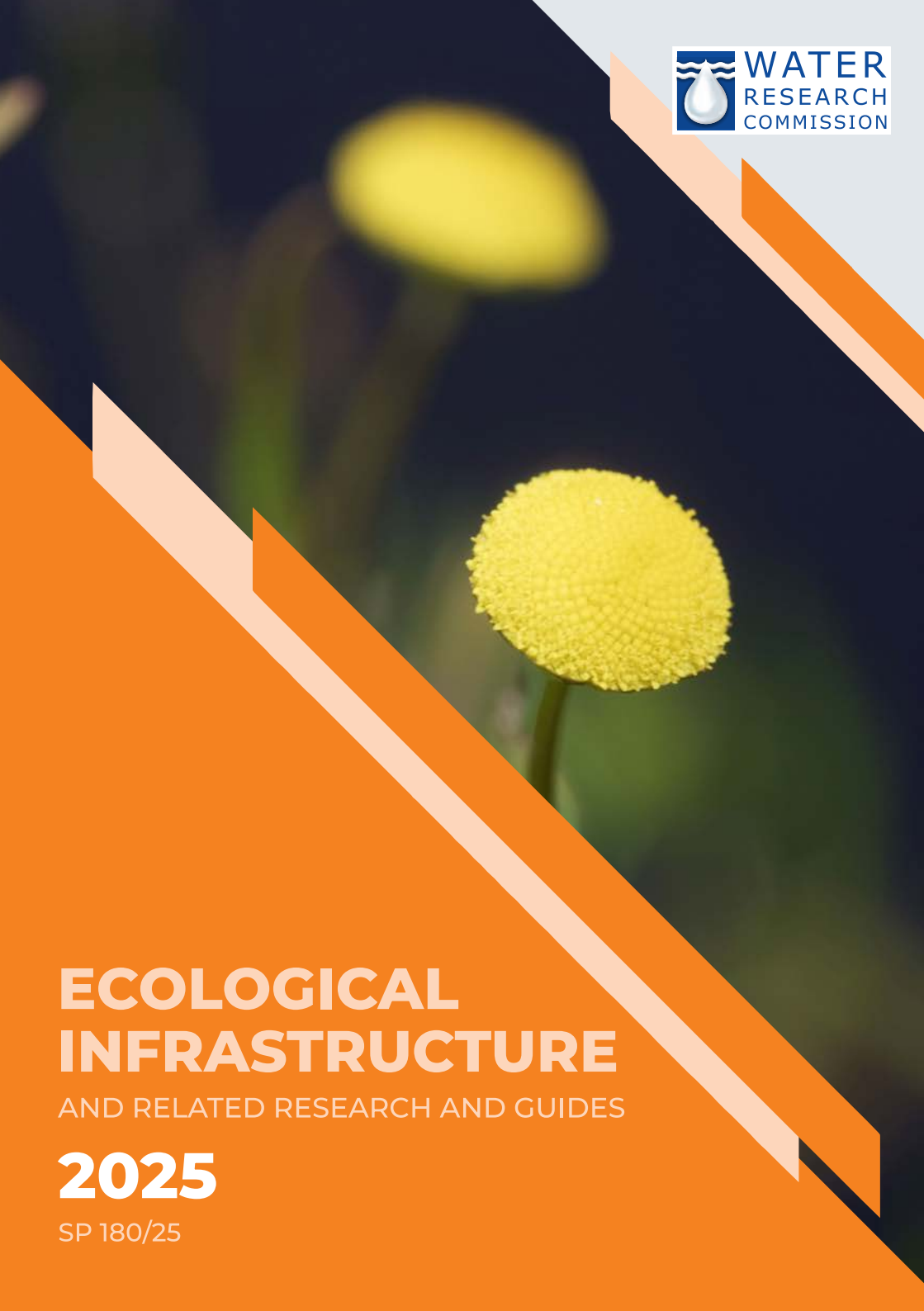

WATER RESEARCH COMMISSION

ECOLOGICAL INFRASTRUCTURE

AND RELATED RESEARCH AND GUIDES

2025

SP 180/25

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0031

SP 180/25
Printed in the Republic of South Africa

EXPANDING THE ECOLOGICAL INFRASTRUCTURE KNOWLEDGE BASE

Ecological infrastructure refers to naturally functioning ecosystems that deliver valuable services to people, such as healthy mountain catchments, rivers, wetlands, coastal dunes, and nodes and corridors of natural habitat, which together form a network of interconnected structural elements in the landscape.

