Water Research Commission

CSIR ENVIRONMENTEK

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

South African NATIONAL PARKS

Loretta Steyn Graphic Design Studio - Pretoria

STATE OF THE RIVERS REPORT

LETABA AND LUVUVHU RIVER SYSTEMS -2001

CONTEXT OF THIS REPORT

This report is based on the findings of river surveys that were conducted as part of the implementation of the River Health Programme in the Northern Province. The surveys on the Luvuvhu System took place during 1999 and 2000 and on the Letaba System during 2000 and 2001.

The Luvuvhu System was largely surveyed prior to the major flood event that took place during the first quarter of 2000 and the Letaba System was surveyed after this event.

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Suggested citation:
State of Rivers Report (2001)
Letaba and Luvuvhu river systems.
WRC report no: TT 165/01
Water Research Commission
Pretoria
ISBN No: 1 86845 825 3

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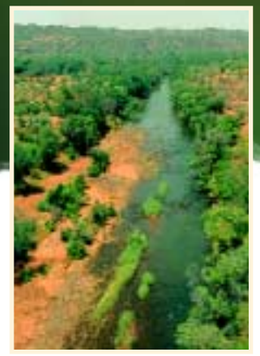


The River Health Programme

BACKGROUND

Water resources in South Africa are limited making them critically important for the sustainable economic and social development of the country. As the custodian of water resources, the Department of Water Affairs and Forestry (DWAF) is responsible for the protection of the health of aquatic ecosystems, thus ensuring the ability of these systems to support utilisation for the benefit of current and future generations. For this reason, DWAF initiated the River Health Programme (RHP) in 1994.

The RHP is designed to develop the capacity and information base to enable us to report on the ecological state of our river systems, in an objective and scientifically sound manner. At the same time, this programme audits management strategies and actions related to water resources. The information generated by the RHP assists in identifying areas of sustainable utilisation and unacceptable ecological deterioration.

The programme is based on assessing the condition of biological communities of rivers (such as fish, aquatic invertebrates and riparian vegetation) as well as river habitats to provide an integrated measure of the integrity or health of river systems.

A COLLABORATIVE VENTURE

The RHP is a collaborative venture and the partnerships that have been established are critical success factors of both the design and implementation phases. At the national level, DWAF plays the lead role while the Department of Environmental Affairs and Tourism (DEAT) and the Water Research Commission (WRC) are actively involved. These national partner organisations support not only the development but also the ongoing improvement of the monitoring protocols and implementation procedures that make up the RHP. These protocols and procedures are available to any institution that wants to become involved in river health monitoring.

Implementation of the RHP is co-ordinated at a provincial level where collaboration also plays an important role. Each province has a network of implementers who work together, usually under the leadership of a Provincial Champion. The composition of the implementation teams reflects the diversity of institutional capacities across South Africa. A mixture of DWAF regional offices, provincial government departments, universities, conservation agencies and private sector organisations take part. Through actively working together and sharing skills and resources, implementation teams can achieve goals that would not be possible for any one organisation working alone. As an example, the implementation team of the Northern Province primarily includes river scientists from the Northern Province Environmental Affairs, Kruger National Park, the University of Venda and the University of the North.

LEGAL CONTEXT

The RHP is essentially a tool for monitoring the ecological state of rivers in South Africa and is not specifically mandated by any South African act of parliament. However, the results obtained through application of the RHP can invoke certain legal principles contained in the National Environmental Management Act (NEMA) and the National Water Act (NWA), for example where there is irrefutable evidence of environmental degradation or a violation of the conditions specified in a water use licence.

The NWA requires that DWAF must, amongst other things, ensure the monitoring of the condition of water resources including the health of aquatic ecosystems. The protection objectives of the new act also require that planning processes take into account the characteristics of in-stream and riparian vegetation as well as the characteristics and distribution of aquatic biota.

NEMA is largely concerned with governing the sustainable use of the environment and the protection of ecosystems. To achieve this, it requires information that would show the current ecological state of ecosystems, indicate where actual environmental impacts are occurring, and provide guidance for the planning of future developments.

STATE OF RIVERS (SoR) REPORTING SERIES

The concept of State of the Environment (SoE) reporting has developed over the past decade in response to a need for appropriate information to assist with environmental decision-making. In response to this need, the RHP addresses monitoring, packaging and dissemination of information on river health in such a way as to:

a) Serve ecologically sound management of rivers in South Africa and
b) Inform and educate the people of South Africa regarding the health and importance of our rivers.

A special format has been developed for reporting the river health information generated by the RHP, in a simplified and summarised SoR report or poster. The first SoR report was published in March 2001 and presented findings of RHP surveys that were conducted on the Crocodile, Sabie-Sand and Olifants rivers as well as some of their tributaries. The Letaba & Luvuvhu report is the second in the SoR report series and this initiative will continue to eventually cover all major river systems of South Africa.

Concepts used in this report

RIVER HEALTH AS RELATED TO GOODS AND SERVICES

The term "river health" simply refers to the condition of a river, in the same way as health would refer to the condition of a person or an economy. It is important to monitor and manage the health of rivers, as these systems are central to human welfare and economic development in many ways. We can express the social and economic value of rivers in terms of the goods and services provided by these aquatic ecosystems. Some of the goods and services that we get from healthy river systems are:

- Tourism and recreation value generated by aquatic habitats and species (just think how many tourist lodges overlook water)
- Enhanced private and commercial property values
- Food value (for example fish from the river and fruits from the riparian zone)
- Domestic water value (drinking, cooking, cleaning, washing)
- Consumptive water value (power generation, manufacturing, aquaculture, irrigation)
- Medicinal plants which grow in the riparian zone
- Building materials (reeds, wood, stone, sand)
- Cultural value (baptism, healing, ancestral worship)
- Water quality improvement through self purification ability or dilution
- Flood control value of natural river channels, wetlands and associated vegetation
- Erosion control of riparian vegetation.

RIVER HEALTH INDICES

A multitude of factors determine the health of a river ecosystem: geomorphological characteristics, hydrological and hydraulic regimes, chemical and physical water quality and the nature of in-stream and riparian habitats. Measuring each of these factors in detail is impractical. The RHP therefore focuses on selected ecological indicator groups that are representative of the larger ecosystem and are feasible to measure. Through scientifically derived measurement indices, the complex data that are collected for each indicator group can be summarised and expressed in an easy-to-understand format. The following indices are currently used to assess the health of rivers:

South African Scoring System (SASS) for aquatic invertebrates – A variety of invertebrate organisms (e.g. insects, mussels, snails, crabs, worms) require specific aquatic habitat types and water quality conditions for at least part of their life cycles. Changes in the composition and structure of aquatic invertebrate communities are signs of changes in overall river conditions. As most invertebrates are relatively short-lived and remain in one area during their aquatic life phase, they are particularly good indicators of localised conditions in a river over the short term. The SASS is a relatively simple index which is based on the families of aquatic invertebrates present at a site. This information is translated into a reflection of the quality of the water in the river.

Fish Assemblage Integrity Index (FAII) – Fish, being relatively long-lived and mobile, are good indicators of longer term influences on a river reach and the general habitat conditions within the reach. The number of species of fish that occur in a specific reach, their sensitivity to various forms of disturbances, as well as factors such as different size classes and the health of fish, can be used as indicators of river health. The FAII integrates such charac-

teristics of a fish assemblage. The output of the FAII is an expression of the degree to which a fish assemblage deviates from what would have been expected in the absence of human impacts.

Riparian Vegetation Index (RVI) – Healthy riparian zones provide habitat for aquatic and terrestrial species, contribute towards maintaining the form of the river channel and serve as filters for sediment, nutrients and light. The structure and function of riparian vegetation are altered with vegetation removal, cultivation, construction, inundation, erosion, sedimentation and alien vegetation invasion within or close to the riparian zone. The RVI is used to determine the degree of modification in riparian conditions.

Index of Habitat Integrity (IHI) – Habitat availability and diversity are major determinants of the suite of biota found in a specific ecosystem. Therefore, knowledge of the quality of habitats is very important in an overall assessment of ecosystem health. The IHI is designed to assess the impact of major disturbances on river ecosystems. Such disturbances include water abstraction, flow regulation and river channel modification. The index accounts for both the condition of the riparian zone and in-stream habitats.The IHI has not been conducted in the Letaba and Luvuvhu river systems since 1996 and was therefore not included in this report.

ECOREGIONS

Ecoregions are regions of broad ecological similarity. In other words, rivers that occur within a particular ecoregion will be more similar to each other than to rivers in other ecoregions. Variation in natural characteristics such as physiography, climate, geology, soils and vegetation was used to delineate the ecoregions used in this report. Because of their similarity, these ecoregions provide convenient boundaries within which to do ecological assessments and set quality objectives.

South Africa has 18 level 1 ecoregions (see page 8). A decimal value (e.g. 5.03) represents a subdivision to level 2.

RIVER HEALTH CATEGORY	ECOLOGICAL PERSPECTIVE	MANAGEMENT PERSPECTIVE
Natural N	No or negligible modification of in-stream and riparian habitats and biota.	Relatively untouched by human hands. No discharges or impoundments.
Good G	Biodiversity largely intact.	Some human-related disturbance but ecosystems essentially in good state.
Fair F	A few sensitive species may be lost in parts and lower abundances of some populations may occur.	Zones of competing uses. Some natural systems may occur but developmental pressures are prominent in other parts.
Poor P	Only more tolerant species remain; alien species have invaded the ecosystem; population dynamics have been disrupted (e.g. where biota can no longer breed); species present are often diseased.	Often characterised by high human densities or extensive resource exploitation. Management intervention is needed to improve river health – e.g. to restore flow patterns, river habitats or water quality.

RIVER HEALTH CATEGORIES

The results that are obtained by applying the biological and habitat indices during a river survey provide the context for determining the health state of the river. In order to standardise the output of the different indices as well as to allow comparison of the health of different river systems, a river health categorisation is used. Each index is calibrated so that its results can be expressed as a river health category (see box on page 4).

SoR REPORTING FORMAT

The national SoE report for South Africa uses the Driving Force-Pressure-State-Impact-Response framework to explain what is causing environmental change, how good or bad the conditions are and what we can and are doing about it. Aligned with this framework, SoR reporting describes the present state and trends in river conditions, the driving forces and pressures on the rivers, and the policies and management actions in place to manage the rivers:

- **Present health** – The present health is a measure of the ecological state of the river during the time of the survey. Due to the time and event integrating nature of the indices used, the present health is a reflection of the response of the river to all the natural as well as human induced disturbances that have taken place prior to the survey. The present health of the river is expressed as a River Health Category, which gives an idea of how much the river has changed from its natural state.

- **Pressures and driving forces** – Pressures are those factors that have an impact on the health of the river, while driving forces refer to the human activities which create these pressures. Knowing the pressures on a river provides insight into why the river is in its present health. Examples of pressures are poor water quality, sedimentation and reduced flows. Examples of associated driving forces are discharge of untreated effluent, bad land management and abstraction of water.

- **Desired health** – Some change in ecosystems is unavoidable. However, a balance must be struck between human and economic uses of water and the need to maintain the biophysical systems that these uses depend on. The desired health of a river is an indication of what the ecological state of the river should be, based on ecological considerations and sustainability. For the purpose of this report, the desired health was 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. Consequently, it reflects how important the protection of these ecological attributes is, from a local, national and even an international perspective. Ecological sensitivity refers to the ability of a specific ecosystem to tolerate disturbances and to recover from certain impacts.

- **Management action** – Once the present as well as the desired health of a river is known, the need and priorities for management intervention can be determined. Management action refers to what is being done, whether current actions are effective and what more should be done to improve river health. Management actions may include policies, national and local management strategies or specific initiatives regarding aquatic ecosystems and the management of natural resources in general.

OVERVIEW OF THE STUDY AREA

Terrain

The Groot Letaba , Politsi, Debengeni, Thabina and Letsitele rivers rise in the Northern Drakensberg Mountains (between 1 100 and 1 800 m above mean sea level (amsl) and cascade down the steep slopes in a north easterly direction. The undulating plains of the lowveld catchment are drained by the Groot Letaba River and its major tributaries the Klein Letaba, the Middel Letaba, Nsama and Molototsi rivers. The Letaba River flows eastwards across the Kruger National Park (KNP), where it joins the Olifants River a short distance upstream of the Mozambique border.

The Luvuvhu River and the Sterkstroom rise on the southern side of the Soutpansberg Mountains east of Louis Trichardt (between 1 000 and 1 400 m amsl). Further eastwards, the Latonyanda, Dzindi, Mutshindudi and Mutale tributaries join the Luvuvhu, all originating from within the mountain ranges east of the Entabeni and Vondo forestry areas. The Luvuvhu River traverses the Kruger National Park and joins the Limpopo River at Crook's Corner on the Mozambique border.

