RIVIERSONDEREND COMPLEX

PART OF THE
CAPE FLORAL REGION PROTECTED AREAS
WORLD HERITAGE SITE
Western Cape, South Africa

Protected Area Management Plan
2021 – 2031

DATE APPROVED: [Date]
MOST RECENT UPDATE: 18 December 2020

CapeNature
Western Cape Government
Environmental Affairs and Development Planning
environment, forestry & fisheries
Department: Environment, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA
UNESCO
United Nations Educational, Scientific and Cultural Organization
World Heritage Convention

RIVIERSONDEREND COMPLEX

PART OF THE
CAPE FLORAL REGION PROTECTED AREAS
WORLD HERITAGE SITE
Western Cape, South Africa

Protected Area Management Plan 2021 – 2031

DATE APPROVED: [Date]
MOST RECENT UPDATE: 18 December 2020

CITATION
CapeNature. 2021. Riviersonderend Complex: Protected Area Management Plan 2021-2031. Internal Report, CapeNature, Cape Town.

AUTHORISATIONS

In terms of section 41(4) the Minister hereby approves part of the Protected Area Management Plan for the Riviersonderend Complex designated as World Heritage Site (See Table 2.1).

TITLE	NAME	SIGNATURE	DATE
NATIONAL MINISTER: Environment, Forestry and Fisheries	Ms Barbara Creecy		

In terms of section 41(4) the Member of Executive Council (MEC) hereby approves part of the Protected Area Management Plan for the Riviersonderend Complex designated as State Land, Provincial Nature Reserve, Forest Nature Reserves and Forest Wilderness Areas (everything not included above – see Table 2.2).

TITLE	NAME	SIGNATURE	DATE
PROVINCIAL MINISTER: Department of Environmental Affairs and Development Planning	Mr Anton Bredell		

Recommended:

TITLE	NAME	SIGNATURE	DATE
CHAIRPERSON OF THE BOARD: Western Cape Nature Conservation Board	Assoc Prof Denver Hendricks		
CHIEF EXECUTIVE OFFICER: CapeNature	Dr Razeena Omar		

Review Date: 10 years from the date of approval by the MEC and Minister.

ACKNOWLEDGEMENTS

CapeNature would like to thank everybody who participated and had input in the formulation of the Riviersonderend Complex management plan.

The Riviersonderend Complex management plan was prepared by the core reserve management planning team consisting of Vicki Hudson, Rhett Smart, and Daleen Burger. The planning team was supported with inputs from various internal and external partners. A special word of thanks to colleagues from Biodiversity Capabilities and Landscape South for their significant contributions.

Furthermore, acknowledgement is given to the many external partners and individuals that contributed to the development of this plan particularly Greyton Conservation Society, Cape Winelands Fire Protection Association and local communities from Riviersonderend and Genadendal.

The authors would also like to express their gratitude to the South African Weather Service for supplying climatic information.

Dr Andrew Turner, Restoration Ecologist: Integrated Catchments, CapeNature for technical and scientific review.

Dr David le Maitre, Principal Researcher, Council for Scientific and Industrial Research, for external review.

Cover page images courtesy of Daleen Burger and Gert Karelse.

TABLE OF CONTENTS

GLOSSARY

Derived from: Conservation Measures Partnership (CMP) 2020; SANParks.

Term	Explanation
Adaptive Management	The incorporation of a formal learning process into conservation action to reduce uncertainty in decision-making. Specifically, it is the integration of knowledge, management, and monitoring, to provide a framework to systematically and efficiently test assumptions, promote learning, and supply timely information for management to make decisions and adjust actions based on outcomes of monitoring. The Conservation Standards explicitly bring adaptive management principles into conservation practice.
Factor	A generic term for an element of a conceptual model including direct and indirect threats, opportunities, and associated stakeholders. It is often advantageous to use this generic term since many factors – for example tourism – could be both a threat and an opportunity. Also known as root causes or drivers.
Ecological/ Conservation Target	An element of biodiversity (natural target) or heritage (cultural target) of the Complex, which can be a species, habitat, ecological system, or heritage feature, that management strives to protect, and threats towards which management should strive to minimise. All focal conservation targets at a site should collectively represent the biodiversity and heritage features of concern at the site.
Human Well-being Target	In the context of a conservation project, human well-being targets focus on those components of human well-being affected by the status of conservation targets. All human well-being targets at a site should collectively represent the array of human well-being needs dependent on the conservation targets
Goal	A formal statement detailing a desired impact of a project, such as the desired future status of a target/value. A good goal meets the criteria of being linked to targets, impact oriented, measurable, time bound and specific.
Indicator	A measurable entity related to a specific information need such as the status of a target / factor, change in a threat, or progress toward an objective, or association between one or more variables. A good indicator meets the criteria of being measurable, precise, consistent, and sensitive.
Key (Ecological) Attribute	An aspect of a focal conservation target's biology or ecology that if present, define a healthy conservation target and if missing or altered, would lead to the outright loss or extreme degradation of that focal target over time.
Objective	A formal statement detailing a desired outcome of a project such as reducing a critical threat. A good objective meets the criteria of being results oriented, measurable, time limited, specific, and practical. If the project is well conceptualized and designed, realization of a project's objectives should lead to the fulfilment of the project's goals and ultimately its vision. Compare to vision and goal.
Results Chain	A visual diagram of management's theory of change. A results chain includes core assumptions and the logical sequence linking interventions to one or more targets. In scientific terms, it lays out hypothesized relationships or theories of change.
Vision	A description of the desired long-term future or ultimate condition that stakeholders see, and management strives to achieve for the Complex.
Heritage Resources	Means any place or object of cultural significance as per the Heritage Resources Act, 1999 (Act No. 25 of 1999).

Term	Explanation
Living Heritage	Means the intangible aspects of inherited culture, and may include - (a) cultural tradition; (b) oral history; (c) performance; (d) ritual; (e) popular memory; (f) skills and techniques; (g) indigenous knowledge systems; and (h) the holistic approach to nature, society and social relationships; in terms of the Heritage Resources Act, 1999 (Act No. 25 of 1999).
Situation analysis	The purpose of a situation analysis is to understand the relationships between the biological environment and the social, economic, political, and institutional systems, associated stakeholders and drivers that affect the focal targets of the Complex.

ACRONYMS

ASPT	Average Score Per Taxon
CBA	Critical Biodiversity Area
CFE	Cape Fold Ecoregion
CFRPA	Cape Floral Region Protected Areas
DCA	Damage Causing Animal
DEFF	Department of Environment, Forestry and Fisheries
EPWP	Expanded Public Works Programme
FEPA	Freshwater Ecosystem Priority Area
FPA	Fire Protection Association
ICM	Integrated Catchment Management
IDP	Integrated Development Plan
IUCN	International Union for Conservation of Nature
KEA	Key Ecological Attribute
MEC	Member of Executive Council
METT-SA	Management Effectiveness Tracking Tool - South Africa
MTEF	Medium Term Expenditure Framework
NBA	National Biodiversity Assessment
NBAL	Natural Biological Alien Land Cover Attribute
NEMA	National Environmental Management Act
NEM: BA	National Environmental Management: Biodiversity Act
NEM: PAA	National Environmental Management: Protected Areas Act
NFEPA	National Freshwater Ecosystem Priority Area
NPAES	National Protected Area Expansion Strategy
NRM	Natural Resource Management
NVFFA	National Veld and Forest Fire Act
PAAC	Protected Area Advisory Committee
SANBI	South Africa National Biodiversity Institute
SAPS	South African Police Service
SASS	South African Scoring System
SDF	Spatial Development Framework
SG	Surveyor-General
SMME	Small, Medium and Micro-sized Enterprise
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WCBSP	Western Cape Biodiversity Spatial Plan
WCPAES	Western Cape Protected Area Expansion Strategy

LIST OF FIGURES

LIST OF TABLES

LIST OF MAPS (Appendix 1)

EXECUTIVE SUMMARY

In compliance with the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) and Chapter 4 of the World Heritage Convention Act, 1999 (Act No. 49 of 1999), the management authority of a protected area is required to develop management plans for each of its protected areas.

Both the national minister and Member of Executive Council (MEC) in a particular province has concurrent jurisdiction to approve a management plan for a protected area submitted under section 39(2) of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003).

In developing the management plan for the Riviersonderend Complex, CapeNature as the management authority strives to establish biodiversity conservation as a foundation for a sustainable economy, providing ecosystem services, access and opportunities for all.

An Overview of the Riviersonderend Complex

The Riviersonderend Complex is approximately 28 580 ha in extent and comprises of the Riviersonderend State Forest and State Land and the Vrolijkheid Provincial Reserve, which are jointly managed by CapeNature from the offices at Vrolijkheid. The Riviersonderend State Forest and State Land is additionally part of the proposed extension to the Cape Floral Region Protected Areas World Heritage Site, which will add significantly to the initial area which was inscribed by United Nations Educational, Scientific and Cultural Organisation (UNESCO) in 2004. The Riviersonderend section is located along the boundary between the Cape Winelands and Overberg District Municipalities between the towns of Villiersdorp in the west and Riviersonderend town in the east, with Vrolijkheid located just to the north of this near the town of McGregor.

The Riviersonderend State Forest and State Land is located within the Riviersonderend Mountains consisting of two portions stretching across the mountain range and is surrounded by the Riviersonderend Mountain Catchment Area. It is located within a winter rainfall area, with the mountains receiving higher rainfall than the adjacent low-lying areas and decreasing in an easterly direction. The Cape Floral Region Protected Areas World Heritage Site was designated due to the exceptional biodiversity present, in particular plants, with the CFR encompassing the Fynbos Biome defined as one of the 25 internationally recognised biodiversity hotspots. The vegetation covering most of the area comprises two sandstone fynbos vegetation types, which are characterised by high diversity with a number of endemic plant species, many of which are threatened due to the narrow distribution and sensitivity to invasive alien plants and inappropriate fire regime. There are additionally fauna species which are endemic, at both the scale of Riviersonderend and the broader CFR. The mountain range forms an important catchment for the Breede River, with the watercourses on the northern slopes draining directly into the Breede River and on the southern slopes into the Sonderend River, one of the main tributaries of the Breede River. Fire is a major ecological driver in the system and plays an important role in the regeneration of the constituent plant species. Integrated catchment management encompassing both fire and aliens is therefore essential to maintain biodiversity and provision of ecosystem services, in particular water generated by the catchments and

the projects associated with these actions provide for significant socio-economic and job creation benefits to the surrounding communities.

The Vrolijkheid Provincial Reserve is located in the foothills to the north of the Riviersonderend Mountains within the Breede River Valley. It receives less rainfall than Riviersonderend as it is located within a rain shadow and is within a warmer climate with summer temperatures frequently over 40°C. Vrolijkheid is located within the Succulent Karoo biome although the vegetation is transitional to Renosterveld. The Succulent Karoo is also one of the 25 internationally recognised biodiversity hotspots. Vrolijkheid contains a number of threatened plant species and healthy naturally occurring faunal populations and forms an important link in the upland-lowland landscape corridor linking the Riviersonderend Mountains to the Breede River and potentially to the Langeberg Mountains. The Breede Valley is agriculturally productive, and irrigation permits expansion of cultivated lands which presents a threat to the lowland vegetation and habitat connectivity, so protected area expansion efforts are focused on consolidating the corridors. Landscape corridors which traverse climatic and edaphic gradients are considered to be essential in mitigating the long-term impacts of climate change on ecosystem integrity and functionality, which is the subject of monitoring projects at Jonaskop in the Riviersonderend Mountain Range.

Planning, Policy, Implementation and Review

To develop this management plan CapeNature applied the Conservation Standards. The Conservation Standards is a Strategic Adaptive Management framework that is robust, yet flexible, multi-disciplinary in approach, and inclusive of internal and external stakeholders, as well as the public at large. It enables management teams to develop effective conservation plans, based on the best available traditional, expert and scientific knowledge. Furthermore, it promotes stakeholder and public engagement throughout the planning and implementation phase of the management plan. Key to this process is identifying the conservation targets and human wellbeing values representative of the protected area, determining what state they are in, and what threats they face. This forms the basis for establishing clear goals, strategies and objectives that are time bound.

This management plan provides the basis for the management, development and operation of the Riviersonderend Complex over a timeframe of 10 years. The implementation of the management plan is subject to legislation, regulations, policies and guidelines to ensure and promote sound financial and biodiversity management, effective compliance, safety, good neighbour relations and to promote sustainable access to the reserve.

Regular reviews are a fundamental step in the pursuing the achievement of conservation outcomes. Strategic Adaptive Management integrates planning, management, and monitoring, and is used to systematically evaluate results, thus enabling management to “change direction” when required. Key to this process is the sharing of results, respectfully, honestly and transparently to facilitate learning through critical appraisal of conservation efforts. CapeNature uses an internationally recognised review system - the Management Effectiveness Tracking Tool for South Africa, adopted by the National Department of Environment, Forestry and Fisheries (DEFF), to assess the management effectiveness of all of its protected areas at a

strategic level. Additionally, mechanisms for monitoring and evaluation are built into each aspect highlighted in the strategic plan.

Purpose, Vision and Desired State

CapeNature manages the Riviersonderend Complex in accordance with its organisational vision, and in agreement with the vision, goals and strategies derived through the planning process. The vision of the reserve is:

"The collaborative conservation and protection of ecosystem services, biodiversity, connectivity, and diverse cultural heritage which promotes the facilitation of benefit sharing and the provision of sustainable opportunities for current and future generations in the face of change."

Protected area targets include healthy catchments, providing ecosystem services and human well-being benefits. Five focal conservation targets that incorporate a number of nested aspects have been selected for the Riviersonderend Complex, these are:

1) Fynbos Mosaic 2) Succulent Karoo 3) Freshwater Ecosystems 4) Landscape Connectivity 5) Diverse Cultural Heritage.

As the public entity responsible for biodiversity conservation in the Western Cape Province, CapeNature delivers a suite of core services to the public in support of the following outcomes: resilient ecosystems; the promotion of local economic development, job creation and skills development; growing diversified nature-based revenue streams; access to environmental education, advocacy and education, and access to natural and cultural heritage. Six focal human well-being values have been identified for the Riviersonderend Complex. These include:

1) Nature-based Economic & Tourism Opportunities 2) Social Upliftment 3) Physical & Spiritual Health 4) Diverse Cultural Identity 5) Environmental Education & Awareness 6) Sustainable Natural Resource Use.

Ten goals have been formulated to maintain or enhance the focal conservation targets and human well-being values of the Riviersonderend Complex. An asterisk * indicates the availability of detailed information in Section 5.

1. By 2031, the Fynbos mosaic in the Riviersonderend Complex has an ecologically healthy fire regime* and comprises 80% indigenous species and reseeding Protea species are represented as per historic data*.
2. By 2031, the Succulent Karoo vegetation mosaic within the Riviersonderend Complex will consist of 50-79% of representative species which will have a stable population size, a perennial vegetation cover of >50%, and a fair* soil health.
3. By 2031, the wetland buffer and riparian zones* of the Riviersonderend Complex will have 80% natural vegetation.
4. By 2031, the upper and middle river reaches in the Riviersonderend Complex support macro invertebrate species communities representing an average score per taxon (ASPT) of 6-8 and with >50% of expected fish species present in at least two age classes and have a natural flow regime*.

5. By 2031, the present ecological state of the Riviersonderend Complex wetland ecosystems will be in a natural (A)* to largely natural (B)* condition.
6. By 2031, the key prioritised sites within the Riviersonderend Complex zone of influence have been secured for conservation, encompassing both the fynbos and succulent karoo vegetation mosaics.
7. By 2031, male, female and juvenile ecotypical antelope species will be present within their natural distribution range throughout the Riviersonderend Complex and landscape corridors.
8. By 2031, all anthropogenic disturbances to heritage features are limited to maintain current conditions within the Riviersonderend Complex.
9. By 2031, local communities have a comprehensive understanding of the economic value of biodiversity of the Riviersonderend Complex and utilise the area in a sustainable manner.
10. By 2030, the Riviersonderend Complex will provide and support socio-economic opportunities through partnerships with stakeholders, enabling surrounding communities to take part in economic activities created by tourism, ecological actions and development strategies in the Riviersonderend Complex.

Threats

Threats and contributing factors that degrade or destroy the Riviersonderend Complex focal conservation targets were identified and unpacked in a conceptual model to illustrate the current conservation situation and to guide the formulation of mitigating strategies. The following six threats had a high and medium impact on the focal conservation targets of the Complex:

1) Protected Area Fragmentation 2) Climate Change 3) Vandalism 4) Invasive Alien Plants 5) Inappropriate Fire Regime 6) Detrimental Agricultural Activities.

In order to assist the Riviersonderend Complex to mitigate and manage threats and contributing factors effectively, both inside and outside the reserve boundaries, the reserve will incorporate spatial planning tools which include the Sensitivity, Zonation and zone of influence.

Strategic Plan

A thorough analysis of the Riviersonderend Complex's conservation situation, inclusive of the biological, social, economic, cultural and institutional systems that affect the protected area's focal conservation targets, formed the basis for developing conservation strategies and action plans. The aim was to identify opportunities and strategic points where intervention is feasible and likely to have the greatest positive impact towards achieving goals. CapeNature will lead the implementation of the management plan, although achieving the reserve's vision requires coordinated effort between various key external stakeholders. Nine key strategies have been identified to ensure the effective conservation of the Riviersonderend Complex, these are:

Strategy 1: Enhance the implementation efficiency of invasive alien plant eradication by the integration of fire and invasive alien plant management in the Riviersonderend Complex.

Strategy 2: Implement an integrated fire management strategy to maintain an acceptable fire regime in the Riviersonderend Complex in consultation with stakeholders and partners in order to support management decisions with regards to fire and invasive alien vegetation management.

Strategy 3: Improve and restore ecological function of the identified degraded areas within the Vrolijkheid Provincial Reserve.

Strategy 4: Enhance partnerships to increase collaboration, legislative compliance and best practice in terrestrial and aquatic ecosystems within the Riviersonderend Complex and its associated zone of influence.

Strategy 5: Develop and implement an integrated environmental education and awareness programme aimed at neighbours, natural resource users, learner groups and visitors, in collaboration with partners, to nurture respect and care for the natural, cultural and historic values of the Riviersonderend Complex.

Strategy 6: Re-evaluate the expansion domain of the Riviersonderend Complex with partners, to facilitate protected area expansion, consolidation and connectivity through stewardship and other protected area expansion methodologies.

Strategy 7: Ensure maintenance and minimise degradation of heritage resources within the Riviersonderend Complex.

Strategy 8: Facilitate sustainable, responsible development, access and activities within the Riviersonderend Complex in collaboration with relevant internal and external partners and stakeholders.

Strategy 9: Contribute to economic and social development by providing job and training opportunities to Expanded Public Works Programme, contract, and small, medium and micro-sized enterprise (SMME) staff.

1 INTRODUCTION

In working towards CapeNature's vision of conserving nature for a sustainable future, CapeNature's protected area management, in accordance with the purpose of the protected area, strives to:

- Conserve and represent natural habitats and indigenous biodiversity including threatened species for their scientific and conservation value in the Western Cape Province;
- Conserve representative samples of significant ongoing ecological processes in the evolution and development of ecosystems and communities of plants and animals;
- Provide ecosystem services that benefit people of the Western Cape;
- Manage protected areas effectively and efficiently, including the interrelationships between biophysical, social and economic environments;
- Ensure that protected area planning and management is integrated and participatory; and
- Provide for sustainable use and equitable access.

The management plan is a Strategic Adaptive Management framework for the protected area, guided by the Open Standards for the Practice of Conservation (hereafter referred to as the Conservation Standards) (CMP 2020) adaptive management paradigm. The Conservation Standards are dependent upon, and promote, stakeholder engagement and participatory planning in the development of the plan. The framework further requires the incorporation of mechanisms to facilitate stakeholder engagement and participation during operationalisation of the plan.

The Riviersonderend Complex protected area management plan serves as a reference for the management and development of the Complex in its current and envisaged future state. It directs management at all levels. The management plan addresses:

- The mandate, human capacity and financial resources that are required to meet goals and objectives based on the condition of natural and cultural targets, and core service areas requiring a focused effort;
- The delivery of socio-economic benefits to neighbouring communities;
- Flexibility of service delivery that encourages innovation and involvement by a wide range of government, community and non-government sectors;
- Performance indicators and accountability measures that provides for regular review and adaptive management.

2 LEGAL STATUS AND BACKGROUND

This section provides a record of the legal status of the protected area, as well as its description, location and includes any areas designated by South Africa in terms of international agreements. Furthermore, it also provides an overview of the biophysical, biodiversity, heritage and socio-economic context.

2.1 Legal Status

2.1.1 Name and legal designations

The Riviersonderend Complex comprises the Riviersonderend State Forest, State Land and Vrolijkheid Provincial Reserve in accordance with the terminology as indicated in the declarations according to the Nature Conservation Ordinance (Ordinance 19 of 1974) and National Forest Act, 1998 (Act No. 84 of 1998). There have not been any proclamations for the Complex since the National Environmental Management: Protected Areas Act (NEM: PAA), 2003 (Act No. 57 of 2003) was promulgated, however this Act takes precedence over the former mentioned legislation with regards to protected areas, and nature reserves are therefore considered to be nature reserves in terms of NEM:PAA. The two components of the Complex are reflected in the Protected Areas Register held by the Department of Environment, Forestry and Fisheries (DEFF) as described above.

The Riviersonderend State Forest and State Land, forms part of the 2015 extension to the Cape Floristic Region Protected Areas (CFRPA) World Heritage Site, inscribed by United Nations Educational, Scientific and Cultural Organisation (UNESCO) as, but not yet declared. According to NEM: PAA, World Heritage Sites are deemed to be one of the kinds of protected areas in South Africa, however World Heritage Sites are governed by the World Heritage Convention Act, 1999 (Act No. 49 of 1999).

A full list of the declarations and legal status of land appears in Table 2.1.

Table 2.1: Land parcels and status that make up the Riviersonderend Complex.

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proc. Date	Proc. No.	Govt. Gazette	Status
Riviersonderend State Land: Land parcels that comprise World Heritage Sites inscribed by UNESCO in 2015, but not yet proclaimed as World Heritage Sites											
G24/1955	Uitkyk Suid	121	Portion 0	462.86	Caledon	C01300000000012100000	Republic of South Africa	16 Aug. 1940	1336/1940	2800	State Forest
T33829/1980	Vooruitzigt	175	Portion 1	376.14	Caledon	C01300000000017500001	Republic of South Africa	N/A	N/A	N/A	State Land
T15621/1959	Big Tiger Berg	184	Portion 1	454.69	Caledon	C01300000000018400001	Republic of South Africa	N/A	N/A	N/A	State Land
T24/1955	Uitkyk Noord	143	Portion 0	275.82	Caledon	C01300000000014300000	Republic of South Africa	7 Dec. 1979	2753/1979	6764	State Forest
T7487/1932	Jonas Plaats	145	Portion 0	1034.30	Robertson	C06500000000014500000	Republic of South Africa	7 Dec. 1979	2753/1979	6764	State Forest
T24914/2010	Bye Nest	153	Portion 0	427.1	Caledon	C01300000000015300000	Republic of South Africa	N/A	N/A	N/A	State Land
Unregistered State Land	Zonder End Forest Reserve	168	Portion 0	1100.15	Caledon	C01300000000016800000	Republic of South Africa	N/A	N/A	N/A	State Land
Unregistered State Land	Farm 176	176	Portion 0	933.96	Robertson	C06500000000017600000	Republic of South Africa	N/A	N/A	N/A	State Land
Unregistered State Land	Farm 185	185	Portion 0	2778.91	Robertson	C06500000000018500000	Republic of South Africa	N/A	N/A	N/A	State Land
Unregistered State Land	Bosch Kloof	188	Portion 0	324.12	Robertson	C06500000000018800000	Republic of South Africa	N/A	N/A	N/A	State Land
T25713/1974	Donkerhoek	64	Portion 1	102.49	Caledon	C01300000000006400001	Republic of South Africa	N/A	N/A	N/A	State Land
G214/1952	Oliphants Berg	29	Portion 0	1593.99	Caledon	C01300000000002900000	Republic of South Africa	19 Nov. 1943	2086/1943	3270	State Forest
G214/1952	Krom Draai	30	Portion 0	1366.04	Caledon	C01300000000003000000	Republic of South Africa	19 Nov. 1943	2086/1943	3270	State Forest

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proc. Date	Proc. No.	Govt. Gazette	Status
G214/1952	Lange Berg	31	Portion 0	2063.34	Caledon	C01300000000003100000	Republic of South Africa	19 Nov. 1943	2086/1943	3270	State Forest
T24914/2010	Gelge Berg	34	Portion 0	762.5	Caledon	C01300000000003400000	Republic of South Africa	7 Dec. 1979	2753/1979	6764	State Forest
Unregistered State Land	Gelge Berg	35	Portion 0	40.41	Caledon	C01300000000003500000	Republic of South Africa	N/A	N/A	N/A	State Land
T24914/2010	Zilvermyn	36	Portion 0	763.73	Caledon	C01300000000003600000	Republic of South Africa	7 Dec. 1979	2753/1979	6764	State Forest
T7682/1970	Farm 144	144	Portion 4	177.85	Caledon	C01300000000014400004	Republic of South Africa	N/A	N/A	N/A	State Land
Unregistered State Land	Dassiedale	401	Portion 0	1651.97	Swellendam	C07300000000040100000	Republic of South Africa	N/A	N/A	N/A	State Land
T38020/1970	Molen Rivier	49	Portion 0	418.04	Caledon	C01300000000004900000	Republic of South Africa	28 Oct. 1977	2193/1977	5789	State Forest
T7425/2017	Watervals Kloof	588	Portion 0	4437.74	Worcester	C08500000000058600000	Provincial Government of Western Cape	07 Dec. 1979	2753/1979	6764	State Forest
G214/1952	Farm 780	780	Remainder	2193.67	Caledon	C01300000000078000000	Republic of South Africa	19 Nov. 1943	2086/1943	3270	State Forest
G214/1952	Farm 780	780	Remainder	81.78	Caledon	C01300000000078000000	Republic of South Africa	19 Nov. 1943	2086/1943	3270	State Forest
G214/1952	Voorste Randt	50	Portion 0	241.57	Caledon	C01300000000005000000	Republic of South Africa	19 Nov. 1943	2086/1943	3270	State Forest
T18194/1959	Oliphants Kloof	185	Remainder	921.67	Caledon	C01300000000018500000	Provincial Government of Western Cape	N/A	N/A	N/A	State Land
T7269/1918	Big Tiger Berg	184	Remainder	713.53	Caledon	C01300000000018400000	Provincial Government of Western Cape	N/A	N/A	N/A	State Land

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proc. Date	Proc. No.	Govt. Gazette	Status
T14993/1973	Donkerhoek	64	Remainder	386.82	Caledon	C01300000000006400000	Republic of South Africa	N/A	N/A	N/A	State Land
Unregistered	Oliphants Bosch	176	Remainder	530.21	Caledon	C01300000000017600000	Republic of South Africa	7 Dec. 1979	2753/1979	6764	State Forest
Vrolijkheid Provincial Reserve: Land parcels that do not comprise World Heritage Sites											
T575/1958	Schoongezicht	131	Portion 0	414.75	Robertson	C06500000000013100000	Provincial Government of Western Cape	10 Dec. 1976	409/1976	3920	Provincial Nature Reserve
T575/1958	Vrolykheid	135	Portion 5	11.25	Robertson	C06500000000013500005	Provincial Government of Western Cape	10 Dec. 1976	409/1976	3920	Provincial Nature Reserve
T575/1958	Vrolykheid	135	Portion 5	122.47	Robertson	C06500000000013500005	Provincial Government of Western Cape	10 Dec. 1976	409/1976	3920	Provincial Nature Reserve
T575/1958	Vrolykheid	135	Portion 31	20.42	Robertson	C06500000000013500031	Provincial Government of Western Cape	10 Dec. 1976	409/1976	3920	Provincial Nature Reserve
T575/1958	Vrolykheid	135	Portion 32	2.78	Robertson	C06500000000013500032	Provincial Government of Western Cape	10 Dec. 1976	409/1976	3920	Provincial Nature Reserve
T4501/1961	Vrolykheid	135	Portion 37	28.92	Robertson	C06500000000013500037	Republic of South Africa	10 Dec. 1976	409/1976	3920	Provincial Nature Reserve
T6807/1991	Vrolykheid	135	Portion 46	200.0	Robertson	C06500000000013500046	Provincial Government of Western Cape	10 Dec. 1976	409/1976	3920	Provincial Nature Reserve
T18258/1957	Doorn Kloof	163	Remainder	966.77	Robertson	C06500000000016300000	Republic of South Africa	10 Dec. 1976	409/1976	3920	Provincial Nature Reserve

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proc. Date	Proc. No.	Govt. Gazette	Status
T18258/1957	Doorn Kloof	163	Portion 5	131.68	Robertson	C06500000000016300005	Provincial Government of Western Cape	10 Dec. 1976	409/1976	3920	Provincial Nature Reserve
T18258/1957	Doorn Kloof	163	Portion 6	65.63	Robertson	C06500000000016300006	Provincial Government of Western Cape	10 Dec. 1976	409/1976	3920	Provincial Nature Reserve

2.1.2 Contractual agreements

There are no contractual land agreements with any private landowners, non-government organizations or Government Departments, for the Riviersonderend Complex.

2.1.3 Location, extent and highest point

The Riviersonderend Complex is situated in the Western Cape, South Africa and is approximately 28 580 ha in extent and situated between latitudes 33° 54' S and 34° 08' S, and longitudes 19° 18' E and 20° 00' E. The inland, mountainous section (Riviersonderend State Land) runs along approximately 66 km east-west gradient and is surrounded by the towns of Villiersdorp (west), Stormsvlei (east), and Genadendal, Greyton and Riviersonderend along the south. To the north of the mountain lies the town of McGregor, which is the closest town to the Vrolijkheid Provincial Reserve, with the town of Robertson to the north.

The Riviersonderend State Land is bordered by the R43 to the west near Villiersdorp, R406 to the south between Genadendal and Riviersonderend, connecting to the N2 on the east to Stormsvlei. The Riviersonderend State Land is accessible via the N2 and R406 on the south side, as well as the R60 and Langverwagten road on the northern side. The Vrolijkheid Provincial Reserve can be accessed via the R43 from Villliersdorp (west), to the R60 and Langverwagten road, as well as via the R317 from Stormsvlei in the east.

Pilaarkop, situated in the eastern section of the Riviersonderend State Land, is the highest peak in the Riviersonderend Complex at 1 653.7 metres above sea level, with Jonaskop, situated in the western section, being the second highest peak at 1646.0 metres above sea level. The highest point in the Vrolijkheid Provincial Reserve is Witkrans at 635.4 metres above sea level (Heard *et al*. 2000a, 2000b).

The location and extent of the Riviersonderend Complex is illustrated in Appendix 1 Map 1.

2.1.4 Municipal jurisdiction

The Riviersonderend Complex is situated within the following district and local municipal boundaries (Appendix 1, Map1):

- Cape Winelands District Municipality:
  - Breede Valley Local Municipality
  - Langeberg Local Municipality

- Overberg District Municipality:
  - Theewaterskloof Municipality

2.1.5 International, national and provincial listings

UNESCO World Heritage Site:

The Riviersonderend State Land is part of the proposed extension of the CFRPA World Heritage Site. As described above, World Heritage Sites are governed by the World Heritage Convention Act, 1999 (Act No. 49 of 1999) The existing CFRPA World

Heritage Site inscribed in July 2004 comprises a serial property of eight initial protected areas with thirteen in the latest extension, covering a total area of approximately 557 584 ha. The extension nomination for the inscribed CFRPA proposes the inclusion of a further 163 components of 577 902.27 ha of protected areas into the inscribed CFRPA (IVC 2015).

The outstanding universal value of the CFRPA World Heritage Site, including both the existing inscribed and proposed extension can be briefly summarised as follows (IVC 2015): “The CFR is a highly distinctive phytogeographic unit which is regarded as one of the six Floral Kingdoms of the world and is by far the smallest and relatively the most diverse. It is also recognised as the worlds “hottest hotspot” for its diversity of endemic plants and contains outstanding examples of significant ongoing ecological, biological and evolutionary processes. It also has some of the most important natural habitats for *in-situ* conservation of biological diversity.” The criteria for World Heritage Site status which the CFRPA extension meets are (IVC 2015):

- Criterion (ix): Outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial ecosystems and communities of plants and animals; and
- Criterion (x): Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science and conservation.

In terms of the justification for the inscription of the Riviersonderend State Land as part of the CFRPA World Heritage Site extension, the same overarching justification for the extension is relevant, as described above. It is further noted that the Riviersonderend State Land’s exceptional floral diversity is due to the physical and climatic diversity in this area of transition between montane and lowland, mesic and semi-arid habitats, and expanding the inscribed CFRPA to include Riviersonderend State Land will increase and improve the overall size, connectivity and integrity of the inscribed CFRPA components in the face of global climate change. The mountain catchments of the Riviersonderend Mountains provide water to the Overberg and Boland regions, which are important economic and agricultural areas in the Western Cape, feeding into the Riviersonderend River which is the main tributary of the Breede River (IVC 2015).

There are no UNESCO Biosphere Reserves or Ramsar Sites located within the boundaries of the Complex.

2.2 Biophysical Description

2.2.1 Climate

The Vrolijkheid Provincial Reserve falls within the winter-rainfall zone of South Africa, and in a semi-arid region, with hot, dry summers from September to April, and mild winters from May to August. Temperatures are generally mild to warm in winter and can drop as low as -5°C during nighttime (Figure 2.1). Mist occurs during the winter in the low-lying areas. Summer days are very hot and dry and average maximum temperatures recorded at Vrolijkheid are generally around 40°C. Occasional north western berg winds may intensify the heat. Figure 2.1 indicates the average maximum and minimum monthly temperatures recorded at Vrolijkheid weather station which is located within the administration complex of the reserve.

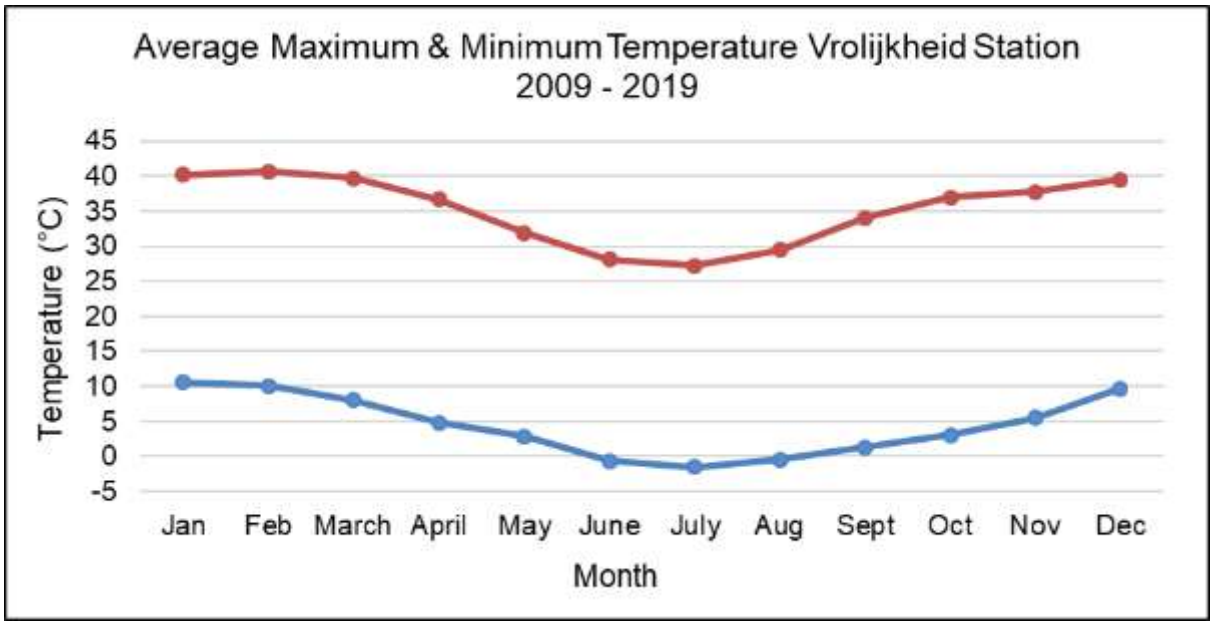


Figure 2.1: Average maximum and minimum temperatures for the Vrolijkheid Provincial Reserve weather station for the period 2009 – 2019. Data provided by CapeNature Vrolijkheid Provincial Reserve (CapeNature 2020a, unpublished data).

The climate of the Riviersonderend State Land varies from west to east, and also within a very short distance from south to north. The main cause of the climatic variation over such short distances is the mountains running parallel to the coastline (Le Roux 1984).

Temperatures on the southern side of the mountain area are much lower than on the northern side within the Robertson Karoo area during summer, due to the cooling effects of the winds from the sea. Temperatures are generally mild to warm during summer, with average maximum temperatures of around 25-30°C, recorded at the Tygerhoek station, situated near the town of Riviersonderend (Figure 2.2). The temperatures during the winter months (May – August) are generally mild to cold and can drop as low as 3°C (Le Roux 1984).

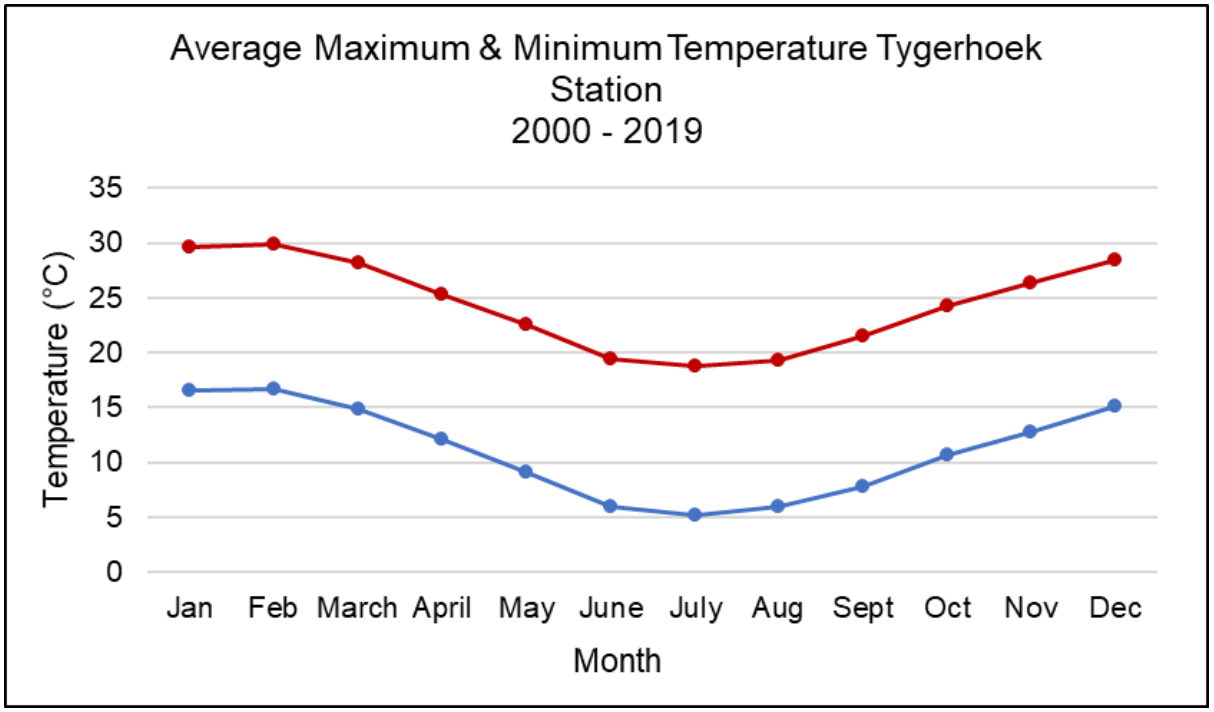


Figure 2.2: Average maximum and minimum temperatures for the Tygerhoek station for the period 2000 – 2019. Data provided by the South African Weather Service (2020, unpublished data).

Frost occurs within the Vrolijkheid Provincial Reserve on an average of 7 days per year. Mean annual rainfall recorded at the Vrolijkheid station is 245 mm per annum over the last 11-year period (2009-2019) but data indicates that there is considerable variability in annual rainfall (Figure 2.3). In 2012 a total of 364 mm was recorded whereas during the height of the drought in 2017 only 152 mm was recorded. The low precipitation of this area is ascribed to the rain-shadow effect due to the high surrounding mountain ranges (Mucina & Rutherford 2006). Total annual rainfall is also seen decreasing over the reporting period (Figure 2.3). Climate change could disrupt rainfall patterns throughout the winter-rainfall regions which is expected to hold dire negative consequences for many endemic species.

Frost in the low-lying areas around the mountain is practically unknown except in the Robertson Karoo area where it is encountered from June to August (Le Roux 1984).

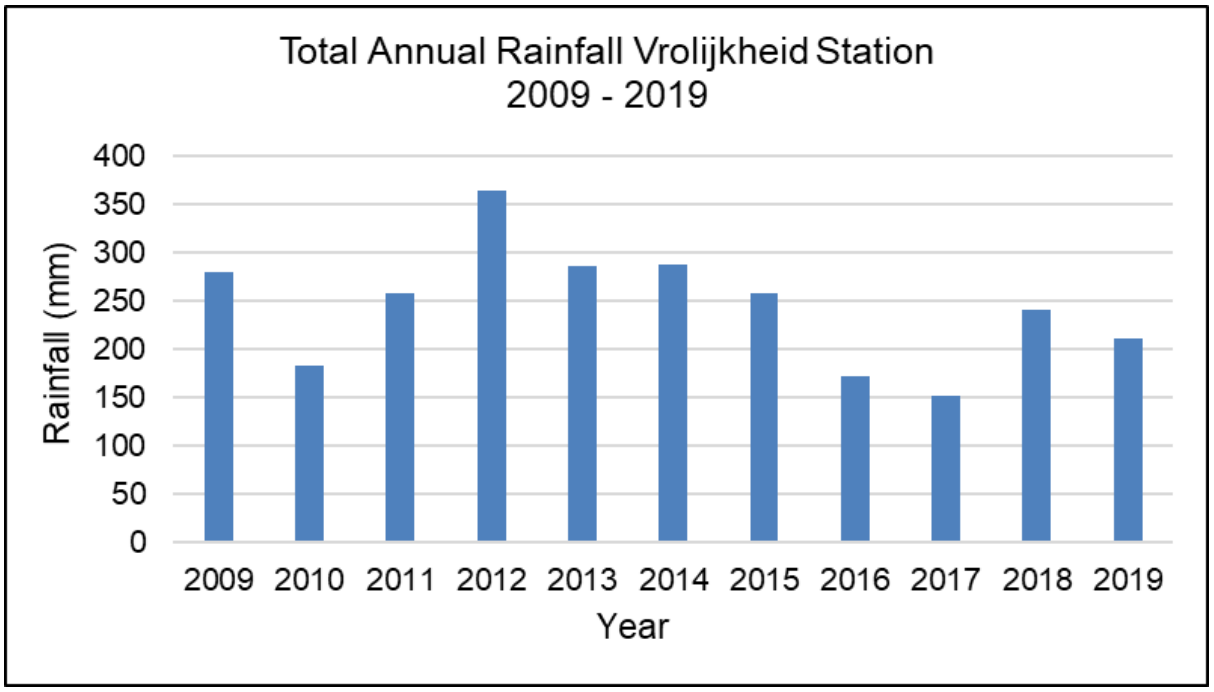


Figure 2.3: Total annual rainfall for the Vrolijkheid Provincial Reserve weather station for the period 2009 – 2019. Data provided by CapeNature Vrolijkheid Provincial Reserve (CapeNature 2020a, unpublished data).

The Riviersonderend State Land also lies within the winter rainfall region with cold, wet winters and dry, hot summers. The rainfall is closely linked to the topography and ranges between 900 to 1 200 mm on the peaks and 300 mm at the foot of the mountain range. The southern slopes also receive much higher rainfall than the northern side, due to the condensation of moist air against the mountains moving from the coast, with a rain shadow effect on the northern slopes. It has been noted by Le Roux (1984) that the rainfall in the mountains on the Villiersdorp side is much higher than in the rest of the Riviersonderend catchment area. Mean annual rainfall recorded at the Tygerhoek station is 483 mm per annum over the last 20-year period (2009-2019) but data indicates that there is considerable variability in annual rainfall (Figure 2.4). In 2014 a total of 700 mm was recorded whereas in 2004 and 2009, only 343 mm and 282 mm, was recorded respectively. Total annual rainfall is seen increasing over the reporting period (Figure 2.4). It is expected that climate change will disrupt rainfall patterns throughout the winter-rainfall regions. Frost in the mountains is more common during winter (Le Roux 1984), and snow can occur between June and September in the higher lying areas (Figure 2.5).

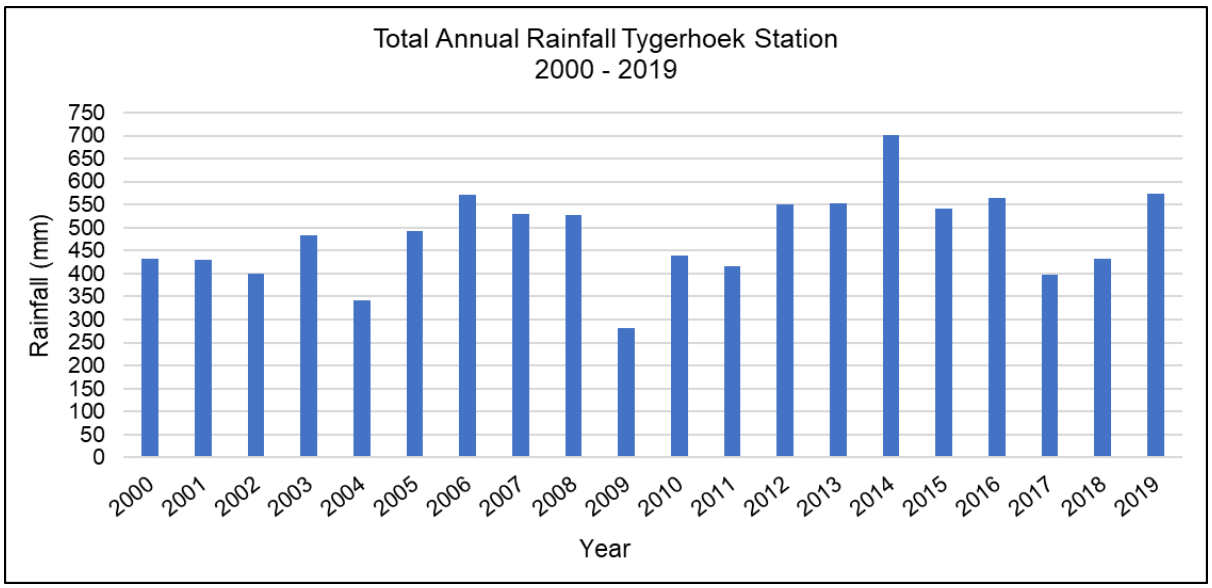


Figure 2.4: Total annual rainfall for the Tygerhoek station for the period 2000 – 2019. Data provided by the South African Weather Service (2020, unpublished data).

Figure 2.5: Snow frequently falls on the high lying peaks of the Riviersonderend Mountains during cold fronts in winter, here seen coating a Protea neriifolia. Photo: Riviersonderend Complex Field Rangers.

The average monthly rainfall recorded at the Vrolijkheid station indicates a distinct peak during June-August. Due to summer rainfall events experienced during the reporting period, a higher than average rainfall was experienced for the months of October (2009 - 36,30 mm; 2010 - 30,80; 2012 - 63,80 mm; 2013 - 31,40 mm) and November (2009 - 36,10 mm; 2013 - 50,80 mm; 2014 - 44,60 mm; 2017 – 44,20 mm) (Figure 2.6).

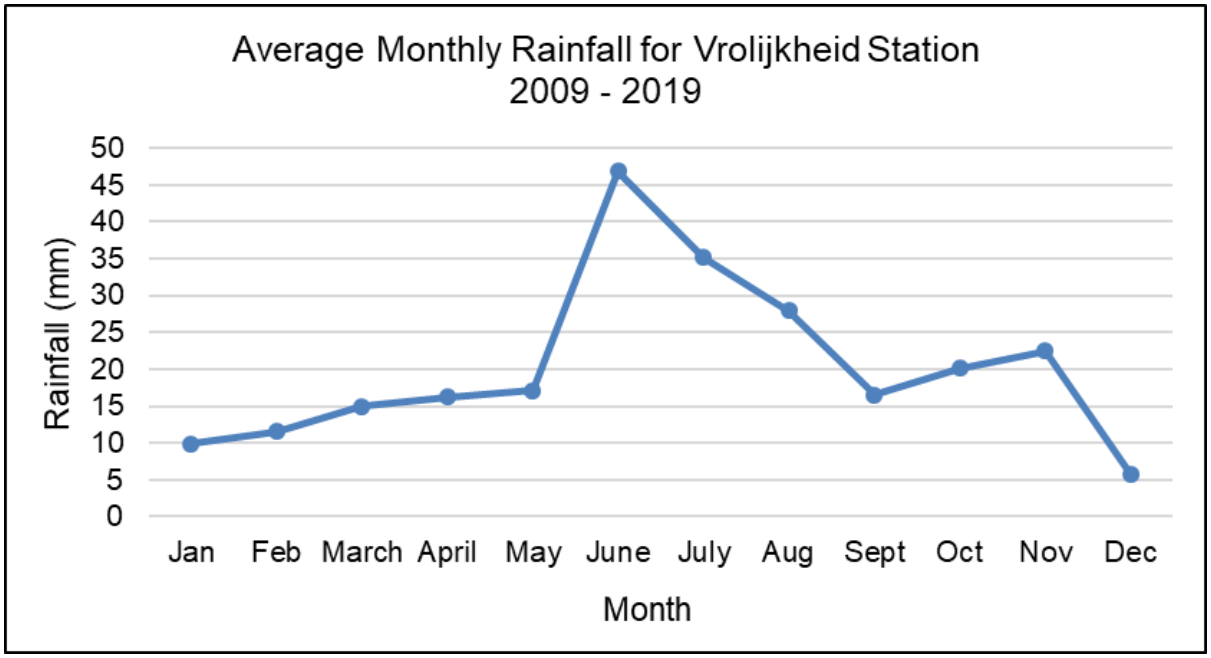


Figure 2.6: Average monthly rainfall for the Vrolijkheid Provincial Reserve weather station for the period 2009 – 2019. Data provided by CapeNature Vrolijkheid Provincial Reserve (CapeNature 2020a, unpublished data).

The average monthly rainfall recorded at the Tygerhoek station indicates distinct peaks during March, June-August, and November. Rainfall data compared between the Vrolijkheid station and the Tygerhoek station indicates a major increase in monthly average rainfall from north to south. Due to the situation of the station along the southern side of the mountain range, and the cloudy coastal conditions, the rainfall is much higher and occurs during the summer months. Summer rainfall events during the reporting period, were experienced during the months of January (2002 - 84,20 mm; 2014 - 220,80 mm), March (2000 - 133,40 mm; 2003 - 109,4 mm; 2019 - 301,4 mm), October (2004 - 110,00 mm; 2009 - 84,20 mm; 2012 - 153,80 mm) and November (2001 - 89,00 mm; 2007 - 159,4 mm; 2008 - 180,8 mm; 2013 - 146,00 mm; 2017 - 102,40 mm) (Figure 2.7).

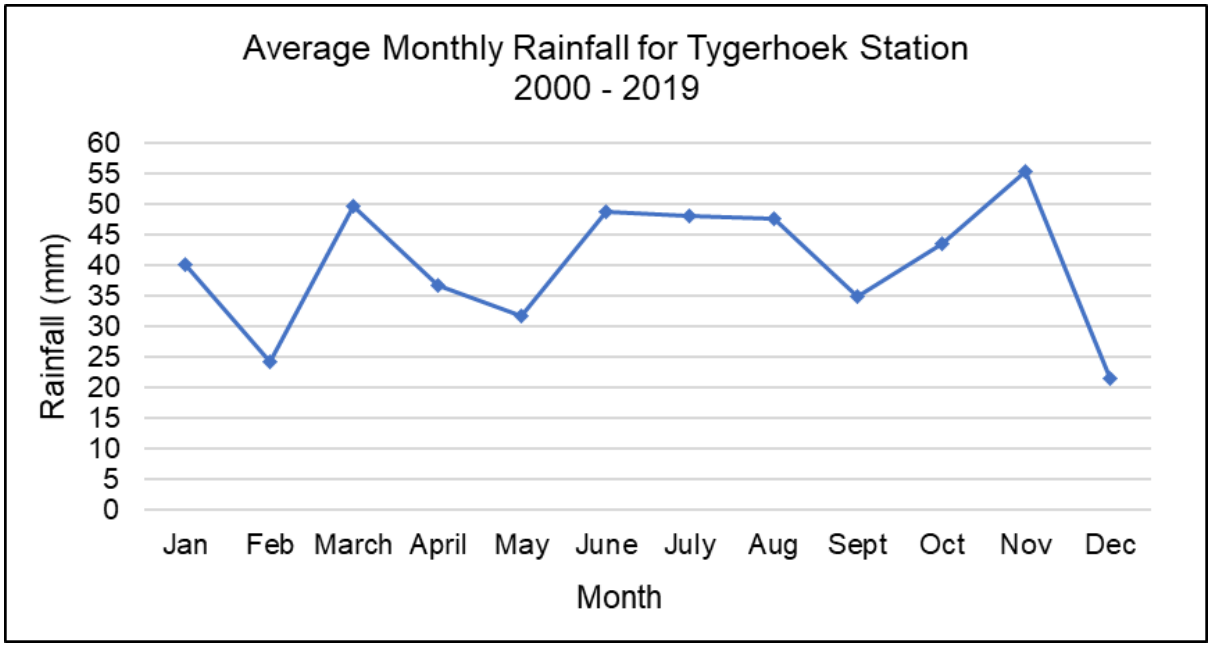


Figure 2.7: Average monthly rainfall for the Tygerhoek station for the period 2000 – 2019. Data provided by the South African Weather Service (2020, unpublished data).

The prevailing wind at the Vrolijkheid Provincial Reserve during summer is south east and in winter the wind blows mainly from the north-west. In general, the north westerly winds are more gusty and stronger than the south easterly winds. The South-Easter that blows during summer has a cooling effect especially during late afternoons when it tends to blow at its strongest (Heard *et al.* 2000a). Berg winds can occur in winter which increases the temperature drastically (Heard *et al.* 2000b).

