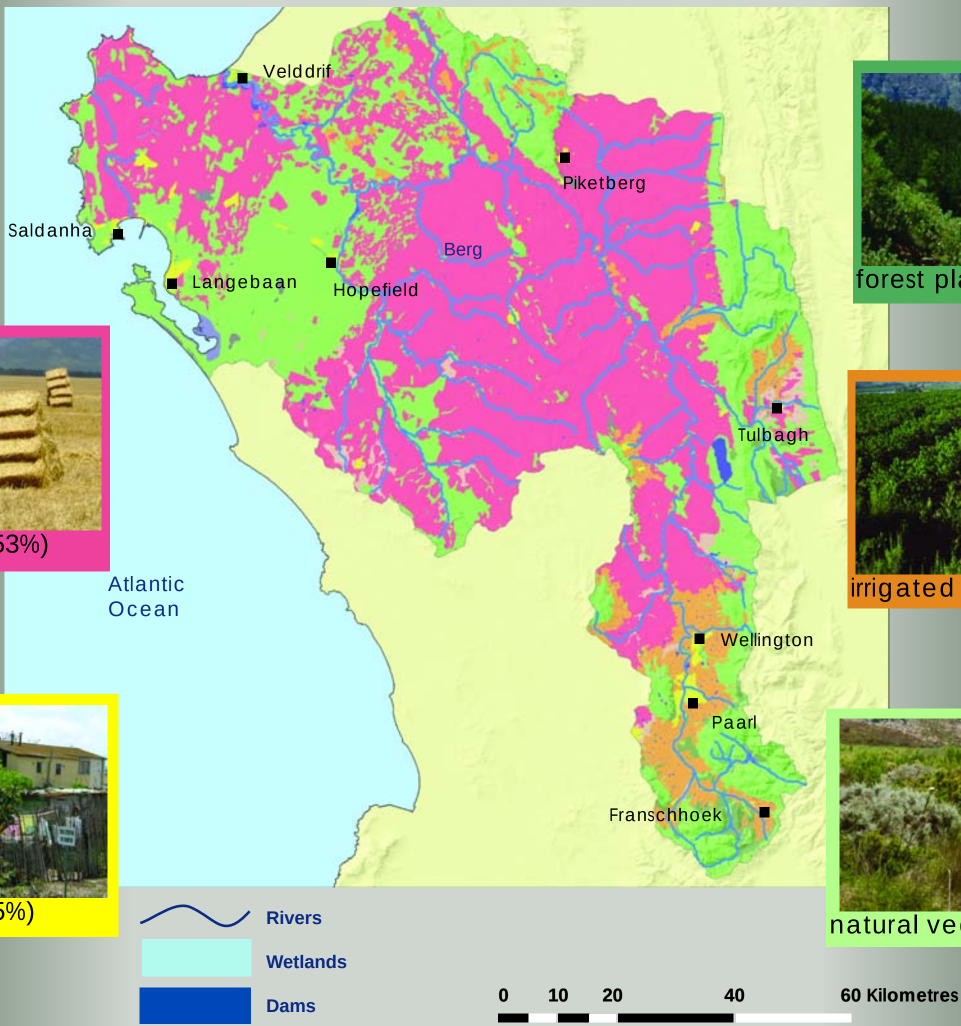
Legend has it that the little sailing cutter ‘Alabama’ carried cargoes up and down the Berg River, and would often come into Table Bay loaded with dekriet (thatch), which was harvested along the Berg River. The dekriet was used for wedding beds of Cape Malay brides. From this originated the Malay folk song “Daar kom die Alabama”.

HIPPOPOTAMI IN THE BERG RIVER

Historically, the Berg River was one of many habitats in the Cape inhabited by hippos but, in the late 1600s, hunters began overexploiting the hippos for their meat and hides, resulting in a decline in their numbers. By the mid-1700s, they had declined to such an extent that governor Tulbagh introduced a fine of 1000 guilders for anyone caught killing a hippo. Despite this protection, their numbers continued to dwindle as human settlement altered and destroyed their habitat. By the early 1800s, perhaps only a dozen remained, sheltering in the region of Kersefontein and the estuary. In 1829, only six hippos remained. The last known hippo was shot in 1869 by Martin Melck when it attacked and killed one of his employees.

LAND-USE

LAND-USE WITHIN THE CATCHMENT comprises mainly dryland wheat farming, livestock farming, forestry, industry, fruit farming, urban areas and nature conservation.




forest plantations (<1%)

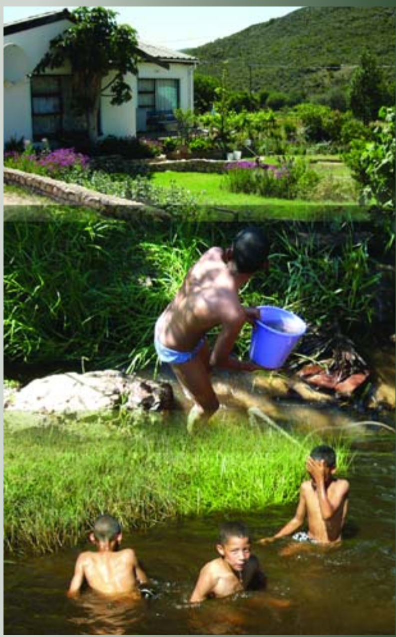

dryland crops (53%)


irrigated crops (7%)


urban areas (2.5%)


natural vegetation(36%)

	Upper Berg River & Tributaries	Upper Middle Berg River & Tributaries	Lower, Middle Berg River & Tributaries	Lower Berg River & Tributaries	Floodplain & Estuary
Main land-use per catchment	Natural vegetation	Irrigated crops	Dryland agriculture	Dryland agriculture	Dryland agriculture Natural vegetation
Dams	Wemmershoek	Nantes, Bethel	Voëlvlei	Misverstand	-
Total dam capacity (Mm^3)	64 (23% MAR)	32 (12% MAR)	189 (66% MAR)	13 (14% MAR)	-
Main dam water usage	Domestic	Domestic	Domestic Irrigation	Domestic Irrigation	-
Population (Urban)	24 345	174 665	21 193	33 805	75311
Population (Rural)	4 317	37 141	19 236	15 729	8813
Population with water services (%)	99	99	91	87	92



Population

The total population in the Berg River catchment for 2004 is estimated at about 420 000. About 79% lived in urban areas and 21% lived in rural areas. The majority of the population is concentrated in urban areas (e.g. Paarl) where they are attracted by economic activity and employment opportunities. Population density in the winelands is moderate, becoming sparse to the north and west, reflecting the combined influence of climate and economic activity.

The average population growth is about 3.2% per annum. The urban population increased at 3.4% per annum and the rural population at 1.4% per annum. Future population growth is expected to increase in the urban areas, as economic opportunities and potential increase. As the potential for agriculture is not expanding, little change in the rural component of the population is expected.

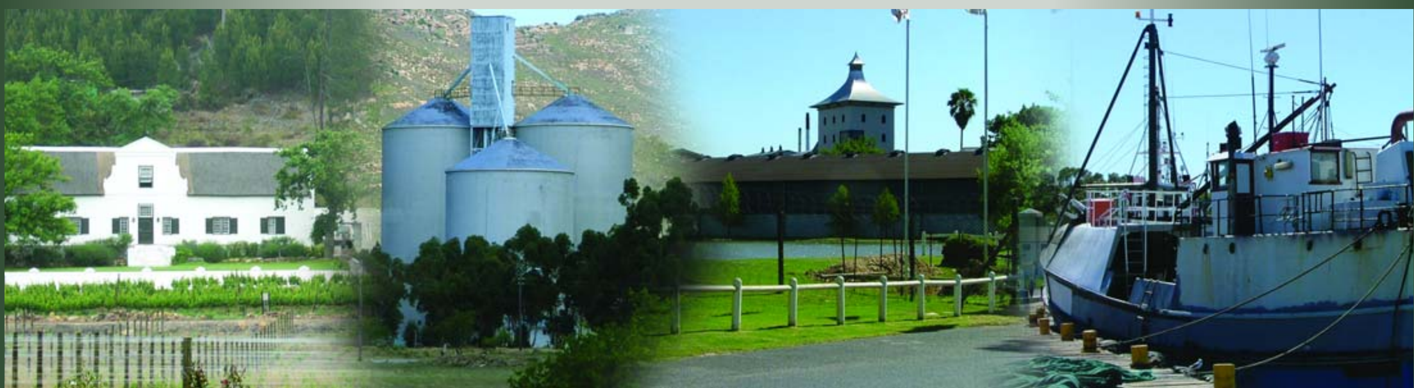
Economic Profile

The major industries in the Berg River catchment are agricultural-based (wheat, grapes and deciduous fruit) and include wineries, canneries and other food processing factories. Wineland tourism provides another major source of income.

Dryland grain farming and stock farming (sheep and cattle) dominates much of the area between Wellington and Velddrif. Forestry (pine) is found near Franschhoek. The upper catchment of the Vier-en-Twintig River remains essentially in a natural state and is an important catchment for water supply to Cape Town.

Major sources of income to the Berg River Estuary are tourism and recreation. Port Owen Marina, hotels and guesthouses along the estuary are popular recreational destinations. The estuary is being promoted as a premier bird-watching locality on the Cape coastline. Fishing industries are located on the estuary at Laaiplek and Velddrif. Cerebos salt works also provides further income to the area.

The total Gross Geographic Product for the catchment was twelve billion rand for 1997. This amounted to 2.5% of the Gross Domestic Product of South Africa.



Future Development

Berg Water Project

In May 2002, the South African Government directed TCTA to fund and implement the BWP, a R1,8 billion project to augment the Berg-Riviersonderend Scheme (see p. 18)

The Berg River Dam, previously Skuifraam Dam, is to be built on the Berg River in the La Motte State Forest, about 5 km west of Franschhoek. It is the largest water project currently being implemented in Southern Africa.

To overcome the frequent water restrictions during summer and a growing water demand from the City of Cape Town, the Department of Water Affairs and Forestry decided to implement a new water project linked directly to water conservation and water demand management. This project, known as the Berg Water Project (BWP), will supply water for agricultural use in the lower Berg River and augment the Berg-Riviersonderend Scheme (see p. 18).

The decision followed a comprehensive 14 year study of the current and future water needs of the Western Cape, the available water resources, and an extensive review of all the alternative options. There was an intensive public consultation process, to ensure that all interests, objections and ideas were considered.

The Proposed Development

The BWP will be integrated with the Western Cape Water System and will consist of:

- A 60 m high dam wall with a gross storage capacity of 130.1 million cubic metres and
- An abstraction works on the Berg River below the confluence of the Dwars River that will increase the yield of the system by 25 million cubic metres.

The BWP will augment the yield of the Berg-Riviersonderend Scheme by 81 million cubic metres (18%) to 523 million cubic metres per annum by 2007. The total demand on the supply system is expected to reach 500 million cubic metres per year by 2009 despite highly effective water demand management measures (saving 20% or more of projected consumption) .

TCTA

TCTA is a public entity created in 1986 by a Government Notice to implement the South African part of the Lesotho Highlands Water Project (LHWP). Subsequently, TCTA was made responsible for the financing and debt and risk management of the entire LHWP, except the hydropower station. Currently, TCTA manages R18,3 billion debt on the LHWP. In 2000, the organisation's mandate was expanded to include additional projects in the water sector. Now TCTA also manages the treasury function of Umgeni Water and is responsible to implement and fund the BWP. A Board of Directors, appointed by the Minister of Water Affairs and Forestry, oversees and directs the organisation.

Sound Environmental Practice

By 1997, both the environmental impact assessment for the Berg River Dam and the Berg River Supplement Scheme had been completed. The BWP is the first project in South Africa that is being implemented according to the development guidelines of the World Commission on Dams. The Department of Environmental Affairs and Tourism, in consultation with the provincial Department of Environmental Affairs and Development Planning, issued a single Record of Decision in 1999, granting authorisation for the project.