Climate

The change in topography (altitude and relief) gives rise to varied climatic characteristics. The mountain zone has a rainfall of some 2 000 mm/a and the dry lowveld in the KNP 400 mm/a. More than 85% of the rain falls during the summer months. Evaporation increases gradually from 1 400 mm/a in the west to 1 900 mm/a in the east. About 60% of the evaporation occurs during the 6 months from October to March.

Temperatures range from a high average of 21°C in the upper catchments, to a very high average of 25°C in the KNP. Frost rarely occurs.

Land use

NATURAL AREAS OF IMPORTANCE

The upper Letaba Catchment contains numerous areas of importance. The Wolkberg Wilderness area is renowned as an important biodiversity "hotspot". Scenic waterfalls occur throughout the escarpment, with probably the most well known being the Debengeni Waterfall. The Modjadji Cycad Reserve holds unique populations of these prehistoric plants. In the lower catchment, numerous private nature reserves, the provincial Merensky Reserve and Letaba Ranch are found. The lowveld region has a number of important geothermal springs (the resort in the Hans Merensky Nature Reserve and Soutini Baleni on the banks of the Klein Letaba River.) Indigenous forests in the upper Luvuvhu Catchment include Hanglip, Piesangkop, Entabeni, Thathe Vondo and the Vhutanda sacred forest. The provincial Mphaphuli Cycad Reserve is located within a biodiversity hotspot near the confluence of the Luvuvhu and Mutshindudi rivers. Lake Fundudzi in the upper Mutale is one of very few natural inland lakes in South Africa. Scenic gorges occur in both the Mutale and Luvuvhu rivers. The Luvuvhu Gorge divides the Makuya Provincial Reserve from the Kruger National Park. The Pafuri floodplain has been proposed a wetland of international importance (Ramsar site).

AGRICULTURE AND FORESTRY

The upper catchments of both the Drakensberg and Soutpansberg mountains are dominated by forestry plantations (pines, eucalyptus and alien mahoganies). The foothill zones of both mountain ranges contain tea estates. The Tzaneen and Letsitele regions of the Letaba Catchment support citrus, mangos, and bananas. The Klein Letaba, Molototsi and Nsama river catchments are dominated by rural populations with cattle, goats and subsistence farming. The Levubu agricultural area in the Luvuvhu Catchment, produces citrus, mangos, bananas and macadamias, while further downstream in the Luvuvhu Catchment, the Mutshindudi and the Mutale River catchments are dominated by rural community gardens, cattle and goats.

Population

The most common languages in the study area are Tshivenda, Xitsonga and Afrikaans. A significant portion of the study area falls within the KNP and thus has a very low population. Fewer visitors frequent the northern section of the park compared to the southern regions.

Less than 5% of the more than 1 130 000 inhabitants in the Letaba Catchment have fully reticulated water supply systems. The remainder of the population obtain water from street pipes, boreholes, hand pumps, streams and springs. Tzaneen, Giyani and Letsitele are the larger formal towns in the Letaba Catchment.

The majority of the 770 000 people in the Luvuvhu Catchment live in rural villages. The villages are heavily concentrated along the river systems. The town of Thohoyandou, with its surrounding villages, is the area of greatest human concentration in the Luvuvhu Catchment.

Economic profile

The economy of the study area is based on forestry, tea, subtropical fruits, summer crops, vegetables and livestock farming. The GGP of the Groot Letaba River catchment was about R491 million in 1994. Subsistence farming plays a major role in the economies of both catchments. Ecotourism is regarded as a core industry of the Northern Province and the study area.

A coal mine exists in the Luvuvhu Catchment, while gold mines occur along the Klein Letaba River. Numerous mining developments are under consideration in the Tzaneen area, but are subject to the availability of water.

A large number of people in the study area are unemployed. Only 10% of the people with jobs are employed within the Letaba and Luvuvhu catchments. Many are migrant workers, travelling to Johannesburg for work. The provincial government is the largest employer in the region.

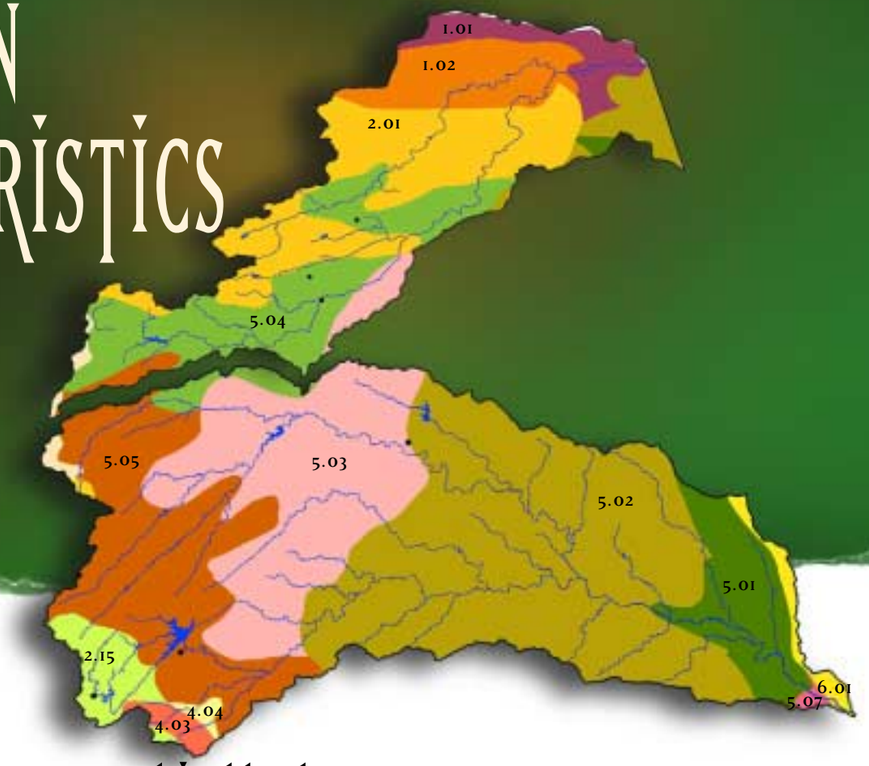
Development priorities

Demands for water in the Letaba Catchment already exceed the available water resources. A new dam in the Letaba River at the confluence with the Nwanedzi River has been evaluated, together with a possible development option in the Letsitele River. The economic viability of both options is still under review. Improved operating techniques appear to offer a more favourable option compared to the construction of new impoundments at this time.

The Luvuvhu Government Bulk Water Supply Scheme is due to be operational in 2002. The scheme comprises the new Nandoni Dam and associated Xikundu Weir. The scheme will interlink with water supplies from both the Albasini Dam and Vondo Dam.

Land-use development is likely to occur mainly in the western and central third zones of the Letaba and Luvuvhu catchments and is likely to be limited to the agricultural and residential sectors. Some industrial/commercial developments may stem from primary development. Development in the semi-arid and more remote parts of the catchment is likely to be limited. Further forestry development in the mountain regions of the catchment is limited.

ECOREGION CHARACTERISTICS



1. Limpopo Plain

ECOREGION 1.01

Landscape: Undulating landscape, plains and lowlands with low to moderate relief
Vegetation: Mopane Bushveld
Altitude: 200 to 475 m
Rainfall: 200 to above 525 mm
Temperature: 1.5 to 42.5°C (mean annual 23°C)
Soils: Alluvial soils, sands and gravel
Geology: Sandstone, shale, grit, conglomerate, quartzite and basalt.

ECOREGION 1.02

Landscape: Plains and lowlands with low to moderate relief
Vegetation: Soutpansberg Arid Mountain Bushveld
Altitude: 225 to 650 m
Rainfall: 225 to 500 mm
Temperature: 3 to 44°C (mean annual 22°C)
Soils: Acidic sandy, loamy to gravelly
Geology: Sandstone, quartzite and shale

2.Central Highlands

ECOREGION 2.01

Landscape: Undulating landscape, hills and low mountains with moderate relief
Vegetation: Sour Lowveld Bushveld, Soutpansberg Arid Mountain Bushveld and patches of Afromontane Forest
Altitude: 325 to 1 550 m
Rainfall: 300 to 2 025 mm
Temperature: 2 to 44°C (mean annual 20°C)
Soils: Sandy to sandy loam soils in the uplands to clayey soils in the bottomlands
Geology: Granite and gneisses (sandstone, quartzite and shale)

ECOREGION 2.15

Landscape: Mountains with high to moderate relief
Vegetation: Northeastern Mountain Grassland and Afromontane Forest.
Altitude: 825 to 2 100 m
Rainfall: 475 to 2 000 mm
Temperature: -8 to 39°C (mean annual 16°C)
Soils: Mostly shallow lithosols
Geology: Granite, quartzite, mudstone, sandstone and shales

4. Great Escarpment Mountains

ECOREGION 4.03

Landscape: Mountains with high relief
Vegetation: Northeastern Mountain Grassland and patches of Afromontane Forest
Altitude: 625 to 1900 m
Rainfall: 600 to 1 325 mm
Temperature: -8 to 39°C (mean annual 18°C)
Soils: Shallow lithosols
Geology: Variety of rock types

5. Lowveld

ECOREGION 5.01

Landscape: Plains and open hills with low to moderate relief
Vegetation: Mopane Shrubveld
Altitude: 200 to 475 m
Rainfall: 325 to 975 mm
Temperature: -1 to 46°C (mean annual 22°C)
Soils: Clayey
Geology: Basalt

ECOREGION 5.02

Landscape: Slightly undulating landscape, plains with low relief
Vegetation : Mopane Bushveld
Altitude: 200 to 800 m
Rainfall: 250 to 725 mm
Temperature: 1.5 to 42.5°C (mean annual 22°C)
Soils: Loamy sands and clayey soils
Geology: Granite and gneiss with dolerite intrusions

ECOREGION 5.03

Landscape: Flat to undulating landscape - plains with low to moderate relief, hills with high relief
Vegetation: Mixed Lowveld Bushveld
Altitude: 450 to 1 300 m
Rainfall: 350 to 1 050 mm
Temperature: -4 to 45°C (mean annual 21°C)
Soils: A range of sandy to clayey soils
Geology: Granite and gneiss with dolerite intrusions

ECOREGION 5.04

Landscape: Undulating landscape, hills and low mountains with moderate relief
Vegetation: Sour Lowveld Bushveld and patches of Afromontane Forest
Altitude: 450 to 1 425 m
Rainfall: 425 to 1 875 mm
Temperature: 2 to 34°C (mean annual 20°C)
Soils: From sandy loam in the uplands to clayey in the bottomlands
Geology: Granite and gneiss

ECOREGION 5.05

Landscape: Hills and low mountains with high relief - the lower eastern slopes and foothills of the Drakensberg and Soutpansberg
Vegetation: Sour Lowveld Bushveld, Mixed Bushveld and patches of Afromontane Forest
Altitude: 475 to 1 825 m
Rainfall: 425 to 1 725 mm
Temperature: 2 to 43° (mean annual 19°C)
Soils: Deep sandy to sandy loam soils in the uplands to clayey or shallow coarse sandy soils in bottomlands
Geology: Quartzite, sandstone, shale, granite and gneiss

ECOREGION 5.07

Landscape: Plains with low relief
Vegetation: Sweet Lowveld Bushveld
Altitude: 175 to 425 m
Rainfall: 375 to 775 mm
Temperature: -2 to 43°C (mean annual 22°C)
Soils: Relatively shallow black, brown or red clayey soil
Geology: Basalt

6. Lebombo Uplands

ECOREGION 6.01

Landscape: Hills with moderate relief, undulating rocky terrain
Vegetation: Lebombo Arid Mountain Bushveld
Altitude: 150 to 500 m
Rainfall: 400 to 950 mm
Temperature: -1 to 46°C (mean annual 22°C)
Soils: Shallow, stony soils – can be classified as lithosols
Geology: Rhyolite and granophyre

THE LETABA RIVER CATCHMENT

Letaba Catchment = 13 670 km²
Mean annual precipitation (MAP) = 612 mm
Mean annual evaporation = 1 669 mm
Mean annual runoff (MAR) = 574 million cubic metres
(range from 100 to 2 700 million cubic metres)

Mean annual runoff (MAR) in the Letaba Catchment varies from more than 10% of the mean annual precipitation (MAP) in the wet mountainous zone to less than 2% in the drier parts of the catchment. More than 60% of the MAR in this catchment derives from only 6% of the area.

More than 20 major dams have been constructed in the Groot Letaba River catchment. The Tzaneen Dam on the Groot Letaba River and the Middel Letaba Dam are the two largest dams in the Northern Province. Other large dams in the catchment include the Ebenezer, Magoebaskloof, Nsami and Modjadji dams.

As mountain and foothill streams, the Groot Letaba, Letsitele, Thabina, Debengeni and Magoebaskloof rivers have very diverse in-stream habitats. The river channels contain steep bedrock and fixed boulder rapids with cascades and occasional waterfalls. Cobble riffles occur in lower gradient sections. Deep pools are present in all river sections. These perennial rivers rise in the Great Escarpment Mountains.