The wind direction for the eastern Riviersonderend Mountain Catchment during summer is predominantly easterly and in winter it is mainly west/west-south-west (Figure 2.8)

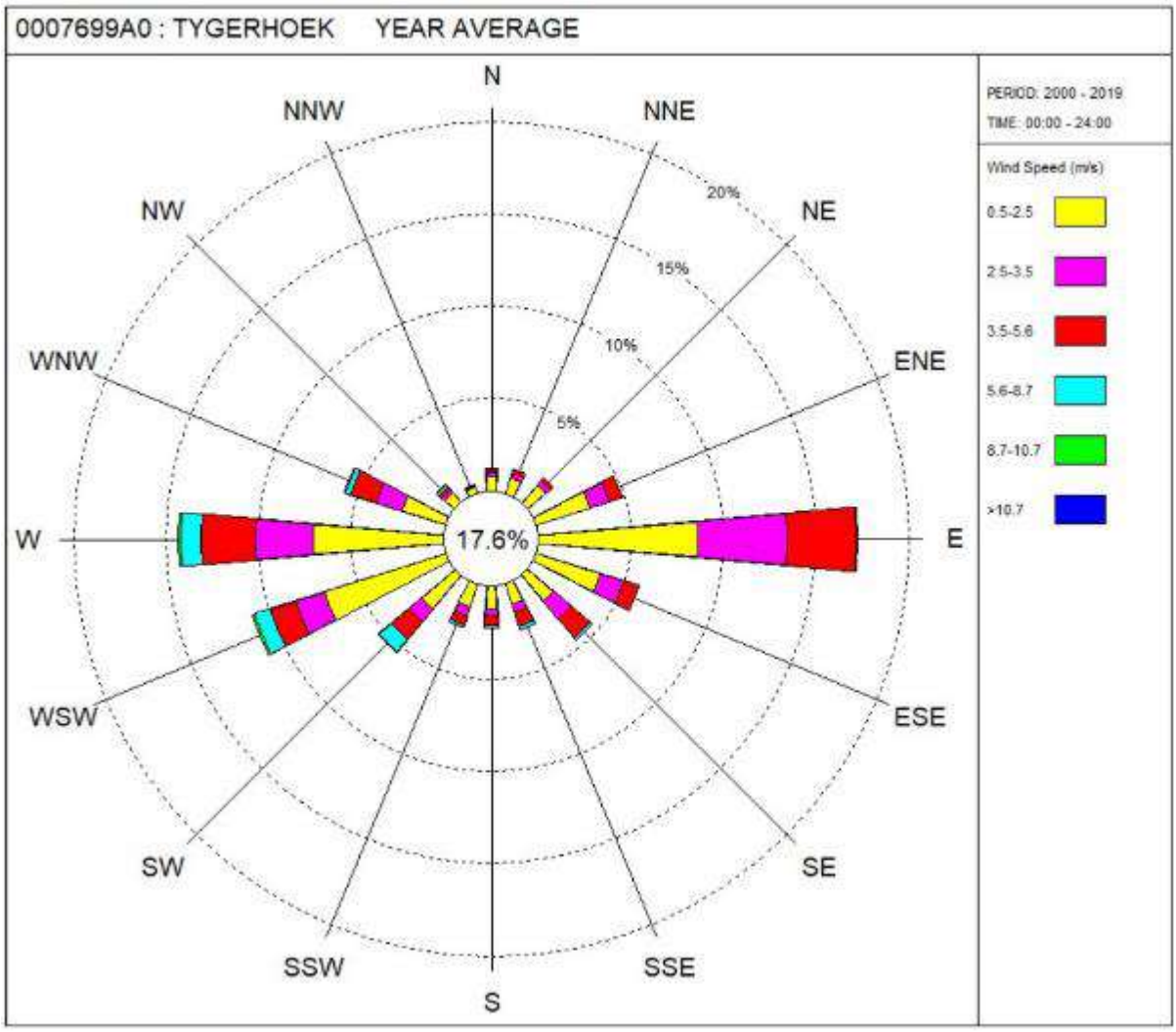


Figure 2.8: Average wind speed and direction for the Tygerhoek weather station for the period 2000 – 2019. Data provided by the South African Weather Service (2020, unpublished data).

2.2.2 Topography

The Riviersonderend State Land consist of rugged mountains of the Riviersonderend Mountain range, running in an east-west direction, where high mountain peaks with steep cliffs on the southern aspect characterise the area, especially between the towns of Genadendal and Riviersonderend, while the mountain becomes lower to the west and east of these towns. On the other hand, the northern slopes of the mountain range are gentler. The mountain range, which forms part of the Cape Fold Belt, connects to the chain of mountains that runs in a south-north direction at Villiersdorp (a study of past and present). The two highest peaks are Jonaskop (Figure 2.9), at 1646 metres above sea level, and Pilaarkop, at 1653.7 metres above sea level. The lowest elevations occur at Stormsvlei Poort with 150 metres above sea level.

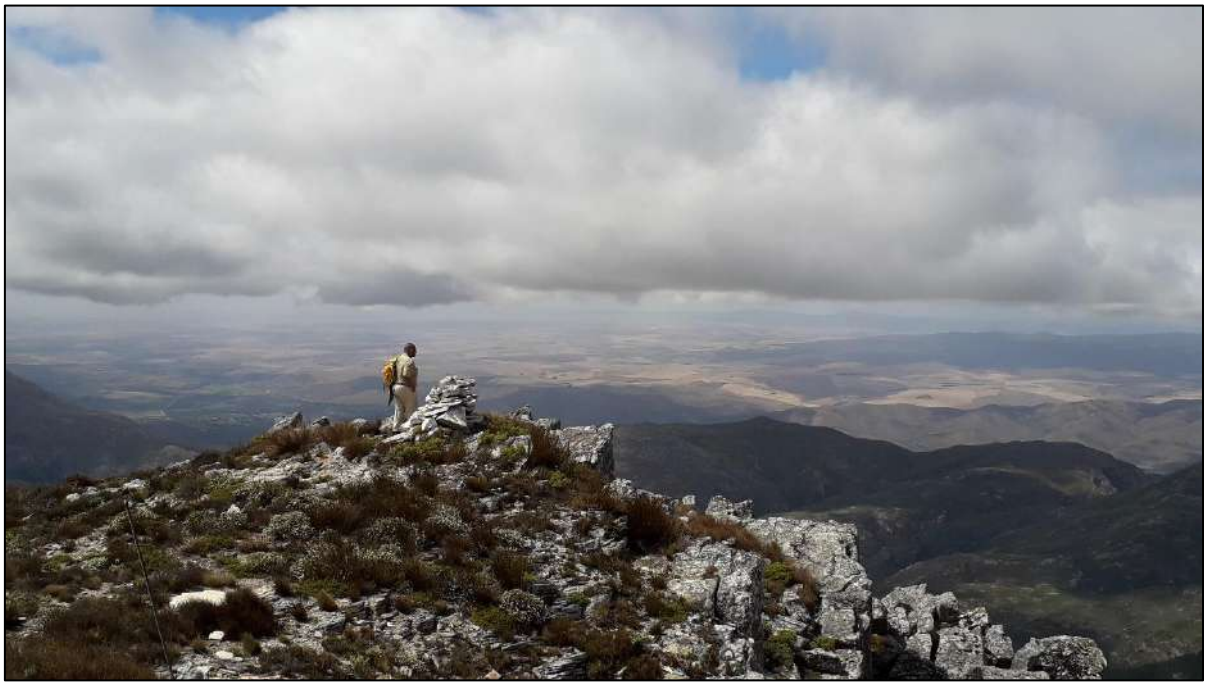


Figure 2.9: Jonaskop, one of the highest peaks within the Riviersonderend Complex. Photo: Riviersonderend Complex Field Rangers.

The Vrolijkheid Provincial Reserve is characterised by undulating flats and adjacent hills, with altitudes ranging from 190 to 635 metres above sea level, with Witkrans being the highest peak in the reserve at 635.4 metres above sea level (Heard *et al.* 2000a, 2000b; Mucina & Rutherford 2006). These are rugged hills that give views over the Breede Valley and surrounding vineyards.

The topography of the Riviersonderend Complex is shown in Appendix 1, Map 2.

2.2.3 Geology and soils

The Riviersonderend Mountain range forms part of the Cape Fold Belt and runs in an east-west direction in the Southern Cape. The mountains were formed by upthrust and faulting along the southern side, which resulted in the high steep cliffs seen on the southern side. The higher rainfall on the southern side, results in higher erosion levels (Le Roux 1984).

The Riviersonderend State Land is mostly comprised of the Table Mountain Group (69% of the area), derived from the Cape Supergroup, which is characterised by quartzitic sandstone (CGS 2012). The quartzitic sandstone was laid done between 510 and 400 million years ago. It is the hardest, and most erosion resistant layer of the Cape Supergroup. It forms most of the highest and most conspicuous peaks in the Western Cape, as well as the steepest cliffs of the Cape Fold Mountains, despite being the oldest, and, therefore, lowermost of the Cape Supergroup sequence (Norman & Whitfield 2006). Le Roux (1984) states that the mountains largely consist of four of the six subgroups that make up the Table Mountain Group, namely the Nardouw Formation, Cedarberg Formation, Pakhuis Formation, and the Peninsula Formation (Appendix 1, Map 3).

The lower sandstone (Peninsula Formations) and quartzites rest unconformably on the older Malmesbury shales. The lower 30 m of this subgroup varies from place to place and can either have intercalations of quartzite and purple shale or a conglomerate that is usually made up of small pebbles. After this the lower sandstone layer is thickly bedded and frequently crossbedded with occasional pebbly arenacous partings. Another feature of this group is the shale partings, lenses and thin beds found throughout (Le Roux 1984).

On top of the lower sandstone a thin layer of tillites (Pakhuis formation) follows, which can be either pure unlayered rock, or conglomeritic beds. Where large flat areas of tillites occur, weathering leaves a rock with pinnacles and holes (Le Roux 1984).

Following on the narrow tillites layer, the upper shale band (Cedarberg Formation) is much wider and very distinct. This layer can easily be separated from the other layers of the Table Mountain Group by the absence of rocky outcrops and by its smooth appearance. The smoother appearance is caused by the faster weathering of the rock in comparison to the harder adjoining sandstone (Le Roux 1984).

The last layer to the Table Mountain Group is the Upper Sandstone. This is very similar to the Lower Sandstone, except that there appears to be more shale present. The Upper Sandstone is also known as the Nardouw Formation. The rocks of this group tend to be red, and this can be seen in many places along the northern aspects of the mountain (Le Roux 1984).

The Nardouw Subgroup, derived from the Table Mountain Group, is characterised by quartzitic sandstone with minor shale (CGS 2012). This subgroup comprises the three upper Formations of the Table Mountain Group.

The Malmesbury shales (Malmesbury Group) form the base upon which the Cape Fold Belt rests (Le Roux 1984), and the Franschhoek Formation, which is derived from the Malmesbury Group, is characterised by quartzite, conglomerate, slate (CGS 2012).

The Hermanus Pluton, derived from the Cape Granite SUI, is characterised by granite (CGS 2012).

The Bokkeveld Group occurs within a small area of the Riviersonderend State Land on the southern side. The Bokkeveld Group lies on top of the Table Mountain Group and constitutes the low-lying valley bottoms and the rolling hills of the Rûens. The shale of this group is usually greenish or greyish at the surface, but a definite grey to black under the ground. The shale can be very fine grains, as in the black shale above the first sandstone zone, otherwise granular quartz can be seen. Along surface faults or joints manganese and iron has been leached out, to concentrate lower down in the fault or joint. To the south of the mountain the sandstone is always rich in clay (Le Roux 1984). The Bidouw Subgroup, derived from the Bokkeveld Group, is characterised by three shale units separated by two sandstone units (CGS 2012). The Ceres Subgroup, also derived from the Bokkeveld Group, is characterised by three sandstone and three shale units (CGS 2012).

The Witteberg Group is the youngest of the three Cape Supergroup, which follows conformably on the Bokkeveld Group. This group has a thickness of 790 m and consists of quartzite and shale. The lowest section of the Witteberg Group consists

mostly of shale, although numerous thin bands of white quartzite and sandstone can be found at various levels. On top of the basal zone another succession of quartzite and shale zones follow. The first quartzite zone is very prominent and weathers red. Shale follows on this, which is then followed by the next quartzite zone that is known as the "White Streak" and forms prominent white cliffs. On top of this white streak, follows another succession of shale, quartzite and shale (Le Roux 1984; CGS 2012).

Vrolijkheid Provincial Reserve is mostly comprised of the Bidouw Subgroup (74%), derived from the Bokkeveld Group, which is characterised by three shale units separated by two sandstone units (CGS 2012). Within the western portion, the Ceres Subgroup, also derived from the Bokkeveld Group, is characterised by three sandstone and three shale units (CGS 2012). These soils are highly erodible and thus result in deep dongas that form on many slopes in the Karoo (CapeNature 2012). The Witteberg Group is also found within the eastern portion of the reserve. (CGS 2012; Appendix 1, Map 3).

Three major soil groups, with their associated soil units are represented within the Riviersonderend Complex (Table 2.2).

Table 2.2: The major soil groups, and their associated soil units, represented within the Riviersonderend Complex.

Soil Group	Soil Unit
Riviersonderend State Land	
Leptosols	• Lithic Leptosols
Solonetz	• Haplic Solonetz
Vrolijkheid Provincial Reserve	
Leptosols	• Lithic Leptosols • Eutric Leptosols
Regosols	• Eutric Regosols

The Leptosols group (also called Mispah soil form by the South African soil taxonomic system) consists of very shallow soils over hard rock, or highly calcareous material, but also deeper soils that are extremely gravelly and/or stony (Driessen *et al*. 2001; Jones *et al*. 2013; Strohbach & Kutuahurina 2014). This soil type is characterised by an ochric A-horizon over fractured rocks. The ochric A-horizon has a brownish black to dark brown moist colour, fine sand to loamy sand texture, slightly to highly alkaline pH, that are well drained. Lithic Leptosols have a low water-holding capacity due to their shallowness (peat layer less than 10 cm deep) and gravelly nature, which also renders them with very limited agricultural potential (Strohbach & Kutuahurina 2014). This group is particularly common in mountain regions (Driessen *et al*. 2001). Eutric leptosols are characterised as shallow soil over hard rock with no acid (Jones *et al*. 2013).

The Regosols group consists of very weakly developed mineral soils in unconsolidated materials that have only an ochric surface horizon and that are not very shallow, sandy, or with fluvic properties. Regosols are extensive in eroding lands, particularly in arid and semi-arid areas and in mountain regions. The central concept of a Regosol is a

deep, well-drained, medium-textured, non-differentiated mineral soil that has minimal expression of diagnostic horizons (other than an ochric surface horizon), properties or materials. Low coherence of the matrix material makes most Regosols in sloping areas prone to erosion. Low water holding capacity and high permeability to water make most Regosols sensitive to drought (Driessen *et al*. 2001). Eutric Regosols are characterised as weakly developed soil in unconsolidated material not acid (Jones *et al*. 2013).

The Solonetz group consists soils with a dense, strongly structured, clay illuviation horizon that has a high proportion of adsorbed sodium and/or magnesium ions. Solonetz are normally associated with flat lands in a climate with hot, dry summers. The essential characteristic of Solonetz is their natric subsurface horizon, which shows signs of clay translocation. 'Typical' Solonetz feature a thin, loose litter layer resting on black humified material about 2-3 cm thick. The surface horizon is brown, granular and shallow but can also be more than 25 cm thick; it is easily eroded away. Most Solonetz are very hard in the dry season and sticky when wet. Clayey Solonetz tend to become lumpy at the surface when ploughed, particularly where the shallow surface horizon was lost and the top of the natric horizon became exposed. The dense natric horizon hinders downward percolation of water and root penetration (Driessen *et al*. 2001). Haplic Solonetz are characterised as soil with a clay accumulation horizon, rich in sodium, but showing no major characteristics (Jones *et al*. 2013).

2.3 Biodiversity Context: Ecosystems

2.3.1 Vegetation

The Riviersonderend Complex falls within the Core Cape Subregion (previously termed the Cape Floristic Kingdom) of the Greater Cape Floristic Region (Manning & Goldblatt 2012).

The Core Cape Subregion is one of the world's smallest but richest floral kingdoms, encompassing a land area of approximately 90 760 km² (less than 4% of the southern African subcontinent). An estimated 9 383 species of vascular plants (ferns and other spore-bearing vascular plants, gymnosperms, and flowering plants) are known to occur here, of which just over 68% are endemic. The majority of these species are flowering plants. The Core Cape Flora of the Greater Cape Floristic Region is characterised by six endemic or near-endemic families and by the conspicuous presence of Asteraceae and Fabaceae (two largest families), and the Iridaceae, Aizoaceae, Ericaceae, Proteaceae, and Restionaceae (Manning & Goldblatt 2012). The Core Cape Subregion is notable for its range of ecosystems ranging from coastal foredunes through strandveld, lowland and mountain fynbos. It is also a global biodiversity hotspot with high plant biodiversity faced with substantial threats (Myers *et al*. 2000).

The vegetation of the area has been mapped nationally at a 1: 1 000 000 scale (Mucina & Rutherford 2006; SANBI 2006, 2018). In the past there have been vegetation studies undertaken specifically on Vrolijkheid at a much finer scale (Van Der Merwe 1977; Du Preez *et al.* 1993; Helme 2007). It was noted that there are discrepancies between the Mucina & Rutherford (2006) National Biodiversity Assessment mapping of the vegetation at Vrolijkheid and the broader Central Breede

Valley, and the fine scale mapping (Helme 2007). The National Biodiversity Assessment classification indicates this as Renosterveld which falls within the Fynbos Biome, whereas the fine scale mapping indicates is as part of the Succulent Karoo Biome. For this PAMP the fine scale mapping has been adopted i.e. the vegetation determination is that of Succulent Karoo. This was informed by the ecosystem functioning and associated management actions. This is reflected as such in the conservation targets (Section 5.4) and subsequent determination of the threats and management actions in the strategic plan.

The original 2006 national vegetation map (Mucina & Rutherford 2006) was recently updated with substantive changes to vegetation units in the Namaqualand area and the Subtropical Thicket vegetation units in the Western Cape and Eastern Cape Provinces (SANBI 2018).

South Africa recognises that different ecosystems have differing species compositions and to effectively conserve biodiversity the country has set targets for each ecosystem (see Table 2.3). The biodiversity target is the minimum proportion of each ecosystem type that needs to be kept in a natural or near-natural state over the long term to maintain viable representative samples of all ecosystem types and the majority of species associated with those ecosystems. The biodiversity target is calculated based on species richness, using species–area relationships, and varies between 16% and 36% of the original extent of each ecosystem type (Desmet & Cowling 2004).

Threat status is provided for each ecosystem (see Table 2.3) according to the draft assessment of the most recent National Biodiversity Assessment (NBA) of 2018 (SANBI 2019), which has adopted the IUCN methodology for the assessment of ecosystem threat status.

The vegetation of the Riviersonderend Complex comprises of 11 vegetation units in four biomes (Mucina & Rutherford 2006) (Table 2.3; Appendix 1, Map 4):

- Fynbos Biome: Breede Alluvium Renosterveld; Breede Quartzite Fynbos; Western Rûens Shale Renosterveld; Breede Shale Renosterveld; Greyton Shale Fynbos; North Sonderend Sandstone Fynbos; South Sonderend Sandstone Fynbos; Western Coastal Shale Band Vegetation
- Forest Biome: Southern Afrotemperate Forest
- Succulent Karoo Biome: Robertson Karoo
- Azonal Vegetation Biome: Cape Lowland Alluvial Vegetation

Of these vegetation units, two are listed as Critically Endangered (South Sonderend Sandstone Fynbos and Western Rûens Shale Renosterveld), three are listed as Endangered (Breede Shale Renosterveld; Cape Lowland Alluvial Vegetation; Breede Alluvium Renosterveld), one is listed as Near Threatened (Greyton Shale Fynbos), and five are listed as Least Concern (Breede Quartzite Fynbos; North Sonderend Sandstone Fynbos; Robertson Karoo; Southern Afrotemperate Forest; Western Coastal Shale Band Vegetation).

Table 2.3: Summary of the vegetation types conserved within the Riviersonderend Complex (Mucina & Rutherford 2006; SANBI 2006; SANBI 2019).

Vegetation Type	WC Provincial Protection Target (ha)	WC Provincial Protection Target (%)	% of WC Target conserved in Riviersonderend Complex	Ha conserved in Riviersonderend Complex	Ecosystem Status (2019)
South Sonderend Sandstone Fynbos	35 875.87	30	42.76	15 341.73	Critically Endangered
Western Rûens Shale Renosterveld	118 997.03	27	0.01	5.29	Critically Endangered
Breede Shale Renosterveld	104 941.50	27	1.6	1 682.25	Endangered
Cape Lowland Alluvial Vegetation	35 918.63	31	0.06	23.19	Endangered
Breede Alluvium Renosterveld	49 757.19	27	0.13	62.34	Endangered
Greyton Shale Fynbos	26 651.94	30	0.89	236.37	Near Threatened
Breede Quartzite Fynbos	9 781.06	30	0.08	7.91	Least Concern
North Sonderend Sandstone Fynbos	53 125.29	30	18.71	9 940.23	Least Concern
Robertson Karoo	65 308.94	16	0.45	296.57	Least Concern
Southern Afrotemperate Forest	64 048.50	34	0.11	70.86	Least Concern
Western Coastal Shale Band Vegetation	13 467.88	30	6.79	914.39	Least Concern

The northern slopes of Jonaskop are host to long term monitoring projects which aim to determine the response of fynbos and succulent karoo vegetation to edaphic and climatic factors. This monitoring can be used to inform predictions of the effects of climate change on ecosystems in the Western Cape. The vegetation biomes transitions from fynbos on the upper and mid slopes to succulent karoo on the lower slopes. A study on survival rates of both fynbos and succulent karoo species along this transition indicates that edaphic factors were more significant. Climatic factors also play an important role, especially for fynbos species. The higher survival rates of the

succulent karoo species provided evidence for the potential of succulent karoo to invade fynbos areas under warmer, drier conditions. The fire regime is however most likely the driver which currently prevents invasion of these species (Esler *et al*. 2015). Studies on five Protea species along this transition provide evidence of variation in traits in response to environmental gradients which drive divergent selection. It is important to note that the rate of environmental change would need to be taken into consideration (Carlson *et al.* 2010; Carlson & Holsinger 2012).

The following is a description of the various National Biodiversity Assessment Vegetation Units occurring in the Riviersonderend Complex as shown in Table 2.3 and Appendix 1, Map 4.

Vrolijkheid Provincial Reserve

Robertson Karoo *(Least Concern)*

The reserve is the only provincial reserve that represents Robertson Karoo vegetation. This vegetation unit is listed as **Least Concern** and Poorly Protected. It occurs in the broad valley and middle reaches of the Breede River around Worcester, Robertson and Ashton at altitudes of 160 to 960 m. This vegetation is characterised by undulating flats and adjacent hills supporting dwarf succulent shrubland to succulent thicket of medium height dominated by succulent species of *Euphorbia, Crassula* and vygies (mainly *Drosanthemum* and *Ruschia*). *Euphorbia mauritanica* is usually dominant on heuweltjies, which are an important element of the landscape and vegetation of the Robertson Karoo. Important taxa include succulent shrubs, low shrubs, succulent climbers, succulent herbs and graminoids. *Drosanthemum* and *Haworthia* show a high concentration of local endemics (Mucina *et al*. 2006a; SANBI 2019).

The region is the heart of the Worcester-Robertson Karoo Centre of Endemism. Two genera are endemic to this vegetation unit, namely *Stayneria* and *Brianhuntleya* (Mucina *et al*. 2006a).

A small area is statutorily conserved in Vrolijkheid Provincial Reserve and marginal patches are under protection in private nature reserves. About 16% has been transformed by urban development as well as by cultivation mainly for vineyards and orchards. Alien plant invasions can be a problem in places.

The provincial conservation target for this vegetation unit is 16%. It covers 296.57 ha in the Riviersonderend Complex which relates to 0.45% of the target (Table 2.3).

Breede Shale Renosterveld *(Endangered)*

The majority of the reserve is classified as Breede Shale Renosterveld. This vegetation unit is listed as **Endangered** and Poorly Protected. It is statutorily conserved in Vrolijkheid Provincial Reserve as well as in Langeberg-wes and Matroosberg Mountain Catchment Areas. It occurs in patches in the Breede River Valley from Tulbagh to Swellendam. The most extensive area occurs near Ashton, McGregor and the confluence of the Riviersonderend and Breede Rivers west of Swellendam (Rebelo *et al.* 2006; SANBI 2019).

This vegetation is characterised by low hills, slightly undulating to undulating plains and lower mountain slopes. In the western regions low, cupressoid-leaved shrubland

is dominated by renosterbos (*Elytropappus rhinocerotis*). Elements of shale fynbos are present (Rebelo *et al.* 2006).

In the eastern regions open, tall shrublands (possibly closely affiliated to Central Rûens Shale Renosterveld) are found, with microphyllous shrubs forming the dominant layer. Heuweltjies are very prominent, with either bush clumps in moister areas or succulent shrubs in drier habitats (Rebelo *et al*. 2006).

The provincial conservation target for this vegetation unit is 27%. It covers 1682.25 ha in the Riviersonderend Complex which relates to 1.6% of the target (Table 2.3).

Breede Quartzite Fynbos *(Least Concern)*

The higher lying area of the reserve represents a small area of Breede Quartzite Fynbos. This vegetation unit is listed as **Least Concern** and Poorly Protected. Only a very small portion is statutorily conserved in Vrolijkheid Provincial Reserve. Approximately 9% of the vegetation unit is additionally protected in the Quaggas Berg and Drooge Rivers Berg Private Nature Reserves. Some 6% is transformed due to cultivation (Rebelo *et al.* 2006; SANBI 2019).

This vegetation unit is often considered part of North Sonderend Sandstone Fynbos, but its delimitation is largely based on the occurrence of Proteaceae. It occurs in the Southern Breede River Valley from the Brandvlei Dam to northeast of Bonnievale, but with by far the largest extent on the Hammansberg, Ouhangsberge, Gemsbokkop, Gannaberg and Rooiberg, at altitudes of 200 to 876 m on the summit of Gannaberg. No invasive alien plant species are found at significant densities, although *Hakea sericea* is prominent in places.

The landscape of this vegetation is characterised by a single range of parallel ridges and flat-topped hills in the west, and high hills and low mountains in the east. The vegetation is an open tall shrubland in a shrub matrix, structurally classified as asteraceous, restioid and proteoid fynbos. Important taxa include small trees such as *Protea nitida* and small and low shrubs (Rebelo *et al*. 2006).

The provincial conservation target for this vegetation unit is 30%. It covers 7.9 ha in the Riviersonderend Complex which relates to 0.08% of the target (Table 2.3).

Breede Alluvium Renosterveld *(Endangered)*

To the west of the reserve the vegetation is classified as Breede Alluvium Renosterveld. This vegetation unit is listed as **Endangered** and Not Protected as only small patches are conserved in Vrolijkheid Provincial Reserve and Riviersonderend State Land. The vegetation unit occurs in broad areas and narrow bands on valley bottomlands from Worcester to Ashton, and in the vicinity of the Breede River. It occurs at altitudes of 150 to 450 m. Some 57% of the vegetation unit has already been transformed through cultivation, mainly vineyards. Alien *Acacia* species occur locally at low densities. The landscape is characterised by flat alluvial fans and valley bottoms supporting short grassy cuppressoid-leaved shrubland usually dominated by renosterbos (Rebelo *et al.* 2006; SANBI 2019).

The vegetation unit occurs on fine loamy sand with high gravel and cobble contents of alluvial fans and river terraces, overlying a variety of rocks from the Cape and Karoo

Supergroups as well as the Uitenhage Group. Important taxa include tall shrubs such as *Montinia caryophyllacea* and *Searsia lucida,* as well as low shrubs, succulent shrubs, herbs, geophytic herbs and graminoids (Rebelo *et al.* 2006).

The provincial conservation target for this vegetation unit is 27%. It covers 62.34 ha in the Riviersonderend Complex which relates to 0.13% of the target (Table 2.3).

Upper Breede Valley Fine Scale Vegetation Units occurring on Vrolijkheid Provincial Reserve:

In 2007, a fine-scale vegetation map was produced for the Upper Breede River Valley with a high degree of accuracy at 1: 50 000, and a moderate level of accuracy at 1: 10 000 (Helme 2007). This study recognised previously undescribed vegetation units. Vrolijkheid Provincial Reserve was included in the study area. The vegetation on the reserve comprises mostly of two vegetation units, namely Bonnievale Gwarrieveld (also referred to as Bonnievale Renosterveld Thicket) and Robertson Gannabos Thicket Mosaic (both included in the Mucina & Rutherford (2006) vegetation unit Robertson Karoo), with minor areas of the reserve comprising Rietvlei Renosterveld (included in the Mucina & Rutherford (2006) vegetation unit Breede Shale Renosterveld), and Oliva Arid Karoo Fynbos Mosaic (included in the Mucina & Rutherford (2006) vegetation unit Breede Alluvium Renosterveld).

Bonnievale Renosterveld Thicket *(Least Threatened)*

This vegetation unit, also referred to as Bonnievale Gwarrieveld, dominates large areas east of Robertson and down to Drew and Bonnievale, and crosses the Breede River. The regionally endemic succulent *Astroloba rubriflora* is most common in this unit, and *Euphorbia nesemanii*, *Aspalathus candicans*, *Haworthia minima* var. *poellnitziana* and *Lotononis rigida* may occur in patches. The rare and seldom collected *Crassula simulans* may be found in this habitat. One of only three known populations of the very attractive geophyte *Chasmanthe bicolor* (Vulnerable) occurs in Vrolijkheid Provincial Reserve (Figure 2.10). This species occurs in Cape Lowland Alluvial Vegetation, Breede Alluvium Renosterveld, and Breede Shale Renosterveld. All three vegetation units have occurrences within the Riviersonderend Complex. *Chasmanthe bicolor* is threatened by habitat loss to crop cultivation, dam construction and competition from invasive alien plants (SANBI 2015).

Figure 2.10: Chasmanthe bicolor is one of the threatened plant species (listed as vulnerable) found on Vrolijkheid Provincial Reserve. Photo: Freddie Munnik.

Robertson Gannabos Thicket *(Least Threatened)*

In Robertson Gannabos Thicket, the shrubs *Euphorbia mauritanica* and *Pteronia paniculata* are prominent, with *Euclea undulata* and *Salsola aphylla* (gannabos) occurring.

Riviersonderend State Land

The vegetation on the reserve is predominately the North and South Sonderend Sandstone Fynbos vegetation units.

North Sonderend Sandstone Fynbos *(Least Concern)*

This vegetation unit is listed as **Least Concern** and Well Protected. It occurs on the northern slopes of the Riviersonderend Mountains from Villiersdorp to Bromberg and Luiperdsberg east of Stormsvlei, including Klipberg and Sandberg towards Robertson, at altitudes from 150 m, with the highest peaks exceeding 1 600 m (Jonaskop and Pilaarkop). The landscape is characterised by gentle to steep north-facing slopes with a midslope sandy plateau and extensive gentle lower slopes (Rebelo *et al.* 2006; SANBI 2019).

The vegetation is an open, tall, proteoid-leaved evergreen shrubland with a dense moderately tall, ericoid-leaved shrubland as understorey (Figure 2.11). Ericaceous fynbos is restricted to the highest peaks. This vegetation unit borders on succulent

karoo shrublands at the lowest elevations. The deep sand habitat of the northern plateau is a distinctive feature associated with many endemic species. The genus *Endonema* (Penaeaceae) is endemic to the Riviersonderend.

The vegetation unit is statutorily conserved in the Riviersonderend State Land, with an additional 51% mainly in a private conservation area of the same name. Only 2% is transformed by cultivation for protea nurseries and fruit orchard (Rebelo *et al*. 2006).

The provincial conservation target for this vegetation unit is 30%. It covers 9940.23 ha in the Riviersonderend Complex which relates to 18.71% of the target (Table 2.3).

Figure 2.11: North Sonderend Fynbos on the northern slope of Jonaskop, in the western section of the Riviersonderend State Land. Photo: Ted Oliver.

South Sonderend Sandstone Fynbos *(Critically Endangered)*

This vegetation unit is listed as **Critically Endangered**, although Well Protected. It is statutorily conserved in the Riviersonderend State Land, with an additional 39% mainly in a private conservation area with the same name. It occurs on the southern slopes of the Riviersonderend Mountains from Villiersdorp to Eseljagsberg in the west to Stormsvlei in the east at altitudes from 200 m, with the highest peaks exceeding 1 600 m (Jonaskop and Pilaarkop) (Rebelo *et al.* 2006; SANBI 2019).

The landscape is characterised by steep to gentle southern slopes with extensive cliffs in places. Vegetation is moderately tall, dense ericoid-leaved shrubland with open emergent proteoids. Ericaceous and restioid fynbos is most common, with proteoid fynbos found mainly on lower slopes.

Only 7% of the vegetation unit is transformed, mainly due to cultivation and pine plantations. Alien *Hakea sericea* and *Pinus pinaster* occur occasionally (Rebelo *et al*. 2006).

The provincial conservation target for this vegetation unit is 30%. It covers 15341.73 ha in the Riviersonderend Complex which relates to 42.76% of the target (Table 2.3). The Complex is therefore very important in terms of the long-term conservation of South Sonderend Sandstone Fynbos.

Minor vegetation units on the reserve include Western Coastal Shale Band vegetation, Greyton Shale Fynbos, Southern Afrotemperate Forest, Cape Lowland Alluvial Vegetation and Western Rûens Shale Renosterveld.

Western Coastal Shale Band Vegetation *(Least Concern)*

This vegetation unit is listed as **Least Concern** and Well Protected. It is embedded within mountain ranges and extends eastwards through the Kleinrivierberge, Caledon Swartberg and Bredasdorpberge. It is also included in the shale bands of the Riviersonderend Mountains and occurs at altitudes of 50 to 1 800 m. The landscape is characterised by a narrow 80-200 m linear feature, smooth and flat in profile compared to surrounding areas. It supports diverse renosterveld and fynbos shrublands of all structural types including waboomveld at lower altitudes (Rebelo *et al*. 2006; SANBI 2019).

Important taxa include small trees such as *Protea nitida* and *Widdringtonia nodiflora,* tall shrubs, low shrubs, geophytic herbs and graminoids.

This vegetation unit is statutorily conserved in the Riviersonderend State Land amongst others, while an additional 30% is protected in Mountain Catchment Areas. Some 6% is transformed by pine plantations. Aliens *Pinus pinaster* and *Hakea sericea* are scattered on about half of the area of the vegetation unit (Rebelo *et al*. 2006).

This vegetation unit plays an important role in water movement and springs and wetlands are associated with this vegetation unit. The edaphic interface also serves as a unique habitat and some endemics are associated with this space.

The provincial conservation target for this vegetation unit is 30%. It covers 914.39 ha in the Riviersonderend Complex which relates to 6.79% of the target (Table 2.3).

Greyton Shale Fynbos *(Near Threatened)*

This vegetation unit is listed as **Near Threatened** and Poorly Protected. Only approximately 1% is statutorily conserved in the Riviersonderend State Land with an additional 6% enjoying protected in a private conservation area of the same name. The vegetation unit occurs south of Riviersonderend and Caledon Swartberg mountains on higher-altitude shales from Theewaterskloof Dam to Stormsvlei, including the Bergfontein and Spitskop hills north of Caledon at altitudes of 200 to 550 m. The landscape is characterised by moderately undulating plains and steep mountain slopes. The vegetation is a moderately tall and dense shrubland, predominantly proteoid and asteraceous fynbos, with some graminoid fynbos. Limited succulent species could be found amongst the shale fynbos types (Rebelo *et al.* 2006; SANBI 2019).

Important taxa include the small tree *Protea nitida*, tall shrubs such as *Leucadendron salicifolium*, *Protea neriifolia*, *P. repens*, *P. aurea* subsp. *aurea* and *P. coronata*.

Shrubs, herbs, geophytic herbs and graminoids are also present. Some 30% is already transformed due to cultivation (Rebelo *et al*. 2006).

The provincial conservation target for this vegetation unit is 30%. It covers 236.37 ha in the Riviersonderend Complex which relates to 0.89% of the target (Table 2.3).

Southern Afrotemperate Forest *(Least Concern)*

This vegetation unit is listed as **Least Concern** and Well Protected. Only a small area is statutorily conserved in the Riviersonderend State Land. Sections of this vegetation unit occur along the feet of south- and east-facing slopes and deep kloofs and ravines of the Cape Fold Belt Mountains (Mucina & Geldenhuys 2006; SANBI 2019).

The forests are a minor element in a landscape dominated by Mountain Fynbos. Patches of evergreen, broad-leafed forests, are confined to narrow kloofs, and other sheltered localities where favourable moisture conditions coupled with shelter against weather and fire permit their development (Mucina & Geldenhuys 2006).

Tall, multi-layered Afrotemperate forests contain ironwood (*Olea capensis* subsp. *macrocarpa*), candlewood (*Pterocelastrus tricuspidatus*), white alder *Platylophus trifoliatus*. Common trees found in the valleys include red alder (*Cunonia capensis*), Cape holly (*Ilex mitis*), wild olive (*Olea europaea* subsp. *africana*), Cape beech (*Rapanea melanophloeos*) and wild peach (*Kiggelaria africana*). The shrub understorey and herb layers are well-developed, especially in mesic and wet habitats (Mucina & Geldenhuys 2006).

The provincial conservation target for this vegetation unit is 22%. It covers 70.86 ha in the Riviersonderend Complex which relates to 0.11% of the target (Table 2.3).

Cape Lowland Alluvial Vegetation *(Endangered)*

This vegetation unit is listed as **Endangered** and Poorly Protected. It occurs on broad alluvia of middle and lower stretches of rivers of the Western Cape at altitudes of 20 to 300 m. The landscape is flat with slow-flowing lowland rivers fringed on the banks by extensive tall reeds dominated by *Phragmites australis* and *Typha capensis* as well as by flooded grasslands and herblands and tall riparian thickets with *Salix mucronata* on the river terraces (Mucina *et al*. 2006b; SANBI 2019).

Only a small portion is statutorily conserved in the Riviersonderend Complex. Some 72% of this vegetation unit has been transformed for cultivation, urban development and road building. Disturbance and invasive alien plant species are very common in this vegetation unit (Mucina *et al*. 2006b).

The provincial conservation target for this vegetation unit is 31%. It covers 23.19 ha in the Riviersonderend Complex which relates to 0.06% of the target (Table 2.3).

Western Rûens Shale Renosterveld *(Critically Endangered)*

This vegetation unit is listed as **Critically Endangered** and Not Protected. It occurs in the western parts of the Rûens region from Bot River and Villiersdorp eastwards, surrounding the Caledon Swartberg at altitudes of 60 to 450 m. The landscape is characterised by moderately undulating plains, mostly under cultivation, with remnants supporting an open to medium dense, cupressoid and small-leaved, low to moderately

tall grassy shrubland dominated by renosterbos. Heuweltjies are not conspicuous. This vegetation unit is distinguished from other Rûens renosterveld types by the absence of *Hermannia flammea* and rare occurrence of *Aloe ferox* and *Vachellia karoo* complex. Shrubby Asteraceae increase as grazing reduces the palatable grasses, resulting in subsequent erosion. A very small portion of this vegetation unit is conserved statutorily, and a small portion also enjoys protection in the Witdraai Private Nature Reserve. Some 86% has already been transformed, mostly through cultivation. Only the steepest slopes still carry remnants of the natural vegetation. Important taxa include the tall shrub *Searsia pallens* and low shrubs such as *Aspalathus nigra*, *Asparagus capensis* var. *capensis*, *Athanasia trifurcata*, *Elytropappus rhinocerotis* and *Erica setacea*. Succulent shrubs, herbs and graminoids are also present (Rebelo *et al*. 2006). The provincial conservation target for this vegetation unit is 27%. It covers 5.29 ha in the Riviersonderend Complex which relates to 0.01% of the target (Table 2.3) (Rebelo *et al.* 2006; SANBI 2019).

The major threats identified to the Succulent Karoo target are climate change, protected area fragmentation, and detrimental agricultural activities. Major threats to the Fynbos Mosaic target are inappropriate fire regime and invasive alien plants (see sections 2.3.1.2 and 2.3.1.3 below).

2.3.1.1 Plant endemism and species of conservation concern

A list of 69 highly restricted species for the Riviersonderend Complex is given in Table 2.4: Riviersonderend State Land representing 4 Critically Endangered species, 13 Endangered species and 42 Vulnerable species; Vrolijkheid Provincial Reserve representing 1 Critically Endangered species, 1 Endangered species and 8 Vulnerable species (Raimondo *et al.* 2009). Hotspots for records of threatened species include Olifantsberg, Jonaskop, Skilpadkop, Pilaarkop and Tygerhoek/Noordhoek, all within Riviersonderend State Land.

SANBI Custodians of Rare and Endangered Wildflowers (CREW) have undertaken site surveys within the Complex and contributed to the species list of threatened species found as reflected in Table 2.4.

Table 2.4: Summary of highly restricted plant species found within the Riviersonderend Complex (SANBI 2015).

Species	Family	Threatened Status according to Raimondo *et al.* (2009);	Threats* according to Raimondo *et al.* (2009)
Riviersonderend State Land			
Agathosma leptospermoides Sond.	Rutaceae	Vulnerable	• Too Frequent Fire
Anaxeton brevipes Lundgren	Asteraceae	Vulnerable	• Invasive Alien Plants
Anaxeton hirsutum (Thunb) Less.	Asteraceae	Vulnerable	• Invasive Alien Plants
Aspalathus taylorii R. Dahlgren	Fabaceae	Vulnerable	• Invasive Alien Plants
Brunia esterhuyseniae (Strid) Class.-Bockh & E.G.H. Oliv	Bruniaceae	Endangered	• Invasive Alien Plants
Brunia latebracteata A.V.Hall	Bruniaceae	Vulnerable	• Invasive Alien Plants • Too Frequent Fire
Centella thesioides M.T.R.Schub & B.-E. van Wyk	Apiaceae	Vulnerable	• Invasive Alien Plants
Cliffortia cruciata C.M. Whitehouse	Rosaceae	Vulnerable	• Too Frequent Fire
Cliffortia monophylla Weim.	Rosaceae	Vulnerable	• Invasive Alien Plants • Crop Cultivation • Urban Development • Lack of Fire
Cliffortia scandens C.M. Whitehouse	Rosaceae	Vulnerable	• Invasive Alien Plants • Unnatural Fire Regime
Diastella divaricata (P.J. Bergius) Rourke subsp. Montana Rourke	Proteaceae	Vulnerable	• Invasive Alien Plants
Diosma pilosa I. Williams	Rutaceae	Vulnerable	• Invasive Alien Plants • Too Frequent Fire
Diosma thyrsophora Eckl. & Zeyh.	Rutaceae	Vulnerable	• Invasive Alien Plants
Endonema lateriflora (L.f.) Gilg	Penaeaceae	Endangered	• Invasive Alien Plants
Endonema retzioides Sond.	Penaeaceae	Vulnerable	• Invasive Alien Plants
Erepsia oxysepala (Schltr.) L. Bolus	Aizoaceae	Vulnerable	• Invasive Alien Plants
Erica alfredii Guthrie & Bolus	Ericaceae	Vulnerable	• Invasive Alien Plants

Erica caledonica A. Spreng.	Ericaceae	Vulnerable	• Invasive Alien Plants • Too Frequent Fire
Erica columnaris E.G.H. Oliv.	Ericaceae	Vulnerable	• Invasive Alien Plants
Erica galgebergensis H.A. Baker	Ericaceae	Vulnerable	• Invasive Alien Plants • Too Frequent Fire
Erica ignita E.G.H. Oliv.	Ericaceae	Vulnerable	• Invasive Alien Plants
Erica insolitanthera H.A. Baker	Ericaceae	Vulnerable	• Invasive Alien Plants
Erica modesta Salisb.	Ericaceae	Endangered	• Invasive Alien Plants • Too Frequent Fire
Erica nematophylla Guthrie & Bolus	Ericaceae	Vulnerable	• Invasive Alien Plants
Erica oakesiorum E.G.H. Oliv.	Ericaceae	Endangered	• Invasive Alien Plants • Too Frequent Fire
Erica orthiocola E.G.H. Oliv.	Ericaceae	Endangered	• Invasive Alien Plants
Erica sicifolia Salisb.	Ericaceae	Vulnerable	• Invasive Alien Plants
Erica trichophylla Benth.	Ericaceae	Vulnerable	• Invasive Alien Plants
Erica viscidiflora Esterh.	Ericaceae	Vulnerable	• Invasive Alien Plants
Hypodiscus squamosus Esterh.	Restionaceae	Vulnerable	• Invasive Alien Plants • Protea Cultivation • Housing Development
Lachnaea greytonensis Beyers	Thymelaeaceae	Vulnerable	• Inappropriate Fire Regime
Lachnaea rupestris Beyers	Thymelaeaceae	Vulnerable	• Invasive Alien Plants
Leucadendron immoderatum Rourke	Proteaceae	Critically Endangered	• Too Frequent Fire • Population Dynamics
Leucadendron platyspermum R. Br.	Proteaceae	Vulnerable	• Flower Harvesting • Invasive Alien Plants • Too Frequent Fire
Leucospermum lineare R. Br	Proteaceae	Vulnerable	• Invasive Alien Plants • Flower Harvesting

Metalasia tenuis P.O. Karis	Asteraceae	Vulnerable	• Invasive Alien Plants
Mimetes argenteus Salisb. ex Knight	Proteaceae	Endangered	• Invasive Alien Plants • Too Frequent Fire • Groundwater Abstraction • Population Dynamics
Muraltia tenuifolia (Poir.) DC.	Polygalaceae	Vulnerable	• Invasive Alien Plants
Nivenia dispar N.E.Br.	Iridaceae	Vulnerable	• No Threats
Paranomus adiantifoius Salisb. ex Knight	Proteaceae	Endangered	• Invasive Alien Plants • Too Frequent Fire • Disease • Population Dynamics
Paranomus bolusii (Gand.) Levyns	Proteaceae	Vulnerable	• Invasive Alien Plants • Forestry • Cultivation • Mining
Phylica calcarata Pillans	Rhamnaceae	Vulnerable	• Invasive Alien Plants • Crop Cultivation • Urban & Infrastructure Development
Protea longifolia Andrews	Proteaceae	Vulnerable	• Flower Harvesting • Invasive Alien Plants • Population Dynamics
Restio colliculospermus H.P. Linder	Restionaceae	Vulnerable	• Inappropriate Fire Regime
Serruria inconspicua L. Guthrie & T.M. Salter	Proteaceae	Vulnerable	• Invasive Alien Plants • Vineyards
Serruria stellata Rourke	Proteaceae	Vulnerable	• Protea Cultivation
Serruria viridifolia Rourke	Proteaceae	Vulnerable	• Protea Cultivation
Serruria williamsii Rourke	Proteaceae	Endangered	• Too Frequent Fires • Protea Cultivation
Sorocephalus alopecurus Rourke	Proteaceae	Endangered	• Invasive Alien Plants • Too Frequent Fire

			• Population Dynamics
Sorocephalus crassifolius Hutch.	Proteaceae	Critically Endangered	• Population Dynamics
Sorocephalus pinifolius (Salisb. ex Knight) Rourke	Proteaceae	Endangered	• Invasive Alien Plants • Too Frequent Fire • Browsing • Population Dynamics
Spatalla argentea Rourke	Proteaceae	Endangered	• Invasive Alien Plants • Fruit Orchards • Population Dynamics
Spatalla colorata Meisn.	Proteaceae	Endangered	• Invasive Alien Plants • Drought • Population Dynamics
Spatalla propingua R.Br.	Proteaceae	Endangered	• Invasive Alien Plants • Pollution • Population Dynamics
Staavia zeyheri Sond.	Bruniaceae	Critically Endangered (last seen in 1970's)	• Invasive Alien Plants
Stilbe serrulata Hochst.	Stilbaceae	Vulnerable	• Invasive Alien Plants
Watsonia minima Goldblatt	Iridaceae	Vulnerable	• Invasive Alien Plants
Zyrphelis glandulosa Zinnecker-Wiegand	Asteraceae	Vulnerable	• Invasive Alien Plants
Zyrphelis nervosa Zinnecker-Wiegand	Ateraceae	Critically Endangered	• Invasive Alien Plants
Vrolijkheid Provincial Reserve			
Acrodon purpureostylus (L. Bolus) Burgoyne	Aizoaceae	Endangered	• Cultivation • Overgrazing
Amphithalea pageae (L. Bolus) A.L. Schutte	Fabaceae	Vulnerable	• Vineyards • Overgrazing
Aspalathus ferox Hary	Fabaceae	Critically Endangered (Possibly Extinct)	• Vineyards
Aspalathus lactea Thunb. Subsp. *breviloba* R. Dahlgren	Fabaceae	Vulnerable	• Vineyards

			• Urban Development
Astroloba rubriflora (L. Bolus) Gideon F Sm. & J.C. Manning	Asphodelaceae	Vulnerable	• Fruit Orchards • Vineyards
Brunsvigia josephinae (Redouté) Ker Gawl.	Amaryllidaceae	Vulnerable	• Harvesting (medicinal) • Crop cultivation
Chasmanthe bicolor (Gasp.) N.E.Br.	Iridaceae	Vulnerable	• Crop Cultivation • Dam Construction • Invasive Alien Plants
Drosanthemum striatum (Haw.) Schwantes	Aizoaceae	Vulnerable	• Invasive Alien Plants • Wheat & Vineyard Cultivation • Habitat Degradation • Pollution
Lotononis rigida (E.Mey.) Benth.	Fabaceae	Vulnerable	• Crop Cultivation • Urban Development • Overgrazing
Otholobium sp. nov. (Stirton & Zantovska 11281 NBG)	Fabaceae	Vulnerable	• Vineyards • Olive Cultivation
Sceletium varians (Haw.) Gerbaulet	Aizoaceae	Vulnerable	• Vineyards • Urban Development

*Threats apply to the species as a whole and not necessarily to the populations in the PA's.

2.3.1.2 Fire Regime

A sub-optimal fire regime has been identified as a high threat to the Fynbos Mosaic target. Too frequent or ill-timed fires have far-reaching ecological impacts.

Fire is a vital ecological process in fynbos ecosystems. This is one of the key principles identified in the CapeNature Veldfire management policy (CapeNature 2016a). Fires are essential to stimulate recruitment (regeneration) and maintain species richness (Van Wilgen & Forsyth 2008; Forsyth *et al.* 2010).

CapeNature's imperatives of integrated catchment management (ICM) (CapeNature 2016b), as well as the compliance requisites of the National Veld and Forest Fire Act (NVFFA), 1998 (Act No. 101 of 1998) require that the entity is constantly prepared for the occurrence and management of fires that occur on or adjacent to CapeNature-managed land.

The CapeNature Veldfire Management Policy guidelines place emphasis on ecological management and the critical relationship between ecological findings and issues such as legislation and the socio-economic environment.

CapeNature carries out fire operations within the framework of integrated fire management. Integrated Fire Management is an approach to manage both damaging and beneficial fires within the context of the natural environments and socio-economic systems in which they occur by integrating the technical components of fire management (prevention, suppression and use) with key ecological attributes and socio-economic necessities of fire.

Slow maturing, serotinous Proteaceae species are used as indicator species to determine acceptable fire return intervals (Van Wilgen *et al*. 1992). These species have been shown to be good indicators for total ecosystem diversity (Vlok & Yeaton 1999, 2000). The minimum fire return period is dependent on the time it takes before 100% of the slowest maturing non-sprouting Proteaceae species have flowered at least once, or when 50% of the slowest maturing Proteaceae species have flowered at least three times (Le Maitre & Midgley 1992). On the rare occasion when the fire return periods become too long, populations of serotinous Proteaceae will reach senescence, which result in declines in seed production. Short return interval fires that occur before insufficient numbers of serotinous Proteaceae have reached maturity and set seed can lead to population declines or local extinction and cause dramatic structural changes in communities (Van Wilgen 1984; Van Wilgen & Forsyth 2008).

A healthy fire regime is especially important for the Riviersonderend Complex's ecosystem values. It directly affects the viability of the fynbos mosaic of veld ages. A healthy fynbos mosaic promotes overall ecological health by providing a balanced and diverse vegetation structure; which in turn benefits all the species that depend directly and indirectly on healthy fynbos stands. Populations of faunal species are also affected by the fire regime, in particular slow-moving species, and appropriate fire return intervals and preventing fires of an excessive extent (more than 25% of the reserve burining in one event) can play an important role in the species' population dynamics (Van Wilgen & Forsyth 2008). Vegetation and fire indicators should be used to measure and monitor the effectiveness of these management actions.

Furthermore, a healthy fynbos mosaic within the Riviersonderend Complex has multiple human well-being benefits, not only within the Complex but extending into the adjacent zone of influence and ultimately far beyond its boundaries. Examples of such benefits include security from natural disasters, improved health and sanitation as a result of the production of good quantities of clean water, economic development, supporting tourism-based livelihoods and promoting access to natural resources for neighbouring communities.

In terms of the status of the fire regime as of April 2020, a fire covering 5 950 ha occurred in December 2019 on the southern slopes within the Greyton area and hence classified as very large (>5 000 ha). For the northern slopes, the largest proportion in the western section last burnt in 2000, with a smaller area in the central section having burnt in 2009. The northern slopes fire interval can be considered as a good fire interval over these large sections. Prior to the very large 2019 fire, the southern slopes burnt in 2012 or 2015 in the western sections, 2009 in the central sections, and 2014, 2015 and 2018 in the eastern sections. The fire interval can be considered too short and rated as fair or poor in certain sections of the southern slopes. In terms of the age classes, the complex is rated as fair, with two of the fire age classes covering between 5 and 20% of the Complex. This provides an indication of the veld age mosaic. The rating for fire seasonality is rated as fair with 77.5% of the fires occurring in summer/early autumn (December – April). The fire size is another factor in determining the optimal ecological fire regime with a mix of small to large fires, however preventing very large fires (> 5000 ha). The fire size is rated as poor, with the recent 2019 fire contributing to this rating.

2.3.1.3 Invasive Alien Plants

One of the main threats to the Fynbos Mosaic target is the spread of invasive alien plant species. Furthermore, invasive alien plants have a major negative impact on our limited water resources and it is estimated that 6.7% of the water runoff of the entire country is used by these plants (Le Maitre *et al.* 2000; Van Wilgen *et al.* 2008; Van Wilgen & De Lange 2011). Moreover, it has been argued that the future impacts of invasive alien species may be much higher than anticipated, especially on surface water runoff, groundwater recharge and biodiversity, and will in all likelihood continue to spread faster than they can be cleared (Van Wilgen *et al.* 2008). The water yield from mountain catchments invaded by invasive alien species may reduce by more than 30% over 20 years of invasion (Van Wilgen *et al.* 2001). The majority of the fynbos mosaic is compromised by several invasive alien tree species, predominantly pine and hakea.

Species listed and recorded in the Riviersonderend Complex are listed in Table 2.5, along with a general indication of the level of infestation within the complex. The overall density of invasive alien plants of the Riviersonderend Complex is shown in Appendix 1, Map 5, per alien clearing compartment (Natural Biological Alien Land Cover Attribute, NBAL). The size of the NBAL differs across the extent of the Complex, as the higher the density of aliens the smaller the size of the NBAL.

In terms of the most recent mapping of alien densities within the Riviersonderend State Land, the densities vary from very scattered (1-5%) to closed (75-100%). It must however be emphasized that the very scattered class covers the largest extent and

includes most of the higher elevations, where there are mainly scattered populations of cluster pine (*Pinus pinaster*) and silky hakea (*Hakea sericea*).

The northern slopes have very low levels of infestation and are therefore a low priority with only the eastern sections bordering on the Mountain Catchment Area infested with silky hakea.

There are specific patches of denser infestations located on the south-facing slopes, in particular above the Baviaanskloof Valley north-west of Genadendal (as described above), Kromrivier and Happy Valley area, Coetzeesbos above Soetmelksvlei and Tygerhoek/Twistwyk above the town of Riviersonderend. Species which are dominant in the denser infestations are long leaved wattle (*Acacia longifolia*) and black wattle (*Acacia mearnsii*) in the valleys and cluster pines on the higher slopes. The densest infestations are along the riparian zone of the Sonderend River north of the town of Riviersonderend (the only NBAL in the closed class) with black wattle as the dominant invasive alien species.

The invasive alien plants in the western section of the Riviersonderend Complex have been cleared over a number of years with funding provided by the Working for Water Programme Alien vegetation is currently cleared by reserve management according to priorities set during the annual Integrated Work Plan sessions which are included in the Integrated Annual Plan of Operations.

There are currently two commercial plantations in areas neighbouring the Riviersonderend Complex, namely a *Eucalyptus grandis* (saligna gum) plantation at Ganzekraal and a commercial pine plantation at Theewaterskloof/Boskloof. Pine plantations were planted in 1830 at the Genadendal Mission Station for timber production. The Mountain Catchment Area north of Genadendal, including within the Riviersonderend State Land, has been invaded by pine species from the Genadendal plantation.

There has been a steady decrease in the overall level of alien infestation across the Riviersonderend State Land with some areas showing a significant change based on the annual density estimates per NBAL. Comparing density estimates over a 10-year period (2010 – 2019) the majority of the area between Greyton and Riviersonderend has decreased from medium (25 – 50%) – closed density (75 – 100%) to occasional (0.01% - 1%) to scattered density (5 – 25%).

There are currently no significant invasive alien infestations for the Succulent Karoo target within the Complex, however maintenance clearing still takes place. The alien densities for Vrolijkheid Provincial Reserve vary from none (0%) to very scattered (1-5%). The only sections of the reserve which contain invasive alien species are the westernmost section of the reserve with scattered individuals of species as indicated in Table 2.5.