The authorisation stipulated that an Environmental Management Plan be compiled prior to construction and that a community-based and representative Environmental Monitoring Committee be appointed to ensure effective environmental management of the project. A condition of the authorisation was that Baseline Monitoring should commence as soon as possible and that implementation of the Reserve requirements be undertaken.

Social Considerations

One of the key lasting benefits of the project is the construction of 80 houses in the village of La Motte, preferably by local contractors. These houses will be transferred to the Stellenbosch municipality to the benefit of the local community on completion of the BWP.

Job creation as a result of the BWP is a major consideration. TCTA developed a skills database which underpins an employment framework known as 'Franschhoek First'. It specifies minimum employment and procurement targets for the employment of local labour and small businesses on the project. Other opportunities created by the project include a R20 million Working for Water project in the previous La Motte State Forest, more than 600 direct jobs on the main construction contract, as well as skills development and training programmes that will increase the marketability of the trainees.

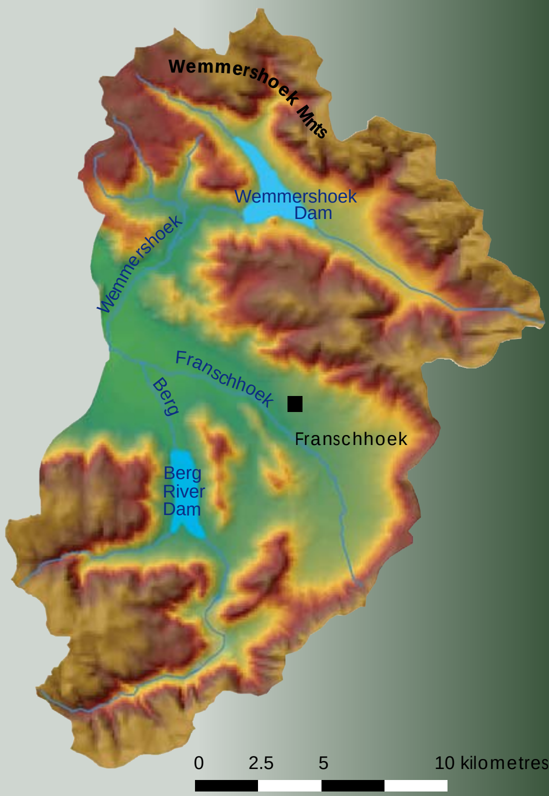
An all encompassing Sustainable Utilisation Plan will be developed by TCTA to ensure the effective utilisation and integration of infrastructure, skills, training, business development and recreational opportunities to benefit all members of the Franschhoek and Dwars River valley communities.

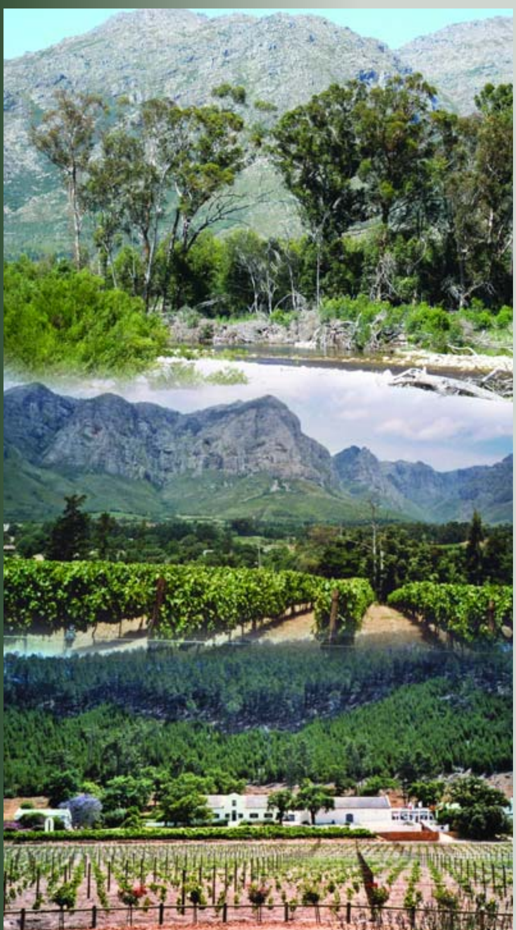
Upper Berg River & Tributaries

The Berg River has its source in the Drakenstein Mountains at a height of 1 500 m. The river drops steeply to its confluence with the Franschhoek and Wemmershoek rivers. This section of the catchment receives high rainfall and accounts for nearly one third of the runoff (267 million cubic metres per annum) of the Berg River.

The mountainous upper Berg River catchment comprises Sandstone Fynbos, plantations and areas invaded by alien trees. The lower lying areas have intensive agricultural development (vineyards and fruit farming).

Alien vegetation infestation (black wattle) is also prolific in the lower reaches of these rivers. Working for Water has a programme to remove alien plants in the upper Berg and Wemmershoek rivers (see p. 18). Much of the pine plantations are currently being cleared to make way for the Berg River Dam, which is under construction on the section of the Berg River that flows through La Motte State Forest (see p. 45).





Franschhoek, the only town in this part of the catchment, obtains its water from bore holes and the Du Toit's River in the Breede System. Wastewater treatment works in Franschhoek (200 cubic metres per day) and Wemmershoek (100 cubic metres per day) discharge treated wastewater into minor tributaries of the Franschhoek and Wemmershoek rivers, respectively.

Wemmershoek Dam on the Wemmershoek River is currently the only large in-stream dam (see p. 18). Many smaller dams provide water to wine and fruit farms in the area.

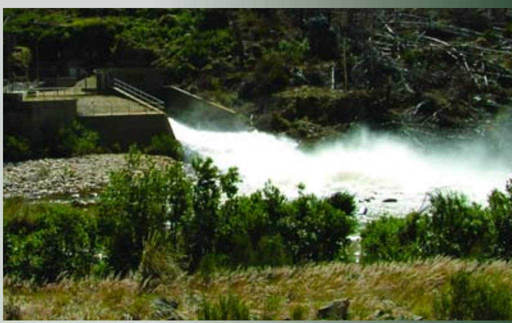
WATER SUPPLY SCHEMES

Wemmershoek Dam (59 million cubic metres) was completed in 1958 to augment water supply to Cape Town, Franschhoek, Paarl and Wellington. Prior to the completion of the Berg-Riviersonderend Scheme (see below), Wemmershoek also released water to supply irrigation demands upstream of Zonkwasdrif, near Gouda.

The Berg-Riviersonderend Scheme (proposed in 1968 and constructed in 1980) transfers water between Theewaterskloof Dam (Breede System) and the Berg River. It consists of four tunnels:

- through the Franschhoek Mountains to the upper Berg River (see Interbasin Transfer below),
- under the Berg River and the Klein Drakenstein Mountains to the Kleinplaas Dam at Jonkershoek,
- from Kleinplaas Dam to an outlet near Stellenbosch, and
- diversion works on the Banhoek and Wolwe rivers which allows surplus winter water to be stored in Theewaterskloof Dam.

Water from the scheme is for domestic use in Cape Town and for irrigation along the Berg River during summer.

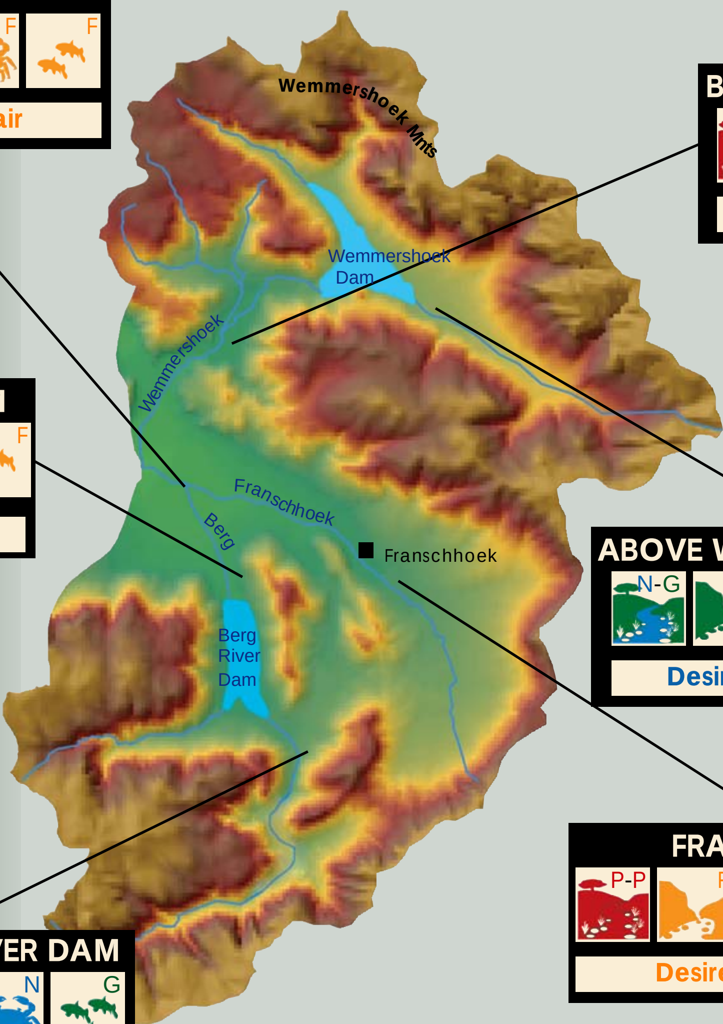


Impending water shortages in Cape Town prompted the design of the Berg River Dam. The dam, approved for completion in 2007, will be located in the upper Berg River near Franschhoek (see p. 15).

INTERBASIN TRANSFER

Water transfers from Theewaterskloof Dam to the upper Berg River in the dry season increase the turbidity and salinity of the water, altering the structure of aquatic macroinvertebrate communities. Large numbers of zooplankton, insect larvae and fish are also transferred through the tunnel, further complicating the species profile. Transfers mainly occur in summer in response to irrigation demand, and increase the flow in the Berg River when it would have been naturally low. There is growing concern regarding the increasingly poor water quality of the water transferred from Theewaterskloof Dam.

Upper Berg River & Tributaries – Present State



JIM FOUCHE

F-F | F | P | F | F

Desired health: Fair

BELOW WEMMERSHOEK DAM

P-P | F | P | F | P

Desired health: Fair

BELOW BERG RIVER DAM

G-P | G | P | G | F

Desired health: Good

ABOVE WEMMERSHOEK DAM

N-G | G | N | N | G

Desired health: Natural

FRANSCHHOEK

P-P | F | P | P | F

Desired health: Fair

ABOVE BERG RIVER DAM

N-F | N | P | N | G

Desired health: Natural

Major Impacts and Management Actions

ALIEN FLORA AND FORESTRY

The upper reaches of the Berg River are moderately to severely invaded by alien vegetation. Alien vegetation and forestry reduce runoff and hence reduce river flows, especially during summer.

ALIEN FISH

The presence of rainbow trout, smallmouth bass and bluegill sunfish has resulted in the loss of indigenous fish (e.g. witvis) and greatly reduced numbers of the endangered Berg River redfin.

RIVER AND FLOW MODIFICATION

Bulldozing and stone mining have modified the river bed and banks, and reduced habitat diversity. Alien trees along the river banks confine the river beds, causing incised channels throughout most of the catchment.

The lack of environmental flow releases from the Wemmershoek Dam results in a dry river bed directly below the dam. A tributary below the dam restores flow in the river, but not the biodiversity.

The interbasin water transfer further reduces water quality in the river and disrupts the flow regime (see p. 18).

URBAN AND AGRICULTURAL DEVELOPMENT

Centuries of cultivation have led to removal of much of the riparian vegetation, resulting in sedimentation in the river. Runoff and wastewater discharge also affect water quality near Franschhoek.