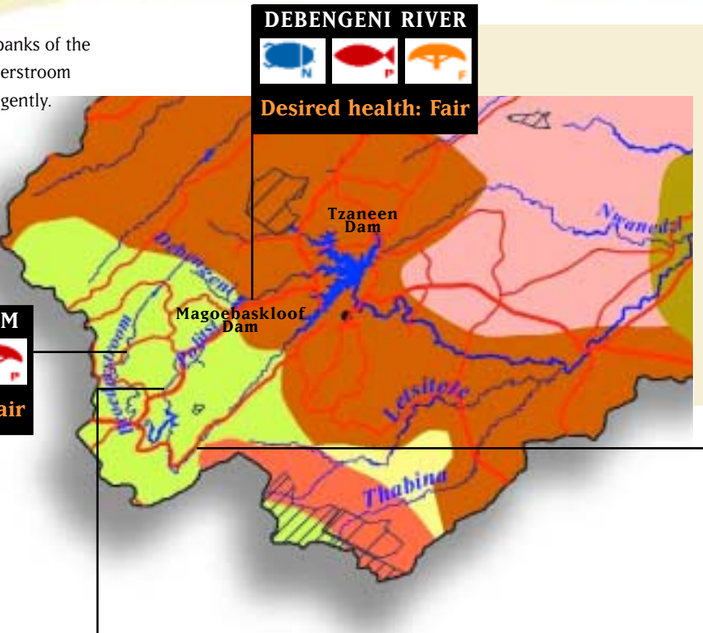
The Klein Letaba, Nsama and Molototsi rivers are typical sandy lowveld rivers, with deeply incised river channels. Wide sandy runs are interspersed with occasional gravel riffles. Bedrock dykes cross these rivers at infrequent intervals, occasionally causing deep pools on their upstream sides. River flows vary considerably during a single annual cycle.

Below the confluence of the Groot and Klein Letaba rivers, (at the KNP border) the Letaba River channel takes on the characteristics of the Klein Letaba River. The Letaba River passes through a steep confined gorge just before joining the Olifants River near the Mozambique border.

THE LETABA RIVER
GROOT LETABA HEADWATERS

The Groot Letaba headwater streams originate in the Drakensberg Escarpment, descending in long runs with an occasional riffle or pool. Bank sides are of gentle slope. Riparian vegetation is sparse. The natural grasslands have been replaced by commercial forestry. About 45% (more than 20 000 ha) of the total area of ecoregion 2.15 in the Letaba Catchment comprises plantations. Less than 5% is undeveloped grassland.

Riverbanks of the Broederstroom slope gently.



Siltation originating from forestry roads is a serious problem. An improvement in the management of timber felling practices, especially during the rainy season, would reduce wash-off of soil into the river.

Predatory trout have destroyed the indigenous fish populations in the Broederstroom.

Sandmining for building purposes has disrupted the river channel and riparian zone of the Broederstroom.

The Politsi River valleys are very steep.

Erosion in the riparian zone from bridge construction works. Agriculture, forestry and informal settlements encroach on the riparian zone. Alien plants include bugweed, pines and eucalypts.

FORESTRY AND RIVER HEALTH

Alien trees need plenty of water, therefore plantations are typically located in the high rainfall regions of a catchment. Plantations and stream sources often coincide and special attention needs to be paid to river health in these areas. The main forestry-related impacts on river systems are streamflow reductions and erosion and siltation associated with roads and harvesting activities.

Plantations cover 3.5% of the Letaba Catchment (30 577 ha eucalypts and 17 851 ha pines) and forestry is an economically and socially important industry. Since the early 1990's, the industry has recognised the need for an environmentally sensitive approach to forestry-related activities and has played a pioneering role in incorporating environmental strategies as part of the business.

The Debengeni Waterfalls attract tourists. Tourism could be of great economic benefit to this area, provided authorities incorporate environmental considerations into their planning.

Plantations and roads impair the functionality of the riparian zone. Alien plants and pine plantations are very close to the river's edge.

The sharp descent from the Central Highlands to the Lowveld makes this an area of incised streams with numerous waterfalls.

Bridge construction has disturbed bank vegetation, causing erosion. Bramble, lantana, bugweed, pines and other alien plants abound in this region.

FORESTRY MANAGEMENT RECOMMENDATIONS

The forestry industry's management recommendations with positive consequences for river health include:

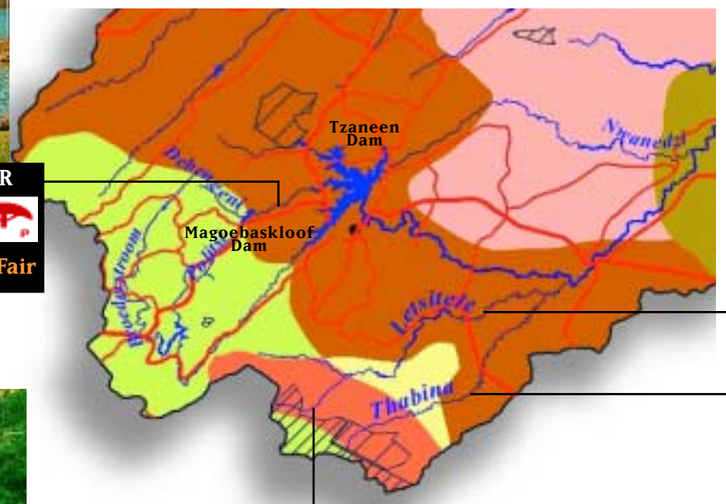
- Planting restrictions: leaving adequate riparian buffer zones undisturbed along all watercourses
- Road infrastructure and associated drainage designed to minimise erosion and sediment deposition into rivers
- Timber harvesting activities: minimise erosion by packing felled debris to slow the down-slope movement of soil and water
- Clearing of alien invasive plants: Prevent erosion and stabilise river banks with indigenous plants or grass mixture.
- Extensive water quality monitoring
- Forming partnerships with neighbouring land users to ensure holistic and cooperative management

THE LETABA RIVER

POLITSI RIVER BELOW MAGOEBASKLOOF DAM, LETSITELE AND THABINA RIVERS

Downstream of the Magoebaskloof Dam, the Politsi River enters the gently sloping Lowveld. A waterfall in the Letsitele River marks the transition from ecoregion 4.03 to ecoregion 4.04. Forestry plantations take up 30% of the total land cover of ecoregion 5.05 in this area and 64% of the area upstream of Tzaneen Dam. Subsistence farming covers 35% and commercial farming 7% of ecoregion 4.04. Ecoregion 5.05 in the Thabina and Letsitele catchments comprises 36% subsistence farming and 22% commercial farming (nearly 45% of the latter is under irrigation).

Magoebaskloof Dam, despite its small size, interrupts the natural flow pattern of the river. It is an irrigation dam with little capability for water releases, so that the resulting downstream flow pattern modifies river habitats.



POLITSI RIVER

Desired health: Fair

Roads next to the Politsi River and bridges across it cause erosion and siltation.

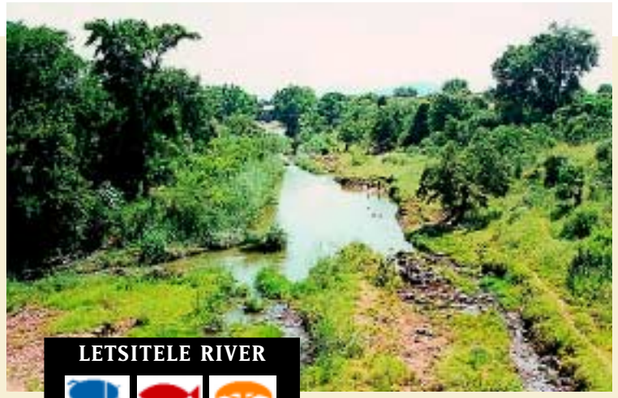
Lantana, jacaranda, bugweed and eucalypts are some of the alien plant species infesting this site.

LETSITELE RIVER

Desired health: Good

The riparian vegetation is in good condition, but invaded with numerous alien plants such as castor-oil plant, sesbania, wild tobacco, large cocklebur (photograph) and sugar cane.

Small weirs allow abstraction for agricultural purposes.



LETSITELE RIVER

Desired health: Fair

Alien plants invading the riparian habitat include peanut butter cassia, castor-oil plant, sesbania, ageratum and large cocklebur.

A rail bridge and small weir dominate this stretch of river and solid waste pollution occurs. The river is used for irrigation and washing of clothes.

Despite these impacts, the water quality and in-stream habitat is good.

THABINA RIVER

Desired health: Good

No water is released from the Thabina Dam for ecological purposes. The seepage from the dam, the tributaries and the runoff that feeds the Thabina River downstream of the dam appears to be sufficient to maintain the in-stream habitat in good health.

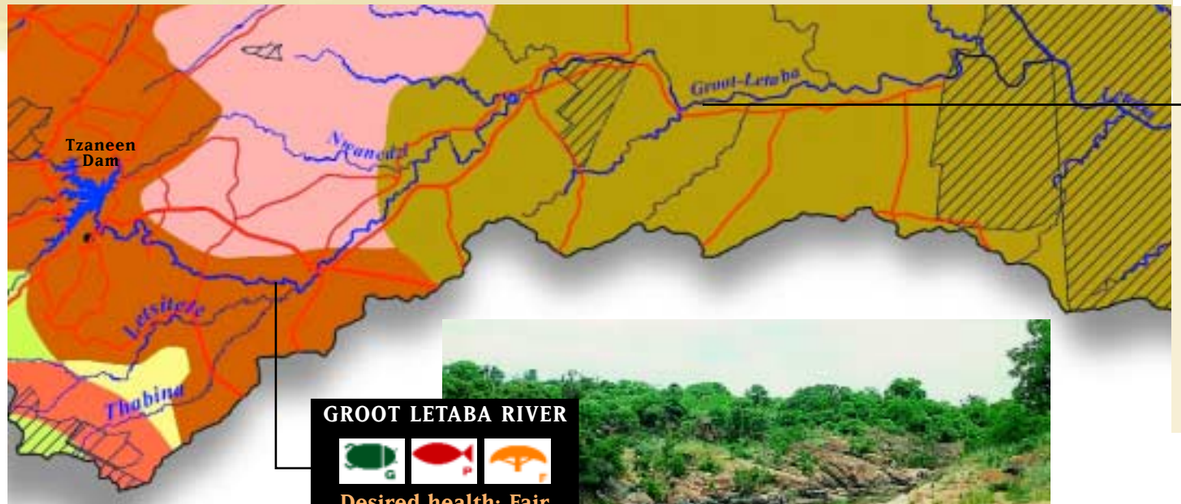
The riparian vegetation is under threat from excessive use by local communities and invasion by a host of alien plants, such as triffid weed (paraffin bush).

THE LETABA RIVER

GROOT LETABA RIVER BETWEEN TZANEEN DAM AND KNP

The Groot Letaba River has a rocky bed with many small channels and islands. Commercial agriculture, of which more than 42% is under irrigation, covers 55% of the Groot Letaba Catchment within ecoregion 5.05. Farming activities comprise nearly 25% of ecoregion 5.02 in this catchment outside of the KNP. This is made up of about 55% subsistence farming (20 800 ha) and nearly 40% commercial irrigated farmlands (14 300 ha).

Hippos and crocodiles have successfully adapted to life in agricultural dams.



GROOT LETABA RIVER

Desired health: Fair

FLOODS ARE A NATURAL PHENOMENON

Flood flows are important events in the yearly cycle of many river systems. Flood waters are responsible for transporting sediments and for defining the shape of river channels. Silts and sediments are deposited onto banks and into flood plain areas, which promote the healthy regrowth of vegetation.

The Letaba Catchment's several thousand impoundments range from small agricultural dams to larger government dam structures. The dams must first fill before waters spill into the natural systems.

Bananas compete with invasive alien plants like lantana, castor-oil plant, bugweed, large cocklebur and peanut butter cassia for a place amongst the natural riparian vegetation.

MIGRATION BARRIERS

Dams, weirs and natural waterfalls often act as barriers to the movement and migration of fish and invertebrates. Where such barriers occur, large numbers of fish can often be seen accumulating at the foot of the barrier, where they are susceptible to predation and poaching.

A few species such as eels are able to navigate past even large barriers, providing that the surface is rough. Some fish migrate downstream and sudden elevation drops can kill them.

A fishway ensures that fish are able to move across the barrier. The Letaba River has many large dams that do not have fishways and as a result, several fish species no longer occur in the upper catchment.

GROOT LETABA RIVER

Desired health: Fair

SHADE NET FISHING

SHADE NET FISHING is often carried out below migration barriers such as dams and weirs and in pools of seasonal rivers. The growing trend of fishing with the use of shade netting raises a number of problems:

- Deep pools act as important refuge areas for the fish communities and if netted regularly with fine mesh shade net, few fish remain to repopulate the river.
- The fine mesh of shade netting results in even juvenile fish being caught.
- Recreation and subsistence fishing, through legal means with a rod and line, is adversely affected through the reduction of fish stocks.
- All Northern Province rivers contain crocodiles. Children are often seen netting fish and can be caught and eaten by the crocodiles.