Fire plays a major role in the dynamics of invasive alien plant populations and must be incorporated into the overall management of invasive alien plants. Fire can assist with the controlling dense infestations of mature trees requiring initial clearing that would be very costly and time consuming to clear while simultaneously reducing the dead biomass. Alternatively, fire stimulates the germination of invasive alien plants which are prevalent in fynbos and can result in a significant increase in alien density

following a fire. Invasive alien trees are generally considerably larger than fynbos plants resulting in higher biomass and hence a higher fuel load resulting in more intense and uncontrollable fires. More intense fires can affect the regeneration of fynbos species in additional to other negative impacts (Esler *et al*. 2014). ICM encompassing invasive alien plant and fire management forms Strategy 1 as discussed in Section 10.

A biological control agent has been released within and adjacent to the Riviersonderend Complex to assist with controlling invasive alien plants. *Dasineura rubiformis* (gall midge) was released for black wattle in 2012 along the Sonderend River at Riviersonderend town and has spread across the entire Mountain Catchment Area (Figure 2.12). *Dicomada rufa* (flowerbud-feeding weevil), *Erytenna consputa* (fruit weevil) and *Aphanasium australe* (stemboring beetle) have been released for silky hakea between Greyton and Riviersonderend, and in 2006 at Genadendal and Greyton. *Rhyssomatus marginatus* (seed weevil) has been released at Vrolijkheid Provincial Reserve for sesbania.

Figure 2.12: Galls on Acacia mearnsii (black wattle) formed by Dasineura rubiformis (flower galling midge). Photo: C. Kleinjan (Veldtman & Mdlangu 2016).

Table 2.5: Invasive alien plant species present within the Riviersonderend Complex.

Scientific Name	Common Name	Distribution
Acacia longifolia	Long leafed wattle	**Riviersonderend:** Occasional (0.01 – 1%) over ± half while scattered (5 – 25%) along the Sonderend River near Riviersonderend and west of Genadendal along the Mountain Catchment Area boundary. **Vrolijkheid:** Occasional (0.01 – 1%) along the water furrow.
Acacia mearnsii	Black wattle	**Riviersonderend:** Occasional over sections of the southern slopes mainly in the valleys, with scattered in Noordhoek, and dense (50 – 75%) stands in Coetzeesbos, Kromrivier, Lismore, Hugosdal and the Sonderend River. **Vrolijkheid:** Occasional in the westernmost sections along Keisers River.
Acacia melanoxylon	Blackwood	**Riviersonderend:** Occasional in the Afromontane Forest in Oubos and very scattered (1 – 5%) in sections of upper Baviaanskloof. **Vrolijkheid:** None
Acacia pycnantha	Golden wattle	**Riviersonderend:** Occasional at De Hoek area on the northern slopes. **Vrolijkheid:** None
Acacia saligna	Port Jackson Willow	**Riviersonderend:** Occasional to very scattered in a few disparate sections. **Vrolijkheid:** Occasional in the westernmost sections.
Eucalyptus camaldulensis	Red River Gum	**Riviersonderend:** None **Vrolijkheid:** Occasional in the westernmost sections.
Eucalyptus sp.	Gum species	**Riviersonderend:** Occasional at Silverstream. **Vrolijkheid:** None
Hakea sericea	Silky Hakea	**Riviersonderend:** Occasional over most of the State Land with scattered in parts of the Baviaanskloof and scattered to medium (25 – 50%) in the eastern section and the northern slopes above Boesmansrivier. **Vrolijkheid:** None
Leptospermum laevigatum	Australian myrtle	**Riviersonderend:** Occasional at Elandskloof / Theewaterskloof /Boskloof **Vrolijkheid:** None
Opuntia ficus-indica	Prickly pear	**Riviersonderend:** None **Vrolijkheid:** Occasional to very scattered in the westernmost sections.
Pinus pinaster	Cluster pine	**Riviersonderend:** Occasional to very scattered over most of the State Land with medium to dense in the upper Baviaanskloof and medium in sections of Noordhoek, Greyton, Kromrivier and Hugosdal. **Vrolijkheid:** None
Prosopis glandulosa	Mesquite	**Riviersonderend:** None

Scientific Name	Common Name	Distribution
		Vrolijkheid: Occasional to very scattered in the westernmost sections.
Sesbania punicea	Red sesbania	**Riviersonderend:** None **Vrolijkheid:** Occasional in the westernmost sections.
Solanum mauritianum	Bugweed	**Riviersonderend:** Very scattered within the riparian zone of the Sonderend River. **Vrolijkheid:** None

2.3.2 Freshwater ecosystems

The land parcels of the Riviersonderend Complex fall entirely within the Breede Water Management Area which is the southernmost water management area in South Africa. The greater part of the area is drained by the main-stem Breede River and its main tributary the Riviersonderend River. In addition, the Riviersonderend Complex also falls under the jurisdiction of the Breede-Gouritz Catchment Management Agency (BGCMA). In addition, the Vrolijkheid Provincial Reserve is a member of the Vrolijkheid Water Users Association.

Most tributaries of the two main-stem rivers drain from the Riviersonderend mountain range (Appendix 1, Map 6), which consist mainly of the underlying high-water yielding arenite (sandstone) geology. The mountain catchment is considered to be a national strategic water source area for surface water provision and forms part of the extended Boland strategic water source area (Le Maitre *et al.* 2018). The southern slope tributaries provide surface water for towns like Genadendal, Greyton and Riviersonderend, while they drain into the Riviersonderend (or Sonderend) River. The northern slope tributaries drain into the middle Breede River and add to water provision for towns such as McGregor and to some degree Robertson. This mountain catchment, however, is mainly surrounded by agricultural areas and most water is used for a variety of farming practices, including vineyards, fruit orchards and livestock farming.

Other freshwater ecosystems found within the Riviersonderend Protected Area boundaries and the greater Mountain Catchment Area include wetlands and groundwater dependent ecosystems. Although few wetlands have been mapped to occur within the mountain catchment or Vrolijkheid Provincial Reserve (Nel *et al*. 2011a, 2011b) a small variety of types are thought to be present, including the sensitive hillslope seeps. Some of these wetlands would be dependent on groundwater and/or aquifer water sources and may also contribute to the sustained base flow for many of the perennial rivers. Moreover, the mountain catchment as a whole also serves as an important recharge zone for the aquifers present in the upper and lower lying areas.

Generally, the rivers and wetlands, and their buffer zones, which are located within the protected area boundaries are found to be in at least a near natural or natural condition. However, there is a degree of intrusion by invasive alien plant species. In addition to the presence of the invasive alien (or invasive non-indigenous) plant species, further pressures on the hydrological functioning of the aquatic systems in

these catchments include the ever-increasing water demands for both the urban areas and surrounding agricultural practices.

Therefore, for most of these freshwater ecosystems, important factors regarding catchment management include the clearing of invasive alien plant species within the Riviersonderend Complex boundaries, specifically within riparian zones and wetlands. Clearing of the invasive alien plants, such as Australian wattles (*Acacia mearnsii*), pines (*Pinus* spp.), red river gums (*Eucalyptus camaldulensis*) and poplars (*Populus* spp.) is also important in areas adjacent to the protected area sites (i.e. zone of influence) and is discussed in more detail in Section 2.3.1.3. In fact, the conservation of the recharge potential of these catchments to not only the surface water ecosystems, but also the aquifers underlying and extending from the mountains is becoming increasingly important. Beyond the boundaries of the Riviersonderend Complex, there are several more factors that also have an impact on the freshwater ecosystems. It is a common practice that rivers are blocked to varying degrees by the presence of diversion weirs just outside of the protected area boundaries. These weirs tend to block off all the natural flow to downstream areas during the dry months and divert it to for example farm dams. The lowland sites are also under increased threat from unsustainable land-use activities related to especially agricultural practices within the rivers and wetlands and their buffer zones.

Another general and significant threat to freshwater ecosystems and water provision are the impacts associated with climate change. It is anticipated that the Western Cape (including the Riviersonderend Complex) will become drier as a result of climate change (Holmes *et al*. 2016). Mitigation for the effects of climate change is difficult and here adaptive management that is informed by thorough long-term monitoring, including the collection of hydrological data for flow regime determination, is of the utmost importance. Flow regime data, together with rainfall data can inform the establishment of a link between surface water (hydrological), groundwater and aquifers (geo-hydrological) and rainfall conditions. This in turn will provide insight into for example the possible impacts imposed by water abstraction (surface or ground) on surface or groundwater flows (Rose & Conrad 2006).

2.3.2.1 Groundwater

The groundwater systems associated with the Riviersonderend Complex fall mainly within the Table Mountain Group quarzitic sandstone and subordinate shale formation aquifers. The Vrolijkheid Provincial Reserve on the other hand is largely underlain by shale formations (Bokkeveld Group), with some outcroppings of sandstones in the eastern section. The major Table Mountain Group formations present include the Skurweberg and to some degree Peninsula in the higher mountain areas, with the Rietvlei and Goudini formations underlying in the southern and northern slopes respectively. Of these formations, the Peninsula layer tends to have the highest storage volume of groundwater. Additionally, the Peninsula Formation has the highest potential for recharge due to where it is situated topographically, forming the high mountain ranges and summits, where precipitation levels tend to be higher, as is the case in the Boland Mountains (Colvin *et al.* 2009). The Skurweberg Formation sub-aquifer on the other hand has a lower recharge potential. In general, the Peninsula aquifer (exposed, unconfined to confined sections) contributes mainly to rivers through surface run-off, hillslope interflow and base flow of larger river systems. In many cases,

the springs emanating from the confined sections of this aquifer tend to be perennial and thought to be less impacted by groundwater abstraction and seasonal variation (Colvin *et al.* 2009). In contrast, the shallower Skurweberg "sub-aquifer" is more responsive to precipitation events and has more unconfined sections, leading to lower water volumes and more seasonal springs. Similar to the case in the Boland Mountains, it is likely that contributions to river base flow from this sub-aquifer would generally be through direct inflow into an overlying river channel (Colvin *et al.* 2009).

When considering groundwater quality, there is a general trend of increased electrical conductivity (EC) levels from west to east in the Riviersonderend mountain catchment, i.e. 0 – 70 mS/m near Helderstroom in the west, to > 520 mS/m near the Boesmans River. Groundwater quality varies between 150 – 370 mS/m at Vrolijkheid Provincial Reserve. There is also some variation in the aquifer types present. All aquifers are considered to be major fractured aquifers as would be expected for Table Mountain Group Aquifers, with some variation in water yields (Parsons & Conrad 1998). Water yields (in l/s) tend to be higher in the western parts (2.0 -5.0 l/s), whereas yields tend to be lower towards the drier eastern parts (i.e. 0.5 – 2.0 l/s). These classifications are reflected in the Department of Water Affairs Aquifer Classification Map (DWAF 2012a).

With regards to the vulnerability of aquifers to contamination by pollutants, the PA land parcels in the west tends to have a moderate vulnerability, while aquifers to the east of the mountain catchment are considered to be the most vulnerable (DWAF 2012b). Moreover, this same pattern exists for the aquifer susceptibility to anthropogenic contamination. Aquifers in the west tend to be less susceptible (medium) to contamination than those in the eastern parts (high susceptibility) (DWAF 2012c).

In summary, it is clear that although there is some variance in the aquifer types contained within the Riviersonderend Complex, the Table Mountain Group aquifers are prevalent in the mountain catchments. Additionally, the higher rainfall (linked to water yield) in the mountain catchments of the Complex leads to a moderate to high groundwater recharge in these areas, with a lower recharge for Vrolijkheid Provincial Reserve (Nel *et al.* 2011a). Due to these characteristics, i.e. moderate to high yield of good quality water, together with the pressures imposed by drought events, the use of groundwater to augment water supply for urban and agricultural areas could become an increasing threat to this ecosystem in the future. However large-scale abstraction has not yet been identified as a significant threat as it is in the Boland Complex. It is anticipated that increased abstraction of groundwater will result in ecological impacts on freshwater (rivers and wetlands) and terrestrial ecosystems in the catchment. Some work has been done in the Boland Mountain complex area, to determine the extent and effect of potential impacts (Colvin *et al.* 2009), however, information is lacking for the Riviersonderend catchments. Therefore, the long-term effects of increased groundwater abstraction in the future can only be estimated. One example of the detrimental effects of over abstraction of groundwater in the Kammanassie Nature Reserve area was assessed and documented in a study done by Cleaver *et al.* (2003). In this study, observed impacts included plant water stress, reduction in surface water flow and the drying up of some of the natural springs. These potential impacts, coupled with the effects of climate change, does not bode well for the ecosystems that are associated with groundwater and/or aquifers.

In future, should borehole development take place within the Riviersonderend Complex, aspects that need to be monitored in the Complex should include the water level of boreholes, and if possible, also the physico-chemical variables which include water temperature, pH and electrical conductivity. This should be done according to the CapeNature Groundwater Monitoring Protocol. Currently there is only one borehole being abstracted from for CapeNature purposes. It is located on the Vrolijkheid Provincial Reserve and the water is used to supplement the water needs for irrigation on the grounds within the development zone.

2.3.2.2 Rivers

The upper sections of the Meul, Gobos, Soetmelksvlei and Baviaans Rivers (Figure 2.13), as well as an unnamed tributary of the upper Riviersonderend (near the town of Helderstroom) fall within the reserve boundaries of the Riviersonderend mountain catchment. These rivers all drain the south facing slopes of the Riviersonderend mountain catchment and flow into the upper and middle sections of the Riviersonderend River which eventually flows into the Breede River upstream of the town of Swellendam. The catchments of the Gobos, Soetmelksvlei and Baviaans Rivers have been highlighted as indigenous fish sanctuaries in the National Freshwater Ecosystem Priority Areas (NFEPA) project (Nel *et al*. 2011a; see Table 2.6). The Hoeks River catchment, which is located in the Riviersonderend Mountain and flows towards McGregor, joins the Houtbaai tributary and becomes the Keisers River (Nel *et al*. 2011b). The Keisers River in turn flows into the Konings River which joins the Breede River (Nel *et al*. 2011b). According to Nel *et al.* (2011b) the Hoeks River is also highlighted as a fish sanctuary as well as a FEPA river catchment. This area also includes some wetland FEPA's along the mid-section of the Keisers River, which forms a part of the Vrolijkheid Provincial Reserve boundary (Nel *et al*. 2011b). The Doring and Meul Rivers located within the western boundaries of the Riviersonderend catchment is not highlighted as either fish sanctuaries or river FEPA's, however these rivers provide important habitat for indigenous fish species as well as water provision into the zone of influence (Nel *et al*. 2011b).

Figure 2.13: Baviaans River upstream of Genadendal. Photo: Martine Jordaan.

Table 2.6: The National Freshwater Ecosystem Priority Area status and estimated health condition of the rivers of the Riviersonderend Complex and the mountain catchment, from west to east. Health scores are defined as follows: natural (A), good-natural (AB), good (B), fair (C), and degraded (D).

River	Condition *	NFEPA Status	River Reach / Type
Donkerhoekberg (6283)			
Riviersonderend	C	No NFEPA status	Lowland – main stem
Riviersonderend tributary	C	No NFEPA status	Foothills
Riviersonderend (6275 - South)			
Spreeudrifspruit	AB**	No NFEPA status	Mountain stream
Meerlustkloof	AB**	No NFEPA status	Mountain stream – foothills
Meul	AB**	No NFEPA status	Mountain stream – foothills
Baviaans	AB**	NFEPA Fish sanctuary	Mountain stream – foothills
Riviersonderend (6275 – North)			

River	Condition *	NFEPA Status	River Reach / Type
Keisie / Doring	AB**	No NFEPA status	Mountain stream – foothills
Unnamed tributary (Breede)	AB**	NFEPA catchment	Mountain stream – foothills
Unnamed tributary (Poesjenels)	AB**	NFEPA catchment	Mountain stream – foothills
Poesjenels	B**	No NFEPA status	Mountain stream – foothills
Riviersonderend (6260 – South)			
Gobos	AB	NFEPA Fish sanctuary	Mountain stream – foothills
Elandskloof	C	No NFEPA status	Mountain stream – foothills
Soetmelksvlei	C	Fish Support Area	Mountain stream – foothills
Krom	AB	No NFEPA status	Mountain stream – foothills
Slang / Ganskraal	B	No NFEPA status	Mountain stream – foothills
Bok	AB**	No NFEPA status	Mountain stream – foothills
Unnamed tributary (Riviersonderend)	AB**	No NFEPA status	Mountain stream – foothills
Riviersonderend (6260 – North)			
Rietvleirivier (tributary of Poesjenels)	AB**	No NFEPA status	Mountain stream – foothills
Konings	AB**	NFEPA catchment	Mountain stream – foothills
Takkap (tributary of Houtbaais)	AB**	No NFEPA status	Mountain stream
Houtbaais	AB	No NFEPA status	Mountain stream – foothills
Hoeks	AB	NFEPA Fish sanctuary	Mountain stream – foothills
Groot	AB**	No NFEPA status	Mountain stream – upper foothills
Boesmans	AB	NFEPA catchment	Mountain stream – foothills
Vrolijkheid Provincial Reserve			
Keisers	D	NFEPA catchment	Lowland

*Condition estimated through a combination of real data, desktop study and specialist input.
**Condition unknown, but expected value given.

Biomonitoring of headwater streams, such as those within the boundaries of the Riviersonderend Complex can be used to establish reference/benchmark conditions for a river system that might be impacted on locally or in the lowland areas. Benthic macro-invertebrates can be used to monitor both water quality and habitat diversity over the long term, using the South African Scoring System version 5 (SASS 5; Dickens & Graham 2002) method, which is extensively used (e.g. River Health Programme). Macro-invertebrate taxa are given a score out of 15, with higher scores for more sensitive (in terms of water quality) taxa, and lower scores for taxa more tolerant to pollution. The final scores take into account the sum of the scores per taxon (SASS Score) observed and the number of different taxa, from where an Average Score per Taxon (ASPT) is calculated. Both the SASS Score and the ASPT is used to determine the health of a river site or system, through the ecological banding system (Dallas 2007). These two scores are plotted on two axes and each point falls into an ecological category, ranging from natural to critically modified (see Table 2.7). In the Riviersonderend Complex rivers, an ASPT score of eight or more would to indicate a good to natural condition ecosystem. There is likely to be seasonal variation in scores (Dallas 2004), so allowances should be made for this e.g. fewer taxa are expected to be collected in Western Cape rivers during the high flow winter months compared to spring and summer sampling events (Dallas 2004).

Table 2.7: Ecological categories for interpreting SASS 5 data. Adapted from Dallas & Day (2007).

Ecological Category	Category Name	Description
A	Natural	Unmodified, natural
B	Good	Largely natural with few modifications
C	Fair	Moderately modified
D	Poor	Largely modified
E	Seriously modified	Seriously modified
F	Critically modified	Critically or extremely modified

A 2019/2020 summer baseline freshwater survey for the Riviersonderend Complex has provided preliminary results using the SASS method. The sites sampled were located within the upper and lower foothill reaches of the rivers and fall into the transition area between the Southern Coastal Belt and the Southern Folded Mountain Level 1 ecoregions (Kleynhans *et al.* 2005). Fourteen river sites were sampled (Figure 2.14). The southern sites (Riviersonderend River catchment; including the Meerlustkloof, Gobos, Baviaans, Soetmelks, Meul and Ganskraal rivers) were sampled during early summer (December 2019). The northern sites (middle Breede River catchment; including the Boesmans (upper and lower), Houtbaais (upstream and downstream of weir), Hoeks, Doring, Poesjenels Rivers and a Vink River tributary) were sampled during late summer (February 2020).

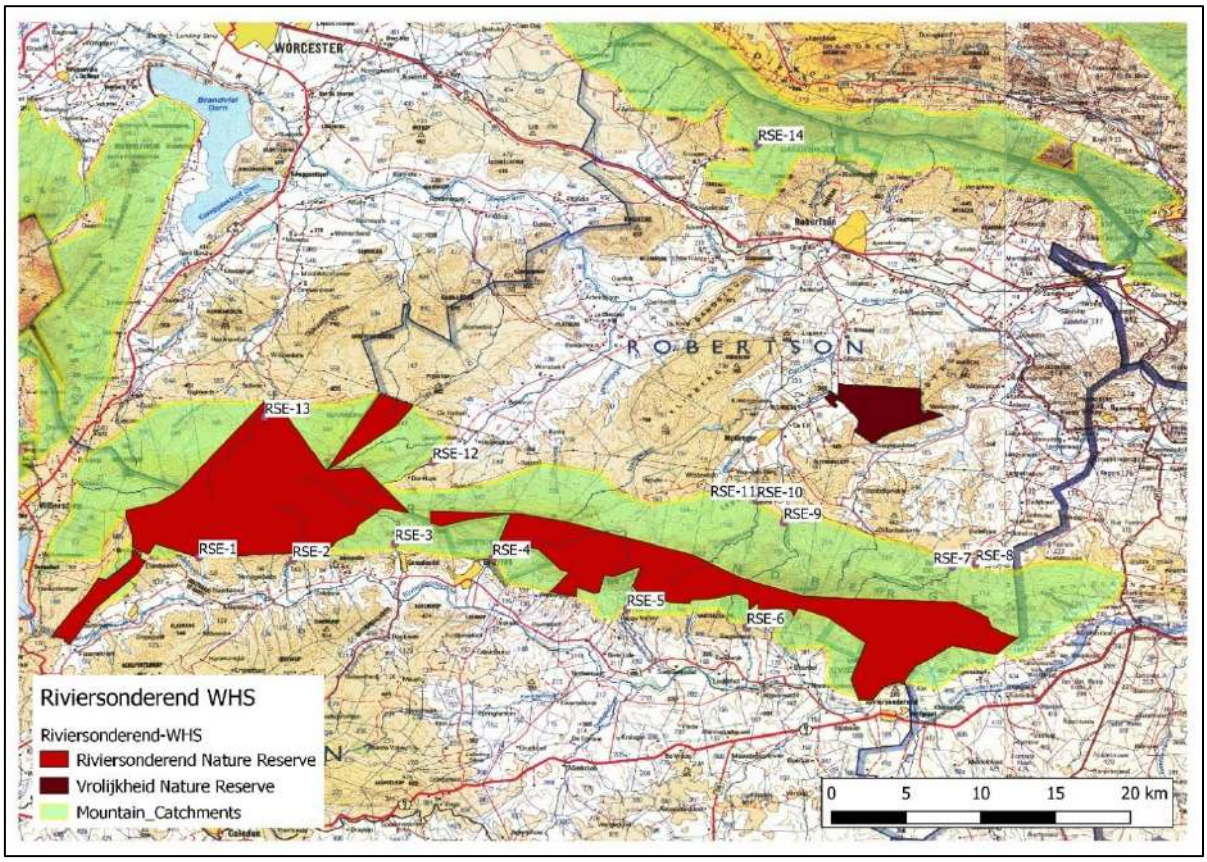


Figure 2.14: Location of the sampling sites for the 2019/2020 summer river survey sites for both SASS 5 ecological condition and fish surveys. The codes for the sampling sites as indicated on the map are located on the following watercourses: Meerlustkloof (RSE-1); Meul (RSE-2); Baviaans (RSE-3); Gobos (RSE-4); Soetmelkskraal (RSE-5); Ganskraal (RSE-6); Boesmans – upstream (RSE-7); Boesmans – downstream (RSE-8); Hoeks (RSE-9); Houtbaais – upstream (RSE-10); Houtbaais – downstream (RSE-11); Poesjenels (RSE-12); Doring (RSE-13); and Vink (RSE-14).

Based on data collected, the riparian zones of many of the sites were still intact, consisting mainly of indigenous plant species (Jordaan & Gouws 2020), with the exceptions where riparian zones are not intact as a result of the presence of invasive alien plant species, including *Acacia mearnsii* (Black Wattle), a recent fire event and the presence of abstraction weirs. The riparian zone and instream impacts were reflected in the SASS 5 results, where mainly low scoring, more tolerant invertebrates were collected at the lower lying sites, indicating lower ecological health conditions (i.e. moderately to largely modified; see Figure 2.15 and Figure 2.16). In contrast, the rivers at sites close to or within the Riviersonderend State Land boundaries and upstream of weirs were generally healthy and all contained a diversity of both lower scoring and more sensitive, high scoring invertebrates (see Figure 2.15 and Figure 2.16).

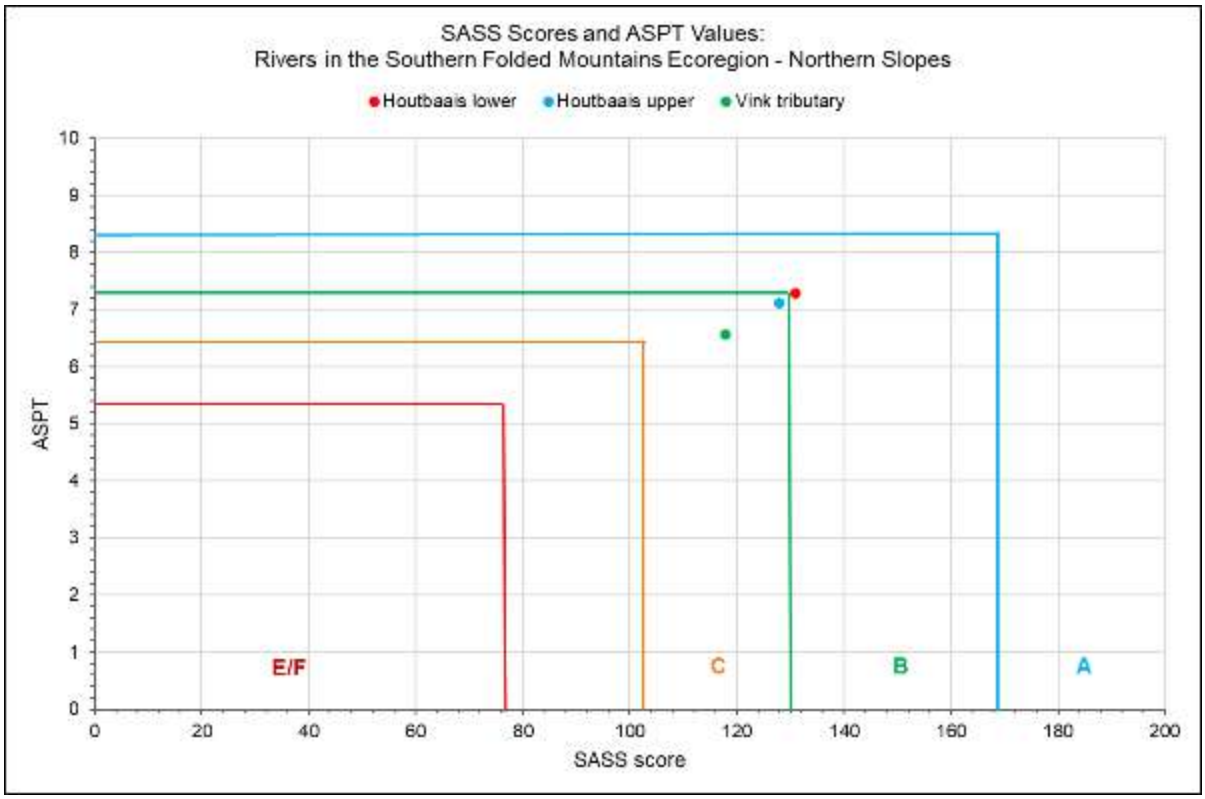


Figure 2.15: The SASS scores and ASPT values at the three sites (coloured circles) sampled during the Riviersonderend Complex freshwater survey located in the upper zone of the rivers in the Southern Folded Mountains ecoregion on the northern slopes. The coloured biological bands represent the changes in health condition, from A to E/F as described in Table 2.7 (Dallas 2007).

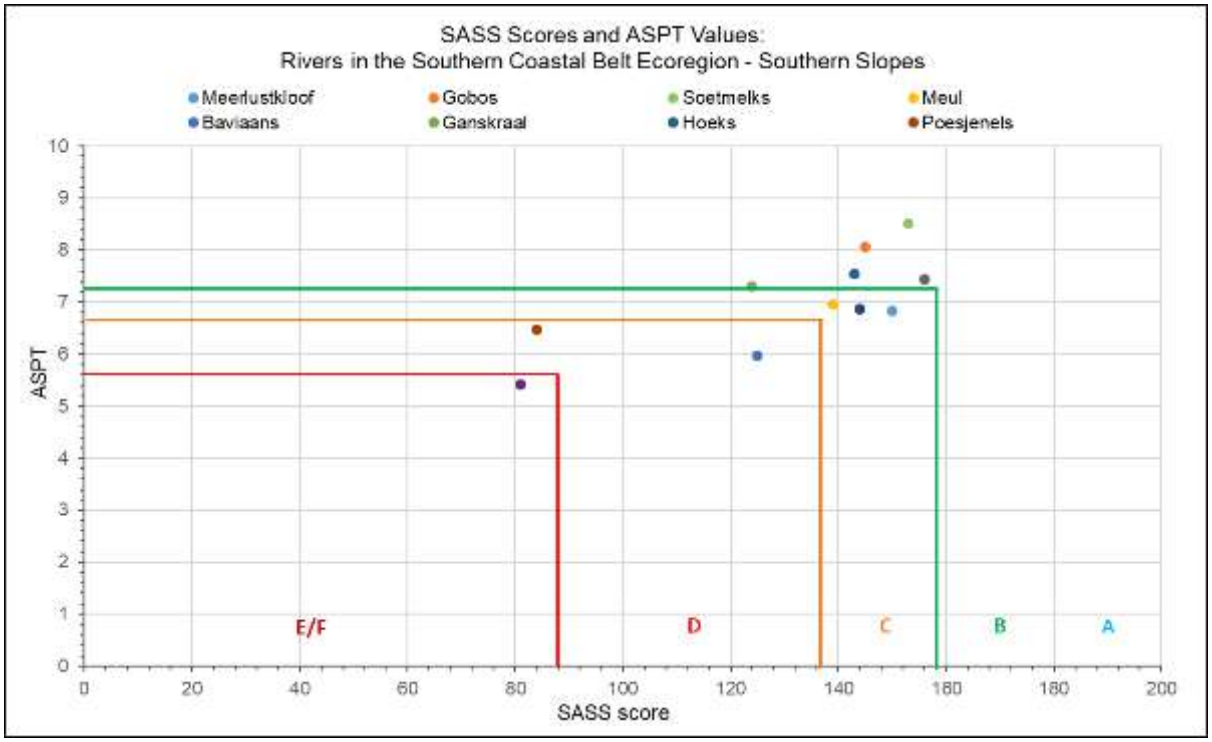


Figure 2.16: The SASS scores and ASPT values at the 10 sites (coloured circles) sampled during the Riviersonderend Complex freshwater survey located in the upper zone of the rivers in the Southern Coastal Belt ecoregion on the southern slopes. The coloured biological bands represent the changes in health condition, from A to E/F as described in Table 2.7 (Dallas 2007).

The threats that have been identified for the river ecosystems located on the Riviersonderend Complex include the presence of invasive alien plant species within the riparian zones and in wetlands and their buffer areas. The presence of structures within the river channels (e.g. weirs) also pose a threat to the ecological function of rivers. With regards to the maintenance of the riparian zones of rivers, the removal of invasive alien trees should be prioritised. Not only will this improve the health of the riparian zones and the instream environments, but it will also allow for the release of more good quality water. Moreover, the establishment of indigenous vegetation after alien clearing should be encouraged to also enable the re-establishment of faunal groups, such as for example aquatic macro-invertebrates (Samways *et al.* 2010b).

The reduction in river flow, in the form of over-abstraction of surface water and groundwater, is also a threat, more so within the zone of influence surrounding the Riviersonderend Complex. The over-abstraction of water is often linked to over allocation of water from the relevant authorities, or in the case of the increasing threat of groundwater over-abstraction, unregulated water use. Most of the rivers are completely diverted by weirs just outside the boundary of the relevant protected area, with little or sometimes no flow reaching the downstream reaches. Moreover, major water off-take points are known to exist on at least five of the rivers originating within the mountain catchment and the Riviersonderend Complex. These include a weir within the Riviersonderend State Land boundary on a tributary of the Riviersonderend River upstream of Riviersonderend town, an instream dam/weir in the Elandskloof

River, a weir upstream of Highlands farm within the State Land on the Doring River and weirs on both the Meul and Meerlustkloof rivers.

Consequently, when it comes to the management of rivers, it is important to consider activities in the entire catchment of the river. This is especially important for rivers that are considered priorities, i.e. Freshwater Ecosystem Priority Area (FEPA) rivers and catchments and fish sanctuaries (Nel *et al.* 2011a, 2011b). For these rivers, flow volume, timing and frequency is of particular importance. Therefore, monitoring the flow regime of strategically selected rivers within the protected area Complex, would add a lot to tracking flow patterns linked to for example invasive alien plant clearing in the catchment. This in turn will highlight the importance of adaptive and sustainable management of our freshwater ecosystems, especially in relation to the ecological services the Riviersonderend Complex provides with regards to water provision. This is particularly important in light of the current and future effects of climate change. Here both rainfall and ambient temperature data would add a lot to the assessment of the flow regime data collected through long-term monitoring. Additionally, monitoring of the flow regime, together with water quality assessments (using bio-indicators such is macro-invertebrates) could significantly add to the informed adaptive management of mostly upper reaches of the rivers originating within the Complex.

2.3.2.3 Wetlands

Not many wetlands have been mapped to occur within the Riviersonderend Complex (Nel *et al.* 2011a, 2011b). However, within those that have been mapped, several higher and lower altitude hillslope seeps, with the likelihood of some bench flats are located on all Riviersonderend Complex parcels within the Riviersonderend mountain catchment. Linking to the above section on groundwater, seepage wetlands are often associated with the areas where the Table Mountain Group Aquifer daylights (is exposed to the surface). Sections of palmiet (*Prionium serratum*) dominated floodplain wetlands associated with the Riviersonderend River falls on the border of the Donkerhoekberg land parcel and further east, on the border of the Riviersonderend State Land near Riviersonderend town. A section of the Keisers River floodplain wetland borders on the western most land parcel of the Vrolijkheid Provincial Reserve. There is also the possibility of the presence of some valley-bottom wetlands in this general area as well. The dominant wetland vegetation type in the mountain catchment falls into the Southwest Fynbos bioregion, while wetlands on Vrolijkheid Provincial Reserve falls within the ecotone between the East Coast Renosterveld and the Rainshadow Valley Karoo bioregions. The threat statuses of the mapped wetlands vary from least threatened and well protected to critically endangered and poorly protected (see Table 2.8). According to the NFEPA wetlands map layer data, all of the wetlands mapped in protected areas are in a good to natural condition.

Table 2.8: The threat status and protection level of the different wetland types of the Riviersonderend Complex. Threat status is defined as follows: Least Threatened (LT), Vulnerable (VU), Endangered (EN), and Critically Endangered (CR).

Wetland Type	Threat Status	Protection Level
Riviersonderend State Land		
Southwest Sandstone Fynbos seeps	Least Threatened	Moderately protected
Southwest Sandstone Fynbos flats	Least Threatened	Well protected
Southwest Sandstone Fynbos floodplain	Critically Endangered	Poorly protected
Vrolijkheid Provincial Reserve		
East Coast Shale Renosterveld	Unknown	Unknown
East Coast Shale un-channelled valley bottom	Unknown	Unknown
Rainshadow Valley Karoo floodplain	Critically Endangered	Not protected
Rainshadow Valley Karoo un-channelled valley bottom	Critically Endangered	Poorly protected

According to the NFEPA wetlands spatial layer data, the majority of the wetlands mapped within the protected areas are in a good to natural condition, as would be expected. However, wetlands outside of the protected areas are generally considered to be impacted in some way, with either modified, degraded or transformed health conditions. Wetlands in general are one of the most highly threatened freshwater ecosystems globally, especially those located in the lowland areas (Gouws *et al.* 2012; Gouws & Gordon 2017). Despite these levels of threat, they continue to be the least studied and monitored freshwater ecosystem in the country. It is with this in mind that a greater understanding of the health of wetlands and other freshwater ecosystems located within the boundaries of the Riviersonderend Complex is needed. This is important, especially when managing a protected area within a strategic water source area (WWF-SA 2013a, 2013b; Le Maitre *et al.* 2018) with the entire catchment (i.e. the "catchment to coast" concept) in mind.

In order to conduct initial baseline assessments and biomonitoring of strategically selected wetland ecosystems, the simplified version of the WetHealth (Macfarlane e*t al.* 2008) assessment method should be used (see Wetland Monitoring Protocol). Some baseline wetland ground-truthing surveys have been conducted on private land in the upper Riviersonderend catchment and on reserve surveys be added to this for the identification of monitoring sites. Long-term monitoring sites should represent a variety of different wetland types and be chosen based on their threat status (e.g. vulnerable, endangered or critically endangered), whether they are groundwater or aquifer dependent ecosystems or where they might be impacted on by any development within the protected area. If a wetland might be impacted on by threats from outside the boundaries of the protected area, like for example groundwater abstraction, these sites should also be considered for long-term monitoring. Furthermore, with the additional threats associated with the presence of invasive alien vegetation and other physical impacts, the vegetation structure of the buffer areas of the wetland systems should also be maintained as close to natural as possible. At least within the first 32 m of any wetland edges.

2.4 Biodiversity Context: Taxa

2.4.1 Invertebrates

Invertebrates are a vital component of terrestrial ecosystems and constitute more than 80% of all animal diversity. They perform important ecosystem functions (McGeoch 2002; Samways *et al.* 2010a, 2012) such as primary production, nutrient recycling, predation, herbivory and competition. The Cape flora, in particular, is dependent on specialised pollination guilds and insect-driven ecological processes (Johnson 1996).

The main threats to invertebrates are habitat destruction and transformation and invasive alien plants. Climate change, together with its knock-on effects, is also a threat. For example, climate change is likely to impact butterflies because of their inability to adapt to changes in vegetation composition, microclimate, and reductions in or loss of host plants and host ants (Mecenero *et al.* 2013). The climate change-related increase in frequency and intensity of fires that is being experienced in the Western Cape can be disastrous for highly localized invertebrates with limited dispersal abilities. Anthropogenic fires add to the stress on these populations and their impacts can be widespread, e.g. the 2019 Greyton fire burnt about 5 950 ha. Fires can also affect soil fauna and microbial communities.

Invertebrates can be protected to some degree by managing ecosystems according to the appropriate fire regimes and by removal of invasive alien plants, especially along watercourses. There are correlations between insect species richness and biomes in the Western Cape (Procheş & Cowling 2006, 2007; Procheş *et al.* 2009), thus protection of the Complex's floral diversity might provide some protection for its invertebrate diversity (Samways *et al.* 2012).

There is no invertebrate species list available for the Riviersonderend Complex but based on Citizen Science (iNaturalist, and Virtual Museum) records for the Robertson Karoo (iNaturalist 2020) and for the complex and surrounds (FPIAO 2020), invertebrate diversity is expected to be high.

2.4.1.1 Terrestrial Invertebrates

The orders Hymenoptera and Diptera contain many pollinators, which drive and maintain the health of ecosystems. The biggest threat to insect pollinators is habitat destruction or transformation resulting in a decrease in available forage (Nicolson & Wright 2017). Other threats include agricultural pesticides such as neonicotinoids, other volatile pollutants, pests, diseases and climate change.

The Cape honey bee, *Apis mellifera capensis,* is an important pollinator in the Riviersonderend Complex and is affected by all of the above threats (WCG 2019). The primary objective of CapeNature's draft bee policy ("Policy for the Regulation and Management of Honey Bee Colonies in CapeNature Protected Areas") is to safeguard healthy, natural and genetically diverse honey bee populations. This allows protected areas to operate as refugia for locally adapted bee populations and contributes towards a network of healthy source honey bee populations that can disperse naturally throughout the rest of the province. In this way, protected areas such as the Riviersonderend Complex provide support to apiculture in the Western Cape. Because of the risks posed by commercial bee-keeping to wild bee populations (e.g. the

introduction of pests or diseases), commercial bee-keeping, including the use of catch boxes, is not permitted in the complex.

Thirty-eight butterfly species are endemic to the Western Cape Province (Mecenero *et al*. 2013). Of these, one threatened species (Kaplan's skolly *Thestor kaplani*) has been recorded in the Riviersonderend Complex and two other taxa of conservation concern have been recorded in the 10-km buffer around the complex (FPIAO 2020; Table 2.9). Kaplan's skolly is Critically Endangered (Morton 2016a). It occurs mainly in South Sonderend Sandstone Fynbos in the Riviersonderend Mountains. It has been recorded at only two locations but has not been seen at one of these for some years after a fire in the area (Morton 2016a). Invasive alien trees such as pines and Hakea pose a threat to this butterfly. The species occurs along popular hiking trails where the presence of hikers may disturb the habitat (Morton 2016a). Riley's opal *Chrysoritis rileyi* (Endangered) is a range-restricted butterfly that is a Western Cape endemic. It has been recorded within the zone of influence of the Complex in the west, where it is threatened by dam development and invasive alien species, particularly *Acacia saligna* (Selb 2016). The dark ranger *Kedestes niveostriga schloszi* (Vulnerable) is known from the foot of the Riviersonderend Mountains, Bain's Kloof and in Du Toit's Kloof. In the Greyton area, threats to this butterfly include habitat degradation as a result of urban encroachment, livestock grazing and invasive alien vegetation. Surveys of Greyton have yielded only one individual of this species since 2015 (Morton 2016b).

Table 2.9: Threatened butterfly taxa recorded in the Riviersonderend Complex and in the 10 km buffer around the Complex.

Scientific Name	Common Name	Recorded Location	Conservation Status (Global)
Thestor kaplani	Kaplan's skolly	Complex	Critically Endangered (Morton 2016a)
Chrysoritis rileyi	Riley's opal	Buffer	Endangered (Selb 2016)
Kedestes niveostriga schloszi	Dark ranger	Buffer	Vulnerable (Morton 2016b)

Myrmecochory, or seed dispersal by ants, is another important ecological function performed by invertebrates in the Fynbos Biome (Le Maitre & Midgley 1992). Approximately 20% of strictly Fynbos plant species are dependent on this process (Johnson 1992), with 78 genera containing species that are ant-dispersed (Bond & Slingsby 1983). The seeds are buried which allows for protection from fire. Seven ant species have been recorded within 10-km of the reserve complex via the iNaturalist website, including the myrmecochorous hairy sugar ant (*Camponotus niveosetosus*) (iNaturalist 2020). It has been demonstrated that in the northern part of the Cape Floristic Region, climate change is likely to result in considerable changes to ant assemblages. Given the importance of ants for ecosystem functioning, these responses will probably not be a response solely to vegetation changes but might in themselves give rise to vegetation changes (Botes *et al*. 2006).

Another ecologically important invertebrate group is the Arachnida. A total of 966 spider species have been recorded in the Western Cape (Dippenaar-Schoeman *et al.* 2015) and more than one-third of these are endemic to the province. There is no spider species list available for the Riviersonderend Complex but there are Citizen Science

records of baboon spiders *Harpactira* spp. as well as a number of scorpions for the complex (FPIAO 2020).

2.4.1.2 Freshwater Macro-invertebrates

Mountainous and upland catchment areas are considered important not only for the provision of good quality of water, but also because of the substantial contributions they make to biodiversity (Furse 2000; Dallas & Day 2007). They often serve as refuge areas for invertebrate species and in some cases serve as habitat for species confined to these upland freshwater ecosystems (Palmer *et al*. 1994; Dallas & Day 2007). This is especially prevalent in the naturally acidic and low nutrient headwaters of rivers in the Cape Floristic region, which are underlain by the Table Mountain Group quartzitic sandstones, as are found within the Riviersonderend Mountains. These conditions have resulted in high aquatic species richness and also high degrees of endemism in the CFR as a whole (De Moor & Day 2013; Gouws & Gordon 2017). There is also a high level of genetic diversity within several invertebrate taxa (i.e. taxonomic disparity; De Moor & Day 2013), which has resulted in the formation of the concept of "catchment signatures" with regards to the invertebrate assemblages present in the different river catchments of the CFR (King & Schael 2001; Dallas & Day 2007). Due to the levels of sensitivity linked to many of the endemic invertebrate taxa within these catchment signature assemblages, this faunal group is used extensively as indicators of river health (Dickens & Graham 2002), such as the SASS 5 sampling which has been undertaken for the Complex as described in Section 2.3.2.2.

The SASS sampling as described in Section 2.3.2.2 provides valuable data regarding the ecological condition of rivers, however it also provides useful information regarding the freshwater invertebrate diversity. Taxa found within the rivers within or adjacent to the Complex included both low scoring, tolerant taxa such as Chironomidae, (midges) and more sensitive, high scoring invertebrates such as Notonemouridae, (stoneflies). The higher lying sites supported several of the South Western Cape endemic insect families (e.g. in the Soetmelks River), including from the mayfly family Teloganodidae and several cased caddisfly families, namely Barbarocthonidae, Glossosomatidae, Petrothrincidae and Sericostomatidae (Jordaan & Gouws 2020). Information on the diversity of species within these South Western Cape endemic and other families is largely lacking, however, recent work on the phylogenetics of Teloganodidae mayflies has added about 22 potentially new species and seven undescribed genera, including surveys in the upper reaches of rivers within the Riviersonderend Complex (Pereira-da-Conceicoa 2016).

There are 76 Odonata species in the Western Cape (Underhill *et al.* 2018). Four taxa have been recorded in the Riviersonderend Complex by Citizen Scientists (FPIAO 2020; iNaturalist 2020) but none of these are threatened. Three dragonfly species of conservation concern have been recorded in the 10 km buffer around the complex (Table 2.10). The Cape thorntail (*Ceratogomphus triceratic*us, Near Threatened) is a highly localized and rare Western Cape endemic that occurs up to an elevation of about 800 m, along wide, shallow, bush-lined and rocky streams and rivers (Samways & Simaika 2016). Threats include habitat degradation due to invasive alien trees, habitat loss caused by viticulture and to a lesser extent, cattle farming and plantation forestry. Over-abstraction of water from streams and possibly pollution is increasing threats. Invasive alien trout may also be a problem. The Mahogany presba

(*Syncordulia venator*, Vulnerable) is a Western Cape endemic that is only found between 300 and 1300 m elevation in clear montane streams in bushy areas (Samways & Simaika 2016). Likely threats are the synergistic effects of invasive alien trees, agricultural activity around streams and introduced trout (Samways 2006). The yellow presba (*Syncordulia gracilis*, Vulnerable) inhabits hard-bottomed montane streams and rivers with undisturbed fynbos margins in treeless river valleys. Invasive alien trees are the major threat to this species, but agricultural activities that cause river siltation and pollution and alien fish may also be a threat (Samways 2006).

Table 2.10: Dragonfly taxa of conservation concern recorded in the 10 km buffer area around the Riviersonderend Complex.

Scientific Name	Common Name	Recorded Location	Conservation Status (Global)
Ceratogomphus triceraticus	Cape thorntail	Buffer	Near Threatened
Syncordulia venator	Mahogany presba	Buffer	Vulnerable
Syncordulia gracilis	Yellow presba	Buffer	Vulnerable

2.4.1.3 Invasive Alien Invertebrates

Alien and invasive arthropod species are represented in most insect orders, arachnids and other non-insect arthropods (Picker & Griffiths 2011). Several of these species were introduced deliberately (e.g. as biological control agents – refer to Section 2.3.1.3) while many invasive invertebrate species are introduced by accident and may have dire consequences if left unmanaged. An example of the latter is the European or German wasp, *Vespula germanica* (Figure 2.17), which is native to Europe, North Africa and temperate parts of Asia but has, in recent times, also become established in parts of the Western Cape.

Population expansion of *V. germanica* has been uncharacteristically slow in the Western Cape compared to other countries where dispersal rates have been documented, where it is still confined to a relatively small area, which up until 2019 included on the fringes of Ceres, Wellington, Grabouw, Somerset West, Franschhoek and Constantia (Veldtman *et al*. 2012; Haupt 2015; Davies *et al.* 2020). *V. germanica* populations have been found in both undisturbed natural vegetation (Richardson *et al.* 1992) and in highly modified areas, but the species is suspected to thrive in the latter (Mooney & Hobbs 2000) due to increased food availability.

Current findings indicate that *V. germanica* nests are found almost exclusively next to permanent rivers, and hence includes all permanent river tributaries of the Berg and Breede rivers, along which these wasps seem to be spreading slowly where suitable foraging areas are in close proximity. Apart from spread along river courses, there is also clear evidence for human mediated jump dispersal.

In 2019, the CapeNature discovered a *V. germanica* nest next to the Gobos River on the northern side of Greyton where it borders the Riviersonderend State Land. Upon targeted search by invasive wasp researchers, a second nest record for Genadendal at the Moravian Church historic buildings was also confirmed. This indicates a replicated jump dispersal of *V. germanica* to sites along the Riviersonderend Mountain range, some 50 km away from Grabouw, which had represented the most easterly

range of *V. germanica* in the Western Cape to date. This invasive alien species can therefore be considered to be a potential emerging threat to the Complex.

Figure 2.17: The invasive wasp Vespula germanica (German Wasp). Photo: S. van Noort (Iziko Museums of South Africa).

2.4.2 Amphibians

Thirteen amphibian species have been recorded in the Riviersonderend Complex and this is likely to be a nearly comprehensive list for the protected area (two to three more species may be present).

None of these species are evaluated as threatened under the International Union for Conservation of Nature (IUCN) criteria, but the Landdroskop mountain toadlet, *Capensibufo magistratus* (Figure 2.18) (previously recorded *C. rosei*), is classified as Data Deficient (Turner & Measey 2017). Rose's mountain toadlet (*C. rosei*) was listed as Vulnerable but has now been split into four separate species including *C. magistratus* (Channing *et al.* 2017). *Capensibufo magistratus* is a habitat specialist that inhabits shallow temporary pools with emergent sedge-like plants in Mountain Fynbos or Grassy Fynbos in the Fynbos Biome (Turner & Measey 2017). It occurs in only a few, small populations and there have been no recent signs of breeding at one of the known historical breeding sites. Annual monitoring, specifically in winter, is needed to assess the continued presence and breeding activity of this species in the Riviersonderend Mountains. Invasive plant species are prolific in the area where this species occurs and, unless managed, may cause population fluctuations (Turner & Measey 2017).

Figure 2.18: Landdroskop mountain toadlet (*Capensibufo magistratus*), IUCN listed as Data Deficient. Photo: Dr. Andrew Turner.

Recent taxonomic studies have revealed the presence of a moss frog species (*Arthroleptella atermina*) (Figure 2.19) which is endemic to the western Riviersonderend Mountains (Turner & Channing 2017). Previous records within the Complex of *A. bicolor* are likely to have been this species. *Arthroleptella villiersi* was also recorded within the Complex during this study (Turner & Channing 2017). *Arthroleptella atermina* is closely associated with mountain seeps that maintain moisture throughout the year and are covered with a dense (typically restioid) vegetation. The conservation status of *A. atermina* has not yet been accurately determined. A significant threat to this species is invasive alien species, including pine and hakea, which result in alteration of the hydrological regimes of the mountain seeps and increase the intensity of fires (Turner & Channing 2017).

The water impoundments at Vrolijkheid Provincial Reserve function as breeding sites for most of the frogs that occur on the reserve although the Karoo caco (*Cacosternum karooicum)* lives and breeds in the seasonal streams that flow through the reserve (A. Turner, Restoration Ecologist, CapeNature, 2020, pers. comm.).

Figure 2.19: Recently described moss frog species (*Arthroleptella atermina*) endemic to the western Riviersonderend Mountains. Photo: Dr. Andrew Turner.

The conservation of amphibians in the Riviersonderend Complex is reliant on ensuring the persistence of wetland breeding habitat and sufficient surrounding foraging and sheltering habitat for frogs. This will primarily be achieved by the effective control of invasive alien woody plant species and the implementation of an appropriate fire-return interval. These management actions should be measured and monitored using vegetation and fire indicators but should also be informed by the presence of *C. magistratus*, a fynbos-dependent and fire-dependent species.

There are no records to date of National Environmental Management: Biodiversity Act (NEM: BA) listed invasive alien amphibians within the Complex on CapeNature databases (Government of South Africa 2016).

2.4.3 Fish

The Cape Floristic Region is largely geographically congruent with the Cape Fold Ecoregion (CFE), one of the six aquatic ecoregions of Southern Africa. Within this region, there are several isolated river systems that are home to both relatively widespread and locally endemic freshwater fish species from five families. Taxonomic research has indicated that many of the described indigenous fish species of the region consist of a number of genetically unique lineages (Skelton & Swartz 2011). This confirms the suggestion by Linder *et al.* (2010) that the current taxonomy vastly underestimates the diversity of freshwater fishes of the region. Ellender *et al.* (2017) reported the current taxonomic richness of the CFE to be 42 unique taxa (described species and known unique lineages). The majority of these lineages await taxonomic description as new species and should in the meantime be managed and conserved as unique taxa (Skelton & Swartz 2011; Chakona *et al.* 2013).

The Riviersonderend Complex is located in the Breede River system that is home to four families of indigenous freshwater fish, namely the family Cyprinidae with three species, the families Galaxidae and Anabantidae with one described species each and the family Anguillidae (freshwater eels) with one species known to occur in the Breede system (Skelton 2001). Indigenous fish are the Breede River redfin *Pseudobarbus burchelli* Smith, 1841, Cape galaxias *Galaxias zebratus* Castelnau, 1861 (Figure 2.20), Cape kurper *Sandelia capensis* (Cuvier 1831), Berg-Breede whitefish *Barbus andrewi* Barnard, 1937 and longfin eel *Anguilla mossambica* Peters, 1852. The results of a 2019/2020 summer survey of the fishes occurring within twelve watercourses within the Complex are reflected in Figure 2.21 below (Jordaan & Gouws 2020).

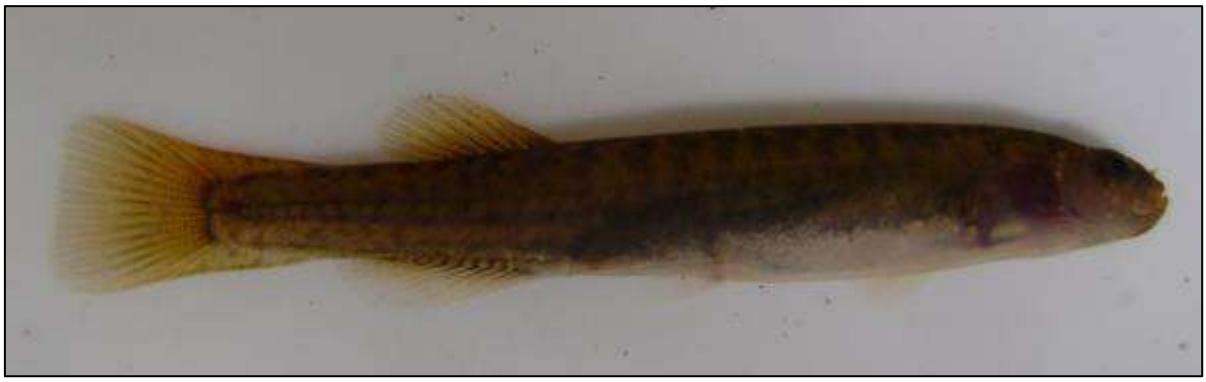


Figure 2.20: A specimen of the indigenous freshwater fish Cape galaxias Galaxias zebratus encoutered during fish surveys in the Riviersonderend Complex. Photo: Dr Martine Jordaan.

Swartz *et al.* (2009) presented the first evidence that the currently described *Pseudobarbus burchelli,* which occurs in the Breede and associated river systems in the Western Cape Province, is a species complex consisting of four genetically distinct lineages. Of these, only the most widespread lineage, provisionally designated as *Pseudobarbus* sp. nov. 'breede' is associated with the Complex. Currently listed as Vulnerable (Jordaan & Chakona 2018), the recent survey reported the presence of at least seven redfin populations associated with the reserve (Jordaan & Gouws 2020). Skelton (2001) reports that this taxon typically inhabits pools and deeper flowing sections of large tributaries as well as mainstream habitat and it can thus utilise the tributary habitat typical of rivers associated with the reserve. It is however not a headwater stream specialist and as a result can be threatened where it occurs off reserve in areas where rivers are impacted by poor land use practices.

