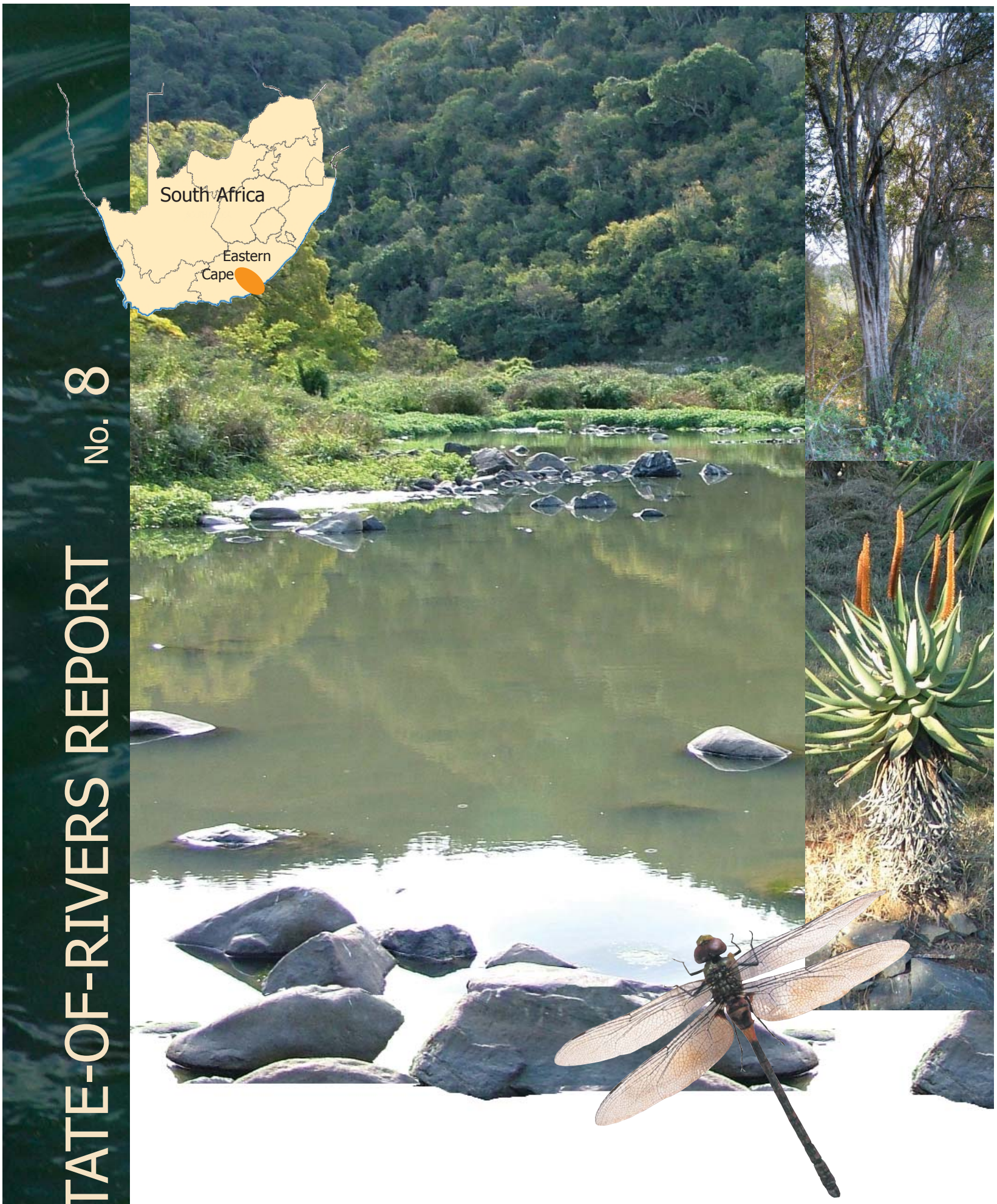

STATE-OF-RIVERS REPORT No. 8

BUFFALO RIVER SYSTEM - 2004

The River Health Programme

FOREWORD

I am pleased to introduce this first State of Rivers Report for the Eastern Cape: A report on the ecological assessment of the Buffalo River.

The Eastern Cape's natural beauty, unique estuaries and rivers, extensive coastlines, its cultural diversity and history, and its varied wildlife and abundant renewable and non-renewable resources, all contribute to its attraction. This report aims to raise awareness and understanding of the current state of one of our important rivers, the impacts on it and what actions we can take to improve it. Its goal is also to empower people at local level to take ownership of their rivers. This will assist the people of the Eastern Cape region to evaluate resource development issues with due consideration for the environment and conservation. Eastern Cape rivers have a rich potential and their sustainable development for food production, ecotourism, and commercial activities rely on them being kept healthy and protected.

The National Aquatic Ecosystem Biomonitoring Programme (called River Health Programme) was initiated ten years ago, in 1994. It is therefore by no coincidence that when the country and the Department of Water Affairs and Forestry celebrate a decade under democratic government, the RHP is also looking back at its humble beginning. Prior to promulgation of the National Water Act (Act No. 36 of 1998) River Health was not a key requirement. The Programme has received huge voluntary support from various non-government organisations, such as South African National Parks, the Universities and Water Boards and provincial government.

The programme is currently being re-designed to be in line with the current legislation and will be expanded to link up with wetlands and estuaries monitoring initiatives.

This report is the product of the collaboration of a diverse group of scientists, researchers and organisations that have contributed time, energy and ideas towards its compilation. Results are based on surveys conducted during 2002 - 2003 and presented in the Buffalo River Technical Report.

Sustainable development requires a new level of environmental literacy in the Eastern Cape. This report aims to make knowledge of aquatic resources more widely available, so that informed decision-making can occur, also hoping that whoever reads it will apply the knowledge to the benefit of this river and the future development of this Catchment.

(MS) B P SONJICA MP
MINISTER OF WATER AFFAIRS AND FORESTRY

Contributing Organisations

Department of Water Affairs and Forestry (DWAF)
Department of Environmental Affairs and Tourism (DEAT)
Water Research Commission (WRC)
Eastern Cape Department of Health
Coastal and Environmental Services (CES)
Amatola Water Board
Buffalo City Municipality
Rhodes University
Unilever Centre for Environmental Water Quality (UCEWQ)
University of Transkei
Border Technikon
National Ports Authority
Down to Earth
CSIR Environmentek
[list to be completed and finalised]

Financial Assistance

Norwegian Agency for Development Cooperation

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CONTENT

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October 2004

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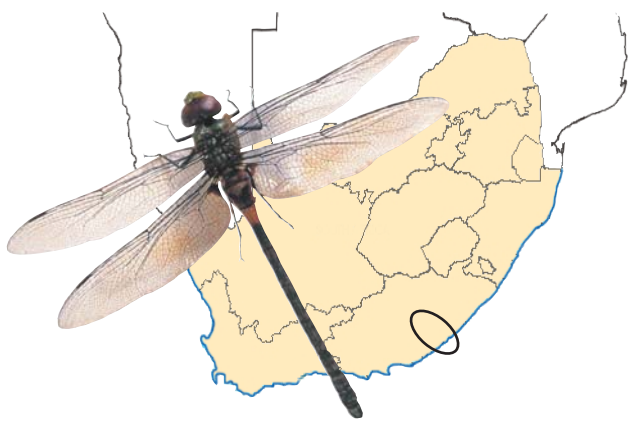
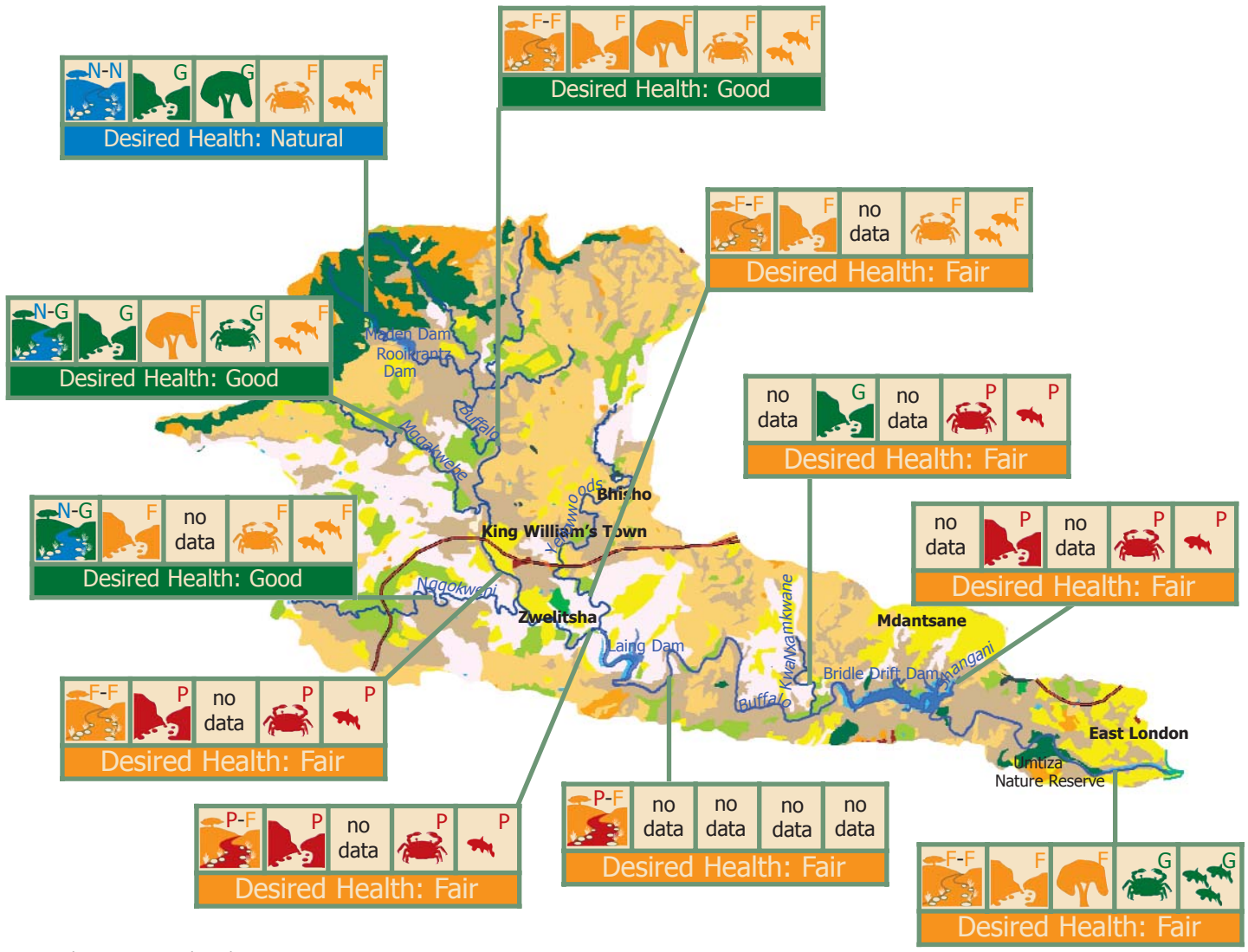
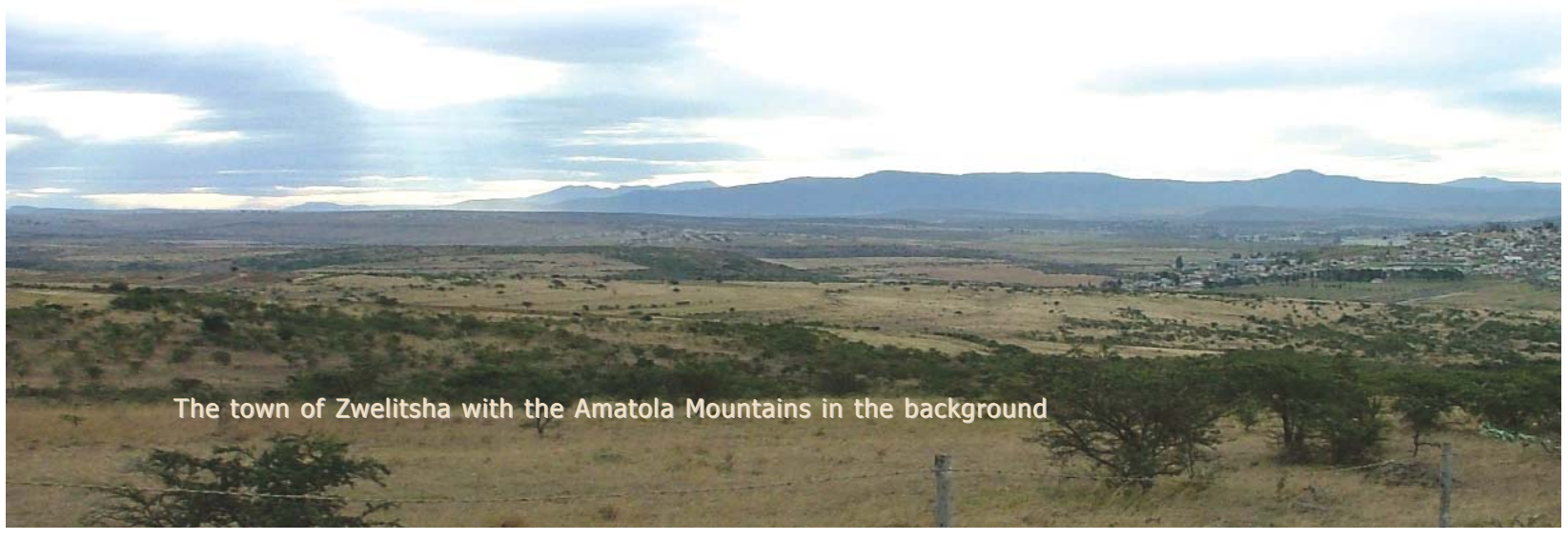
SUMMARY





The icons are explained on pages 6 to 9.



The town of Zwelitsha with the Amatola Mountains in the background

Rising at an altitude of 1200 metres, the Buffalo River drains the forested Amatola Mountains of the Eastern Cape. It flows eastwards across the coastal plateau before entering the Indian Ocean at East London harbour.

The Buffalo River is almost pristine at its source, but urban developments and dense peri-urban and rural settlements impact the middle and lower reaches. The catchment supports about 570 000 people within its 1287 km^2 area, so population pressure on surface water resources is very high. Less than 500 m^3 of water is available per person per annum, amongst the lowest in the country.

Along the Buffalo River, four dams supply the main urban areas of King William's Town, Zwelitsha, Mdantsane and East London. While dams restrict the natural movements of fish, they do have some benefits. Laing Dam, for example, is an efficient silt trap and a sink for nutrients, at the same time diluting saline effluent from upstream sources.

The dams have no mechanisms for releasing water in a controlled pattern, for example to stimulate natural river flows that maintain functioning aquatic ecosystems. Overflow from Maden Dam and a trickle from a crack in the Rooikrantz Dam are the only water releases from these two upstream dams. Fortunately, side streams augment the river flow.

River health and other water quality problems in the Buffalo River are the consequence of:

- Population pressures in a small catchment with inadequate water resources
- Natural high salinity levels derived from the catchment geology
- Position of two large dams immediately downstream of large urban areas
- Dysfunctional and overloaded sewerage systems and sewage treatment works
- Industrial effluent

Blockages in the sewerage systems, inadequate treatment capacity and poor management result in the discharge of partially treated and untreated sewage into the river and dams. This results in problems that include algal blooms and unacceptably high concentrations of faecal bacteria. Industrial effluents are either inadequately treated or not treated at all. Poor water quality poses a serious health risk for rural communities, since many households rely solely on untreated river water.

The pollution of the Buffalo River basin also extends beyond the estuary, affecting both marine and coastal water quality. The non-compliance with marine water quality standards will render coastal waters unfit for recreational and other beneficial users, including the non-attainment of blue flag beach status, which will in turn impact negatively on coastal tourism and related activities.

THE RIVER HEALTH PROGRAMME

- DWAF initiated the River Health Programme in its capacity as the custodian of water resources in South Africa, in partnership with the Water Research Commission and DEAT.

- The requirements of sustainable use and development of river systems include an understanding of river health: the National Water Act of 1998 (NWA) requires that DWAF must ensure the monitoring of water resources, to provide sufficient information to managers for the protection of the ecosystems.

- If the results obtained through the River Health Programme provide evidence of environmental degradation, the Department of Environmental Affairs and Tourism (DEAT) may intervene in terms of the NWA and the National Environmental Management Act of 1998 (NEMA). DEAT is therefore an important partner in the River Health Programme.

- The River Health Programme assesses the biological and habitat integrity of rivers. Thus, the programme enables us to report on the ecological state of a river system in an objective and scientifically sound manner.

- The information obtained from the programme supports the sustainable utilisation and control of the deterioration of aquatic resources.

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RIVER HEALTH PROGRAMME BACKGROUND

An old and well-proven management principle states, "If you can't measure it, you can't manage it". This applies as much to water resource management as to managing any other human endeavour. The National Water Act (Act No. 36 of 1998) (NWA) recognises the principle explicitly in Chapter 14, which requires the monitoring of water resource quality to be an integral part of water resource management. The NWA mandates the Minister of Water Affairs and Forestry to establish national systems that monitor, record, assess and disseminate information regarding, amongst many other things, the quality of water resources. The National Water Resources Strategy (NWRS) emphasises this imperative in its Part 6 on monitoring and information systems and Part 9 regarding financial implications.

The National Aquatic Ecosystem Biomonitoring Programme (NAEBP) was launched in 1994. Since the NAEBP focussed largely on riverine ecosystems, the shorter name, River Health Programme (RHP), was adopted. However, the original broader focus of the monitoring programme remains valid, namely to monitor the ecological health of all aquatic ecosystems that fall under the custodianship of the Department of Water Affairs and Forestry.

South Africa's national water policy has, as its central objective, the equitable, efficient and sustainable use of our water resources. The NWA and the NWRS both recognise that the best way to achieve this is to manage aquatic ecosystems at the catchment scale through joint participation by all interested parties. The RHP supports this management process by providing management information needed by water resource managers and other stakeholders involved in water management decisions. Although the initial emphasis is on riverine ecosystems, the programme will eventually expand to include other aquatic ecosystems such as wetlands and estuaries.