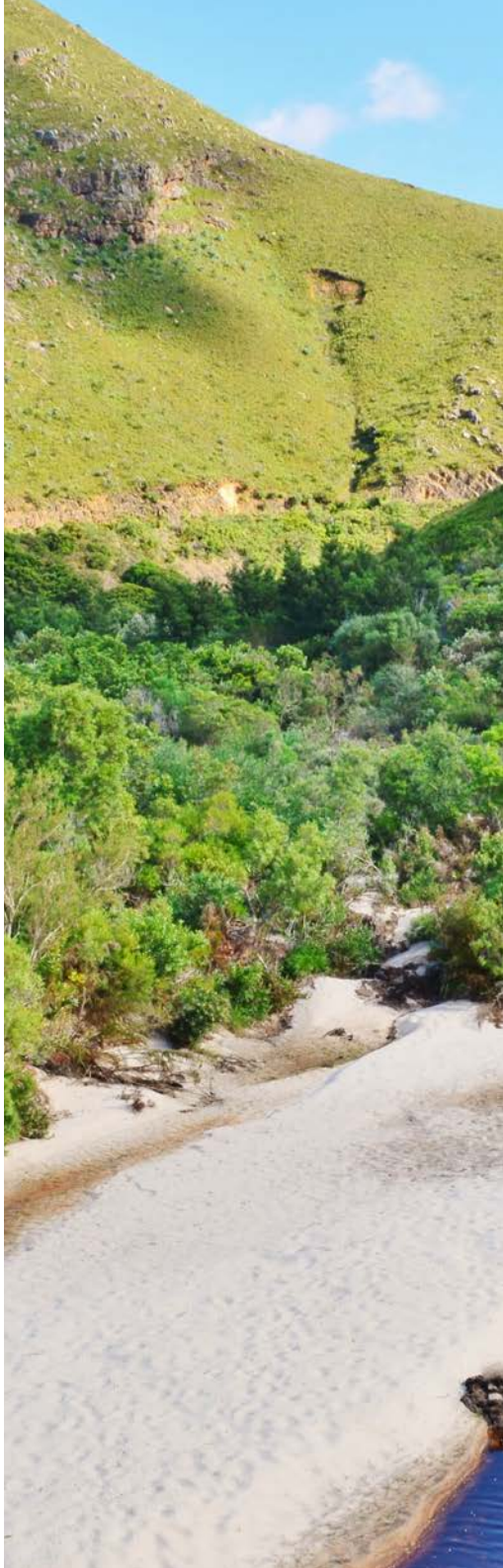
Anthropocentric actions are driving substantial changes to ecological infrastructure. These changes are affecting the resilience of social-ecological systems and their ability to absorb, adapt and recover from disturbance. This, in turn, exposes society to a wide variety of increasing risks.