CONSTRUCTION OF NEW DAMS AND EIAs

The National Environmental Management Act (NEMA) requires an Environmental Impact Assessment (EIA) before any new weir or dam can be built. An EIA:

- Investigates the actual and potential impacts of the proposed action or development
- Investigates alternatives to lessen possible harm on environment
- Considers socio-economic conditions and cultural heritage
- Keeps impacts on the environment to the minimum (option not to implement activity)

The proposed Nwamitwa Dam, at the confluence of the Groot Letaba and Nwanedzi rivers, should be evaluated against the findings of an EIA.

Towards the eastern part of the Letaba River, local communities over-utilise the vegetation in the riparian zone through cutting and grazing. Alien plants have invaded the remaining riparian vegetation. The condition of the northern bank is worse than that of the southern bank.

Agricultural pesticides and fertilisers affect water quality and are the biggest threat to the western section of the Groot Letaba River.

Large weirs disrupt flows in river systems: apart from impeding fish migration, they cause bank scouring, sedimentation and loss of riparian vegetation.

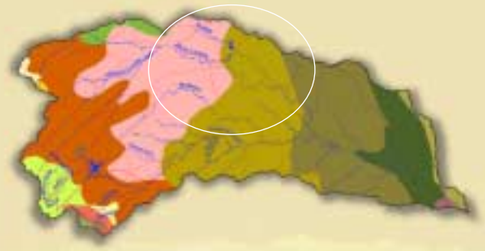
THE LETABA RIVER

MOLOTOTSI AND NSAMA RIVERS

The Molototsi River is a seasonal stream. The river is mostly a small trickle that disappears into the sand before it reaches the main river, but it experiences occasional heavy flooding during the summer months.

Subsistence farming is the main land-use in the Molototsi (36%) and Nsama river catchments (32%). Urban developments comprise 6,5% and 5% of the total catchment areas respectively.

During this survey, the Nsama River in ecoregion 5.03 was dry and no fish or invertebrate index scores are available.



Rural communities and their cattle impact on water quality, especially during the dry season. Washing, agriculture, cutting of trees and overgrazing within the riparian zone and other poor land-use practices all contribute to the problem.

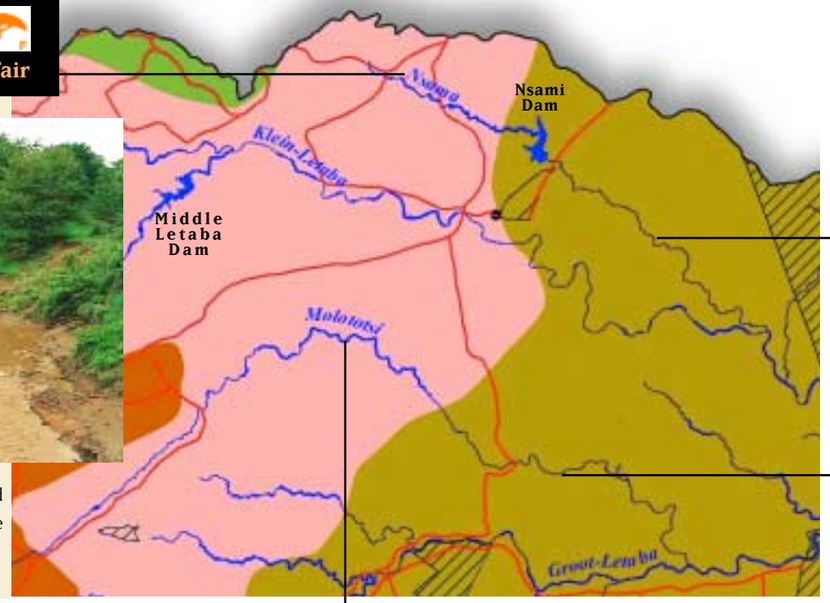
Fishing with shade nets is not a sustainable harvesting practice.

No releases are made from the Nsami Dam. A canal system exists for irrigation of bananas from the Nsami Dam. The Mangombe Nature Reserve is next to the Nsami Dam.

NSAMA RIVER

Desired health: Fair

Vegetation cutting by local communities and occurrence of alien invasive vegetation have negative impacts on the riparian habitats.



NSAMA RIVER

Desired health: Fair

Pools in seasonal rivers are important sanctuaries for fish. Rivers such as the Klein Letaba and Molototsi rivers retain very few permanent pools of water throughout the dry season. In addition, these rivers have few flowing tributaries.

MOLOTOTSI RIVER

Desired health: Fair

The Molototsi River downstream from the Modjadji Dam.

The Modjadji Dam, which stores water for domestic use, restricts flow downstream. The dam management programme does not include water releases that benefit the river ecology. This loss of flow is detrimental to the next 20-30 km of river.

Overgrazing, vegetation cutting and other poor agricultural practices occur in the catchment.

The Modjadji Cycad Reserve overlooks the Modjadji Dam.

The Molototsi River after the 2000 floods.

Environmentally unsustainable land-use practices such as overgrazing result in accelerated erosion. Alien invasive plants occur within the riparian zone.

THE LETABA RIVER

KLEIN LETABA RIVER

The Klein Letaba tributaries like the Soeketse and Koedoes rivers are wide, dry and sandy ditches for most of the year. The Middel Letaba Dam is situated in the Middel Letaba River.

Subsistence farming takes up 35% of the total land-use in ecoregion 5.03 in the Klein Letaba Catchment and 20% in ecoregion 5.02 upstream of the confluence with the Nsama River. There is no commercial farming and less than 8% subsistence farming downstream of the confluence with the Nsama River.

Lantana and triffid weed are the most serious alien invader plants in ecoregion 5.03.

Apart from alien invasive plants such as large cocklebur, castor-oil plant and thistle in ecoregion 5.02, the riparian vegetation is in very good health.

KLEIN LETABA RIVER

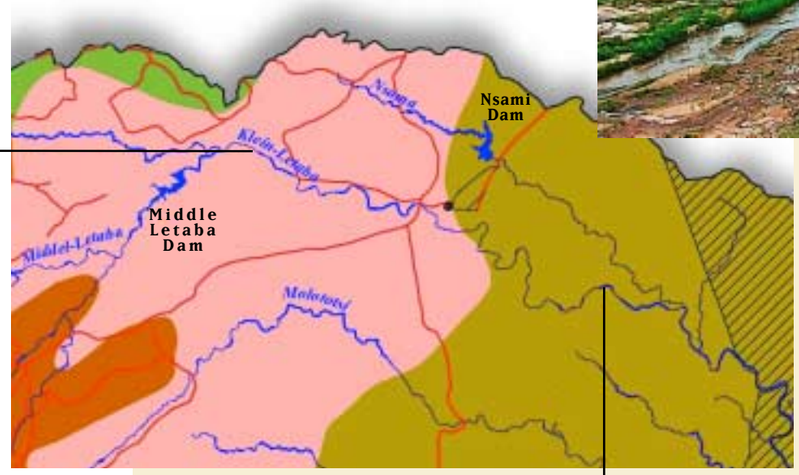
Desired health: Fair

The Middel Letaba Dam dates from the 1980s and has no facility to provide water releases that could benefit river ecology. The dam feeds a 60 km long irrigation canal (photograph) which flows into the Nsami Dam. Spillage and seepage from the dam ensure good refuges for fish in the area just below the dam.

Sand mining destroys natural habitat and is unsightly.

Agriculture consists of small-scale farming by rural communities and large commercial banana, papino, paw-paw and mango plantations upstream from Giyani. The commercial fruit farms are fed by the Middel Letaba Canal irrigation scheme

The Klein Letaba river during April 2000 (left) and July 2001 (right). In-stream biota are adapted to seasonally variable flows.



KLEIN LETABA RIVER

Desired health: Good

The lower end of the river (in this ecoregion) is in quite good condition. Population densities near the river are low because the roads and infrastructure tend away from the river.

Soutini-Baleni, a geothermal wetland, is a Natural Heritage Site on the Ivory Route.

Downstream of Soutini, the river has more permanent water. The river is close to natural with exceptionally good indigenous vegetation and almost no human impacts. A small salt works, fed by a natural geological fault, thrives.

Overgrazing in the riparian zone contributes toward donga erosion.

The eastern area of this ecoregion around the Klein Letaba River has the potential to be incorporated into the Kruger National Park.

The Letaba River in the Kruger National Park

The very sandy reaches of the Letaba River support only a narrow riparian vegetation band. The riverbed in ecoregion 5.01 is sandy with increasing occurrences of bedrock downstream. The Letaba River in the KNP forms multiple channels of up to 300 m wide. In ecoregion 5.07 and 6.01 the Letaba River flows through a series of gorges and ravines. These could form significant fish barriers if water flows were to drop below a certain level.

This part of the Kruger National Park is a wilderness area with Shimuwini being the only tourist camp. Tourism impacts are therefore minimal.

The Klein Letaba carries high sediment loads because of erodible soils and poor land management in the catchment. At the confluence of the Groot and Klein Letaba Rivers the gradient decreases and lower flow rates allow sediment to settle, aggravating the natural sand deposition on the Letaba River bed. Impoundment and abstraction, mainly for agriculture, reduce the flow of the Groot Letaba River, causing further settling of sediment.

In response to the lack of water brought in by the Groot Letaba, the Kruger National Park administration has had to build dams to provide water for game and to create habitats for fish, mammals, birds and reptiles.

The setting of Ecological Reserves for rivers gives the KNP management the confidence to cease all dam building practices.

A decision was made not to repair all the flood-damaged dams in the KNP, e.g. the Black Heron Dam is modified into a low flow gauging weir with fish-ladder and Shimuwini Dam completely removed.

LETABA RIVER

Desired health: Natural

There have been no recordings of the tiger fish in the Letaba River outside of the Kruger National Park since 1990. This temperature sensitive species dies at temperatures below 15°C. Dam walls obstruct migration towards warmer waters during cold spells.

KNP in collaboration with Northern Province Environmental Affairs and private sponsors has recently begun reintroducing tiger fish into selected Northern Province dams.

The Kruger National Park has appointed a river manager, who will promote integrated catchment management by encouraging cooperation between the park and people and institutions outside the park.

Both dams in this area, the Mingerhout Dam and the Engelhardt Dam further downstream near Letaba Camp, have good fishways.

Many matumi, sycamore fig and jackal berry trees occur along the river. Natal mahogany is also present, but some distance away from the river edge.

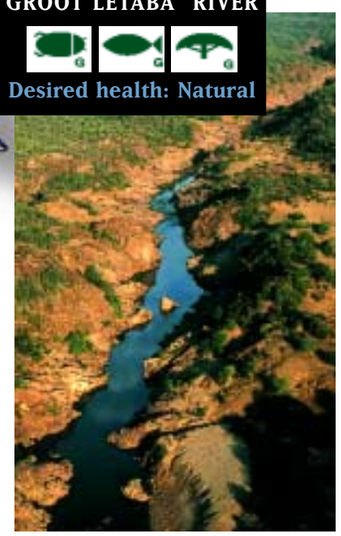
LETABA RIVER

Desired health: Natural

The Kruger National Park's Letaba camp overlooks the Letaba River and is one of the most popular camps in the park.

GROOT LETABA RIVER

Desired health: Natural



THE MISSION STATEMENT OF THE KRUGER NATIONAL PARK

- Conserve the unique biodiversity of the area
- Preserve the wilderness qualities
- Provide human benefits
- Balance the human benefits with the conservation of the biodiversity and the preservation of the wilderness qualities

This is a wilderness area, with only a few hiking trails. The river is in a near natural state.

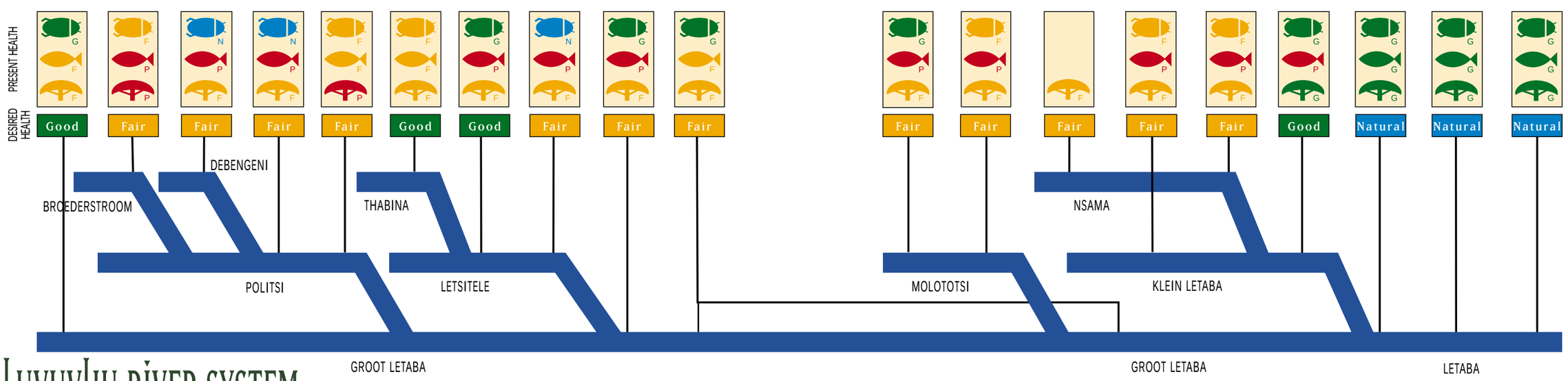
Very little riparian vegetation is present and the terrestrial vegetation grows right up to the rocky edges of the river.