The RHP focuses on the biological attributes of a river that serve as indicators of ecological health. A biomonitoring programme goes beyond the classic approach of monitoring only physical and chemical water quality and generates information on the overall health of an aquatic ecosystem.

Aquatic communities, which include fish, riparian vegetation and aquatic invertebrate fauna, adapt to a certain range of environmental conditions. These organisms and communities integrate, respond to and reflect the effects of multiple disturbances that occur in aquatic ecosystems over extended periods of time. Examples of such stressors include habitat alteration, water abstraction, water pollution, creation of barriers that alter stream flow and the introduction of alien species. Whereas monitoring of chemical attributes alone is insufficient to detect the cumulative effects of multiple stressors impacting on an aquatic ecosystem over time, biolological communities provide a direct, integrated measure of the ecological integrity of their river. If healthy biological communities inhabit a river, the river as a whole is ecologically resilient and healthy.

The RHP has the overall goal of delivering the ecological information required to support the rational management of river systems (and later, a broader range of aquatic ecosystems). The RHP is designed to develop the capacity and information base required to enable DWAF and other role players to report on the ecological state of South Africa's river systems, in an objective and scientifically sound manner. The information products generated by the RHP assist in distinguishing between aquatic ecosystems exposed to sustainable utilisation and those experiencing ecological deterioration. River health monitoring also provides a baseline for subsequent audits of management strategies and actions implemented to maintain or improve the ecological status of aquatic ecosystems.

The Department of Water Affairs and Forestry is the custodian of all water resources in South Africa and, together with the Department of Environmental Affairs and Tourism and the Water Research Commission, launched the River Health Programme in 1994 to gather information on the health of South Africa's river systems. At a provincial level, partnerships and collaborations are established through a network of interested and enthusiastic stakeholders who work together to ensure that bio-monitoring is undertaken and that results are disseminated widely to a range of interested parties.

MONITORING SYSTEMS

A number of water resource quality monitoring programmes exist in DWAF and several other institutions involved in water resources management. DWAF has therefore embarked on a new approach to align data collection, processing and dissemination, while focussing on the needs of the users of the information. A strategic framework for national water resource quality monitoring programmes outlines the requirements and the need for integration and standardisation of terminology across various levels and scales. All monitoring efforts around the country will be faced with the challenge of integration in order to provide meaningful interpretations to decision-makers. National monitoring will be overseen by DWAF's Policy and Regulation branch.

Catchment Management Agencies (CMAs) (or DWAF Regional Offices as their current substitutes or future partners) and other local management institutions are likely to assume primary responsibility for the following types of monitoring programmes:

- Status and trend monitoring of local catchments to evaluate the achievement of the Reserve and Resource Quality Objectives.
- Assessing compliance of water users regarding water licence conditions or general authorisations.
- Assessing impacts of proposed water uses for the purpose of issuing water use licenses or designing other water management interventions.
- Process control monitoring, e.g. for water releases from a reservoir.

For example, water boards and local authorities would assume primary responsibility for monitoring:

- The quality of their intake water and effluent discharge for process control purposes as well as the outflow from industries.
- Status and trends of local aquifer systems under control of the Water User Associations.
- Water use of all legal water users.

Read DWAF's Strategic Framework for National Water Resource Quality Monitoring Programmes for more information in this regard. (Obtainable from DWAF, Pretoria. http://www.dwaf.gov.za/iwqs/wrmais/)

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INDICES USED IN THIS REPORT

An indicator is a measure of some variable of interest. In this case it is related to the environmental management of our rivers, by which the ecological status of the river is determined, changes and trends of the river can be tracked, and effectiveness of responses measured.

If management of our rivers is to be effective, there must be indicators that can:
- discern changes and trends
- provide early warning of emerging problems and
- provide an understanding of the ecosystem processes

Several key indicators may be combined together to form an index.

Based on the above, the River Health Programme uses indices or composite indicators to report on the current state of the river, the causes of change, the desired state of the river, and makes recommendations for managing river systems.

In addition to the indicators used during monitoring, flow and water quality data are needed to interpret biological information.

Index of Habitat Integrity (IHI)

The availability and diversity of habitats are major determinants of the biota that will be found in a specific ecosystem. Knowledge of habitat quality is important in an overall assessment of ecosystem health. The IHI assesses the impact of disturbances such as water abstraction, flow regulation and river channel modification on the riparian zone and in-stream habitats. The IHI icon shows the river and river bank which are colour-coded according to the state of the in-stream and riparian habitat, respectively.

Geomorphological Index (GI)

Geomorphological processes form the physical template upon which ecosystems exist and function.

The geomorphological index assesses river channel condition and channel stability. The channel condition is based on the channel impacts evident in a river reach, e.g. weirs, bridges or dams, and the type of channel, e.g. bedrock or alluvial. Channel stability is based on the potential for erosion of the riverbanks and bed.

Invertebrate identification

STATE OF ENVIRONMENT REPORTING

State of the Environment (SOE) reporting arose from the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. SOE reporting provides environmental information for decision-making at all levels of administration, from local to international. State-of-Rivers (SoR) reports supply the river component of this knowledge base.
(continued on facing page)

Riparian Vegetation Index (RVI)

The plants growing near or on the banks of rivers and streams make up the riparian vegetation. Riparian vegetation is adapted to the occasional periods of inundation that occur in the riparian area, as well as the specific soil and microclimate conditions associated with rivers. Riparian vegetation is usually more biologically diverse than that of surrounding areas, and is important for the ecological functioning of the river.

The RVI determines the status of riparian vegetation within river reaches and is based on a number of criteria. These include species composition, structure and extent of cover, presence of juvenile indigenous riparian species, cover of invasive alien vegetation, and human influences, such as vegetation removal and construction. The Eastern Cape RHP team developed a modified index to assess riparian vegetation, the Integrated Riparian Vegetation Index (IRVI).

South African Scoring System (SASS)

Aquatic invertebrates are sensitive to changes in water quality and habitat in their immediate surroundings. Their life cycles are short, so changes in the composition and structure of aquatic invertebrate communities are often the first signs of change in overall river condition.

The SASS is based on the presence of families of aquatic invertebrate fauna and their sensitivity to water quality changes. SASS results include an index score and the average score per taxon (ASPT).

Fish Assemblage Integrity Index (FAII)

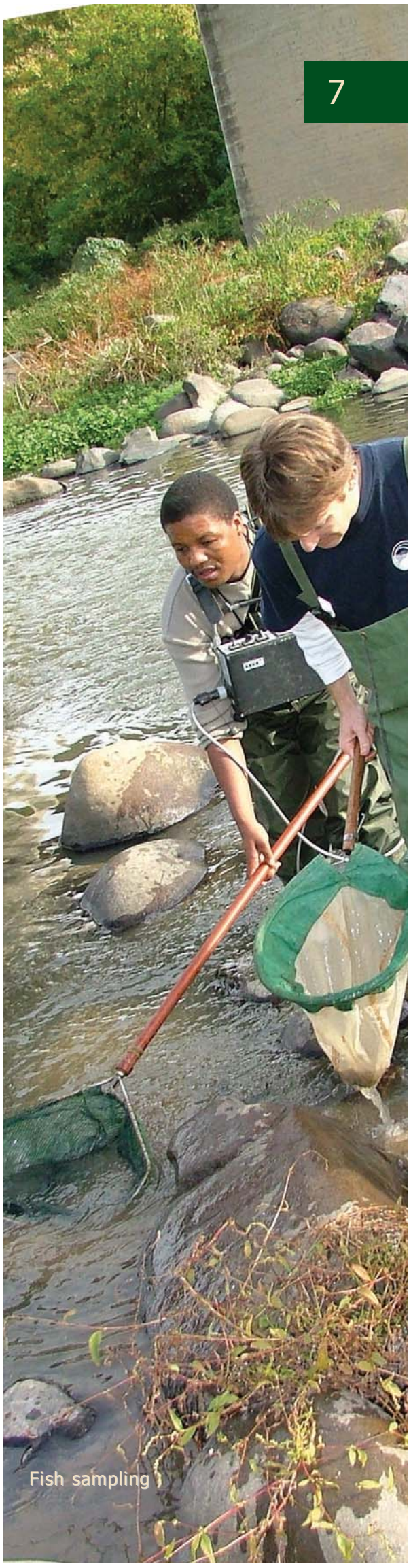
Fish live longer than invertebrates and are more mobile, so they are good indicators of longer-term changes in a river reach. The FAII assesses fish assemblages in homogenous fish habitat segments within the reach of a river.

The result of the FAII is expressed as a ratio of observed conditions versus theoretical near-natural conditions.

SOE reports:

- Provide information for better management of sustainable development
- Compare the environmental performances of different areas
- Increase public awareness of the environment and development
- Empower individuals and organisations to improve their environment and quality of life

(continued on next page)



Fish sampling

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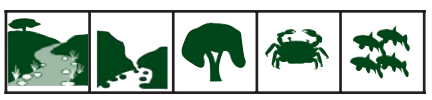
RIVER HEALTH CATEGORIES

Once river health indices are measured, they need to be interpreted within a framework that allows comparison of the health of monitoring sites and even river systems.

The results obtained by applying the biological and habitat indices during river surveys provide the information that determines the health of the river. A river health categorisation system is used for standardisation purposes, allowing comparison of the health of different river systems.

Each of the river health categories (facing page) is associated with a level of ecosystem health. The ecosystem health is linked to the potential of a river system to offer a particular range of ecosystem services. A 'fair' or 'poor' river may have lost its potential for most uses, e.g. tourism, conservation and even agriculture. It might, however be acceptable for a river to be 'fair' if a higher socio-economic return is deemed more important than the loss of some uses. This trade-off should be agreed upon by all involved stakeholders, as long as sustainable use and ecosystem function are not compromised.

The **present health** of a river is a measure of the ecological state of the river when surveyed, classified according to the river health classes shown opposite. The diagram below portray present health.



The **desired health** of a river is the best possible future ecological state based on ecological considerations, sustainable development and management actions. The diagram below portray desired health.

Desired Health

STATE OF ENVIRONMENT REPORTING (CONTINUED)

SOE reports use a philosophy based on cause and effect, known as the "Driving force-Pressure-State-Impact-Response" framework. This describes the human activities that create pressures on the environment, the current state and trends in environmental conditions, the consequences for sustainability and human livelihoods, and the policies and actions in place to manage the environment. This way of presenting information is comprehensive and easy to understand, especially if specific indicators represent changes in pressures, states and responses.

State of Environment reports answer questions such as:

- How are the condition and functioning of the environment changing?
- What is causing these changes?
- What are the consequences of these changes?
- What is our response and are our actions effective?
- What more can we do to improve river health and, therefore, the quality and flow of aquatic goods and services from which people benefit?

The identification of common linkages in the SA National SOE Report supports alignment and future harmony with other environmental tools. Two themes deal with water issues:

- The "Inland Water Theme" addresses specific Freshwater Ecosystem Integrity Issues, including Riparian Vegetation, Aquatic macro-invertebrate composition, Fish Communitgy Health and Aquatic Habitat Integrity
- The "National Marine, Coastal and Estuarine Environment" addresses several Resource Quality Issues for which indicators have been developed (Estuarine Health Index,

RIVER HEALTH CATEGORY	ECOLOGICAL PERSPECTIVE	MANAGEMENT PERSPECTIVE
Natural N	No or negligible modification of in-stream and riparian habitats and biota	No or negligible modification of in-stream and riparian habitats and biota
Good G	Ecosystem essentially in good state; bio-diversity largely intact	Some human related disturbance but mostly of low impact
Fair F	Sensitive species may be lost, with toler-ant or opportunistic species dominating	Multiple disturbances associated with socio-economic development, e.g. water quality degradation
Poor P	Mainly tolerant species present, alien species invasion; disrupted population dynamics; species are often diseased	High human densities or extensive resource exploitation

STATE-OF-RIVERS REPORTS

1. Crocodile, Sabie-Sand and Olifants River Systems - 2001
2. Letaba and Luvuvhu River Systems - 2001
3. uMngeni River and Neighbouring Rivers and Streams - 2002
4. The Hartenbos and Klein Brak River Systems - 2003
5. Diep, Hout Bay, Lourens and Palmiet River Systems - 2003
6. Free State Region River Systems - 2003
7. Berg River System - 2004 (in print)

Pollutant Loading entering the Sea, Blue Flag Beaches, Concentration of Heavy Metals in Sediments and Biological Tissues)

The RHP has built on the SOE experience and has developed the SoR report layout for providing information on the ecological state of rivers.

The SoR process consists of river monitoring, data analysis and information dissemination to man-agers and decision makers. The SoR thus provides ecologically sound management information while also informing and educating people about the health and importance of their rivers.

RHP information is available as raw data, in interpreted report format or as posters. Eventually the RHP will cover all of South Africa's major river systems. The RHP will also revisit rivers periodically in order to provide information on long-term trends in the health of river systems.

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OVERVIEW OF THE BUFFALO RIVER CATCHMENT

Terrain

The Buffalo River has its source in the seeps and sponges of the Amatola Mountains at an altitude of 1200 m. The river is 126 kilometres long and drains a catchment of 1287 square kilometres.

From its source, the river descends through indigenous forest in a deeply-incised channel, flanked by rock cliffs up to 120 metres high. The quality of these headwaters is good.

After only seven kilometres, the river faces its first obstruction, the small, century-old Maden Dam. Four kilometres downstream of Maden Dam, the much larger Rooikrantz Dam impounds about five million cubic metres. Rooikrantz Dam supplies water to King William's Town and the surrounding areas.

Twenty kilometres from its source, at an altitude of 450 metres above mean sea level, the Cwengcwe and Izele rivers join the Buffalo from the northeast. From here the river runs through undulating plains.

Two major tributaries from the west that join the middle section of the Buffalo River are the Mgqakwebe just upstream of King William's Town and the Ngqokweni at Zwelitsha. The other important tributary is the Yellowwoods, which flows from the north directly into Laing Dam. When full, Laing Dam covers 203 hectares and contains 20 million cubic metres of water.

From Laing Dam, the Buffalo River flows eastwards for 40 kilometres to Bridle Drift Dam, the largest impoundment on the river, with a full supply volume of 101 million cubic metres. Small streams on the northern bank bring runoff directly into Bridle Drift Dam from Mdantsane, the second largest township in South Africa.

From Bridle Drift Dam, the Buffalo River flows through low altitude coastal forest for twenty kilometres, before entering the Indian Ocean through the estuary harbour of East London.

Climate

The climate is warm and temperate. Temperatures are moderate in the coastal zone (8 - 39 °C) with a warm mean annual value of 21 °C. Inland temperatures vary between -2 and 42 °C with a mean annual value of 18 °C.

The mainly summer rainfall in the Buffalo River catchment ranges from 400 to more than 1000 mm per year with an annual mean value of about 700 mm. The coastal grassland, coastal forest and afromontane forest receive the highest rainfall.

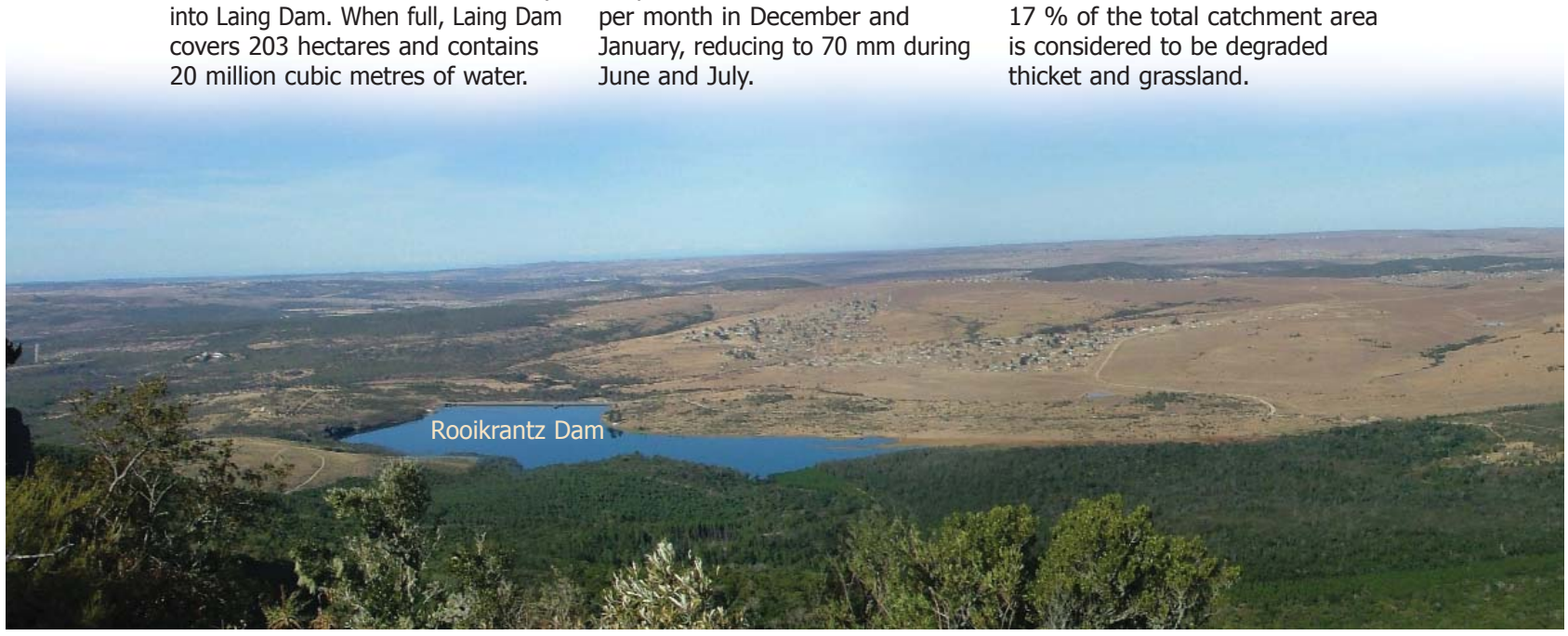
Evaporation rates are 160-170 mm per month in December and January, reducing to 70 mm during June and July.