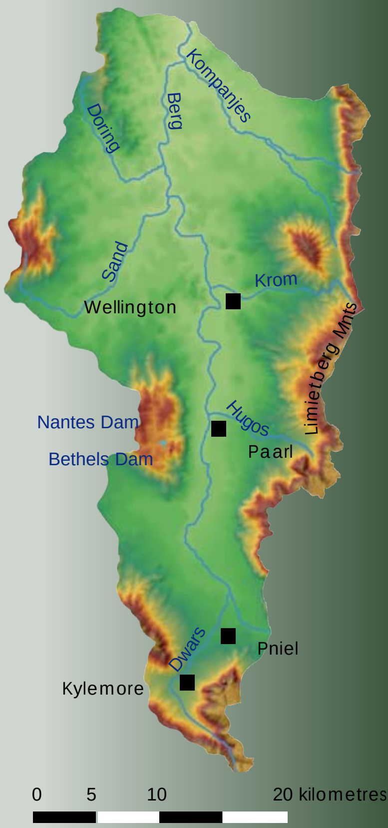
Management Actions

- **Clear alien vegetation in the upper catchments and next to rivers and maintain cleared areas**
- **Re-introduce indigenous riparian vegetation to act as a buffer between the river and surrounding areas**
- **Construct a weir above the proposed Berg River Dam to prevent migration of alien fish upstream and to assist with making water releases required for the ecological Reserve**
- **Improve monitoring and management of runoff and wastewater discharges from agricultural and urban areas**
- **Improve farming practices to reduce sedimentation and water quality problems**
- **Ensure environmental flow releases are made from the Wemmershoek and Berg River dams**

Upper Middle Berg River & Tributaries

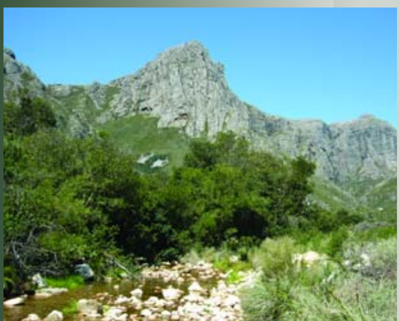
Tributaries in this section of the catchment are the Dwars, Krom, Hugos, Sand and Kompagnes rivers. These tributaries drain the Groot Drakenstein and Limietberg mountain ranges, generating about 28% of the runoff for the Berg River. The Hugos and Dwars rivers are the only tributaries that are naturally perennial.

Renosterveld, a fynbos type, which was previously the dominant vegetation, has made way for vineyards, orchards and vegetable farms. Today, natural vegetation consists largely of Sandstone Fynbos remnants in the mountainous areas.



The pH and total dissolved salts of the river increases as a result of the underlying geology (Malmesbury Group). The naturally mineralised water is further impacted by agricultural runoff and water received via the interbasin transfer (see p. 18).

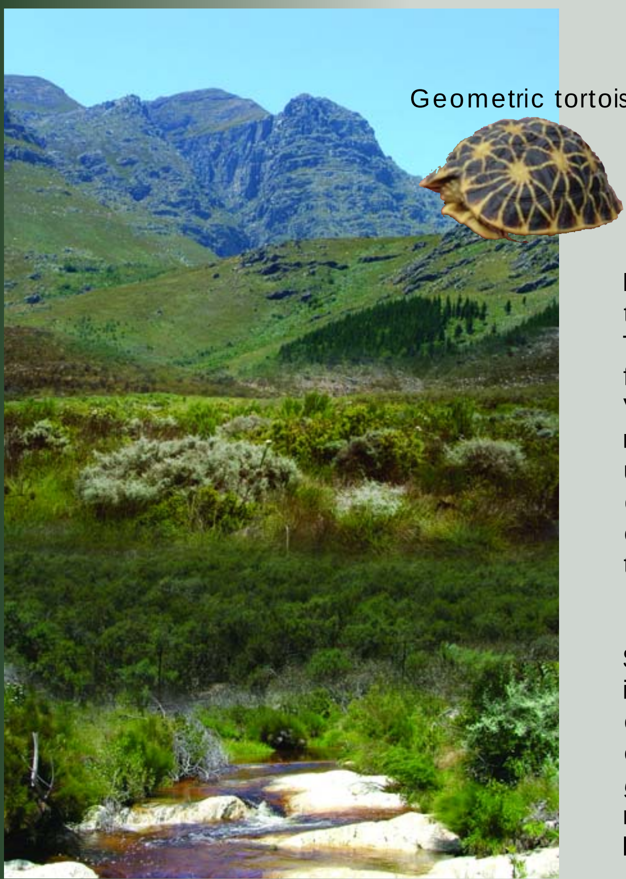
Urban areas are Pniel, Kylemore, Paarl and Wellington. Pniel and Kylemore rely on local mountain streams for their water, while the Wemmershoek Dam supplies Paarl and Wellington. Paarl's water supply is augmented from the Nantes and Bethels dams and from the Berg River (2.8 million cubic metres per annum). Wellington supplements its water from Antoniesvlei in Bain's Kloof (0.5 million cubic metres per annum).



The wastewater treatment works at Paarl discharges treated wastewater (16 million cubic metres per annum) into the Berg River, while the treatment works at Wellington discharges (0.6 million cubic metres per annum) into ponds.

Irrigation Schemes

Irrigation districts in this catchment that administer water allocations are Berg River, Banhoek, Daljosaphat, Palmiet, Simonsberg, Noord- and Suid-Agter-Paarl, La Motte, Kromme River and Perdeberg. Most of these districts obtain water from the Berg-Riviersonderend Scheme (see p. 18) via the Berg River. Daljosaphat and Palmiet districts divert water from the Dal and Hugos (1.0 million cubic metres per annum) rivers. Banhoek district abstracts water from the Dwars River (1.8 million cubic metres per annum), with additional water from Theewaterskloof Dam supplied on request. Similarly, the Kromme district abstracts water from the Krom River with an additional 5 million cubic metres per annum being transferred from Gawie's se Water (Wit River, Breede System).



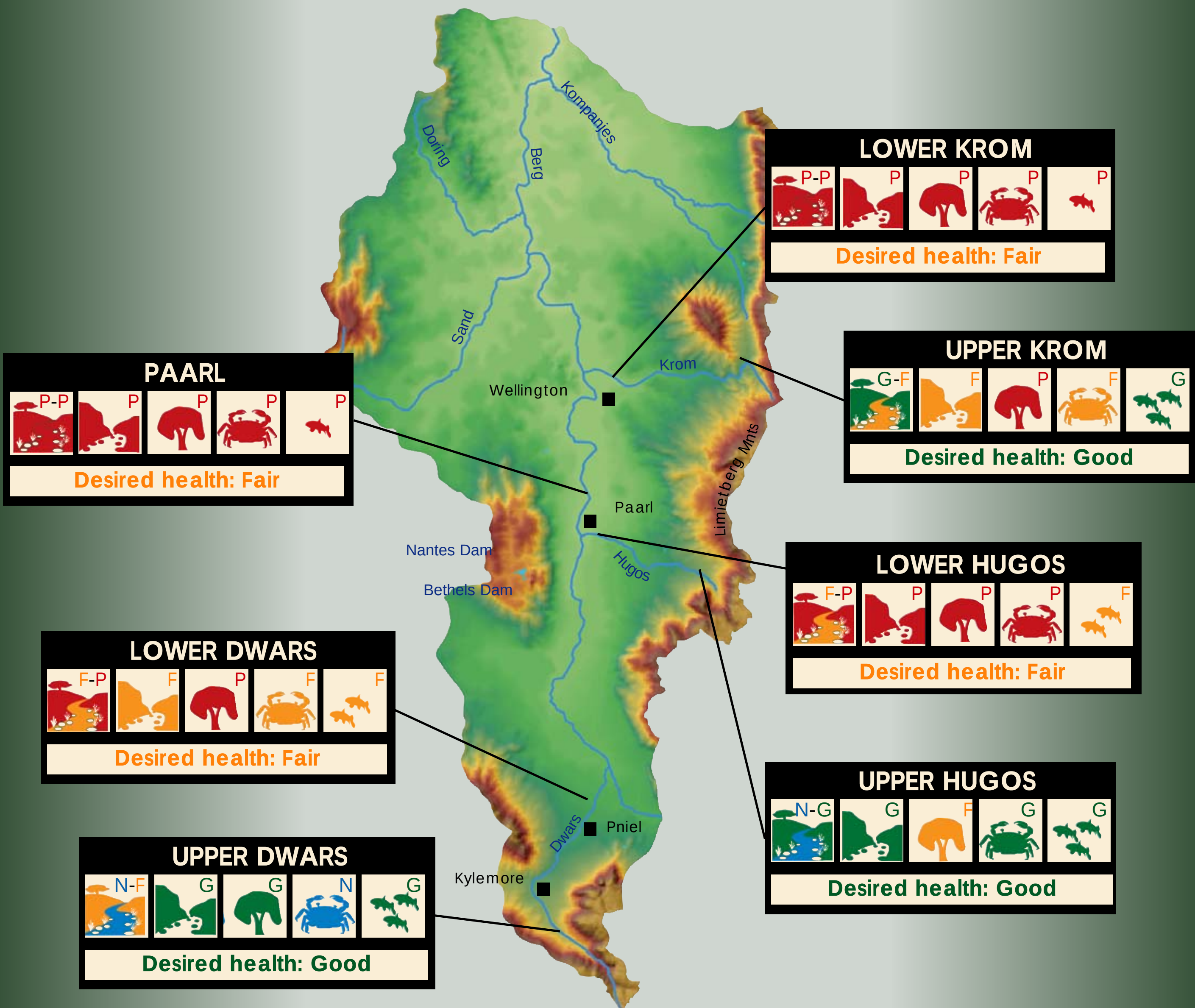
Geometric tortoise

Limietberg Nature Reserve

Limietberg Nature Reserve (117 000 ha) lies in the Du Toitskloof Mountains, stretching from Franschhoek in the south and Groot Drakenstein in the east, to Voëlvlei Dam (see p. 26) in the north. The reserve is an important water catchment area feeding the Berg River and Wemmershoek and Voëlvlei dams. The reserve serves to maintain reaches of the Berg River system in a relatively unimpacted condition. Rainbow trout were introduced prior to the reserve's establishment and occur in most of the rivers. Some invasion by alien trees (e.g. black wattle, hakea and pine) occurs, but is being controlled by Cape Nature.

Sandstone Fynbos predominates, with remnants of indigenous forest in the river valleys. A large area of renosterveld near Voëlvlei Dam is habitat to the endangered geometric tortoise (*Psammobates geometricus*). This tortoise only occurs in lowland renosterveld, of which more than 90% has been lost due to farming (wheat, vineyards and grazing), alien vegetation and too frequent veld fires.

Upper Middle Berg River & Tributaries - Present State



Major Impacts and Management Actions

ALIEN VEGETATION
The Dwars, Krom and Hugo rivers are severely infested with black wattle, poplars, spanish reed, river gum and longleaf wattle. This has reduced river flow, caused incised channels and destabilised river banks.

RIVER MODIFICATION
Straightening and stabilising of the river channels by gabions have reduced habitat diversity. This has resulted in a loss of sensitive aquatic species (e.g. caddisflies).

AGRICULTURAL AND URBAN DEVELOPMENT
Water quality and habitat diversity in the lower reaches have been reduced by agricultural and urban activities at Paarl, Wellington and Pniel. Runoff has resulted in poor water quality and hence a loss of sensitive aquatic invertebrates (e.g. stoneflies and mayflies).

Habitat loss due to removal of natural riparian vegetation causes a loss of refuge areas for biota.

Management Actions

- **Clear alien vegetation and re-establish indigenous vegetation in the upper catchment and riparian zone of rivers**
- **Maintain a buffer area of at least 10 m next to the river**
- **Use environmentally acceptable farming practices**
- **Improve management and monitoring of stormwater quality in urban areas**
- **Stock dams with indigenous fish rather than alien fish**
- **Ensure that tributaries receive environmental flow releases**

WATER ABSTRACTION
High levels of water abstraction in the Dwars River have reduced its flow, particularly during summer. The decrease in flow concentrates pollutants and impacts on river health.