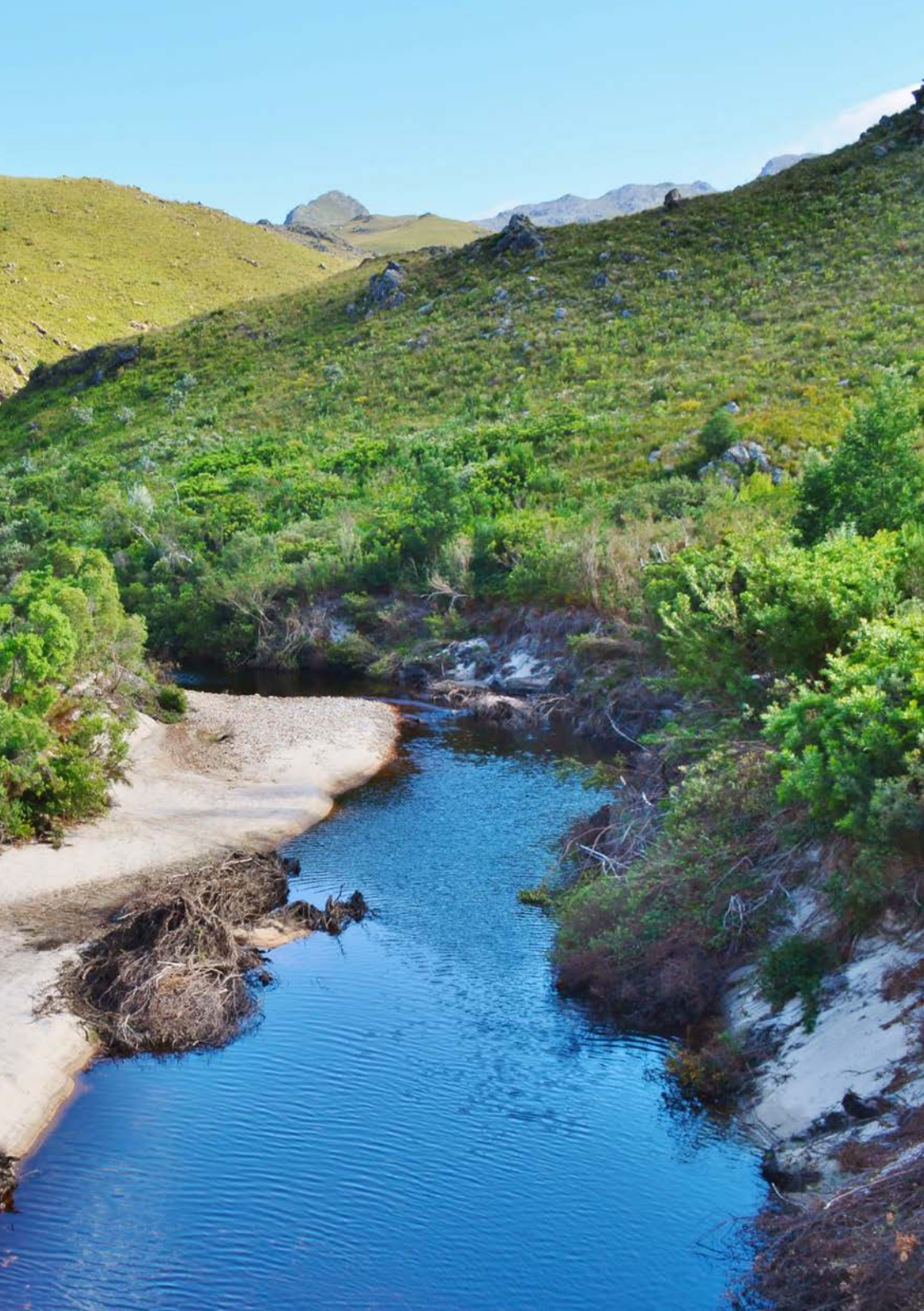
The Water Research Commission (WRC) was established in terms of the Water Research Act (Act no 34 of 1971) following a period of serious water shortage. It was deemed to be of national importance to generate new knowledge and to promote the country's water research purposefully, owing to the view held that water would be one of South Africa's most limiting factors in the twenty-first century.

Now in its fifth decade of serving South Africa, the WRC is working with its government and non-government partners to contribute new

water knowledge and solutions to South African, African and global water challenges by developing and harnessing the water research and development capability in the country. The primary functions of the WRC are to fund and steer the water research agenda in South Africa, and to effectively disseminate and communicate research findings.

Ecological infrastructure has attracted worldwide attention. In South Africa, the WRC has played a primary role in steering local research into ecological infrastructure. This booklet highlights the latest research and guides under this theme.





REPORTS AND GUIDES ACCOMPANYING THIS BOOKLET

TRANSFORMING THE FUTURE OF DURBAN BAY: STRENGTHENING SOCIO-ECOLOGICAL RESILIENCE

WRC report no. TT 945/24

The Port of Durban, situated in a deepwater estuarine bay, faces significant environmental challenges, including plastic pollution from local rivers, exacerbated by urbanisation and climate change. Over 90% of its habitats have been lost, negatively impacting water quality and biodiversity. This translates into a loss of essential ecosystem services. A socio-ecological system model allowed for a comprehensive analysis of the interconnectedness of ecosystem and socio-economic systems within Durban Bay, using a cross-disciplinary approach, fostering stakeholder collaboration and enhancing both environmental health and economic resilience, aiming for a sustainable and improved system.