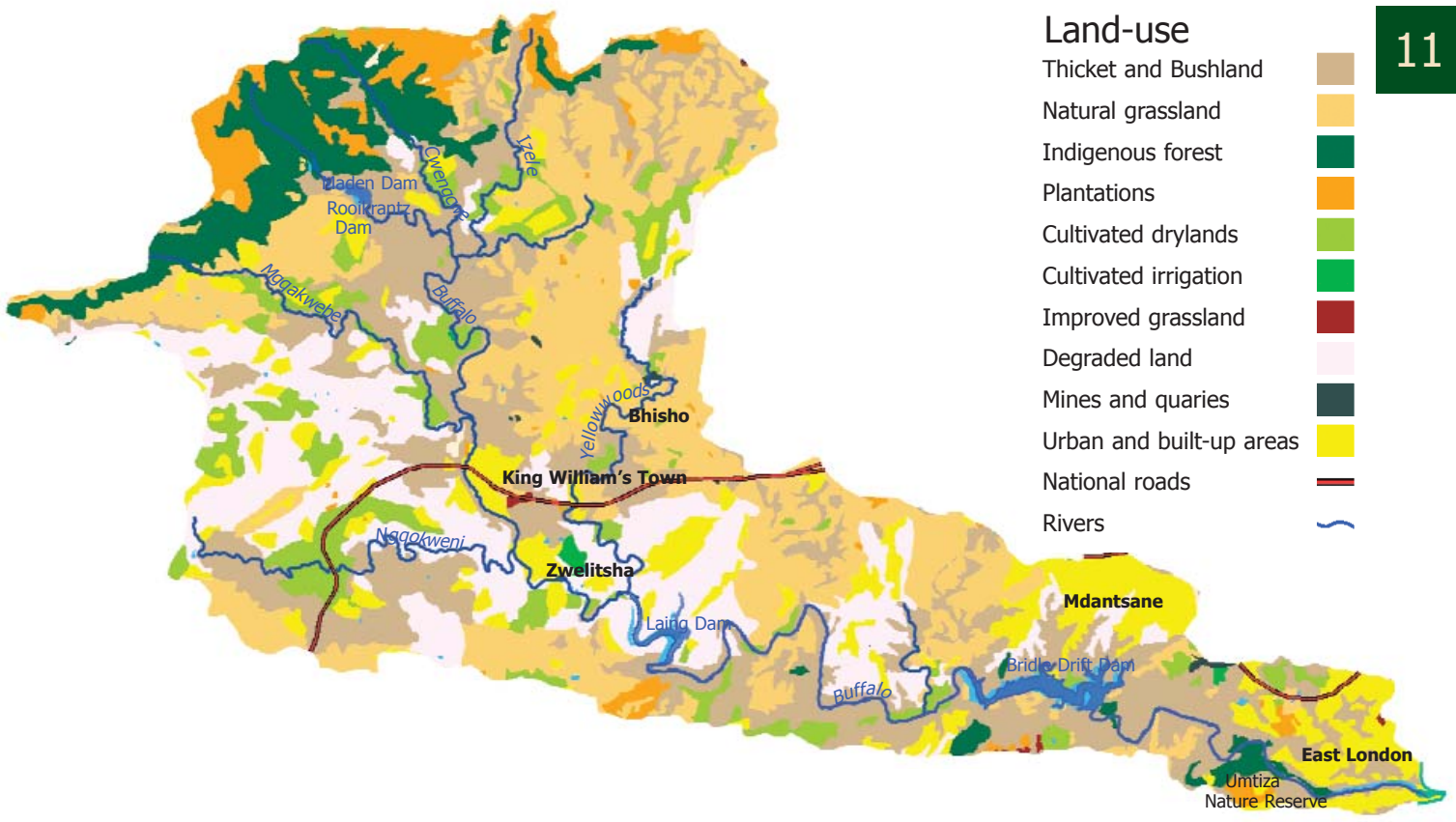
Land cover and Land-use

There are four biomes in the study area: false macchia, forest, savannah and thicket. The more arid savannah and thicket vegetation separate the afromontane forests on the mountain slopes from the low altitude coastal forest. The arid savannah, which covers the catchment from below the Rooikrantz Dam to Bridle Drift Dam, is dominated by grasslands and thornveld.

Indigenous forest covers 7 % of the total catchment area, while pine and blue gum plantations account for a further 4 %. Pirie Forest, in the upper catchment, is the home of a closed canopy indigenous forest. Evelyn Valley Forest, to the west of Pirie forest, is not formally conserved and includes indigenous forest (about 2 000 ha) as well as plantations. Many species are used for muti and traditional rites, for example, umthathi (sneezewood) and umnquma (forest olive). The Working for Water Programme is clearing invasive black wattles, on the border of the remaining indigenous forests to restore the grasslands. Forest trees are used for firewood and structural timber.

A large proportion of the Buffalo catchment has been transformed from its natural condition. Almost 17 % of the total catchment area is considered to be degraded thicket and grassland.





Urban built-up and industrial areas cover almost 12 % of the catchment.

Agriculture is widespread in the middle reaches of the catchment, from the foothill zone down-stream of Rooikrantz Dam to King William's Town and as far downstream as Bridle Drift Dam. Goat, cattle and sheep farming prevail. Although subsistence farming predominates, local areas of intensive irrigation (less than 1 % of the catchment area) provide fresh produce and other crops such as lucerne. Dryland cultivation covers about 8 % of the total catchment area.

The lower reaches downstream of Bridle Drift Dam comprise coastal forest and the East London harbour, situated in the estuary. About 560 ha of natural forest is conserved in the Umtiza Coastal Nature Reserve.

Geology and Soils

Rocky outcrops of the catchment consist of sedimentary rocks with dolerite outcrops. The sedimentary rocks consist of mudstones, shales and sandstones that produce highly erodible grey sandy loam soils. The dolerite outcrops weather to form red dolerite and black dolerite clays that are less prone to erosion.

Reduced vegetation cover in large parts of the catchment exacerbates the medium to high natural erodability of the soil.

OVERVIEW (CONTINUED)

Social Profile

The Buffalo catchment, with approximately 570 000 inhabitants, has one of the highest population densities in the Eastern Cape (440 persons per square kilometre), although more than a third of the people live in low-density rural areas (Census 2001). The population density is highest in the middle and lower reaches of the catchment (as much as 1 000 people per square kilometre). The largest towns are East London, Bhisho, King William's Town, Zwelitsha and Mdantsane.

Expanding townships put pressure on water and waste systems, which cannot cope with the demand:

Type of Water Supply	**Percentage of Population**
Clean piped water in the house	30 %
Standpipe in the yard	30 %
Standpipe within 200 metres	18 %
Standpipe further than 200 metres	16 %
Boreholes, springs, rain tanks, dams, pools or rivers	6 %
Type of Sanitation	
Flush toilet	64 %
Pit latrine (ventilated and unventilated)	25 %
Bucket, Chemical toilet and Septic tank	3 %
None	8 %

Economic Profile and Education

The Buffalo River catchment lacks significant exploitable mineral resources.
The coastal zone is commercially important for tourism, fishing and related activities. It also fulfils critical functions as spawning grounds, nurseries and feeding grounds for fish and marine organisms. The value to tourism is estimated at more than R300 million per year in the Buffalo City Municipal area. According to the Buffalo City Municipality Master Plan survey data, 72 % of all visitors identified the beaches as the most enjoyed facility in the area. If the popular beaches could obtain Blue Flag Beach status it would further promote tourism in the area (see page 33).

Community, social and personal services are the main source of employment:

Employment Sector	**Percentage of Population**
Community, social and personal services	28.2 %
Manufacturing	17.8 %
Trade	15.4 %
Private households	8.6 %
Financial, insurance, real estate and business services	8.4 %
Construction	4.7 %
Transport and communication	4.3 %
Agriculture, forestry and fishing	2.0 %
Other and undefined	10.6 %

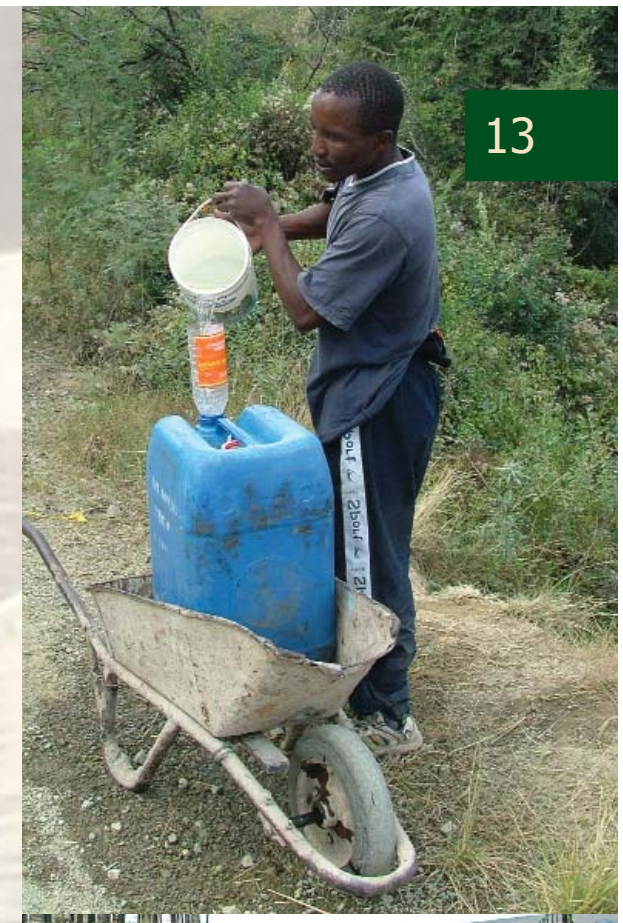
While two thirds of the inhabitants of working age (15 to 65 years) have no formal income, half of them consider themselves to be unemployed. Less than 10 % either cannot find work or choose not to work. Almost 50 % of men and 43 % of women are either fully employed or studying. The mean income of those who are employed is about R32 000 per year. More than 70 % of the population with income earn less than this mean annual. Although there is no big gender difference in the numbers of those unemployed, the mean annual income of women is almost R7 000 less than that of men.

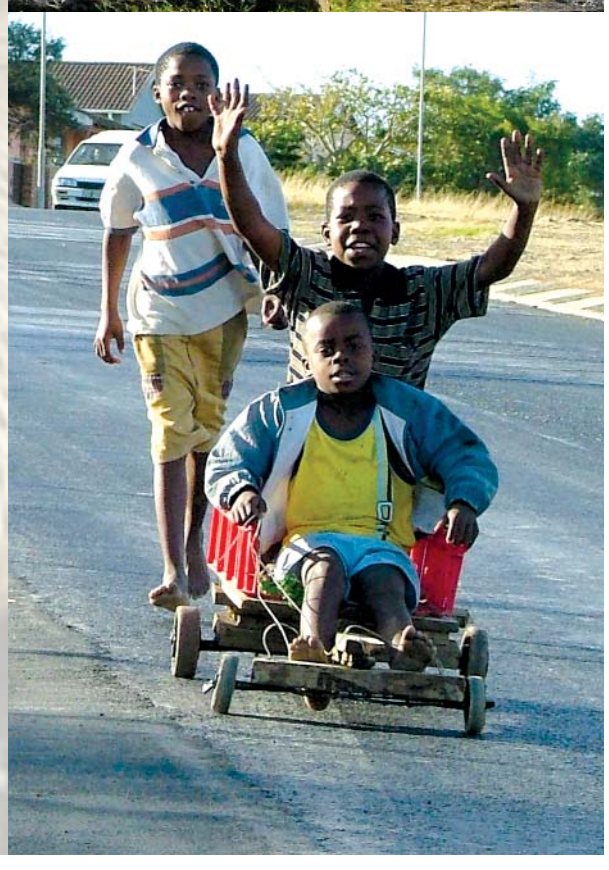
Interestingly, more women than men are now obtaining a tertiary education.

Level of Education	Percentage of Population
Tertiary	5 %
Grade 6 to 12	44 %
Grade 1 to 5	34 %
None	17 %

Amatola Water Transfer Scheme

The Buffalo River catchment is a densely populated region as a result of several historical socio-political factors. The demand on water resources due to the high population had already approached total exploitation in the early 1980s. Solutions included the Amatola Water Transfer Scheme and the reclaiming of water from sewage effluent. The Amatola inter-basin scheme transfers water from the Wriggleswade Dam to KwaNkwebu River, an upper branch of the Yellowwoods tributary to the Buffalo River. Wriggleswade Dam is situated on the Kubusi River, a tributary to the Great Kei River, to the northwest of the Buffalo Catchment. Water is presently transferred about once in five years during exceptionally dry spells. This transfer scheme will be used more frequently as the population and hence demand increases.





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BUFFALO RIVER HEADWATERS

The Buffalo River headwater streams originate in the indigenous forests of the Amatola Mountains. Clear waters babble over pebbles and stones between riverbanks covered with indigenous vegetation. Afromontane forest dominates the steep valleys, where indigenous trees such as the forest elder, Cape fig, common yellowwood, Cape chestnut and white stinkwood, form a continuous canopy of evergreen and deciduous trees.

The highest part of the catchment was once covered with natural grassland, but now consists of pine and blue gum plantations. However, areas where black wattles previously invaded the natural grasslands have been cleared and will be replaced with pine forest plantations, which will create jobs and supply wood for the timber industry.

Major dams in the Buffalo River headwaters are the Maden and Rooikrantz dams. Maden Dam, which is stocked with trout for angling purposes, is a well-kept recreational area and the Amatola Hiking Trail starts here. The King William's Town Municipality built Maden Dam in 1908, but by 1943 required more water than Maden Dam could supply, and applied for permission to build a larger dam, Rooikrantz, which was completed in 1952.

AMATOLA HIKING TRAIL

The Amatola Hiking Trail starts in the Buffalo River catchment at Maden Dam and ends near Hogsback. The trail, intended for the reasonably fit, consists of a six-day linear trail and several loops. Features of the trail include indigenous closed canopy forests, waterfalls, cascades, pools and dramatic views.

A guide to the Amatola Hiking Trail, AMATOLA HIKING TRAIL NETWORK, can be obtained from The Department of Water Affairs and Forestry, Private Bag 7485, King William's Town, 5600.

FISH HATCHERIES


Marron crayfish

In 1897, in the upper area of the Evelyn Valley, the Frontier Acclimatization Society tried to acclimatise trout for economical and recreational purposes. This cold-water fish hatchery was moved to Pirie and handed to the Cape Provincial Administration authority in 1946. This was the first alien fish hatchery in the country and was soon followed by the hatchery in Jonkershoek, Stellenbosch.

The Pirie hatchery was extended to the hatchery at Rooikrantz Dam. In 1981 it was handed to the then Ciskei authority. Marron Crayfish were introduced in 1986. Most of these marrons (alien fresh water crayfish) from Australia escaped into the Buffalo River system, but were not well adapted and were eaten by otters. The crayfish project stopped in 1997 and the trout breeding project ended in 2002. The SA Eels Company now leases the infrastructure.

Another hatchery, Amalinda fish station, is a warm water hatchery and produces ornamental Koi fish.


Amatola Mountain rock cliffs

WETLANDS

The riparian zone is the area along a river bank. The four main wetland types in the Buffalo River riparian zone are seep, floodplain, marsh and pan.


Seep wetland

- Seeps: 31 are present; 14 at crests and 12 at mid slope areas. Several of these have been damaged or destroyed by forestry or by alien vegetation, which has a drying effect.
- Floodplains: 21 are present of which 19 are on the valley floor. Several floodplains occur along the Yellowwoods River. They have dried out and were previously used as a farmland.
- Marshes: Two at the mid slope areas.
- Pans: Two on the plains.
- Besides the four wetland types, a small number of springs were encountered.

Management Suggestions

The landowners need to rehabilitate the seeps by removing alien vegetation and pine plantations and dealing with the erosion problem caused by over-grazing.


Floodplain

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BUFFALO RIVER HEADWATERS (CONTINUED)

DRIVING FORCES, PRESSURES AND IMPACTS

Alien plant infestation by black wattle, bugweed, pines and blue gum within the riparian zone, result in undercutting and slumping of riverbanks. Downstream of Rooikrantz Dam, terrestrial vegetation encroachment into the river channel is evident.

Alien plantations reduce runoff and thus river flows. Harvesting that does not comply with good forestry management practices can lead to increased siltation.

Structures such as the Maden Dam, Rooikrantz Dam and smaller weirs, contain the river flow. The only water that is released is when these dams overflow. Currently, a trickle from a crack in the dam wall is the only water release from the Rooikrantz Dam. In the past, water was released via the hatchery to the river downstream. Even if these dams had mechanisms to release water, demand is so high that there might not be enough water to simulate natural flow patterns.