Rainbow trout

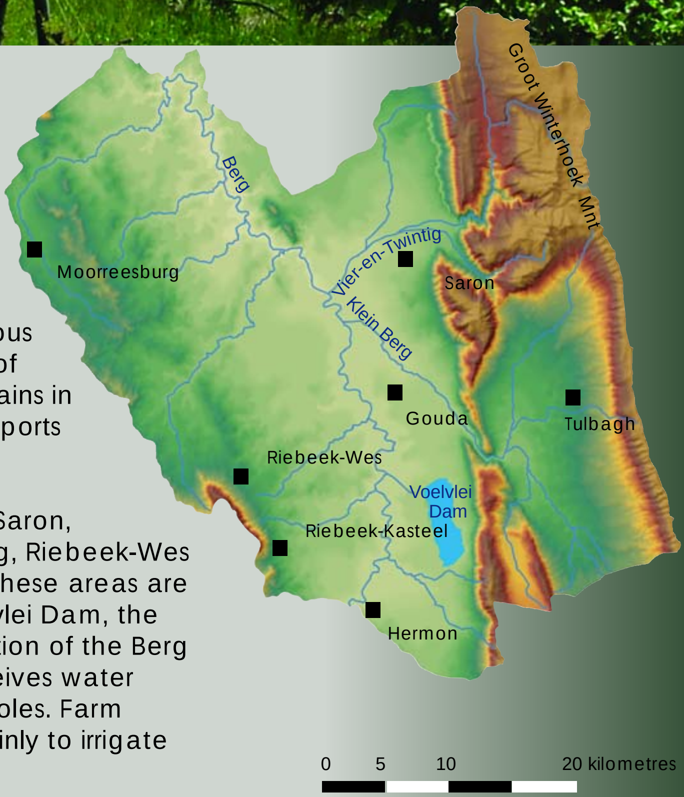
ALIEN FISH
Rainbow trout and smallmouth bass have contributed to localised extinctions of indigenous fish (e.g. Berg River redfin, Cape kurper and witvis).

Lower Middle Berg River & Tributaries

The Vier-en-Twintig and Klein Berg rivers rise in the Groot Winterhoek and Witzenberg mountains and join the Berg River near the towns of Saron. Both tributaries were historically perennial. These rivers no longer flow in their lower reaches during summer as a result of over abstraction for agriculture and the diversion of water to Voëlvlei Dam (see p. 26).

Under natural conditions, West Coast Renosterveld would have dominated this region, but most has been cleared for agriculture (grain and vineyards). The mountainous eastern portion of this section of the Berg River catchment remains in a natural state and mainly supports Sandstone Fynbos.

Urban areas include Tulbagh, Saron, Hermon, Gouda, Moorreesburg, Riebeek-Wes and Riebeek-Kasteel. Most of these areas are supplied with water from Voëlvlei Dam, the only major dam within this section of the Berg River catchment. Tulbagh receives water from local streams and bore-holes. Farm dams in the area are used mainly to irrigate vineyards.



Wastewater treatment works at Tulbagh discharge treated wastewater (0.2 million cubic metres per annum) into a tributary of the Klein Berg during winter but use it for irrigation during summer. Moorreesburg (0.5 million cubic metres per annum), Riebeek-Wes (~ 0.1 million cubic metres per annum) and Riebeek-Kasteel (~ 0.1 million cubic metres per annum) use oxidation ponds to treat wastewater.

The Working for Water Programme has removed much of the alien vegetation, mainly black wattle, in the upper reaches of the Klein Berg River. Plantations in this area are also being cleared by Working for Water.

Voelvlei Dam

Voëlvlei Dam was commissioned in 1952 and was the first large water supply scheme in the Berg River catchment. It was constructed by impounding the natural Vogelvlei lake near Gouda. As the catchment of the lake was only 31 km², additional water was obtained via a canal from the Klein Berg River (max 1.3 million cubic metres per day). The dam supplied water to Riebeek-Kasteel, Riebeek-Wes, Malmesbury, Darling, Moorreesburg and farms along the supply route. Water was released into the Berg River for riparian farmers downstream of Zonkwasdrif and for abstraction at Misverstand Dam (see p. 30).

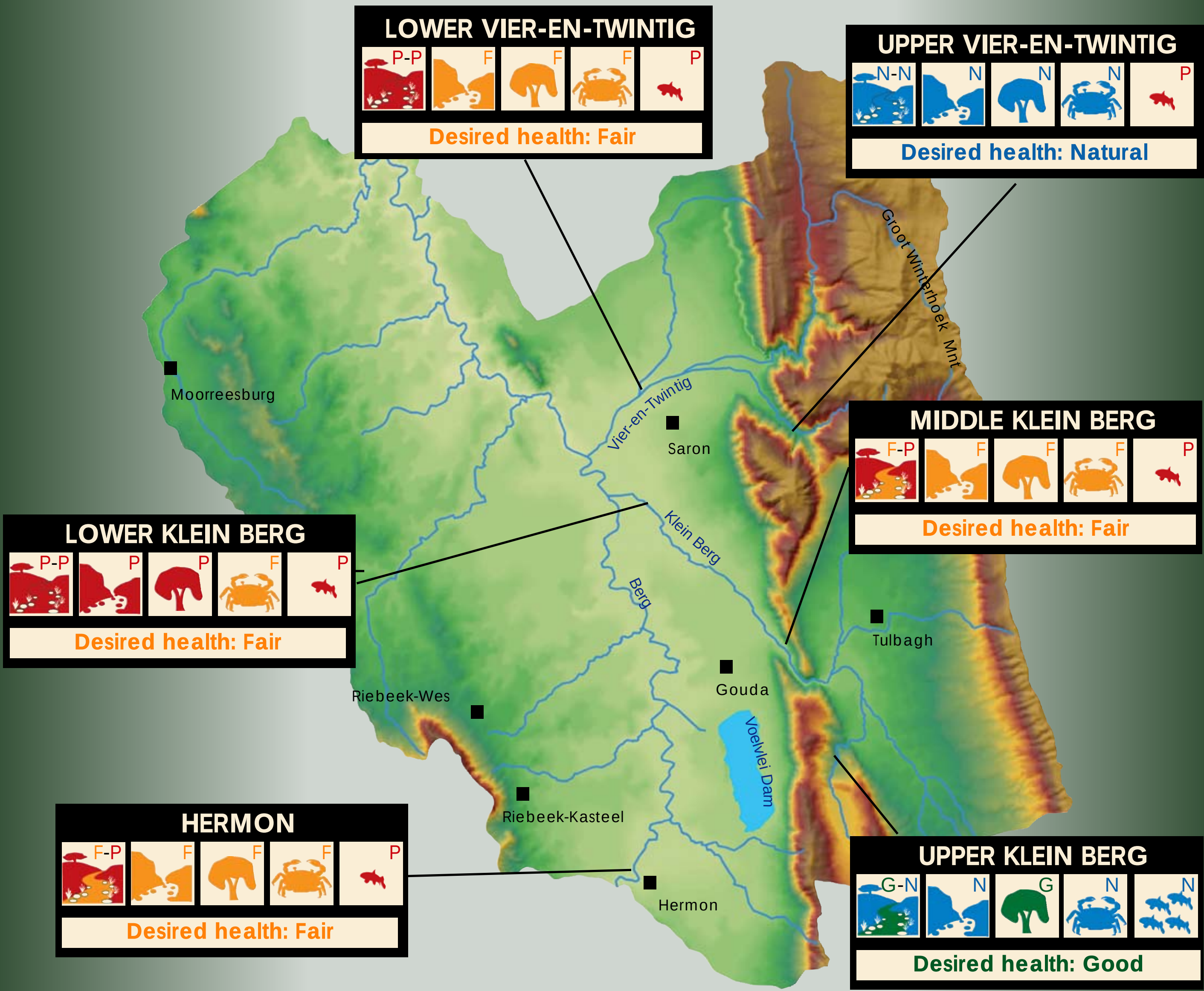
In 1969, Cape Town's increasing water demand resulted in the dam wall being raised and more water being abstracted from the Klein Berg River (max. 1.7 million cubic metres per day). This supply to Cape Town was increased in 1971 to 1.8 million cubic metres per day by constructing an additional canal to divert water from the Vier-en-Twintig and Leeu rivers (max. 2.9 million cubic metres per day).

Groot Winterhoek Wilderness Area

The Groot Winterhoek Wilderness area (30 608 ha) is situated north of Tulbagh and east of Porterville. This is an important catchment area for Voëlvlei Dam and is popular amongst eco-tourists. The Wilderness is an important wildlife area for the conservation of Sandstone Fynbos and associated fauna (e.g. klipspringer, grey rhebok, leopard and grysbok).

Various rare, threatened and endangered species occur here, e.g. threatened flat-leaf clusterhead protea *Sorocephalus scabridus*. The red disa *Disa uniflora* grows in abundance along streams in this area, while the rare yellow form also occurs here. The beautiful 2 m tall *Ixianthes retzioides* shrub is endemic to mountain streams in this wilderness area.

Lower Middle Berg River & Tributaries - Present State



Major Impacts and Management Actions

RIVER AND FLOW MODIFICATION

Diversion weirs in the Klein Berg and Vier-en-Twintig rivers divert much of the flow, including the entire summer flow, from these tributaries to the Voëlvlei Dam (see p. 26). This results in greatly reduced river health scores in the lower reaches.

Inappropriate farming practices along the river banks has resulted in a need to construct levees to prevent flood damage. Levees intensify flood flow, reduce the natural ability of the floodplain to absorb flood water and result in increased levels of siltation.

ALIEN VEGETATION AND FORESTRY

An improvement in the state of the Klein Berg River is evident where alien trees are being cleared. However, the lower reaches of the tributary, as well as the main stem of the Berg River, are still infested with river gum and black wattle. These trees destabilise river banks resulting in increased erosion and deposition of sediments in pools and riffles.

Management Actions

- **Ensure that environmental flow releases are made from diversion weirs (e.g. Vier-en-Twintig River)**
- **Continue clearing of invasive alien vegetation and maintain cleared areas**
- **Improve land-use practices (e.g. farming) to reduce sedimentation and water quality problems**
- **Improve monitoring and management of runoff and discharges from urban and agricultural areas**
- **Stock farm dams with indigenous fish rather than alien fish**

URBAN AND AGRICULTURAL DEVELOPMENT

Wastewater discharges in the Tulbagh area reduce water quality in the Berg River. Pesticides are used to control pests in vineyards and orchards near Tulbagh and Porterville. Pesticide residues that are washed off into surface waters result in low levels of contamination in the area. This has resulted in a loss of pollution-sensitive aquatic invertebrates.

Mozambique tilapia

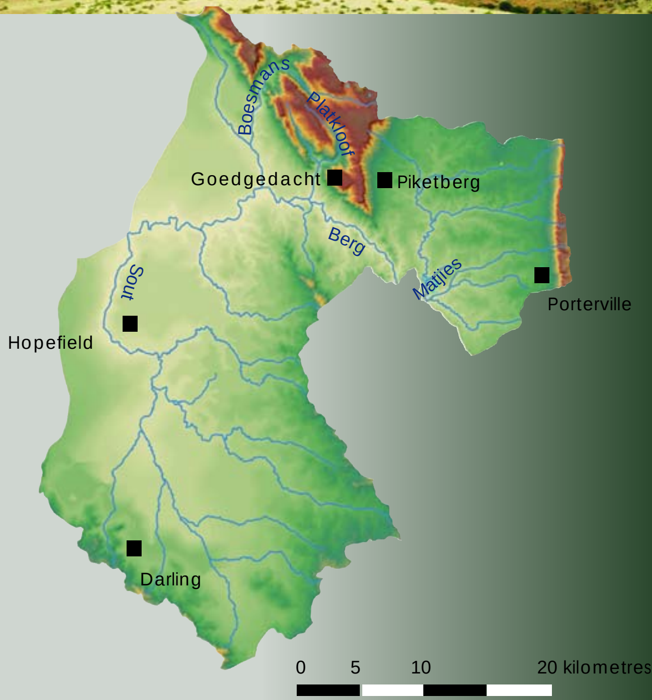
ALIEN FISH

With the exception of the upper Klein Berg River, all the other rivers are infested with alien fish (carp, sharptooth catfish, smallmouth bass, Mozambique tilapia, rainbow trout). These fish, together with habitat degradation, have caused the localised extinction of Berg River redfin, Cape kurper and witvis.