Most fish species found here are large and predatory. Crocodiles are abundant within the KNP.

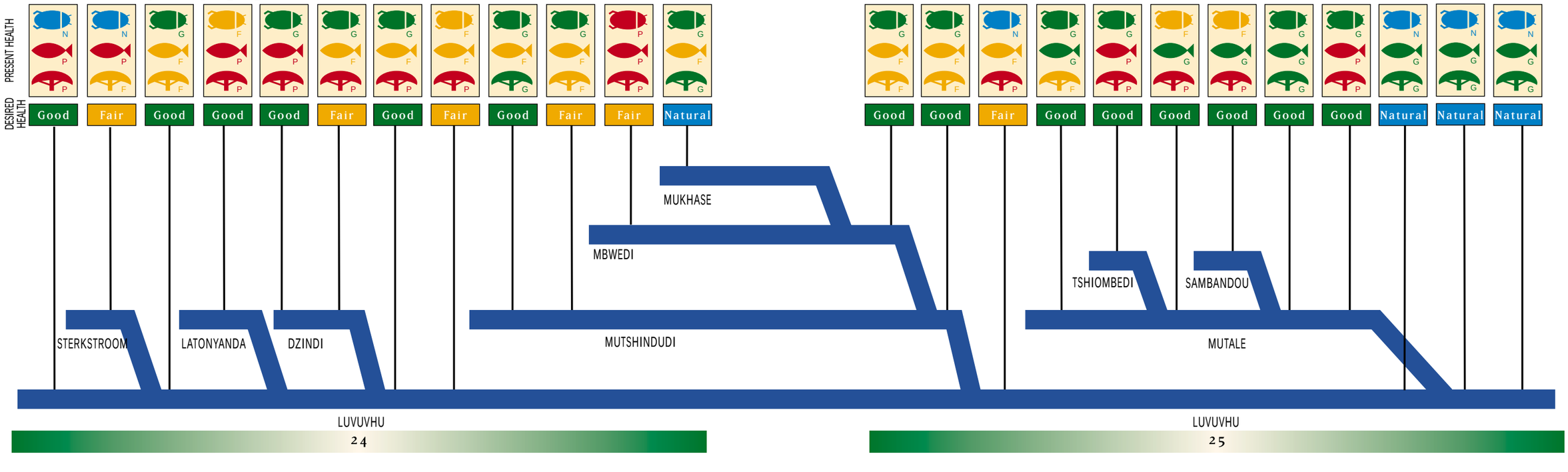
This section forms part of the Gaza-Kruger-Gonarezhou Transfrontier Park.

SUMMARY DIAGRAMS
OF THE LETABA AND LUVUVHU RIVER SYSTEMS

LETABA RIVER SYSTEM

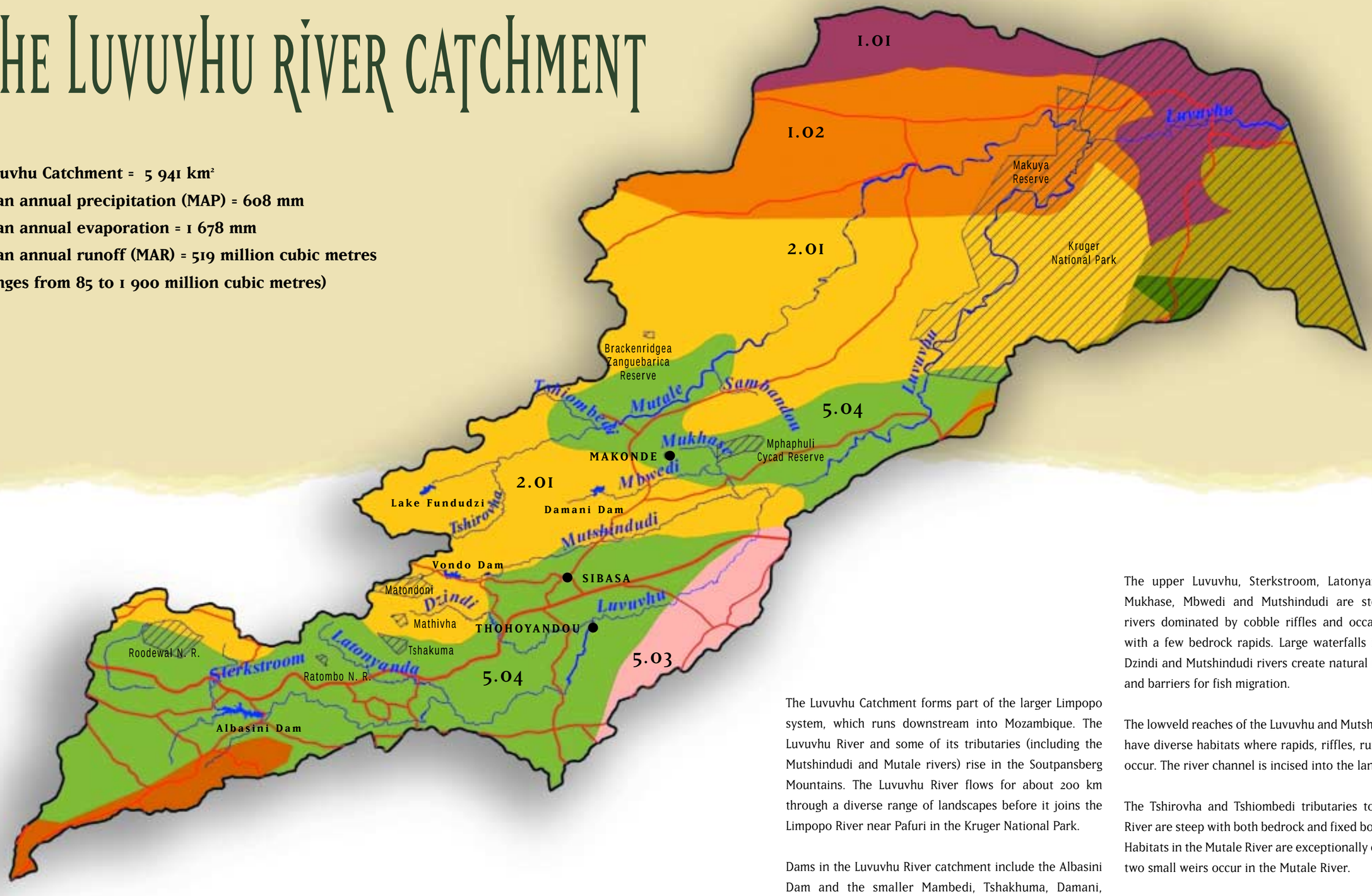


LUVUVHU RIVER SYSTEM



THE LUVUVHU RIVER CATCHMENT

Luvuvhu Catchment = 5 941 km²
Mean annual precipitation (MAP) = 608 mm
Mean annual evaporation = 1 678 mm
Mean annual runoff (MAR) = 519 million cubic metres
(ranges from 85 to 1 900 million cubic metres)



The Luvuvhu Catchment forms part of the larger Limpopo system, which runs downstream into Mozambique. The Luvuvhu River and some of its tributaries (including the Mutshindudi and Mutale rivers) rise in the Soutpansberg Mountains. The Luvuvhu River flows for about 200 km through a diverse range of landscapes before it joins the Limpopo River near Pafuri in the Kruger National Park.

Dams in the Luvuvhu River catchment include the Albasini Dam and the smaller Mambedi, Tshakhuma, Damani, Vondo, and Phiphidi dams, of which the latter two lie in the Mutshindudi River. The Nandoni Dam is currently being constructed in the middle section of the Luvuvhu River east of the confluence with the Dzindi tributary Thohoyandou.

The upper Luvuvhu, Sterkstroom, Latonyanda, Dzindi, Mukhase, Mbwedi and Mutshindudi are steep, narrow rivers dominated by cobble riffles and occasional pools with a few bedrock rapids. Large waterfalls in the upper Dzindi and Mutshindudi rivers create natural reach breaks and barriers for fish migration.

The lowveld reaches of the Luvuvhu and Mutshindudi rivers have diverse habitats where rapids, riffles, runs and pools occur. The river channel is incised into the landscape.

The Tshirovha and Tshiombedi tributaries to the Mutale River are steep with both bedrock and fixed boulder rapids. Habitats in the Mutale River are exceptionally diverse. Only two small weirs occur in the Mutale River.

Near the western Kruger National Park border, in the steep Lanner Gorge, the Mutale River joins the Luvuvhu River.

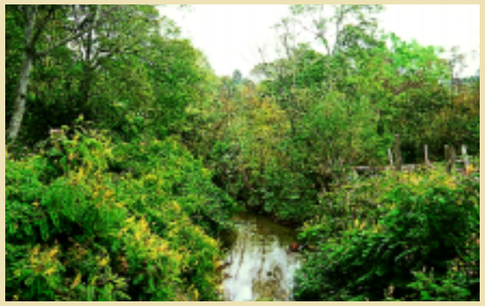
The Luvuvhu River and all its tributaries rising in the Soutpansberg are perennial.

The Luvuvhu River

Luvuvhu Headwaters

The Luvuvhu River rises as a steep mountain stream in the southeasterly slopes of the Soutpansberg Mountains. Indigenous trees form closed canopies in some areas of the Sterkstroom and wetlands, such as the extensive reedbed downstream of the confluence with the Luvuvhu River, are found. The area around the Albasini Dam is a private conservancy. Riparian vegetation consists of dense stands of large trees, shrubs and reeds.

Land-use activities include forestry (11%) and agriculture (20%). Forestry plantations cover 44% of the upper reaches of the Luvuvhu and Latonyanda rivers, decreasing to less than 10% towards the Albasini Dam and confluence in ecoregion 5.04. Subsistence farming is about a third of the total agricultural component.



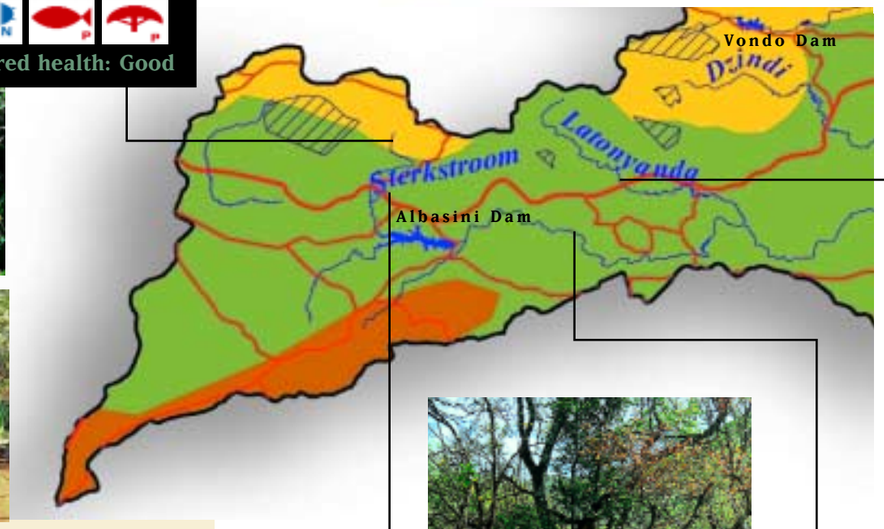
Downstream, the vegetation becomes very dense – partly due to alien plant encroachment. Alien vegetation includes pine and eucalyptus plantations. Peanut butter cassia, mulberry and lantana are abundant.

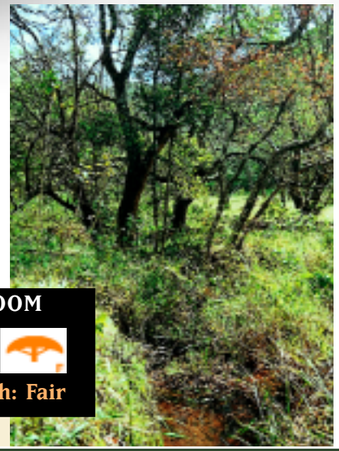
LUVUVHU RIVER

Desired health: Good

The riparian vegetation consists of dry acacia woodland species. Riparian vegetation in large areas has been removed to accommodate orchards. Alien vegetation such as eucalypts, poplars and Mauritius thorn invade the riparian zone.