The Cape kurper *S. capensis* and Cape galaxias *G. zebratus*, are also present in rivers on and associated with the reserve and Jordaan & Gouws (2020) reported 11 populations of each species. The Cape kurper, a CFE endemic, is a hardy species that can survive in a range of habitat types, but favours quiet or slow flowing water (Skelton 2001). While the Cape kurper can occur in headwater sections of rivers, its preferred habitat is more typically associated with larger tributaries and lowland habitat and thus it is also at risk of impacts associated with poor land use practices where it occurs in off-reserve reaches of rivers. Presently, this species is listed as Data Deficient due to taxonomic uncertainty (Chakona 2018). The Cape galaxias is another species that is relatively widespread in the CFE but endemic to the region. While this

small-bodied species is a habitat generalist, it can thrive in very small headwater streams where habitat would be too limited for other fish species to persist (Chakona & Swartz 2012). The Cape galaxias is also currently listed as Data Deficient due to taxonomic uncertainty (Swartz *et al*. 2007). Chakona *et al.* (2013) provided evidence for at least 14 divergent lineages of *Galaxias*, but knowledge of their distribution ranges and current status, including the populations associated with the Complex, is largely incomplete. Cape galaxias is also under threat from poor land use practices, but marginally less so than redfins and Cape kurper as they can utilise protected headwater habitats within the reserve that may not be available to other indigenous species due to different habitat preferences.

In addition to loss of habitat resulting from poor land use practices (such as instream habitat disturbance by earthmoving equipment, unsustainable levels of water abstraction and urban and agrichemical pollution), freshwater fish in the region are also highly threatened by the presence of alien and invasive fish species. These species affect indigenous fishes through predation, habitat alteration, competition for resources, the introduction of diseases and the disruption of ecological processes (Skelton 1987; De Moor & Bruton 1988). The primary impact is predation on smaller species and on juveniles of larger species and this has resulted in the extirpation of most indigenous species from mainstream rivers and tributaries (Weyl *et al*. 2014).

A number of invasive species are present in the greater Breede system. These include invaders both from outside the country (e.g. rainbow trout *Oncorhynchus mykiss* and black bass *Micropterus spp*.) as well as species native to the country but extralimital to the CFE such as African sharptooth catfish *Clarias gariepinus* and banded tilapia *Tilapia sparrmanii*. Alien and invasive species are widespread throughout the Breede system with rainbow and brown trout favouring cooler mountain streams and black bass, tilapia and common carp being more common in the warmer lower altitude sections of rivers. Sharptooth catfish is also a typical lowland species but Ellender *et al.* (2015) reported its ability to invade headwater streams in its extralimital range in the Eastern Cape. The threat of invasive alien fish is discussed in detail in Section 5.5.

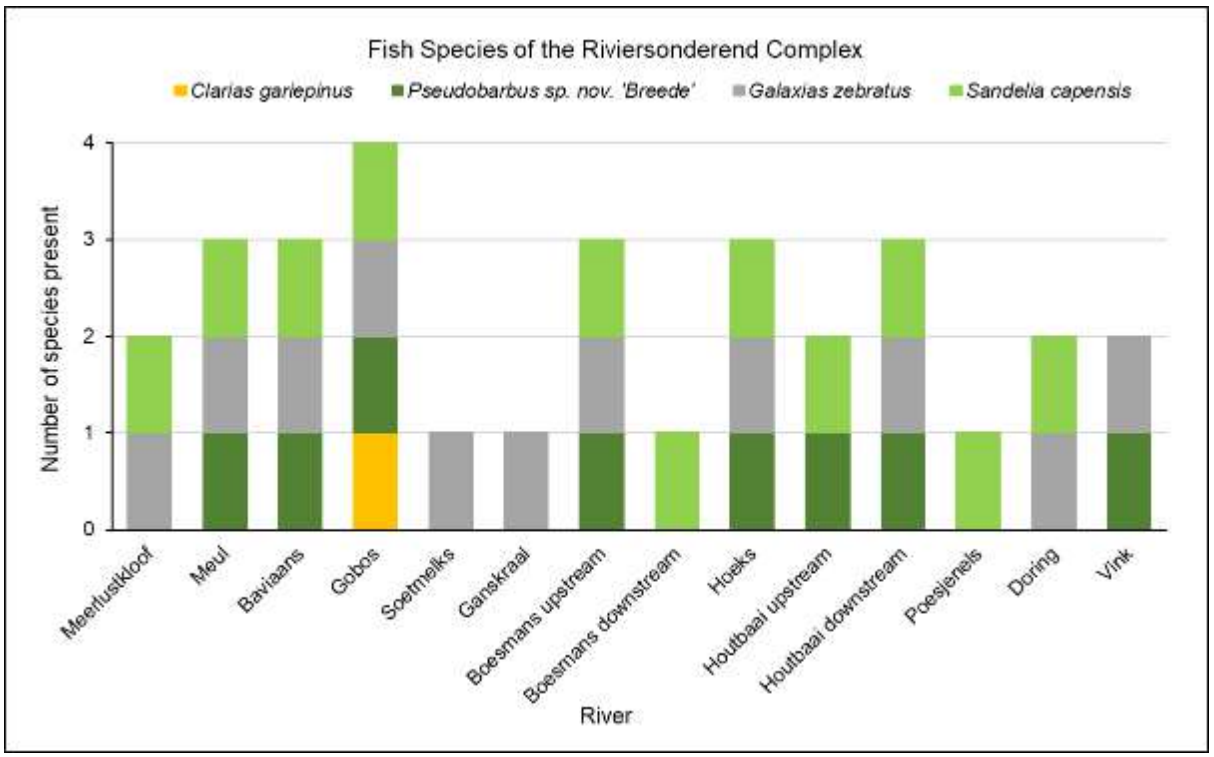


Figure 2.21: Fish species encountered in sampling surveys during the 2019/2020 summer in twelve watercourses on both the northern and southern slopes within the Riviersonderend Complex (refer to Figure 2.14 in Section 2.3.2.2 indicating the rivers and sampling points).

2.4.4 Reptiles

Forty reptile taxa have been recorded in the Riviersonderend Complex. All of these are listed as Least Concern according to the IUCN criteria. There are likely to be at least five other species present (all Least Concern) but surveys are needed to confirm this. This includes species which are restricted to peaks of the Cape Fold Mountains such as the Cape Mountain Lizard (*Tropidosaura gularis*) and the Cape Crag Lizard (*Pseudocordylus microlepidotus microlepidotus*) which although not currently of conservation concern, these habitats may be affected in the future by climate change.

As for amphibians, the conservation of reptiles in the Complex depends on effective control of invasive alien woody plant species and fire management.

There are no records to date of NEM: BA listed invasive alien reptiles within the Riviersonderend Complex on CapeNature databases.

2.4.5 Avifauna

Two hundred and seventeen species of birds have been recorded in the Riviersonderend Complex. The avifauna species diversity is typical of the Karoo and Fynbos vegetation units found within Complex and includes species such as rufous-eared warbler *Malcorus pectoralis*, Karoo chat *Cercomela schlegelii,* Cape rock-jumper *Chaetops frenatus* and Cape rock-thrush *Monticola rupestris.* The three sizeable dams on the Vrolijkheid Provincial Reserve and the large dam in the Elandskloof in the Riviersonderend Mountains provide habitat for a wide range of

water-dependent species that would not otherwise be recorded within the Complex. This includes species such as lesser swamp-warbler *Acrocephalus gracilirostris*, African reed-warbler *Acrocephalus baeticatus,* common sandpiper *Actitis hypoleucos,* common greenshank *Tringa nebularia,* yellow-billed duck *Anas undulata* and little grebe *Tachybaptus ruficollis.*

Seventeen threatened species have been recorded within the Riviersonderend Complex (Table 2.11). The complex occurs in areas where seven of these species (marked with an asterisk in Table 2.11) occur at high densities (Taylor *et al.* 2015). Reporting rates for five of these species, black harrier *Circus maurus*, African marsh-harrier *Circus ranivorus*, Verreaux's eagle *Aquila verreauxii*, blue crane *Anthropoides paradiseus* and Cape rock-jumper *Chaetops frenatus* are relatively high (SABAP2 2019) indicating the importance of the reserve complex for all of these species except the blue crane. The high reporting rate for the latter species is due to the overlap of the survey areas with adjacent agricultural lands on which they reside as the reserve complex does not have sufficient habitat to support high numbers of cranes.

Three of the threatened species with high reporting rates as listed above are raptors. Large raptors have large home ranges and forage widely for prey and hence can be affected by fragmentation of habitat. Habitat loss and fragmentation is a threat to black harriers, particularly the loss of breeding habitat, primarily due to agriculture. (Birdlife International 2017). Three of the below threatened species are endemic to the fynbos biome/CFR, namely Cape rock-jumper, protea seed-eater and Agulhas long-billed lark.

Ostrich (*Struthio camelus*) was historically present on Vrolijkheid Provincial Reserve, having been introduced as a game species. This species was identified as having a negative impact on the succulent karoo vegetation, with degradation, loss of vegetation cover and consequent erosion having occurred as a result of trampling. The ostrich was subsequently removed from the reserve in 2015.

NEM: BA listed invasive alien bird species which have been recorded from the Complex include house sparrow (*Passer domesticus*) and European Starling (*Sturnus vulgaris*), however no management interventions have been identified as necessary as they do not cause any obvious or measured negative environmental impact (Government of South Africa 2016).

Table 2.11: Threatened bird species of the Riviersonderend Complex. Regional conservation status following Taylor *et al.* (2015); Global conservation status following IUCN (2019).

Scientific Name	Common Name	Conservation Status (Regional)	Conservation Status (Global)
Circus maurus	Black harrier*	Endangered	Endangered
Polemaetus bellicosus	Martial eagle	Endangered	Vulnerable
Circus ranivorus	African marsh-harrier*	Endangered	Least Concern
Sagittarius serpentarius	Secretary bird	Vulnerable	Vulnerable
Afrotis afra	Southern black korhaan	Vulnerable	Vulnerable
Neotis denhami	Denham's bustard	Vulnerable	Near Threatened

Scientific Name	Common Name	Conservation Status (Regional)	Conservation Status (Global)
Ciconia nigra	Black stork	Vulnerable	Least Concern
Falco biarmicus	Lanner falcon	Vulnerable	Least Concern
Aquila verreauxii	Verreaux's eagle*	Vulnerable	Least Concern
Anthropoides paradiseus	Blue crane*	Near Threatened	Vulnerable
Chaetops frenatus	Cape rock-jumper*	Near Threatened	Near Threatened
Crithagra leucopterus	Protea seedeater*	Near Threatened	Near Threatened
Eupodotis vigorsii	Karoo korhaan	Near Threatened	Least Concern
Certhilauda brevirostris	Agulhas long-billed lark*	Near Threatened	Not Recognised**
Buteo trizonatus	Forest buzzard	Least Concern	Near Threatened
Geocolaptes olivaceus	Ground woodpecker	Least Concern	Near Threatened
Monticola explorator	Sentinel rock-thrush	Least Concern	Near Threatened

* Species occurring at high densities
** Not yet recognised as a separate species by the IUCN

2.4.6 Mammals

The CapeNature Biodiversity database contains comprehensive records of all mammal taxa recorded by or reported to CapeNature within the Western Cape Province and is used to inform the records of mammal (and other faunal) species within the Riviersonderend Complex. Camera traps have been placed within the Complex in order to increase the number of verifiable records of various fauna occurring within the Complex and to capture records of species not typically recorded through observer surveys e.g. nocturnal and cryptic species. More systematic biodiversity surveys are planned for the Complex, which along with the camera traps, will reduce the bias in terms of recording both the presence and relative abundance of species within the Complex. A total of 1 929 State of Biodiversity records of mammals were recorded between 2010 and 2019.

The introduction of camera traps has significantly increased the records of some species, including those not previously recorded (Figure 2.22). Nocturnal species in particular are more frequently recorded on camera traps than observation surveys which are normally undertaken during the day. More than two thirds of the records of Aardvark (*Orycteropus afer*), African Wild Cat (*Felis silvestris ssp. lybica*) and Honey Badger (*Mellivora capensis*) are from camera traps. In addition to camera traps, other nocturnal species are additionally also mainly recorded through signs of their presence such as scat, spoor and quills rather than observations of the animals themselves e.g. Porcupine (*Hystrix africaeaustralis*), Leopard (*Panthera pardus*).

Figure 2.22: A selection of mammal species recorded on camera traps in the Riviersonderend Complex, top left to bottom right: aardvark (*Orycteropus afer*); African wild cat (*Felis sylvestris* ssp. *lybica*); caracal (*Caracal caracal*); honey badger (*Mellivora capensis*); porcupine (*Hystrix africaeaustralis*); and grey rhebok (*Pelea capreolus*). Photos: Riviersonderend Complex camera traps.

For each of the threatened and Near Threatened species, threats and conservation actions are summarized in Table 2.12. The main threats to the mammals of the complex are habitat deterioration and fragmentation and hunting, including persecution. Loss of habitat corridors within the lowland habitats surrounding Vrolijkheid Provincial Reserve, most prominently through agriculture, affects the long-term persistence of fauna through the impact on gene flow. Ecotypical antelope species can be used as indicators to identify if there are functional ecological corridors present at the scale of medium sized mammals.

Table 2.13 is a list of species that are not threatened but are also of concern. These include Western Cape endemics, rare taxa and CapeNature priority species for monitoring (Birss 2017). Also included are ecotypical species (discrete populations below the level of subspecies that can be recognized on genetic, phenotypic or zoogeographic grounds), apex predators (at the top of the food chain), keystone species (species which have an disproportionately high impact on a particular ecosystem) and indicator species (serve as a measure of the environmental conditions that exist in a given location). Also included are species which cause damage to infrastructure, crops or livestock.

Riviersonderend State Land

Twenty-five mammal species have been recorded from Riviersonderend State Land. A total of 566 State of Biodiversity records of mammals were recorded between 2010 and 2019, compared to 28 records for 2000-2009. The most frequently recorded mammals were Klipspringer (*Oreotragus oreotragus*), Grey Rhebok (*Pelea capreolus*) and Cape Grysbok (*Raphicerus melanotis*), each with over 100 records. A total of 25 species were recorded in 2010-2019 compared to eight for 2000-2009, with

noteworthy additional records including, Bushpig (*Potamochoerus larvatus*), African Clawless Otter (*Aonyx capensis*), Caracal (*Caracal caracal*), African Wild Cat (*Felis silvestris ssp. lybica*), Honey Badger (*Mellivora capensis*) and Hewitt's Red Rock Rabbit (*Pronolagus saundersiae*). The camera traps have been up since 2018 and have been placed at Jonaskop, Kleinfontein and Coetzeesbos.

Three species of conservation concern have been recorded within the Riviersonderend State Land. The leopard (*Panthera pardus*) is regionally and globally Vulnerable and grey rhebok (*Pelea capreolus*) and African clawless otter (*Aonyx capensis*) are regionally Near Threatened (Okes *et al*. 2016; Swanepoel *et al*. 2016; Taylor *et al*. 2016). Otters, which are indicators of aquatic system health, have been recorded from within the Riviersonderend State Land.

Klipspringer are considered to be an indicator species for connectivity in the mountainous sections of the Complex (Figure 2.23). Sections of the Riviersonderend State Land which have the highest records for both Klipspringer and Leopard are Jonaskop and Boesmankloof/Galgeberg, which could partly be attributed to higher sampling intensity, (camera traps and hiking trail respectively), however both species have been recorded throughout the length of the Riviersonderend Mountain Range.

Figure 2.23: Klipspringer (*Oreotragus oreotragus*) is an inhabitant of rocky and mountainous terrain and is widespread throughout the Complex and considered to be an indicator of habitat connectivity. Photo: Riviersonderend Complex camera trap.

Vrolijkheid Provincial Reserve

Thirty-five mammal species have been recorded from Vrolijkheid Provincial Reserve. A total of 788 State of Biodiversity records of mammals were recorded between 2010 and 2019, compared to 3 records for 2000-2009, with the only species in common being Grey Rhebok (*Pelea capreolus*). The most frequently recorded mammals were Common Duiker (*Sylvicapra grimmia*) and Cape Grysbok (*Raphicerus melanotis*), with over 200 and over 100 records respectively. The camera traps donated by the Friends

of Vrolijkheid have been in place since 2014 (supplemented by Landmark Foundation camera traps) and have been placed in seven different locations across the reserve.

Two of the species recorded within the provincial reserve are of conservation concern, namely grey rhebok (*Pelea capreolus*) and African clawless otter (*Aonyx capensis*), both of which are regionally Near Threatened (Okes *et al*. 2016; Taylor *et al*. 2016). Table 2.12 provides further details regarding the species of conservation concern. It should be noted that the threat listings have changed for a number of species since the previous PAMP.

Springbuck (*Antidorcas marsupialis*) was historically introduced to Vrolijkheid Provincial Reserve as a game species, however the species did not adapt well to the provincial reserve and steadily declined over time until there were none left. The provincial reserve is not within the historical distribution range of this species (Skead 2011). The decline could have been enhanced through poaching. Only low numbers of this species were encountered since 2010, with the last record of springbuck in May 2017.

The Vrolijkheid Nature Conservation Station was founded in 1958 as a Vermin Research Farm and Hound Breeding Station. The facilities of this station were used as a venue for the Cape Quagga experimental breeding programme being undertaken by the S.A. Museum to “re-breed” the extinct Cape Colony quagga (*Equus quagga quagga*). This project started at Vrolijkheid with the arrival of nine zebra from Etosha Pan on 21 April 1987. Lucerne was grown on the reserve to feed the animals. The project was stopped during 1993. Alien game species on the reserve included black wildebeest (*Connochaetes gnou*), blesbok (*Damaliscus pygargus phillipsi*), gemsbok (*Oryx gazella*) and fallow deer (*Dama dama*) along with naturally occurring species and reintroduced species such as springbok (*Antidorcas marsupialis*) and ostriches (Heard *et al.* 2000a)

Buffer Zone / Zone of Influence

The areas adjacent to the provincial reserve and state land must also be taken into consideration in ensuring healthy populations of mammals within the broader landscape, particularly for species with very large home ranges which would stretch beyond the boundaries of the provincial reserve and state land e.g. Leopard (*Panthera pardus*). Corridors of natural habitat connecting protected areas which fauna would utilize are therefore vital not only for those with large home ranges but to ensure that there is gene flow across the landscape for all species in order to prevent inbreeding of small isolated populations. Corridors of natural habitat are also important to secure in order to allow for movement of biota and gene flow for adaptation in response to climate change in the long term (De Villiers *et al*. 2016).

Ecotypical small to medium sized antelope species can be useful indicator species for landscape connectivity. Klipspringer (*Oreotragus oreotragus*), grey rhebok (*Pelea capreolus*), Cape grysbok (*Raphicerus melanotis*) and common duiker (*Sylvicapra grimmia*) have been frequently recorded throughout the Complex (as reported above) and can be considered as indicator species for connectivity.

Two species of conservation concern have been recorded within a 10-km buffer zone around the Riviersonderend Complex, but not within the complex. Spectacled

dormouse (*Graphiurus ocularis*) and African striped weasel (*Poecilogale albinucha)* are both listed as regionally Near Threatened (Child *et al*. 2016b; Wilson *et al*. 2016) and have been recorded in the vicinity of Vrolijkheid Provincial Reserve.

There are no records to date of NEM: BA listed invasive alien mammals within the Complex on CapeNature databases (Government of South Africa 2016). This excludes records of species which were kept in captivity in the centre for Damage Causing Animals (DCAs).

Table 2.12: Threats to, and conservation actions for, threatened and Near Threatened species in and near the Riviersonderend Complex. Regional conservation status Child *et al.* (2016a). Global conservation status: IUCN (2019).

Scientific Name	Common Name	Conservation Status (Regional; Global)	Threats	Red Data Book (Child *et al.* 2016a) Recommended conservation actions	CapeNature Conservation Actions
Aonyx capensis	African clawless otter	Near Threatened; Near Threatened	Deterioration of freshwater systems (riparian habitat transformation, pollution, disturbance, changes in flow regimes). Habitat degradation and loss (bush clearing, deforestation, overgrazing, human settlements, draining wetlands, burning riverbeds) (Okes *et al*. 2016).	Long-term monitoring to determine population trends, distribution, habitat preferences, and genetics. Protection of riverside, wetland and coastal habitats. Extension regarding river care and agricultural management practices (Okes *et al*. 2016).	*Ad hoc* records. Conflict mitigation (off reserve).
Graphiurus ocularis	Spectacled dormouse	Near Threatened; Least Concern	Habitat loss and fragmentation by agriculture (emerging threat - rooibos plantations and vineyards). Climate change and aliens with related increase in wildfires (Wilson *et al*. 2016).	Corridors between areas of suitable habitat. Long-term monitoring for population trends. Data on distribution and population densities. Clear alien vegetation (Wilson *et al*. 2016).	*Ad hoc* records. Protected area expansion and stewardship programme. Alien clearing programme.
Panthera pardus	Leopard	Vulnerable; Vulnerable	Unsustainable persecution exacerbated in areas where intensive wildlife breeding of high-value game increases conflict. Robertson a hotspot of Damage Causing Animal incidents. Illegal hunting for skins (cultural regalia) (Swanepoel *et al.* 2016).	Livestock and game conflict mitigation. Applying sustainable trophy hunting regulations. Reducing the illegal trade in skins. Protected area expansion to create a more resilient population overall (Swanepoel *et al.* 2016).	Conflict mitigation (extension, enforcement). Protected area expansion and stewardship programme. Research by Cape Leopard Trust and Landmark Foundation. Participation in SANBI national monitoring programme. Monthly records, including camera trap records and scat.
Pelea capreolus	Grey rhebok	Near Threatened; Least Concern	Illegal hunting (sport, bush meat), predation by feral dogs, habitat loss and fragmentation (Taylor *et al*. 2016).	Long-term population monitoring, combat illegal hunting, education/awareness, conservancy establishment, maintenance of indigenous habitat on private land near small reserves, encourage reintroduction on private conservation areas (Taylor *et al*. 2016).	Game counts. *Ad hoc* records. Protected area expansion and stewardship programme.

Scientific Name	Common Name	Conservation Status (Regional; Global)	Threats	Red Data Book (Child *et al.* 2016a) Recommended conservation actions	CapeNature Conservation Actions
Poecilogale albinucha	African striped weasel	Near Threatened; Least Concern	Habitat loss (grassland: crop agriculture, overgrazing). Traditional medicine trade; heavily hunted. Hunting by dogs. Predation by artificially inflated jackal populations. But possible population increase in the Western Cape. (Child *et al*. 2016b).	Conservation of grassland habitat. Extension to promote improved agricultural land management (stocking rates, ground cover). Long-term monitoring to determine population trends. (Child *et al*. 2016b).	*Ad hoc* records.

Table 2.13: Other species of concern (not threatened) within the Riviersonderend Complex. Regional conservation status: Child *et al.* (2016a). Global conservation status: IUCN (2019).

Scientific Name	Common Name	Conservation Status (Regional, Global)	Additional Conservation Importance	Vrolijkheid Provincial Reserve	Riviersonderend State Land
Canis mesomelas	Black-backed jackal	Least Concern; Least Concern	Meso-predator. Damage Causing Animal.	Yes	Yes
Caracal caracal	Caracal	Least Concern; Least Concern	Meso-predator. Damage Causing Animal.	Yes	Yes
Hystrix africaeaustralis	Cape porcupine	Least Concern; Least Concern	Keystone species (ecosystem engineer), Damage Causing Animal.	Yes	Yes
Mellivora capensis	Honey badger	Least Concern; Least Concern	Agricultural pest control (arthropods, rodents). Damage Causing Animal.	Yes	Yes
Neoromicia capensis	Cape serotine bat	Least Concern; Least Concern	Agricultural pest control (insects).	Yes	No
Oreotragus oreotragus	Klipspringer	Least Concern; Least Concern	Ecotypical. Indicator species.	Yes	Yes
Orycteropus afer	Aardvark	Least Concern; Least Concern	Keystone species (ecosystem engineer).	Yes	No
Otocyon megalotis	Bat-eared fox	Least Concern; Least Concern	Agricultural pest control (termites).	Yes	Yes
Panthera pardus	Leopard	Vulnerable; Vulnerable	Apex predator (control of caracal, jackal, baboon). Damage Causing Animal.	No	Yes
Papio ursinus	Chacma baboon	Least Concern; Least Concern	Seed disperser. Damage Causing Animal.	Yes	Yes
Pelea capreolus	Grey rhebok	Near Threatened; Least Concern	Ecotypical.	Yes	Yes
Potamochoerus larvatus	Bushpig	Least Concern; Least Concern	Damage Causing Animal.	No	Yes

Scientific Name	Common Name	Conservation Status (Regional, Global)	Additional Conservation Importance	Vrolijkheid Provincial Reserve	Riviersonderend State Land
Procavia capensis	Rock dassie	Least Concern; Least Concern	Keystone species (important prey for eagles, leopard, etc.). Damage Causing Animal.	Yes	Yes
Raphicerus campestris	Steenbok	Least Concern; Least Concern	Ecotypical.	Yes	Yes
Raphicerus melanotis	Cape Grysbok	Least Concern; Least Concern	Ecotypical. Near-endemic to Western Cape.	Yes	Yes
Rhabdomys pumilio	Striped mouse	Least Concern; Least Concern	Pollinator of some Fynbos species. Keystone species (food for diurnal predators).	Yes	Yes
Sylvicapra grimmia	Common duiker	Least Concern; Least Concern	Ecotypical.	Yes	Yes

2.5 Heritage Context

Section 5 of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) outlines general principles for heritage resources management while Section 9 of this Act outlines responsibilities of the state and supported bodies.

2.5.1 Heritage resources

Kaplan (1990) stated that the southern Cape is rich in archaeological resources, but that most of the research on the precolonial history has taken place at the coast and near-coastal zones, where many rock shelters and shell middens are found. The archaeological context of the Riviersonderend Mountain and surrounding area is poorly known as it lies outside the area of present archaeological research with surveys only conducted for developments in the area. One survey was conducted on the northern side, one on the eastern side, and two on the southern side near the towns of Greyton, and Riviersonderend. During these surveys various Early-, Middle- and Late Stone Age artefacts were found. These comprised of flakes (occasionally with faceted platforms), assortment of cores (including large irregular and disc cores), prepared platform, a chalcedony flake, crudely manufactured choppers, complete and incomplete hand axes, cleavers, and large chunks. Other formally retouched artefacts include miscellaneous retouched pieces on large flakes and chunks. The raw materials are almost exclusively fine-grained quartzite with some silcrete occurring. Kaplan (1990) has estimated one site to probably be older than 200 000 years. Another site surveyed by Kaplan (1990), located on river gravels, is littered with both large and small quartzite boulders and cobbles. There is evidence indicating that this site was a quarry or flaking site, where extensive stone artefact manufacturing took place. Based on the evidence found within this area, Kaplan (1990) stated that they are fairly confident that the region around Riviersonderend would yield considerable evidence of early human occupation in the form of open sites and caves/rock shelters (Kaplan 1990, 2004; ACO 2011).

The abovementioned archaeological survey sites fall outside the boundary of the Riviersonderend Complex but due to its proximity to the reserve, it will be of importance to broaden the research and knowledge base around these features within the Complex.

Historical heritage includes active sites found where pre-colonial and colonial pastoralists lived and moved through the Cape Winelands and Overberg regions. Some historical structures such as a stone wall and buildings older than 50 years found on Vrolijkheid Provincial Reserve, a number of grave sites dating from 1815-1956 and fourteen cave sites have been discovered within the Complex. These sites are recorded through informal heritage surveys conducted by staff, local landowners, historians and archaeologists. Andrea September (Heritage Officer, Heritage Western Cape, 2020, pers. comm.) has indicated that possible heritage resources that may be found within the Complex will be rock art sites and archaeological sites in rock shelters and overhangs, both on the Breede Valley and the Overberg side of the Riviersonderend mountain range. A formal archaeological survey is required to fully understand the rich cultural and historical heritage found within the Complex. As heritage sites become known, or are located, they are recorded onto the reserve heritage inventory and conserved *in situ*.

2.5.2 Living heritage

Two distinct groups have been documented in the Cape: the one following a herding way of life (Khoekhoen) and the other a hunting-and-gathering (Soaqua or Bushmen). Archaeological evidence indicates that Soaqua or Bushmen, were the original inhabitants of the Cape area and their ancestors occupied the region extending back thousands of years, whereby they subsisted through hunting game and gathering plant foods (Clift 2001). Within the Overberg area, this has been confirmed by the discovery of sites containing their paintings. Most of these sites have been discovered on the drier northern side of the Riviersonderend Mountain (Le Roux 1984).

The arrival of the Khoekhoen in the Overberg area can be dated back to around 200 years ago through evidence of sheep and pottery gathered from at least two sites in the area, (Humphreys 1989; Clift 2001). Very little is known about the social organisation of the Cape Khoekhoen and the little that is known is based on Dutch records (Clift 2001).

As identified in the earliest historical records, the Khoekhoen were comprised of several groups. However, within the south-western Cape, the two main groups that were living in the Overberg were the Hessequas and Chainoquas (Le Roux 1984; Humphreys 1989). The Chainoquas were the Khoekhoen group that occupied kraals that were mostly located along the rivers and fertile valleys of the Riviersonderend Mountains (Le Roux 1984). However, Chainoqua area can be roughly described as the area from the Hottentots Holland Mountains to around Cape Agulhas and inland to the Riviersonderend Mountains (Humphreys 1989; Clift 2001). This is one of the largest Khoekhoen areas in the order of 12 242 square kilometres (Humphreys 1989). On the other hand, the Hessequas occupied the areas to the east of the Breede River to the Keurbooms River, which divided the Chainoqua and Hessequas (Humphreys 1989). Le Roux (1984) has provided a map to show the approximate areas that were occupied by the various groups at the time of the first colonial expeditions into the interior. These maps indicate that they did not occupy the areas within the Riviersonderend Complex but rather along its southern and western boundaries.

Within the Chainoqua area, there were four main concentration points where the Khoekhoen kraals were found (Le Roux 1984). The first group occupied the area between Grabouw and Bot River, where Chainoquas and Hessequas could be found living side by side. A Chainoqua captain, Klaas, had his kraal in the higher lying Groenland area, while Gaukau the Hessequa leader, lived along the Bot River. The second group was under the leadership of Soeswa (who died during 1663) as the main Chainoqua leader who occupied the Villiersdorp valley along the upper reaches of the Riviersonderend. The third group occupied the land between the Riviersonderend River and the Riviersonderend mountains and smaller kraals within the area from the present towns of Genadendal and Riviersonderend. It is within this area where reports of Khoekhoen kraals occur as late as 1803. The last main concentration of Khoekhoen kraals in the Overberg is that of a group of Chainoqua captains who occupied the land adjoining the Sout River (Le Roux 1984; Clift 2001).

The Khoekhoen lived in kraals or camps (Figure 2.24), each consisting of the members of the same clan and a variety of hangers-on, which included Bushmen clients. These camps were mobile and very flexible in terms of size. Kraal size would vary depending on the availability of natural resources, season migration patterns and the need for defence during raiding activities. Historical records document Khoekhoe camps that vary from about 20 huts, also called matjieshuise, to over 100 huts. Each kraal had a headman, or chief, who made decisions regarding the general well-being of the kraal (Clift 2001).

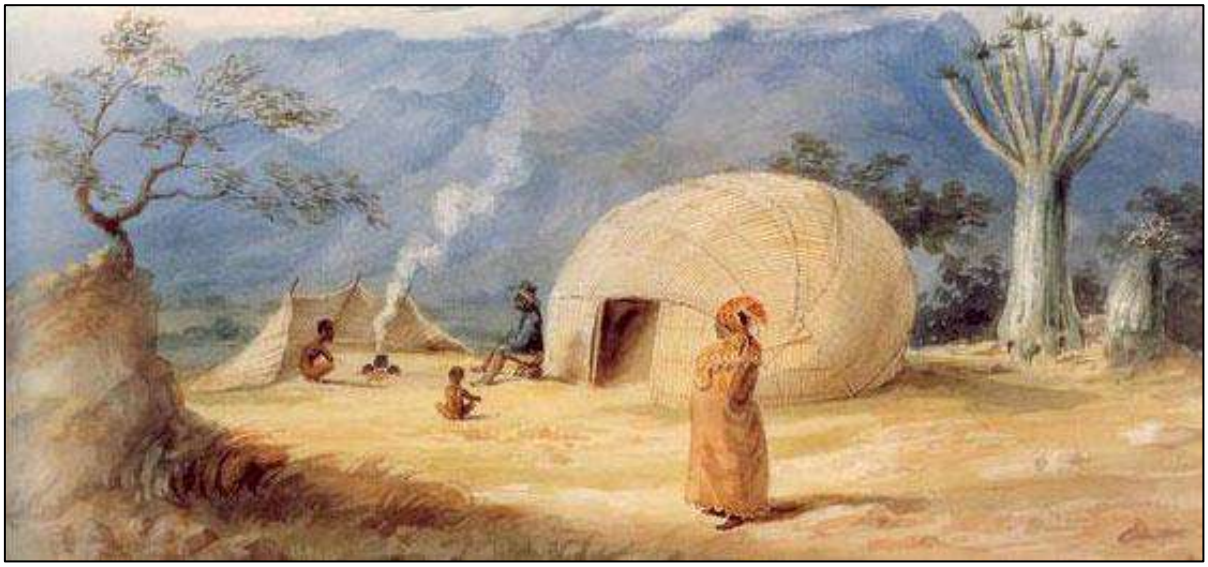


Figure 2.24: Watercolour painting (1835) by Charles Bell of a Khoekhoen settlement (McCallum 2016).

Livestock, in particular cattle, played an important role in Khoekhoen society as being the main criterion through which wealth was measured (Figure 2.25). In a society where land could not be divided amongst individuals, livestock was the most valued form of private property. The ownership of livestock was the main characteristic distinguishing Khoekhoen from Soaqua, however some groups of Soaqua did own small number of livestock, as confirmed through historical records. The hunting of wild game for meat and the gathering of plant food by women still remained important economic activities in the Khoekhoe society (Clift 2001).

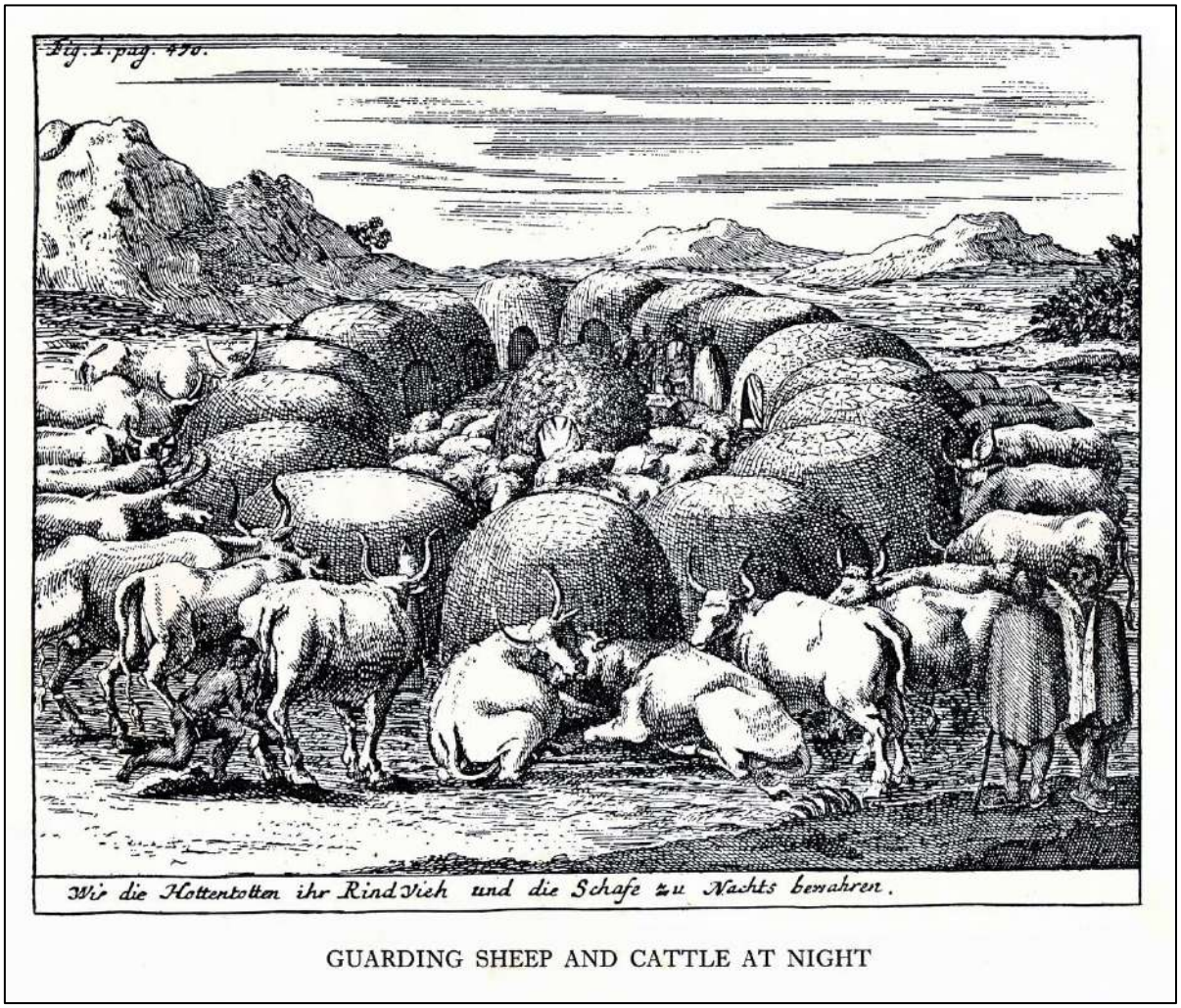


Figure 2.25: Historical drawing (1719) by Peter Kolbe of a Khoekhoen settlement guarding their sheep and cattle at night (Sekonya 2017).

Archaeological evidence of the social and ecological impact of domestic animals, and the herding lifestyle of the Khoekhoen, on the indigenous Soaqua have been found within the Cape west coast but not as yet for the Chainoqua area. Within the west coast, it was suggested that the Soaqua were forced to shift their settlements into the mountains where pasture was less attractive, with the introduction of pastoralism into the area. Early historical records from 1488 described large herds of cattle, as a result of the movement of Khoekhoen into the area, which would have created competition between the herds of cattle and the wild game for grazing and water (Clift 2001). Within the mountains the Soaqua concentrated on plant foods and small but abundant animals such as tortoises and dassies rather than the larger game species they exploited before the Khoekhoen arrived. As there is evidence of the Soaqua in the mountains north of Genadendal, it is suggested that a similar pattern as the west coast could have occurred in the Chainoqua area (Humphreys 1989).

With the spread of pastoralism into the Cape some 2000 years ago, and more recently through the emphasis of the Khoekhoen with cattle, it can be assumed that the Soaqua had already been experiencing some degree of strain by 1652 (Humphreys 1989; Clift 2001). By this time, the Portuguese as well as English and Dutch ships, had been

bartering with the local Khoekhoen for fresh meat (Figure 2.26). Indigenous stock was readily exchanged for iron, copper, beads and 'trinkets' (Clift 2001). However, the Dutch did not actively approach the Soaqua as they did with the Khoekhoen due to the perception that the Soaqua would not have anything worth trading (Clift 2001). During 1652, a European settlement (refreshment station) was established at the Cape which attracted the Chainoqua and other Khoekhoen groups. The first Dutch contact with the Chainoqua took place on 14 November 1657 where after regular trading and hunting expeditions into the Overberg region occurred (Humphreys 1989; Clift 2001). Le Roux (1984), stated that the Chief of the Chainoqua, Soeswa, visited Jan van Riebeeck in the year 1661, establishing a stock trade agreement between the Chainoquas and the Dutch at the Cape. During the years 1662 to 1713, the Chainoqua and the Hessequa were the main cattle suppliers to the refreshment station at the Cape. This is evident by the size of the area they occupied and its suitability for grazing (Humphreys 1989; Clift 2001).

Figure 2.26: Historical drawing of Khoekhoen bartering their sheep and cattle with the colonists (SAHO 2019).

Since 1669, during the regular expeditions into the Overberg region, the Dutch settlers started to look for grazing areas of their own. The nomadic lifestyle of the Khoekhoen around the landscape, necessitated by the need for fresh grazing due to the relatively low nutrient value of the natural veld, made it seem to the Dutch settlers that the land was unoccupied and free for the taking (Clift 2001). At the Huis River, today known as Greyton, they found unusually fine pastures. During the years 1679 to 1693, the Chainoqua 'Captain' Dohra, also known as Klaas, was the go-between person in the trade relations between the DEIC officials at the Cape and the Chainoqua and the Hessequa. Dohra had a kraal at Knoflokskloof, which is near the present-day Lebanon forestry station in the Grabouw area (Clift 2001). Towards the end of the seventeenth century, the Company had many cattle-stations in the Overberg where they kept animals, bartered from the Khoekhoen, until they are needed in the Cape (Le Roux 1984).

During 1713, an outbreak of smallpox, brought on by passing ships and settlers, had a major impact on the Khoekhoen population. This in turn left land unoccupied. The result was an increase of European immigrants to the area and posts established by the Company within the Overberg to aid people through the provision of supplies and healthcare (Xplorio 2020). The Cape governor, Pieter Gysbert van Noodt, expanded the Riviersonderend post in 1727 to Zoetemelksvlei beyond the river. From this post the Company farmed the forests between the present towns of Greyton and Riviersonderend for timber, as well as cattle, for the Cape (Le Roux 1984; Schoeman 2017). It was noted that the Company made more of an income from the timber cut in Oliphants Bos that they could make from selling crops grown in the area (Le Roux 1984). More Dutch East India Company (VOC) posts followed including one at Tygerhoek near present-day town of Riviersonderend (Schoeman 2017).

In addition, the area between the Riviersonderend River and the Riviersonderend mountains was an important part of the defence of the Cape. The Dutch, and later the British, used the area to store equipment and food in case they had to withdraw from the Cape. Buildings were erected at Soetemelksvlei specifically for this purpose. A warning system consisting of a series of canons was introduced. One of these posts was constructed on the mountain slopes above the Farm Oubos, situated to the west of Riviersonderend (Le Roux 1984).

In September 1737, George Schmidt, in the company of Africo and Kibido, two Khoi wagon drivers, set off for Africo's home. It was noted that Africo had considerable influence among the Chainoqua found in the vicinity of a military outpost on the Riviersonderend River, which provided George Schmidt the opportunity to make contact with the people in the area. After erecting a borrowed tent next to Africo's hartbeeshuis, the spot became known as Hartebeeskraal and a centre to which the local Chainoqua were drawn as they realised Schmidt had not come to obtain cattle or sheep (Humphreys 1989).

In April 1738, Schmidt, and 18 Khoekhoen, moved to the area presently known as Genadendal, which was at an existing Chainoqua settlement, at the foot of the then called Baviaanskloof, close to the mountains into which the hunter-gatherers retreated. His primary aim, as pointed out by Henry Bredekamp, was to completely convert the religious and socio-economic transformation of the Khoekhoen society in the area. Part of his strategy was to become a strict disciplinarian, which influenced the move to Genadendal and away from the degenerate influence of the military outpost. Schmidt's first priority was preaching and teaching to the Khoekhoen in the area, although the phasing out of the traditional houses (matjieshuise) also was part of the transformation of the Khoekhoen lifestyle. As part of this transformation, he condemned the traditional Khoekhoen lifestyle, and certain aspects of the colonial life, as evil and banned people from the area from visiting outlying settlements so as to cut contact with any outsiders. Forbidden activities included the use of bows and arrows as well the transient grazing of cattle and sheep. By 1742, Schmidt had succeeded in transforming the Chainoqua lifestyle and established a new labour pattern based on permanent cultivation at Genadendal (Humphreys 1989). Genadendal (referred to as Sergeants River by Schmidt), situated on the northern edge of the Chainoqua area, has the distinction of being the first mission station in South Africa (Humphreys 1989; Figure 2.27).

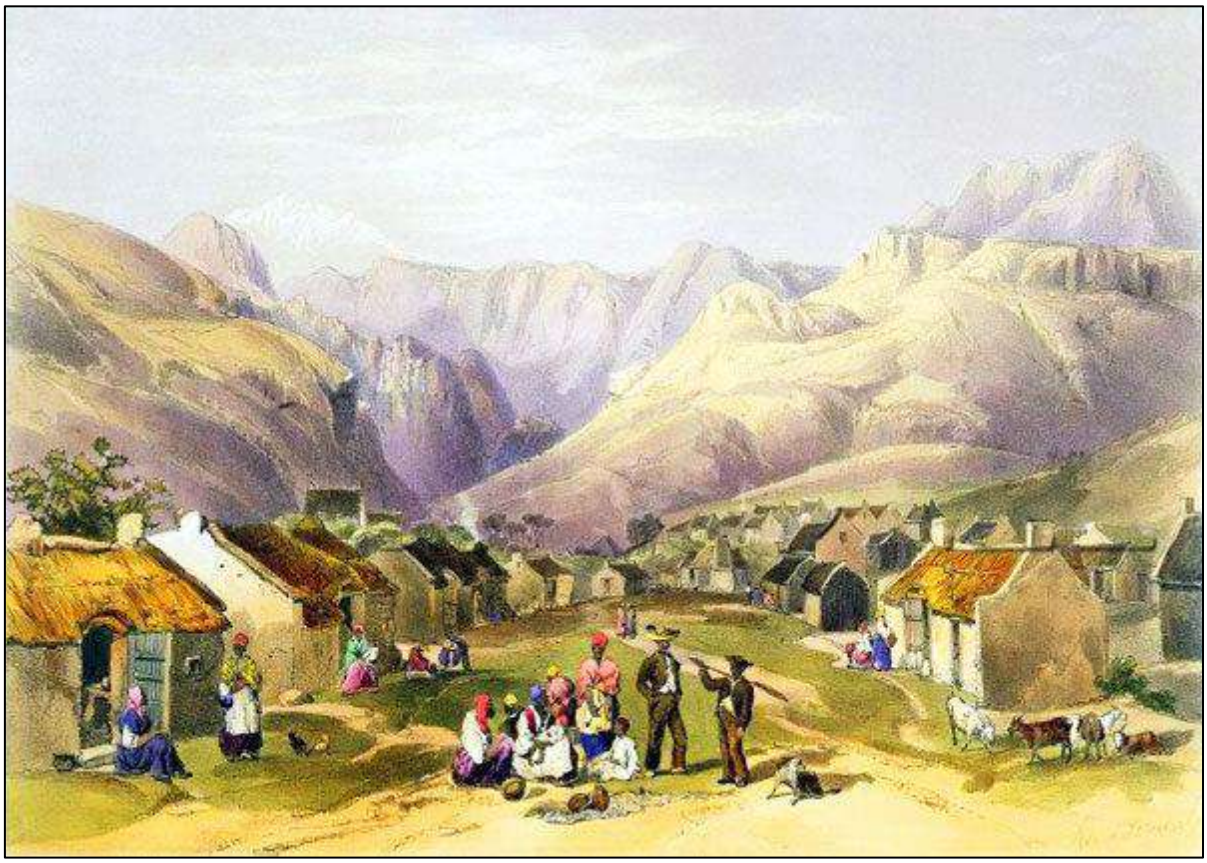


Figure 2.27: Historical painting (1849) by George French Angas of the Genadendal Mission Station (Schoeman 2017).

The movement of the Khoekhoen within the Overberg were greatly limited by the escalation in the number of farms granted in freehold from the mid-18th century as this barred their access to water resources and grazing (Clift 2001). Due to the Dutch East India Company (VOC) having possession of the best grazing land situated between the Riviersonderend and the mountains, most of the farmers that had stock were using land further away from the mountains (Le Roux 1984). The increasing pressures on the natural resources and the limits on free access to grazing in the area became more evident in the later parts of the 18th century. Khoekhoen faced difficulty with gaining access to grazing and water resources to maintain and replenish their herds, which as suggested by Guelke & Shell (1992) was the main factor in the decline of the Khoekhoen. The only options the Khoekhoen had was to either move into territories further away, or to go into service of freeburgher stock farmers. By going into service of freeburgher stock farmers, the Khoekhoen were allowed to graze their stock on the farmers land, but with it came its own issues, such as farmers refusing to release the stock once the Khoekhoen decided to move on (Clift 2001).

During 1809, the British colonial government passed the “Hottentot Proclamation”, which saw the Khoi being forced to have a fixed address and carry a magistrate issued pass to be able to travel in the colony (Schoeman 2017).

Alienation from land and its resources as a result of colonial expansion through the different perceptions of land ownership had a major impact on the local indigenous

groups. This ultimately resulted into the disintegration of traditional Khoekhoen society (Clift 2001). Despite varying degrees of resistance to colonial domination, the Khoekhoen and the Soaqua alike lost their independence and were ultimately consumed by colonial society becoming part of the lower class occupied by slaves (Clift 2001).

Vrolijkheid Provincial Reserve

The history of the original farm "De Vrolykheid" dates back to 4 July 1831, when the field-cornet of Midden Boschjesveld granted the land to Hercules Viljoen. The original farm covered a total area of approximately 26 km^2 and it stretched from McGregor in the south-west to Uitnood in the north-east (Heard *et al*. 2000a). There have been numerous subdivisions and subsequent consolidations since 1831 and today there are 12 farms within the original boundary of "De Vrolykheid", later to be known as "De Vrolykheid aan de Keisersrivier". The Vrolijkheid Provincial Reserve includes only a small portion of the original farm - this being a piece of ground that was known initially as "Klawer Leegte" and later as "Fairview 3".

The Vrolijkheid Provincial Reserve was previously known as the Vrolijkheid Nature Conservation Station which was founded in 1958 as a Vermin Research Farm and Hound Breeding Station and is still referred to by the locals as the "Proefplaas" (Heard *et al*. 2000a). The breeding of hounds for hunting vermin, including a special strain of Jack Russell dogs to hunt rock dassie (*Procavia capensis*) in the rocky hills, was stopped during 1984 and the last of the hounds were transferred to Adelaide in 1985 (Heard *et al*. 2000a). Following this, the facilities of this station was used as a venue for the Cape Quagga experimental breeding programme as described in the mammal section (Section 2.4.6). Since 1987, this station was managed as a nature reserve *per se* focusing on conserving indigenous species, although it was already proclaimed a Provincial Reserve in terms of section 6 of the Nature Conservation Ordinance (Ordinance 19 of 1974) (Heard *et al*. 2000a).

2.6 Socio-Economic Context

In terms of the Municipal Systems Act, 2000 (Act No. 32 of 2000), municipalities are required to use integrated development planning to plan for future development in their mandated management areas. The municipal Integrated Development Plan (IDP) sets the strategic and budget priorities for development and aims to co-ordinate the work of local and other spheres of government. The IDP should also address how the environment will be managed and protected and is supplemented by a Spatial Development Framework (SDF), which indicates this on a spatial dimension.

IDPs and SDFs are tools for integrating social, economic, and environmental issues. As biodiversity is a fundamental component of sustainable development, IDPs and SDFs offer an opportunity to ensure that biodiversity priorities are incorporated into municipal planning processes through consultation. In turn, the identification of biodiversity-related projects for the IDP can support local economic development and poverty alleviation. The Riviersonderend Complex falls within the District Municipalities of the Cape Winelands and Overberg (Appendix 1, Map 1). The Langeberg, Theewaterskloof and Breede Valley Local Municipal IDP's are relevant to the Complex.

Primary land uses in the Langeberg Municipal Area are agricultural (intensive) and agri-industrial, which serves as the most important economic activity (CNdV Africa 2016). In the Theewaterskloof Municipal Area agriculture is the primary land use and 30% of the population in this municipality live on farms (UDWC 2012). The Breede Valley Municipal Area has a vibrant economy that is based on strong agricultural, manufacturing and tourism sectors. The commercial and service sectors are also well developed (WCG 2018d). The region is world renowned for its wine farms that produce export quality wines and create sustainable livelihoods for many citizens in the Breede Valley (24.3% contribution to employment) (BVM 2020).

Development density in the Langeberg Municipal Area can be classified as low, Theewaterskloof Municipal Area also low with the rural population forming the majority and Breede Valley Municipal Area low with the economic engine of the Breede Valley comprises of farming and related farming activities. This high-potential agricultural land must be protected as a resource to provide employment to the increasing number of potential economically active persons in the Breede Valley. Currently, spatial factors play a strong role in limiting housing development in the Breede Valley (BVM 2020).

Urban sprawl is limited to the bigger urban settlements within municipal areas and not applicable to towns within the zone of influence of this complex. Municipalities also have densification strategies drawn up in their SDF's to mitigate urban sprawl should it occur.

Socio-economic information for the Cape Winelands and Overberg District Municipality as well as Breede Valley Municipal Area, Langeberg Municipality, Theewaterskloof Municipality is provided below (Table 2.14) as obtained from the Western Cape Government Socio-Economic Profiling (SEP) (2018).

Table 2.14: Socio-economic information for the District and Local Municipalities relevant to the Riviersonderend Complex (WCG 2018a-e).

Municipality	No of Residents	House-holds	Unemployment Rate* (2017)	Indigent Households (2016)	Summary of Socio-economic Risks (According to SEP 2018)
District Municipality					
Cape Winelands	926 698	236 006	10.7%	42 756	• Stagnating Economic Growth • Increasing Population & Demand for Services • Rising Unemployment
Overberg	308 010	91 835	11.8%	11 571	• Slow Economic Growth • Increasing Population & Demand for Services • Rising Unemployment

Local Municipality					
Langeberg	112 269	28 401	7.1%	7 265	• Drought • Increasing Population & Demand for Services • Stagnating Economic Growth
Breede Valley	186 584	47 569	10.8%	7 611	• Climate Change & Water Security • Increasing Population & Demand for Services • Stagnating Economic Growth
Theewaters-kloof	124 374	33 097	10.3%	7 959	• Slow Economic Growth • Increasing Population & Demand for Services • Rising Unemployment

*Economically active people.

In light of the above demographics and challenges, economic and social development in many of the communities around the Riviersonderend Complex remain a challenge, particularly those situated in isolated rural settlements. The management of this Complex therefore has to strive towards job creation in order to help mitigating the unemployment and poverty rates. It is currently done through the central government Expanded Public Works Programme (EPWP) and Natural Resource Management (NRM) programmes together with the CapeNature ICM programme. The programmes strive to employ a high number unskilled and semi-skilled youths (55%), women (55%) and disabled persons (2%). The threat of invasive alien plants to the Complex as described in Section 2.3.1.3 provides for opportunities for employment within these programmes while simultaneously addressing ecological concerns.

Local economic development is also promoted through the appointment and development of local services providers (SMME's) in the conservation field e.g. fire suppression, maintaining firebreaks, roads, hiking trails and other infrastructure. A further aim of the employment of unskilled workers is to up-skill them through specific training sessions in order to able to be permanently employed within various economic sectors. Strategies related to job creation and local economic development are described in Section 10.

3 POLICY FRAMEWORK

CapeNature is subject to the framework of the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996), national legislation including the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003), National World Heritage Convention Act, 1999 (Act No. 49 of 1999), and all associated regulations and norms and standards for the management of protected areas in South Africa and all other relevant requirements as set out in the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).

3.1 Purpose of Protected Area Management

The declaration of protected areas is part of a strategy to manage and conserve South Africa's biodiversity. Accordingly, the object of the management plan is to ensure the protection, conservation and management of the natural and cultural historic heritage in a manner that is consistent with the objectives of the NEM: PAA, and for the purpose for which protected areas were declared.

3.2 Guiding Principles

The following guiding principles underpin the management plan for the Riviersonderend Complex:

- Articulate desired results in terms of conservation outcomes, not actions.
- Articulate how management responses will lead to desired results.
- Monitor progress towards achieving desired results.
- Consider monitoring programme design at the onset of planning.
- Consider expected outcomes of management at the outset of planning.
- Invest in management response appropriate to the risk.
- Adapt strategies based on lessons learnt, understanding that measuring effectiveness alone may not resolve uncertainty; data and analyses are necessary to guide management towards doing more of what works and less of what does not work.
- Share results to facilitate learning, acknowledging that although success is not a given, learning can be, through honest appraisal of efforts.

The Complex is also subject to the principles and provisions of relevant international treaties and conventions, national and provincial legislation and policy, and any local contractual or co-management agreements.

3.3 Strategic Adaptive Management

Strategic Adaptive Management integrates planning, management and monitoring to provide a framework for:

- Testing assumptions;
- Learning through monitoring and evaluation; and
- Adapting strategies or assumptions.