Lower Berg River & Tributaries

The Matjies, Boesmans and Platkloof rivers originate on the north-eastern portion of the catchment in the Olifantsrivier and Piketberg mountains. The Sout River drains the south-western portion, which has a very low gradient, near Malmesbury. These rivers feed the lower Berg River, with the Matjies River being the only historically perennial tributary. Although this section of the Berg River constitutes over 40 % of the total catchment area, it contributes only 10 % of the runoff (97 million cubic metres per annum) due to significantly lower annual rainfall.

Major towns in this part of the catchment are Porterville, Piketberg, Hopefield and Darling. Water supply to most of these towns is from Voëlvlei and Misverstand dams. Porterville obtains its water from a local mountain spring.



Wastewater treatment works at Porterville (0.2 million cubic metres per annum) and Darling (0.1 million cubic metres per annum) discharge treated wastewater into minor tributaries of the Berg and Sout rivers, respectively. Hopefield (0.1 million cubic metres per annum) and Piketberg (0.5 million cubic metres per annum) wastewater treatment works use their wastewater for irrigation purposes.

Dominant land-use in this region is grain farming, together with limited cultivation of table and wine grapes. The underlying geology of the lower Berg River comprises the Malmesbury Shales that have a high salt content. Irrigation results in an increase in inorganic salt concentrations and turbidity. Due to these factors, the water quality of the Berg River deteriorates downstream, with the Sandspruit River near Riebeek-Wes and the Matjies River being major contributors to this deterioration.

Misverstand Dam

The old Berg River pump station was located about 60 km from the river mouth and supplied water to the Saldanha Bay – Vredenburg area from 1942. This scheme was dependent on river flow to minimize seawater intrusion. Increased demand for water resulted in the construction of a weir higher up in the Berg River at Misverstand in 1977 to improve water supply to the area.

Sea Level and Climate Change

Saldanha skull

Over the last 2 million years, sea level changes have been frequent due to freezing and thawing of the polar ice caps. These changes in sea level affect not only the area of exposed land, but also the underlying rocks and soils. Under these changing conditions, lowland fauna and flora have evolved, adapted and either colonised or become extinct. At Elandsfontein, 13 km south west of Hopefield, rich fossil remains give a picture of the animal life of the past. Fossils found here indicate that this area was originally a swampy region where the Berg River met the sea. It also had dense vegetation and was rich in animal life. The Saldanha skull is one of the earliest remains of the Stone Age Man found in southern Africa.

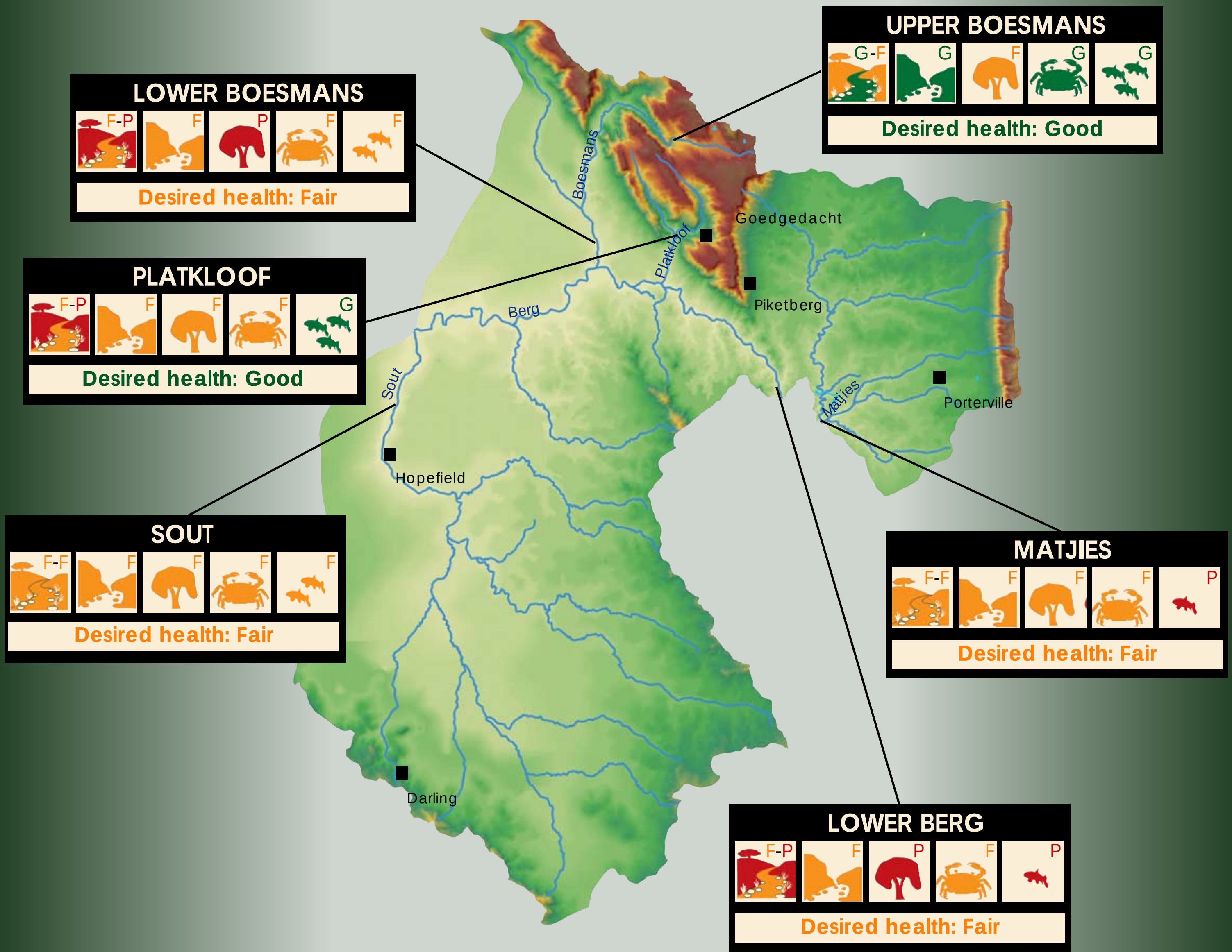
Climate change, as a result of Global Warming, is expected to have a significant impact on the West Coast, which is likely to become hotter and drier. This will place a greater stress on the already stressed water resources of this region, as well as its fauna and flora, with many species likely to become endangered or possibly extinct.

Extinct giant pig lower jaw

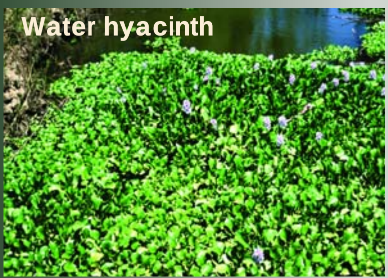
Extinct rhino jaw

Early elephant species jaw

Lower Berg River - Present State



Major Impacts and Management Actions



ALIEN VEGETATION & REMOVAL OF INDIGENOUS VEGETATION

Farming practices along the river banks have resulted in the removal of natural vegetation and subsequent alien vegetation infestation. Where infestation by alien trees does not occur denuded river banks are subject to erosion and cause sedimentation problems in the river.

Alien trees (e.g. black wattle) use large amounts of water throughout this catchment. Water hyacinth clog the water surface of the lower Berg River and reduce water quality and habitat integrity (see p. 45).

ALIEN FISH

The lower Berg River is dominated by invasive alien fish (e.g. carp and Mozambique tilapia). Estuarine fish (e.g. mullet and round herring) often penetrate the freshwater zone of the river. Indigenous fish are confined to the upper reaches of the Boesmans, Platkloof and Sout rivers.

Management Actions

- **Clear alien vegetation along the banks of the Berg, Boesmans and the Platkloof Rivers**
- **Re-introduce indigenous riparian vegetation to reduce sedimentation problems**
- **Manage flows in the Platkloof River at Goedverwacht and the upper reaches of the Boesmans River to ensure sufficient water in summer for threatened indigenous fish**
- **Obtain support of the Goedverwacht community to become caretakers of the highly sensitive Platkloof River**
- **Improve management and monitoring of water abstraction, particularly during summer**

RIVER MODIFICATION

Farming activities within the river banks and bed lead to erosion and increased sedimentation. Deposition of sediments in rivers reduces habitat quality and diversity.

WATER ABSTRACTION

Water abstraction in the tributaries, particularly in the Boesmans River, decreases the low flows during summer. In addition, no environmental flow releases are made from most of the dams in these tributaries.

Releases for irrigation from Misverstand Dam create water quality problems below the weir. These releases are made from the bottom waters, which are of poor quality.

WATER QUALITY

The WATER QUALITY in the Berg River has changed considerably over time, with the major impactors being agricultural return flows, irrigation releases, urban and industrial runoff and wastewater discharges. Temporal trends in water quality in the Berg River catchment can be summarised as follows:

PRE-DEVELOPMENT

There are no water quality records for the Berg River in its unimpacted state (see box on p. 9). Naturally, the upper reaches of the river could be described as having freshwater with a low pH and nutrient concentration. These characteristics change with distance downstream, depending on the underlying geology and flow conditions. Different tributaries assert different degrees of influence on the Berg River at different times of the year. During summer, river flow is dominated by low conductivity waters from the upper reaches and perennial tributaries. The saline ephemeral tributaries generally impact on the Berg River for a short period at the onset of winter.

PRE-1960

Generally, the upper reaches remained in a near natural state, while conductivity and total dissolved salts increased with distance downstream. Localised impacts were organic enrichment downstream of the Franschhoek River, possibly as a result of Franschhoek and neighbouring farms. Runoff from Pniel, local farms and a cannery reduced the water quality in the Dwars River, while domestic and industrial pollution occurred in the Paarl and Wellington areas. Increased levels of abstraction from tributaries caused the elevation of pollutant concentrations in summer and the disappearance of pollution-sensitive species.