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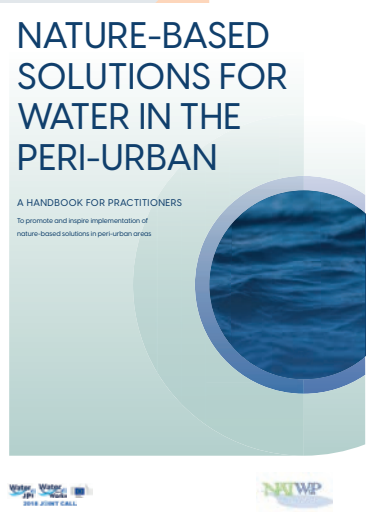

NATURE-BASED SOLUTIONS FOR WATER IN THE PERI-URBAN – A HANDBOOK FOR PRACTITIONERS

WRC report no. TT 828/20

This handbook provides guidance on the holistic consideration of nature-based solutions to support water sustainability in peri-urban areas. The reader is presented with an innovative, holistic and operational framework that has been developed through transdisciplinary processes. The framework considers all three phases of nature-based solutions, the first being the socio-spatial context assessment (research and planning phase), the second being implementation processes (implementation phase) and the third being the evaluation and results, including long-term results, unintended consequences and co-benefits (monitoring and evaluation phase). For each of these three phases, three sustainability dimensions are considered: environmental, social and economic. The framework includes a set of indicators for each dimension within each of the three phases that can be adapted to local contexts.

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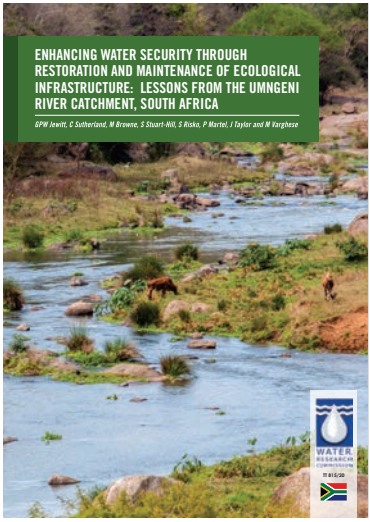

ENHANCING WATER SECURITY THROUGH RESTORATION AND MAINTENANCE OF ECOLOGICAL INFRASTRUCTURE: LESSONS FROM THE UMNGENI RIVER CATCHMENT, SOUTH AFRICA

WRC report no. TT 815/20

The uMngeni River Basin supports over six million people, providing water to South Africa's third largest regional economy, contributing approximately 11%, or about R460 billion, to national GDP. It is therefore a significant catchment that contributes to human wellbeing locally, regionally and nationally. The role of ecological infrastructure (EI) in enhancing and sustaining water and sanitation delivery in the catchment has been recognised. The overall aim of this project was to identify where and how investment into the protection and/or restoration of ecological EI can be made to produce long-term and sustainable returns in terms of water security assurance. In short, the project aimed to guide catchment managers when deciding "what to do" in the catchment to secure a more sustainable water supply, and where it should be done. This seemingly simple question encompasses complexity in time and space, and reveals the connections between different biophysical, social, political, economic and governance systems in the catchment.

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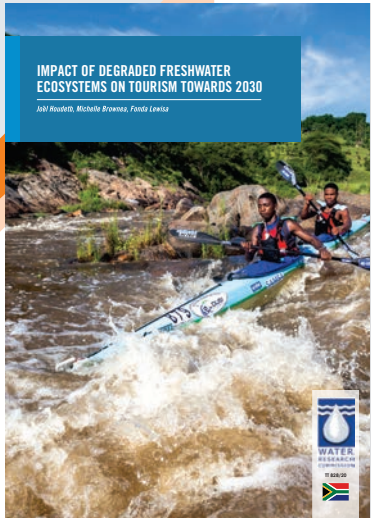

IMPACT OF DEGRADED FRESHWATER ECOSYSTEMS ON TOURISM TOWARDS 2030

WRC report no. TT 828/20

Tourism, like all economic sectors, is both directly and indirectly dependent on natural capital and the ecosystem services it provides. However, there is growing concern that ongoing degradation of natural capital, due to various global and local drivers of change, will compromise the delivery of these critical services. Securing natural capital is critical to sustaining and growing South Africa's tourism sector, while degradation of natural capital undermines the sectors potential to support economic transformation. Among others, this study aimed to demonstrate the links between natural capital, tourism and global change and the influence such links have on the development potential of the tourism sector and its contribution to generating economic benefits and supporting Small, Medium and Microenterprise (SMME) development; as well as generate recommendations regarding policy and further research needs to promote environmental management and ecological restoration through tourism.