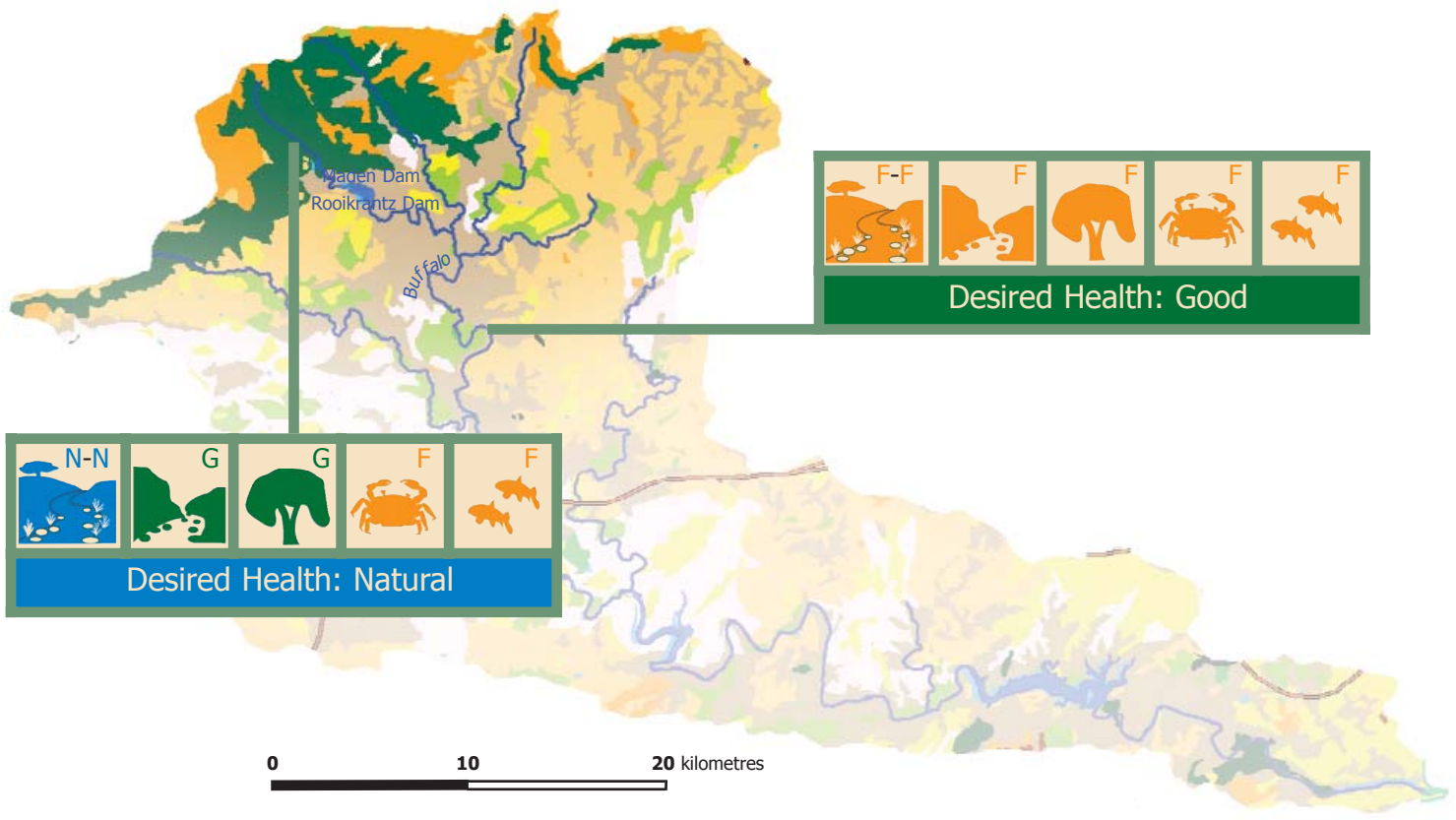
Trout and other alien fish species were introduced during the 1950s. They dominate sampling sites and very few indigenous fish species occur.

Historical uncontrolled harvesting of several indigenous tree species such as yellowwood, olive and sneezewood have resulted in disturbance of the natural composition of the forest, contributing to the invasion of alien vegetation species.

Much of the catchment upstream of Maden Dam enjoys the status of a protected state forest, so pressures from human activity are limited to forest management and recreational activities. Hunting and poaching of wild animals change the browsing dynamics and cause a change in species composition. The SASS results are unexpectedly low and need to be investigated further.

The impacts of high population densities downstream of Rooikrantz Dam include sand mining, rubbish dumping, removal of wood from the riparian zone, cattle crossings and trampling of the riparian zone.

PRESENT STATE



MANAGEMENT RECOMMENDATIONS

Prevent further encroachment of alien species into the riparian zone

Apply measures for sensitive management of the indigenous forest

Rehabilite the wetlands by removing alien vegetation and adhering to buffer zones when establishing plantations

Determine through toxicity testing why the SASS (invertebrate) scores do not reflect the otherwise pristine conditions above Maden Dam

WATER QUALITY

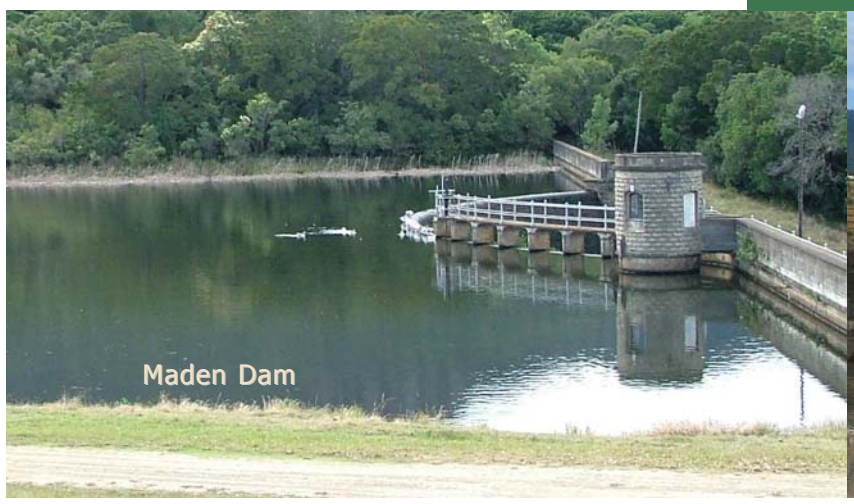
A combination of suitable water quality variables is selected to detect deteriorating water quality, and to indicate the potential for obtaining goods and services from the water.

The Buffalo River headwaters are almost pristine, so impacts on water quality are relatively low. Forestry activities may be releasing herbicides and pesticides in this section, but the impact of their usage is not detectable in the available water quality data.

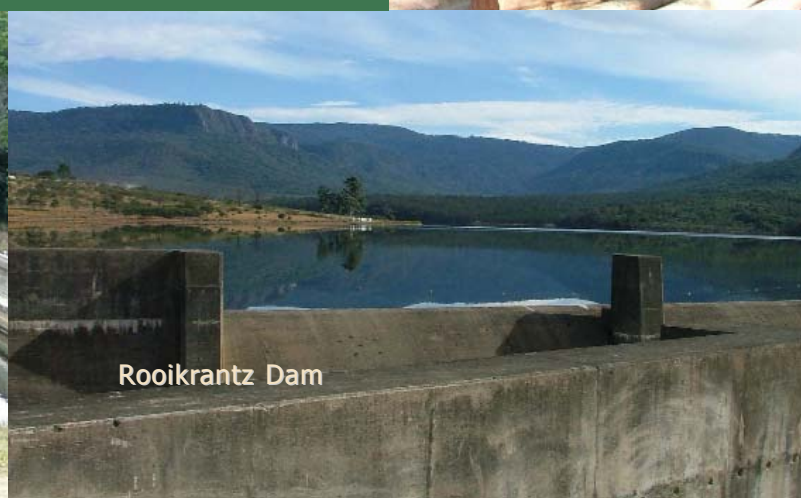
COMMERCIAL FORESTRY

The Amatola Mountain range and Keiskammahoek areas receive sufficient rainfall to support forestry. Forests are heavy consumers of water, so certain parts of the Buffalo River catchment are off-limits for plantations, to safeguard the future water requirements of Buffalo City.

DWAF is restructuring existing state plantations in order to ensure sustainable job creation and economic growth. To give an idea of the value of forestry, over a 25-year period every 100 hectares of timber plantation creates as many as 50 000 employee working days, equivalent to R2.7 million in wages. DWAF is managing the lease of plantations to ensure that the legitimate owners of the land receive a fair income from the process.



Maden Dam



Rooikrantz Dam

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MAJOR TRIBUTARIES TO THE BUFFALO RIVER

Three major tributaries feed the Buffalo River between Rooikrantz Dam and Laing Dam. They are the Mgqakwebe, Ngqokweni and Yellowwoods rivers.

The Mgqakwebe tributary is a meandering river with an average width of 4 metres. Trees and shrubs dominate the marginal vegetation. Cobbles and pebbles occur in long stretches of riffle. The pools are shallow.

Ngqokweni River, joining the Buffalo River downstream of the Mgqakwebe River, has an average width of 10 to 15 metres. Bedrock and boulders occur with small patches of riffle, and the pools are deep.

Subsistence farming is the dominant land-use in this area. Dryland farming and the keeping of mixed livestock (goats, sheep, cattle) predominates.

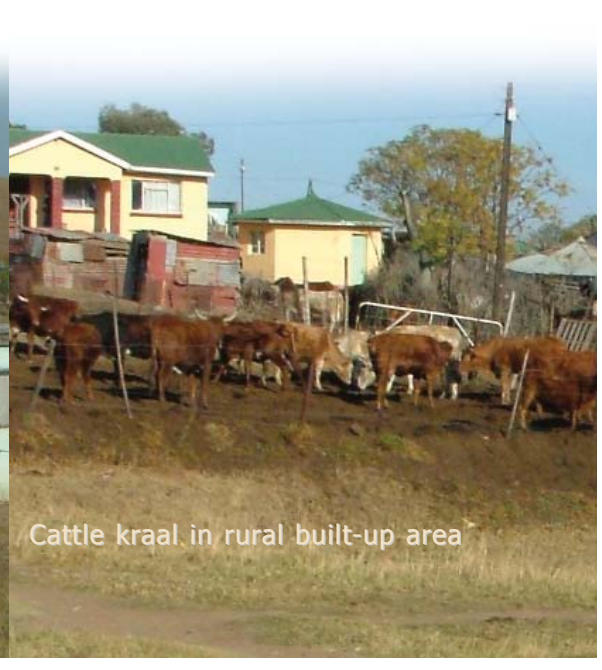
Cobbles, gravel and sand dominate the upstream and middle section of the Yellowwoods River, while mainly bedrock and boulders with small riffle areas occur downstream. Pools are shallow. The average stream width is 8 to 10 metres. Sedges and reeds dominate the riparian vegetation. Some small waterfalls occur in the middle and lower section of the river: the largest, Yellowwoods Falls, is near Breidbach.

A canal, which forms part of the Amatola Water Transfer Scheme, links Wriggleswade Dam, in the adjacent Kubusi River catchment, to the upper Yellowwoods River via the KwaNkwebu tributary.

Flow in the lower reaches of the Yellowwoods tributary consists of run-off from urban and rural areas and discharge from sewage treatment works.

The endangered Eastern Cape rocky

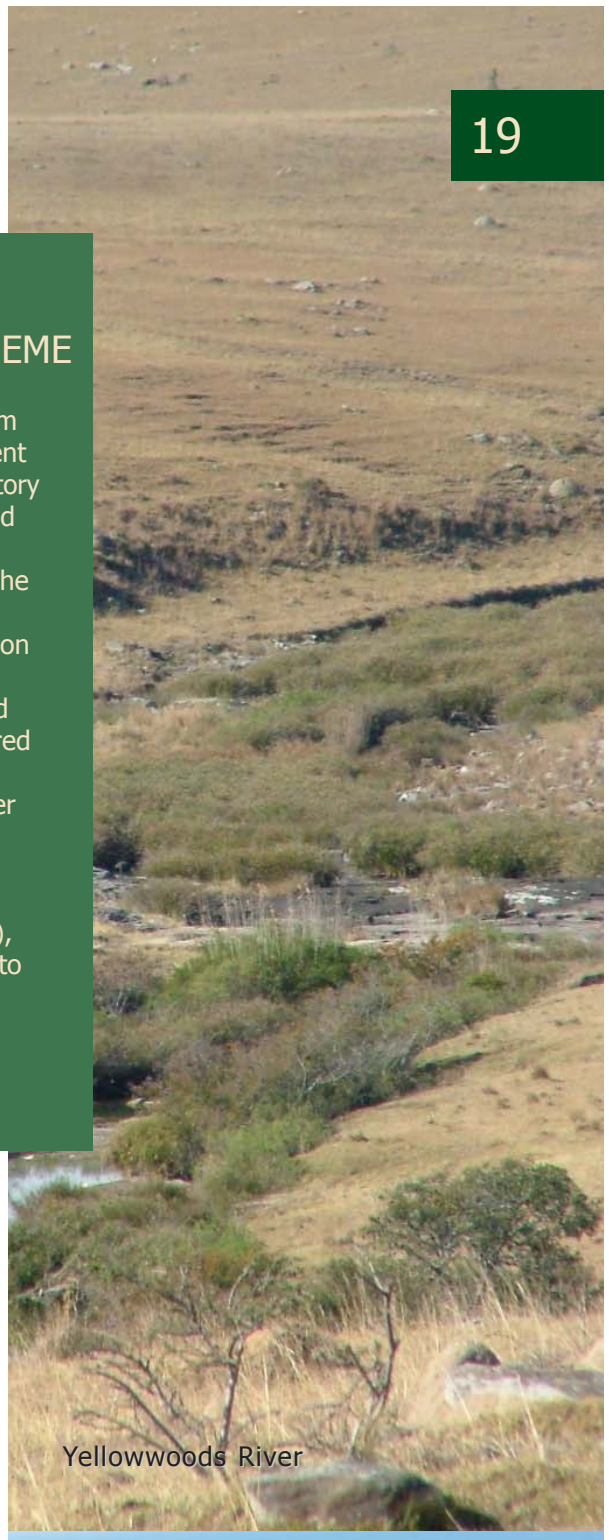
Typical rural built-up area



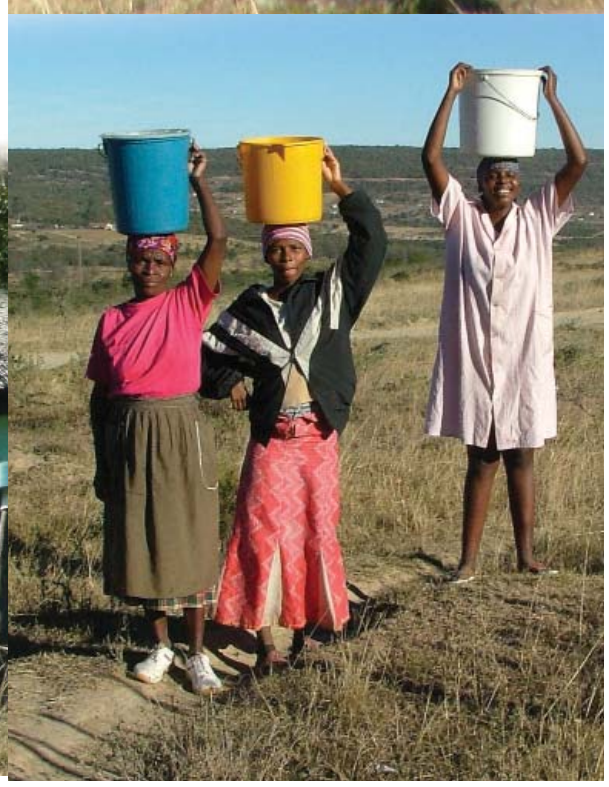
Cattle kraal in rural built-up area

IMPACTS OF THE AMATOLA WATER TRANSFER SCHEME

The transfer of water from the Kubusi River catchment could bring in alien predatory fish. High flows associated with releases from the Wriggleswade Dam into the KwaNkwebu tributary are likely to cause bank erosion and increased silt loads, disrupting the habitat and life cycle of the endangered Eastern Cape rocky, *Sandelia bainsii*. The other indigenous fish in the KwaNkwebu River is the widespread chubbyhead minnow (*Barbus anoplus*), which is not as sensitive to flow-related habitat changes.



Yellowwoods River



Stack of wood next to traditional hut

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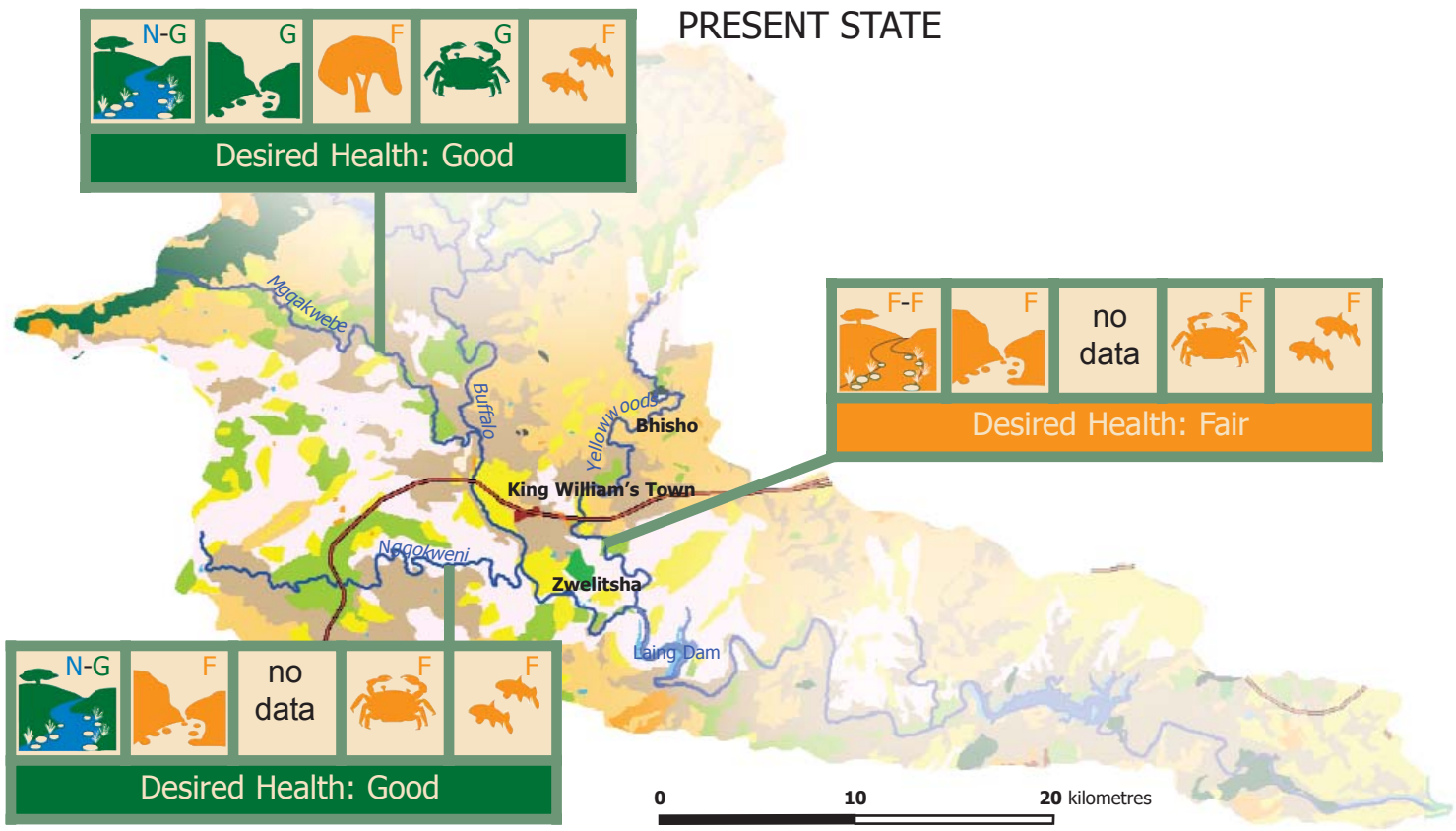
MAJOR TRIBUTARIES (CONTINUED)

DRIVING FORCES, PRESSURES AND IMPACTS

High population densities have several impacts on the river and include:

- Cemeteries close to the rivers.
- Excessive use of riparian trees for firewood.
- Sand mining in the riverbeds destroys natural habitat and increases siltation downstream.
- Cattle crossings and overgrazing destroy the riparian zone, erode riverbanks and form gullies.
- Alien vegetation invades disturbed areas.
- Poor management practices associated with subsistence farming.
- Discharge of raw sewage into the river causes rapid depletion of oxygen.
- Solid waste dumps on river banks.