Several introduced fish species such as black bass and common carp occur in the Albasini Dam.





STERKSTROOM

Desired health: Fair

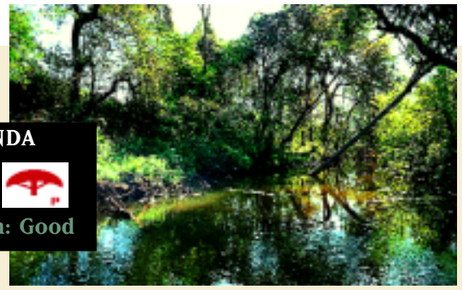
Smallholdings that are developed intensively for orchards occur along the river. A very narrow riparian strip is left because of orchards planted to the waters edge. Herbicide and insecticide spraying and fertiliser application have negative impacts on the water quality.

THE EFFECT OF CHANGES IN LAND USE ON FLOODS

Forestry, poor agricultural practices, deforestation and urbanisation affect the rainwater run-off from the land. Man-induced changes to catchments increase the intensity and shorten the duration of floods. In areas where land-use practices are poor and where riparian vegetation is being removed, flood events accelerate bank and donga erosion.

LATONYANDA

Desired health: Good



Forestry practices in the upper reaches result in sedimentation and erosion of the highly erodible soils. Sawmills, numerous road bridges crossing the river and flood prevention structures cause high turbidity.

Photographs taken from the same road bridge across the Latonyanda River before the 2000 floods and after (April 2001).

LUVUVHU RIVER

Desired health: Good

The Latonyanda River contributes a constant flow to the Luvuvhu River. This helps to compensate for the lack of releases from Albasini Dam.

Flow-dependent fish species suffer as a result of weirs, channels and abstraction. A red data species, the southern barred minnow, is no longer present, possibly due to the combination of flow reduction and the presence of many weirs.

Irrigated lands and orchards, common towards the confluence of the Latonyanda and Luvuvhu Rivers, reduce the riparian zone to a very narrow strip in some places.

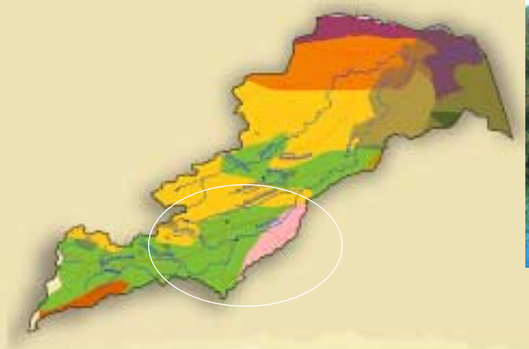
Alien species that are abundant include lantana, bugweed, guava, castor-oil plant, syringa and eucalypts.

The Luvuvhu River

Dzindi and Luvuvhu rivers upstream and downstream of their confluence

The upper Dzindi River flows through a forestry area before it plunges down a large waterfall. Plantations cover about 35% and subsistence farming 26% of the upper Dzindi Catchment (ecoregion 2.01). The main land-use of the lower Dzindi River is subsistence farming, covering 45% of ecoregion 5.04.

The marginal riparian vegetation of this Luvuvhu reach is dominated by reeds. Pre-flood conditions included large beds and reed islands. The dominant land-use is subsistence farming.



Community activities include fishing, bathing and washing of cars. Clay is removed from the riverbank for use in brick manufacturing. These pressures damage the channel banks and impact on the water quality.

The local community farm on the steep slopes adjacent to the upper reaches of the Dzindi River. Some grazing occurs as well as cutting of trees in the riparian zone.

UPPER DZINDI RIVER

Desired health: Good

LUVUVHU RIVER

Desired health: Fair

Fish movement is blocked by the big weir below Malamulele pumphouse.

The construction of the Nandoni Dam impacts heavily on the section immediately downstream. Access roads, in-stream coffer dams and diversions have damaged the riparian vegetation and river bank, while the in-stream habitat has been degraded through excessive siltation.

NATURAL BARRIERS INFLUENCE THE OCCURRENCE OF FISH SPECIES.

Where natural barriers like waterfalls occur, the fish community above the barrier is often different to that below. While some species may never have occurred above the barrier, drought, fires, cold spells, toxic spills, alien predators and overfishing may eliminate species in the upstream reach. When species are lost through events like these, it is necessary to consider restocking programmes. Below the waterfall in the upper Dzindi River, the barred minnow (red data species) is found as well as the scarce line spotted barb. There are no records of these two species above the waterfall.

DZINDI RIVER

Desired health: Fair

The river is used for washing clothes. Sediment inflow is caused by forestry, agriculture and poorly planned rural settlements. In the lower section of the Dzindi River, a fish farm utilises the sewage outflow from Thohoyandou sewage works. Water quality from this source remain a cause for concern.

The riparian vegetation is disturbed and removed by farming and grazing activities in and around the riparian zone. Terrestrial vegetation is encroaching into the riparian zone.

LUVUVHU RIVER

Desired health: Good

Alien vegetation such as lantana and castor-oil plant are common along the Luvuvhu River.

The riparian vegetation in the area of Thohoyandou has been largely destroyed for use as firewood and to provide grazing. This has led to increased donga erosion. Large, dense stands of trees occur at intervals.

Surveys throughout the Luvuvhu Catchment were made difficult because of the abundance of crocodiles.

THE LUVUVHU RIVER

UPPER REACHES OF MUTSHINDUDI AND MBWEDI RIVERS

Subsistence farming is the dominant land-use in the upper reaches of the Mutshindudi and Mwedi rivers (up to 50%) with plantations covering some 17% of the total sub-catchment area.

RURAL PRACTICES ALONG THE MUTSHINDUDI RIVER

The underdeveloped rural regions of the Northern Province are subject to severe environmental degradation. Rural communities with a low per capita income are highly dependent on available natural resources, including riparian and aquatic resources, for survival. Limited environmental awareness and a lack of infrastructure and planning for sustainable utilisation worsen the situation.

Due to poor reticulation infrastructure, many people use water directly from streams for household purposes. The washing of laundry in rivers is a common activity. There are no other water sources available. No refuse removal system or functional recycling process exists.

Fish is an important protein source and a large proportion of the rural community eat freshwater fish. Methods of fishing include line and hook, gill nets, seine nets and traps. At this time, fishing effort is starting to show signs of overexploitation.

RURAL AGRICULTURAL PRACTICES

Agriculture (small scale subsistence and commercial crop production) is the main economic activity in the Mutshindudi River catchment. Traditional cattle farming, irrigated estates and schemes, rain-fed orchards and irrigated informal gardens are expanding. The land tenure system has resulted in the overstocking of cattle and goats with resultant high levels of erosion.

The riparian vegetation is over-utilised, mainly for firewood, fence construction, furniture, medicinal purposes and food. In many areas, the riparian vegetation has been completely replaced by crops and, as a result, siltation of the river is increasing.

The resultant health of the riparian zone along the Mutshindudi River is fair but is deteriorating. Sediment inflows into the Mutshindudi are likely to increase, causing loss of in-stream habitats and eventual loss of fish and invertebrate species from the river.

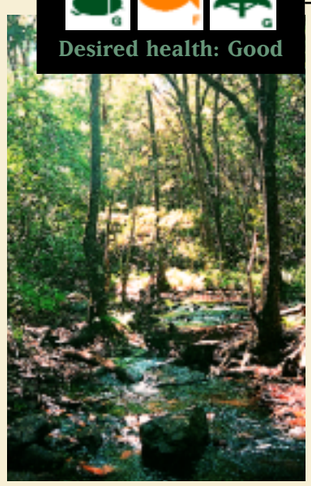
The Vondo Dam supplies water to the surrounding tea estates as well as to the town of Thohoyandou.

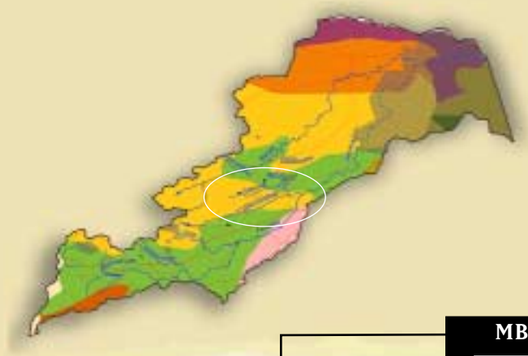
Waterfalls occur in the steep upper reaches of the Mutshindudi River.

Phiphidi Forest Reserve is located just downstream of the Phiphidi Dam and adjacent to a forest plantation. The scenic Phiphidi Waterfall is located in this very small reserve. However, signs of littering at the adjacent picnic site are distressing.

UPPER MUTSHINDUDI

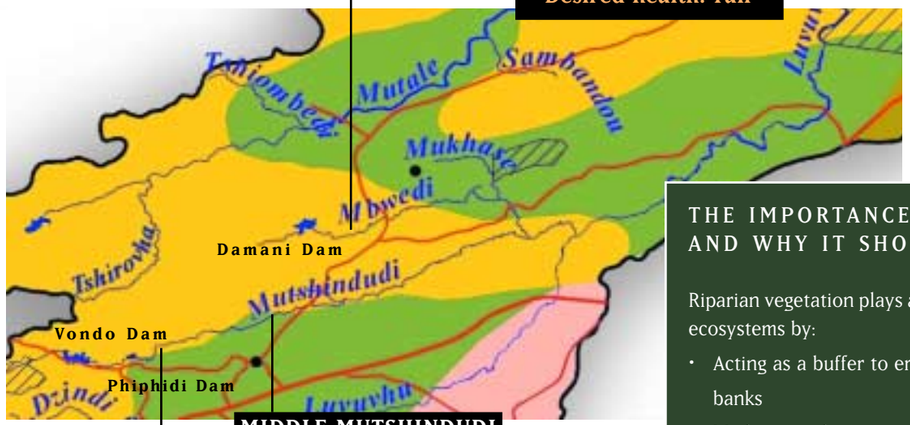
Desired health: Good





MBWEDI RIVER

Desired health: Fair



The Damani Dam supplies water to the coffee estates. There is no mechanism for releasing water for the environment from the dam. Weirs and pump stations contribute to the unnatural flow in this section of the river.

MIDDLE MUTSHINDUDI

Desired health: Fair

Indigenous vegetation stabilises river banks.

Cultivated lands and orchards are common along the middle section of the Mutshindudi River, and often reduce the riparian vegetation to a narrow strip.

THE IMPORTANCE OF THE RIPARIAN ZONE AND WHY IT SHOULD BE CONSERVED

Riparian vegetation plays a very important role in protecting river ecosystems by:

- Acting as a buffer to erosion through stabilisation of the river banks
- Moderating the impacts of flooding on surrounding areas
- Regulating water quality by acting as a buffer or filter, preventing nutrients, sediments and contaminants from entering the river
- Providing important habitat for many plant and animal species
- Providing an ecological corridor, connecting habitats that would otherwise be isolated, for the movement and migration of terrestrial and avian species

Riparian vegetation is vulnerable to invasion by alien plants.

THE LUVUVHU RIVER A BIODIVERSITY HOTSPOT

BIODIVERSITY HOTSPOT

The area surrounding the confluence of the Mutshindudi and the Luvuvhu River is regarded as a diversity hotspot for fish and invertebrates for the following reasons:

- Healthy populations of a red data fish species, southern barred minnow and the provincially scarce line-spotted barb occur in the Mukhase River. When conditions permit, these species move into the Mbwedi, Mutshindudi and Luvuvhu rivers.
- Both warm and cool water species are present. The cool waters of the mountain streams mix with the warmer waters of the lowveld rivers in this area. Cool water species such as the common mountain catfish have been recorded down into the Kruger National Park, while warm water species such as the sawfin rock catlet migrate upstream from this warmer area.
- The absence of dams in the lower catchment permits the free migration of species from the coastal zone to this point.

The biodiversity of this hotspot is under threat due to diminishing in-stream habitat. Impacts within the riparian zone are contributing towards erosion and deposition of sediments in the river.