Strategic Adaptive Management bridges management and decision science by systematically evaluating results and using this information in a community of practice (CMP 2020) enabling management to change course when it becomes evident that it

is necessary, rather than waiting until the end of a strategy to determine whether an intervention worked (CCNet 2012).

CapeNature has adopted, and applies, the Conservation Standards for the Practice of Conservation adaptive management framework (CMP 2020) as illustrated in Figure 3.1. The Conservation Standards facilitates Strategic Adaptive Management through a systematic evidence based participatory process with stakeholders (CMP 2020). The systematic approach makes explicit the links between goals, conservation targets, threats, strategies and actions, enabling management to define and measure success of their actions in the protected area over time.

The Conservation Standards framework is comprised of five stages (Figure 3.1):

- Conceptualising the protected area (i.e. defining the purpose of the protected area, establishing scope and vision; selecting focal conservation targets and assessing threats, and analysing the conservation situation (i.e. assessing contributing factors in terms of opportunities and challenges);
- Planning actions and monitoring (i.e. drafting the plan based on theories of change using results chains);
- Implementing actions and monitoring (i.e. drafting work plans, doing the work and monitoring the work);
- Analysing and using results to adapt (i.e. deciding if what was planned is working); and
- Capturing results, sharing and learning (i.e. learning and sharing what is learned).

Figure 3.1: Strategic Adaptive Management framework adapted from The Conservation Standards for the Practice of Conservation (CMP 2020).

The framework works on the rationale that effective conservation of carefully selected targets will ensure the conservation of all indigenous biodiversity and cultural historic heritage within the protected area that in turn contributes to a functional landscape. At the same time, the rationale follows that healthy focal conservation targets deliver ecosystem services essential for human wellbeing. An assessment of the current condition of focal conservation targets serves as a baseline against which to measure condition over the next 10 years and guides the formulation goals and conservation strategies with associated objectives, indicators and work plans.

As such, step one of the adaptive management framework illustrated in Figure 3.1 is foundational to effective management of the area.

Focal conservation targets are classified as follows:

- Natural targets can be species, habitats or ecological systems, which collectively represent and encompass the biodiversity of the protected area. They can include the physical, natural features from which ecosystem services flow, benefitting humans in a variety of ways.
- Cultural historic targets are described in terms of the tangible features that collectively represent and encompass the cultural historic heritage of the protected area. They can also include the physical, cultural and/or historic features from which human wellbeing values are derived.
- Human wellbeing values are the intangible or non-material values derived from tangible values, and which collectively represent the array of human wellbeing needs dependent on natural and cultural features; they can be defined in terms of the benefits delivered to humans by healthy ecosystems, or by intact cultural or historical features.

3.4 Protected Area Management Effectiveness

Management effectiveness evaluation is the assessment of how well a protected area is being managed, primarily the extent to which management is protecting conservation targets and achieving objectives (Hockings *et al.* 2015). The following questions underpin management effectiveness evaluation (Leverington & Hockings 2004):

- Is the protected area effectively conserving the conservation targets for which it exists?
- Is management of the area effective and how can it be improved?
- Are specific projects, interventions and management activities achieving their objectives, and how can they be improved?

The monitoring and evaluation framework applied (Figure 3.2) measures compliance and management effectiveness of the Complex in terms of the NEM: PAA and associated norms and standards for protected area management. Management effectiveness is assessed over time using the Management Effectiveness Tracking Tool – South Africa (METT-SA) which is based on the six elements of good management:

- It begins with understanding the **context** of existing conservation targets and threats;
- progresses through **planning**;
- and allocation of resources (**inputs**);
- and as a result of management actions (**processes**);
- eventually produces products and services (**outputs**); that
- result in impacts or **outcomes**.

Management effectiveness is measured at the strategic level as a percentage, drawing upon the results of fine scale monitoring linked to management actions, objectives, goals and focal conservation targets articulated in this plan (Figure 3.2). Management effectiveness includes the measurement of administrative processes such as capacity

and budgets that, when adequate, are likely to result in positive conservation outcomes.

Mechanisms for monitoring and evaluation are built into each aspect of the strategic plan (Section 10) through the inclusion of verifiable indicators of progress. The protected area monitoring and evaluation programme, supplementary to the management plan, monitors site level implementation of the plan, status of conservation targets and effectiveness of strategies. Results contribute to the Western Cape State of Biodiversity report, produced at five-year intervals.

Furthermore, management reports annually on implementation of the plan through CapeNature's strategic performance management system. The performance management system ensures that implementation of the protected area management plan is embedded in individual staff performance agreements.

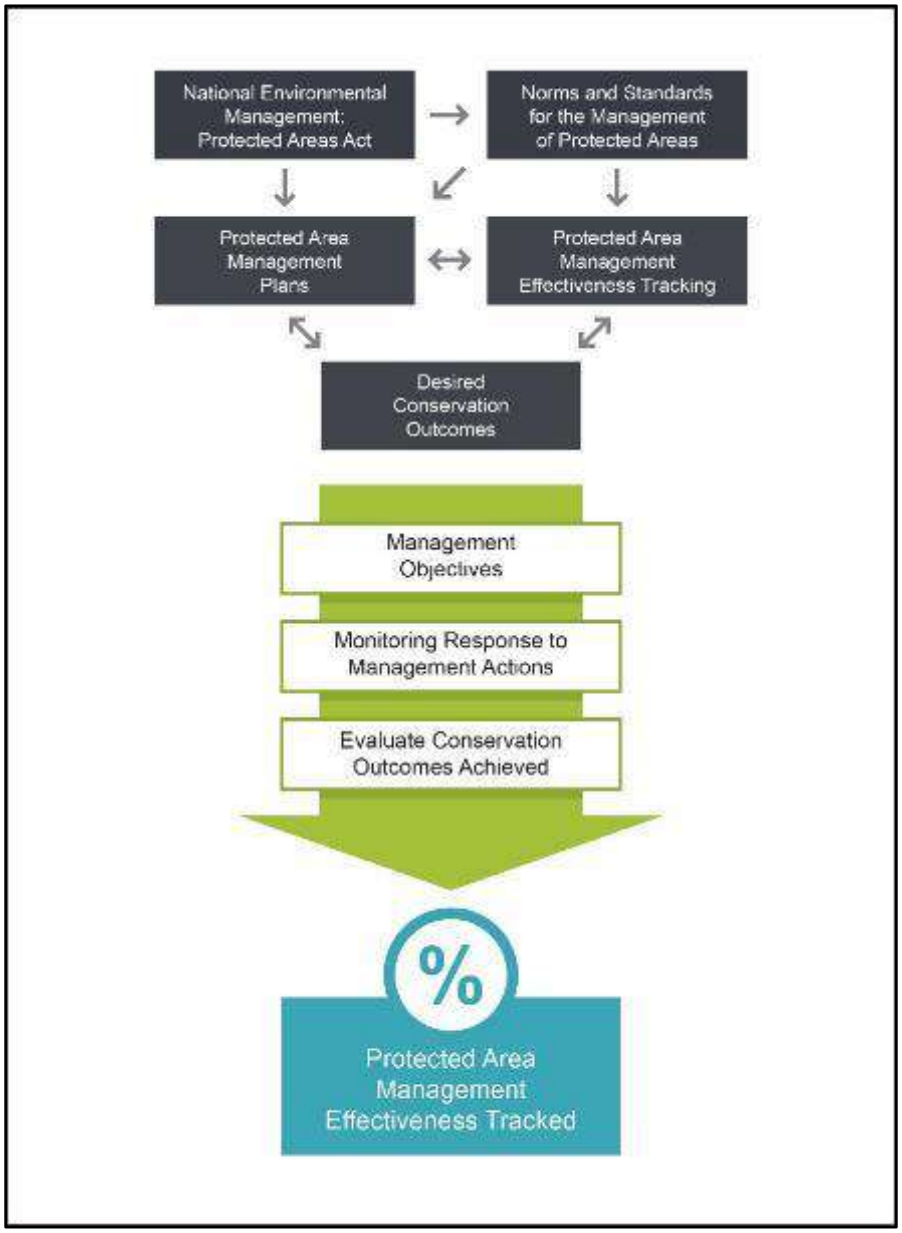


Figure 3.2: Protected area monitoring and evaluation framework.

3.5 Policy Frameworks

Protected area management is guided by CapeNature policies, procedures and guidelines for use across the organisation. Policies, procedures and guidelines applicable to this management plan are referenced here and in Section 10.

3.5.1 Internal rules

In terms of Section 52 of NEM: PAA, as amended, the management authority of a nature reserve may, in accordance with prescribed norms and standards, make rules for the proper administration of the area.

In addition to the Regulations for the Proper Administration of Nature Reserves, as gazetted on 12 February 2012 in Government Gazette 35021, and Regulations for the Proper Administration of Special Nature Reserves, National Parks and World Heritage Sites, as gazetted on 28 October 2005 in Government Gazette 28181, the Complex implements the Nature Conservation Ordinance, 1974 (Ordinance No. 19 of 1974) and Provincial Notice 955 of 1975.

3.5.2 Financial

CapeNature is a schedule 3C public entity responsible for nature conservation in the Western Cape. CapeNature is the executive arm of the Western Cape Nature Conservation Board, established in terms of the Western Cape Nature Conservation Board Act, 1998 (Act No. 15 of 1998) as amended. The objectives of the Board as per the Board Act are:

- To promote and ensure nature conservation and deal pro-actively with related matters in the province;
- To render services and provide facilities for research and training that would inform and contribute to nature conservation and related matters in the province; and
- To generate income, within the framework of the applicable policy framework.

Funding for the entity comprises three main revenue streams. The majority of funding, which equates to approximately 80% of funding, is received in terms of a provincial allocation received in terms of Vote 9. Secondary funding, which is approximately the further 20%, is received from external donors and own revenue. Own revenue generation consists mainly of tourism income generated through activities and accommodation available on various nature reserves managed by the entity.

The organisation prides itself on its strong internal controls, sound financial management and practicing of good corporate governance. Corporate governance within the entity embodies sound processes and systems and is guided by the Public Finance Management Act, 1999 (Act No. 1 of 1999) and the principles contained in the King 4 Report of Corporate Governance.

3.5.3 Safety and security

Business Continuity Plan: The CapeNature business continuity plan establishes and provides emergency response procedures and protocols which need to be implemented should an event significantly disrupt the operations of the organisation or an emergency situation is declared by management. The plan identifies critical

services, how it will be maintained, how to minimise the impact, increase preparedness and initiate an effective response.

Integrated Compliance Plan: The integrated compliance plan for the Riviersonderend Complex details how compliance and enforcement will be implemented in the Complex in order to:

- Prevent biodiversity loss caused by human activities on the protected area through the implementation of active and passive compliance and enforcement operations.
- Ensure compliance with legislation through the monitoring of activities in the protected area.
- Address and combat illegal activities through the institution of criminal proceedings.
- Report illegal activities to the delegated authority where activities have a negative impact on the protected area (e.g. listed activities in terms of the National Environmental Management Act (NEMA)).
- The integrated compliance plan is a dynamic reference document which is continually updated and improved, using the data that is gathered in the course of the implementation thereof in order to achieve the management objectives of the protected area.

Fire Protection Associations: CapeNature is obliged in terms of the National Veld and Forest Act (Act No. 1010 of 1998) to be a member of the local Fire Protection Associations (FPA). Within the Western Cape, five large FPAs have been established that cover the whole area of the Province. The Riviersonderend Complex is a member of the Greater Overberg, and Cape Winelands FPAs. FPAs are the primary partnership tool in veld fire management in South Africa.

Fire Management Plan: The Fire Management Plan is essentially a derivative and part of the protected area management plan, of which the latter details the objectives of the Riviersonderend Complex. The Fire Management Plan uses this information to detail how fire will be managed to ensure that the ecological objectives of the Complex are met. This includes the management of both wild and controlled fires.

Fire Response Plan: The Fire Response Plan forms part of the Fire Management Plan and serves as an operational document for cooperative wildfire management in the Riviersonderend Complex. This plan is compiled annually at a regional level according to the CapeNature Fire Policy to ensure that there is complete co-operation at a higher level. It includes updated names and telephone numbers of all contact persons, radio frequencies and emergency notifications.

3.5.4 Resource use

Resource utilisation is governed by CapeNature's policy on consumptive use of wild flora from CapeNature managed protected areas (CapeNature 2019a). The policy implementation framework and protocol provide guidelines on how access to natural resources inside the Complex should be managed.

According to NEM: PAA, Section 50, the management authorities of protected areas, including World Heritage Sites may, subject to the management plan of the protected

area or site, allow or enter into a written agreement with or authorise a local community inside or adjacent to the protected area or site, to allow members of the community to use in a sustainable manner biological resources in the protected area or site. Section 50, however also states that an activity allowed in terms of this section may not negatively affect the survival of any species in, or significantly disrupt the integrity of the ecological systems of the protected area or site.

CapeNature undertakes to build the capacity of natural resource users and other relevant stakeholders on the sustainable utilisation of natural resources and its environmental regulatory framework in and outside protected areas.

3.5.5 Biodiversity management

Integrated Catchment Management Strategy: ICM is regarded as improving and integrating the management of land, water and related natural biological resources in order to achieve the conservation, and sustainable use of these resources. The CapeNature ICM strategy (CapeNature 2016b) will focus on three key areas including; catchments, freshwater and coastal management. All of these contribute to socio-economic development and are underpinned by key principles including knowledge, advocacy, awareness and an enabling environment.

The ICM strategy is aligned to national and provincial priorities and has five strategic objectives to guide implementation namely:

- To integrate the management of the physical, ecological and man-made components of the environment to ensure sustainability and integrity of the ecosystems and the services that they provide in order to ensure long-term climate change resilience.
- Management of biodiversity assets, ensuring their contribution to the economy, rural development, job creation and social wellbeing is enhanced.
- To enhance the implementation of biodiversity conservation measures through the development of strategic tools and knowledge management systems.
- People are mobilised to adopt practices that sustain the long-term benefits of biodiversity.
- The required enabling environment (including institutional and professional capacity, policy and legal framework, partnerships, strategic and operational alignment and stakeholder support) is established and sustained.

Invasive Species Monitoring, Control and Eradication Plan: The invasive species monitoring, control and eradication plan for the Riviersonderend Complex was compiled according to the requirements and regulations of the NEM: BA. The plan guides management action to reduce infestation densities and rates of invasive and alien fauna and flora species within the protected area through systematic integrated control methods.

Integrated Compliance Plan: The Integrated Compliance Plan for the Riviersonderend Complex details how compliance and enforcement will be implemented in the Complex in order to achieve the management objectives of the Complex and to minimise biodiversity loss due to anthropogenic causes.

Western Cape Protected Area Expansion Strategy: The Western Cape Protected Area Expansion Strategy (WCPAES) and Implementation Plan 2015-2020 (CapeNature 2015a) aims to expand the Western Cape protected area network to encompass a more representative and resilient suite of areas that support biodiversity and ecological infrastructure, especially those threatened species and ecosystems that remain as yet unprotected. The Riviersonderend Complex expansion will be achieved in line with the WCPAES.

Management of Large Game: All large game species in protected areas will be managed in accordance with the Fencing and Enclosure of Game and Predators in the Western Cape Province Policy (CapeNature 2015b) as well as the Game Translocation and Utilization Policy for the Western Cape Province (CapeNature 2019b). CapeNature advocates the following broad best practice guidelines:

- All game farms bordering the protected area that have extra-limital or historic alien animals, must be enclosed to the standards as stipulated in the CapeNature fencing policy. Protected area personnel must do regular inspections on the reserve side of the fence and escapees must be reported to the owner immediately.
- If the owner is in possession of a Certificate of Adequate Enclosure, they must be given reasonable time to remove the animals as soon as possible. Game animals escaping from properties without a valid Certificate of Adequate Enclosure are *res nullius* and must be dealt with accordingly. Protected area staff must stipulate and regulate the actions to remove the animals (*i.e.* flying with a helicopter to recapture or to chase back).
- In cases where *res nullius* game animals enter the protected area, reserve staff must report it immediately and a decision must be taken to either have the animals removed, culled or that they may remain on the protected area.
- All protected areas with game animals who wish to remove surplus animals, must follow approved CapeNature protocols.
- Where invasive alien game (*e.g.* fallow deer) are observed in protected areas, staff must take immediate action by removing these animals in a humane manner.

Damage Causing Wild Animals: CapeNature's position statement on human-wildlife conflict aims to ensure coexistence of humans and indigenous wild animals and considers human-wildlife conflict as situations where artificially induced interactions between humans and wildlife lead to situations requiring mitigation of loss, disturbance or damage. CapeNature requires that human-wildlife conflict be managed, taking into consideration all legal, ethical and welfare implications and that interventions are carried out within an ecologically sound framework. There is a provincial co-operative agreement between CapeNature and the Predation Management Forum to facilitate the management of predators on private land to ensure best practice and self-regulation.

CapeNature advocates the five-step approach to holistic wildlife management of damage causing wildlife namely (1) understanding the origin of the problem; (2) maintaining the correct attitude and respect towards the animal; (3) the responsible species must be identified correctly; (4) implement suitable mitigation measures; and

(5) implement effective selective control methods. CapeNature advocates the following broad best practice guidelines:

- All reports of predators found on protected areas and causing stock losses on neighbouring properties must be reported to CapeNature. All actions against predators must be actioned on the property where the losses occurred and not within the protected area; no hunting or pursuing of predators on any protected area is legally allowed.
- Landowners are encouraged to form part of the Predation Management Forum through their local farmers association to obtain management and mitigation support.
- All other wildlife found on protected areas and causing losses or damage on neighbouring properties must be reported to and investigated by relevant CapeNature staff who will assist the landowner with mitigation management.
- Domestic animals (e.g. donkeys, goats, cattle, sheep and pigs) that roam onto protected areas from neighbouring properties must be addressed by relevant staff in conjunction with the local municipal authority through the draft National Animal Pounds Bill and/or any local authority bylaws.
- All feral animals (domestic animals that have become wild and without an owner) found within a protected area must be removed in a humane manner immediately.
- No confiscated, nuisance, damage-causing wildlife or rehabilitated wild animals may be released onto a protected area unconditionally.

3.5.6 Cultural resource management

CapeNature acknowledges that access to protected areas for traditional, spiritual, cultural and historical purposes has major benefits for people and accepts that protected areas have intrinsic and extrinsic value for the people of the region. CapeNature therefore recognises the need to manage, conserve and promote natural assets for the benefit of all. CapeNature contributes towards the promotion of culture and heritage through the development and conservation of heritage resources as well as the facilitation of access.

The Complex does not currently have a specific Cultural Historic Heritage Management Plan. The aim of such a document would be to ensure that cultural and heritage sites within the reserve are managed and preserved in a sustainable manner for future generations and to create awareness. This document would include information on the identification and recording of specific sites, controlling access to the sites and management activities. However, the reserve has done some ground-truthing of cultural and heritage sites on the Complex and created an inventory list in line with the Archaeological Data collection protocol described in the CapeNature Baseline Manual, version 2 (CapeNature 2010).

3.5.7 Neighbour relations

According to the NVFFA (Act 101 of 1998) a landowner must maintain fire breaks on his property borders to prevent fire from spreading from his property to neighbouring properties. However, the FPA can apply for an exemption where a strategic firebreak is placed in the area and there is a deviation from the NVFFA requirements. It is under

these circumstances that a Firebreak Agreement will be signed between the FPA and the landowner. As the boundaries of the Riviersonderend Complex are higher in the mountain areas, it has agreements to establish and maintain firebreaks on lower areas agreed by both parties. The Mountain Catchment boundaries along the Riviersonderend Mountain are used as a guide for placement of the firebreak. CapeNature also created strategic firebreaks along its boundaries where appropriate.

The Riviersonderend State Land has draft firebreak agreements with the neighbouring properties along the catchment boundaries that is a mutual agreement that each party is responsible for the maintenance of the agreed firebreaks. It is an agreement that allows CapeNature to either establish and/or maintain firebreaks along boundaries or at agreed areas. The agreement is a signed agreement that CapeNature or a contracting team will enter the property for establishing or maintaining the firebreak against the NVFFA. The agreement indicates distance, width and maintenance cycle. It also allows information from neighbouring properties indicating where they have or will create or maintain firebreaks.

Most neighbouring properties of the Riviersonderend State Land are members of their local FPA. The Riviersonderend State Land falls within the Greater Overberg FPA on the south side, and the Winelands FPA on the north side, of the Riviersonderend Mountain range. There are neighbouring areas that operate their own FPA or are busy with establishing their own. This is to have a quicker response to fires and to implement strategic firebreaks along their properties. The FPAs are formed and governed under the NVFFA as voluntary associations of landowners who wish to cooperate for the purpose of predicting, preventing, managing and extinguishing veld fires. The Riviersonderend State Land is not fenced and is therefore easily accessible. All firebreaks that are managed by reserves are kept in a register and this is used to determine when a firebreak is due for maintenance or not. The register provides the cycle of maintenance and priority of the firebreak. This register is updated on an annual basis, when work was done, or the area has burnt.

The Vrolijkheid Provincial Reserve does not have any firebreaks as it is located within the succulent karoo, but there is an agreement for lei water with fellow neighbours, whom all belong to the Vrolijkheid Water Users Association. Unlike the Riviersonderend State Land, the Vrolijkheid Provincial Reserve is fenced but still prone to illegal access by the public. Fences are cleared and maintained by both parties to prevent damages if there is a fire.

3.5.8 Research and development

The National Biodiversity Research Development and Evidence Strategy 2015-2025 highlights the increasing demand for knowledge and evidence to support policy and decision making for the protection of biodiversity and the realisation of benefits from our natural resources (DEA 2016a). In response to this CapeNature developed a biodiversity research and monitoring strategy. The overall goal of this strategy is to provide reliable data and knowledge to inform and facilitate the conservation of the biodiversity and sustained ecosystem functioning in the Western Cape Province.

Structured monitoring programmes need to be put in place and carried out consistently over time to monitor the state of biodiversity and ecosystem functioning. This allows tracking of ecosystem health and allows for critical evaluation of management

practices by employing Strategic Adaptive Management. There is a strong focus on applied scientific research that is driven by protected area management requirements. The strategy emphasises research and monitoring that measures biodiversity outcomes so that management can be clearly linked to the biodiversity and ecosystem function targets.

The guiding principles of the strategy are good science (robust and defensible), alignment with management requirements, taking an integrated management and ecosystems approach, employing a full monitoring lifecycle approach to planning and implementing monitoring programmes and considered (evidence-based) prioritisation of research and monitoring actions.

The CapeNature Biodiversity Research and Monitoring Strategy (CapeNature 2016c) facilitates research and monitoring that guides management actions in the Riviersonderend Complex pertaining to the following:

- Priority species (which includes invasive alien; threatened; endemic; keystone; and indicator species);
- Integrated catchment management (fire regime and ecology; catchment water quantity and quality; and invasive alien plant species);
- Ecosystem threat status and protection level (extent and representivity);
- Landscape level ecosystem function, genetic processes and connectivity, including landscape initiatives;
- Impacts of natural resource use;
- Land-use change and habitat loss;
- Rehabilitation and restoration;
- Climate change and weather;
- Protected area management effectiveness;
- Damage-causing animals and human-wildlife conflict;
- Ecosystem services and associated human well-being;
- Cultural, historical and heritage sites; and
- Social and socio-economic impacts, including disease and disaster response.

3.5.9 Access

CapeNature strives to establish a differentiated and leading brand of products in outdoor nature-based tourism across the Western Cape Province for all to enjoy. This is achieved by providing opportunities to the public and interacting in an environmentally responsible and sustainable manner specifically to:

- Optimise income generation for biodiversity conservation;
- Optimise shared growth and economic benefits, to contribute to national and provincial tourism strategies and transform the tourism operations within CapeNature; and
- Strengthening existing and developing new products with special attention to the provision of broader access for all people of the Western Cape Province.

Furthermore, CapeNature strives to increase and improve stakeholder awareness, understanding and participation in environmental conservation through:

- Developing the capacity of local people to meaningfully and responsibly participate in the management and enjoyment of protected areas; and
- Educating relevant stakeholders and creating awareness around key environmental issues to increase knowledge about the environment, develop a deeper understanding about environmental principles and encourage environmentally conscious values that allow for more informed and environmentally responsible decision making.

As part of its multi-sectoral approach, CapeNature aims to support the Western Cape Education Department's efforts through presenting curriculum aligned environmental education programmes to schools. CapeNature will endeavour to collaborate with like-minded partners in pursuit of environmentally sustainable development goals as platforms for involving citizens and groups with the aim of expressing a "call to action". Behaviour change efforts will be optimised through targeting specific audiences with innovative, transformative, quality assured programmes and interventions.

3.5.10 Administrative framework

In terms of CapeNature's administrative operating footprint, the province is divided into two regions, namely region east and region west. Each region is further sub-divided into two landscapes; of which each landscape is divided into three units.

The Riviersonderend Complex is one of six protected area complexes that occurs within the organisation's east region. It falls into landscape south; located within the Overberg and Langeberg units. The reserve is supported primarily through head office as well as the landscape office located in George.

The Riviersonderend Complex staff component is primarily based in the Vrolijkheid Provincial Reserve in Robertson and report through the conservation manager through to the Landscape Manager. The staffing structure for the Complex is depicted in Figure 3.3.

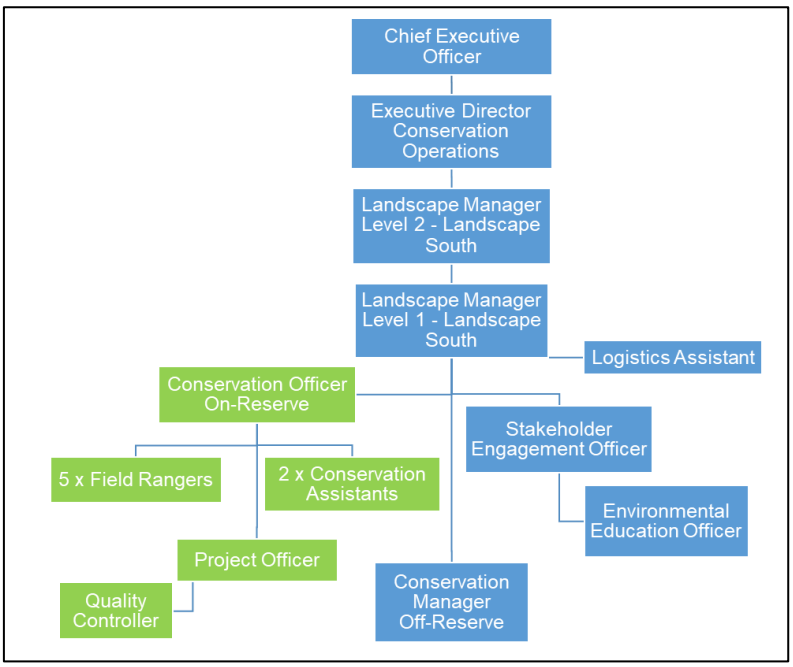


Figure 3.3: Approved organogram for the Riviersonderend Complex.

4 CONSULTATION

This section outlines procedures for public participation during the development of the management plan, including formal processes for public comment on the draft plan and establishes procedures for public participation during the implementation phase of this plan, Figure 4.1.

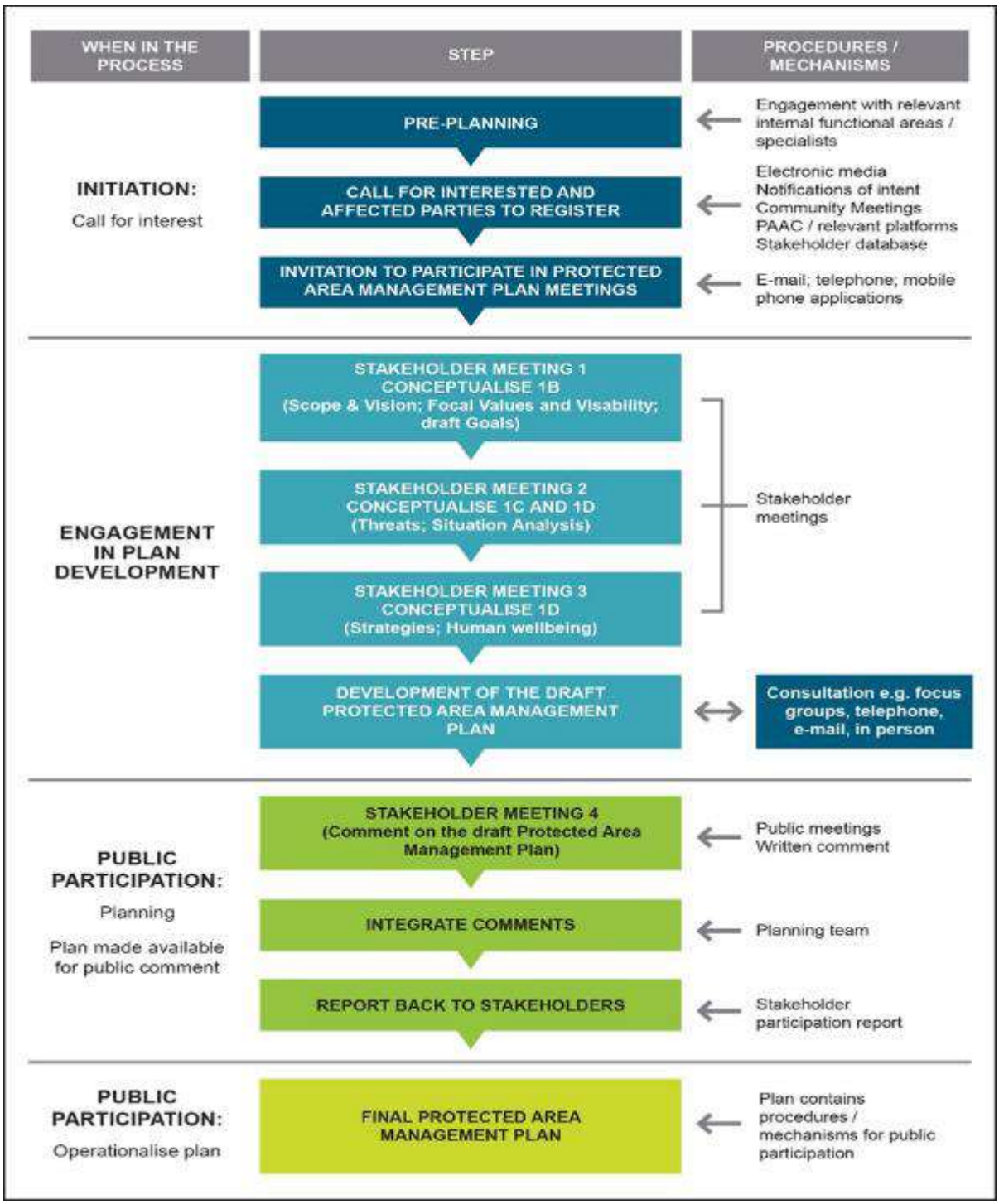


Figure 4.1: Process flow for protected area stakeholder engagement.

Stakeholder engagement takes place throughout the adaptive management cycle and enables public participation essential for sustainability, builds capacity and enhances responsibility. It promotes communication and the derivation of new information and/or expertise.

At the outset of the planning process for the protected area, a stakeholder analysis identified relevant internal and external stakeholders, and defined the scope and purpose of engagement.

4.1 Stakeholder Engagement

4.1.1 Participatory planning

Several approaches to engaging internally and externally with stakeholders were applied, including structured facilitated workshops, meetings, site visits and the provision and circulation of information for input. Different stakeholders were engaged using varied approaches during the stages of the planning process, from gathering and sharing information, to consultation, dialogue, working groups, and partnerships. The degree of engagement was guided by the stakeholder analysis and in response to the need (i.e. transparency of process/expert opinion/buy-in and support, etc.).

During 2019-2020 a series of expert-facilitated stakeholder workshops were coordinated and hosted by CapeNature. Due to the COVID-19 pandemic and the resulting lockdown regulations, some of the stakeholder engagement occurred remotely via telephone and online meetings, as public gatherings were by law not permitted. A range of stakeholders representing individuals or agencies with an interest in, and/or knowledge/expertise of the landscape, and individuals or agencies with the capability to support the implementation of the Riviersonderend Complex management plan were involved, see section 4.1.1.1. Workshops were aimed at developing a strategic framework for the Complex to help coordinate efforts in the landscape towards a common vision. The desired outcomes were to capacitate stakeholders in the understanding of the natural and cultural conservation targets/values in the Riviersonderend Complex and to identify mechanisms to maintain those values over time.

The outcomes of the above-mentioned process were precursors to the site-specific management planning process for the protected area and formed the foundation for smaller working groups towards the development of the management plan. The Riviersonderend Complex management planning process was further facilitated by the core planning team comprised of the CapeNature conservation manager, landscape conservation intelligence manager, landscape ecologist, ecological coordinator, off-reserve conservation manager/officer, stakeholder engagement manager/officer and landscape manager. A series of workshops and core planning team meetings were held with relevant internal stakeholders.

4.1.1.1 Key stakeholder groups engaged

- Communities (Greyton, Genadendal, Riviersonderend);
- Private landowners;
- Resource managers mandated to manage the land for conservation:

    - CapeNature;
    - Private landowners;
    - Greater Overberg Fire Protection Association;
    - Cape Winelands Fire Protection Association.
- Government agencies mandated to support and regulate land and water management and other relevant affairs:
    - Department of Agriculture, Rural Development and Land Reform (DARDLR);
    - Department of Agriculture (Western Cape);
    - Department of Environment, Forestry and Fisheries;
    - Department of Water Affairs;
    - Breede-Gouritz Catchment Management Agency
- Government Agencies mandated to support and regulate heritage management:
    - Heritage Western Cape.
- Local authorities
    - Cape Winelands District Municipality;
    - Overberg District Municipality;
    - Breede Valley Municipality;
    - Langeberg Municipality; and
    - Theewaterskloof Municipality.
- Non-governmental organisations (NGO)
    - Greyton Conservation Society
- Other interested and affected parties who support and/or work in the planning domain
    - Friends of Vrolijkheid;
    - Greyton Nature Reserve Advisory Board;
    - Genadendal Moravian Church;
    - Vrolijkheid Water Users Association;
    - Greyton Tourism;
    - McGregor Tourism;
    - Zonderend Bewarea;
    - Donkerkloof Bewarea;
    - Genadendal Omgewingsforum;
    - McGregor Heritage Society; and
    - Helderstroom Correctional Services.

To date approximately seven targeted stakeholder engagements have been initiated and facilitated with the eight above-mentioned stakeholder groupings through the following mechanisms:

4.1.1.2 Workshops and Engagements

Stakeholder workshops had the following key themes:

- Planning purpose: introducing stakeholders to planning for adaptive management; planning scope and vision;
- Conceptualisation: capacitating stakeholders in adaptive management planning; selecting focal conservation targets and assessing the condition of

focal conservation targets; threats assessment and conservation situation analysis;
- Planning actions: identifying strategies; developing theories of change and developing objectives and indicators;
- Internal stakeholder engagement: scientific and technical review.

Six external organisations (total of 10 people) attended the workshops out of all the organisations invited to attend (Figure 4.2).

Figure 4.2: Stakeholder participation in the Riviersonderend Complex. Photo: Daleen Burger.

4.1.1.3 Working groups and other input opportunities

In instances where specific input was required or stakeholders and/or experts were unable to participate in workshops, smaller teams engaged and/or public meetings were facilitated to:

- Share workshop outputs and progress, and test the rationale of situation analyses, for example meetings with internal stakeholders related to taxon and habitat specific planning;
- Address relevant knowledge gaps and test rationale, for example, program managers and taxon specialists were consulted to find mechanisms to address knowledge gaps in areas where needed. Internal stakeholders were consulted to address knowledge gaps;
- Provide opportunities for specific community engagements to reach as many individuals as possible via platforms such as the Riviersonderend Protected Area Advisory Committee (PAAC);
- Facilitate information sessions and registration of interest with community members.

4.1.2 Procedures for public comment

The formal stakeholder participation process was initiated on 19 October 2020 and was concluded on 19 November 2020. The process was facilitated by an external service provider – Footprint Environmental Services. A process inviting the public and interested and affected parties to register their interest and comment on the draft protected area management plan was initiated via the media and direct contact via email and telephone calls. Notification were placed in two local newspapers ('Hermanus Times and Breederivier Gazette', and 'Die Hoorn'), electronic media e.g. CapeNature's website and Facebook Page.

Furthermore, copies of the draft management plan were placed at public libraries in Greyton, Riviersonderend, and Robertson. The draft management plan was also available at the Vrolijkheid Provincial Reserve office, and on the CapeNature website for the duration of the stakeholder participation process. Written comment was invited on the draft protected area management plan for a period of 30 days.

Registered interested and affected parties were invited to public meetings and provided the opportunity to provide information and express their opinion. Three meetings were held:

- 3rd November 2020 – Riviersonderend Community Hall at 10:00;
- 3rd November 2020 – Greyton Old Moravian Hall at 15:00; and
- 4th November 2020 – Robertson at the Callie de Wet Hall at 13:00.

The Riviersonderend meeting was attended by four stakeholders, while three stakeholders attended the Greyton meeting and Robertson meeting, respectively. Only the Vredendal meeting was attended by four stakeholders. A number of comments from the stakeholder meeting as well as the general public were received during the stakeholder participation process. Based on a comprehensive stakeholder engagement report containing all inputs received from the public meetings, written comments and comments and responses received by email, the draft management plan was amended where relevant. Feedback were provided to registered interested and affected parties.

A comprehensive stakeholder register, maintained by the Riviersonderend Complex lists all stakeholders and registered interested and affected parties, as well as comments received, and responses provided. Refer to Appendix 2 – Stakeholder Engagament Process Report for the Riviersonderend Complex.

4.1.3 Procedures for participatory implementation

4.1.3.1 Protected Area Advisory Committee

Participatory management is facilitated through structures such as the PAAC with the aim of regular interaction with stakeholders and a mechanism to evaluate stakeholder feedback, to promote good neighbour relations and to influence beyond protected area boundaries.

- A PAAC for the complex existed in the form of the Vrolijkheid Provincial Reserve PAAC, which was established in January 2011. The PAAC functioned until 2019 when a meeting was held in the month of January. The PAAC needs

reconstitution as its structure has lapsed due to the executive members not being actively involved in the constituted committee anymore. This new structure should be in place as soon as possible. It will be in place for two years after which new members will be elected. This PAAC needs further development to have more representation on the southern side of the Complex.

- Key themes include People and Parks topics such as access, environmental projects, youth development and environmental awareness. Focus areas include the involvement of youth in programmes and projects concerning the environment.
- The structure consisted of community groups representing youth development, tourism, education, sustainable harvesting, farming and culture, entrepreneurship, land claimants and the unemployed. The tourism sector in McGregor and Robertson had representation on the PAAC. Municipal representation for water quality and fire and disaster management existed on the previous structure.

4.1.3.2 Other mechanisms for stakeholder engagement

Enhancing engagement and participation by relevant stakeholders throughout the protected area is a key focus going forward. Current structures for stakeholder engagement, additional to the PAAC include:

- The Friends of Vrolijkheid is a community-based group aimed at supporting the Vrolijkheid Provincial Reserve and the broader conservation community.
- The National People and Parks Programme implemented by CapeNature has established a regional structure in the area to enable community engagement. The primary objective is to link communities with relevant government departments that can assist with issues such as access for marine resource utilisation or for spiritual, recreational, educational, traditional and other purposes. The programme is also designed to capacitate communities with regard to relevant legislation, policies and regulations.
- Zonderend Bewarea representing landowners in the eastern part of the Complex up to Stormsvlei.
- Worcester Cluster Rural Forum: CapeNature represented by Off-Reserve component on this rural safety forum which includes representatives of the South African Police Service (SAPS), agriculture and private rural security firms.
- Breede-Gouritz Catchment Management Agency: The lead agent for water resources management within the Breede-Gouritz Water Management Area. CapeNature plays an integral role in the management into restoration and ecological maintenance of these catchment areas.
- Greater Overberg FPA: CapeNature is a statutory member of this integrated wildfire management body.
- Greyton Nature Reserve Advisory Board: A representative of CapeNature will participate in meetings of this board to provide technical guidance and cooperation in combined conservation efforts.
- Vrolijkheid Water Users Association: CapeNature is a member of this association and participate in the management of water turn arrangements in the area the Vrolijkheid Provincial Reserve.

5 PURPOSE AND VISION

This section makes provision for CapeNature to manage the protected area for the purpose for which it was declared. It presents the vision, purpose, conservation targets and key threats foundational to developing the desired state for the Complex.

The desired state, articulated as goals in this management plan, defines the outcome of management and directs management within and beyond protected area boundaries. This serves as a foundation for appropriate ongoing monitoring and evaluation to assess management effectiveness.

5.1 Management Intent and Desired State

The Riviersonderend Complex is situated in the Greater Cape Floristic Region and forms part of the CFRPA World Heritage Site extension. The Riviersonderend Mountain Range supports mountain fynbos of high diversity with a number of threatened and endemic species. It is also a strategic water source area and hence an important catchment which requires appropriate management. Vrolijkheid Provincial Reserve currently forms an important protected area for fauna and flora of the succulent karoo of the Breede Valley.

The aims for the Riviersonderend Complex are to strategically, and adaptively, manage biodiversity towards ensuring the expansion and persistence of terrestrial biodiversity of international importance, intact natural climate change corridors, freshwater ecosystems, and unique cultural heritage of the region through:

- The prioritised strategic management of threats;
- Maximizing ecosystem service provision of freshwater resources and sustaining biodiversity through ICM;
- Ensuring that the properties comprising the Complex are legally secured and protected area design is augmented by expansion/consolidation through stewardship or other effective means;
- Cooperative governance across all tiers and sectors of government and associated agencies;
- Effective illegal natural resource use control;
- Managed access to facilitate sustainable and sensitive access and tourism;
- Providing a valuable research and learning space for Fynbos and Succulent Karoo systems along ecological gradients informing climate change adaptation; and
- To contribute meaningfully to socio-economic development of the region and its people.

5.2 Purpose

The Riviersonderend State Land was nominated as an extension of the CFRPA World Heritage Site in 2015. The primary reasons for inclusion of this complex into the extension nomination for the CFRPA were to improve representation of vegetation types within the CFRPA, as well as to increase and improve the overall size, connectivity and integrity of the CFRPA, thus ensuring protection of an increased land area within the World Heritage Site. The primary criteria for which the Riviersonderend State Land qualifies for World Heritage Site status are on-going biological and

ecological processes, and biological diversity and threatened species. The inclusion of the Riviersonderend Complex into the inscribed CFRPA increases resilience in the face of global climate change and improves both biodiversity pattern and process of the inscribed CFRPA World Heritage Site.

Vrolijkheid Nature Conservation Station was founded in 1958 as a DCA research centre, including breeding of hounds to control DCAs which eventually stopped in 1985. The property was declared a provincial nature reserve in terms of the Nature Conservation Ordinance in 1976, while still functioning as a DCA research centre. The Cape Quagga experimental breeding project which aimed to rebreed the extinct quagga (*Equus quagga quagga*) was initiated at Vrolijkheid in 1987. At this time, the focus of the management of the property changed to the management objectives of a nature reserve, and included the removal of animals not indigenous to the area, the removal of internal fences and allowing some of the lands been to revert back to their natural state. Currently the purpose of the management of the reserve has transitioned fully to biodiversity conservation objectives, with all alien game species removed from the property and restoration projects proposed for disturbed sections of the reserve.

CapeNature manages the Riviersonderend Complex in accordance with its organisational vision, and in accordance with the vision, goals and strategies derived in consultation with stakeholders, as set out in this section.

The Riviersonderend Complex was declared for the following purposes (Section 17 of the NEM: PAA):

a) to protect ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes in a system of protected areas;
b) to preserve the ecological integrity of those areas;
c) to conserve biodiversity in those areas;
d) to protect areas representative of all ecosystems, habitats and species naturally occurring in South Africa;
e) to protect South Africa's threatened or rare species;
f) to protect an area which is vulnerable or ecologically sensitive;
g) to assist in ensuring the sustained supply of environmental goods and services;
h) to provide for the sustainable use of natural and biological resources;
i) to create or augment destinations for nature-based tourism;
j) to manage the interrelationship between natural environmental biodiversity, human settlement and economic development;
k) generally, to contribute to human, social, cultural, spiritual and economic development; or
l) to rehabilitate and restore degraded ecosystems and promote the recovery of endangered and vulnerable species.

5.3 Vision

The vision for the Riviersonderend Complex is:

Collaborative conservation and protection of ecosystem services, biodiversity, connectivity, and diverse cultural heritage which facilitate benefit sharing and the provision of sustainable opportunities for current and future generations in the face of change.

5.4 Focal Conservation Targets

In consultation with stakeholders, natural and cultural historic conservation targets were identified, explicitly defined, and selected for their ability to represent the full suite of biodiversity and cultural historic heritage found within the protected area.

Focal conservation targets are summarised in Table 5.1. Features considered to be nested within or catered for by the conservation of the focal conservation target, are noted. Key human well-being values derived from the tangible natural and cultural focal targets/values are also noted. Since human well-being values are those components of wellbeing affected by the status of tangible natural or cultural targets/values, their 'health' or status is not assessed separately but seen as contingent upon the status of the natural and cultural focal targets/values selected.

Table 5.1: Summary of the Riviersonderend Complex focal conservation targets and viability as at 2019.

Conservation Target	Description, Nested Targets, Key Attributes & Associated Human Well-being Values	Current Status
Fynbos Mosaic	**Description:** A healthy fynbos mosaic and vegetation structure supports numerous fauna and flora species. Supported by connectivity it promotes ecological functioning and resilience. The fynbos vegetation mosaic in the Riviersonderend Complex includes eleven vegetation types that include among other shale fynbos sandstone fynbos, afrotemperate forest, and alluvial vegetation. **Nested targets of note:** Afrotemperate forest; renosterveld; associated fauna and flora communities. **Key attributes:** Fire frequency; fire return interval; fire season; fire size; post-fire recruitment; indigenous vegetation species composition. **Associated human well-being value(s):** Nature-based Economic & Tourism Opportunities; Social Upliftment; Responsible Utilisation of Natural Resources; Environmental Education & Awareness; Physical & Spiritual Health; Diverse Cultural Identity.	**Good****
Succulent Karoo	**Description:** A healthy succulent karoo mosaic and vegetation structure supports numerous fauna and flora species. Supported by intact connectivity it promotes ecological functioning and resilience. The succulent karoo vegetation occurs on Vrolijkheid Provincial Reserve. **Nested targets of note:** Associated fauna and flora communities. **Key Attributes:** Indigenous vegetation species composition; indigenous vegetation cover (excluding "opslag"/ephemeral species); heuweltjie condition; presence/absence of threatened priority species (Endangered, Critically Endangered, and Vulnerable); soil health. **Associated human well-being value(s):** Nature-based Economic & Tourism Opportunities; Social Upliftment; Responsible Utilisation of Natural Resources; Environmental Education & Awareness; Physical & Spiritual Health; Diverse Cultural Identity.	**Very Good*****
Freshwater Ecosystems	**Description:** Freshwater Ecosystems includes the river channel and associated buffer that supports riparian fauna and flora assemblages. Included are seasonal tributaries, seeps, wetlands and springs. **Nested targets of note:** Indigenous fish; freshwater invertebrates; riparian vegetation; riparian fauna; seeps; wetlands; springs; rivers.	**Fair***

Conservation Target	Description, Nested Targets, Key Attributes & Associated Human Well-being Values	Current Status
	Key attributes: River health; indigenous vegetation structure and species composition within the riparian zone; wetland ecosystem health; intact wetland buffers (isolated wetlands and seeps); river flow regime; groundwater; freshwater fish species composition (includes threatened fish species). **Associated human well-being value(s):** Nature-based Economic & Tourism Opportunities; Social Upliftment; Responsible Utilisation of Natural Resources; Environmental Education & Awareness; Physical & Spiritual Health; Diverse Cultural Identity.	
Landscape Connectivity	**Description:** The increase in the conservation estate through stewardship, land purchases and the transfer of state land will promote reserve consolidation, expansion and increase habitat connectivity and resilience. This approach is regarded as one of the best responses to climate change (Pool-Stanvliet *et al*. 2017). Furthermore, it will also contribute to the conservation of priority succulent karoo, fynbos and renosterveld habitat. **Nested targets of note:** All flora and fauna species associated with the Riviersonderend Complex and within its zone of influence. **Key attributes:** Consolidation withinin corridors; ecotypical mammal species population. **Associated human well-being value(s):** Nature-based Economic & Tourism Opportunities; Responsible Utilisation of Natural Resources; Physical & Spiritual Health.	**Good**
Diverse Cultural Heritage	**Description:** All heritage assets including pre-colonial heritage and historical structures such as graves, fossils, rock art, artefacts and historical structures and ruins. **Nested targets of note:** Fossilised fauna and flora, geological history, pre-colonial history, colonial history, cultural history and living heritage. **Key attributes:** Heritage condition (the conservation state of pre-colonial structures, rock art, artefacts, and colonial structures). **Associated human well-being value(s):** Social Upliftment; Diverse Cultural Identity; Environmental Education and Awareness; Physical & Spiritual health.	**Fair**

* Fair for River Health, but six KEA's indicated as "Not Specified".
**One KEA indicated as "Not Specified".
***Very Good for Indigenous Vegetation Species Composition, but four KEA's indicated as "Not Specified".

As the public entity responsible for nature conservation in the Western Cape, CapeNature delivers a suite of core services to the public towards the following outcomes: resilient ecosystems; the promotion of local economic development, job creation and skills development; growing diversified nature-based revenue streams; access to environmental education, advocacy and education, and access to natural and cultural heritage.

Human well-being is articulated as an outcome of conservation and is illustrated in Table 5.2. These focus areas are essential to the effective execution of this management plan and achievement of goals.

Table 5.2: Human wellbeing values of the Riviersonderend Complex.

Human Well-being Values	Description and Associated Benefits	Current Status
Nature-based Economic & Tourism Opportunities	**Description:** The Riviersonderend Complex contributes to local economic development by providing a number of job opportunities to local people in the area, mostly of an operational nature. Tourism expansion in the reserve can increase employment availability in the Complex. **Key attributes:** Operational/Tourism job opportunities.	**Good**
Physical & Spiritual Health	**Description:** The landscape, remoteness, open spaces and ecological diversity of the Riviersonderend Complex promotes a sense of place allowing for physical and spiritual health to be instilled, restored and refreshed. **Key attributes:** Aesthetic experience, and reconnecting with nature.	**Fair**
Diverse Cultural Identity	**Description:** This value is focused on the diverse cultures and heritage found within the broader Riviersonderend Complex area. **Key attributes:** Indigenous cultural knowledge.	**Good**
Social Upliftment	**Description:** Social upliftment and empowerment of people within and surrounding the Riviersonderend Complex is critical. Collaboration and engagement with partners in the area is key to enhance training availability and opportunities; a lack of which ultimately has an impact on the whole area, including the Complex. The reserve aims to provide its contract staff component with meaningful functional and life-skills training during their employment period; contributing to their social upliftment and employability. Entrepeneurship is encouraged and facilitated where possible. **Key attributes:** Functional & life skills training opportunities.	**Good**
Environmental Education & Awareness	**Description:** The Complex strives to provide an effective environmental education, awareness and interpretation programme that supports all the conservation targets of the Complex and promotes respect and care for the natural environment. This is particularly relevant to local schools, communities and landowners. **Key attributes:** Comprehensive environmental interpretation and awareness plan.	**Fair**
Sustainable Natural Resource Use	**Description:** The Riviersonderend Complex aims to promote and provide access for consumptive and non-consumptive natural resource use, underpinned by structures that promote and enable responsible, sustainable use. **Key attributes:** Access permits issued (research, day visitors, filming).	**Fair**

5.5 Threats

CapeNature aims to mitigate threats to focal conservation targets, either through direct threat mitigation, or through mitigation or management of a factor contributing to or driving the threat. Threats to focal conservation targets and the relevant contributing factors of key threats need to be described in sufficient detail to support effective planning and management.

Threats assessment influences the direction and effectiveness of management options. Rating threats according to scope, severity and irreversibility of impact

facilitates the allocation of limited resources, simplifies complex scenarios and provides a systematic decision support method to focus efforts (Table 5.3).

Table 5.3: Summary of critical threats highlighting the foval conservation targets of the Riviersonderend Complex at greatest risk.

Focal Targets	Critical Threats	Threat Rating
Diverse Cultural Heritage	Lack of information; Land claims; Pollution; Vandalism.	**Very High**
Succulent Karoo	Climate change; Detrimental agricultural activities; Historical landuse practices; Inappropriate infrastructure development; Invasive alien plants; Land claims; Poaching.	**High**
Fynbos Mosaic	Climate change; Detrimental agricultural activities; Inappropriate fire regime; Inappropriate infrastructure development; Invasive alien plants; Poaching.	**High**
Landscape Connectivity	Protected area fragmentation.	**High**
Freshwater Ecosystems	Climate change; Inappropriate fire regime; In-stream structures; Invasive alien fish; Invasive alien plants; Over-abstraction; Poaching; Pollution.	**Medium**

The results of the above threat rating highlighted the following key threats affecting the focal conservation targets of the Riviersonderend Complex as outlined in Table 5.4 below:

Protected Area Fragmentation (High): Protected area fragmentation is a threat to the long-term viability of the ecosystems and Landscape Connectivity conservation targets for the Complex. Fragmentation negatively affects ecological processes. Connectivity is required for to assist with climate change adaptation through the protection of corridors of natural vegetation. Securing these areas for conservation is of high priority. The Riviersonderend Mountain Catchment Area reserve design maintains strong connectivity from east to west. However, this could be futher enhanced through stewardship by formally securing the land in the gap between the two large state land segments.

Loss of habitat corridors within the lowland habitats surrounding Vrolijkheid Provincial Reserve, most prominently through agriculture, affects the long-term persistence of fauna through the impact on gene flow. This is a challenge in the lowland areas as the Breede Valley has a high agricultural potential with continuing loss of natural vegetation to cultivation. Hence the focus will be on connectivity in the Mountain Catchment Area.

Future protected area expansion will focus on consolidation of the reserve footprint (section 8) to support and maintain viable ecosystem and evolutionary processes and enhancing habitat connectivity and resilience. This approach is regarded as one of the best responses to climate change (Pool-Stanvliet *et al*. 2017).

Apart from the ecological benefits of a consolidated reserve footprint, it will also greatly enhance operational management effectiveness; especially related to travelling distances, reduced fencing requirements and better access and compliance control.

Climate Change (High): Climate change, which is anticipated to result in warming, drying and increased rainfall irregularity in the Western Cape, has been identified as a high rated threat affecting three of the Riviersonderend Complex conservation targets (Freshwater Ecosystems; Fynbos Mosaic; and Succulent Karoo). Annual rainfall over the last 10 years for the Vrolijkheid Provincial Reserve has seen an overall general trend of decline from an 11-year annual average of 245 mm, with 152,2 mm recorded during the drought in 2017 (Section 2.2.1).

Climate change will have significant environmental, social, cultural and economic consequences. Although the effects of climate change are speculative, in general, it is likely to have major negative impacts on the Fynbos and Succulent Karoo Biomes (Pool-Stanvliet *et al.* 2017), and their freshwater ecosystems. It is expected that rainfall patterns throughout the winter-rainfall regions will be disrupted (Helme 2016; Holmes *et al*. 2016). This could have dire negative consequences for some specialised endemic species found in the Succulent Karoo where the relatively small climatic envelope is the limiting factor (Helme 2016). This will most likely result in reduced geographic ranges and possible extinction of species (Pool-Stanvliet *et al*. 2017).

In this context, the reserve aims to build habitat resilience through increased reserve connectivity and reducing/mitigating contributing threat factors such as invasive alien plant species and inappropriate fire management. Furthermore, through long-term monitoring, including the collection of hydrological data for flow regime determination, is of the utmost importance. Flow regime data, together with rainfall data can inform the establishment of a link between surface water (hydrological), groundwater (geohydrological) and rainfall conditions. This in turn will provide insight into for example the possible impacts imposed by water abstraction (surface or ground) on surface or groundwater flows (Rose & Conrad 2006).

Vandalism (High): Some incidents of vandalism, especially related to damaging of heritage features, have occurred in the Riviersonderend State Land. A lack of awareness to the sensitivity of the environment, value of heritage features and the ease of access to the reserve are contributing factors. These incidents are of a localised nature.