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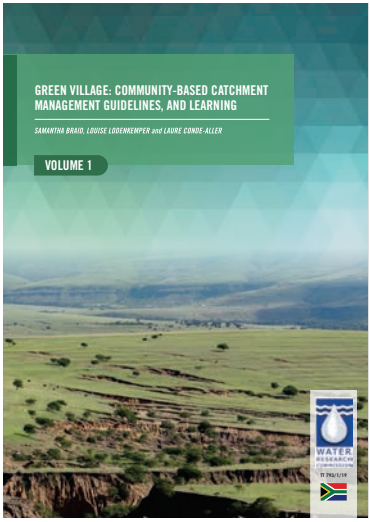

WRC GREEN VILLAGE: COMMUNITY-BASED CATCHMENT MANAGEMENT GUIDELINES

WRC report no. TT 793/1/19 and TT 793/2/19

The aim of the WRC Green Village: Community-Based Catchment Management Guidelines and Learning Project was to contextualise the household within the catchment, and build the relationship between household, the village, the community and the broader catchment. The primary objective of this project was to compile a single source reference document aimed at resource-poor farmers and rural villages, covering Green Village activities and village-scale catchment management, including natural resources management and household resource utilisation. The end result, is a 'how to' handbook in understanding, managing and rehabilitating the local environment; a comprehensive document that villagers can pick up and use without expensive consultants to support it or outside intervention. The guidelines provide information on the basics of conservation agriculture, wise use, green energy, land restoration, and rehabilitation. This was developed for use in a community context, where the 'catchment area' is both the village and its surrounds of concern.

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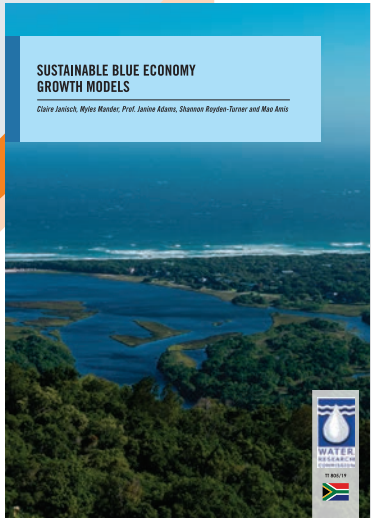

SUSTAINABLE BLUE ECONOMY GROWTH MODELS

WRC report no. TT 805/19

South Africa's coastal resources are highly valuable to the economy, but are under threat. South Africa's coastal areas generate substantial capital through their ecosystem services including tourism, recreation and fishing. The Blue Economy is defined as a sustainable and equitable oceans economy that: provides social and economic benefits for current and future generations, restores, protects and maintains the diversity, productivity, resilience, core functions, and intrinsic value of marine ecosystems – the natural capital upon which its prosperity depends, and is based on circular material flows, clean technologies and renewable energy, to secure economic and social stability over time, while keeping within the limits of one planet. This WRC project aimed to inform more sustainable and inclusive Blue Economy initiatives for South Africa, informed by new economic models as well as proven and operational SMMEs, with a particular focus on activities that improve estuary health and the lives of marginalised coastal communities.

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THE GREEN VILLAGE PROJECT – IMPROVING SOCIO-ECONOMIC CONDITIONS OF THE TSITSA RIVER CATCHMENT AND OKHOMBE COMMUNITIES THROUGH LANDSCAPE GREENING AND INTEGRATED GREEN INNOVATIONS

WRC report no. TTT 777/18

The Green Village concept is based on the premise that providing access to green technologies can improve the wellbeing of both impoverished communities and the local environment. In the context of this project, green technologies fall into two main groups: the provision of green, off-the-grid energy for household use and to promote small businesses and greening of the landscape through rehabilitation measures. The 'green concept' is becoming even more relevant as the impacts of climate change are beginning to be felt in the entire value chain, but in particular in marginalised rural areas. A growing response to this challenge points to the increasing interest in developing a Green Economy in the country as an approach to generate jobs, improve livelihoods and reduce vulnerability to the risks posed by climate change.