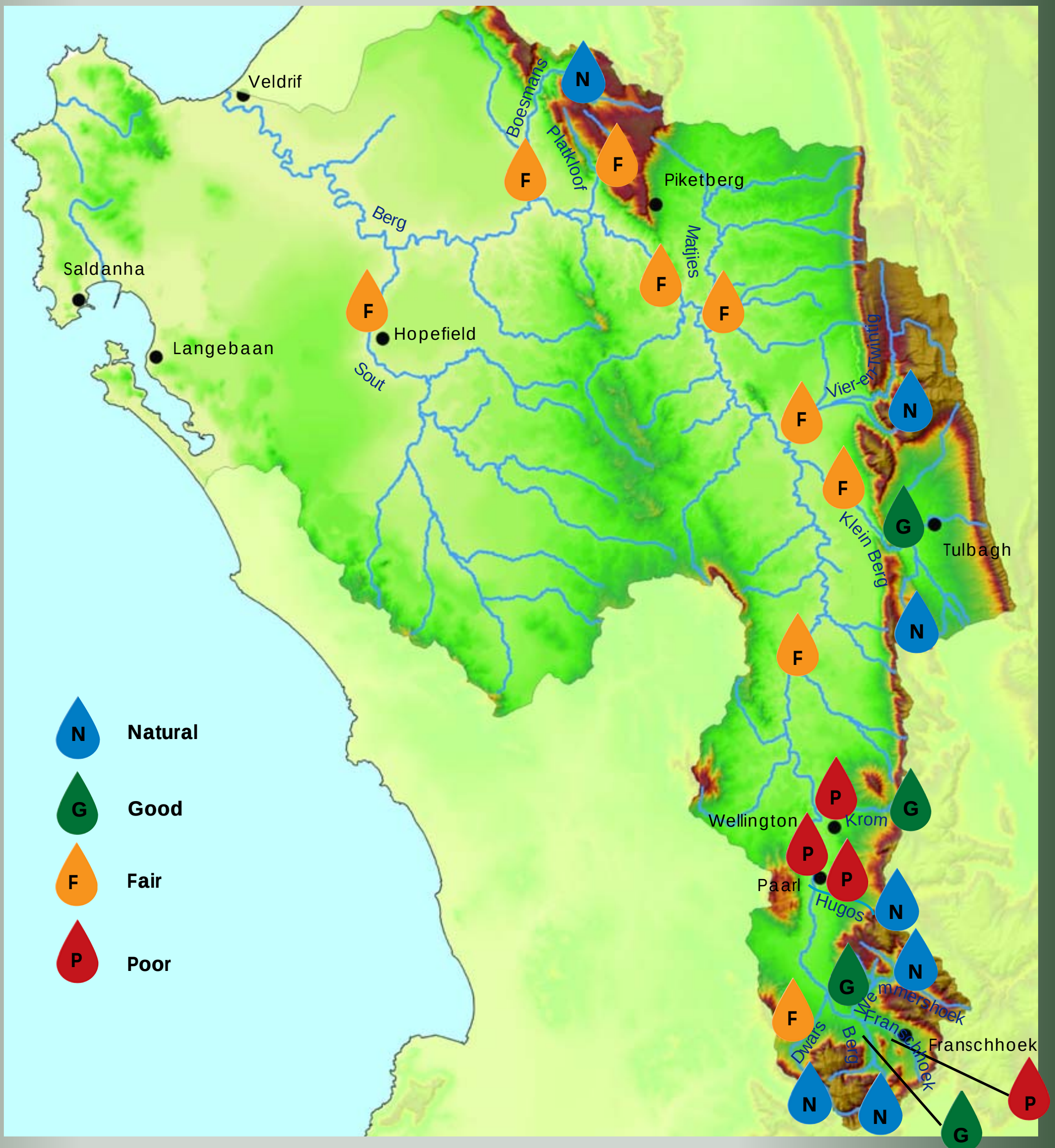
1960 – 1980

The upper reaches remained unpolluted. Water quality deteriorated downstream as a result of increased organic loading (wastewater discharges) to the river between Paarl and Wellington. Irrigation releases from Voëlvlei Dam during summer resulted in a sharp increase in conductivity during these months. Overall, the Berg River showed a substantial increase in mineralisation along its course. Many lower reaches of tributaries were now showing substantial declines in water quality due to excessive rates of water abstraction and use of fertilisers.

1980 – 2004

The interbasin transfer (see p. 18) into the upper reaches of the Berg River increased conductivity, pH and suspended solids and transformed the river downstream during the dry summer months. Conductivity continued to increase with distance downstream, with a marked increase below Voëlvlei Dam as a result of irrigation return flows. Major point sources of nutrients into the river occurred in the Paarl and Wellington areas, associated with wastewater discharges. The major source of phosphorus into the river was from non-point sources.

The PRESENT WATER QUALITY is indicated according to its **suitability for aquatic biota**. This assessment is based on the phosphate, nitrate, nitrite, ammonia, suspended solids, dissolved oxygen, pH and conductivity measured in water samples from each sampling site.



Pollution from Pesticides and Fertilisers

Fertilisers and pesticides are heavily utilised to optimise production of grapes, deciduous and citrus fruits. Typically these chemicals can reach rivers via vapour/spray drift, surface runoff, spills or through leaching into groundwater. These chemicals, many of which are copper-based, adversely affect aquatic biota (e.g. reduce reproduction or cause mortality) resulting in the disappearance of important pollution-sensitive species.

Environmentally-friendly chemicals, applied appropriately, will reduce the above-mentioned effects. It is also essential that riparian land-owners leave a 10 – 20 m buffer strip of natural vegetation between the planted crops and the river. This buffer zone protects the river from runoff, spray drift and siltation and plays an important role in maintaining the habitat integrity in the riparian zone.

FLOODPLAIN

FLOODPLAINS are broad and relatively flat areas on either side of a stream or river that are inundated by water during floods. They are integral parts of a river ecosystem and are as dynamic as the rivers that create them.

The well developed **flood-plain of the Berg River**, above the estuary, is unique in the south-western Cape.

Evaporation on the flood-plain is three times more than the rainfall. Thus, the floodplain and the surrounding communities rely on floods originating higher up in the catchment for their existence. It is thus essential that environ-mental flow releases are made to ensure the future existence and viability of this locally unique ecosystem.

The floodplain vegetation provides food and shelter for many bird species (see p. 39). The floodplain is also important as a fish nursery (e.g. flathead mullet).

Floodplains act as flood buffers, water filters, fish nurseries and are generally major centres of biological activity in the river ecosystem. During periods of high water, floodplains act as natural sponges, which store and release floodwaters slowly. They improve water quality by providing fresh water to wetlands and backwaters, diluting salts and nutrients and generally improving the overall habitat health. In addition to filtering out pollutants, floodplain trees and plants also prevent bank erosion and provide shade, which reduces water temperatures.

Many floodplain species are dependent on flooding for survival. For example, floods trigger breeding in water birds and fish as food availability increases, while seedlings of a number of floodplain plants establish during flood events. Terrestrial grazers and browsers are attracted to the floodplain at the end of the wet season when rich alluvium deposits activate new growth. Lack of flushing during floods gradually results in increased salinity levels in floodplain soils.

Water abstraction and dams reduce the frequency and intensity of flooding of the Berg River floodplain, while agricul-tural and urban encroachment further damage the floodplain.

MANAGEMENT ACTIONS

- **Ensure that environmental flow releases allow for sufficient water to fill the floodplain during average rainfall years**
- **Take “after-flood” snapshots to show the importance of the braided river for floodplain functioning**

GROUNDWATER

Groundwater in the Berg River catchment is stored mainly in the Table Mountain Group and Malmesbury Group aquifers. The Table Mountain Group Aquifer is the dominant aquifer in the upper catchment and along the eastern and northern fringes of the catchment, while the Malmesbury Group Aquifer underlies most of the central and lower catchment. This groundwater does not exist in isolation and plays a vital role in ensuring the baseflow of rivers during the dry season.

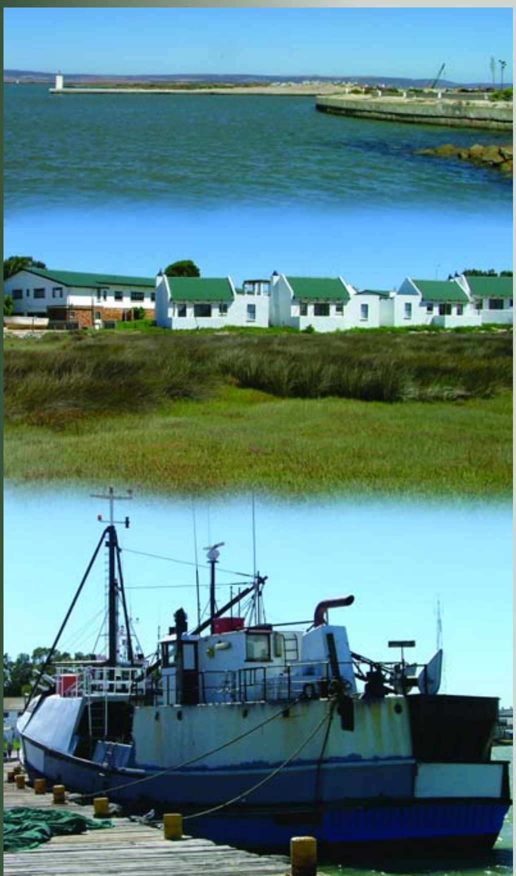
The total harvest potential for the Berg River basin is about 325 million cubic metres per annum. High yielding aquifers are the Table Mountain Group Aquifer and one near Langebaan. Aquifers associated with the Malmesbury Group, Cape Granite Suite and Klipheuwel Group are considered to be of low harvesting potential.

Total groundwater use in the catchment is about 8.5% of the harvest potential, with agriculture being the largest user. Most of the groundwater in the catchment is used in the western and southern parts, with little being used in the central region where dryland crops predominate. Poor groundwater quality, particularly in the Malmesbury Group Aquifer, and the availability of surface water supplies have limited the use of groundwater as a resource. It is essential that groundwater use does not result in the ecological collapse of surface waters, such as wetlands and rivers.

The Table Mountain Group Aquifer contains substantial supplies of groundwater. The City of Cape Town is investigating this groundwater resource for additional water supply in certain areas, for example the Watervalsberge near Voëlvlei Dam.

The Berg River Estuary

ESTUARIES are unique habitats where rivers interact with the sea to varying degrees. The extent of seawater penetration and whether an estuary mouth will be open or closed depends strongly on river flow. The salinity regime and mouth status of an estuary in turn, govern the nature of the habitats on which most estuarine biota depend.



The mouth of the BERG RIVER ESTUARY is kept permanently open by a constructed channel and dredging.

The estuary reflects strong seasonal patterns. River inflow during winter creates more turbid, freshwater-dominated conditions, with limited saline intrusion near the mouth. During summer, the estuary becomes marine-dominated with less turbid saline waters penetrating up to about 40 km from the mouth. Upwelling during these summer months is a typical feature along the West Coast when colder, nutrient-rich seawater is introduced into the estuary. This seasonal variability drives the ecology of the estuary.

Length: 70 km
Area: 3 615 ha
Depth: ~ 5 m below mean sea level

IMPORTANCE OF THE BERG RIVER ESTUARY

The Berg River Estuary is South Africa's second most important estuary in terms of national conservation importance for estuarine birds, fish, invertebrates and vegetation (see p. 39-40). Despite extensive human activity, the system is still particularly important for birds because it supports large populations of both resident species and Palaearctic migrants.

DAMS AND WATER ABSTRACTION

Storage and abstraction of water in the catchment have reduced fresh-water inflow to the Berg River Estuary by 30%. This results in:

- extensive upstream intrusion of seawater into the estuary, particularly during summer,
- reduction in frequency and extent of floodplain inundation, and
- a decrease in the scouring of sediment within the estuary.

The extensive upstream intrusion is also exacerbated by the stabilisation of the mouth which keeps it permanently open via a constructed channel.

EROSION IN THE CATCHMENT

Increased silt supply from agriculture may contribute to the siltation of sensitive areas (e.g. Die Plaat) in the estuary.

LOSS AND DESTRUCTION OF NATURAL HABITAT

Livestock grazing and the construction of salt works and Port Owen Marina have resulted in extensive loss of natural habitat, mainly saltmarsh. Although the salt works has destroyed this habitat, the area now provides rich feeding grounds for flamingos and waders.

Power boating activities, as well as the stabilisation and regular dredging of the mouth have resulted in increased bank erosion in the estuary, with the associated loss of saltmarsh habitat and a decline in floodplain vegetation.

OVEREXPLOITATION OF LIVING RESOURCES

Overexploitation of estuarine fish is a serious concern in the Berg River Estuary. As a result, Marine and Coastal Management withdrew all gillnet permits for 2003 to protect the nursery function of the estuary and allow for stock recovery. Preliminary surveys already show a strong recovery of flathead mullet and elf stocks in the estuary.

DETERIORATION IN WATER QUALITY

Potential threats to water quality include wastewater discharges from a fish processing plant, seepage from the salt works, harbour activities (e.g. dumping of fish offal and petroleum oils). Agricultural return flow is another potential source of pollutants (nutrients and pesticides) to the system.