At this stage the impact of these acts and how they relate to the heritage targets of the reserve cannot be comprehensively evaluated, as a full heritage inventory and assessment still needs to be undertaken. However, it must be noted that physical heritage features are often irreplaceable and once destroyed or altered their heritage significance diminishes. Several interventions have been highlighted in this management plan to ensure compliance action and to address and promote controlled access to, and increase awareness of, the unique heritage targets in the Complex (section 10).

Invasive Alien Plants (Medium): The fynbos mosaic, succulent karoo, and freshwater ecosystems are threatened by invasive alien plants in the Riviersonderend Complex. Australian *Acacia*, *Hakea*, and *Pinus* species are amongst the most problematic woody invasive species in the CapeNature managed Nature Reserves

and the surrounding areas, although several other species, such as poplars (*Populus* spp.) and eucalyptus (*Eucalyptus camaldulensis*) are also problematic in the riparian zones, mountain catchment and lowland areas adjacent to the protected area sites (i.e. zone of influence) and are discussed in more detail in Section 2.3.2. Sustained active management intervention is required to prevent it from negatively affecting species diversity and ecosystem services. An integrated approach to clearing invasive alien plants is needed for both aquatic and terrestrial ecosystems.

The presence of invasive alien plant species within the riparian zones is a threat to the river ecosystems in the Riviersonderend Complex. Samways *et al*. (2010b) recommend that the removal of invasive alien trees should be prioritised for maintenance of the riparian zones, especially for rivers in the high-water yield catchments. The invasive alien trees outside of the riparian areas within the catchment do however also contribute significantly to reducing water yield and must also be controlled with the long-term goal of eradication. Moreover, the establishment of indigenous vegetation after alien clearing should be encouraged to also enable the re-establishment of faunal groups, such as for example aquatic macro-invertebrates (Samways *et al.* 2010b).

Inappropriate Fire Regime (Medium): Too frequent, too large and out of season fires have far-reaching ecological impacts. The majority of fires are human induced either through accidental ignition or are intentionally set. In order to reduce the incidence of wildfire in the Riviersonderend Complex and surrounding areas, the Overberg and Cape Winelands FPAs have been established and Working on Fire teams are based at Vrolijkheid Provincial Reserve. Many private landowners (especially farmers) in this region are actively involved in fire prevention, detection and firefighting through their membership with the FPAs.

Over the past 10 years, the size of fires has increased, especially on the southern slopes of the Riviersonderend Mountain, resulting in larger areas of the Riviersonderend State Land consisting of young veld. In addition, fires have become more frequent with areas burning at too short return intervals and this is impacting negatively on the Riviersonderend Complex ecosystems, whereby serotinous plant species have not had the opportunity to set sufficient seed prior to burning. Some aquatic systems, such as wetlands, are also affected by an unhealthy fire regime.

Detrimental Agricultural Activities (Medium): Detrimental agricultural activities have been identified as a medium threat affecting the Fynbos Mosaic, Succulent Karoo, and Freshwater Ecosystems conservation targets of the Riviersonderend Complex. Outside the Complex boundaries, the rivers and wetlands, and their buffer zones, are under increased threat from unsustainable land-use activities related to agricultural practices.

Historical Land Use Practices (Low): Sections of the Vrolijkheid Provincial Reserve have historically been farmed to some extent, particularly in the western section. Previous farming practices were mainly small livestock and game grazing and limited dryland grain production, which continued after the establishment of the Vrolijkheid Vermin Research Farm (see Section 2.4.6). Associated with the previous land use practices are a number of impacts that are still clearly visible today and, in many respects, will have lasting effects and take many years to rehabilitate or restore.

Examples of these include jeep tracks, clearing of vegetation for planting of crops, grazing by livestock and associated water and housing infrastructure etc. Some of these land use practices, or associated infrastructure have also resulted in secondary land impacts such as gully erosion, sheet erosion and habitat modification (Figure 5.1). Furthermore, the reserve historically contained poorly managed game species, including springbuck (*Antidorcas marsupialis*) and ostrich (*Struthio camelus*) which resulted in degradation of the natural vegetation and erosion in a section of the Vrolijkheid Provincial Reserve. An assessment and continued monitoring of the vegetation is required to evaluate the recovery of the vegetation and general condition over time. The proposals is that the Karoo Veld: Ecology and Management (Esler *et al.* 2006) veld assessment form can be used as the basis for monitoring, which includes vegetation cover (excluding “opslag”), forage value, grazing intensity, disturbance indicators, seedling ratio and soil health as variables to assess vegetation condition. This may need to be amended to take into account the absence of large herbivores.

There are also other less intensive methods of vegetation condition monitoring such as fixed point photography (Coetzee 2016).

Figure 5.1: Example of erosion rehabilitation inside the Vrolijkheid Provincial Reserve due to historical grazing impacts. Photo: Riviersonderend Complex Field Rangers.

In-stream Structures (Low): Instream structures include weirs, instream dam walls, bridges and causeways (Figure 5.2). The presence of weirs and other structures also causes upstream inundation (pooling) and alters the natural flow velocity and pattern of the river. In the case of weirs, it seems to be standard practice that rivers are blocked to varying degrees by the presence of diversion weirs just outside of the protected area boundaries. These weirs tend to block off all the natural flow to downstream areas during the dry months and divert it to for example farm dams. The same would be the case for instream dams. Furthermore, these structures negatively impact indigenous fish species through the loss of habitat resulting from the disturbance of instream habitat by earthmoving equipment.

Figure 5.2: Weir on the Boesmans River, with a lot of water being diverted into the canal visible in the right-hand corner. Photo: Jeanne Gouws.

Inappropriate Infrastructure Development (Low): Pool-Stanvliet *et al*. (2017) lists the primary loss of biodiversity in the Western Cape is loss of habitat, mainly driven through transformation, degradation and fragmentation. Helme (2016) recommends that land-use activities and development within Succulent Karoo plant communities should be confined to previously disturbed footprints or kept to an absolute minimum as recovery is extremely slow, if at all possible.

Inappropriate infrastructure development has been rated as a low threat, mainly affecting the vegetation and connectivity targets of the Riviersonderend Complex. It also affects the human well-being value related to physical and spiritual health. It relates to the construction of infrastructure either inside or outside of the reserve that

would compromise these targets. Infrastructure development inside the reserve will be guided through the zonation and concept development plan (section 6 and 9 respectively) and restricted to previously disturbed footprints.

Invasive Alien Fish (Low): Invasive alien fish species affect indigenous fishes through predation, habitat alteration, competition for resources, the introduction of diseases and the disruption of ecological processes (Skelton 1987; De Moor & Bruton 1988). The primary impact is predation on smaller species and on juveniles of larger species and this has resulted in the extirpation of most indigenous species from mainstream rivers and tributaries (Weyl *et al*. 2014).

The Riviersonderend Complex is relatively free of invasive fish species as the only record of non-native fish reported by Jordaan & Gouws (2020) was sharptooth catfish detected in low numbers in the Gobos River near the town of Greyton. Despite their ability to invade a range of habitat types, the impacts of sharptooth catfish in the headwater streams of the CFE are to date largely unstudied. The invasion in the Gobos River has been monitored since 2012 and to date there is limited evidence of negative impacts associated with the presence of sharptooth catfish. The non-detection of other invasive fish species is likely a combination of site selection (most rivers were sampled in headwaters unsuitable to many invasive species) and the presence of invasion barriers such as instream weirs. It is also possible that there are relatively few invasion reservoirs, such as farm dams stocked with alien fish, which can serve as invasion sources to the reserve. Carp, bass and sharptooth catfish have been reported from the dams on Vrolijkheid Provincial Reserve but have not been identified as a priority for management response.

Land Claims (Low): This threat had been identified specifically for the Vrolijkheid Provincial Reserve. Members of the McGregor community have approached the Vrolijkheid Provincial Reserve to inform CapeNature that a portion of Vrolijkheid's southern boundary falls within their land claim. The claim is based on nine families that received land from Queen Victoria for farming and residential purposes, thus making them the original owners of the land, but unfortunately there was no deed of sale for the property. The claim has been lodged at the Department of Rural Development and Land Reform by the land claimants.

Over-abstraction (Low): Pressures on the hydrological functioning of the aquatic systems in these catchments include the ever-increasing water demands for both the urban areas and surrounding agricultural practices.

The reduction in river flow, in the form of over-abstraction of surface water and groundwater, is also a threat, more so within the zone of influence surrounding the Riviersonderend Complex. The over-abstraction of water is often linked to over allocation of water from the relevant authorities, or in the case of the increasing threat of groundwater over-abstraction, unregulated water use. Most of the rivers are completely diverted by weirs just outside the boundary of the relevant protected area, with little or sometimes no flow reaching the downstream reaches. Moreover, major water off-take points are known to exist on at least five of the rivers originating within the mountain catchment and the Riviersonderend Complex. These include a weir within the Riviersonderend State Land boundary on a tributary of the Riviersonderend River upstream of Riviersonderend town, an instream dam/weir in the Elandskloof

River, a weir upstream of Highlands farm within the State Land on the Doring River and weirs on both the Meul and Meerlustkloof rivers. While on Vrolijkheid Provincial Reserve the water off-take point is the water allocation sluice.

Poaching (Low): The threat mostly affects the two vegetation targets (including the nested faunal targets) and is of a localised nature; hence a low rating. In the Succulent Karoo many rare and endemic plant and animal species, particularly reptiles, are intentionally sought after by local and international collectors for the horticultural and wildlife trade (Helme 2016). Furthermore, there is also a component of people that contribute to this problem unintentionally. A lack of awareness to the sensitivity of the environment and the ease of access to the reserve is contributing factors. Helme (2016) also warns that the proliferation of bio-prospecting and commercial interests in medicinal plants in the Succulent Karoo is of concern.

A number of interventions have been highlighted in this management plan to enhance compliance and to address and promote controlled access to, and increase awareness of, the unique biodiversity in the reserve (section 10).

Pollution (Low): This threat mainly relates to surface pollution/litter that impacts our freshwater ecosystems and heritage, and is mostly found to occur in the zone of influence. There are cases of dumping within the Complex boundaries. Pollution/litter is found to be a problem at the Baviaans River (Genadendal), the Riviersonderend town's off take weirs (e.g. camp-fires and visitors to the old cave), and any other sites where there is easy access to the kloofs. These areas are generally very localised. Raising awareness within the communities and the broader area will assist with alleviating the threat (section 10).

Table 5.4: Summary rating of key threats for the Riviersonderend Complex.

Threats	Associated Focal Targets	Summary Threat rating
Protected area fragmentation	Landscape Connectivity	**High**
Climate change	Fynbos Mosaic; Succulent Karoo; Freshwater Ecosystems	**High**
Vandalism	Diverse Cultural Heritage	**High**
Invasive alien plants	Fynbos Mosaic; Succulent Karoo; Freshwater Ecosystems	**Medium**
Inappropriate fire regime	Fynbos Mosaic; Freshwater Ecosystems	**Medium**
Detrimental agricultural activities	Fynbos Mosaic; Succulent Karoo	**Medium**
Historical land use practices	Succulent Karoo	**Low**
In-stream structures	Freshwater Ecosystems	**Low**
Inappropriate infrastructure development	Fynbos Mosaic; Succulent Karoo	**Low**

Threats	Associated Focal Targets	Summary Threat rating
Invasive alien fish	Freshwater Ecosystems	**Low**
Land claims	Succulent Karoo; Diverse Cultural Heritage	**Low**
Over-abstraction	Freshwater Ecosystems	**Low**
Poaching	Fynbos Mosaic; Succulent Karoo; Freshwater Ecosystems	**Low**
Pollution	Freshwater Ecosystems; Diverse Cultural Heritage	**Low**

5.6 Goals

Clear and measurable outcome-based goals, strategies and objectives are fundamental for the assessment of protected area management effectiveness and to the whole process of management itself. Based on the viability and threats assessment, a desired future condition was established for focal conservation targets and core service areas by setting measurable, time-bound goals directly linked to the targets and their key attributes.

Riviersonderend Complex Goals:

To maintain and build healthy and resilient ecological infrastructure, that supports the focal conservation targets and human wellbeing values of the Riviersonderend Complex, management needs to achieve the following:

1. By 2031, the Fynbos mosaic in the Riviersonderend Complex has an ecologically healthy fire regime[1] and comprises 80% indigenous species and reseeding Protea species are represented as per historic data[2].
   [1]Three veld age classes fall between 5-20% of the Protected Area, 75-90% of the area burnt during December-April, fire return intervals Southern slopes: >15 years since last fire; Northern slopes: >20 years.
   [2]According to the Protea Atlas data.

2. By 2031, the Succulent Karoo vegetation mosaic within the Riviersonderend Complex will consist of 50-79% of representative species which will have a stable population size, a perennial vegetation cover of >50%, and a fair[1] soil health.
   [1]Rating of 3 according to Karoo Veld Assessment Form (Esler *et al.* 2006)

3. By 2031, the wetland buffer and riparian zones[1] of the Riviersonderend Complex will have 80% natural vegetation.
   [1]Definition in Water Act of riparian zone.

4. By 2031, the upper and middle river reaches in the Riviersonderend Complex support macro invertebrate species communities representing an ASPT of 6-8 and with >50% of expected fish species present in at least two age classes and have a natural flow regime[1].
   [1]100% natural flow levels for all portions.

5. By 2031, the present ecological state of the Riviersonderend Complex wetland ecosystems will be in a natural (A)[1] to largely natural (B)[2] condition.
   [1]PES definition: unmodified or approximates natural condition (Macfarlane *et al*. 2008).
   [2]PES definition: largely natural with few modifications, but with some loss of natural habitats (Macfarlane *et al*. 2008).

6. By 2031, the key prioritised sites within the Riviersonderend Complex zone of influence have been secured for conservation, encompassing both the fynbos and succulent karoo vegetation mosaics.
7. By 2031, male, female and juvenile ecotypical antelope species will be present within their natural distribution range throughout the Riviersonderend Complex and landscape corridors.
8. By 2031, all anthropogenic disturbances to heritage features are limited to maintain current conditions within the Riviersonderend Complex.

Achieving human wellbeing, derived from healthy responsibly managed ecological infrastructure and heritage, requires that:

9. By 2031, local communities have a comprehensive understanding of the economic value of biodiversity of the Riviersonderend Complex and utilise the area in a sustainable manner.
10. By 2030, the Riviersonderend Complex will provide and support socio-economic opportunities through partnerships with stakeholders, enabling surrounding communities to take part in economic activities created by tourism, ecological actions and development strategies in the Riviersonderend Complex.

5.7 Sensitivity Analysis

Sensitivity analysis based on the protected area's biodiversity, heritage and physical environment is a key informant for spatial planning and decision-making in protected areas. Sensitivity analysis aims to:

- Highlight areas containing sensitive biodiversity and heritage features;
- Inform all infrastructure development e.g. location of management and tourism buildings and precincts, roads, trails, firebreaks;
- Facilitate holistic reserve planning and zonation; and
- Support conservation management decisions and prioritisation of management actions.

At the regional scale, sensitivity mapping also allows for direct comparison of sites both within and between protected areas to support organisational planning across CapeNature's protected areas network. The process elevates:

- Sites with the highest regional conservation value;
- Areas where human access or disturbance will have a negative impact on biodiversity or heritage, and specific environmental protection is required;
- Areas where physical disturbance or infrastructure development will cause greater environmental impacts, and / or increasing construction and maintenance costs;
- Areas where there is a significant environmental risk to infrastructure; and
- Areas that are visually sensitive and need to be protected to preserve the aesthetic quality of the visitor's experience.

Sensitivity analysis provides decision support to ensure that the location, nature and required mitigation for access, utilisation and infrastructure development in the

protected area are guided by the best possible landscape-level biodiversity and heritage informants. The process is transparent, relying on defensible expert-derived information and scientific data. Sensitivity maps do not replace site-level investigation, although do allow for rapid assessment of known environmental risks, guiding planning to minimise negative impacts.

Sensitivity analysis uses a hierarchical approach. The method uses the premise that if a portion of the landscape is demarcated as highly sensitive in one of the categories considered in analysis then, regardless of the sensitivity in other categories, that portion is elevated as highly sensitive in the overall scoring. The approach thus allocates the highest allocated sensitivity in any of the input categories as the ultimate sensitivity class for that particular portion. As new and improved data become available, these data can be included.

Biodiversity, heritage and physical features are rated on a standard scale of one to five, where one represents ‘no’ or ‘minimal sensitivity’ and five indicates ‘maximum sensitivity’ (see Figure 5.3). Additional features such as visual sensitivity, fire risk and transport costs can be included. Higher scores represent areas that should be avoided for conventional access and infrastructure development, or where a specific strategy is applicable relative to sensitivity. A score of five typically represents areas where mitigation for conventional access or infrastructure development would be extensive, costly or impractical enough to be avoided at all costs or features so sensitive that they represent a ‘no go’ area.

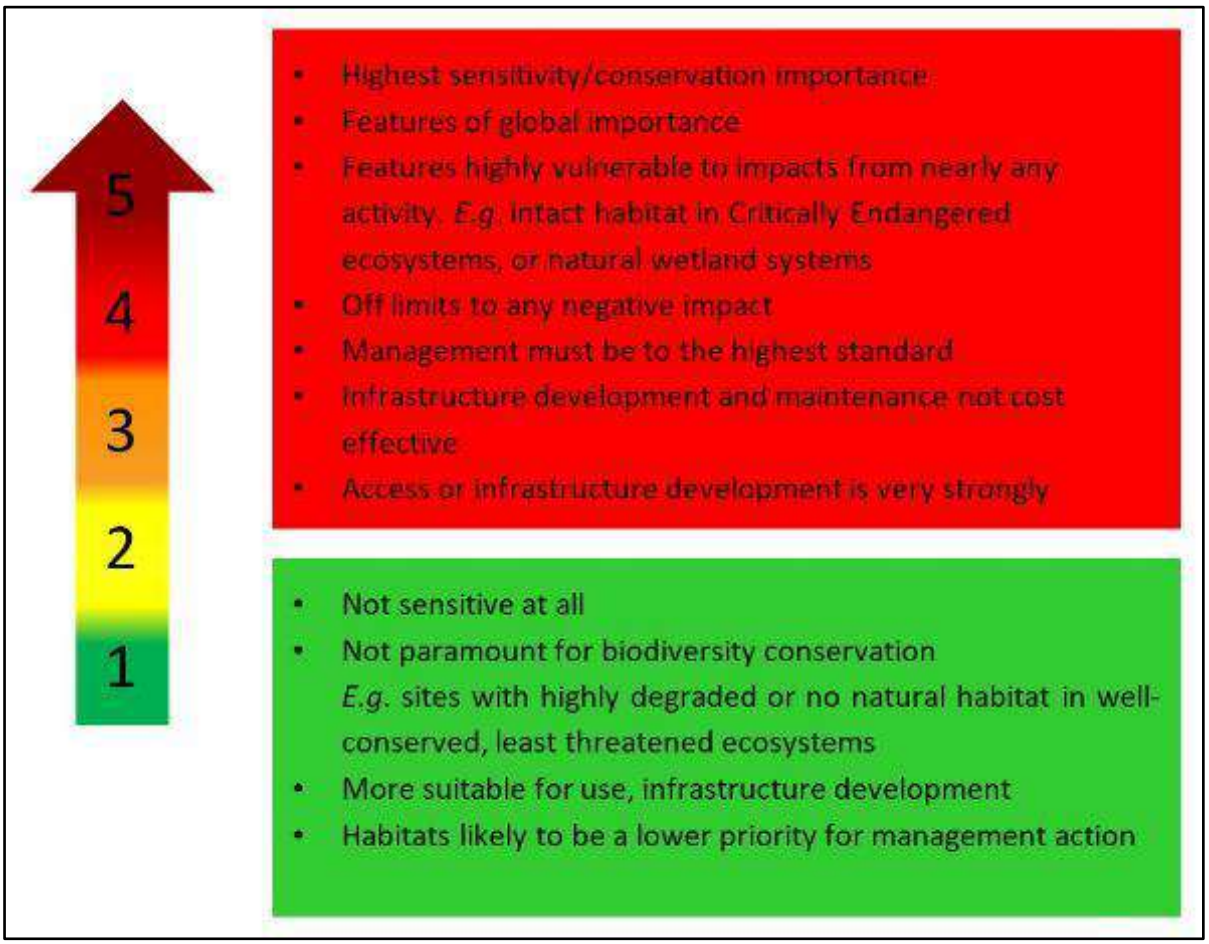


Figure 5.3: CapeNature method for sensitivity scoring and synthesis.

Physical, biodiversity and heritage features included in the sensitivity analysis for the Riviersonderend Complex is illustrated in Table 5.5.

Table 5.5: Physical, biodiversity and heritage factors included in the sensitivity analysis of the Riviersonderend Complex.

	Category	Dataset	Criteria	Sensitivity Score	
Physical	Slope (degrees)	Slope calculated from 20 m resolution digital elevation model	> 30° Effectively off-limits for infrastructure development due to extreme risk of erosion and instability, or extreme engineering mitigation and associated construction costs required.	Highest sensitivity	5
			20°-30° Strongly avoid for infrastructure development – cut and fill or other difficult and expensive construction method required. Appropriate engineering mitigation essential to prevent erosion and slope instability. Highest initial and on-going cost due to slope stabilization and erosion management required.	High sensitivity	4

	Category	Dataset	Criteria	Sensitivity Score	
			10°-20° Avoid for road, trail and firebreak construction if possible. Severe erosion will develop on exposed and unprotected substrates. Pave roads and tracks, and ensure adequate drainage and erosion management is implemented. May provide good views.	Moderate sensitivity	3
			5°-10° Low topographic sensitivity, likely still suitable for built infrastructure. Use of gentle slopes may provide improved views or allow access to higher areas.	Low sensitivity	2
			0°-5° Preferred areas for any built infrastructure, lowest risk of erosion or instability, lowest construction and on-going maintenance costs.	Lowest sensitivity	1
	Soil erodibility / Geology	Soil erodibility categories per the SA Atlas of Climatology and Agrohydrology (Schulze & Horan 2007)	Soil erodibility presents a risk due to increased vulnerability to disturbance. High soil erodibility classified as high sensitivity. Moderate and low soil erodibility is not included as a feature.	High sensitivity	4
Biodiversity	Rivers	1: 50 000 National Geo-Spatial Information Rivers	Within 200 m of perennial river.	Highest sensitivity	5
			Within 100 m of non-perennial river.	High sensitivity	4
	Wetlands and seeps	National Biodiversity Assessment 2018 wetlands (Van Deventer *et al*. 2018) and Seeps	Wetlands and seeps. Only included natural wetlands, hence dams excluded.	Highest sensitivity	5
			Within 200 m of wetlands and seeps.	High sensitivity	4
	Vegetation status / Red-Listing Ecosystems (RLE) (previously referred to as ecosystems threat status)	Red-Listing Ecosystems by Andrew Skowno, done for the National Biodiversity Assessment per vegetation type, SA Veg Map 2018 (SANBI 2006 & 2018) (Previously referred to as Ecosystem Threat Status based on Cape's 2014 or	Critically Endangered – South Sonderend Sandstone Fynbos; Western Rûens Shale Renosterveld.	Highest sensitivity	5
			Endangered – Breede Alluvium Renosterveld; Breede Shale Renosterveld; Cape Lowland Alluvial Vegetation.	High sensitivity	4
			Vulnerable – None.	Moderate sensitivity	3
			Near Threatened – Greyton Shale Fynbos.	Low sensitivity	2
			Least Concern – Breede Quartzite Fynbos; North Sonderend Sandstone Fynbos; Robertson Karoo; Southern	Lowest sensitivity	1

	Category	Dataset	Criteria	Sensitivity Score	
		2016 assessments per veg type (Mucina & Rutherford 2006)).	Afrotemperate Forest; Western Coastal Shale Band Vegetation.		
	Protection levels per vegetation type	Protection levels by Andrew Skowno, done for the National Biodiversity Assessment per vegetation type, SA Veg Map 2018 (SANBI 2006 & 2018)	Not Protected – Breede Alluvium Renosterveld; Western Rûens Shale Renosterveld.	High sensitivity	4
			Poorly Protected – Breede Quartzite Fynbos; Breede Shale Renosterveld; Cape Lowland Alluvial Vegetation; Greyton Shale Fynbos; Robertson Karoo.	Moderate sensitivity	3
			Moderately Protected – None.	Low sensitivity	2
			Well Protected – North Sonderend Sandstone Fynbos; South Sonderend Sandstone Fynbos; Southern Afrotemperate Forest; Western Coastal Shale Band Vegetation.	Lowest sensitivity	1
	Vegetation Status / Ecosystems Threat Status	Ecosystem Threat Status based on Cape's 2016 assessments per vegetation type 2012 (Mucina & Rutherford 2006)	Critically Endangered – Cape Lowland Alluvial Vegetation; Western Rûens Shale Renosterveld	Highest sensitivity	5
			Endangered – Breede Alluvium Renosterveld; Greyton Shale Fynbos	High sensitivity	4
			Vulnerable – None	Moderate sensitivity	3
			Threatened – None	Low sensitivity	2
			Least Threatened – Breede Quartzite Fynbos; Breede Shale Renosterveld; North Sonderend Sandstone Fynbos; Robertson Karoo; South Sonderend Sandstone Fynbos; Southern Afrotemperate Forest; Western Coastal Shale Band Vegetation; Western Cape Afrotemperate Forest	Lowest sensitivity	1
	Rare and endangered plant species	Rare and endangered plant species extracted from CapeNature	Locality records of all plant species rated as Critically Endangered, Critically Rare, Declining, Endangered, Near Threatened, Rare or Vulnerable, and a buffer of 5 m.	Highest sensitivity	5

	Category	Dataset	Criteria	Sensitivity Score	
		State of Biodiversity Data Base; All threatened Species (SANBI 2015)			
	Afrotemperate forest patches	Captured from aerial photography	Remnant patches of Southern Afrotemperate Forest	Highest sensitivity	5
Heritage	Archaeological and cultural sites	Cultural and heritage sites (CapeNature Infrastructure Register)	Heritage sites (point features) and a buffer of 100 m. Historic wall (linear feature) and a buffer of 25 m.	Highest sensitivity	5

The sensitivity category occupying the highest percentage of the Complex is highest sensitivity (score = 5), which occupies 70.8% of the Riviersonderend Complex. For the Riviersonderend State Land, the sensitivity category with the highest percentage is highest sensitivity (score = 5), which occupies 75.5% of the State Land, whereas for Vrolijkheid Provincial Reserve, the sensitivity category with the highest percentage is high sensitivity (score = 4).

The key drivers for the sensitivity for the Riviersonderend State Land are the slope sensitivity and Red-Listed ecosystems, of which 38.7% and 57.7% of the state land is rated as highest sensitivity for these two categories respectively. The reason for this is that the Riviersonderend State Land is located within the Riviersonderend Mountains and therefore is dominated by steep slopes which are not suitable for development and therefore require mitigation measures and appropriate design for roads, jeep tracks and hiking trails in order to prevent erosion.

South Sonderend Sandstone Fynbos is listed as Critically Endangered (rated as highest sensitivity) in the current draft Terrestrial Red List of Ecosystems South Africa 2020 and occupies a large proportion of the State Land (Skowno *et al*. 2020) and hence accounts for a large area of highest sensitivity. It should be noted that according to the 2011 gazetted National List of Ecosystems that are Threatened and in Need of Protection, this vegetation type was not listed, and therefore classified as least threatened, which can explain increased coverage of higher sensitivity compared to the previous PAMP (Government of South Africa 2011). The new listing utilizes the IUCN methodology and the vegetation type is listed due to the restricted distribution and threatening processes, in particular invasive alien plants. Western Rûens Shale Renosterveld is also critically endangered but only occupies a very small percentage of the state land, however North Sonderend Sandstone Fynbos (listed as least threatened) and South Sonderend Sandstone Fynbos occupy the majority of the state land. The areas of lower sensitivity in the Riviersonderend State Land are the north

facing slopes containing North Sonderend Sandstone Fynbos and which are of a gentler gradient.

The key drivers for the sensitivity for the Vrolijkheid Provincial Reserve are the river buffers and the Red-Listed ecosystems, of which 61% and 84.5% of the reserve is listed as high sensitivity for these two categories respectively. There are a number of non-perennial watercourses traversing Vrolijkheid Provincial Reserve, which occupies over half of the reserve when buffered by 100 m, which has been determined as high sensitivity. Breede Shale Renosterveld which occupies over three quarters of the reserve is listed as endangered (rated as high sensitivity) in the current draft Terrestrial Red List of Ecosystems South Africa 2020, with Breede Alluvium Renosterveld adjacent to the Keisers River also listed as endangered (Skowno *et al*. 2020). It should be noted that Breede Shale Renosterveld was not listed according to the 2011 gazetted National List of Ecosystems that are Threatened and in Need of Protection, and as above has resulted in increased coverage of higher sensitivity compared to the previous PAMP (Government of South Africa 2011).

The sections of the Complex which have been rated as high or highest sensitivity as a result of the threat status of the ecosystems present would need to ensure that there is no further loss of these ecosystems types within the protected area through developments which would result in habitat loss and any other threatening processes, such as invasive alien plant species which result in the displacement of the indigenous species representative of the ecosystems present.

The sections of Vrolijkheid Provincial Reserve which are rated as highest sensitivity (score = 5) comprising 8.2% of the area, includes the steeper slopes, wetlands, the Keisers River (perennial) buffered by 200 m and heritage features. The heritage features include the buildings at the administrative headquarters of the reserve buffered by 100 m and the historical wall buffered by 25 m and indicated by the geometric delineation which would not be typical of a biological or natural feature. Sensitivity for the Riviersonderend Complex is illustrated in Table 5.6 and Appendix 1, Map 7.

Table 5.6: Sensitivity scores for the Riviersonderend Complex.

Sensitivity Score	Rivier-sonderend Area (ha)	Vrolijkheid Area (ha)	Complex Area (ha)	Rivier-sonderend Area (% of total)	Vrolijkheid Area (% of total)	Complex Area (% of total)
1 = lowest sensitivity	280.00	0.00	280.00	1.10	0.00	1.00
2 = low sensitivity	413.10	0.00	413.10	1.60	0.00	1.40
3 = moderate sensitivity	1 466.70	37.20	1 503.90	5.50	1.90	5.30
4 = high sensitivity	4 375.80	1 768.40	6 144.30	16.40	89.90	21.50
5 = highest sensitivity	20 092.70	160.50	20 253.10	75.50	8.20	70.80

6 ZONING PLAN

This section outlines the zoning plan for the protected area. The Complex forms part of a planning matrix and locating the protected area in terms of the municipal IDP and SDF is aimed at minimising conflicting development in either the protected area or the neighbouring municipal area.

The primary objective of the zoning plan is to establish a coherent spatial framework within and around the protected area to guide and co-ordinate conservation, tourism and visitor experience, access and utilisation, and stakeholder and neighbour relations.

Zoning is intended to minimise user conflict by separating potentially conflicting activities such as wildlife viewing, recreational activities and tourism accommodation, whilst ensuring that activities and utilisation continues in appropriate areas and do not conflict with the goals and objectives of the protected area.

6.1 The Riviersonderend Complex in the Context of Municipal Integrated Development Planning

The Riviersonderend Complex encompasses two district municipalities, namely the Cape Winelands and Overberg District Municipalities, and within these three local municipalities, namely Langeberg and Breede Valley Local Municipalities within the Cape Winelands District Municipality and Theewaterskloof Local Municipality within the Overberg District Municipality. IDPs are compiled annually and for five-year periods by all municipalities in South Africa in order to establish prioritization and allocation of budget expenditure in terms of development priorities (Table 6.1).

SDFs are compiled in order to illustrate current and desired future land uses spatially across the municipality and link in to the IDP in terms of the spatial allocation of the municipal budget. As such, there are five IDPs and five SDFs which need to be taken into consideration in the PAMP, in terms of alignment between statutory initiatives at the three tiers of government and management of the Complex and identification of risks and interventions required. The IDP and SDF should be taken into consideration in determining the zone of influence and establishing potential threats and opportunities in these areas. There is also the opportunity to identify projects and interventions that need to be included in the IDPs and SDFs where appropriate and within the legislated stakeholder engagement processes.

6.1.1 Cape Winelands District Municipality:

The IDP includes the United Nations Sustainable Development Goals as a basis for its strategy. Environmental concerns identified include over-utilisation of water, water quality, soil erosion and loss of biodiversity and natural beauty.

The sector plans considered for environmental planning are the Draft Cape Winelands District Municipality Environmental Management Framework, the Cape Winelands Strategic Environmental Assessment and the Cape Winelands Biosphere Reserve SDF Plan with only the Strategic Environmental Assessment relevant to the Complex. The Western Cape Biodiversity Spatial Plan (WCBSP) should be the spatial biodiversity informant for planning across the municipality.

In terms of projects and programmes across the municipality, the health and air quality programme focus on environmental education and urban greening. Disaster management is of high relevance for the Complex, in particular the firefighting services, which forms a separate programme. The CSIR Veld Fire Risk Assessment is an important informant for fire management. The Fire and Rescue Training Academy, co-ordinated planning for the fire season (including CapeNature) and the FPA are other interventions related to fire management.

The principles of bioregional planning are applied with regards to spatial planning for the municipality. There are several NRM programmes which include water conservation and biodiversity. The projects specified are not in the vicinity of the Complex. The projects also relate to the Climate Change Adaptation Strategy, which includes the Cape Winelands River Rehabilitation Programme, Cape Winelands Invasive Alien Vegetation Management Programme and EPWP Working for Water Programme, which are relevant to the Complex and zone of influence. Nature-based tourism forms part of the tourism programme and should include CapeNature.

In terms of infrastructure expenditure within the district municipality by the Western Cape Government from 2016 – 2019, the CapeNature expenditure (peaking in 2017/2018) is small compared to the other departments such as Transport and Public Works, Human Settlements, Education and Health, which is expected as aligned to associated project expenses.

The Cape Winelands SDF has incorporated the WCBSP in order to inform the spatial planning categories, and to indicate biodiversity features and priorities, and therefore the WCBSP can be referred to, in order to inform proposed plans for areas surrounding the Complex and to inform buffers and the zone of influence.

The northern side of the Riviersonderend State Land is mainly surrounded by declared Mountain Catchment Areas which are classified as Protected Areas. There are only two properties in the west which are not bordered by Mountain Catchment Area and are bordered by a combination of agricultural land and natural habitat. Vrolijkheid Provincial Reserve is surrounded by Critical Biodiversity Areas (CBAs) to the north, east and south, which are priority areas to prevent transformation, with the CBAs delineating a corridor linking from Riviersonderend through Vrolijkheid to the Breede River. The western boundary consists of transformed agricultural land associated with the Keisers River valley interspersed with natural areas classified as ecological support area and other natural.

The WCBSP classification can be aligned to spatial planning categories, which define the permissible development and other activities per category, which in turn affects the impacts within the zone of influence.

Breede Valley Municipality:

The IDP for the local municipality falls within the framework of the district municipality. Relevant programmes and projects include those related to alien clearing, fire management and disaster risk management (including flood damage) which are implemented across the municipality.

The SDF for the municipality is currently in draft phase which has been represented in the IDP at a broad conceptual level. The SDF has reflected the protected areas

including the Riviersonderend State Land of which only a small section in the north west falls within the municipality. In this SDF, areas are indicated as CBAs, however these are not based on the WCBSP. These areas indicate corridors, including a corridor leading from the state land to the Breede River.

Langeberg Municipality:

The IDP for the local municipality falls within the framework of the district municipality. In terms of the environmental control and nature conservation, the focus includes maintenance and upgrading, and development of management plans for the local authority nature reserves/areas, which are not located near to the Complex. Also proposed is a protection plan for indigenous vegetation. A challenge listed is nature conservation capacity, however, a nature conservation officer has recently been appointed to manage state land, hiking trails, firebreaks and alien clearing. The municipality has an invasive alien plant species management plan which is updated annually.

For disaster management and fire services, it is proposed to develop a satellite fire station in another town. The municipality obtains its water from dams and associated irrigation schemes. Groundwater is not listed as an important current or proposed source of water. The Riviersonderend Mountains would however form an important catchment for the smaller dams and streams within the municipality.

Vrolijkheid Provincial Reserve is listed as a tourist attraction for the McGregor ward. The wastewater treatment works upgrade at Vrolijkheid Provincial Reserve, as described in Section 9.3.2, is included in the list of provincial infrastructure investment projects in the Langeberg Municipality for the Medium-Term Expenditure Framework (MTEF) period 2020/21 – 2022/23.

The SDF for the Langeberg Municipality (CNdV Africa 2016) has used the Western Cape Biodiversity Framework (WCBF, Kirkwood *et al.* 2010) as the biodiversity informant and that the spatial planning categories followed the appropriate classification. Mountain Catchment Areas are included as protected areas and the CBA corridor linking Vrolijkheid as described above is in indicated. Apart from this the Complex is bordered by buffer or intensive agriculture. Vrolijkheid Provincial Reserve is identified as a tourist attraction.

6.1.2 Overberg District Municipality

In response to climate change adaption, the municipality is implementing the following actions which could relate to the Riviersonderend Complex: alien vegetation removal on municipal properties, promotion of wetland conservation, municipal fire services and a disaster management plan. The extensive list of environmental sector projects does not include any from the Riviersonderend Complex. None of the major development projects in the IDP will impact on the Riviersonderend Complex.

The National Wind and Solar Photovoltaic Energy Strategic Environmental Assessment identified renewable energy development zones (REDZs) throughout the country, one of which is in the Overberg. This is restricted to the lowlands and is located to the south of the Riviersonderend State Land with the boundary being the road between Villiersdorp and Riviersonderend via Genadendal and Greyton. Wind energy facilities are unlikely to have a highly significant impact on bird and bat

populations of conservation significance within the Complex, although bird species nesting in the Complex could be affected, including cliff-nesting raptors.

In terms of environmental management, the primary informant for biodiversity is the WCBSP. The district municipality was one of 11 in South Africa participating in the Local Action for Biodiversity (LAB): Wetlands South Africa project. There are important wetlands within the Complex and the zone of influence that could benefit from this programme. The municipality has an Alien Invasive Species Monitoring, Control and Eradication Plan in accordance with the Department of Environmental Affairs guidelines, with the implementation according to the municipal budget process. Challenges identified for the environmental management section include the relevant mandate and adequate budget to fulfil their duties.

The disaster management plan forms part of the IDP, with firefighting forming an important component which is of relevance to the Complex. Overberg Fire and Rescue Service provides this service throughout the Theewaterskloof Municipality. Key partners include the Overberg Fire Prevention Association and Working on Fire. Relevant intergovernmental forums are District Fire Working Group, Disaster Management Advisory Forum, Provincial Fire Working Group, and Provincial Disaster Management Advisory Forum.

In terms of provincial development projects, there weren't any which affect the Complex. With regards to tourism, the Complex is not included specifically in the Participatory Appraisal of Competitive Advantage (PACA) by Department of Economic Development and Tourism.

With regards to the listing of environmental projects, no projects relevant to the Riviersonderend Complex are listed. The other projects including those related to other entities such as Non-governmental Organisations would not be relevant to this Complex. A major flower harvesting export business contributing to the local economy is located near the southern boundary of the Riviersonderend State Land.

The SDF has included the WCBF (2010, Kirkwood *et al*. 2010) as the biodiversity informant. The spatial planning categories have indicated most CBAs as Buffer, with others classified as Core 1c, with Core 1b consisting of private nature reserves and conservancies, and Mountain Catchment Areas indicated as protected area. Mountain Catchment Areas border the majority of the southern section of the Riviersonderend State Land within this municipality, apart from the western section between Helderstroom and Bereaville and around the Donkergat extension. The boundary of the latter section is mainly natural vegetation classified as CBA or ecological support area.

For the tourism destinations and routes, the road between Villiersdorp and Riviersonderend passing south of the State Land and encompassing Genadendal and Greyton is identified as a rural tourism route. There are hiking trails within the Riviersonderend Complex adjacent to Genadendal and Greyton as referred to in Section 7.3.2.

Theewaterskloof Municipality:

The IDP for the local municipality falls within the framework of the district municipality. The IDP refers to the local authority nature reserves as serving an important role in

the contribution to conservation of biodiversity as well as an important recreational and resource for the local community (e.g. hiking trails) and a tourism attraction. The Greyton Local Authority Nature Reserve is located adjacent to the Riviersonderend State Land. Extension of the State Land was identified through the IDP stakeholder engagement, as it was through the PAMP stakeholder engagement. Conservation on private land through the CapeNature stewardship programme, conservation easements and conservancies are also referred to. The Riviersonderend State Land is not discussed with regards to conservation areas within the municipality.

Climate change is addressed through the district municipality programme Overberg Climate Change Response Framework and encompasses impacts on biodiversity.

Flood mitigation is necessary for the predicted increase in extreme rainfall events, and the vulnerability of the areas directly downstream of the Riviersonderend Mountains.

Alien clearing is identified as a priority activity in order to achieve several goals including water resource management and biodiversity conservation and associated budget is provided for within the IDP. A municipal-wide alien clearing plan has been developed and provided to CapeNature. This includes the Greyton Nature Reserve adjacent to the Riviersonderend State Land. Maintenance of firebreaks is provided for within the IDP and is an important action for fire management.

Water resources are identified as important natural resources to serve the local community, with many of these located within the Riviersonderend State Land or adjacent areas. This includes:

- Genadendal: a weir situated in the Baviaans River, approximately 3.5 km upstream from Genadendal, in the Riviersonderend Mountains;
- Bereaville: a perennial mountain stream and a borehole;
- Voorstekraal: a weir on a perennial mountain stream and a borehole;
- Greyton/Boschmanskloof: weir on the Wolwekloof mountain stream and from three abstraction points on the Gobos River (Boesmanskloof). A refurbished existing borehole augments the raw water supply; and
- Riviersonderend: The main water supply originates from a weir situated in the Olifantbos. Water is also pumped directly from the Sonderend River and from a borehole.

The floodplain of the Gobos River and Sonderend River are concerns and constraints to both existing developments (e.g. Greyton Wastewater Treatment Works) and proposed developments.

Greyton and Genadendal have been identified as priority tourism and heritage destinations, as well as the route between Villiersdorp and Riviersonderend also listed as described above. Upgrade of the Boesmanskloof pipeline is listed as a project for implementation for individual capital projects.

The SDF is informed by the concept of bioregional planning and therefore has used the WCBSP as a key informant, as described above, by aligning the spatial planning categories to the WCBSP categories. Permissible land uses are then explicitly aligned to the spatial planning categories.

As in the IDP, the Villiersdorp to Riviersonderend route is identified as an important tourism route for investment, including the towns of Genadendal and Greyton which are identified as a major focus for tourism in the municipality. The Riviersonderend State Land could be included in the strategy, and adventure-based tourism has been identified as a strategy. Expansion of the Greyton Nature Reserve is indicated in the SDF as a proposal in collaboration with CapeNature and management of the flood lines of the Gobos River, which would facilitate management of the freshwater resources within the zone of influence.

It is noted that one of the proposals in the SDF is for the development of a resort along the Sonderend River in the vicinity of Riviersonderend town, which could potentially impact on the Complex. The primary action however for local economic development (LED) for Riviersonderend town is nature-based tourism which would link with the Riviersonderend State Land. More specifically the proposal indicates that the Kleinberg Mountain should be included within the Riviersonderend State Land, and that a low impact ecotourism development should be encouraged here

As for the district municipality, renewable energy is identified as an opportunity for economic development in the SDF. Although there are towns and villages adjacent to the State Land, there are currently no threats to the State Land in terms of proposed housing developments and land invasions, although Voorstekraal is included in the upgrading of poverty pockets. Identification of areas of industrial development within Voorstekraal and Genadendal could have negative environmental impacts due to the sensitive surroundings and proximity to the Riviersonderend State Land.

The SDF indicates strategies for development adjacent to sensitive natural areas, steep slopes and floodplains, which would support minimizing impacts on the State Land and the zone of influence.

Table 6.1: Aspects of the municipal Integrated Development Plans applicable to the Riviersonderend Complex.

Municipality	Aspect in IDP to be Addressed	Proposed Intervention
All Municipalities	Provide for protection of important biodiversity areas and identification of natural corridors in forward planning documents	• Incorporate the WCBSP to inform the spatial planning categories in the SDF. • Provide for adequate development controls for the special planning categories.
Langeberg Municipality & Theewaterskloof Municipality	Invasive alien vegetation on both public and private properties	• Implement a municipal-wide alien clearing plan on all municipal properties. • Budgeting for alien clearing in the IDP. • Facilitate implementation of alien clearing programmes from various funding sources through partnership. • Encourage and enforce landowner compliance.
All Municipalities	Integrated fire management across the landscape	• Ensure municipal properties implement appropriate fire management • Fire-fighting partnerships, in particular the FPAs and associated strategies.

Municipality	Aspect in IDP to be Addressed	Proposed Intervention
All Municipalities	Provide for nature-based tourism development opportunities and associated infrastructure	• Identify nature-based tourism opportunities that benefit the local community and support conservation of biodiversity. • Identify infrastructure needs to support nature-based tourism development.
Langeberg Municipality & Theewaterskloof Municipality	Ensure the natural resources required for service provision are sustainable and minimise ecological impact, in particular water	• Ensure that water sources are monitored to ensure sustainability and minimise impact on water sources • Thorough investigation of new water sources to ensure impact of abstraction is minimised.

6.2 Protected Area Zonation

The primary function of the protected area is to conserve biodiversity. However, other functions such as ensuring access and providing benefits to neighbouring communities and local economies may conflict with this primary function.

The zonation plan is thus a standard framework and set of formal guidelines to balance conservation, access and utilisation within the protected area, and is informed by sensitivity analysis. Zonation:

- Is foundational to planning and development within the protected area;
- Provides a framework for development of the protected area;
- Recognises the purpose for which the protected area is established;
- Ensures ecosystem resilience by limiting human intrusion in the landscape;
- Mitigates user conflict and minimises the impact of utilisation on natural and cultural heritage through access and activity management;
- Accommodates a range of activities ensuring that nature-based recreation and experiences for solitude do not conflict with social and environmental requirements or needs; and
- Confines development within the protected area to areas deemed appropriate to tolerate transformation without detracting from sense of place.

CapeNature's zonation categories, illustrated in Table 6.2, are derived from existing protected area zonation schemes worldwide, to develop a coherent scheme that provides for visitor experiences, access and conservation management needs.

Table 6.2: Guide to CapeNature conservation management zones.

Zonation Category	Explanation
Wilderness / Wilderness (declared)	Areas with pristine landscape, sensitive areas or threatened ecosystems. Very limited access.
Primitive	Areas providing natural landscape, solitude and limited access. Normally a buffer area to wilderness zones.
Nature Access	Providing easy access to natural landscape. Includes areas with roads and trails, and access to popular viewing sites and other sites of interest.

Zonation Category	Explanation
Development – Low intensity	Area with existing degraded footprint. Providing primarily self-catering accommodation and camping, environmental education facilities.
Development – High intensity	Area extensively degraded. Providing low and/or higher density accommodation, and maybe some conveniences such as shops and restaurants.
Development – Management	Location of infrastructure and facilities for reserve administration and management.
Development – Production	Commercial or subsistence farming (applicable to privately owned and managed nature reserves).
Development – Private Areas	Private dwellings and surrounds (only applicable to privately owned and managed nature reserve).
Species / Habitat / Cultural Protection	Areas for protection of species or habitats of special conservation concern.
Cultural Species / Habitat Visual Natural Resource Access	Special management overlays for areas requiring specific management interventions within the Species / Habitat / Cultural Protection Zone.

The following underlying decision-making rules are applied in determining zones:

1. Strike a balance between environmental protection and development of the protected area to meet broader economic and social objectives of the protected area.
2. Consider existing development footprints and tourism access routes based on:
    - The principle that all else being equal, an existing transformed site is preferable to a green fields site from a biodiversity perspective;
    - Increasing costs, the further developments are from existing infrastructure;
    - The socio-economic benefit of existing tourism nodes and access routes; and
    - Infrastructure design and services with due consideration for focal conservation targets.
3. Where existing development nodes, tourist sites and access routes occur in areas with high sensitivity-value, associated zonation must aim to confine the development footprint as much as possible and preferably within the existing transformed site.
4. Sites with high biodiversity sensitivity value are put into stronger protection zones and peripheral development is favoured.

As indicated above, the majority of the Riviersonderend Complex is considered to be highly to very highly sensitive due to steep slopes, threatened ecosystems represented and the presence of watercourses. The sensitivity of the Complex therefore presents constraints to potential development opportunities. The zonation has therefore been assigned mainly to indicate the existing activities occurring on the Complex and the areas which could also be considered for additional activities, mainly

adjacent to the existing activities. Zonation thus aims to strike a balance between conservation of threatened ecosystems and species, and facilitate opportunities for socio-economic development.

The primary area of activity is at the Complex offices which are located in the small section of Vrolijkheid Provincial Reserve west of the public road, which houses the administration buildings and tourism accommodation and has historically been disturbed through various activities. There is however the Keisers River and a tributary (Klawerleegte River) located in this section which are sensitive to disturbance.

Within the Riviersonderend State Land and Vrolijkheid Provincial Reserve east of the public road, the primary activities are hiking trails, which is an appropriate activity for areas with a more restrictive zoning and which has a minimal impact on sensitive areas provided it is appropriately designed and managed. There are additionally bird hides adjacent to historical farm dams accessed by hiking trails in the eastern section of Vrolijkheid Provincial Reserve which is a less restrictive zone.

Apart from the access tracks and paths required for management, the elevation of the Riviersonderend Mountains provide an ideal location to telecommunication structures and therefore provision is made for this, although this does need to be appropriately managed in order to minimize associated impacts.

A summary of the zonation scheme applicable to the Riviersonderend Complex is depicted in Table 6.3 and illustrated in Appendix 1, Map 8.

Table 6.3: Summary of CapeNature zonation categories applicable to the Riviersonderend Complex.

Zonation Category	Explanation
Primitive	The majority of the Riviersonderend Complex is zoned as primitive. Vrolijkheid Provincial Reserve: The majority of the reserve, including east of the public road and the riverine area and buffers west of the public road. Riviersonderend State Land: Entire state land, except for the road to the Telecom towers, the dam and road to the dam that were zoned as management.
Nature Access	Only the following areas within the Riviersonderend Complex were zoned as nature access: Vrolijkheid Provincial Reserve: Area around bird hides east of the public road. Greater area around all the different development zones. Road between Robertson and McGregor buffered by 25 m. Riviersonderend State Land: None.
Development – Low intensity	Vrolijkheid Provincial Reserve: Rondawels, chalets (houses), other recreational infrastructure (swimming pool, putt-putt course, etc.), conference centre and environmental education centre
Development – Management	Vrolijkheid Provincial Reserve: Office complex and other reserve management infrastructure, including the wastewater treatment works. Riviersonderend State Land: Jeep tracks to telecommunication towers, telecommunication infrastructure, trig beacons, and dam and pump station buffered by 2.5 m.

6.3 Protected Area Zone of Influence

CapeNature seeks to maximise positive influences and/or minimise direct and indirect negative pressures on conservation targets, with the aim of ensuring the persistence of species and biodiversity in general. Activities managed include those that might have direct impacts on conservation targets, and those that have only indirect effects, often at considerable distance from the location where the activity takes place.

The zone of influence is a mechanism that recognises, and activates, the abovementioned principle. Three key informants (Figure 6.1) used to delineate the zone include:

- Viability of focal conservation targets;
- Threats assessment; and
- Protected area sensitivity and zonation.

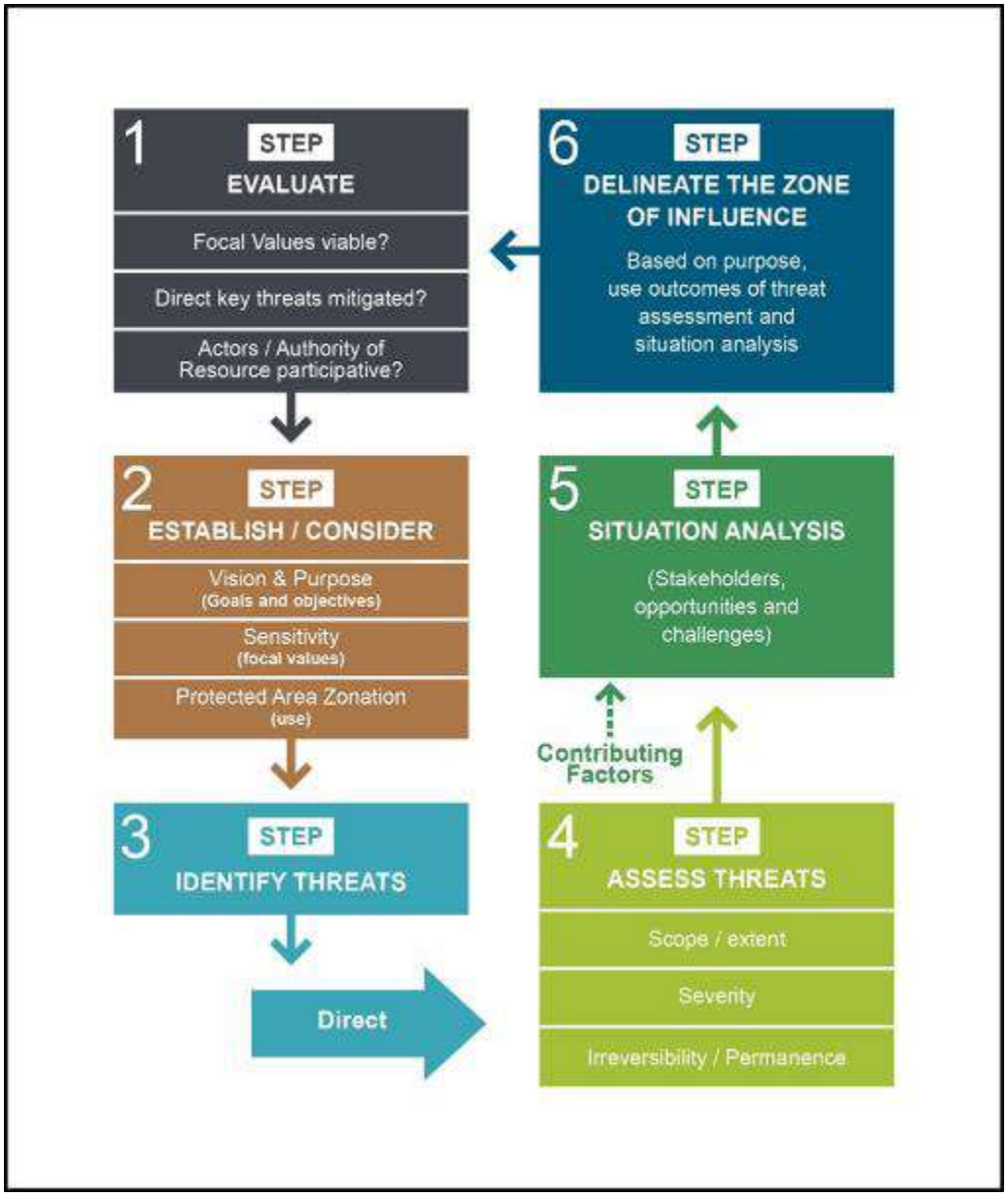


Figure 6.1: Process flow for the delineation of the zone of influence.

The zone of influence is a non-legislated area spatially depicted around the protected area. The zone ultimately aims to facilitate strategic stakeholder engagement by linking key stakeholders to prioritised influences to promote an ecologically functional landscape that supports goals and objectives of the Complex, and enhances the benefits derived from the protected area. The process of delineation helps to identify:

1) Actions to directly restore a target or mitigate a threat;
2) Actions designed for people to continue positive behaviours or halt direct threats; and/or
3) Actions to address enabling conditions.

The zone of influence is thus:

- A tool to guide resource allocation and investment outside of the protected area;
- A tool to match stakeholder engagement / authorities of resource to activities;
- A spatial prioritisation of where to support compatible land and water use, and positive behaviours;
- A spatial prioritisation of where to collaborate and with whom;
- A mechanism to prioritise support to landowners or managers of priority landscapes; and
- All-encompassing mechanism that includes all or part of a buffer zone as prescribed in terms of legislative frameworks and conventions.

The spatial features used in the zone of influence calculation are rated on a standard scale of one to four: Low (1), Medium (2), High (3), and Very high (4). These ratings are assigned to each input feature within the zone of influence. Higher scores represent areas where many features overlap, elevating the necessity to engage stakeholders and positively influence neighbour relations and/or activities.