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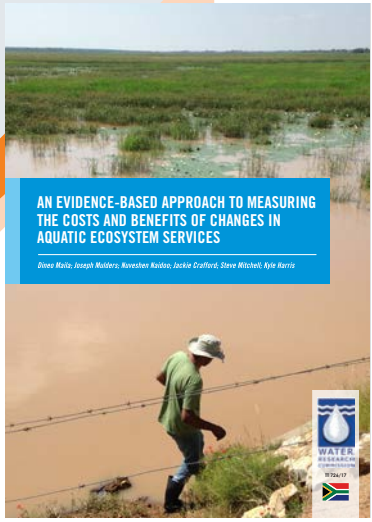

AN EVIDENCE-BASED APPROACH TO MEASURING THE COSTS AND BENEFITS OF CHANGES IN AQUATIC ECOSYSTEM SERVICES

WRC report no. TT 726/17

Human well-being and ecosystems are intimately connected. Human understanding of the value of ecosystems has matured rapidly over the past two decades. The Millennium Ecosystem Assessment's (MEA) concept of ecosystem services introduced a radical new framework for analysing the value of ecosystems, and this, combined with electronic data collection systems and rapidly increasing computing power has enabled us to improve both our understanding of the value of ecosystems as well as the accuracy of valuations. This study focused on aquatic ecosystem services produced by urban river systems. These ecosystem services are especially relevant in South Africa where rapidly increasing urbanisation puts significant pressure on scarce water resources. Among others, the study provides evidence of loss of crucial informal economy income by people living in peri-urban areas; demonstrates the significant increase in value on private property (subsequent municipal rates income) resulting from proximity to high quality ecosystems; as well as the significant and practical value of wetlands in treating water pollution.

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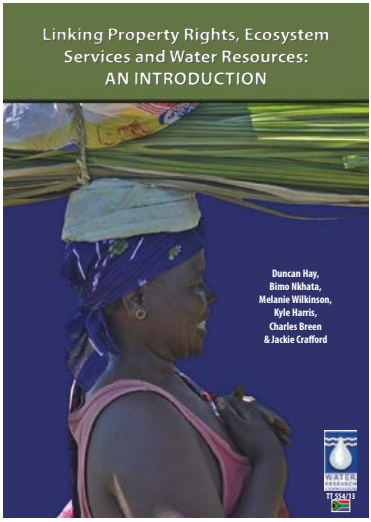

LINKING PROPERTY RIGHTS, ECOSYSTEM SERVICES AND WATER RESOURCES: AN INTRODUCTION

WRC report no. TT 554/13

As development progresses, rights to benefit from natural resources, including water resources, are regularly being compromised, often because we are either unaware of who holds rights to benefits or because we assume some rights to be of little consequence. And, it is often those who can least afford the loss of benefits – rural residents who are directly reliant on the natural resource base for survival – who endure the most serious personal consequences. This document aimed to introduce property rights, ecosystem services and associated concepts as they relate to water resource management; to illustrate their importance and relevance to the South African situation, and to do so simply in a way that promotes a broader understanding and appreciation.

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OTHER REPORTS

STRENGTHENING THE COMMUNITY OF PRACTICE WORKING ON THE INTEGRATION OF WATER-RELATED ECOLOGICAL INFRASTRUCTURE AND BUILT INFRASTRUCTURE IN SOUTH AFRICA'S WATER MANAGEMENT AREAS

This project acknowledges the many challenges facing the catchment management agencies (CMAs) and aims to develop recommendations for a sustainable community of practice that can facilitate capacity-building and learning within and across the CMAs. This investment in CMA institutions is seen as critical in supporting the effective management of water resources and the longer-term protection and management of ecological infrastructure.

WRC report no. 3182/1/24

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A FRAMEWORK TO SUPPORT INVESTMENT IN ECOLOGICAL INFRASTRUCTURE: HOW TO BRING INVESTORS INTO THE FUNDING LANDSCAPE

In the past, EI investment in South Africa was predominantly from government. However, there has been a growing need to source investment finance more broadly, including a variety of Development Finance Institutes (DFIs) and the private sector. In response to this tremendous need for EI investment, a framework has been developed to support DFIs and the private sector with investment in EI. There is no 'one size fits all' approach to developing an EI initiative that will be attractive to multiple investors. Each initiative or project requires an approach suited to its specific context. However, some key elements have been identified in the framework that, when in place, will likely increase the potential for securing investment in EI. These elements are arranged into three main sections. Volume 2 provides a review of target case studies that informed the framework.