MANAGEMENT ACTIONS

- **Determine the ecological Reserve for the Berg River Estuary before any further reduction in river inflow is approved (see p. 49)**
- **Register the Berg River Estuary as a wetland of international importance under the Ramsar Convention to ensure a high level of bird habitat protection**
- **Ensure that prescribed environmental flow releases are made from large dams in the catchment**
- **Clear the alien vegetation, especially river gum and water hyacinth**

The Floodplain & Berg River Estuary Fauna & Flora

Birds

The floodplain and the Berg River Estuary are known collectively as the Lower Berg River Wetlands and are listed as an Important Bird Area (Ramsar Convention). In addition to the estuary, winter flooding of the Berg River inundates an extensive flood-plain of about 5 500 ha. Although this floodplain is known to support large numbers of breeding birds, the distribution and abundance of these floodplain species and their conservation status has never been quantified.

The floodplain supports at least 127 species of water birds, of which 85 are observed regularly, 31 are of regional significance, 25 are of national importance and 5 are listed as red data species. Migratory birds from Europe and northern Asia use the floodplain as feeding grounds during summer.

A number of large heronries occur within the Berg River floodplain. Riparian reedbeds also provide breeding habitat for large water birds, colonies of red bishops, various weaver species and populations of small warblers and cisticolas. Ducks, coots and blackwinged stilts breed in the sedge pans and South African shelducks breed in burrows near open pans.

The breeding season of water birds in the Western Cape is closely linked to the winter rainfall regime. Peak breeding activity is restricted and mirrors the seasonal pattern of flooding with a time lag of approximately two months. Any development that alters the seasonal flow pattern (e.g. construction of large in-streams dams on the Berg River) would severely impact on the breeding behaviour and performance of water birds.

The estuary is one of the few suitable habitats along the west coast for migratory birds. Migratory waders on the East Atlantic, Mediterranean and Middle East flyways (with South Africa as the southerly end-point) use the estuary as a feeding ground. In addition, the estuary supports approximately 250 resident bird species, representing 50 % of the species of the South-Western Cape in the area. These include white pelican *Pelecanus onocrotalus*, african spoonbill *Platalea alba*, greater flamingo *Phoenicopterus ruber* and lesser flamingo *P. minor*. Little blue heron *Egretta caerulea* (1st ever recorded outside the Americas) have also been recorded in the estuary.

Estuarine Fish


Flathead mullet


Estuarine roundherring


Elf

Nearly 80 % of the Western Cape coastal fish species have been recorded in the Berg River Estuary and floodplain. Of these fish, some are entirely estuarine or partially dependent on the estuary and floodplain. Over 30 fish species have been recorded, including six estuarine residents (e.g. estuarine roundherring *Gilchristela aestuaria*), eleven euryhaline migrants (e.g. flathead mullet *Mugil cephalus*), seven marine migrants (e.g. elf *Pomatomus saltatrix* and leervis *Lichia amia*) and six freshwater species (e.g. Mozambique tilapia *Oreochromis mossambicus*). The southern mullet *Liza richardsonii*, is the most abundant species making up more than 80% of total catches.

Due to the scarcity of suitable sheltered habitats along this stretch of coast, west coast floodplains and estuaries are of tremendous local importance to fish, particularly as nursery areas.

Estuarine Invertebrates

Invertebrates are an important food source for bird and fish in the estuary. The system supports an extremely high abundance of invertebrates, including polychaete worms *Ceratonereis erythraeensis*, mud prawns *Upogebia africana* and sand prawns *Callianassa kraussi*.


Polychaete worm


Mud prawns

Estuarine Vegetation

Dense stands of the indigenous reed *Phragmites australis* line the upper reaches of the Berg River Estuary. Sedgeland (*Juncus kraussi* with *Scirpus maritimus* and *S. triqueter*) and reed beds (*Phragmites australis*) occur along the floodplain and banks of the middle reaches of the estuary.

The lower reaches of the estuary include the third largest saltmarsh in the Cape. Sea grass *Zostera capensis* occurs on tidally exposed and subtidal mudflats. The sago pondweed *Potamogeton pectinatus* occurs in brackish pools (10 - 15%) along the edge of the main channel. These plants provide food and habitat for estuarine fauna.


Zostera


Phragmites


Sarcocornia

Flora of the Berg River Catchment

The natural vegetation of the area includes Sandstone Fynbos, Sand Fynbos, Fynbos Thicket Mosaic and Renosterveld.

Indigenous Flora

SANDSTONE FYNBOS

The dominant vegetation type in the Berg River catchment is mountain fynbos. Some 70 % of the remaining Sandstone Fynbos is on privately owned land, while the remainder is protected in water catchment areas by national legislation (Forest and Mountain Catchment Areas Acts). This fynbos occurs on acidic, nutrient-poor sands. The Piketberg Mountain Fynbos complex is one of the centres of endemism in the fynbos vegetation.

Erica mammosa

SANDPLAIN FYNBOS

The lower Berg River region is extensively covered by Strandveld and Sand Fynbos which occur on alkaline, sandy soils. The vegetation is typically Asteraceous and Proteoid Fynbos and is characterised by the presence of ninepin heath *Erica mammosa*, starface *Phyllica cephalantha* and sandveld thatching reed *Thamnochortus punctatus*. Only 1.4 % of the remaining Sand Fynbos is protected in a single private nature reserve. About 40 % of the Strandveld is undeveloped, with only 1 % occurring in conservation areas.

FYNBOS THICKET MOSAIC

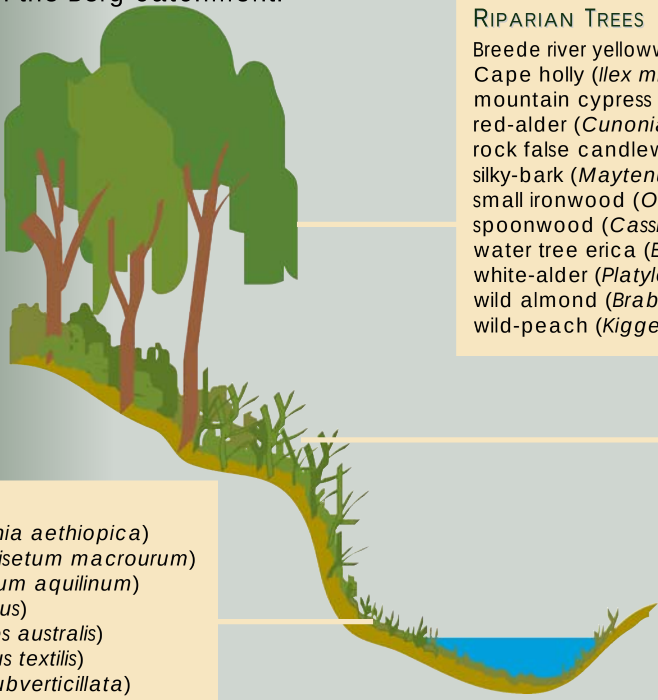
Dune fynbos and thicket patches occur along the Langebaan coastline. Dominant trees and shrubs include: cherrywood *Pterocelastrus tricuspidatus*, common spike-thorn *Gymnosporia buxifolia* and sea guarri *Eulea racemosa*. A majot threat is the removal of thicket for coastal resorts and invasion by alien vegetation.

Felicia filifolia

RENOSTERVELD

Renosterveld occurs on the fertile clay soils of the Western Cape where renosterbos is the dominant shrub. Less than 3 % of the original renosterveld remains, with less than 1 % being found in nature reserves. The largest remaining tract of renosterveld in the Berg River catchment is in the Elandsberg Private Nature Reserve between Wellington and Voëlvlei Dam. Dominant species include renosterbos *Elytropappus rhinocerotis*, kouterbos *Anthanasia trifurcata*, draaibossie *Felicia filifolia* and slangbos *Stoebe spiralis*. Bush clumps, associated with termitaria, are dominated by wild olive *Olea europaea* and dune taaibos *Rhus laevigata*.

The diagram below shows indigenous riparian species commonly found within the Berg catchment:



Riparian Trees

Breede river yellowwood (*Podocarpus elongatus*)
Cape holly (*Ilex mitis*)
mountain cypress (*Widdringtonia nodiflora*)
red-alder (*Cunonia capensis*)
rock false candlewood (*Maytenus oleoides*)
silky-bark (*Maytenus acuminata*)
small ironwood (*Olea capensis*)
spoonwood (*Cassine schinoides*)
water tree erica (*Erica caffra*)
white-alder (*Platylophus trifoliatus*)
wild almond (*Brabejum stellatifolium*)
wild-peach (*Kiggelaria africana*)

Riparian Shrubs

blue laurel (*Cryptocarya angustifolia*)
bog rice-bush (*Cliffortia strobilifera*)
bush willow (*Salix mucronata*)
fly bush (*Myrsine africana*)
fynbos star-apple (*Diospyros glabra*)
honey-bells (*Freylinia lanceolata*)
lance-leaved waxberry (*Morella serrata*)
notsung (*Halleria elliptica*)
palmiet (*Prionium serratum*)
river currant bush (*Rhus angustifolia*)
slangbessie (*Lycium ferrocissimum*)
smalblaar (*Metrosideros angustifolia*)
vleiknopbos (*Berzelia lanuginosa*)
water white alder (*Brachylaena neriifolia*)

Herbaceous Flora

arum lily (*Zantedeschia aethiopica*)
bedding grass (*Pennisetum macrourum*)
bracken fern (*Pteridium aquilinum*)
bulrush (*Typha latifolius*)
fluitjiesriet (*Phragmites australis*)
matjiesgoed (*Cyperus textilis*)
restios (*Ischyrolepis subverticillata*)
rush (*Juncus lomatophyllus*)
sedge (*Isolepis prolifer*)
sundew (*Drosera trinervia*)
wire grass (*Aristida junciformis*)

Other Flora of Interest in the catchment


Dagger-leaf sugarbush

DAGGER-LEAF SUGARBUSH (*Protea mucronifolia*)
This protea is one of only two shale sugerbushes that occur on the shale soils of the lower Berg Catchment. Both proteas have ivory coloured flowers with pink tips and a sweet scent and are pollinated by wasps. In the Berg catchment, the *P. mucronifolia* occurs from Hermon to Saron, east of the Berg River. They are listed as vulnerable in the Red data book as they have been reduced by agriculture to one population of a few thousand plants. Most occur on a private nature reserve south of Voëlvlei Dam.


Brushing bride

BLUSHING BRIDE (*Serruria florida*)
Courting young men during early settler days wore these flowers in their buttonholes to express an intent of honour and matrimony, causing the maiden to blush prettily. During these times the plant was rare and grew only in the Franschhoek Mountains. For 100 years it was thought to be extinct after a devastating fire. Later some plants were found in the high mountains and were cultivated and preserved in Kirstenbosch National Botanical Gardens. This plant is currently listed as vulnerable due to invasion of its habitat by pines and hakeas. A single population of about 1000 plants remains, in 6 to 8 stands of a few hundred plants each. This species has shown the important role of fire in fynbos ecology.

Fauna of the Berg River Catchment

Rivers and their riparian zones provide habitat and migration routes for many animals. Examples of animals that migrate along the rivers include: Cape clawless otter, water mongoose and bushpig. Plant seeds and propagules (e.g. mosses) are transported downstream on the flowing waters.


Water mongoose

WATER MONGOOSE (*Atilax paludinosus*)
The water mongoose is the only mammal to display a preference for open freshwater, as opposed to seeps and marshes. Water mongooses live amongst bulrushes and create runs and tunnels through thick vegetation along the river. Their droppings and prey remains indicate a liking for frogs, birds' eggs and small mammals.