All of these impact on in-stream biota by reducing habitat diversity. Very few of the expected indigenous fish species were sampled.



Removal of indigenous riparian vegetation results in alien infestation and erosion

MANAGEMENT RECOMMENDATIONS

Establish an alien vegetation control programme, especially around the Mgqwakwebe River

Restore river banks that have collapsed or eroded

Work with the land care management programme, Working for Water programmes and others in the environmental education of the local community

Monitor agricultural practices and educate subsistence farmers about sustainable grazing practices

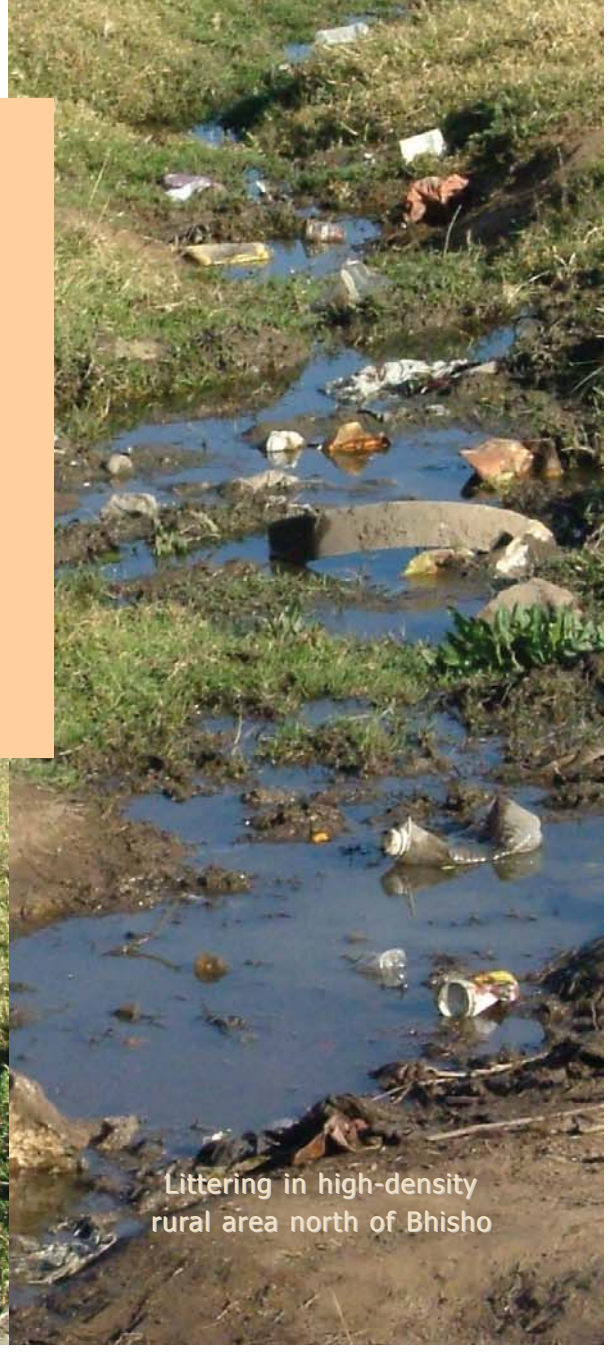
Educate local communities in the sustainable use of plants and the detrimental effects of removing of riparian vegetation

Improve management of sewage treatment works and improve infrastructure to control water quality impacts

Monitor impacts and trends of nutrient levels

WATER QUALITY

The Yellowwoods River passes through an urban area and high-density rural areas. Sewage discharges and overflowing sewerage systems that cannot cope with the load, have a severe impact on the water quality of the river. Poorly functioning sanitation infrastructure results in unacceptably high chemical oxygen demand, faecal coliform counts, nutrients and algal blooms. (Nutrients are mainly phosphorus and nitrogen compounds.)



Untreated sewage flowing into the Yellowwoods River

Littering in high-density rural area north of Bhisho

22

BUFFALO RIVER UPSTREAM OF LAING DAM

Dense rural populations and extensive urban developments dominate the Buffalo catchment upstream of Laing Dam.

Run-off from rural and urban areas and discharges from sewage treatment works make up a large part of the flow in this section of the river.

Laing Dam supplies water to the towns of Zwelitsha, Bhisho, Berlin and parts of Mdantsane. The dam also aids in improving water quality by trapping silt and nutrients, and diluting saline effluent. As with Maden and Rooikrantz dams, Laing Dam has no mechanism to release water in a way that simulates natural flow patterns in the downstream river reach.

In this reach, the average width of the Buffalo River is 8 to 20 metres. The substrate consists of sand, cobbles and boulders.

WATER AND THE XHOSA CULTURE

SHELTER:
Building a mud house (rondavel) makes extensive use of water.

RITUALS:
Water is used in the making of homebrew, and to symbolize cleansing for growing young maidens and young men. Even a woman coming out of widowship is cleansed in the river.

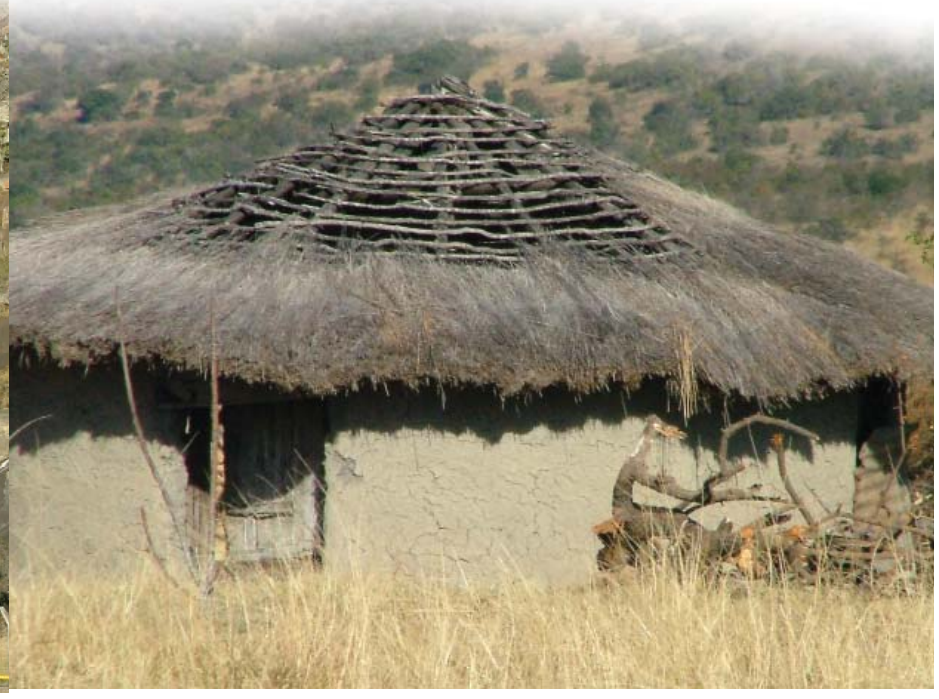
ART:
Clay pots, ornaments and a host of toys for children can only be built with the use of water.

COSMETICS:
Maidens decorate themselves with clay, red and white ochre, which need water for mixing.

RELIGION:
Church members are baptized in water when they are converted and confirmed to full membership.

REED-MATS:
The reeds growing alongside the river are often the only raw material available for making mats and baskets.

Laing Dam

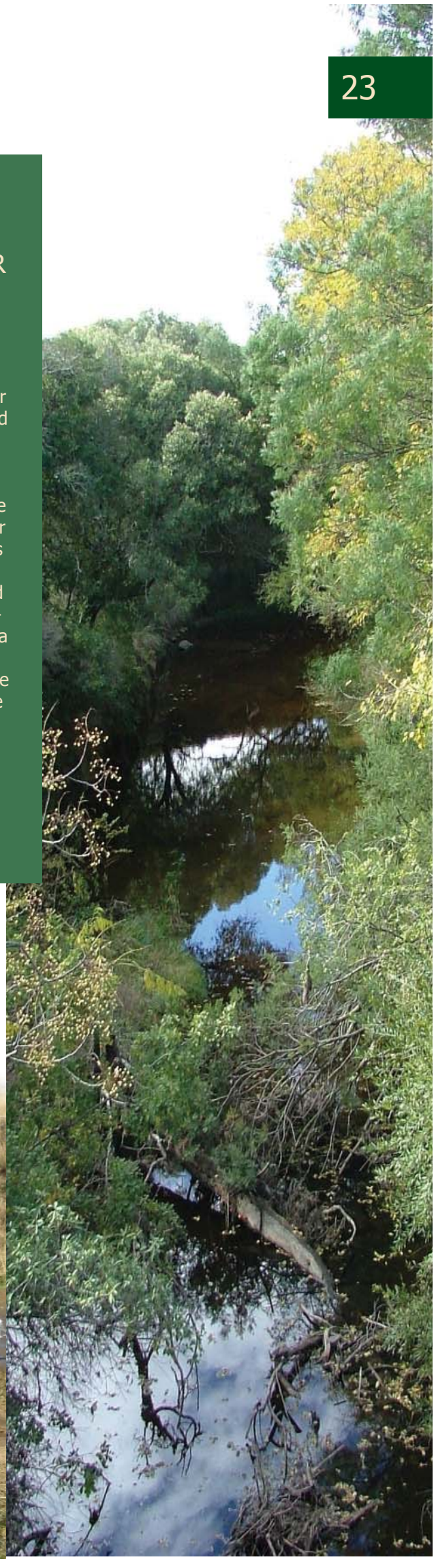


ECOSYSTEM SERVICES OF THE BUFFALO RIVER

People and animals need healthy rivers for their survival. Human and economic well-being depend on the river system for providing goods and services, such as water for drinking, washing, cooking and watering vegetable gardens.

People irrigate crops on a larger scale, they harvest reeds from the river, have picnics on the banks or use the river for cultural purposes (sangoma training, baptism). Rivers provide fish and crabs, and a surface for recreation and associated tourism. Rivers even have a capacity to purify our wastes. Therefore, a particular state of the river ecosystem enables us to use a particular range of goods and services provided by the river.

Water collection point at Bhalasi Village near Bhisho



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BUFFALO RIVER UPSTREAM OF LAING DAM (CONT.)

DRIVING FORCES, PRESSURES AND IMPACTS

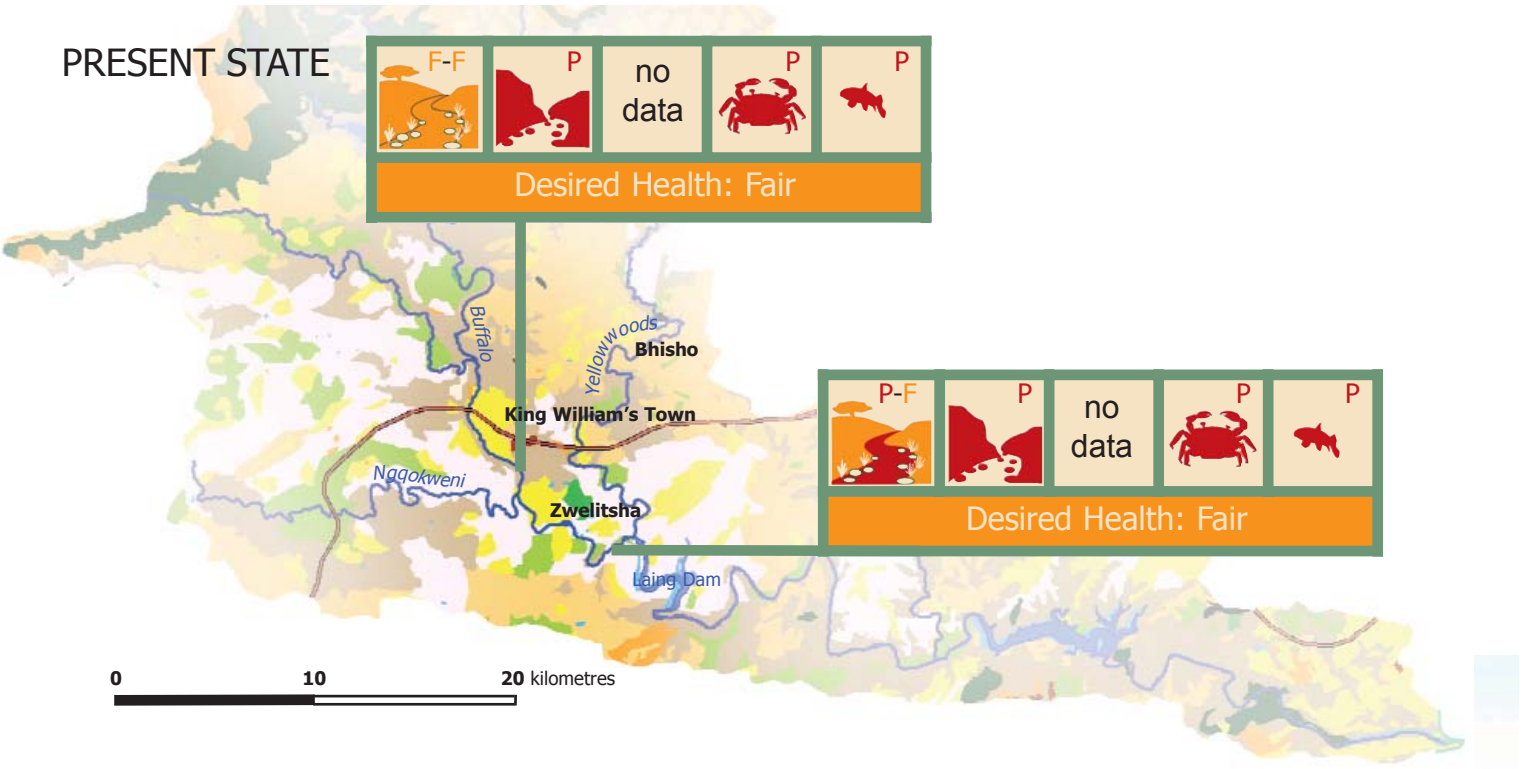
A textile factory, established fifty years ago to provide employment in the area, discharges its waste into the Buffalo River, just upstream of Laing Dam. In one incident, heavy downpours in 1988 caused the factory holding dams to overflow with the release of toxic chemicals that caused fish kills.

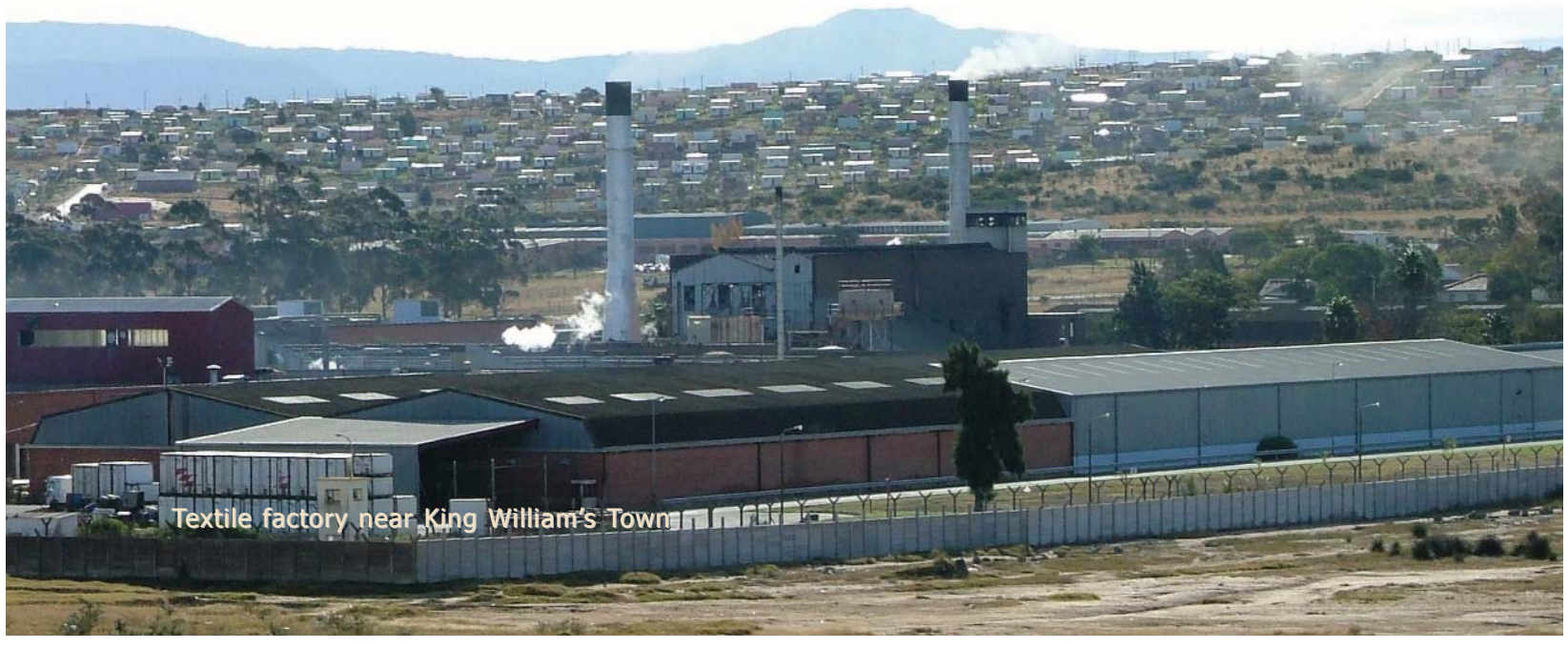
Urban developments and expanding rural settlements, aggravated by the high population densities, impact heavily on the river:

- Sewage treatment works are overloaded, spilling effluent that is not properly treated into the river.
- High nutrient levels result in eutrophication.
- Human activities worsen sedimentation: the removal of indigenous vegetation from the riparian zone opens the way to alien infestation, which in turn accelerates the process of bank undercutting and slumping. Alien plant species include eucalyptus, black wattle and red sesbania.