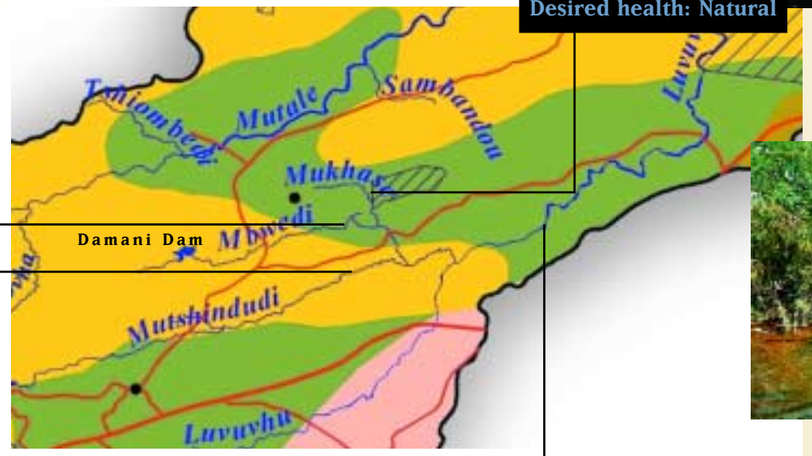
MUKHASE RIVER

Desired health: Natural

Local people collect water at the mountainous Mphaphuli Cycad Reserve gate, recognising the extremely good water quality of the perennial Mukhase River.

MBWEDI RIVER

Desired health: Good



A large new weir is under construction at Xikundu as part of the Nandoni Scheme. A fishway has been incorporated into the design of the weir, motivated by the high diversity of rare and sensitive species found in this area.

Livestock trampling occurs causing sheet and donga erosion of riverbanks.

Dirt roads, bridge crossings and bridge construction lead to erosion and sediment in the river.

LUVUVHU RIVER

Desired health: Fair

Local communities utilise the lower Mbwedi and lower Mutshindudi rivers for bathing, swimming and washing cars and clothes.

LOWER MUTSHINDUDI

Desired health: Good

The gradient of the Mutshindudi River decreases towards the confluence with the Luvuvhu River.

RESERVE DETERMINATIONS

In the past, the location of dams and weirs for water extraction was dictated by geology, topography and economics. Recently, social and environmental issues have led to a more holistic and participatory approach to the placement of large water resource developments.

Although the in-stream flow requirements have been determined for the lower main stem of the Luvuvhu River, the Letaba and Letsitele rivers, an ecological reserve, as stipulated in the National Water Act of 1998, has not yet been set. All studies to date have been in response to the proposed developments of new dams.

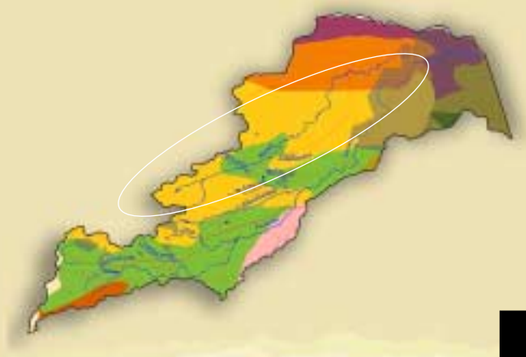
There is a high density of rural communities in this area. Activities that have negative impacts on the river include overgrazing, trampling, vegetation cutting, washing, sand mining and hand irrigated lands within the riparian zone.

THE LUVUVHU RIVER

THE MUTALE RIVER

Lake Fundudzi lies in the upper Mutale River. Debris, caused by a landslide blocked the valley floor, creating the lake. The Mutale River re emerges as a spring from below the blockage.

Subsistence farming is the dominant form of agriculture in the Mutale Catchment. Almost all the agricultural activities in ecoregion 2.01 and ecoregion 5.04 are associated with subsistence farming.



MUTALE RIVER

Desired health: Good

Excessive fishing is a problem.

The riparian vegetation is over-utilised. In one area, maize is planted within the riparian zone.

Coal-bearing formations occur in the Northern Province. During mining operations, pyrite is exposed to air and water, forming acid. This acid leaches into aquatic systems and can continue to impact on ecological health for decades after mining operations have stopped.

Lake Fundudzi has high cultural importance for the people of the area. Several caves with Khoi/San art occur nearby and add to the cultural importance of the area.

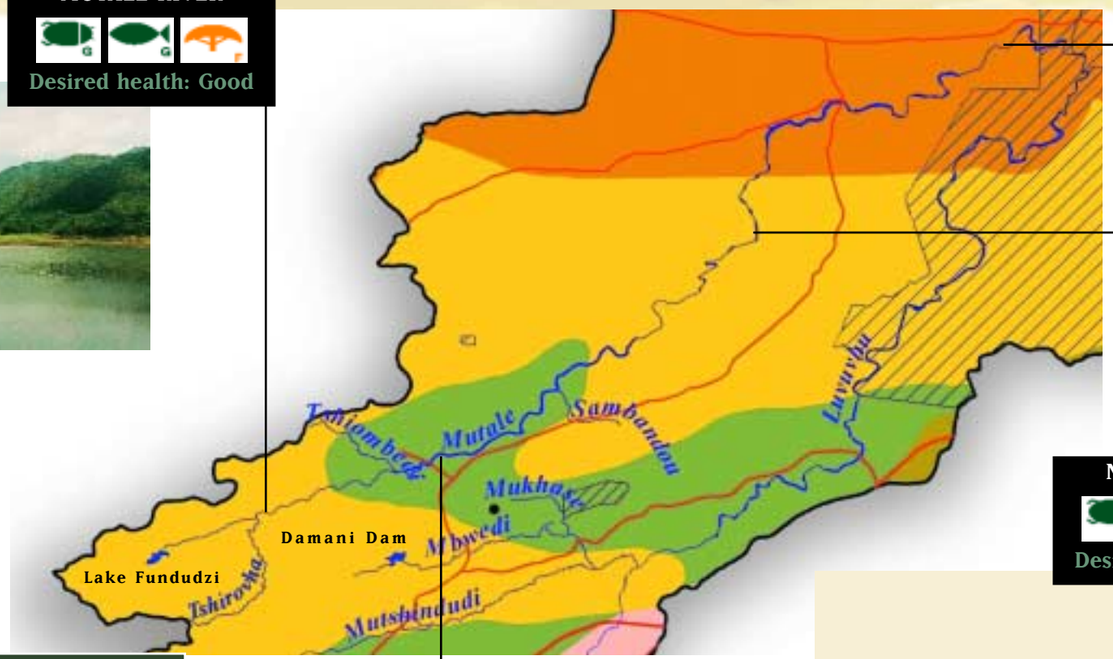
A road runs parallel to the river, sometimes within the riparian zone.

Local communities use the river for washing clothes and cars, causing erosion, sediment and solid waste.

Grazing and cutting within the riparian zone accelerates erosion of riverbanks and river sedimentation.

MUTALE RIVER

Desired health: Good



MUTALE RIVER

Desired health: Good

Abstraction of water from agricultural weirs reduces flow considerably, while the weirs also act as barriers to fish migration.

A road bridge and overgrazing cause erosion with resultant sedimentation in the river.

AQUATIC BIOTA BENEFIT FROM FLOODS

Floods provide natural cues for fish and invertebrates to breed. Flooded marginal habitats provide sheltered areas for some fish to breed and for juvenile fish to develop.

Lower down in the catchment, floodwaters are responsible for maintaining the connectivity of estuaries to the open sea. Estuaries act as important breeding grounds for many marine species. Open estuaries permit the migration of species such as eels to the upper catchments, where they play an important role in the river's ecology.

MUTALE RIVER

Desired health: Good

The Mutale River runs through an inaccessible gorge in ecoregion 2.01. The river has flattened out to form deep pools with riffles before it exits the gorge. Habitat in the gorge is dominated by bedrock rapids.

Above the gorge, Tshikundalema village is located right next to the river. The plots extend to the riverbank and little riparian vegetation remains.

The Luvuvhu River

Tshiombedi and Sambandou rivers - tributaries of the Mutale River

The Tshiombedi River has a steep gradient with waterfalls. Above the waterfalls, the river is almost natural with none or very little human impact.

The Sambandou wetland is a source area for both the Luvuvhu and Mutale rivers.

Agricultural practices right up to the river's edge and cutting of riparian vegetation reduces the riparian zone to a very narrow strip.

The washing of maize, clothes and cars in the river is a common activity.

TSHIOMBEDI RIVER

Desired health: Good

FLOODWATERS RECHARGE AQUIFERS

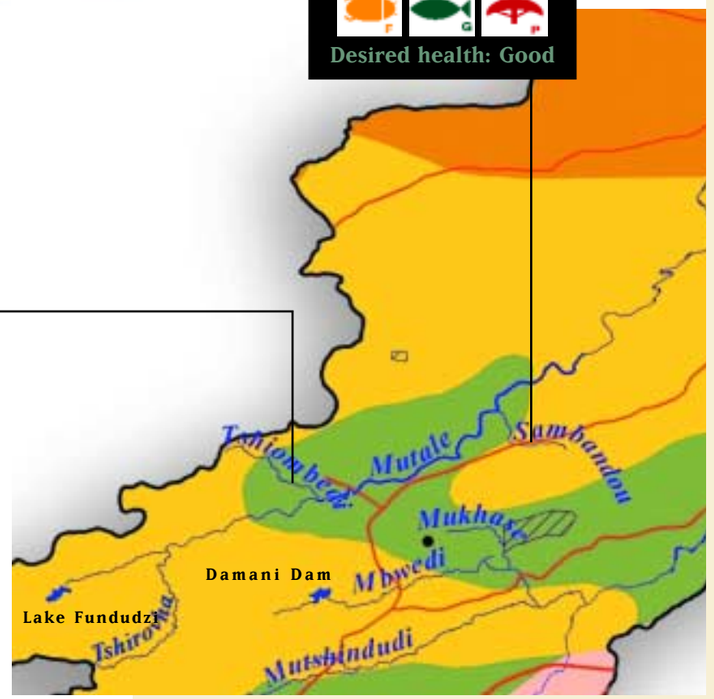
Floodwaters are important for the recharge of aquifers and for the general flushing and cleansing of the river system. Flooding is often followed by several seasons of strong base flows, which allow aquatic communities to recovery.

While very high flood flows are natural, it can be argued that the amplitude and frequency of flooding has changed due to human impacts. Under very high flows, river channels may change drastically and long established indigenous vegetation may be destroyed.

The 2000 floods made significant impacts to the lower catchments of the Letaba and Luvuvhu rivers. Scientists have little information with which to indicate whether these changes are completely natural, or are attributable to the combined effects of nature and poor catchment management practices.

SAMBANDOU RIVER

Desired health: Good



The Sambandou Wetland is thought to have a high conservation importance. The wetland is under pressure from agricultural developments and is rapidly being degraded by clearing and planting.

WETLANDS ATTENUATE FLOODWATERS

Wetland habitats act as sponges that help to attenuate floodwaters.

On a global basis, wetland habitats are amongst the most threatened habitat types. Wetlands are being drained to provide agricultural lands, to provide space for urban development and to reduce risks of diseases such as malaria, or are being dammed.

Destruction of wetland habitats is one of the man-induced changes that influence the intensity and duration of floods.

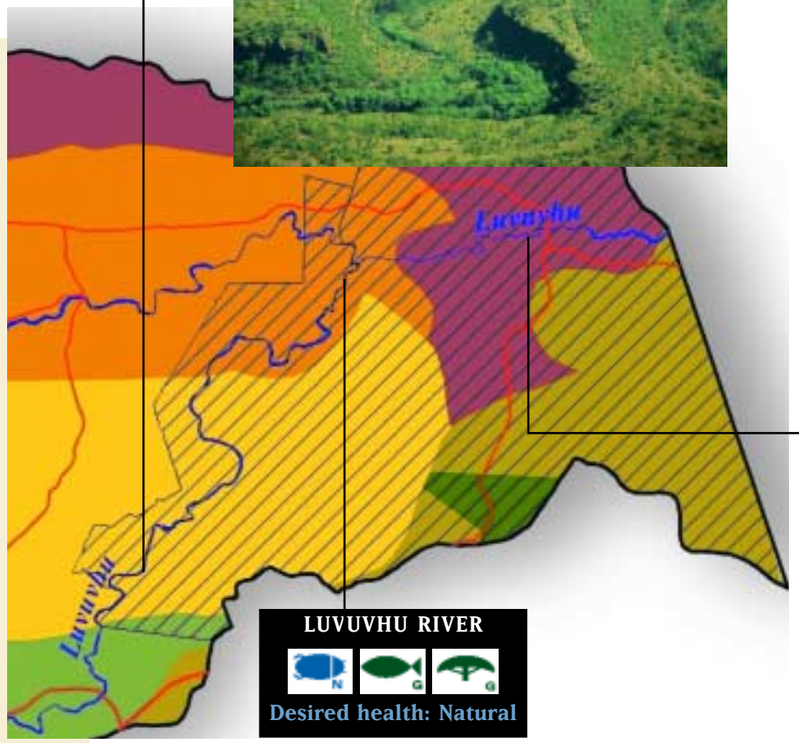
The biomonitoring team samples fish in the Sambandou Wetland.

The Sambandou River after the 2000 flood.

THE LUVUVHU RIVER
IN THE KRUGER NATIONAL PARK

This section of the Luvuvhu River is surrounded by conservation areas, the Kruger National Park and the Makuya Provincial Reserve. It is desirable that this wilderness area be maintained in a natural state.