Hippopotamus

HIPPOPOTAMUS (*Hippopotamus amphibius*)
Hippopotami were once widespread along the Berg River (see p. 12). They prefer open stretches of permanent water which are deep enough to allow them to submerge totally. Highly selective grazers, they can eat about 130 kg of green grass at a feed. Their food includes short grass, fallen fruits and other plants, as well as occasional aquatic vegetation.


Hydroptilid

SPECIALISED AQUATIC FAUNA OF THE BERG RIVER

The Berg River falls within the Cape Floristic Kingdom. Winter rainfall, fynbos and the underlying geology result in unique riverine fauna, particularly in the upper reaches which are poorly mineralised and acidic. These conditions have resulted in a highly specialised aquatic fauna, many of which are only found in the Western Cape. The uniqueness of the conditions and riverine fauna in the Berg River have led some scientists to propose that the Berg River should be considered a "living museum".

Recently a new genus of hydroptillid caddisfly, thought to be a Gondwanaland relic, was recorded in the Berg River.

FROGS AND TOADS

About 28 % of southern African frogs and toads occur in the fynbos biome. Some of the frogs in the Berg River include the giant rain frog (*Breviceps gibbosus*)and the montane marsh frog (*Poyntonia paludicola*).

The giant rain frog (top right) lives in the sandy flats between Stellenbosch, Cape Town and Piketberg. This species is listed as near endangered.

The recently discovered montane marsh frog (below right) is a very small, very warty fynbos endemic with attractive white or red stripes on its snout and is found at high altitudes in seeps and shallow water bodies.


Giant rain frog


Montane marsh frog

Freshwater Fish

Cape galaxias

Cape kurper

Berg-Breede witvis

Berg River redfin

Cape Floral Kingdom rivers have few fish species (19 indigenous fish species), of which 16 are endemic. Four indigenous fish species have been recorded in the Berg River system, the Berg River redfin (*Pseudobarbus burgi*), Cape galaxias (*Galaxias zebratus*), Cape kurper (*Sandelia capensis*) and Berg-Breede witvis (*Barbus andrewi*).

Indigenous fish in the Berg River mainstream and perennial tributaries were once naturally abundant. Historical descriptions provide a glimpse of the river near Groot Drakenstein: "Clean stony runs alternated with basins of large water-worn stones and long deep pools, fringed with palmiet rushes and overhanging trees and bush, silt beds being confined to the backwater. The bed was in splendid condition and the dire effect of soil erosion had not begun to appear. There was a large population of indigenous fishes. Shoals of witvis up to about 4 lb in weight, and rooivlerk minnows amounted to thousands of individuals. The Cape kurper lurked under all favourable stones or swam boldly in the open water, and the little galaxias haunted the marginal weedy areas" (Piscator,1934).

Today, witvis are extinct in the Berg River, the Berg River redfin is critically endangered, and the other two species mentioned above are near threatened. The upper reaches of the Berg River and a handful of tributaries are the last refuge areas where indigenous fish are still relatively abundant. A project to re-establish the witvis has recently been implemented by the WCNCB and conservation-minded farmers.

MAJOR IMPACTS & MANAGEMENT ACTIONS

Invasive alien fish, as well as reduced water quality, degraded riparian zones and extensive rates of abstraction have impacted severely on the indigenous fish populations in the Berg River system. Farming activities (levees, bulldozing) have destroyed much of the riparian zone of the mainstream and lower reaches of tributaries which provides shade, shelter and food for fish. Inappropriate use of fertilisers, pesticides and the transfer of inferior quality water from Theewaterskloof Dam into the Berg River (see p. 14) in summer have reduced water quality and negatively impact on indigenous fish. Excessive water abstraction from certain tributaries (e.g. Boesmans, Hugos, Dwars and Vier-en-Twintig rivers) further reduce habitat quality and diversity for smaller species. This results in repeated recruitment failure and the eventual localised extinction of indigenous fish.

The most important areas remaining for indigenous fish conservation are the upper Berg, Boesmans, Krom, Platkloof, Waterval and Wemmershoek rivers. Development in these catchments should ensure that habitat is retained, sufficient flow is provided and good water quality is maintained. No further stocking of alien fish into such areas should be allowed.

Alien Flora in the Catchment

Alien Flora

Invasion by alien plants poses one of the largest threats to the survival of the Fynbos Biome. At least 109 terrestrial alien plant species have been found in the fynbos. Rooikrans (*Acacia cyclops*) is the most extensive in the Strandveld while eucalypts (*Eucalyptus camaldulensis*), long-leafed wattle (*Acacia longifolia*) and black wattle (*Acacia mearnsii*) prevail along river courses. About 17 % of the natural vegetation between the Berg River catchment and False Bay is infested, with hakeas and pines infesting the mountains, and thicket forming aliens (e.g. black wattle) infesting the lowland areas.

In 1998, alien vegetation infestation in the Berg River catchment was estimated to be 101 882 ha, or 11.5 % of the total catchment area. Working for Water has cleared a "condensed area" of about 6 507 ha of alien vegetation within the Berg Water Management Area (surface area of 1.3 million ha, including the Berg River catchment and Cape Town). This clearing is calculated to provide an additional 5 million cubic metres per annum of water to the environment and potentially to water users.

There remains an urgent need to clear the extensive stands of eucalypts lining the Berg River near Paarl. Each mature plant has been calculated to utilise 250 litres of water per day. Its control would increase the water in the Berg River considerably.


Rooikrans


black wattle


black wattle

WATER HYACINTH (*Eichornia crassipes*)
Water hyacinth grows in dense mats in dams and slow-flowing rivers. Imported from tropical South America as an ornamental plant, this weed has found its way into many of our rivers where it can double its mass every four days under ideal warm and eutrophic conditions. Dense mats prevent recreational activities (e.g. Berg River Canoe marathon), disrupt water flow, block water infrastructure, reduce water availability and reduce habitat suitability for aquatic biota. Dense mats can also smother indigenous vegetation leaving bare patches which are highly prone to erosion. The recommended method of removal of this weed is mechanically or by hand, although herbicides or biocontrol methods are generally used.


Water hyacinth

Alien Fauna in the Catchment


rainbow trout


brown trout


carp


banded tilapia


Mozambique tilapia


sharptooth catfish

Alien Fish

Rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) were introduced into the Berg River mainstream during the early 1900's by anglers. Other invasive alien species stocked into the river later were largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), carp (*Cyprinus carpio*), banded tilapia (*Tilapia sparrmanii*), Mozambique tilapia (*Oreochromis mossambicus*) and bluegill sunfish (*Lepomis macrochirus*).

During recent years, anglers illegally stocked sharptooth catfish (*Clarias gariepinus*) into the river. These now dominate the fish community of the mainstem and may be replacing the alien basses. Alien fish impact on indigenous fish in three ways,

- they prey on them (e.g. smallmouth bass),
- they compete with them for food (e.g. banded and Mozambique tilapia), or
- they degrade their habitat (e.g. carp).


bluegill sunfish


smallmouth bass

GREY SQUIRREL (*Sciurus carolinensis*)
The grey squirrel, originally from North America, was introduced to the Western Cape around 1900 via England by Cecil John Rhodes. The squirrel spread rapidly from Cape Town and are now common throughout the Boland and the Peninsula. Acorns and pine seeds form their staple diet, followed by pine nuts, vegetables and deciduous fruits (almonds, grapes, peaches). The squirrel is invasive, especially in alien tree plantations and urban areas, where the invasion of riparian vegetation by the oak (*Quercus robur*) is positively correlated with the distribution range of the grey squirrel. The squirrel is, however, not considered a serious ecological or agricultural problem.


Grey squirrel

Protecting Indigenous Fauna & Flora

What Can We Do to Protect & Conserve our Rivers?

Join a clearing or hack group and encourage others to become involved

Remove alien plants from rivers and their catchment in co-operation with local authorities

Buy products made by alien clearing programmes (firewood, crafts, furniture, mulch)

Inform authorities about the location of invasive alien plants and fish

Protect natural species by not buying and introducing alien fauna and flora into rivers

Obtain permission from conservation authorities before stocking rivers and dams with fish

Protect best areas for river and fish conservation by establishing conservancies

Plant indigenous vegetation to control erosion of river banks and improve biodiversity

How to Get Involved

New legislation provides for formal structures and processes for integrated water resource management at a catchment and local level, through the establishment of catchment management agencies and a strong user representation. These agencies provide a forum for government authorities and stakeholders to work towards a consensus on the management and development of objectives for a catchment. The active cooperation of water users is of the utmost importance in maintaining a healthy environment.

Remove alien plant material from river banks as this could clog up the river

Minimize disturbance to the river

Improve agricultural and forestry practices, prevent erosion & reduce fertilizer and pesticide usage

Request permission to modify river banks, sink boreholes in riparian zones or to build dams on rivers

Avoid straightening river channels and smoothing riverbeds

Water is precious - use it sparingly and wisely!

Avoid dumping litter, garbage, pesticides or building rubble on river banks and in rivers

Who to Consult

Consult local offices at Cape Nature (Tel: 021-866 8000), Department of Water Affairs and Forestry (Tel: 021-950 7100, Regional Office: Bellville), Department of Environmental Affairs and Development Planning (Tel: 021-483 4282) and where applicable the City of Cape Town (Tel: 021-487 2205) or other District Municipalities for guidance regarding river and catchment issues. They are there to help you.

GLOSSARY

Alien species Fauna and flora introduced intentionally or by accident from other countries. Not all alien species are invasive.

Biodiversity The variety and variability among living organisms and the ecological complexes in which they occur.

Biota refers to the community of plants and animals .

Desired health An indication of the envisioned ecological state of the river and is determined by considering the ecological importance and sensitivity of the specific river ecosystems.

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

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

Ecological Reserve The quality and quantity of water that is required to protect the aquatic ecosystems of a water resource.

Environmental Impact Assessment Investigates the actual and potential impacts of the proposed action or development on an area.

Euryhaline Able to tolerate a wide range of degrees of salinity.

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

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

Gross Geographic Product (GGP) The total value of all final goods and services produced within the economy in a geographic area for a given period.

Gross Domestic Product (GDP) The total market value of all final goods and services produced in a country for a given period.

Harvest potential is the maximum volume of groundwater that can be abstracted per square kilometre per annum, without depleting an aquifer.

Indigenous species Fauna and flora occurring naturally in an area.

Instream refers to "within the river channel".

MAP (Mean Annual Precipitation) Average rainfall (including snow, hail and fog condensation) over a year.

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

nMAR (natural Mean Annual Runoff) Average yearly available stream flow at a point in the river, calculated over a long period of time (usually 50 years or more), in undeveloped conditions.

Marginal vegetation refers to plants growing at the edge of the river.

Present health A measure of the present ecological state of the river during the time of the survey. This is expressed as a river health category which reflects how much the river has changed from its natural state.

Riparian habitat refers to the habitat on the river bank.

Riparian zone The area adjacent to a river or water body that forms part of the river ecosystem. The riparian zone plays an essential role in the functioning of the river ecosystem. It is characterized by frequent inundation or sufficient flooding to support vegetation distinct from the surrounding area.

Runoff Runoff is water flowing over the surface of a catchment.

spp. Abbreviation after a genus name denoting that several species belonging to the genus are being referred to. Species (sp.) refers to the unit of biological classification and diversity.

Further Reading

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Web pages to explore are:
City of Cape Town: www.capetown.gov.za
Department of Water Affairs and Forestry: www.dwaf.gov.za
Department of Environment Affairs and Tourism: www.environment.gov.za
Cape Nature: www.capenature.org.za
TCTA: www.tcta-metsi.com
Working for Water: www-dwaf.pwv.gov.za/wfw
Berg River Baseline Monitoring: www.dwaf.gov.za/Projects/BergRiver

http://www.csir.co.za/rhp/

Department of Water Affairs and Forestry
Department of Environmental Affairs and Tourism

Water Research Commission

CapeNature

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

TCTA

CSIR
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NORAD
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NORWEGIAN AGENCY FOR DEVELOPMENT COOPERATION