A tannery dumping site, since closed, still leaches toxic heavy metals into the Buffalo River, near Zwelitsha.

All the above impair the water quality, which further reduces macro-invertebrate and fish diversity.





Textile factory near King William's Town

MANAGEMENT RECOMMENDATIONS

Establish an alien vegetation control programme

Restore river banks that have collapsed or eroded

Work with land care management programme, Working for Water programmes and others in the environmental education of the local community

Monitor and manage agricultural practices

Educate local residents in the sustainable use of plants and the detrimental effects of removal of riparian vegetation

Monitor and manage eutrophication impacts and nutrient loads

Monitor industrial discharges

Continue improving the sewage treatment works and the management thereof

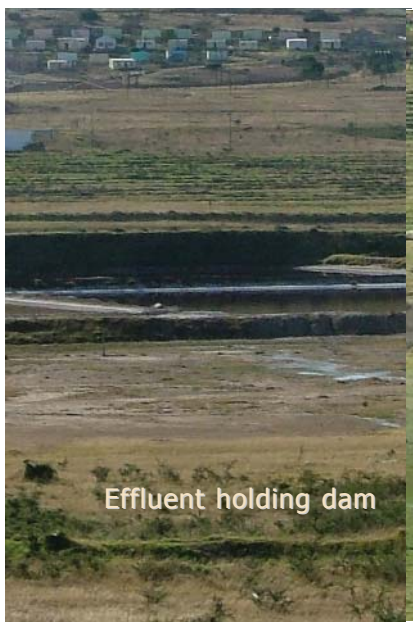

Collecting firewood

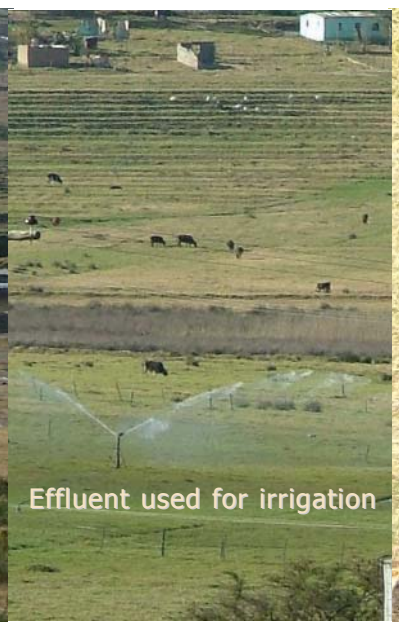
WATER QUALITY

This section of the Buffalo River passes through urban and densely populated rural areas. The major impacts are caused by treated sewage discharges, textile industry effluent and overflowing sewerage systems from overcrowded townships. Sewage works do not comply with the Department of Water Affairs and Forestry general standards for discharge. Raw and partially treated sewage entering the river causes unacceptably high chemical oxygen demand values, faecal coliform counts and nutrient concentrations.

High nutrient concentrations lead to eutrophication with excessive growth of aquatic plants, nuisance algae and cyanobacteria. Algal blooms are a serious problem in Laing Dam as they prevent light penetration through the water, thereby preventing natural reduction of iron and manganese and causing treatment problems for the Amatola Water Board. Moreover, cyanobacteria produce toxins that are expensive to remove with normal treatment processes and are a health hazard to water consumers.

The textile industry present in this section of the river contributes to the high salt concentrations in the Mlakalaka Stream, which enters the Buffalo River above Laing Dam.


Effluent holding dam


Effluent used for irrigation


Contaminated stream

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THE BUFFALO RIVER ON THE COASTAL PLAIN

This section of the Buffalo River stretches from Laing Dam across the coastal plain to Bridle Drift Dam. The channel width is about 30 metres. Eutrophic conditions in the river and Laing Dam encourage the growth and spread of the invasive water hyacinth.

Mdantsane, the second largest township in South Africa, lies to the north of Bridle Drift Dam. Several small streams, including the Shangani, Tindeli and Sitotana, drain Mdantsane directly into Bridle Drift Dam, which supplies water to the greater East London area, including Mdantsane. Bridle Drift Dam is the only dam in this catchment that can release water when it is not overflowing, so that flow can be maintained downstream.

Shangani Stream collects the overflow from the Potsdam sewage works to the west of Mdantsane and discharges it into the Bridle Drift Dam.

KwaNxamkwane Stream, with an average width of 4 to 6 metres, joins the Buffalo River near Potsdam. Grass and sedges dominate the marginal vegetation.

The catchment area to the north of the Buffalo River between Laing Dam and Bridle Drift Dam, is characterised by natural grassland and thicket, interspersed by large built-up areas and extensive areas of degraded land.

The alien largemouth bass prey on indigenous fish

Rainbow trout is an alien fish species

A view of Bridle Drift Dam from Mdantsane

USE AND IMPORTANCE OF THE BUFFALO RIVER TO THE XHOSA KINGDOM

- Mgolombana, the King of the Xhosas on the southern side of the Kei River, used the Hoho Forest as a hiding place against the British forces in 1877 and 1878.

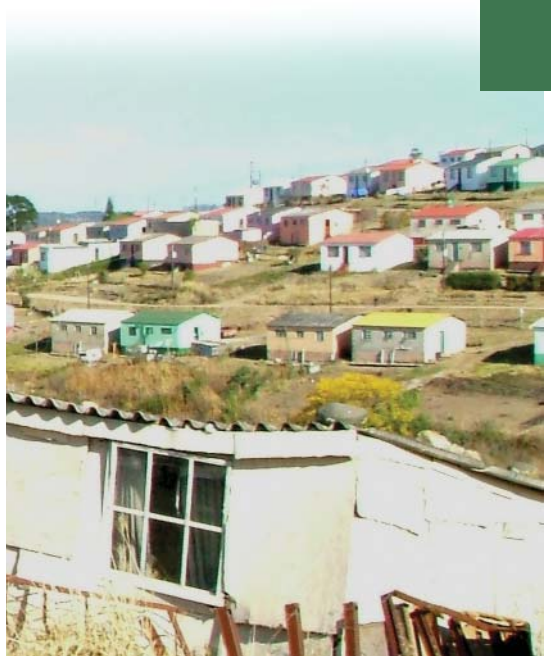
- Sandile's Cave is just a few metres above the still waters of the Buffalo River; his warriors used the river as a source of potable water. When the warriors were about to go to war, they would be cleansed by washing in the Buffalo River using herbs like intelezi emhlophe. This would take place in certain pools selected by a sangoma: different pools were used for different purposes.

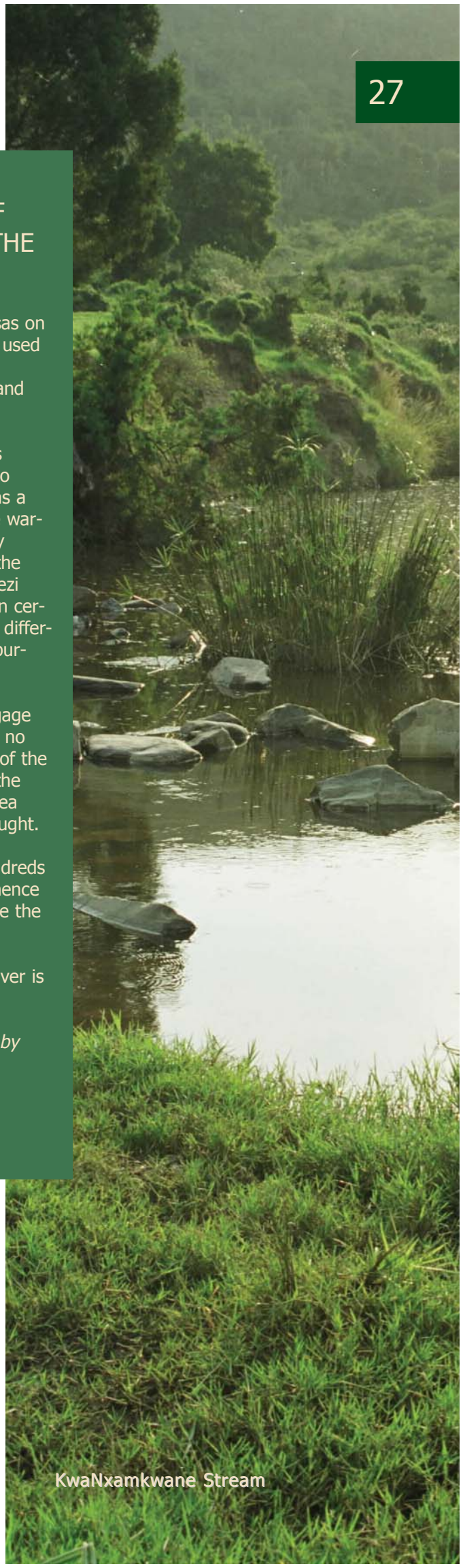
- At times the river was used to engage the enemy forces, as the river has no access in certain areas. The signs of the battlefields are still evident along the Buffalo River in the Fort Murray area where the war of Mlangeni was fought.

- In the late eighteenth century hundreds of buffalo grazed along the river, hence the British settlers decided to name the river after them.

- The Xhosa name for the Buffalo River is iQonce.

The above information was supplied by Prince Zolile Burns-Ncamashe.





KwaNxamkwane Stream

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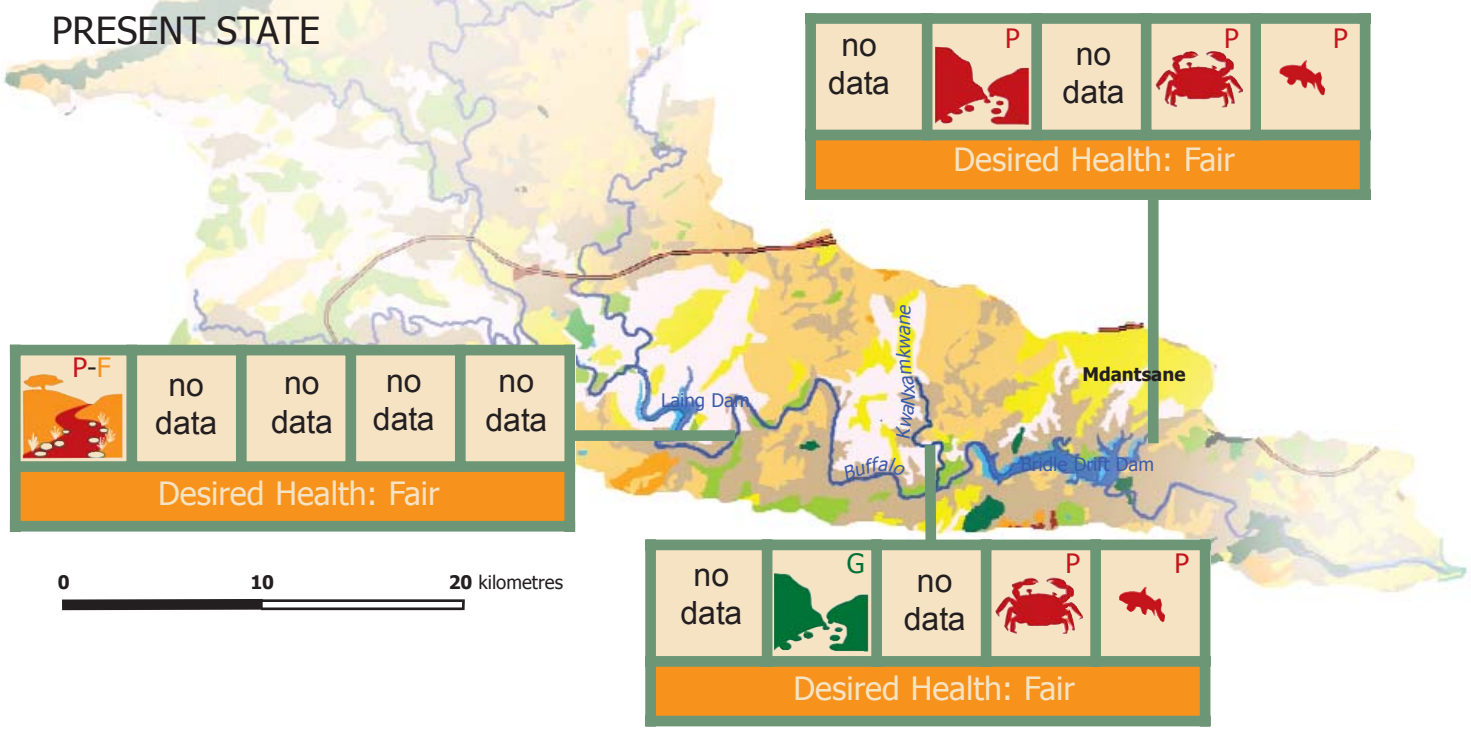
THE BUFFALO RIVER ON THE COASTAL PLAIN (CONTINUED)

DRIVING FORCES, PRESSURES AND IMPACTS

The population pressure in this area is high:

- Access to proper sanitation is inadequate. This results in microbial pollution of the water resource.
- The sewerage system at Mdantsane is too old and too small to cope with the large volumes of sewage from this area. Sewage consequently flows via small tributaries into the Bridle Drift Dam. Pump failures at Potsdam sewage treatment works result in raw sewage overflows, which enter Bridle Drift Dam via Shangani Stream.
- The high nutrient loads cause eutrophication and result in potentially toxic algal blooms in the dam and excessive growth of water hyacinth.
- Dumping sites are either lacking or not properly managed, leading to solid waste pollution.
- Clearing of indigenous vegetation from the riparian zone, provides an opportunity for alien vegetation to invade.
- Agriculture along the river, even on steep slopes, is extensive and overgrazing is common. This leads to erosion and increased sediment loads.
- Cemeteries along river banks are a growing concern, especially on the banks of the KwaNxamkwane Stream. Here, trampling at cattle crossings also occurs.




Potsdam Sewage Treatment Works

MANAGEMENT RECOMMENDATIONS

Enlarge and expand the sewerage system. Upgrade sewage treatment works and ensure continuous proper functioning of the sewage systems

Upgrade the water purification plant to cope with the growing population and its requirements for clean tap water

Take action to control river pollution

Use activated carbon filters to remove dyes and smelly by-products of algae. (This treatment method is effective, but costly)

Restore natural flow patterns - occasional summer flooding and no-flow periods

Start managing on a catchment basis

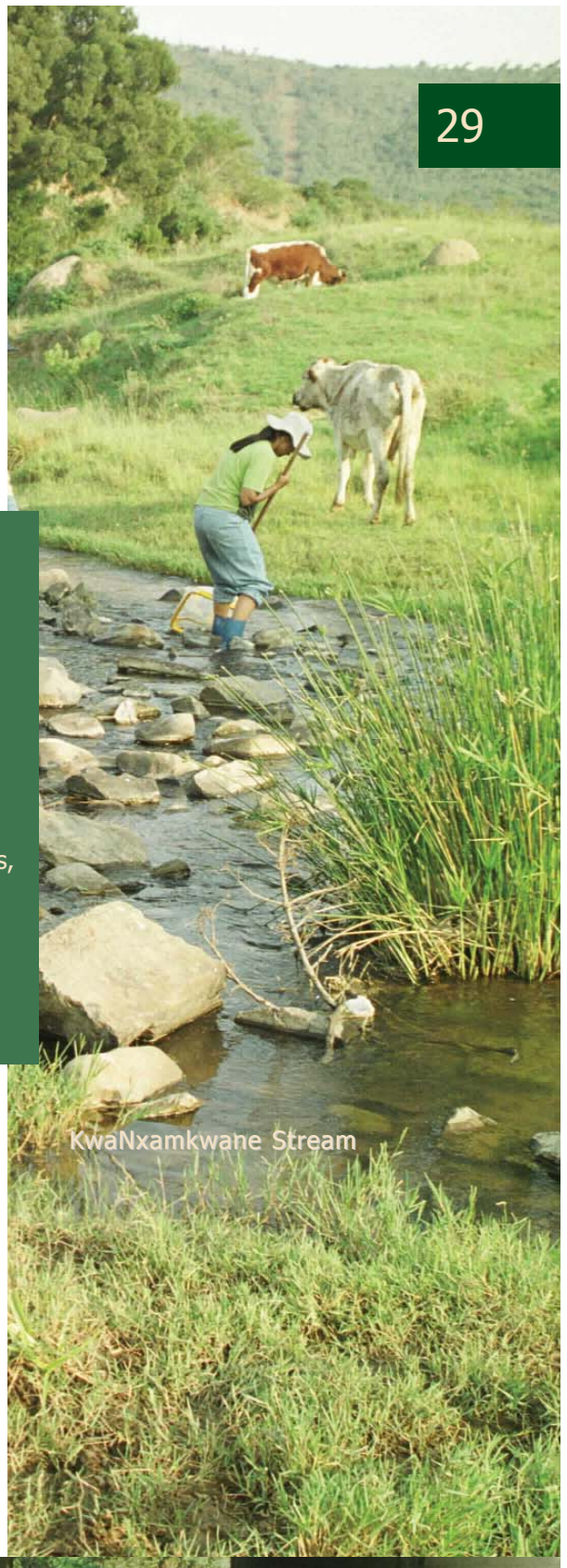
Remove alien vegetation from the riparian zone and control vegetation encroachment

Initiate monitoring programmes in this section of the river

Improve management of dumping sites

ALTERNATIVE SANITATION

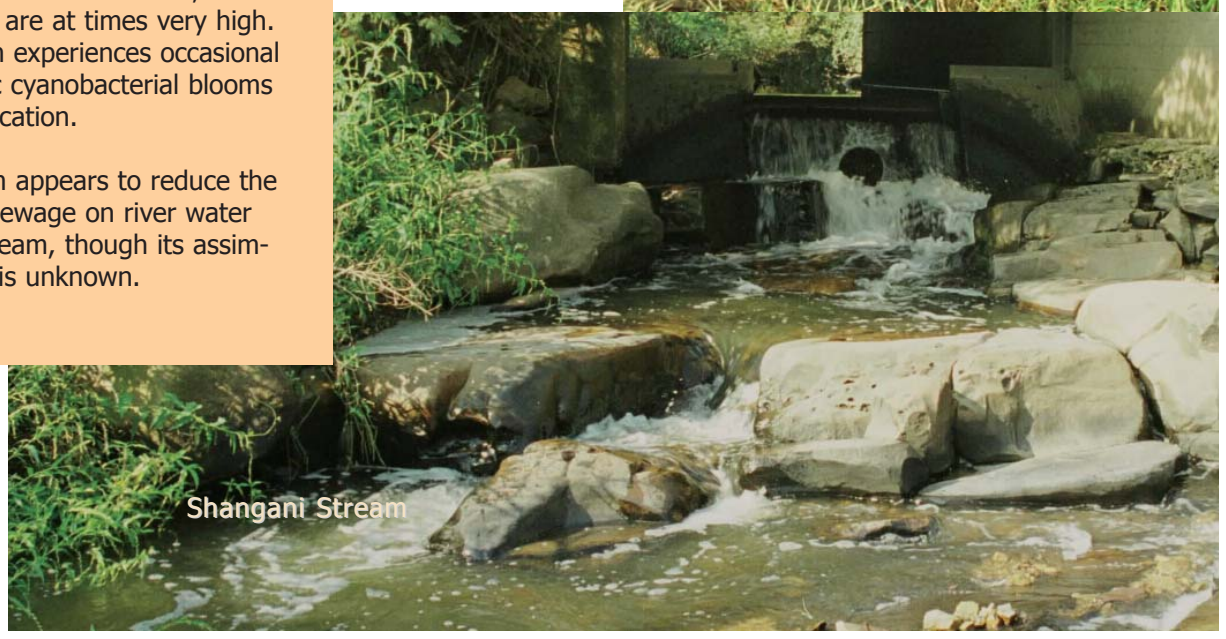
Buffalo City Municipality Integrated Environmental Management Plan (IEMP) Unit is investigating alternative sanitation solutions and technologies, rather than only focusing on the upgrading of sewage treatment works.