Table 6.4 lists the features, criteria and rating applied to delineate the zone of influence of the Riviersonderend Complex. Appendix 1, Map 9 illustrates the zone of influence for the Complex.

Table 6.4: The criteria used for defining the zone of influence of the Riviersonderend Complex.

Feature	Criteria	Rating	Zone area (ha)	% of zone
Fire hazards (high fire frequency)	Inappropriate fire frequency due to anthropogenic fires. Irrespective of the fire hazards (ignition sources), the flammability of the vegetation determines the fire hazard for fires moving from outside the reserve into the reserve. Fire hotspot areas are determined annually based on various factors such as frequent ignitions and causes, which was used to identify fire hazards. Flammability of the vegetation was determined based on the fire frequency, with areas with a fire frequency of 5 and more since 1980. Also incorporated areas with high	High (3)	14 951.80	13.00

Feature	Criteria	Rating	Zone area (ha)	% of zone
	invasive alien plant density as invasive alien plants increase fire intensity and facilitate spread.			
Invasive alien plants	Stands of Invasive alien plants or plantations within a radius of the Protected Area is a source of infestation. No formal plantations recorded within the buffer area. Data from the National Invasive Alien Plant Survey (Kotze *et al.* 2010). Grid cells which recorded infestations of invasive alien plants and were within 3 km from any reserve boundary were used.	High (3)	21 880.50	19.10
Climate change	Increased drought and flooding events are negative impacts that can be attributed to climate change. Mitigation can be achieved by ensuring the stabilization of riverbanks to prevent erosion during flooding, through clearing of invasive alien trees and rehabilitation of riverbanks. Rivers where riverbanks were bulldozed need to be rehabilitated. Rivers highlighted with high impacts of invasive alien plants and bulldozing are buffered by 100 m (Bok, Die Poort, Elandskloof, Gobos, Hoeks, Jagersboskloof, Klein-Elandskloof, Koning, Meerlustkloof, Meul, Olifants, Slang)	High (3)	1 659.50	1.40
Connectivity (protected areas fragmentation)	Landscape connectivity for fauna movement, such as leopards. Connectivity is diminishing due to more agricultural activities surrounding the reserve and associated loss of habitat. This is mainly applicable to the area around the Vrolijkheid Provincial Reserve Areas with agricultural potential that have not been ploughed within the 5km buffer zone around the Vrolijkheid Provincial Reserve were used to inform this layer.	High (3)	8 357.50	7.30
Agricultural Activities	Detrimental agricultural activities, including unsustainable water and pesticide usage, illegal dams and weirs and modification of rivers through agricultural activities, buffered by 100 m.	Medium (2)	667.40	0.60
	Areas of shale geology which supports fertile clay soils and a slope of less than 20% which could be ploughed and cultivated.	Low (1)	21 540.10	18.80
Pollution: Water pollution from agriculture activities & littering	Water pollution due to agricultural activities near rivers based on field surveys. The rivers listed are Doring River, Riviersonderend and Soetmelksvlei river. The listed rivers are buffered by 50 m and exclude sections upstream from the agricultural fields.	Low (1)	420.90	0.40

Feature	Criteria	Rating	Zone area (ha)	% of zone
	Litter identified at the Baviaans River (Genadendal), Riviersonderend town at weir(s) (e.g. camp fires and visitors to the old cave) and any other sites where there is easy access to the kloofs e.g. access roads and trails. Buffered by 50 m.			
Fresh water management in rivers and dams	Rivers identified for low level of conservation intervention due to the presence of threatened fish species as a preventative measure and Invasive Alien Species strategies (both invasive alien plant and alien fish). Also include rivers where weirs occur for water abstraction and / or serves as Invasive Alien Species fish barriers. Dams inside reserve or on rivers passing through reserve also have an impact on the river ecology, both upstream and downstream. There are two dams in Vrolijkheid that have bird hides, one instream dam that doesn't reach Hoeks River, and also dams on both sides of Donkerkloof to Elandskloof River (Riviersonderend). Data from river surveys and these rivers were buffered by 32 m.	Low (1)	1 278.40	1.10
Over abstraction of water (surface and groundwater)	Abstraction of water which impacts on the Complex, including groundwater recharge areas. Borehole abstraction is not monitored, therefore irrigated fields within the water source area were used to infer water abstraction. For the abstraction of surface water, abstraction points through either weirs or pumps were identified. Abstraction points were buffered by 100 m.	Low (1)	4 678.70	4.10
Illegal resource use	Illegal resource use, which include various unregulated human activities such as overgrazing by livestock (stray animals), illegal harvesting of fauna (indigenous fish poaching) and flora (mainly succulents in Vrolijkheid, Proteaceae and buchu (*Agathosma sp*.) from southern slopes of Riviersonderend), vandalism of heritage artefacts (such as rock paintings), informal human settlement encroachment, and dumping of litter within reserve boundary. Illegal resource use (activities) emanate from known areas. Towns were buffered 1.5km.	Low (1)	17 702.70	15.40
Mountain Catchment Areas	Included all adjacent Mountain Catchment Areas into the zone of influence. Mountain Catchment Areas are privately owned but form an important component of integrated catchment management along with the adjacent nature reserves, with regards to	Low (1)	42 855.20	37.40

Feature	Criteria	Rating	Zone area (ha)	% of zone
	managing fire and aliens and the run-off from the catchment's areas (overlaps with these features above) Consist of the entire Riviersonderend Mountain Catchment Area.			
Local Authority Nature Reserves	Included all the adjacent local authority nature reserves into the zone of influence. Adjacent protected areas can consolidate the conservation objectives on the nature reserve and need to be appropriately managed. There is only one, namely Greyton Local Nature Reserve.	Low (1)	2 050.00	1.80
Stewardship sites	Select the stewardship sites that have direct land- and/or water management responsibilities and that contribute to Protected Area targets and appropriate Protected Area design (connectivity and extent). All signed and designated stewardship sites that are adjacent and those connected to them (forming a clump).	Low (1)	3 338.10	2.90
Areas identified in Protected Area Expansion Strategy (Conservation Action Priority map)	Include areas identified for the protected areas expansion strategy, (Conservation Action Priorities map). Extracted all the adjacent properties and those connected to them (forming a clump).	Low (1)	21 864.30	19.10

The zone of influence for the Riviersonderend Complex has a total extent of 114 676.1 ha (Appendix 1, Map 9). The most important features within the zone of influence which were attributed a rating of high were fire hazard, invasive alien plants, climate change and connectivity. These factors are consistent with the threats identified (Section 5.5), as the threats within the reserve boundaries also extend outside of the reserve boundaries, and in turn present a threat to the Complex. The extent of the zone of influence of these factors are in turn 13%, 19%, 1.4% and 7% of the zone of influence. Invasive alien plants and fires form part of ICM with the Complex situated within mountain catchments, such as the Riviersonderend State Land as discussed elsewhere in this document, with neighbouring areas playing an in important role in the ability to undertake ICM. Alien plant species which are invasive within the fynbos biome generally produce large quantities of seed which are stimulated to germinate through fire, therefore alien infestations on adjacent properties can significantly influence the success and resource requirements for alien clearing efforts on a property. It is important to manage both alien and fire beyond property boundaries in order to be effective, which requires collaboration between landowners and partners.

Landscape connectivity provides for movement corridors for fauna, with larger fauna requiring broader corridors covering larger areas. Corridors of intact habitat are therefore important to maintain connecting protected areas and can be compromised by habitat fragmentation. One of the primary causes of habitat loss within the Breede River Valley is cultivation, with increasing areas available through irrigation. Areas of

priority natural habitat as identified need to be secured in order to maintain connectivity. Maintenance of buffers and alien clearing along watercourses within productive landscapes provide for protection from erosion and damage to property during flooding events associated with climate change as well as a more sustained flow in periods of drought. Pollution of freshwater (0.4%), freshwater resource management (1.1%) and over-abstraction (4.1%) were other freshwater-related factors which were taken into account in the zone of influence.

Other factors which occupied a large area within the zone of influence are potential agricultural areas (19%), illegal resource use (15%), Mountain Catchment Areas (37%) and the protected area expansion strategy (19%), all of which are rated as low. Mountain Catchment Areas are private land declared in terms of the Mountain Catchment Areas Act (Act 63 of 1970) in order to provide a supporting role to the management of nature reserves within the Mountain Catchment Areas. This relates to the discussion above regarding ICM. Potential agricultural areas and the protected area expansion strategy links in with the discussion regarding landscape connectivity and the strategies implemented to address these threats.

Illegal resource use includes various activities which are undertaken without relevant approvals and may result in impacts on biodiversity and requires engagement with the communities from which the perpetrators emanate, most often those which are nearest to the protected area. This includes awareness raising as well as enforcement and consideration of the potential for sustainable use and alternative options. It should be noted that perpetrators are not only from nearby communities and include foreign nationals who poach succulents from Vrolijkheid Provincial Reserve.

7 ACCESS AND FACILITIES

This section describes infrastructure and procedures necessary for management of the protected area, inclusive of operations and visitors. It provides information on access facilities, operational facilities, control measures as well as commercial and community use.

7.1 Public Access and Management

The main access to the Vrolijkheid Provincial Reserve is at the office complex where the visitors may enter through a controlled gate. Entry fees are applicable, through a self-issue permit system. This entrance and the entrance on the opposite side of the road provide access to all the visitor facilities. The reserve is completely fenced, but in places the fences are very old leading to illegal access from neighbouring properties.

The Riviersonderend State Land has a number of access points that are accessible by reserve management, the municipality, private landowners and the public. These provide access to firebreaks, footpaths, hiking and mountain biking trails and for firefighting or other emergencies. Gates are installed in order to prevent illegal access. The reserve is not fenced and can be entered at different points, but borders onto private farms where entry is restricted, which provide a level of protection against illegal entry.

Controlled and uncontrolled access points to the Complex are listed in Table 7.1 and illustrated in Appendix 1, Map 10.

Table 7.1: Managed access points to the Riviersonderend Complex.

Locality	Name	Type of Access	Activity
Vrolijkheid Provincial Reserve Office Complex	Main Gate	Controlled access (Outside work hours)	Management and Tourism (overnight guests only)
Vrolijkheid Provincial Reserve Office Complex	House No. 8	Controlled access	Management
Vrolijkheid Provincial Reserve	Reserve Gate 1	Uncontrolled access	Management and Tourism
Vrolijkheid Provincial Reserve	Reserve Gate 2	Uncontrolled access	Management and Tourism (Mountain Bike route)
Vrolijkheid Provincial Reserve	Reserve Gate 3	No Public Access	Management access only
Vrolijkheid Provincial Reserve	Reserve Gate 5	No Public Access	Management access only
Vrolijkheid Provincial Reserve	Reserve Gate 4	No Public Access	Management access only
Vrolijkheid Provincial Reserve	Bird Hide 1	No Public Access	Management access only
Vrolijkheid Provincial Reserve	Bird Hide 2	Uncontrolled access	Management and Tourism

Locality	Name	Type of Access	Activity
Vrolijkheid Provincial Reserve	Strykhoogte	No Public Access	Management access only
Vrolijkheid Provincial Reserve	Uitnood	No Public Access	Management access only
Vrolijkheid Provincial Reserve	Charl Baard	No Public Access	Management access only
Riviersonderend State Land	Kleinfontein access road through private property	Uncontrolled access	Management and service provider access only, through private property
Riviersonderend State Land	Jonaskop access road through private property	No Public Access	Management access only, through private property
Riviersonderend State Land	De Hoek access road through private property	No Public Access	Management access only, through private property
Riviersonderend State Land	Wa and Osse access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Galg access road through private property	No Public Access	Management access only, through private property
Riviersonderend State Land	Groot Toren access road through private property	No Public Access	Management access only, through private property
Riviersonderend State Land	Oudekraal access road through private property	No Public Access	Management access only, through private property
Riviersonderend State Land	Sandfontein access road through private property	No Public Access	Management access only, through private property
Riviersonderend State Land	Dasberg access road through private property	No Public Access	Management access only, through private property
Riviersonderend State Land	Jongenskloof access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Morningstar access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Tygerhoek access road through private property	No Public Access	Management access only, through private property
Riviersonderend State Land	Olifantsbos access road through private property	Uncontrolled access	Management access only, through private property

Locality	Name	Type of Access	Activity
Riviersonderend State Land	Esperance access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Oubos access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Kromrivier access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Happy Valley access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Lismore access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Greyton access road through Municipal property	Uncontrolled access	Management and tourism access through Municipal land
Riviersonderend State Land	Uitkykkop access road through Moravian Church grounds	Uncontrolled access	Management access through Moravian Church grounds
Riviersonderend State Land	Baviaanskloof access road through Moravian Church grounds	Uncontrolled access	Management and tourism access through Moravian Church grounds
Riviersonderend State Land	Wonderklippe access road through Moravian Church grounds	Uncontrolled access	Management and tourism access through Moravian Church grounds
Riviersonderend State Land	Berea access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Jagersbos access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Meerluskloof access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Rusty Gate access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Helderstroom access road through private property	Uncontrolled access	Management access only, through private property

Locality	Name	Type of Access	Activity
Riviersonderend State Land	Silverstream access road through private property	Uncontrolled access	Management access only, through private property
Riviersonderend State Land	Wolfkloof access road through private property	Uncontrolled access	Management access only. through private property

7.2 Airfields and Flight Corridors

Section 47 of NEM: PAA stipulates prescriptions for the use of aircraft in a World Heritage Site, namely the Riviersonderend State Land. A helicopter landing pad is located near the Working on Fire office building that is situated on the Vrolijkheid Provincial Reserve. This landing pad is mainly used for firefighting operations by the Working on Fire team during the fire season but is also used for emergency rescue operations.

The closest airfields on the northern side of the Riviersonderend Complex, are situated in Robertson (33°48’43” S; 19°54’08” E) and Worcester (33°40’00” S; 19°25’00” E). The southern side of the Complex, the closest airfields are located near Caledon (34°15’36” S; 19°24’55” E). The primary function for these airfields is for use by fixed wing aircraft during the fire season.

No flights without authorisation from the management authority (CapeNature), except emergency and management flights, are allowed in the World Heritage Site.

7.3 Administrative and Other Facilities

The Riviersonderend Complex is managed from Vrolijkheid Provincial Reserve, which is situated approximately 15 km outside the town of Robertson, on the road to and approximately 5 km from the town of McGregor. The office complex is situated on the western side of the road between Robertson and McGregor. The reserve is supported by other centres including the landscape office in George and head office in Cape Town.

Infrastructure and associated building maintenance requirements are captured and managed in the protected area infrastructure register for implementation. Major infrastructure is illustrated in Appendix 1, Map 11.

The concept development plan, associated zonation scheme and strategic framework guide newly proposed development of new infrastructure over the planning period, see Section 9. Focus areas include infrastructure evaluation, environmental scoping and land use advice to define environmentally responsible development options. This includes feasibility studies and costings for proposed restoration and/or replication of heritage structures that can serve the dual purpose of heritage conservation and awareness and operational and tourism management.

7.3.1 Roads / Jeep Tracks

Most of the Riviersonderend Complex is accessible by gravel jeep tracks that is utilised for operational purposes. Some of these tracks are only accessible by 4x4 vehicle.

The entrance road to the Vrolijkheid Provincial Reserve gate is accessible by all vehicles and is used by day visitors when hiking the Agama Trail and/or cycling along the 8 km Mountain Biking route. The Riviersonderend State Land is only accessible through private property with locked gates.

All roads and tracks need regular maintenance as they are prone to erosion, being washed away, and/or overgrown by adjacent vegetation. Rehabilitation and maintenance of jeep tracks are a factor of operational need, finance availability and ecological sensitivity. At the current moment, maintenance of jeep tracks is focused on tracks identified for critical operational reasons, such as ecological work and firefighting.

7.3.2 Hiking trails

Vrolijkheid Provincial Reserve has four-day trails, namely the Rooikat Trail, Agama Trail, Heron Trail, and the Braille Trail. The Rooikat Trail is a 19 km trail that takes the hiker up to one of the highest points in the reserve, where they have a view of the Breede River and valley. The Agama Trail is a 10 km trail that winds along the Mountain Bike Trail and access to the island dam, which provides bird watching experiences, before joining up with the Rooikat Trail and veering down to the third bird hide to join the Heron Trail back to the picnic area. The Heron Trail is a 3 km walk to three bird hides, of which one is wheelchair friendly, that overlook dams. The Braille Trail is a new trail for visually impaired visitors that follows the first kilometre of the Heron Trail. It leads to the first bird hide and back and has boards with interesting information in braille along the route.

The Riviersonderend State Land has two overnight hiking trails traversing the area, namely the Genadendal Hiking Trail, and the Boesmanskloof Trail. The Genadendal Hiking Trail is 22 km long and traverses the De Hoek section of the Riviersonderend State Land. It is operated as a standard overnight hiking trail, allowing for two groups of up to 14 people each per day. The Boesmanskloof Trail can be walked as a 14 km route from Greyton to the overnight accommodation at Die Galg, which is on private land just beyond the reserve boundary. A further hike is then from Die Galg to McGregor. This route can also be walked from McGregor to Greyton, via Die Galg. Only 5.28 km of this trail traverses the Riviersonderend State Land.

These trails need regular maintenance to clear overgrowing vegetation, replace broken poles, maintain and create water flow contour berms and fill erosion dongas. Maintenance schedules are updated and implemented on an annual basis through the Integrated Annual Plan of Operations for the Complex.

7.3.3 Buildings

Buildings of the Riviersonderend Complex are designed and utilised for operations and staff accommodation, and maintained by CapeNature. The Concept Development Plan, associated zonation scheme and strategic framework identified existing development footprints and focus areas for management.

Vrolijkheid Provincial Reserve administrative complex's main building infrastructure is centred on the office and staff complex and the tourist accommodation. The office complex consists of the main Conservation offices', four storerooms, four houses located in the development zone is used as staff accommodation or rented out on a

short-term basis (year-to-year) to a private tenant, and six rondawels used as environmental education accommodation. Two halls, one situated near the rondawels and one adjacent to the Conservation office, and a thatch lapa, are utilised for meetings (internal and external), training, and interpretation for school groups (Figure 7.1). A building near the large stores, and a helipad are utilised by Working on Fire. One of the old stores is currently being renovated into a green conference venue that will be used for weddings and other gatherings. Five houses have been converted to tourism overnight self-catering accommodation.

Figure 7.1: Example of buildings found at the Vrolijkheid Provincial Reserve. Photo: Riviersonderend Complex Field Rangers.

In addition to the above-mentioned, the following are also situated within the Vrolijkheid Provincial Reserve administration complex: tennis court and putt-putt area, two communal swimming pools, private swimming pool at one tourist house, pump house containing the fire hydrant pump and water filtration system, graveyard, an incinerator, weather station, and a parking area.

Situated to the east of the road between Robertson and McGregor, another section of the Vrolijkheid Provincial Reserve has the following infrastructure: an interpretation centre, two self-issue permit stands for use by day-visitors, a picnic site (wheelchair accessible) with parking area, braai and ablution facilities, and three bird hides situated at two dams (one is wheelchair accessible).

A satellite office based in Genadendal, leased from a local company, is utilised as a base for the management of the NRM project. In addition, the EPWP staff and the ICM team are based at this office.

7.3.4 Fences

The boundaries of the Vrolijkheid Provincial Reserve, and the office complex, are fenced by 1.4 m stock-proof fencing (Appendix 1, Map 11). Sections of the reserve fence are in excess of 50 years old and in urgent need of replacement.

The Riviersonderend State Land has insufficient to no fencing, of which some are still remnants of old farm stock fences. The insufficient fencing results in difficulties managing the access into the Riviersonderend State Land.

The fences are maintained by the ICM project, when funds are available, but *ad hoc* maintenance is carried out by the Field Rangers when necessary.

7.3.5 High sites

Jonaskop, a high site situated within the Riviersonderend State Land, is controlled by one locked gate. There are no registered servitudes for access to, and no CapeNature communication equipment located on this high site. The telecommunication infrastructure at Jonaskop and Galgeberg is owned by external service providers.

7.3.6 Signage

Signage is located at all major entrance points to the Riviersonderend Complex. Directional and informative signage exist at hiking trails, bird hides and other visitor facilities. Interpretive signage is also placed at selected sites and points of interest, such as along the Braille Trail. Signage informs and displays the major rules and regulations to promote legal compliance by all users of the protected area as well as applicable tariffs, entry times and duty staff contact details.

All signage must conform to the CapeNature brand as per the signage manual and designed and approved by the Communication Section of CapeNature. Signage pollution needs to be avoided and the use of information kiosks and/or centres are encouraged. Indemnity notices are essential at all visitor entry points. The placing of signage should also be done in collaboration with the communications section. Signage is maintained and replaced if it becomes weathered or is vandalised.

7.3.7 Utilities

7.3.7.1 Water supply

The primary water supply, for irrigation and domestic use, to the Vrolijkheid Provincial Reserve is derived from a water allocation sluice allocated by the Vrolijkheid Water Users Association, which is incorporated into the title deeds of the properties. The water is fed via two cement water channels from the Hoeks River and Houtbaais River and lead into earth dams and reservoirs on Vrolijkheid Provincial Reserve, where it is purified by a filtration plant that is maintained and chlorine blocks replaced when necessary by reserve staff and monitored weekly. Furthermore, the reservoirs are cleaned and maintained annually by reserve staff. The allocation is monitored by measuring the size and speed of the stream flow in the channel at the time.

An existing operational borehole is also used for supplementing the water needs of the reserve for the irrigation of the grounds in the development zone, is located between the Vrolijkheid Provincial Reserve office and staff houses. Groundwater utilisation should be accompanied by monitoring of boreholes.

On Vrolijkheid Provincial Reserve water for all utilities i.e. irrigation and domestic use, is derived from a water allocation sluice allocated by the Vrolijkheid Water Users Association (previously known as Vrolijkheid Irrigation Board) and is incorporated into the title deeds of the properties. Annual tax is paid to the Water Users Association for this water. The water is fed via two cement water channels from the Hoeks River and Houtbaais River and lead into earth dams and reservoirs on Vrolijkheid Provincial Reserve.

7.3.7.2 Electricity supply

Eskom supplies electricity to most of the development sites in the Riviersonderend Complex, but the maintenance of the internal reticulation infrastructure is the responsibility of CapeNature. The electricity to the Vrolijkheid Provincial Reserve office and tourism facilities is supplied by the Langeberg Municipality.

The use of solar energy needs to be encouraged at all buildings in the Vrolijkheid Provincial Reserve where hot water is needed. As operational centres are upgraded, facilities are equipped with solar power systems to provide basic electricity needs for accommodation facilities and water installations. Although initial capital investment for solar or wind electricity and water systems are high, the use of such systems are a sustainable alternative to grid electricity supply.

7.3.7.3 Waste management

There are no waste disposal sites within the Vrolijkheid Provincial Reserve. All waste is collected by reserve staff on a regular basis and transported to the relevant municipal collection sites, namely at Robertson and McGregor. “Leave No Trace” waste management principles apply to all staff, researchers and visitors to the reserve.

Sewage systems at operational centres (office and accommodation) located on the reserve currently mainly comprise septic tanks with soakaways and pit latrines, while a Biolytic system is used at the youth centre. The current septic tank system is not functioning optimally and will be replaced with a SOG trickling filter system. This has been evaluated for implementation and is described in detail in the Concept Development Plan (Section 9).

7.3.8 Visitor facilities

Visitor facilities at Vrolijkheid Provincial Reserve is comprised of an Interpretation Centre at the main gate (only utilised for school groups), a wheelchair accessible picnic area with braai facilities and ablution facilities, three bird hides (one being wheelchair accessible) with interpretation boards that overlook two dams, tennis court, putt-putt, and a communal swimming pool (Figure 7.2). Accommodation comprises of five houses that can accommodate up to eight people per unit, of which one house has a private swimming pool and two has a Jacuzzi each. One of the old stores is currently being renovated into a green conference venue that will be used for large group functions, such as weddings. Day trails and overnight hiking trails (Riviersonderend State Land) are also available as described in section 7.3.2.

Figure 7.2: Visitor facilities at the Vrolijkheid Provincial Reserve. Photo: Riviersonderend Complex Field Rangers.

7.4 Commercial Activities

No commercial activities exist on the reserve and state land in the Riviersonderend Complex and no agreements or concessions are in place.

7.5 Community Use

No community use activities or agreements currently exist for the use of any resources in the Riviersonderend Complex. A proposed community garden at the Vrolijkheid Provincial Reserve office complex is currently still in the investigation stage.

7.6 Servitudes

A number of servitude agreements are registered on properties that comprise the Riviersonderend Complex. Conditional access regulated through servitudes includes agreements with neighbouring landowners for water user-rights, pipelines and access for infrastructure maintenance. All registered and known servitudes are listed in Table 7.2 and mapped in Appendix 1, Map 10.

Table 7.2: Servitudes applicable to the Riviersonderend Complex.

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	Conditions of Use
1963/08/16	Road servitude	Unknown	Unknown	Jonas Plaats 145	Servitude road 30' wide
1964/05/12	Water pipeline servitude	Unknown	Unknown	Watervals Kloof 586	Servitude pipeline 30' wide
1964/05/12	Furrow servitude	Unknown	Unknown	Watervals Kloof 586	Servitude furrow 30' wide
1965/12/20	Servitude road	Unknown	Unknown	Watervals Kloof 586	Servitude road 30' wide
1980/03/24	Area servitude	Unknown	Unknown	Remainder of Farm 780	Servitude area 6,4179 ha in extent – Water infrastructure (Dam)
1980/07/28	Road servitude	Unknown	Unknown	Remainder of Farm 780	4-metre-wide servitude road
1993/05/27	Road servitude	Unknown	Unknown	Remainder of Farm 780	4-metre-wide servitude road
1993/05/27	Area servitude	Unknown	Unknown	Remainder of Farm 780	Servitude area 671m^2 in extant – Water infrastructure (Pump house?)
1993/05/27	Water pipeline servitude	Unknown	Unknown	Remainder of Farm 780	Servitude pipeline – Water infrastructure
1993/05/27	Area servitude	Unknown	Unknown	Remainder of Farm 780	Servitude area 10,5359 ha in extent

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	Conditions of Use
					– Water infrastructure (Dam)
2013/10/08	Road servitude	Unknown	Unknown	Remainder of Doorn Kloof 163	Northern boundary of a 4-metre-wide servitude road. Road access - a 12.59 m right of way 2239/2013
10094/197 3001	Road servitude	Unknown	Unknown	Remainder of Donkerhoek 64	Servitude Obsolete
10094/197 3001	Road servitude	Unknown	Unknown	Remainder of Donkerhoek 64	Servitude Obsolete
10094/197 3001	Road servitude	Unknown	Unkown	Remainder of Donkerhoek 64	Servitude Obsolete

Unformalised servitudes have been identified on the Riviersonderend State Land parcels. Investigation and facilitation processes are currently underway to bring these servitudes into legislation alignment.

Reserve personal, through ground-truthing, have identified the following several structures within the Complex which would require a servitude, but which do not have the necessary supporting documentation:

- Pipelines;
- Weirs;
- Roads; and
- Telecommunication and other towers.

8 EXPANSION STRATEGY

Protected area expansion in South Africa is guided by the National Protected Area Expansion Strategy (NPAES) (DEA 2016b). In response to the NPAES, CapeNature has produced a WCPAES and Implementation Plan 2020-2025 (CapeNature 2020b).

Stewardship refers to the wise use, management and protection of that which has been entrusted to you or is rightfully yours. Within the context of conservation, stewardship means protecting important ecosystems, effectively managing invasive alien species and fires, and grazing or harvesting without damaging the veld. The four options available to landowners are Conservation Areas, Biodiversity Agreements, Protected Environments and Nature Reserves.

Mechanisms for protected area expansion for the Riviersonderend Complex include the promotion of stewardship options on both private and communal land in collaboration with landowners, and Department Public Works state land to be vested with CapeNature and declared as formal protected area.

Two focus areas for expansion include:

1. Leslie Hill Succulent Karoo Trust Stewardship Project, to expand Vrolijkheid Provincial Reserve to include:

    - More threatened Succulent Karoo vegetation and associated species;
    - Extremely threatened Breede Alluvium vegetation (this area contains the last remaining example of intact river-veld ecotone);
    - Priority properties north of, and adjacent to Vrolijkheid Provincial Reserve. Three properties have been incorporated in the CapeNature Stewardship Program and declared as Contract Nature Reserves. These properties represent an important climate change TMF corridor, with an upland-lowland corridor between Vrolijkheid Provincial Reserve, and the Breede River to the north-east. Wolvendrift Annex no 126 (State Land with National Department of Public Works) is in process of transfer to the Western Cape Department of Public Works, to be vested and declared as a Provincial Nature Reserve under management of CapeNature. This cadastral unit would represent a critical element in establishing a variable corridor towards the Breede River; and
    - A corridor to the south to improve connectivity with the Riviersonderend Mountains. Intact natural ecosystems along this corridor, offer opportunity for expansion.

2. Genadendal Moravian Church land and adjacent Communal land, secured under Stewardship arrangements in future, will assist in consolidation of the Riviersonderend State Land cadastral fragments on the Riviersonderend Mountains, and expand the Riviersonderend Complex connectivity into the critically endangered Central Rûens Shale Renosterveld Lowlands to the south.

The expansion map is indicated in Appendix 1, Map 12.

9 CONCEPT DEVELOPMENT PLAN

The concept development plan sets out the long-term plan for the development of the protected area in keeping with the purpose of the reserve and with due consideration for protected area expansion and the zoning plan.

Tourism products and related infrastructure developments in CapeNature are considered investments and are intended to:

- Harness and enhance the income generation potential of protected areas with a view to achieving long term business sustainability;
- The provision of safe, informative and purpose-built access to protected areas;
- To enhance the operational efficiency and management of protected areas.

9.1 Project Selection

Organisationally, potential tourism product developments are selected based on internal consultation and approval where factors such as appropriateness, environmental authorisation, financial feasibility and the apparent return on investment are considered. Where external approvals for developments are required, these are sought from the relevant authorities prior to the commencement of any development activities (Figure 9.1).

CapeNature may elect to operate tourism products and services internally, or via other mechanisms described in the Public Finance Management Act, 1999 (Act No.1 of 1999) such as concessions or public private partnerships.

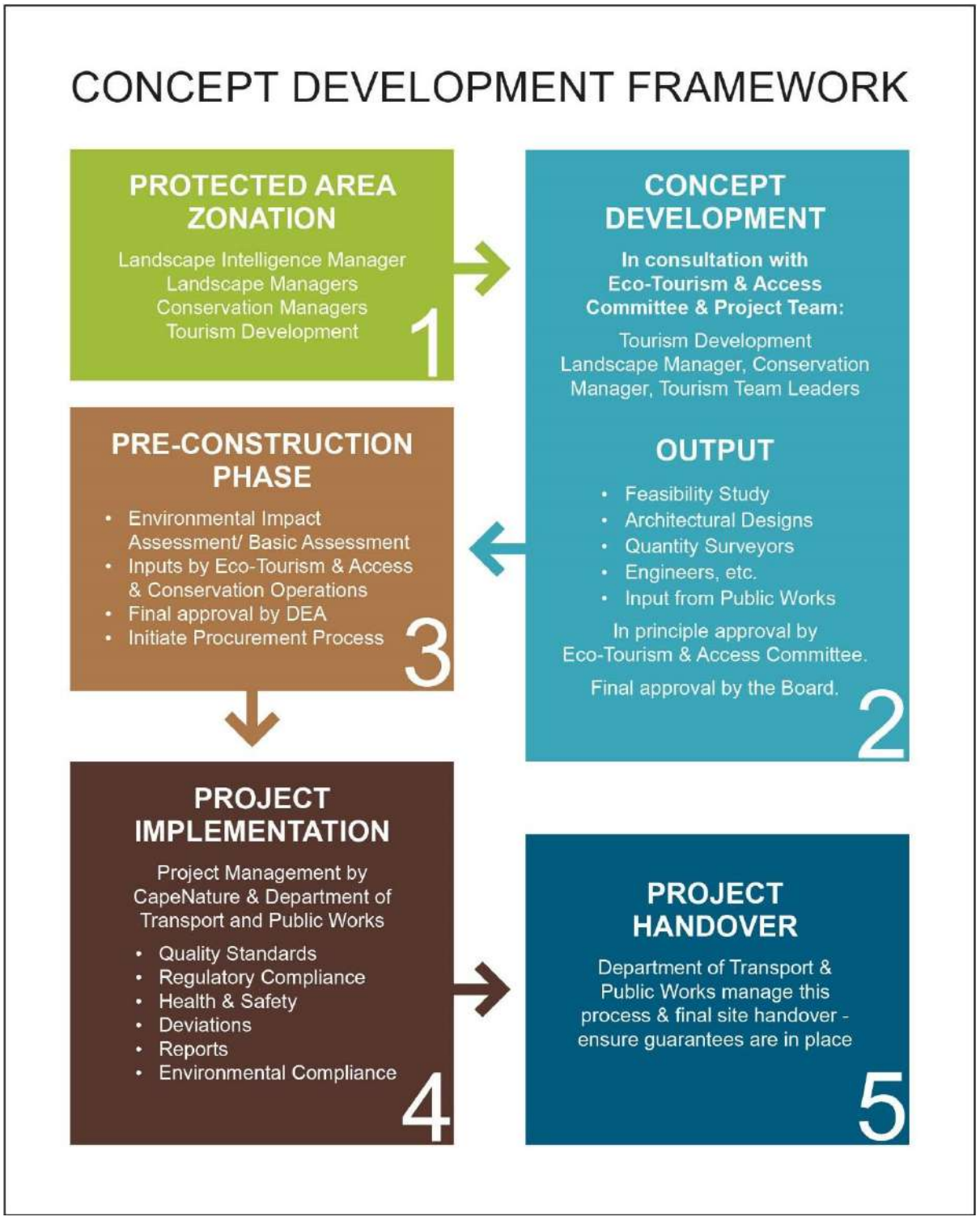


Figure 9.1: Concept development framework implemented by CapeNature.

9.2 Methodology

Tourism products and infrastructure within CapeNature protected areas are designed to be sensitive to their locations and are intended as prime examples of responsible and sustainable commercial developments. These include: off-grid bulk water and energy services; passive design efficiencies; enhanced resource utilisation and

resource-saving features. Tourism developments aim to comply with prevailing zonation schemes and sensitivity analysis unless approval to the contrary has successfully been sought.

Wherever possible, tourism products, developments and services are intended to provide training and employment opportunities to communities within and surrounding the protected area.

9.3 Infrastructure Management and Development

Within the previous ten years the tourism accommodation and associated infrastructure at Vrolijkheid Provincial Reserve has been upgraded. This was described in the previous PAMP, although detailed proposals were not yet available at the time. The upgrade to the tourism development has been completed and there are no additional plans for developments within the Riviersonderend Complex.

9.3.1 Development nodes

There is only one development node within the Riviersonderend Complex, namely the administration and tourism complex for Vrolijkheid Provincial Reserve, which is located in the small section of the reserve to the west of the public road between Robertson and McGregor. The tourism upgrades referred to above were located within this development node.

There is other infrastructure within the Complex as referred to above, consisting of jeep tracks, hiking trails, bird hides and telecommunication infrastructure, however these would not be considered as development nodes.

9.3.2 Infrastructure development proposals

The wastewater treatment plant servicing the administration and tourism complex requires replacement as the current system is not functioning properly. This process was initiated at the beginning of the PAMP process and has been evaluated in terms of the sensitivity analysis and zonation.

Further to the above, the initial wastewater system for the office complex was a conservancy tank which was serviced by the municipality. In 2018, an eco-gater system was installed by a local contractor, which results in the production of grey water which can then be utilised. There were faults with the installation process and the grey water was of poor quality and could not be used. It was then decided that this system would need to be replaced.

After investigation of alternative methods of wastewater treatment, it was decided to install the SOG trickling filter system which uses natural biological processes to improve the water quality whereby the water trickles down between the layers where it is treated. A sustainable organic system was considered appropriate for a nature reserve.

In a SOG tricking filter system, the solids in the system are removed before the effluent enters the trickling filter. The trickling filter consists of several layers through which the effluent is filtered and cleansed through biological processes, until the final product consists of effluent which can be safely utilised for a number of potential uses apart from potable use. The proposal is that all effluent from the system will be utilised for

toilets and irrigation and there will be no excess effluent outflow. This system will ensure that there are no harmful chemicals introduced to the system and there will be no effluent outflow. The solid waste from the process can be utilised as fertilizer. The footprint of the facility for Vrolijkheid Provincial Reserve is 12 m^2, and the location of the facility is to the north-west of the existing development footprint of the administration/tourism complex as indicated in Appendix 1, Map 12b.

In terms of the NEMA listed activities, the facility will be below the thresholds for the relevant listed activities and therefore did not require NEMA authorisation.

9.3.3 Visitor facilities

A new bird hide is proposed by Friends of Vrolijkheid local interest group at one of the dams located on Vrolijkheid Provincial Reserve. Detailed designs are not yet available, and the development proposal will need to be screened against the sensitivity analysis and zonation in order to ensure that it complies and based on this it can be included within the concept development plan. The development proposal would also need to be screened with regards to NEMA and any other relevant approvals that may be required.

9.3.4 Other infrastructure and facilities

It has been confirmed that none of the following are proposed within the next 10 years, and consequently do not require environmental authorisation:

- Communication routes;
- Service supply routes;
- Administration and other facilities: and
- Commercial facilities and activities.

10 STRATEGIC PLAN

This section presents the strategic plan for the protected area. The strategic plan was derived from an assessment of the conservation situation, inclusive of the biological environment and the social, economic, cultural and institutional systems that influence focal conservation targets and human well-being values. Strategic intervention points formed the basis for developing strategies; using results chains to test theories of change and establish short to medium term objectives. From these, detailed actions with timeframes were developed to guide implementation, monitoring and evaluation.

Strategies are aimed at:

- Focal conservation target restoration / stress reduction;
- Behavioural change / threat reduction; and
- Establishing / promoting enabling conditions.

A summary of selected strategies and objectives for the Riviersonderend Complex is provided in Table 10.1. Table 10.2 details the actions and associated timeframes for each separate strategy.

CapeNature will lead the implementation of the management plan, although achieving the vision requires coordinated effort. Stakeholder groups and organisations identified in the strategic plan are key role players in successful delivery of this management plan.

Table 10.1: Summary of strategies and objectives identified for the Riviersonderend Complex.

Threats Abated	Strategy Type	Strategy	Objectives
Invasive alien plants impacting on fire regime, biodiversity and water availability; Inappropriate and unnatural fire regime; Climate change related impacts.	Threat reduction	**Strategy 1:** Enhance the implementation efficiency of invasive alien plant eradication by the integration of fire and invasive alien plant management in the Riviersonderend Complex.	**Objective 1.1:** By 2022, CapeNature has an annually revised, implemented and approved Riviersonderend Complex Invasive Alien Species Control Plan.
			Objective 1.2: By 2024, alien clearing staff are properly trained, and quality control is implemented.
Inappropriate and unnatural fire regime; Invasive alien plants impacting on fire regime, biodiversity and water availability; climate change related impacts.	Threat reduction	**Strategy 2:** Implement an integrated fire management strategy to maintain an acceptable fire regime in the Riviersonderend Complex in consultation with stakeholders and partners in order to support management decisions with regards to fire and invasive alien vegetation management.	**Objective 2.1:** By 2022, the ideal fire regime for the Riviersonderend Complex is determined.
			Objective 2.2: By 2022, consultation with relevant stakeholders, including municipalities and Fire Protection Associations, takes place regarding integrated fire management.
			Objective 2.3: By 2022, CapeNature have developed an Integrated Fire Management Plan for the Riviersonderend Complex.
			Objective 2.4: By 2023, and beyond, the Riviersonderend Integrated Fire Management Plan is implemented.
			Objective 2.5: By 2023, CapeNature has developed and implemented a fine-scale fire rapid response plan specific to the Riviersonderend Complex.
Habitat modification due to historical land use; Climate change related impacts.	Restoration	**Strategy 3:** Improve and restore ecological function of the identified degraded areas within the Vrolijkheid Provincial Reserve.	**Objective 3.1:** By 2022, develop a restoration plan for the degraded areas within the Vrolijkheid Provincial Reserve.
			Objective 3.2: By 2023, implement the restoration plan for degraded areas within the Vrolijkheid Provincial Reserve.

Threats Abated	Strategy Type	Strategy	Objectives
Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Modification of riparian & in-stream habitat; Pollution of surface and groundwater; Poaching of fauna and flora; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors.	Threat reduction	**Strategy 4:** Enhance partnerships to increase collaboration, legislative compliance and best practice in terrestrial and aquatic ecosystems within the Riviersonderend Complex and its associated zone of influence.	**Objective 4.1:** By 2022, water abstraction quantity and water quality of the Riviersonderend Complex water sources are being monitored and have the relevant registration and/or licenses.
			Objective 4.2: By 2023, CapeNature water sources have the relevant registration and/or licenses.
			Objective 4.3: By 2022, an integrated groundwater monitoring framework of the zone of influence is established and implemented.
			Objective 4.4: By 2022, ecological condition and river flow of identified rivers in the Riviersonderend Complex are being monitored in line with CapeNature protocol.
			Objective 4.5: By 2022, a screening tool for opportunistic identification of invasion reservoirs (i.e. sources of invasive alien fish) is developed and implemented. The focus area for implementation is the zone of influence and the screening tool should also identify appropriate management interventions.
			Objective 4.6: By 2022, a monitoring protocol is developed and implemented for determining freshwater fish community composition and population status in priority rivers* for the Riviersonderend Complex. *Meerlustkloof, Meul, Baviaans, Gobos, Boesmans, Hoeks, Houtbaai rivers.
			Objective 4.7: By 2025, increase successful compliance interventions* from 2021 baseline. *Prevention, apprehension and prosecution.
			Objective 4.8: By 2021, all compliance and law enforcement entities agree on roles and responsibilities.

Threats Abated	Strategy Type	Strategy	Objectives
			Objective 4.9: By 2022, all enforcement staff identified in the compliance plan have been appointed and trained.
			Objective 4.10: By 2023, in-stream structures within the Riviersonderend Complex have been identified and legal compliance established.
			Objective 4.11: By 2022, CapeNature will monitor and report unlawful land clearing activities within the zone of influence.
			Objective 4.12: By 2024, CapeNature has engaged with the relevant authorities regarding the regulation of pesticide, fertiliser, and other agricultural land use activities within the zone of influence that can impact on biodiversity.
			Objective 4.13: By 2022, CapeNature actively engages with priority partners in the Riviersonderend Mountain Catchment Area to secure the water source area.
Inappropriate and unnatural fire regime; Pollution of surface and groundwater; Poaching of fauna and flora.	Threat reduction / Enabling conditions	**Strategy 5:** Develop and implement an integrated environmental education and awareness programme aimed at neighbours, natural resource users, learner groups and visitors, in collaboration with partners, to nurture respect and care for the natural, cultural and historic values of the Riviersonderend Complex.	**Objective 5.1:** By 2022, CapeNature have revised and implemented the Riviersonderend Complex environmental education and awareness programme.
			Objective 5.2: By 2023, there is a decrease in ignition points within the targeted hotspot areas from the 2020 baseline, and the understanding of the impacts of invasive alien vegetation on fire risk, biodiversity and water supply is improved.
			Objective 5.3: By 2023, ensure awareness raising initiatives elevate awareness around all other relevant conservation issues in the Riviersonderend Complex.

Threats Abated	Strategy Type	Strategy	Objectives
			Objective 5.4: By 2024, Natural Resource User Groups in the Riviersonderend Complex will have extensive awareness of the CapeNature Natural Resource Utilisation policy and Permitting System.
Invasive alien plants impacting on fire regime, biodiversity and water availability; Inappropriate and unnatural fire regime; Climate change related impacts; Development of buildings and infrastructure impacting on natural habitat; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors; Poaching of fauna and flora.	Threat reduction / Enabling conditions	**Strategy 6:** Re-evaluate the expansion domain of the Riviersonderend Complex with partners, to facilitate protected area expansion, consolidation and connectivity through stewardship and other protected area expansion methodologies.	**Objective 6.1:** By 2025, secure Conservation Action Priority properties for conservation through stewardship or other mechanisms as identified in the Conservation Action Priority Map and Leslie-Hill Succulent Karoo Trust for the Riviersonderend Complex.
			Objective 6.2: By 2030, NEM: PAA compliance for local authority nature reserves adjacent to the Riviersonderend Complex.
Change in management practices as a result of a change in land occupancy; Vandalism of heritage features.	Threat reduction / Enabling conditions	**Strategy 7:** Ensure maintenance and minimise degradation of heritage resources within the Riviersonderend Complex.	**Objective 7.1:** By 2030, the Riviersonderend Complex has an approved heritage management plan for implementation.
Development of buildings and infrastructure impacting on natural habitat; Modification of riparian and in-stream habitat; Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Pollution of surface and groundwater; Vandalism of heritage features.	Threat reduction / Enabling conditions	**Strategy 8:** Facilitate sustainable, responsible development, access and activities within the Riviersonderend Complex in collaboration with relevant internal and external partners and stakeholders.	**Objective 8.1:** By 2022, engage with relevant authorities, including Department of Agriculture: LandCare and Department of Environmental Affairs and Development Planning, to initiate area-wide planning within the zone of influence.
			Objective 8.2: By 2021, the Riviersonderend World Heritage Site, Provincial Reserve, and zone of influence is integrated into the Municipal Land Use Planning products.
			Objective 8.3: By 2022, initial reserve specific carrying capacity (type, number and frequency) for all non-consumptive utilisation for terrestrial and freshwater environment are set in line with sensitivity analysis and detailed zonation scheme.

Threats Abated	Strategy Type	Strategy	Objectives
			Objective 8.4: By 2023, sustainable access* for a diversity of spiritual, religious and cultural uses is determined, agreed upon, communicated and implemented. *Where, what, how much, frequency and compliance.
Lack of training and job opportunities for the surrounding communities; Inadequate access for socio-economic opportunities.	Threat reduction / Enabling conditions	**Strategy 9:** Contribute to economic and social development by providing job and training opportunities to Expanded Public Works Programme, contract, and small, medium and micro-sized enterprise (SMME) staff.	**Objective 9.1:** By 2023, CapeNature have identified and prioritised viable economic development projects for implementation within the Riviersonderend Complex and its zone of influence.
			Objective 9.2: By 2021, CapeNature have collated recommendations from existing reports that support tourism livelihoods and economic development in the zone of influence of the Riviersonderend Complex.

Table 10.2: Strategic Plan for the Riviersonderend Complex.

STRATEGY 1:	Enhance the implementation efficiency of invasive alien plant eradication by the integration of fire and invasive alien plant management in the Riviersonderend Complex.
LINKED GOALS:	1; 3
THREATS:	Invasive alien plants impacting on fire regime, biodiversity and water availability; Inappropriate and unnatural fire regime; Climate change related impacts.

Objectives	Actions	Responsibility	Time-frame	Measurable Indicators / Outputs	References / Existing Procedures
Objective 1.1: By 2022, CapeNature has an annually revised, implemented and approved Riviersonderend Complex Invasive Alien Species Control Plan.	Review and update the existing Invasive Alien Species Control Plan.	**Lead:** NRM Manager **Enablers:** Landscape Ecologist; Integrated Catchment Specialist; Landscape Manager 1.	Year 1	Approved annual Riviersonderend Complex Invasive Alien Species Control Plan (Reserve specific).	Riviersonderend Complex Invasive Alien Species Control Plans
	Implement approved Invasive Alien Species Control Plan as per the annual invasive alien species management plan against approved Annual Plan of Operations.	**Lead:** NRM Manager **Enablers:** Landscape Manager 1.	Year 1	Updated Riviersonderend Complex Invasive Alien Species Control Plan (Reserve specific) presented to Department of Environment, Forestry and Fisheries, and Programme Manager.	Riviersonderend Complex Invasive Alien Species Control Plans that manage the implementation strategy.
	Collect and submit density verification data for all NBALs within the Riviersonderend Complex boundary.	**Lead:** Field Rangers; Project Manager. **Enablers:** Ecological Technician; Integrated Catchment Specialist; GIS Technician.	Annually	Density data spreadsheet.	Standard annual procedure as mandated by Ecological Matrix.
	Undertake process of NBAL prioritisation based on densities, fire history and ecological requirements.	**Lead:** NRM Manager **Enablers:** Landscape Ecologist; Integrated Catchment Specialist.	Annually	NBALs prioritised for the Annual Plan of Operations and for three yearly bid documentation	3-year priority plan specifically for Riviersonderend Complex.
	Compile prioritisation maps for the Riviersonderend Complex and for the bid process.	**Lead:** Biodiversity Conservation Innovation Unit (GIS) **Enablers:** Ecological Technician.	Annually	Maps and Shape files.	

STRATEGY 1:	Enhance the implementation efficiency of invasive alien plant eradication by the integration of fire and invasive alien plant management in the Riviersonderend Complex.				
LINKED GOALS:	1; 3				
THREATS:	Invasive alien plants impacting on fire regime, biodiversity and water availability; Inappropriate and unnatural fire regime; Climate change related impacts.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
	Compile the Integrated Work Plan and Annual Plan of Operations of the Riviersonderend Complex.	**Lead:** Project Manager **Enablers:** Landscape Manager 1; Integrated Catchment Specialist; Relevant Internal Stakeholders.	Annually	Integrated Work Plan and Annual Plan of Operations.	
	Compile a progress report on the implementation of APOs and submit to Department of Environment, Forestry and Fisheries.	**Lead:** NRM Project Manager; Project Manager. **Enablers:** Conservation Officer On-Reserve; Field Rangers.	Annually	Progress report; Management Information System report.	WIMS system capturing work completed.
Objective 1.2: By 2024, alien clearing staff are properly trained, and quality control is implemented.	Facilitate that all staff involved with alien plant clearing attend training to ensure enhanced delivery and adherence to the operating standards for the Programme.	**Lead:** NRM Project Manager **Enablers:** Conservation Officer On-Reserve	Annually	Number and percentage of staff undertaken training	
	Update functional training certification and confirm compliance.	**Lead:** NRM Project Manager **Enablers:** Conservation Officer On-Reserve	Annually	Number and percentage of staff compliant with certification	
	Perform quality control checks on alien clearing work to ensure it is undertaken according to standard operating protocols.	**Lead:** NRM Project Manager **Enablers:** Conservation Officer On-Reserve	Annually	Percentage of NBALs cleared to satisfaction	NRM Standard Operational Principles

STRATEGY 2:	Implement an integrated fire management strategy to maintain an acceptable fire regime in the Riviersonderend Complex in consultation with stakeholders and partners in order to support management decisions with regards to fire and invasive alien vegetation management.				
LINKED GOALS:	1				
THREATS:	Inappropriate and unnatural fire regime; Invasive alien plants impacting on fire regime, biodiversity and water availability; Climate change related impacts.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Objective 2.1: By 2022, the ideal fire regime for the Riviersonderend Complex is determined.	Analyses of fire frequency, fire return interval, fire size, fire season, post-fire, and permanent protea plot data of the Riviersonderend Complex.	**Lead:** Landscape Ecologist **Enablers:** Ecological Technician; Integrated Catchment Specialist; Biodiversity Conservation Innovation Unit (GIS).	Year 3	Post-fire season executive summary; Analysed data; Thresholds of potential concern for the Riviersonderend Mountain Catchment.	Post-fire season executive summary; Thresholds of potential concern report
	Conduct post-fire and permanent protea plot monitoring.	**Lead:** Field Rangers; Ecological Technician **Enablers:** Conservation Manager On-Reserve; Landscape Ecologist	Annually	Raw and electronic data	Monitoring protocols.
Objective 2.2: By 2022, consultation with relevant stakeholders, including municipalities and Fire Protection Associations, takes place regarding integrated fire management.	Engagement with relevant stakeholders regarding integrated fire management in the Riviersonderend Complex and zone of influence in order to inform the Integrated Fire Management Plan.	**Lead:** Stakeholder Engagement Officer; Conservation Officer On-Reserve **Enablers:** Landscape Manager 1; Integrated Catchment Specialist.	Year 1	Minutes of meetings with stakeholders which will inform Integrated Fire Management Plan	
Objective 2.3: By 2022, CapeNature have developed an Integrated Fire Management Plan for the Riviersonderend Complex.	Develop an Integrated Landscape Fire Response Plan for the Riviersonderend Complex, incorporating outcomes from Objectives 2.1 and 2.2.	**Lead:** Integrated Catchment Specialist; Disaster Manager. **Enablers:** Landscape Ecologist; Ecological Technician; Landscape Manager 1.	Year 1	Landscape Fire Response Plan	CapeNature Fire Policy
Objective 2.4: By 2023, and beyond, the Riviersonderend Integrated	Implement the Integrated Fire Management Plan for the Riviersonderend Complex.	**Lead:** Integrated Catchment Specialist; Conservation Officer On-Reserve	Annually	An ecologically appropriate fire regime in the Riviersonderend Complex.	CapeNature Fire Management Policy 2017; Annual Landscape Fire Response Plan.

STRATEGY 2:	Implement an integrated fire management strategy to maintain an acceptable fire regime in the Riviersonderend Complex in consultation with stakeholders and partners in order to support management decisions with regards to fire and invasive alien vegetation management.				
LINKED GOALS:	1				
THREATS:	Inappropriate and unnatural fire regime; Invasive alien plants impacting on fire regime, biodiversity and water availability; Climate change related impacts.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Fire Management Plan is implemented.		**Enablers:** Ecological Technician; Landscape Ecologist.			
Objective 2.5: By 2023, CapeNature has developed and implemented a fine-scale fire rapid response plan specific to the Riviersonderend Complex.	Develop and implement a fine-scale plan to enable rapid response to fires in the Riviersonderend Complex.	**Lead:** Conservation Officer On-Reserve; Integrated Catchment Specialist **Enablers:** Landscape Manager 1	Year 2	A fine-scale rapid response plan to fire, specific to the Riviersonderend Complex.	Regional response plan; Annual Landscape Fire Response Plan.

STRATEGY 3:	Improve and restore ecological function of the identified degraded areas within the Vrolijkheid Provincial Reserve.				
LINKED GOALS:	2				
THREATS:	Habitat modification due to historical land use; Climate change related impacts.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Objective 3.1: By 2022, develop a restoration plan for the degraded areas within the Vrolijkheid Provincial Reserve.	Conduct a survey to assess degraded areas and effectiveness of rehabilitation work carried out in previous Protected Area Management Plan period.	**Lead:** Landscape Ecologist; Ecological Technician; Field Rangers **Enablers:** Restoration Ecologist; Conservation Officer On-Reserve.	Year 2	Data collected and analysed.	
	Compile a restoration plan to improve the ecological condition of degraded areas and integrate into annual Integrated Work Plan.	**Lead:** Landscape Ecologist; Restoration Ecologist; Conservation Officer On-Reserve **Enablers:** Landscape Manager 1; NRM Project Manager	Year 2	Approved restoration plan for the Vrolijkheid Provincial Reserve.	
Objective 3.2: By 2023, implement the restoration plan for degraded areas within the Vrolijkheid Provincial Reserve.	Implement actions identified in the restoration plan.	**Lead:** Conservation Officer On-Reserve; Field Rangers **Enablers:** Landscape Manager 1	Year 3 and beyond	Measure success of identified actions in accordance with the restoration plan.	
	Monitor and assess effectiveness of the restoration plan on an annual basis and use strategic adaptive management to ensure efficacy.	**Lead:** Landscape Ecologist; Conservation Officer On-Reserve; Ecological Technician; Field Rangers **Enablers:** Restoration Ecologist.	Year 2	Data collected and analysed; Feedback loop to inform ongoing conservation management actions completed.	