WRC report no. 3183/1/24 (Volume 1) and 3183/2/24 (Volume 2)

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Volume 2: Click here to download

BUILDING SOCIAL AGENCY AND LOCAL CAPACITY FOR SUSTAINABLE AND EQUITABLE COMMUNITY RESOURCE MANAGEMENT

This project brought together experts from various scientific disciplines, community development practitioners and local communities, using a transdisciplinary, participatory approach in order to enhance the knowledge base towards a shared understanding of the natural resource base, climate variability, community needs and priorities, and governance decision-making and power dynamics, and co-learn for stimulating action, building social agency and improved decision-making and governance outcomes.

WRC report no. 3162/1/24

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PARTICIPATORY COURSE TO ACTIVATE ECOLOGICAL INFRASTRUCTURE FOR WATER SECURITY LEARNING NETWORKS

This project aimed to proactively design and develop a participatory course for supporting the EI4WS Change Projects in order to strengthen social learning and knowledge mediation around EI4WS financing, policy, planning and development. The course was designed to support and strengthen learning networks in the Berg-Breede and uMngeni catchments, which were demonstration catchments for the EI4WS project.

WRC report no. 3098/1/23

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SUPPORTING SOCIAL LEARNING AND KNOWLEDGE MANAGEMENT WITHIN THE ECOLOGICAL INFRASTRUCTURE FOR WATER SECURITY (EI4WS) PROJECT

The core contribution of this project, undertaken by Rhodes University, has been the articulation of a strategy-as-practice for social learning, knowledge management and mediation (SLKMM) to support the work of Component 3 in the EI4WS project. The project identified six core practices grounded in the on-going practices of investing in ecological infrastructure in living catchments.

WRC report no: 2988/1/23

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DESIGNING VIABLE STRATEGIES AND FINANCING MECHANISMS FOR SECURING HYDROLOGICAL ECOSYSTEM SERVICES IN SOUTH AFRICA: A REVIEW, INVESTIGATION AND DECISION-SUPPORT FRAMEWORK

It is increasingly recognised that addressing ecosystem degradation at scale requires significant financial investment, but that such investment also needs to be smarter in order to yield a higher return on investment. This project sought to provide strategic guidance for future initiatives to secure hydrological ecosystem services in South Africa, based on an improved understanding of the potential opportunity and viable approaches for investing in hydrological ecosystem services.

WRC report no. 3089/1/23

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NATURE-BASED SOLUTIONS FOR WATER MANAGEMENT IN THE PERI-URBAN: ECOLOGICAL, SOCIAL AND ECONOMIC NEXUS

This research aimed to move beyond the state of the art by taking a systemic perspective on nature-based solutions for water, with an emphasis on complexity, uncertainty, resilience and adaptation for different peri-urban contexts. It focused on the need to ensure the involvement of multiple stakeholders and combine multi- and transdisciplinary knowledge as key elements in the implementation and assessment of nature-based solutions as local responses with replicability potential. This is intended to make progress towards a new management paradigm for peri-urban areas.

WRC report no. 3036/1/22

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RESTORATION OF ESTUARIES USING A SOCIO-ECOLOGICAL SYSTEMS FRAMEWORK

The research project focused on the restoration of estuary water quality using the Swartkops Estuary as a case study. The objective of the project was to develop a socio-ecological systems framework for the restoration of estuaries.

WRC report no. 3061/1/22

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THE ROLE OF ECOLOGICAL INFRASTRUCTURE (EI) IN MITIGATING THE IMPACTS OF DROUGHTS

The most economically and socially valuable services that we obtain from healthy catchments are those related to hydrological services, which include water filtration/purification, seasonal flow regulation, erosion and sediment control, and habitat preservation. The approaches for investing in EI are also in line with the National Water Resource Strategy, which promotes rehabilitating strategic water ecosystems and protecting and maintaining freshwater ecosystem priority areas.

WRC report no. 2928/1/21

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STRENGTHENING INSTITUTIONAL CAPACITY AND OPERATIONAL GOVERNANCE IN CATCHMENT MANAGEMENT AGENCIES (CMA) FOR ECOLOGICAL INFRASTRUCTURE

The Ecological Infrastructure and Water Security (EI4WS) Project intends to ensure that there is effective and sustainable water resource management for improved application of policies and financial mechanisms to improve water security and integrate biodiversity in the selected pilot catchments (the Berg-Breede and the Greater uMngeni). This document will provide an overview, analysis and recommendations on the current national status of CMAs and way forward thereof.