The Luvuvhu Gorge



LUVUVHU RIVER

Desired health: Natural

MIGRATION BARRIERS AND ALIEN FISH SPECIES

Recently, a number of highly invasive alien fish have been recorded in the Limpopo River. As a result, there is now a debate over the benefits of erecting fishways on proposed new dams, since the structures may permit free passage of these invasive species across barriers and deeper into the river systems. Each dam should be assessed individually.

The biggest threats to this area are the influences from outside the Kruger National Park, e.g. flow regulation and reduction, increased silt loads and spreading of alien plants. Alien plants such as cocklebur washed into the area during the 2000 floods.

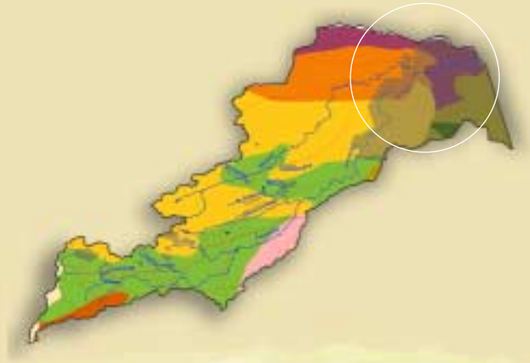
Tourist roads and parking areas close to rivers impact on riparian vegetation.

LAND DISTURBANCE AND ALIEN PLANTS

South Africa has many problem invasive alien plant species that out-compete and displace indigenous vegetation.

Alien plants are often associated with disturbed areas caused by flood-waters and are the first to recolonise bare ground. These alien plants do not perform the same function as indigenous riparian vegetation and in areas where they are prolific, river banks can become very unstable. The cycle of disturbance and infestation is very difficult to break.

Both the Luvuvhu and the Letaba catchments are heavily infested with these problem plants and recent floods have caused their numbers and distribution to increase.



The rivers and the riparian vegetation are home to many bird and animal species.

The extensive riverine forest on the banks of the Luvuvhu River is a very important habitat. A large variety of organisms are dependent on the riparian zone in this dry landscape, including riparian birds and rare bat species.

The riparian trees are also home to special bird species such as fish owl, tropical bou bou, longtailed starling and white backed herons.

The hippos in this area almost became locally extinct during the 1992/3 droughts. The original 100 individuals declined until only one was left. Since then the hippo population has recovered to about 20 with individuals coming in from the Limpopo River and the flood plains.

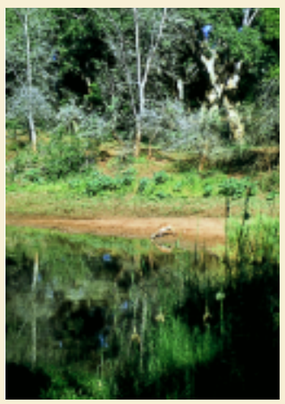
The biggest nyala population in the KNP occurs here and crocodiles are abundant.

As the Luvuvhu River exits the Lanner Gorge and enters the wide Pafuri floodplain, the gradient decreases.

LUVUVHU RIVER

Desired health: Natural

The area is largely unspoilt, but the 1993 drought compounded the effect of the upstream activities that caused low flows. The river came to a standstill, resulting in the death of many riparian trees.



The area between the Luvuvhu and Limpopo rivers has been proposed as a Ramsar site. This area will fall within the proposed Gaza-KNP-Gonarezhou Transfrontier Park.

The **high biodiversity in this area** can be attributed to the geographic location as well as the diversity of landscape features. Three biomes converge in the Pafuri area.

Nine geological features with contrasting rock types are found, including quartzite, sandstone, mudstone, shale and basic lavas.

Extensive areas of floodplain alluvium occur at the confluence of the Luvuvhu and Limpopo rivers. Several landscape features are found in this wetland, which include riverine forest, riparian floodplain forest, floodplain grassland and river channels and pans.

The riverine forest is confined to the riverbanks. It consists of large, broad canopied trees more than 20 m in height.

Glossary

Alien species Fauna and flora introduced intentionally or by accident from other countries. Not all alien species are invasive. Of the approximately 8 750 plant species introduced into South Africa, only 161 are regarded as invasive and 75 of these require control by law.

Buffer zone A buffer strip on the outer edge of the riparian zone is required to protect the habitat and the water resource. A minimum of 20 m is required depending on the type of land-use, the sensitivity of the habitat and the scarcity of the water resource.

Bedrock Solid immovable rock in the river channel.

Biodiversity The variety and variability among living organisms and the ecological complexes in which they occur. Biodiversity can be organised at various levels, ranging from complete ecosystems to molecules.

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

Ecologically sensitive releases Releases from impoundments in terms of water quantity, quality and variability that are designed to maintain a certain state of river health downstream of the impoundment.

Environmental impact assessment (EIA) A process of predicting and evaluating the effects of an action or series of actions on the environment. The conclusions are then used as a tool in planning and decision-making.

Erosion The lowering of the land surface by weathering, corrosion and transportation, under the influence of gravity, wind and running water. Erosion is a natural process but the rate and nature of erosion can be accelerated by human activities.

Floodplain The low land that borders a river, ocean or lake, usually dry, but subject to flooding.

Hybridise To cross-breed.

In-stream Flow Requirement (IFR) The volume and nature of water releases from impoundments to maintain the river in a pre-determined state of health. The objective of an IFR is to manage flow to ensure long-term maintenance and conservation of riparian vegetation and to ensure sustainable resource utilisation. The latter includes the water quantity, in-stream aquatic communities and riparian communities.

Overgrazing The level of livestock grazing that exceeds the land's ability to support that level of grazing over the long term. Overgrazing leads to degradation of the land.

Ramsar sites are wetlands of international importance. South Africa has 16 Ramsar sites, including Nylsvley Nature Reserve and the St. Lucia System. The Ramsar Convention on Wetlands provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Red data species Species of plants and animals that are under threat. The red data categorisation of species helps to determine their conservation status. The categorisation follows the IUCN guidelines and includes categories such as extinct, endangered, vulnerable and rare.

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 characterised by frequent inundation or sufficient flooding to support vegetation distinct from the surrounding area.

Subsistence agriculture A level and type of agricultural practice that supports the basic livelihood of an individual or group of people.

Wetland An area where the soils are periodically or permanently waterlogged. Wetland plants are adapted to tolerate seasonal inundation. Wetlands moderate water flow by acting as sponges during wet periods. Wetlands regulate water quality by slowing down the flow of water, causing suspended matter to settle out or to be absorbed by wetland plants.

Working for Water (WfW) The WfW programme was launched by the national Department of Water Affairs and Forestry to control the alien invasive plant problem, in particular the impacts of these plants on water resources. A combination of methods such as manual clearing, chemical control and biological control is used.

Further Reading

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Alien and Indigenous Plant and Fish species

COMMON NAME	SCIENTIFIC NAME
ALIEN PLANTS	
ageratum	*Ageratum* spp.
bugweed	*Solanum mauritianum*
castor-oil plant	*Ricinus communis*
eucalypts/ gum trees	*Eucalyptus* spp.
guava	*Psidium guajava*
jacaranda	*Jacaranda mimosifolia*
lantana	*Lantana camara*
large cocklebur	*Xanthium strumarium*
Mauritius thorn	*Caesalpinia decapetala*
mulberry	*Morus alba*
paraffin bush/triffid weed	*Chromolaena odorata*
peanut butter cassia	*Senna didymobotrya*
pines	*Pinus* spp.
poplars	*Populus* spp.
sesbania	*Sesbania punicea*
syringa	*Melia azedarach*
thistle (spear, or Scotch thisle)	*Cirsium vulgare*
wild tobacco	*Nicotiana glauca*
INDIGENOUS PLANTS	
common reed	*Phragmites mauritianus*
Cape willow	*Salix mucronata*
jackal berry	*Diospyros mespiliformis*
matumi or mingerhout	*Breonadia salicina*
Natal mahogany	*Trichilia emetica*
sycamore fig	*Ficus sycomorus*
ALIEN FISH	
black bass (large mouth)	*Micropterus salmoides*
common carp	*Cyprinus carpio*
Nile tilapia	*Oreochromis niloticus*
rainbow trout	*Oncoryhynchus mykiss*
bluegill sunfish	*Lepomis macrochirus*
INDIGENOUS FISH	
line-spotted barb	*Barbus lineomaculatus*
sawfin rock catlet	*Chiloglanis paratus*
common mountain catfish	*Amphilius uranoscopus*
southern barred minnow	*Opsaridium peringueyi*
tigerfish	*Hydrocynus vittatus*

ADAPTIVE MANAGEMENT CYCLE

VISIONING

The visioning process is about developing a mental picture of what the health of a river should be. A good vision should be: shared by all relevant stakeholders, practically achievable, scientifically sound and should focus on a defined outcome (which may be to sustain certain uses of the river). Catchment Management Agencies will ultimately become responsible for facilitating the visioning process.

GOALS & OBJECTIVES

Goals are statements that provide broad direction to aim at in order to advance towards the vision. The desired health categories suggested in this report are examples of such goals. These categories should be regarded as preliminary as their setting was not preceded by a formal and participative visioning process.

To give operational meaning to goals that are stated as health categories, they have to be defined in terms of measurable information about river flows, water chemistry, river habitats and aquatic biota. Such information could serve as quality objectives, which allow us to quantitatively evaluate the present health of the river against the desired health for the river.

STRATEGIES & LOGISTICS

Detailed strategies are needed to align the efforts and resources of collaborating institutions with achieving the set goals and objectives. Such strategies must address both the strategic protection of water resources and regulatory function related to the use of water resources. Strategies should:

- Adhere to existing policy and legal frameworks
- Cater for shared responsibilities regarding the monitoring and management of river ecosystems
- Spell out the roles and responsibilities of collaborating institutions (both public and private sector)
- Plan to acquire the necessary resources (workers and equipment)
- Provide suitable mechanisms to link with, and draw from, relevant research findings
- Provide a framework and action plan for the coordination of river surveys, information management and reporting.

MANAGEMENT ACTIONS

The following are examples of actions that relate to the monitoring and management of river health:

Department of Water Affairs and Forestry

- Determine the ecological reserve for the Letaba and Luvuvhu rivers. The ecological reserve is the statutory concept that makes quality objectives legally binding and provides the basis for issuing water use licences.
- Formulate and administer water use licences (for water abstraction and discharge of treated effluent) in line with the in-stream quality and quantity objectives.
- Audit and control compliance with licence conditions.
- Manage water releases from storage dams to simulate seasonal variations in flows and natural hydrological fluxes as closely as possible.

Forestry Sector

- Ensure that a sufficient buffer zone is maintained along all rivers to protect riparian habitats and their functionality
- Minimise erosion potential, especially related to construction and maintenance of access roads and harvesting of timber during the rainy season

Working for Water Programme

- Coordinate programmes to eradicate or control invasive alien plants
- See that riparian zones are properly restored after alien plants have been removed

Local Government

Ensure that sewage treatment plants adhere to required operating standards and that treated sewage is of acceptable quality before it is discharged to a river

Department of Environmental Affairs and Tourism

- Ensure that all major developments (e.g. tourist lodges, roads and dams) are subject to an environmental impact assessment (EIA) before approval to proceed

Agricultural Sector

- Protect riparian zones
- Use water efficient technologies
- Comply with livestock carrying capacities

MONITORING & REPORTING

The River Health Programme (RHP) monitoring must be maintained for the Letaba and Luvuvhu rivers and should be expanded to include other rivers in the Northern Province. A three-yearly survey frequency has been adopted for the Letaba and Luvuvhu rivers. All collected data should be stored on the national Rivers Database and SoR reports should be compiled and updated for all rivers every six to nine years.

Within the Northern Province, the provincial Department of Environmental Affairs and Tourism, the Kruger National Park, the University of the North and the University of Venda are the main institutional drivers of river health monitoring. In future, relevant Catchment Management Agencies are likely to play a prominent role in the coordination of river health initiatives. At national level, the Departments of Environmental Affairs and Tourism (responsible for state-of-environment reporting) and Water Affairs and Forestry (responsible for protection of water resources) are active stakeholders and partners in the implementation of the RHP.

AUDITING

Monitoring and reporting are essential to give regular account of the state of our rivers. However, it is advisable to conduct periodically a comprehensive analysis (audit) of the monitoring results as well as the overall implementation of the programme in order to:

- Assess how the actual health of the river system compares with / relates to the stated vision, the set goals and objectives and the specific management actions that have been carried out
- Evaluate the performance of those agencies that have a responsibility for the monitoring and management of river ecosystems in terms of their allocation of resources, implementation of actions and achievement of goals

The auditing function will be overseen by the Department of Water Affairs and Forestry.

STRATEGIC REFLECTION AND REVIEW

This step is necessary to ensure that the vision, goals, objectives and strategies are periodically reviewed, updated and refined. It is necessary to capture and incorporate new information and improved insights into the next loop of the adaptive monitoring and management cycle.