KwaNxamkwane Stream

WATER QUALITY

This stretch of the river passes through semi rural areas and Bridle Drift Dam receives polluted runoff from the urban area of Mdantsane. Due to overflowing of the sewage system and lack of sanitation in some areas, faecal coliform counts are at times very high. Bridle Drift Dam experiences occasional potentially toxic cyanobacterial blooms due to eutrophication.

Bridle Drift Dam appears to reduce the impact of raw sewage on river water quality downstream, though its assimilative capacity is unknown.


Shangani Stream

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THE LOWER BUFFALO RIVER, ESTUARY AND HARBOUR

Downstream of Bridle Drift Dam, the Buffalo River forms a wide incised channel with numerous bedrock intrusions and vegetated islands. The average width of the river channel is between 40 and 50 metres. Bedrock predominates with few cobbles. Although some alien invasion occurs, river banks are stable as a result of good indigenous vegetation cover.

A natural gorge limits access to the Umtiza Nature Reserve so human impacts are low. This 560 ha reserve conserves the *Umtiza listeriana*, a tree found in this area only. It is also home of the Samango monkey, tree dassie and the rare African finfoot.

Because rivers have a self-cleansing nature (ability to recover naturally), it is important to protect natural ecosystem functioning. An example where a river restored itself is at the Umtiza Nature Reserve where anthropogenic impacts are low and the river health improves downstream over a relatively short distance. The result is that high diversity of reasonably sensitive organisms are found.

The Buffalo City Municipality coastline provides a unique habitat for marine, shellfish and coastal wildlife.

Local inhabitants use this section of the river for cultural rites.

Umtiza tree

NATURAL CLEANSING PROCESS

Every water resource has an assimilative capacity in which it can tolerate a certain amount of pollutants without having a detrimental impact to its users.

Rivers provide habitats for a range of plants, animals and microbes which assist in the natural process of breaking down wastes (including anthropogenic waste): some plants and microbes take up the wastes and are able to break them down, some animals eat the plants, some animals eat each other and some animals eat the broken-down plants and animals. In this way, rivers are able to clean themselves.

Under natural conditions, the river processes are able to cope easily with minimal amounts of waste discharged into the river. When increased amounts of waste are discharged to the river and changes are made to the structure of the river, these natural processes can no longer cope because of changes in the numbers and kinds of animals and plants, and changes in habitat. The breakdown processes can no longer take place and the structure and functions of the river change.

EAST LONDON HARBOUR

A harbour port offers a strategic competitive advantage to economic development, stimulating growth and economic efficiency. Well-run ports are catalysts, facilitators and attractors of international seaborne trade (*Address to the Maritime Africa 2000 Conference by the late Minister of Transport, Abdulah M. Omar*).

Pollution from port activities includes: ship and associated transport activities, operational spillages, port installation, ship maintenance or repairs including discharges, waste disposal and other allied activities.

The bottom sediments in a harbour are often contaminated by heavy metals. Disruption of these during dredging or transport to a marine disposal site poses an ecological hazard.

The East London harbour, situated in the Buffalo Estuary, is the final receiving point of the Buffalo River freshwater discharge. The harbour area is severely polluted with elevated levels of heavy metals, bacteria (faecal and total coliforms) and contaminated run-off. Non-compliance to SA water quality guidelines for mariculture and bathing water quality standards has been reported in the adjacent coastal zone. Although the Buffalo River is a primary source of contamination in the near-shore coastal environment, other sources include the West Bank Hood Point industrial and domestic wastewater outfall, graving dry dock and ship repair yard, stormwater run-off from the city centre, the Gately industrial zone, and First Creek and Second Creek that drain urbanised sub-catchments of the city of East London. The leachate from unlicensed, inappropriately located and ill-managed landfill sites is a further pollution source.

Effective management and protection of estuarine and coastal marine environments require a holistic approach:

- In assessing conditions across a complex array of interconnected and interdependent systems from upstream habitats to coastal marine waters and
- Formulating strategies and implementing plans to restore or maintain system components.

A range of institutions will have to collaborate to achieve the effective and co-ordinated regulation of impacts on the aquatic system in the harbour.

The water quality of the Buffalo River lower reaches is improving, because it passes through a protected nature reserve. The recovery of the river may be attributed to its natural cleansing process. However, the Buffalo River may lose its assimilative capacity if pollution problems occurring in the middle reaches are not eliminated. Improvement of infrastructure, functional sewage treatment works and responsible effluent and waste disposal by industries are essential to improve the Buffalo River health status.

East London Harbour

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THE LOWER BUFFALO RIVER, ESTUARY AND HARBOUR (CONTINUED)

DRIVING FORCES, PRESSURES AND IMPACTS

Industrial development results in the loss of terrestrial and aquatic habitats and the consequent decline in biodiversity (fauna and flora).

Pollution output of industries is high, leading to water contamination. Examples are:

- Discharge of effluent from petrochemical industries contaminates Gately Stream.
- Second Creek waste disposal site leaches directly into the estuary.
- The Central Sewage Treatment Works (Amalinda) is overloaded and releases effluent that is not properly treated.

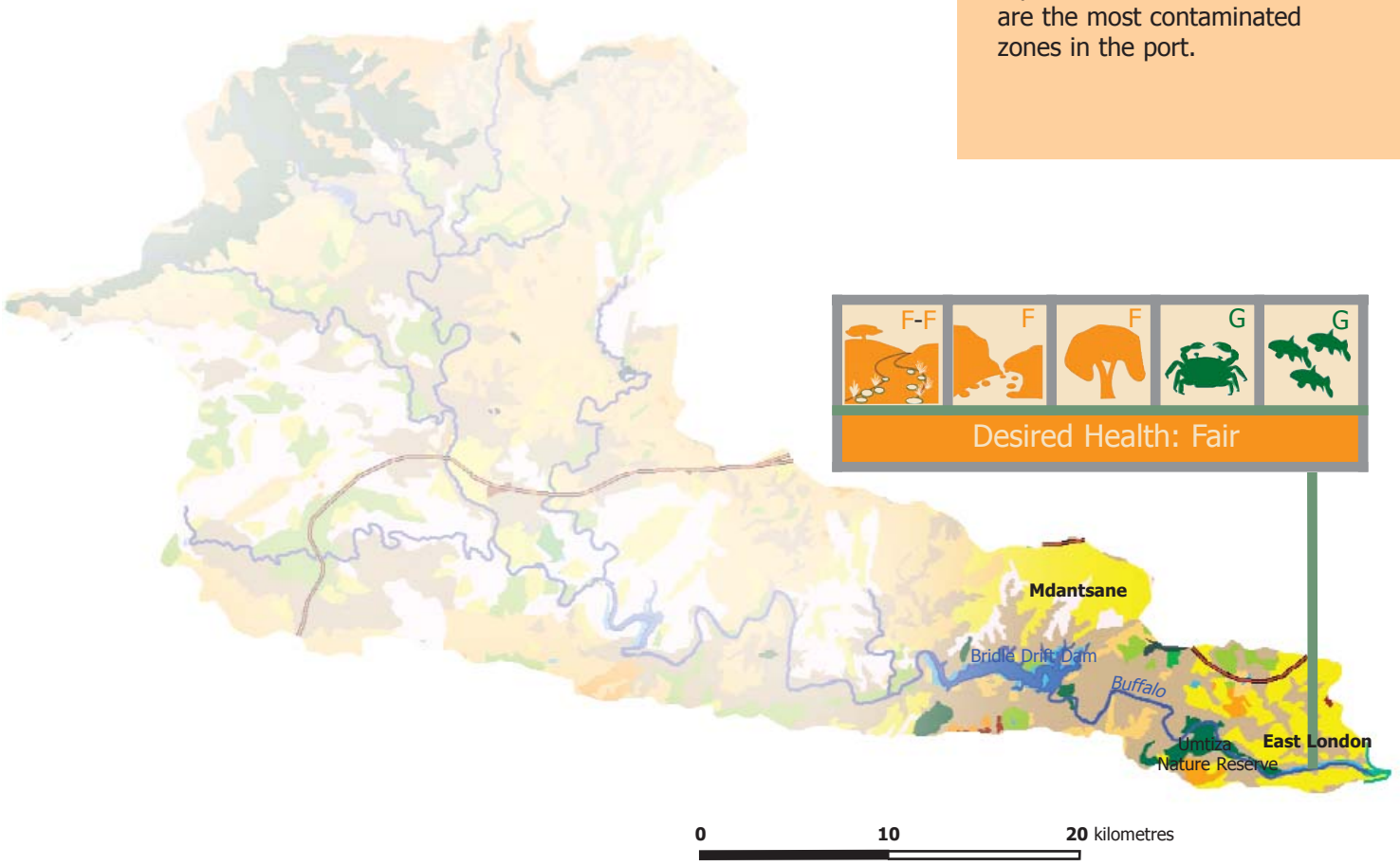
Encroachment of alien weed species such as castor oil plant, ink berry, syringa, cactus vine and balloon vine.

Removal of plant material from the forest.

WATER QUALITY

Previous heavy metal sediment surveys demonstrate that the upper harbour sites and the inner harbour area in the central sector downstream of the ship repair and storm water inflows are the most contaminated zones in the port.

PRESENT STATE



MANAGEMENT RECOMMENDATIONS

Ensure adherence to the Environmental Management Plan for the East London Industrial Development Zone

Arrange for the removal of alien vegetation along the river banks by Working for Water

Control aquatic alien plants. Since the river acts as a conduit for the down-stream dispersal of seeds, these plants must also be controlled upstream

Continue with the upgrading of the sewage treatment works

Conduct environmental awareness programmes to educate the public and school children

THE BUFFALO RIVER AND MARINE POLLUTION

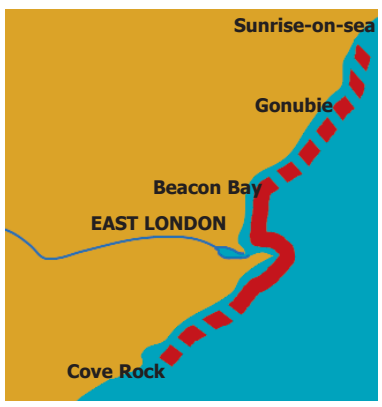
Contaminants enter estuarine and ocean waters via five primary path-ways:
- riverine inputs
- non-point source runoff from land
- direct pipeline discharges
- discharges and dumping from ships
- atmospheric deposition

The most common human-generated wastes in estuarine and coastal marine environments worldwide are dredged spoils, sewage, and industrial and municipal discharges. These wastes generally contain a wide range of pollutants, notably heavy metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, chlorinated hydrocarbons, litter and other substances.

COASTLINE AND DEGREE OF POLLUTION

very polluted

polluted



ESTUARIES

An estuary is the meeting place between a river and the sea. It is a dynamic and complex ecosystem, with varying levels of saline, brackish and fresh water. Estuaries are influenced by both marine and terrestrial environments. They support a uniquely adapted but varying biodiversity.

The 6.5 km Buffalo estuary covers 98 ha and is about 4.7 m deep. The harbour breakwaters keep the system permanently open. Dredging has deep-ened the channel, removing the tidal flood delta and changing the character-istics of the estuary.

Fish, birds and botanical characteristics are used to determine estuary health. A total of 23 fish species were sampled during 1997. Five of these species breed in estuaries and the young of 16 species depend on estuaries. The natu-rally steep banks with little available intertidal and floodplain habitat, as well as the harbour construction, contribute to the low botanical diversity in the estuary (only 9 plant species were identified). Birdlife is sparse due to long-term human influence.

High faecal coliform counts render the water unsuitable for human contact. High nitrate and phosphate concentra-tions cause excessive algal growth. Raised heavy metal concentrations were detected.

The overall state of the estuary is fair to poor.

The main threats posed by human activities to estuarine biodiversity in South Africa are:
- reduction in freshwater flows
- sedimentation due to soil erosion
- eutrophication
- residential and industrial develop-ment
- road and rail construction across estuaries
- fixing/stabilisation of mouths and
- pollution.

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FISH SPECIES IN THE BUFFALO RIVER

SPECIES NAME	COMMON NAME	SAMPLED DURING 1980S	SAMPLED DURING 2002/03	ECOLOGICAL STATUS	HABITAT REQUIREMENTS	OCCURRENCE IN OTHER SYSTEMS
INDIGENOUS FISH						
Anguilla marmorata	Giant spotted eel	Y	Y	Common	Catadromous - migration peaks in summer after high flows	Eastern Cape and KwaZulu-Natal rivers
Anguilla mossambica	Longfin eel	Y	Y	Common	Catadromous - migration peaks in summer after high flows	Eastern Cape, Southwestern Cape and KwaZulu-Natal rivers
Awaous aeneofuscus	Freshwater goby	Y	Y	Fairly common	Pools and running water in rivers and estuaries	Eastern Cape and KwaZulu-Natal rivers
Barbus anoplus	Chubbyhead barb	Y	Y	Widespread. Endemic	Prefers cool slow-flowing water and pools and backwaters	Highland rivers
Barbus trevelyani	Border barb	Y	Y	Critically Endangered	Pools and riffles in clear rocky streams	Keiskamma and Buffalo rivers
Gilchristella aestuaria	Estuarine round-herring	Y	N	Common. Important link in foodchain	Estuaries and fresh water	KwaZulu-Natal, Southern and Eastern Cape rivers
Glossogobius callidus	River goby	N	Y	Fairly common	Bottom feeder, between plants and stones in pools	Eastern Cape and KwaZulu-Natal rivers
Monodactylus falciformis	Cape moony	Y	Y	Common	Catadromous, migrate during summer months	KwaZulu-Natal, Southern and Eastern Cape rivers
Mugil cephalus	Flathead mullet	Y	Y	Common	Catadromous, peak migration from June to September	All coastal rivers
Myxus capensis	Freshwater mullet	Y	Y	Threatened. Endemic	Catadromous, peak migration in early summer	Southern and Eastern Cape coastal rivers
*Oreochromis mossambicus**	Mozambique tilapia	Y	Y	Common	Slow-flowing water	Eastern Cape and KwaZulu-Natal rivers
Sandelia bainsii	Eastern Cape rocky	Y	N	Endangered	Prefer slow-flowing water and pools and backwaters	Buffalo, Keiskamma, Great Fish and Kowie rivers
ALIEN SPECIES						
Clarias gariepinus	Sharptooth catfish	Y	Y	Translocated to Buffalo River system	All types of habitat: flood plains, dams, turbid and drying pools	Widespread in Southern Africa
Cyprinus carpio	Carp	Y	Y	Introduced into South Africa from Central Asia	Hardy species that flourish in slow flowing rivers and dams	Widespread
Labeo umbratus	Moggel	Y	Y	Translocated to Buffalo River system	Slow flowing water and shallow dams	Orange/Vaal, Gourits, Gamtoos and Eastern Cape
Lepomis macrochirus	Bluegill sunfish	Y	Y	Introduced into South Africa from North America	Prefer backwaters with plants in abundance	Cape coastal rivers and KwaZulu-Natal midlands
Micropterus dolomieu	Smallmouth bass	Y	Y	Introduced into South Africa from North America	Flowing water	Several KwaZulu-Natal, Southern and Eastern Cape rivers
Micropterus punctulatus	Spotted bass	Y	Y	Introduced into South Africa from North America	Turbid backwaters and dams	A few KwaZulu-Natal and Eastern Cape rivers
Micropterus salmoides	Largemouth bass	Y	N	Introduced into South Africa from North America	Clear, slow flowing water	Widespread in Cape coastal rivers
Onchorhynchus mykiss	Rainbow trout	Y	N	Introduced into South Africa from North America	Cool, clear, running water	Highlands and Western and Eastern Cape mountain streams
Salmo trutta	Brown Trout	Y	N	Introduced into South Africa from Europe	Cool, clear, running water	A few KwaZulu-Natal, Western and Eastern Cape streams
Tilapia sparrmanii	Banded tilapia	Y	Y	Translocated to Buffalo River system	Wide range of habitats, prefers backwaters	Mainly in KwaZulu-Natal and Orange River system