WRC report no. 3003/1/21

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ASSESSING AQUATIC ECOSYSTEM SERVICES VALUE CHAINS AND MARKETS IN SOUTH AFRICA: SOME CASE STUDIES

We still have a limited understanding of the value chains, markets and the actual economic value of ecosystem services from aquatic ecosystems. This study focused on identifying key ecosystem services and their forward linkages, understanding how to improve market access to such services, and creating or improving the value chains in the South African context. The research is intended to help identify opportunities for improvements that benefit society more broadly.

WRC report no. 2341/1/17

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PRACTISING ADAPTIVE IWRM (INTEGRATED WATER RESOURCES MANAGEMENT) IN SOUTH AFRICA

This project recommends the use of the term Adaptive IWRM to signify the new approach and practice. The results provide clear, positive evidence that investment in further research into, and related practice of, Adaptive IWRM is essential.

WRC report no. 2248/1/18

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EXPLORING LANDSCAPE GREEN INNOVATIONS TO IMPROVE AQUATIC ECOSYSTEM SERVICES FOR THE BENEFIT OF URBAN AND PERI-URBAN COMMUNITIES: A CASE STUDY OF THE KHAYELITSHA WETLANDS

Wetlands are extremely valuable type of aquatic ecosystems that provide many benefits to society. This research focuses on the Khayelitsha wetlands system and the ecosystem services it provides to the surrounding communities in a context of socio-economic and spatial disparities in relation to upstream users of the Kuils River. The research explores the characteristics of Kuils River catchment as one cannot speak about the Khayelitsha wetlands without understanding where the water that gives it life comes from.

WRC report no. 2507/1/17

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TOWARDS BUILDING RESILIENT LANDSCAPES BY UNDERSTANDING AND LINKING SOCIAL NETWORKS AND SOCIAL CAPITAL TO ECOLOGICAL INFRASTRUCTURE

This project focused on integrated and systemic ways of approaching risk by linking the concepts of social capacity for governance and social and natural capital to ecological infrastructure in order to build resilient landscapes. The southern Cape region has in the past experienced frequent stochastic events, particularly floods and droughts. As one of the most risk-prone areas of South Africa the study focused on the Eden district.

WRC report no. 2267/1/15

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A STUDY ON HOW MBONGOLWANE WETLAND NATURAL RESOURCES CAN BENEFIT SOCIETY

Mbongolwane is a large wetland and grassland area located at the headwaters of the Amatigulu River in the KwaNtuli Tribal Authority, KwaZulu-Natal. This report was prepared as a short-term consultancy to investigate value chains and ecosystem services associated with the Mbongolwane wetland and their potential role in generating rural local economic development in rural areas.

WRC report no. KV 346/15

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THE ECONOMICS OF SUSTAINABLE AQUIFER ECOSYSTEM SERVICES: A GUIDELINE FOR THE COMPREHENSIVE VALUATION OF AQUIFERS AND GROUNDWATER

The field of research regarding groundwater ecosystems services is in its early phases of development. The objective of this study was to begin to construct a comprehensive and integrated framework for the economic assessment of groundwater resources and aquifer systems.

WRC report no. 2165/1/13

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EMBEDDING PROPERTY RIGHTS THEORY IN COOPERATIVE APPROACHES TO THE MANAGEMENT OF AQUATIC ECOSYSTEM SERVICES IN SOUTH AFRICA

In South Africa, with a growing appreciation of water scarcity, we have seen a shift away from the notion of ownership to rights of use. This shift marks explicit acknowledgement that water and the associated ecosystems need to be understood and managed as common pool resources.

WRC report no. 2073/1/13

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DETERMINING THE ECONOMIC RISK/RETURN PARAMETERS FOR DEVELOPING A MARKET FOR ECOSYSTEM GOODS AND SERVICES FOLLOWING THE RESTORATION OF NATURAL CAPITAL: A SYSTEM DYNAMICS APPROACH

This study focused on developing an evidence base for the use of economic tools/instruments in the decision-making process about the restoration. By making both the cost and the benefits of restoration explicit, the project aimed to illustrate the potential for the development of markets for ecosystem goods and services (offered by restoration). The underlying assumption was that by changing market signals, market participants will adjust their behaviour.

WRC report no. 1803/1/13

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