* An alien species in some river systems

SOME PLANT SPECIES ALONG THE BUFFALO RIVER

COMMON NAME (ENGLISH)	COMMON NAME (XHOSA)	BOTANICAL NAME	ECOLOGICAL STATUS	ECONOMIC OR CULTURAL VALUE
TREES				
Assegaai	umlahleni	*Curtisia dentata*	Common	Bark used medicinally for stomach ailments, large specimens rare due to past exploitation for furniture
Cape beech	isiqwane sehlathi	*Rapanea melanophloeos*	Common	Used medicinally for stomach disorders, used in the past for violin making, fruit eaten by birds, monkeys, bushpig
Red beech	umhluthi	*Protorhus longifolia*	Smaller trees common	Used medicinally and for furniture, fruit eaten by monkeys & birds
Black ironwood	ugqwangxe	*Olea capensis*	Common	Used in the past for furniture
Cape onionwood	ummemezi	*Cassiporea flaniganii*		medicinal
Real yellowwood	umcheya	*Podocarpus latifolius*	Protected	Past use for furniture, good ornamental
Common yellowwood	umkhoba	*Podocarpus falcatus*	Protected	Past use for furniture
Umtiza	umthiza	*Umtiza listeriana*	Protected, rare	Traditional protection against lightning
Forest boerbean	umgxam	*Schotia latifolia*	Common	Good ornamental, used for wood in the past
Buffalo thorn	umphafa	*Ziziphus mucronata*	Common	Edible fruit, medicinal use, fodder and firewood
Wild plum	ilitye	*Harpephyllum caffrum*	Relatively common	Fruit eaten by monkeys and bushpigs, used medicinally and for furniture
SHRUBS, FORBS, ETC...				
Plectranthus		*Plectranthus ambiguus*	common	Ornamental groundcover
Camomile	imphepho	*Helichrysum sp.*	common	Used medicinally for colds and various ritual purposes
Fever tea	izinziniba	*Lippia javanica*	common	Used medicinally to treat coughs and colds
Red Paintbrush		*Scadoxus puniceus*	Common	Medicinal uses as well as ornamental.
Arum lily	intebe	*Zantedeschia ethiopica*	common	Tubers eaten and plants used ornamentally and medicinally
Hard fern	inkomankomo	*Pellaea calomelanos*	common	Used medicinally to treat colds and other ailments
ALIEN PLANT SPECIES				
Black Wattle		*Acacia mearnsii*	Category 2 invader	Bark, wattle extract for tanning
Syringa		*Melia azederach*	Category 3 invader	Shade, ornamental
Red Sesbania		*Sesbania punicea*	Category 1 invader	Ornamental
Gum trees		*Eucalyptus sp.*	Category 2 invader	Timber
Lantana		*Lantana camara*	Category 1 invader	Ornamental
Balloon vine		*Cardiospermum grandiflorum*	Category 1 invader	
Blade apple		*Pereskia aculeata*		
Ink berry		*Cestrum laevigatum*		
Castor oil	umhlavuthwa	*Ricinis communis*		Medicinal

GLOSSARY

Alien species
Fauna and flora introduced intentionally or by accident into a country or (eco)region that is not part of their natural range Not all alien species are invasive or undesirable.

Anthropogenic
Caused or produced by human activities.

Aquatic biomonitoring
The monitoring of the condition of organisms in rivers, wetlands and lakes in order to gauge the overall quality of the aquatic environment.

Aquatic invertebrates
A broad collective term for the insects, larvae, crustacea and other small animal life inhabiting rivers and lakes: "invertebrate" means "lacking a backbone" and excludes amphibians, fish, birds, mammals and reptiles.

Biodiversity
The structure, composition, and functions of living organisms, and the ecological complexity of habitats in which they occur. It includes the richness, abundance, and variability of plant and animal species and communities and the ecological processes that link them with one another.

Biota
Living plants and animals.

Buffalo City
The megacity of Bhisho, East London, King William's Town and Mdantsane.

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.

Catadromous
A catadromous fish (such as the eel) lives most of its life in fresh water and breeds at sea. The larvae and juveniles then migrate upstream. After a number of years, the adults migrate downstream again to breed at sea. Their migratory life history makes these fish vulnerable to man-induced changes in river flow, because dams, weirs and low flows prevent or interrupt migration. (Anadromous fish, such as North American salmon, start off in fresh water, live in the sea, and return to rivers to breed.)

Desired health
The envisioned ecological state of the river, determined by considering the ecological importance and sensitivity of the specific river ecosystems.

Ecological sensitivity
The ability of a specific ecosystem to tolerate disturbances and to recover from certain impacts. Lack of sensitivity, however, does not always imply the ability to recover.

Ecologically sound
Maintaining the integrity of interrelations between living things and their surroundings.

Ecosystem
A natural system in which living organisms interact with their surroundings through the processes of production, consumption and decomposition: an aquatic ecosystem could range in scale from a puddle of water to a whole lake.

Environmental flow requirement (EFR)
The flow (quality and quantity) needed to maintain a river in a pre-determined state of health.

Eutrophication
The natural process of nutrient enrichment (from rocks that are gradually weathered and dissolved in runoff from the surrounding catchment). It is greatly accelerated by human impacts such as sewage and fertiliser. Abnormally high nutrient loads cause eutrophication and algal blooms. When the blooms decay and settle in a dam, the bottom layer becomes depleted of oxygen.

Fauna
The collective term for animals living in a particular area.

Flora
The collective term for plants growing in a particular area.

Geomorphology
The study of the structure of physical features of the earth especially in relation to the underlying geological structure.

Indigenous species
Fauna and flora occurring naturally in an area.

In-stream
Within the river channel.

Marine pollution
The introduction by human activities, directly or indirectly, of substances or energy into the marine environment, resulting in deleterious effects that harm living resources, are hazardous to human health, hinder marine activities including fisheries, impair the quality of seawater, and cause a reduction of amenities.

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

Riparian habitat
Refers to the habitat on both banks of the river.

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 that is distinct from the surrounding area.

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THE RHP IN THE EASTERN CAPE: ORGANISATIONAL ARRANGEMENTS

DEVELOPMENT OF THE RHP IN THE EASTERN CAPE

The Institute for Water Research (IWR) at Rhodes University spearheaded the introduction of a River Health Programme (RHP) in the Eastern Cape in 1996. The programme finally took off in 2002 with financial assistance from the national RHP. The leadership of the programme was based at Coastal and Environmental Services (CES) at the time and was handed over to the Eastern Cape Regional Office of DWAF in 2004: the University, CES and various consultants continue to provide technical strength to the provincial team. The challenge ahead will be to expand the team and to strengthen the team's capacity to take the programme forward.

EASTERN CAPE TEAM

The DWAF: Eastern Cape Regional Office leads the RHP in the province and interacts with various role players. Many new relationships are emerging in response to policy requirements for greater integration and co-operation in environmental planning and management. These developments are also affected by a rapidly changing institutional environment, with the establishment of new institutions such as catchment forums, Water User Associations and Catchment Management Agencies.

The River Health team already has strong research partners in universities and consultancies. The team plans to broaden these links to include other research bodies. The River Health team maintains an information exchange relationship with Amatola Water Board and is eager to link with local catchment forums as they develop.

Emerging partners in local government include the provincial Dept. of Health, provincial Dept. of Education, provincial DEAT and Buffalo City Municipality. The National Ports Authority (NPA) and provincial Dept. of Agriculture are potentially strong partners for the medium and long term, providing specialist perspectives.

The Eastern Cape team also regards other provincial River Health teams as potential partners (in particular their neighbours: Western Cape, Kwazulu-Natal and the Free State teams), to share experience as part of strengthening their River Health knowledge base.

STRATEGIC PARTNERSHIP EXAMPLES

THE RHP, DEPARTMENT OF HEALTH (ENVIRONMENTAL HEALTH) AND BUFFALO CITY IEMP (POLLUTION CONTROL)

The Department of Health is responsible for identifying pollution sources that may affect human health. River health results reflect a river's integrated ecological response to numerous catchment-based activities. The provincial River Health Programme, the Department of Health and the local municipality therefore need to explore meaningful linkages between their goals and systems. Already, the IDPs of both Buffalo City Municipality and Amatole District Municipality link with Buffalo River issues.

Preliminary areas where the Department of Health (Environmental Health) and Buffalo City Municipality (Pollution Control) can make use of River Health results include:

- An additional layer of information to help decide whether or not the state of the resource will impact negatively on human health.
- Strengthen confidence around cause-and-effect relationships relating to observed river health state and trends, using pollution monitoring results.
- Local government's Integrated Environmental Management Planning and Integrated Development Planning process.
- Capitalising on joint awareness programmes.

THE RHP AND NATIONAL PORTS AUTHORITY (NPA)

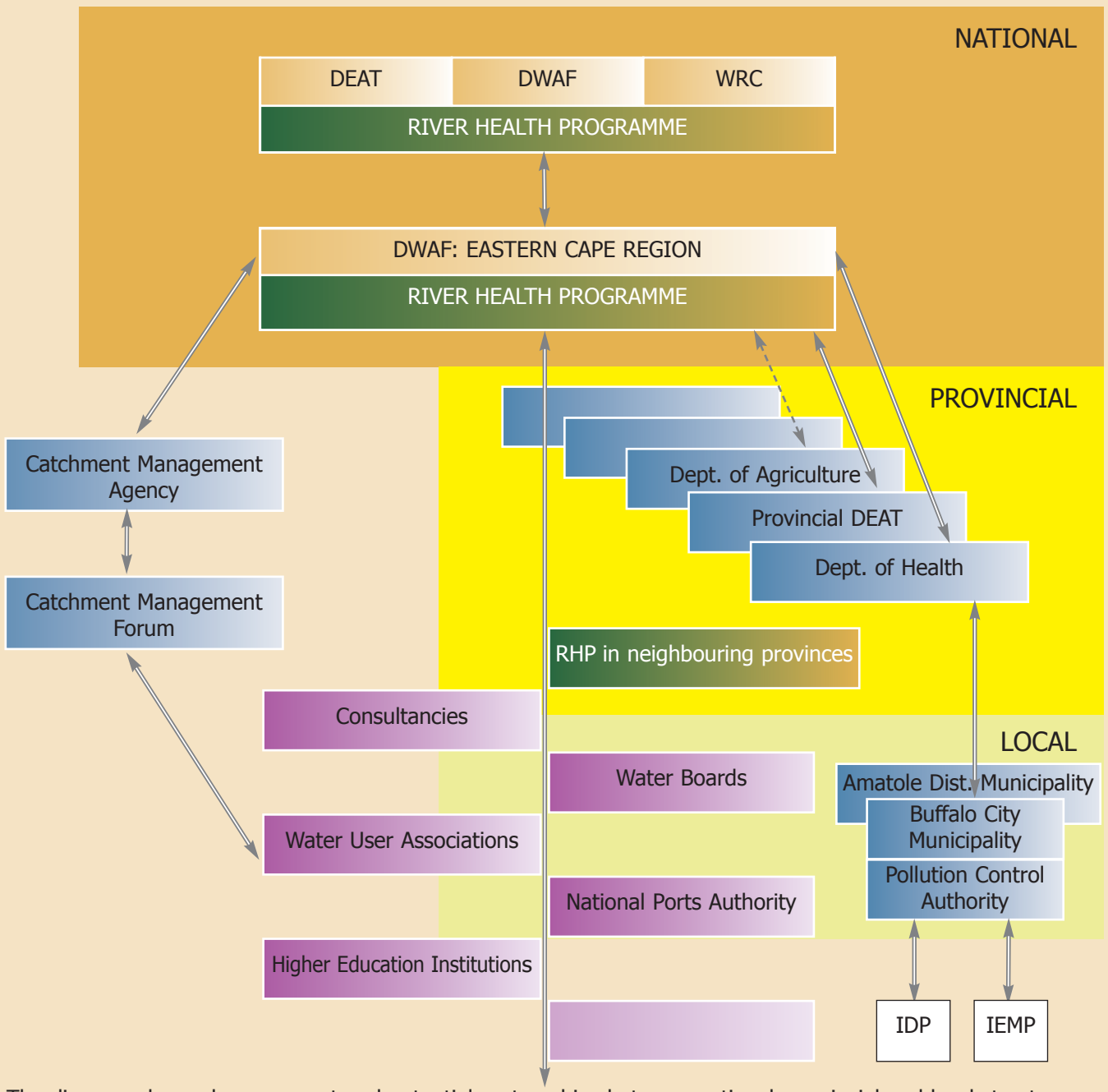
The NPA, a para-statal organisation, is responsible for the use and management of the Port of East London. Its tasks include monitoring its own impacts on the estuary and the cumulative impacts of upstream activities. Activities that would promote better co-ordination of, and understanding of, catchment-based impacts include:

- Briefing sessions where the RHP presents river health results. These would encourage discussion around the relationship between river health, estuary health and marine health.
- Establishment of a catchment forum to define a common objective for the catchment. With a common objective, participants will better understand their responsibilities towards healthier riverine, estuary and marine systems.

The link between the NPA and the Eastern Cape RHP holds much potential for DWAF: Eastern Cape Region and DEAT to show that government departments can work together in areas such as wise allocation of water use authorisations.

EASTERN CAPE RIVER HEALTH VISION

Biomonitoring programmes should exist in each river catchment of the Eastern Cape Region, inclusive of estuaries and wetlands. River health biomonitoring results would then support the sound management of all catchments, enabling them to maintain their ecological integrity, thereby ensuring long-term sustainable development.



The diagram above shows current and potential partnerships between national, provincial and local structures, as well as other relevant organisations.

The Eastern Cape River Health champion is passionate about knowledge exchange between the EC River Health team and the partners and potential partners outlined here. The team envisages collective learning to be a distinct characteristic of these partnerships, promoting an understanding of each other's goals and mandates. For example, consultants and DWAF participants can work together more closely in the technical River Health monitoring and data capture process.

Various stakeholders have shown increasing interest in the River Health Programme and by the time the second Eastern Cape SoR report is produced, the Programme should have wide support in the Eastern Cape.

CHALLENGES AND OPPORTUNITIES

OPPORTUNITIES

- Eastern Cape has a number of higher education institutions that are willing to help the RHP (Rhodes University, Institute for Water Research, Unitra, Fort Hare, University of Port Elizabeth and Border Technikon).

- Support on the ground from various organisations, stakeholders and partners, for example water boards and environmental organisations.

- Sound relationship between the Department of Water Affairs and Forestry and Provincial DEAT.

- Good signs of strong relationship between the municipalities and the private sector

- Wealth of knowledge among environmentalists around the area who are also prepared to help (Albany Museum, SAIAB, CES).

CHALLENGES

- Strengthening ties and comitments of the biomonitoring team. Make sure that SoR becomes a useful tool in water resource management decisions.

- Setting up biomonitoring protocols for all Eastern Cape rivers.

- Prioritising and budgeting for RHP activities in the DWAF Regional Office.

- Building capacity, through training sessions and courses to ensure that monitoring can be undertaken and continued.

- Expanding of the biomonitoring team so as to include the agricultural sector in general.

- Sharing river health concepts and outcomes with local communities and schools.

- Exploring the options available for public/private partnerships between DWAF, Buffalo City, consultancies and stakeholders

- Persuading communities to buy into the River Health Programme in the light of more pressing concerns, such as the recent outbreak of cholera in the Eastern Cape, the backlog in service delivery and the fact that RHP cannot be interpreted in terms of human health.

- Making research outcomes accessible to the public.

- Involving both men and women in water resource management to ensure effective development, utilisation and management of water resources.

MANAGEMENT GUIDELINES

MANAGEMENT ACTION	WHAT IT ENTAILS	RESPONSIBLE ORGANISATION
Environmental flow releases. Restore natural flow patterns.	Release of water during dry season for the existence of the aquatic ecosystems, in order to keep the system close to natural. Ensure that specifications are met.	DWAF, Amatola Water Board
Remove alien invasive vegetation and establish an alien vegetation control programme.	Physically removing plants, destroying seeds, informing the public and following up.	WfW, DWAF
Improve farming practices and land-use. Monitor and manage agricultural practices.	Strict licensing of water users to avoid over abstraction. Monitor the building of farm dams to ensure that it meets specifications. Monitor overgrazing to prevent excessive erosion. Inform the public, water users and farmers.	DWAF and Provincial Dept. of Agriculture
Upgrade sewage treatment works. Ensure a functional sewage disposal network.	Upgrade and monitor sewage treatment works. Employ and train staff. Monitor success.	Buffalo City Municipality, DWAF
Improve monitoring.	Employ the necessary people and/or get partners on board to assist with the monitoring. Proficiency testing and spot checks to be done regularly to ensure quality data.	DWAF, Buffalo City Municipality, Amatola Water Board
Manage effluent discharges and license compliance.	Establish an Environmental Business Forum for the Buffalo River East Bank/West Bank Industries to facilitate consultation with regulatory authorities (Buffalo City IEMP Unit and Department of Environmental Health) on industrial effluent management and compliance issues.	DWAF, Buffalo City Municipality
Manage indigenous forests.	Manage according to forestry management recommendations.	DWAF, National Parks Board
Rehabilitate and restore river banks that have collapsed or eroded.	Survey river banks to determine extent of collapses and eroded sections. Design and implement appropriate remedial works to halt further erosion.	Department of Agriculture, DWAF
Inform local communities about the sustainable use of plants and the detrimental effects of removing riparian vegetation.	Implement the DWAF 20/20 strategy. Educate the local communities.	DWAF, Buffalo City Municipality, Amatola Water, National Parks Boards, Department of Health, Provincial DEAT
Continue upgrading the water purification plants to cope with the growing demand for clean water.	Upgrade and monitor plants. Employ and train staff.	Buffalo City Municipality
Start managing on a catchment basis.	Establish Buffalo River Catchment Management Forum to define common objectives and monitoring strategy with relevant roleplayers.	DWAF, DEAT, Buffalo City Municipality
Implement Buffalo City Municipality IDP strategic plans relating to Buffalo River and coastal marine water pollution.	Resource allocation, meetings by regulatory authorities Public/Private sector participation workshops in order to achieve common Buffalo River water resource quality objectives.	Marine Coastal Management (DEAT), DWAF, Department of Health, National Ports Authority, Buffalo City Municipality

DEPARTMENT: WATER AFFAIRS AND FORESTRY

Water Research Commission

DEPARTMENT: ENVIRONMENTAL AFFAIRS AND TOURISM

Province of the Eastern Cape

Amatola Water - Amanzi

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