STRATEGY 4:	Enhance partnerships to increase collaboration, legislative compliance and best practice in terrestrial and aquatic ecosystems within the Riviersonderend Complex and its associated zone of influence.				
LINKED GOALS:	4; 5				
THREATS:	Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Modification of riparian & in-stream habitat; Pollution of surface and groundwater; Poaching of fauna and flora; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Objective 4.1: By 2022, water abstraction quantity and water quality of the Riviersonderend Complex water sources are being monitored and have the relevant registration and/or licenses.	Monitor water abstraction quantity and quality of a production borehole at Vrolijkheid (and any future CapeNature boreholes within the Riviersonderend Complex) according to CapeNature and site-specific monitoring protocols.	**Lead:** Conservation Officer On-Reserve; Field Rangers **Enablers:** Freshwater Ecologist; Landscape Ecologist	Year 1-10	Monitoring report	Monitoring protocol
Objective 4.2: By 2023, CapeNature water sources have the relevant registration and/or licenses.	Secure legal compliance of the existing borehole at Vrolijkheid Provincial Reserve.	**Lead:** Capability Manager: Integrated Catchments **Enablers:** Freshwater Ecologist; Conservation Officer On-Reserve	Year 3	Internal compliance audit undertaken Obtain relevant approval	WULA licence
Objective 4.3: By 2022, an integrated groundwater monitoring framework of the zone of influence is established and implemented.	Initiate engagement and maintain communication with stakeholders through Protected Area Advisory Committee and water use liaison structure channels on water use best practice and compliance.	**Lead:** Conservation Officer On-Reserve **Enablers:** Stakeholder Engagement Officer; Landscape Manager 1; Freshwater Ecologist.	From year 1	Minutes of meeting with Protected Area Advisory Committee and relevant entities	Protected Area Advisory Committee
	Actively participate in groundwater monitoring frameworks and their implementation within the zone of influence through	**Lead:** Integrated Catchment Specialist **Enablers:** Stakeholder Engagement Officer; Freshwater Ecologist;	Year 2	Monitoring framework established i.e. groundwater monitoring strategy in new Breede-Gouritz	Breede-Overberg Catchment Management Strategy 2010

STRATEGY 4:	Enhance partnerships to increase collaboration, legislative compliance and best practice in terrestrial and aquatic ecosystems within the Riviersonderend Complex and its associated zone of influence.
LINKED GOALS:	4; 5
THREATS:	Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Modification of riparian & in-stream habitat; Pollution of surface and groundwater; Poaching of fauna and flora; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors.

Objectives	Actions	Responsibility	Time-frame	Measurable Indicators / Outputs	References / Existing Procedures
	the Breede-Gouritz Catchment Management Agency and the Department of Water Affairs structures.	Conservation Officer On-Reserve		Catchment Management Agency Catchment Management Strategy	
Objective 4.4: By 2022, ecological condition and river flow of identified rivers in the Riviersonderend Complex are being monitored in line with CapeNature protocol.	Identify the rivers to be monitored.	**Lead:** Freshwater Ecologist **Enablers:** Landscape Ecologist; Conservation Officer On-Reserve; Ecological Technician	Year 1	List of identified rivers for monitoring	CapeNature river flow monitoring protocol
	Procure the necessary equipment for monitoring e.g. flow meter, either a handheld or telemetric system which will be permanently fixed at a site.	**Lead:** Ecological Technician; Landscape Manager 1; Landscape Administrator Assistant **Enablers:** Freshwater Ecologist	Year 1-2	Monitoring equipment	CapeNature river flow monitoring protocol
	Monitor river flow of identified rivers where water is being abstracted.	**Lead:** Field Rangers; Conservation Officer On-Reserve; Ecological Technician **Enablers:** Freshwater Ecologist	Year 2-10	Stream flow report	CapeNature river flow monitoring protocol
	Undertake SASS assessments of identified rivers where water is being abstracted	**Lead:** Ecological Technician; Conservation Officer On-Reserve; Field Rangers **Enablers:** Freshwater Ecologist	As per protocol	River ecological condition report	SASS monitoring protocol

STRATEGY 4:	Enhance partnerships to increase collaboration, legislative compliance and best practice in terrestrial and aquatic ecosystems within the Riviersonderend Complex and its associated zone of influence.				
LINKED GOALS:	4; 5				
THREATS:	Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Modification of riparian & in-stream habitat; Pollution of surface and groundwater; Poaching of fauna and flora; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Objective 4.5: By 2022, a screening tool for opportunistic identification of invasion reservoirs (i.e. sources of invasive alien fish) is developed and implemented. The focus area for implementation is the zone of influence and the screening tool should also identify appropriate management interventions.	Develop and implement screening tool (landowner questionnaire) to identify potential invasion reservoirs (e.g. farm dams) and identify invasion risk.	**Lead:** Fauna Ecologist **Enablers:** Conservation Officer On-Reserve; Landscape Ecologist; Ecological Technician	Development of questionnaire: 2022 Implementation: 2022 onwards.	Record of landowner engagements and register of feedback (GPS points of dams, species present etc.), as well as possible management interventions.	None
Objective 4.6: By 2022, a monitoring protocol is developed and implemented for determining freshwater fish community composition and population status in priority rivers* for the Riviersonderend Complex. *Meerlustkloof, Meul, Baviaans, Gobos, Boesmans, Hoeks, Houtbaai Rivers.	Develop indigenous fish monitoring protocol specific to the Riviersonderend Complex.	**Lead:** Fauna Ecologist **Enablers:** Landscape Ecologist	Protocol developed by 2022	Beta version of monitoring protocol developed for implementation	Generic Fish Monitoring Protocol developed in 2019, site selection for monitoring sites done in 2020. Need to consolidate these into a reserve specific monitoring protocol.
	Procure sampling equipment for the Riviersonderend Complex and train reserve staff in fish sampling methodology and water safety.	**Lead:** Fauna Ecologist **Enablers:** Conservation Officer On-Reserve; Landscape Ecologist; Ecological Technician; Field Rangers	Procurement of equipment & water safety training: 2020 Training: Ongoing until relevant staff are proficient with sampling	Fish survey data (relative abundance, species composition, size class distribution) presented in field report along with	Existing template available for field survey reports.

STRATEGY 4:	Enhance partnerships to increase collaboration, legislative compliance and best practice in terrestrial and aquatic ecosystems within the Riviersonderend Complex and its associated zone of influence.				
LINKED GOALS:	4; 5				
THREATS:	Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Modification of riparian & in-stream habitat; Pollution of surface and groundwater; Poaching of fauna and flora; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
			methodology and species identification and data is collected to the desired standard. Implementation: Every 2 years with exception of Gobos river which is surveyed annually due to catfish invasion.	relevant management recommendations.	
Objective 4.7: By 2025, increase successful compliance interventions* from 2021 baseline. *Prevention, apprehension and prosecution.	Identify common issues that require elevated effort and focus.	**Lead:** Conservation Officer On-Reserve **Enablers:** Compliance and Enforcement Specialist; Landscape Manager 1	Within first year of implementation	Number of action plans that renders a positive effect.	Reserve specific Integrated Compliance Plans.
	Maintain baseline of 2021 compliance interventions.	**Lead:** Conservation Officer On-Reserve **Enablers:** Conservation Manager Off-Reserve; Compliance and Enforcement Specialist	Within first year of implementation	Number of successful compliance interventions in 2021.	
Objective 4.8: By 2021, all compliance and law enforcement entities agree on roles and responsibilities.	Engage with relevant authorities responsible for law enforcement and clarification of roles and responsibilities.	**Lead:** Conservation Officer On-Reserve **Enablers:** Land Use Scientist; Stakeholder Engagement Officer;	Year 2 and annually thereafter	Minutes of meetings	Relevant suite of environmental legislation and associated regulations, by laws and policy.

STRATEGY 4:	Enhance partnerships to increase collaboration, legislative compliance and best practice in terrestrial and aquatic ecosystems within the Riviersonderend Complex and its associated zone of influence.				
LINKED GOALS:	4; 5				
THREATS:	Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Modification of riparian & in-stream habitat; Pollution of surface and groundwater; Poaching of fauna and flora; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
		Compliance and Enforcement Staff			
	Implement the Riviersonderend Complex Integrated Compliance Plan to ensure integration and to complement relevant initiatives planned by law enforcement entities and neighbours.	**Lead:** Conservation Officer On-Reserve **Enablers:** Land Use Scientist; Stakeholder Engagement Officer; Compliance and Enforcement Staff	Year 2 and annually thereafter	APO aligned to long term Integrated Compliance Plan objectives	Relevant suite of environmental legislation and associated regulations, by laws and policy.
Objective 4.9: By 2022, all enforcement staff identified in the compliance plan have been appointed and trained.	Implement a training programme to develop staff skill and ability.	**Lead:** Compliance and Enforcement Specialist; Conservation Officer On-Reserve **Enablers:** Conservation Manager Off-Reserve; Human Resources; Landscape Manager 1	Year 2 and a refresher every 2 years thereafter	Compliance & law enforcement training programme. Number of trained and capacitated staff.	Training Register; Appointment letters & cards.
Objective 4.10: By 2023, in-stream structures within the Riviersonderend Complex have been identified and legal compliance established.	Undertake an audit of all in-stream structures within the Riviersonderend Complex.	**Lead:** Field Rangers; Conservation Officer On-Reserve **Enablers:** Landscape Ecologist; Freshwater Ecologist	Year 2	Audit of structures completed	
	Report unlawful structures to the relevant authorities and follow-up as required.	**Lead:** Conservation Officer On-Reserve; Conservation Manager Off-Reserve; Conservation Officer Off-	Year 3	Unlawful activities reported to the relevant authorities	

STRATEGY 4:	Enhance partnerships to increase collaboration, legislative compliance and best practice in terrestrial and aquatic ecosystems within the Riviersonderend Complex and its associated zone of influence.
LINKED GOALS:	4; 5
THREATS:	Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Modification of riparian & in-stream habitat; Pollution of surface and groundwater; Poaching of fauna and flora; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors.

Objectives	Actions	Responsibility	Time-frame	Measurable Indicators / Outputs	References / Existing Procedures
		Reserve **Enablers:** Land Use Scientist			
Objective 4.11: By 2022, CapeNature will monitor and report unlawful land clearing activities within the zone of influence.	Land clearing activities within the zone of influence, either reported or observed, are followed up regarding legal compliance and reported, where necessary, in the approved format.	**Lead:** Conservation Manager Off-Reserve; Land Use Scientist **Enablers:** Landscape Ecologist	Annually from Year 1	All land clearing activities observed or reported are followed up. Unlawful land clearing activities are reported to relevant authority in approved format.	
Objective 4.12: By 2024, CapeNature has engaged with the relevant authorities regarding the regulation of pesticide, fertiliser, and other agricultural land use activities within the zone of influence that can impact on biodiversity.	Engage with the Department of Agriculture regarding regulation of harmful activities and identify potential actions to address this.	**Lead:** Stakeholder Engagement Officer; Conservation Manager Off-Reserve; Conservation Officer Off-Reserve **Enablers:** Landscape Ecologist; Fauna Ecologist	Year 3	Minutes of meetings & workshops If relevant: Information Support materials Evidence of collaboration with LandCare	
	Assist with implementation of identified actions.	**Lead:** Stakeholder Engagement Officer; Conservation Manager Off-Reserve; Conservation Officer Off-Reserve	Annually from Year 3	Implement identified actions	

STRATEGY 4:	Enhance partnerships to increase collaboration, legislative compliance and best practice in terrestrial and aquatic ecosystems within the Riviersonderend Complex and its associated zone of influence.				
LINKED GOALS:	4; 5				
THREATS:	Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Modification of riparian & in-stream habitat; Pollution of surface and groundwater; Poaching of fauna and flora; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
		Enablers: Landscape Ecologist; Flora Ecologist; Fauna Ecologist			
Objective 4.13: By 2022, CapeNature actively engages with priority partners in the Riviersonderend Mountain Catchment Area to secure the water source area.	Engage with the Breede-Gouritz Catchment Management Agency, Department of Agriculture, Municipalities, and Working for Water to prioritise invasive alien plant clearing and associated compliance action in the private catchment and associated properties.	**Lead:** Conservation Officer On-Reserve **Enablers:** Integrated Catchment Specialist; Landscape Manager 1	Year 2	Prioritisation and compliance products.	Invasive Alien Species legislation.

STRATEGY 5:	Develop and implement an integrated environmental education and awareness programme aimed at neighbours, natural resource users, learner groups and visitors, in collaboration with partners, to nurture respect and care for the natural, cultural and historic values of the Riviersonderend Complex.				
LINKED GOALS:	1; 2; 3; 4; 5; 7; 9				
THREATS:	Inappropriate and unnatural fire regime; Pollution of surface and groundwater; Poaching of fauna and flora.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Objective 5.1: By 2022, CapeNature have revised and implemented the Riviersonderend Complex environmental education and awareness programme.	Revise the approved Riviersonderend Complex plan.	**Lead:** Environmental Education Officer; Stakeholder Engagement Officer **Enablers:** Stakeholder Engagement and Access Manager; Integrated Catchment Specialist; Relevant staff as required.	Year 2	Approved Riviersonderend Complex plan	Environmental Education, Awareness and Interpretation Programme; Integrated Work Plan.
	Implement the approved Riviersonderend Complex plan.	**Lead:** Environmental Education Officer; Stakeholder Engagement Officer **Enablers:** Stakeholder Engagement and Access Manager; Integrated Catchment Specialist; Relevant staff as required.	Year 2 and beyond	Number of awareness events	Environmental Education, Awareness and Interpretation Programme; Integrated Work Plan.
Objective 5.2: By 2023, there is a decrease in ignition points within the targeted hotspot areas from the 2020 baseline, and the understanding of the impacts of invasive alien vegetation on fire risk, biodiversity and water supply is improved.	Identify internal and external stakeholders.	**Lead:** Environmental Education Officer; Stakeholder Engagement Officer **Enablers:** Stakeholder Engagement and Access Manager; Integrated Catchment Specialist; Relevant staff as required.	Within the first year of implementation.	Reduction in ignition points.	Fire response plan hotspots and fire data base ignition points.
	Coordinate and streamline awareness efforts among stakeholders/partners within the agreed hotspots.	**Lead:** Environmental Education Officer; Stakeholder Engagement Officer	Year 2 of implementation	Reduction of ignition points. One Fire Wise community established.	Environmental Education, Awareness and Interpretation Programme; Integrated Work Plan.

STRATEGY 5:	Develop and implement an integrated environmental education and awareness programme aimed at neighbours, natural resource users, learner groups and visitors, in collaboration with partners, to nurture respect and care for the natural, cultural and historic values of the Riviersonderend Complex.				
LINKED GOALS:	1; 2; 3; 4; 5; 7; 9				
THREATS:	Inappropriate and unnatural fire regime; Pollution of surface and groundwater; Poaching of fauna and flora.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
		Enablers: Integrated Catchment Specialist; Relevant staff as required.			
Objective 5.3: By 2023, ensure awareness raising initiatives elevate awareness around all other relevant conservation issues in the Riviersonderend Complex.	Compile information and material on the Riviersonderend Complex for dissemination and presentation on Environmental Awareness calendar days (e.g. Heritage Day and Arbour Day)	**Lead:** Stakeholder Engagement Manager; Stakeholder Engagement Officer; Environmental Education Officer; Field Rangers **Enablers:** Senior Manager Communications and Marketing.	Year 1-10	Awareness raising material compiled. Articles published.	People and Parks Action Plan; CapeNature Communications Policy; The Development of Educational Resources (Corporate Strategic Plan); Youth Development & Environmental Education Programme Strategic Plan.
	Collaborate with partners to arrange events on Environmental Awareness days and schedule school activities (e.g. youth camps).			Number of learners provided with environmental education opportunities as per annual Annual Plan of Operations targets.	
	Present talks and presentations when requested.				
	Assist with planning and implementation of awareness raising events.				
	Create an enabling environment to accommodate students, researchers and volunteers to contribute to projects on the Riviersonderend Complex.				

STRATEGY 5:	Develop and implement an integrated environmental education and awareness programme aimed at neighbours, natural resource users, learner groups and visitors, in collaboration with partners, to nurture respect and care for the natural, cultural and historic values of the Riviersonderend Complex.				
LINKED GOALS:	1; 2; 3; 4; 5; 7; 9				
THREATS:	Inappropriate and unnatural fire regime; Pollution of surface and groundwater; Poaching of fauna and flora.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Objective 5.4: By 2024, Natural Resource User Groups in the Riviersonderend Complex will have extensive awareness of the CapeNature Natural Resource Utilisation Policy and Permitting System.	Conduct workshops on, and implement, the approved Natural Resource Utilisation Policy and Permitting System.	**Lead:** Stakeholder Engagement Officer; Environmental Education Officer **Enablers:** Stakeholder Engagement and Access Manager; Conservation Manager Off-Reserve; Conservation Officer Off-Reserve	Year 4	At least 4 workshops annually regarding the Natural Resource Utilisation Policy and Amended Permit System in the Riviersonderend Complex; Natural Resource User Group permits issued.	Policy; Current permit system.

STRATEGY 6:	Re-evaluate the expansion domain of the Riviersonderend Complex with partners, to facilitate protected area expansion, consolidation and connectivity through stewardship and other protected area expansion methodologies.				
LINKED GOALS:	6; 7				
THREATS:	Invasive alien plants impacting on fire regime, biodiversity and water availability; Inappropriate and unnatural fire regime; Climate change related impacts; Development of buildings and infrastructure impacting on natural habitat; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors; Poaching of fauna and flora.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Objective 6.1: By 2025, secure Conservation Action Priority properties for conservation through stewardship or other mechanisms as identified in the Conservation Action Priority Map and Leslie-Hill Succulent Karoo Trust for the Riviersonderend Complex.	Negotiate and sign-up four priority stewardship agreements with landowner for Conservation Action Priority priorities and/or facilitate conservation of these properties through other mechanisms with assistance from partners.	**Lead:** Conservation Manager Off-Reserve **Enablers:** Conservation Stewardship Specialist; Landscape Ecologist.	Year 5	4 properties have landowners signed up for conservation (*expansion targets subject to adequate staff capacity and resources).	Initiation and record of preliminary negotiations.
	Proceed with process for securing the property in accordance with relevant status (e.g. declaration for nature reserve).	**Lead:** Legal Advisor **Enablers:** Conservation Manager Off-Reserve; Conservation Stewardship Specialist.	Year 5	4 properties have landowners signed up for conservation*	Existing legal documentation
	Ensure compilation of relevant management plan.	**Lead:** Conservation Manager Off-Reserve **Enablers:** Conservation Stewardship Specialist; Landscape Ecologist.	Year 7	Completion of management plan	Management plan template
	Post-declaration support and auditing of the management plan.	**Lead:** Conservation Manager Off-Reserve **Enablers:** Conservation Stewardship Specialist.	Annually from year 7	Annual audits undertaken	Audit template
	Provide support to partners to implement Objective 6.1, including through the Protected Area Expansion Strategy Reference Group.	**Lead:** Conservation Manager Off-Reserve **Enablers:** Conservation Stewardship Specialist.	Annually from year 3	As required	Stewardship review and peer learning events.

STRATEGY 6:	Re-evaluate the expansion domain of the Riviersonderend Complex with partners, to facilitate protected area expansion, consolidation and connectivity through stewardship and other protected area expansion methodologies.				
LINKED GOALS:	6; 7				
THREATS:	Invasive alien plants impacting on fire regime, biodiversity and water availability; Inappropriate and unnatural fire regime; Climate change related impacts; Development of buildings and infrastructure impacting on natural habitat; Agricultural practices which impact negatively on biodiversity; Fragmentation of natural habitat and ecological corridors; Poaching of fauna and flora.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Objective 6.2: By 2030, NEM: PAA compliance for local authority nature reserves adjacent to the Riviersonderend Complex.	Provide support and assistance to the Theewaterskloof Municipality for ensuring NEM: PAA compliance for the Greyton Local Authority Nature Reserve, including investigation of expansion.	**Lead:** Conservation Manager Off-Reserve **Enablers:** Conservation Stewardship Specialist; Landscape Ecologist.	Year 10	Greyton Nature Reserve NEM: PAA compliant	None
	Review of the Greyton Local Authority Nature Reserve Protected Area Management Plan.	**Lead:** Conservation Manager Off-Reserve **Enablers:** Landscape Ecologist.	Year 10	Submission of Protected Area Management Plan review	Existing management plans

STRATEGY 7:	Ensure maintenance and minimise degradation of heritage resources within the Riviersonderend Complex.				
LINKED GOALS:	8				
THREATS:	Change in management practices as a result of a change in land occupancy; Vandalism of heritage features.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Objective 7.1: By 2030, the Riviersonderend Complex has an approved heritage management plan for implementation.	Conduct a formal baseline heritage survey through the Riviersonderend Complex. Ensure all heritage infrastructure on the Riviersonderend Complex is included in the reserve maintenance plan.	**Lead:** Conservation Officer On-Reserve **Enablers:** Landscape Manager 1	Year 5	Heritage inventory completed.	Adopt applicable procedures used in approved Heritage management plans in CapeNature managed reserves via Google Drive
	In partnership with Heritage Western Cape, draft and implement the heritage management plan for the Riviersonderend Complex.	**Lead:** Conservation Officer On-Reserve **Enablers:** Landscape Manager 1	Year 6-10	Approved heritage management plan.	Use existing Memorandum of Understandings between CapeNature & Heritage Western Cape to identify benefits. Include management aspects in the annual Integrated Work Plan.

STRATEGY 8:	Facilitate sustainable, responsible development, access and activities within the Riviersonderend Complex in collaboration with relevant internal and external partners and stakeholders.
LINKED GOALS:	2; 3; 5; 8
THREATS:	Development of buildings and infrastructure impacting on natural habitat; Modification of riparian and in-stream habitat; Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Pollution of surface and groundwater; Vandalism of heritage features.

Objectives	Actions	Responsibility	Time-frame	Measurable Indicators / Outputs	References / Existing Procedures
Objective 8.1: By 2022, engage with relevant authorities, including Department of Agriculture: LandCare and Department of Environmental Affairs and Development Planning, to initiate area-wide planning within the zone of influence.	Initiate and implement area-wide planning in priority areas within the zone of influence. Engage with the Department of Agriculture: LandCare and Department of Environmental Affairs and Development Planning to identify pilot areas for area-wide planning. Participate in the area-wide planning process and product development. Assist and review the implementation of projects.	**Lead:** Conservation Manager Off-Reserve; Landscape Conservation Intelligence Manager; Landscape Manager 1 **Enablers:** Landscape Ecologist; Mainstream Specialist; Land Use Scientist	Year 1 – 10	Map of identified pilot areas; Minutes of engagement meetings.	Cape Farm Mapper; Forums; Inter-governmental meetings.
Objective 8.2: By 2021, the Riviersonderend World Heritage Site, Provincial Reserve, and zone of influence is integrated into the Municipal Land Use Planning products.	Ensure that protected areas and priority corridors are incorporated into the Municipal Strategic Development Framework's and other Governmental planning initiatives and products Ensure that infrastructure development is legally compliant, unobtrusive and environmentally friendly	**Lead:** Landscape Conservation Intelligence Manager; Landscape Ecologist; Mainstream Specialist; Land Use Scientist **Enablers:** Landscape Manager 1	Year 1 - 10	Strategis Development Framework; Environmental authorisations; Comments submitted on development; Infrastructural development within the Riviersonderend Complex and zone of influence	Conservation Development Framework; Western Cape Biodiversity Spatial Plan; NEMA; Integrated Work Plan; Integrated Annual Plan of Operations.

STRATEGY 8:	Facilitate sustainable, responsible development, access and activities within the Riviersonderend Complex in collaboration with relevant internal and external partners and stakeholders.				
LINKED GOALS:	2; 3; 5; 8				
THREATS:	Development of buildings and infrastructure impacting on natural habitat; Modification of riparian and in-stream habitat; Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Pollution of surface and groundwater; Vandalism of heritage features.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
	within specific identified zones and maintained according to schedule.				
	Provide comments on developments that may impact on the Riviersonderend Complex and zone of influence.				
Objective 8.3: By 2022, initial reserve specific carrying capacity (type, number and frequency) for all non-consumptive utilisation for terrestrial and freshwater environment are set in line with sensitivity analysis and detailed zonation scheme.	List all activities and current and desired infrastructure and collate information on user groups, current numbers, projected future use and limits thereon.	**Lead:** Stakeholder Engagement Officer **Enablers:** Integrated Catchment Specialist; Eco-Tourism and Access Manager.	Within first year of implement-tation	List of activities and user groups	Zonation Scheme
	Translate information into a carrying capacity for current non-consumptive utilisation, and further refine the zonation scheme and related rules, if needed, based on sensitivity information	**Lead:** Landscape Ecologist **Enablers:** Eco-Tourism and Access Manager.	Within first year of implement-tation	Detailed zonation scheme and rules that addresses the full suite and diversity of non-consumptive uses desired in the Riviersonderend Complex.	Zonation Scheme
	Investigate and evaluate additional responsible tourism facilities, products and services for commercial and recreational use, using	**Lead:** Eco-Tourism and Access Manager; Landscape Ecologist **Enablers:** Ecological Technician; Integrated Catchment Specialist	Within two years of implement-tation	Additional responsible tourism facilities, products and services identified.	Concept Development Framework; Zonation Scheme

STRATEGY 8:	Facilitate sustainable, responsible development, access and activities within the Riviersonderend Complex in collaboration with relevant internal and external partners and stakeholders.				
LINKED GOALS:	2; 3; 5; 8				
THREATS:	Development of buildings and infrastructure impacting on natural habitat; Modification of riparian and in-stream habitat; Over-abstraction of surface and groundwater within the zone of influence; In-stream structures affecting flow; Pollution of surface and groundwater; Vandalism of heritage features.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
	the sensitivity analysis and zonation as an informant.				
	Source, collate and develop a feedback loop with regards to recommendations from existing reports to partners and communities.	**Lead:** Stakeholder Engagement Officer; Project Officer **Enablers:** NRM Project Manager; Project Specialist.	Annually	Summary report; Protected Area Advisory Committee meeting minutes.	Municipal Integrated Development Plans and Strategic Development Frameworks
Objective 8.4: By 2023, sustainable access* for a diversity of spiritual, religious and cultural uses is determined, agreed upon, communicated and implemented. *Where, what, how much, frequency and compliance.	Enable and allow access to the Riviersonderend Complex for spiritual, cultural and traditional purposes subject to permit conditions and with prior approval.	**Lead:** Stakeholder Engagement Officer **Enablers:**	Years 1 – 10	Number of persons accessing CapeNature protected areas for cultural, traditional, spiritual, and sustainable harvesting activities.	People and Parks Action Plan.
	Identify sustainable sites suitable for spiritual and cultural activities and set site specific carrying capacities for each activity.	**Lead:** Stakeholder Engagement Officer; Landscape Ecologist **Enablers:** Ecological Technician; Integrated Catchment Specialist; Stakeholder Engagement Manager.	Within second year of implement-tation	Sustainable sites with carrying capacities suitable for spiritual and cultural activities have been identified.	Zonation Scheme.

STRATEGY 9:	Contribute to economic and social development by providing job and training opportunities to Expanded Public Works Programme, contract, and small, medium and micro-sized enterprise (SMME) staff.				
LINKED GOALS:	10				
THREATS:	Lack of training and job opportunities for the surrounding communities; Inadequate access for socio-economic opportunities.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators / Outputs**	**References / Existing Procedures**
Objective 9.1: By 2023, CapeNature have identified and prioritised viable economic development projects for implementation within the Riviersonderend Complex and its zone of influence.	Implement existing and additional economic development opportunities as funding becomes available.	**Lead:** Landscape Manager 1; Stakeholder Engagement Officer; Project Officer. **Enablers:** Conservation Officer On-Reserve; NRM Project Manager; Project Specialist: Analytics; Land Use Scientist.	Annually	SMME register; MIS report	Municipal Integrated Development Plans and Strategic Development Frameworks
Objective 9.2: By 2021, CapeNature have collated recommendations from existing reports that support tourism livelihoods and economic development in the zone of influence of the Riviersonderend Complex.	Source, collate and develop a feedback loop with regards to recommendation from existing reports to partners and communities.	**Lead:** Stakeholder Engagement Officer; Project Officer. **Enablers:** Conservation Officer On-Reserve; NRM Project Manager; Project Specialist: Analytics; Land Use Specialist.	Annually	Summary report	Municipal Integrated Development Plans and Strategic Development Frameworks
	Determine the process to include CapeNature input (job creation, projects, structural developments, conservation actions, tourism developments, etc.) into local Municipality Integrated Development Plans.	**Lead:** Landscape Manager 1; Stakeholder Engagement Officer; Project Officer **Enablers:** Conservation Officer On-Reserve; NRM Project Manager; Project Specialist: Analytics; Land Use Scientist.	Annually	Summary report	Municipal Integrated Development Plans and Strategis Development Frameworks

11 COSTING

This section provides an overview of costing and fund allocation for strategies. It outlines the existing financial resources (current budget), funding shortfalls, sources of alternate funding and future financial projections.

11.1 Finance and Asset Management

In line with the legal requirement, the strategies identified for implementation within the Complex, to achieve the desired state, have been costed below.

The Complex will adhere to the guiding principles listed below:

- Responsibly manage the allocation of budget, revenue raising activities and expenditure;
- Ensure solid financial management supporting the achievement of the objectives of this plan; and
- Compliance with the Public Finance Management Act, 1999 (Act No. 1 of 1999) as well as CapeNature's financial policies and procedures.

A budget was derived based upon the activities in this management plan. When estimating the costing, the following items were considered:

- Those costs and associated resources which could be allocated to specific activities and which were of a recurring nature;
- Those costs and associated resources which could be allocated to specific activities, but which were of a once-off nature;
- Unallocated fixed costs (water, electricity, phones, bank fees, etc.);
- Maintenance of infrastructure; and
- Provision for replacement of minor assets, (furniture, electronic equipment, vehicles, etc.).

11.1.1 Income

CapeNature's budget is funded by the MTEF allocation, other government grants and generated from own revenue sources derived from commercial activities. Any surplus revenue generated is used to fund shortfalls in management costs across the organisation.

CapeNature has overhead costs relating to support services such as human resources, communications, marketing and learning, finance, biodiversity capabilities, conservation operations, eco-tourism and access, legal services, etc. which is not allocated to individual protected area complexes and must also be funded through grant funding or own revenue generated.

This management plan is a 10-year plan, and thus straddles multiple MTEF periods that impact on actual budget allocation and projection. Due to the challenging fiscal position the country faces and additional strain brought on by the COVID-19 pandemic, the organisation is facing budget cuts and reduced tourism income that will have to be considered during the implementation of this management plan.

Total income projected for 2021/22 is budgeted at R 7 297 421.49. An annual summary is presented in Table 11.1.

Table 11.1: An annual summary of the total projected income for the Riviersonderend Complex.

Allocation	2021/22
Total Income	R 7 297 421.49
MTEF Allocation	R 4 727 943.00
Own Funding	R 0.00
External Funding	R 2 569 478.49

11.1.2 Expenditure

11.1.2.1 Recurring costs

Annual direct costs may include staff, transport and travel, stores and equipment and fixed costs. This expenditure is split according to strategies as illustrated in Figure 11.1.

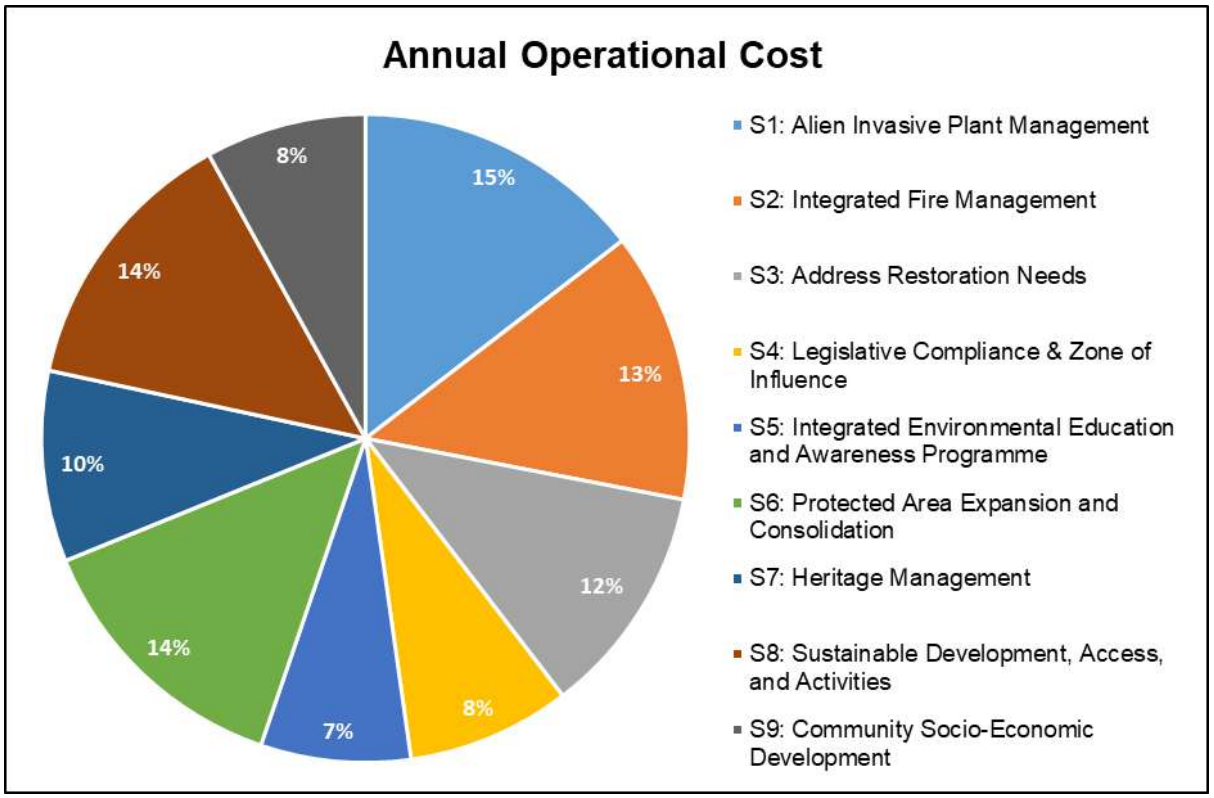


Figure 11.1: The estimated proportion of annual operational costs for the Riviersonderend Complex for year 2021/22 aligned with the identified and prioritised strategies.

11.1.2.2 Once off costs

In addition to the recurring costs there might be once-off replacement costs of assets, e.g. tractor, fencing equipment, field equipment, etc. that are aligned with the life span of the relevant assets being replaced.

11.1.2.3 Maintenance

An annual earmarked allocation is provided for the development of new tourism infrastructure, upgrades and maintenance of existing tourism and management infrastructure. Tourism projects are prioritised across all CapeNature facilities and maintenance is scheduled accordingly.

11.1.2.4 Implications

Unsuccessful securing of external funding and replacement of crucial capital equipment could lead to potential shortfall and will have a negative impact on strategies throughout. Further reductions in organisational budget can be expected during the management plan cycle. The implications of this being that the strategic plan may not be fully achieved. Available funding will have to be prioritised accordingly.

A zero-based budget approach is needed to determine the true financial needs of the Complex.

12 REFERENCES

ACO Associates (ACO). 2011. Environmental Impact Assessment for the Establishment of the Caledon Wind Farm, Western Cape Province. Environmental Scoping Report: Heritage Assessment. Prepared for Arcus GIBB (Pty) Ltd.

BirdLife International. 2017. *Circus maurus*. The IUCN Red List of Threatened Species 2017: e.T22695379A118433168. URL: https://www.iucnredlist.org/species/22695379/118433168. Accessed on 19 May 2020.

Birss C. 2017. Chapter 9: Mammals. In: Turner A.A., editor. Western Cape Province State of Biodiversity 2017. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-45962-3.

Bond W.J. & Slingsby P. 1983. Seed dispersal by ants in shrublands of the Cape Province and its evolutionary implications. *South African Journal of Science* 79: 231-233.

Botes A., McGeoch M.A., Robertson H.G., van Niekerk A., Davids H.P. & Chown S.L. 2006. Ants, altitude and change in the northern Cape Floristic Region. *Journal of Biogeography* 33: 71-90.

Breede Valley Municipality (BVM). 2020. Review of the Integrated Development Plan – 2020-2021: Third review of the 4th Generation IDP (2017 – 2022). Breede Valley Municipality, Worcester.

CapeNature. 2010. Baseline Manual, Version 2. CapeNature, Cape Town.

CapeNature. 2012. Vrolijkheid Nature Reserve Complex Management Plan 2013-2018. Internal Management Plan. CapeNature, Cape Town.

CapeNature. 2015a. Western Cape Protected Area Expansion Strategy: 2015-2020. Internal report. CapeNature, Cape Town.

CapeNature. 2015b. Fencing and Enclosure of Game and Predators in the Western Cape Province Policy. Internal report. CapeNature, Cape Town.

CapeNature. 2016a. Veldfire Management Policy. Version 6. Internal Report. CapeNature, Cape Town.

CapeNature. 2016b. CapeNature Integrated Catchment Management Strategy: 2016 – 2021. Internal Report. CapeNature, Cape Town.

CapeNature. 2016c. CapeNature Biodiversity Research & Monitoring Strategy. Internal Report. CapeNature, Cape Town.

CapeNature. 2019a. Consumptive use of Wild Flora from CapeNature managed Protected Area Policy. Internal Report. CapeNature, Cape Town.

CapeNature. 2019b. Game Translocation and Utilization Policy for the Western Cape Province. Internal report. CapeNature, Cape Town.

CapeNature. 2020a. Vrolijkheid Nature Reserve Weather Station Database. Unpublished Raw Data. CapeNature, Cape Town.

Carlson J.E. & Holsinger K.E. 2012. Developmental Plasticity in *Protea* as an Evolutionary Response to Environmental Clines in the Cape Floristic Region. *PLoS One* 7: e52035. DOI: 10.1371/journal.pone.0052035.

Carlson J.E., Holsinger K.E. & Prunier R. 2010. Plant Responses to Climate in the Cape Floristic Region of South Africa: Evidence for Adaptive Differentiation in the Proteaceae. *Evolution* 65: 108-124. DOI: 10.1111/j.1558-5646.2010.01131.x.

Chakona A. & Swartz E.R. 2012. Contrasting habitat associations of imperilled endemic stream fishes from a global biodiversity hot spot. *BMC Ecology* 12: 19. DOI: 10.1186/1472-6785-12-19.

Chakona A. 2018. *Sandelia capensis*. The IUCN Red List of Threatened Species 2018: e.T19890A99447632. URL: https://www.iucnredlist.org/species/19890/99447632.

Chakona A., Swartz E. & Gouws G. 2013. Evolutionary Drivers of Diversification and Distribution of a Southern Temperate Stream Fish Assemblage: Testing the Role of Historical Isolation and Spatial Range Expansion. *PLoS One* 8: e70953. DOI: 10.1371/journal.pone.0070953.

Channing A., Measey G.J., De Villiers A.L., Turner A.A. & Tolley K.A. 2017. Taxonomy of the *Capensibufo rosei* group (Anura: Bufonidae) from South Africa. *Zootaxa* 47: 282-292.

Child M.F., Rowe-Rowe D., Birss C., Wilson B., Palmer G., Stuart C., Stuart M., West S. & Do Linh San E. 2016b. A conservation assessment of *Poecilogale albinucha*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T., editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T., editors. 2016a. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Cleaver G., Brown L.R., Bredenkamp G.J., Smart M.C. & Rautenbach C.J. 2003. Assessment of environmental impacts of groundwater abstraction from Table Mountain Group (TMG) aquifers on ecosystems in the Kammanassie Nature Reserve and environs. WRC Report Number: 1115/1/03. Water Research Commission, Pretoria. ISBN 1-77005-034-5.

Clift H. 2001. A sortie into archaeology of the Moravian Mission Station, Genadendal. MA Thesis. University of Cape Town, Cape Town.

CNdV Africa. 2016. Langeberg Municipal Spatial Development Framework: Final Spatial Development Framework Report. Compiled for the Langeberg Municipality. Langeberg Municipality, Montagu.

Coetzee K. 2016. Practical Techniques for Habitat and Wildlife Management: A Guide for Game Ranches, Conservation Areas and Farmland. New Voices Publishing, Cape Town. ISBN: 978-0-620-70843-2.

Colvin C., Riemann K., Brown C., Le Maitre D., Mlisa A., Blake D., Aston T., Maherry A., Engelbrecht J., Pemberton C., Magoba R., Soltau L. & Prinsloo E. 2009. Ecological and Environmental Impacts of Large-scale Groundwater Development in the Table Mountain Group (TMG) Aquifer System. WRC Report Number: 1327/1/08. Water Research Commission, Pretoria. ISBN 978-1-77005-796-8.

Conservation Coaches Network (CCNet). 2012. Harmonized Open Standards Presentations. URL: http://cmp-openstandards.org/library-item/basic-open-standards-presentations-ccnet-2012/.

Conservation Measures Partnership (CMP). 2020. Open Standards for the Practice of Conservation. Version 4.0. URL: https://cmp-openstandards.org/download-os/.

Council for Geoscience (CGS). 2012. Geology_1M_scale_WCape_gw. [vector geospatial dataset] 2012. Council for Geoscience, Pretoria.

Dallas H.F. & Day J.A. 2007. Natural variation in macroinvertebrate assemblages and the development of a biological banding system for interpreting bioassessment data – a preliminary evaluation using data from upland sites in the south-western Cape, South Africa. *Hydrobiologia* 575: 231-244.

Dallas H.F. 2004. Seasonal variability of macroinvertebrate assemblages in two regions of South Africa: Implications for Aquatic Bioassessment. *African Journal of Aquatic Science* 29: 173-184.

Dallas H.F. 2007. River Health Programme: South African Scoring System (SASS) Data Interpretation Guidelines. Institute of Natural Resources and Department of Water Affairs and Forestry, Pretoria.

Davies S.J., Jordaan M.S., Karsten M., Terblanche J.S., Turner A.A., van Wilgen N.J., Veldtman R., Zengeya T.A. & Measey J. 2020. Experience and Lessons from Alien and Invasive Animal Control Projects in South Africa. In: van Wilgen B., Measey J., Richardson D., Wilson J. & Zengeya T., editors. Biological Invasions in South Africa. Invading Nature - Springer Series in Invasion Ecology, Vol 14. Springer, Cambridge. ISBN: 978-3-030-32393-6.

De Moor F.C. & Day J.A. 2013. Aquatic biodiversity in the Mediterranean region of South Africa. *Hydrobiologia* 719: 237-268. DOI: 10.1007/s10750-013-1488-7. ISSN: 0018-8158.

De Moor I.J. & Bruton M.N. 1988. Atlas of alien and translocated indigenous aquatic animals in southern Africa. South African National Scientific Programmes Report Number 144. Foundation for Research Development, Pretoria. ISBN: 0-7988-4496-5.

De Villiers C., Brownlie S., Rebelo T., Holmes P., Wood J., Maree K., Ralston S., Manuel J., Holness S., Cadman M. & Driver A. 2016. Chapter 3: Planning for a mosaic of land uses in living landscapes. In: Cadman M., editor. Ecosystem

Guidelines for Environmental Assessment in the Western Cape. 2nd Edition. Fynbos Forum, Cape Town. ISBN: 978-0-620-72215-5.

Department of Environmental Affairs (DEA). 2016a. National Biodiversity Research Development and Evidence Strategy (2015-2025). Department of Environmental Affairs, Pretoria. URL: https://www.environment.gov.za/sites/default/files/docs/biodiversity_research_strategy.pdf.

Department of Environmental Affairs (DEA). 2016b. National Protected Areas Expansion Strategy for South Africa. Department of Environmental Affairs, Pretoria.

Department of Water Affairs and Forestry (DWAF). 2012a. Aquifer Classification of South Africa. Map recompiled in 2012. Original map compiled CSIR (1999). Department of Water Affairs and Forestry, Pretoria.

Department of Water Affairs and Forestry (DWAF). 2012b. Aquifer Vulnerability of South Africa. Map recompiled in 2012. Original map compiled CSIR (1999). Department of Water Affairs and Forestry, Pretoria.

Department of Water Affairs and Forestry (DWAF). 2012c. Aquifer Susceptibility of South Africa. Map recompiled in 2012. Original map compiled CSIR (1999). Department of Water Affairs and Forestry, Pretoria.

Desmet P. & Cowling R. 2004. Using the Species–Area Relationship to Set Baseline Targets for Conservation. *Ecology and Society* 9: 11.

Dickens C.W.S. & Graham P.M. 2002. The South African Scoring System (SASS) Version 5 rapid bioassessment method for rivers. *African Journal of Aquatic Science* 27: 1-10.

Dippenaar-Schoeman A.S., Haddad C.R., Foord S.H., Lyle R., Lotz L.N. & Marais P. 2015. South African National Survey of Arachnida (SANSA): Review of current knowledge, constraints and future needs for documenting spider diversity (Arachnida: Araneae). *Transactions of the Royal Society of South Africa* 70: 245-275.

Driessen P.M., Deckers J., Spaargaren O. & Nachtergaele F., editors. 2001. Lecture Notes on the Major Soils of the World. Food and Agriculture Organization of the United Nations, Rome. ISBN: 925-104637-9.

Du Preez D., Hodgson B.H. & Scott W.M. 1993. Vrolijkheid Nature Reserve Vegetation Description. Unpublished report. Department of Nature and Environmental Conservation, South Africa.

Ellender B.R., Wasserman R.J., Chakona A., Skelton P.H. & Weyl O.L.F. 2017. A review of the biology and status of Cape Fold Ecoregion freshwater fishes. *Aquatic Conservation: Marine and Freshwater Ecosystems* 27: 867-879.

Ellender B.R., Woodford D.J. & Weyl O.L.F. 2015. The invasibility of small headwater streams by an emerging invader, *Clarias gariepinus*. *Biological Invasions* 17: 57–61.

Esler K.J., Milton S.J. & Dean W.R.J., editors. 2006. Karoo Veld: Ecology and Management. Briza Publications, Pretoria. ISBN: 978-1-875093-52-6.

Esler K.J., Pierce S.M. & De Villiers C., editors. 2014. Fynbos: Ecology and Management. Briza Publications, Pretoria. ISBN: 978-1-920217-37-2.

Esler K.J., Von Staden L. & Midgley G.F. 2015. Determinants of the Fynbos/Succulent Karoo Biome Boundary: Insights from a Reciprocal Transplant Experiment. *South African Journal of Botany* 101: 120-128.

FitzPatrick Institute of African Ornithology (FPIAO). 2020. Virtual Museum. URL: http://vmus.adu.org.za/. Accessed on 07 January 2020.

Forsyth G.G., Kruger F.J. & Le Maitre D.C. 2010. National Veldfire Risk Assessment: Analysis of Exposure of Social, Economic and Environmental Assets to Veldfire Hazards in South Africa. CSIR Report Number: CSIR/NRE/ECO/ER/2010/0023/C. Council for Scientific and Industrial Research, Stellenbosch.

Furse M.T. 2000. The application of RIVPACS procedures in headwater streams – an extensive and important natural resource. In: Wright J.F., Sutcluffe D.W. & Furse M.T., editors. Assessing the biological quality of fresh waters: RIVPACS and other techniques. Freshwater Biological Association, United Kingdom.

Gouws E.J. & Gordon A. 2017. Freshwater Ecosystems. In: Turner A.A., editor. Western Cape Province State of Biodiversity Report 2017. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-45962-3.

Gouws E.J., Malan D., Job N., Nieuwoudt H., Nel J., Dallas H. & Bellingan T. 2012. Chapter 2: Freshwater Ecosystems. In: Turner A.A., editor. Western Cape Province State of Biodiversity 2012. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-41407-3.

Government of South Africa. 2011. National Environmental Management: Biodiversity Act (Act 10 of 2004) National List of Ecosystems that are Threatened and in Need of Protection. Notice 1002 of 2011. *Government Gazette* 34809: 1-544.

Government of South Africa. 2016. National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004): Alien and Invasive Species Lists, 2016. *Government Gazette* 40166: 31-104.

Guelke L. & Shell R. 1992. Landscape of Conquest: Frontier Water Alienation and Khoikhoi Strategies of Survival, 1652-1780. *Journal of Southern African Studies* 18: 803-824.

Haupt K. 2015. Assessment of the invasive German wasp, *Vespula germanica*, in South Africa. M.Sc Thesis. Stellenbosch University, Stellenbosch.

Heard H.W., Hodgson B.H., Hoekstra T., Impson D. & Lloyd P.H. 2000a. Management Plan for the Vrolijkheid Nature Reserve. Western Cape Nature Conservation Board, Cape Town.

Heard H.W., Hoekstra T., Impson D., Lloyd P. & Van Zyl A.P. 2000b. Management Plan for the Riviersonderend Conservation Area. Western Cape Nature Conservation Board, Cape Town.

Helme N.A. 2007. Botanical report: Fine scale vegetation mapping in the Upper Breede River Valley. Report compiled for CapeNature as part of the C.A.P.E. Fine-scale Biodiversity Planning Project. Unpublished. Nick Helme Botanical Surveys, Scarborough.

Helme N.A. 2016. Chapter 5: Ecosystem Guidelines: Succulent Karoo Ecosystems. In: Cadman M., editor. Ecosystem Guidelines for Environmental Assessment in the Western Cape. 2nd Edition. Fynbos Forum, Cape Town. ISBN: 978-0-620-72215-5.

Hockings M., Leverington F. & Cook C. 2015. Protected area management effectiveness. In: Worboys G.L., Lockwood M., Kothari A., Feary S. & Pulsford I., editors. Protected Area Governance and Management. ANU Press, Canberra.

Holmes P., Dorse C., Rebelo T., Helme N., Wood J., Palmer G. & Harrison J. 2016. Chapter 4: Planning for and managing risk, restoration, *ex situ* conservation and animals. In: Cadman M., editor. Ecosystem Guidelines for Environmental Assessment in the Western Cape. 2nd Edition. Fynbos Forum, Cape Town. ISBN: 978-0-620-72215-5.

Humphreys A.J.B. 1989. The archaeological setting of Genadendal, the first mission station in South Africa. *The Digging Stick* 6: 2-4.

iNaturalist. 2020. iNaturalist: A community for Naturalists. URL: https://www.inaturalist.org/. Accessed on 07 January 2020.

Indigenous Vegetation Consultancy (IVC). 2015. Nomination of the Extension of the Cape Floral Region Protected Areas: World Heritage Site of South Africa. Government of the Republic of South Africa, South Africa.

International Union for Conservation of Nature (IUCN). 2019. The IUCN Red List of Threatened Species. URL: https://www.iucnredlist.org./. Accessed on 05 December 2019.

Johnson S.D. 1992. Plant-animal relationships. In: Cowling R.M., editor. The Ecology of Fynbos: Nutrients, fire and diversity. Oxford University Press, Cape Town.

Johnson S.D. 1996. Pollination, Adaptation and Speciation Models in the Cape Flora of South Africa. *Taxon* 45: 59-66.

Jones A., Breuning-Madsen H., Brossard M., Dampha A., Deckers J., Dewitte O., Gallali T., Hallett S., Jones R., Kilasara M., Le Roux P., Micheli E., Montanarella L., Spaargaren O., Thiombiano L., Van Ranst E., Yemefack M. & Zougmoré R., editors. 2013. Soil Atlas of Africa. European Commission, Publications Office of the European Union, Luxembourg.

Jordaan M.J. & Gouws E.J. 2020. Field Report: Fish and river surveys for the Riviersonderend Nature Reserve Complex. Internal Scientific Report. CapeNature, Cape Town.

Jordaan M.S. & Chakona A. 2018. *Pseudobarbus* sp. nov. 'breede'. Red List of South African Species. South African National Biodiversity Institute. URL: http://speciesstatus.sanbi.org/assessment/last-assessment/561/. Accessed on 07 January 2020.

Kaplan J. 1990. An Archaeological Investigation of the Proposed Riviersonderend Bypass Road. The Archaeology Contracts Office, University of Cape Town, Cape Town.

Kaplan J. 2004. Phase 1 Archaeological Impact Assessment Portion 4 of the Farm Olifantsdoorn No. 210, Robertson. Prepared for Ecosense.

King J.M. & Schael D.M. 2001. Assessing the ecological relevance of spatially-nested geomorphological hierarchy for river management. WRC Report Number: 754/1/01. Water Research Commission, Pretoria. ISBN: 1-86848-818-0.

Kirkwood D., Pence G.Q. & Von Hase A. 2010. Western Cape Biodiversity Framework: Critical Biodiversity Areas and Ecological Support Areas of the Western Cape. Unpublished Report. Cape Action for People and the Environment (C.A.P.E), Claremont.

Kleynhans C.J., Thirion C. & Moolman J. 2005. A Level 1 River Ecoregion Classification System for South Africa, Lesotho and Swaziland. RQS Report Number: N/000/00REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.

Kotze I., Beukes H., Van den Berg E. & Newby T. 2010. National Invasive Alien Plant Survey. ARC Report Number: GW/A/2010/21. Agricultural Research Council: Institute for Soil, Climate and Water, South Africa.

Le Maitre D.C. & Midgley J.J. 1992. Plant reproductive ecology. In: Cowling R.M., editor. The Ecology of Fynbos: Nutrients, fire and diversity. Oxford University Press, Cape Town.

Le Maitre D.C., Seyler H., Holland M., Smith-Adao L., Nel J.L., Maherry A. & Witthüser K. 2018. Identification, Delineation and Importance of the Strategic Water Source Areas of South Africa, Lesotho and Swaziland for Surface Water and Groundwater. WRC Report Number: TT 754/1/18. Water Research Commission, Pretoria. ISBN: 978-0-6392-0006-4.

Le Maitre D.C., Versfeld D.B. & Chapman R.A. 2000. The impact of invading alien plants on surface water resources in South Africa: A preliminary assessment. *Water SA* 26: 397-408.

Le Roux G.H. 1984. A Study of Past and Present Uses of the Riviersonderend Mountain Catchment Area. Unpublished M.Sc Thesis. University of Cape Town, Cape Town.

Leverington F. & Hockings M. 2004. Evaluating the effectiveness of protected area management. The challenge of change. In: Barber C.V., Miller K.R. & Boness M., editors. Securing protected areas in the face of global change: Issues and strategies. International Union for Conservation of Nature, Gland.

Linder H.P., Johnson S.D., Kuhlmann M., Matthee C.A., Nyffeler R. & Swartz E.R. 2010. Biotic diversity in the Southern African winter-rainfall region. *Current Opinion in Environmental Sustainability* 2: 109-116.

Macfarlane D.M., Kotze D.C., Ellery W.N., Walters D., Koopman V., Goodman P. & Goge C. 2008. WET-Health: A technique for rapidly assessing wetland health. In: Breen C., Dini J., Ellery W., Mitchell S. & Uys M., editors. Wetland Management Series. WRC Report Number: TT 340/08. Water Research Commission, Pretoria.

Manning J. & Goldblatt P. 2012. Plants of the Greater Cape Floristic Region 1: The Core Cape Flora. *Strelitzia* 29. South African National Biodiversity Institute, Pretoria. ISBN: 978-1-919976-74-7.

McCallum G.L. 2016. The Cape-wagon: Form follows function. URL: https://grahamlesliemccallum.wordpress.com/2016/07/14/the-cape-wagon-function-follows-form/. Accessed on 14 July 2020.

McGeoch M.A. 2002. Insect conservation in South Africa: An overview. *African Entomology* 10: 1-10.

Mecenero S., Ball J.B., Edge D.A., Hamer M.L., Henning G.A., Krüger M., Pringle E.L., Terblanche R.F. & Williams M.C. 2013. Conservation assessment of the butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas. Saftronics, Johannesburg and Animal Demography Unit, Cape Town.

Mooney H.A. & Hobbs R.J. 2000. Invasive Species in a Changing World. Island Press, Washington, D.C.

Morton A. 2016a. *Thestor kaplani*. Southern African Lepidoptera Conservation Assessment (SALCA). Red List of South African Species. South African National Biodiversity Institute. URL: http://speciesstatus.sanbi.org/assessment/last-assessment/1117/. Accessed on 07 January 2020.

Morton A. 2016b. *Kedestes niveostriga schloszi.* Southern African Lepidoptera Conservation Assessment (SALCA). Red List of South African Species. South African National Biodiversity Institute. http://speciesstatus.sanbi.org/assessment/last-assessment/1207/. Accessed on 07 January 2020.

Mucina L. & Geldenhuys C.J. 2006. Chapter 12: Afrotemperate, Subtropical and Azonal Forests. In: Mucina L. & Rutherford M.C., editors. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Mucina L. & Rutherford M.C., editors. 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria. ISBN 10: 1-919976-21-3.

Mucina L., Jürgens N., Le Roux A., Rutherford M.C., Schmiedel U., Esler K.J., Powrie L.W., Desmet P.G. & Milton S.J. 2006a. Chapter 5: Succulent Karoo Biome. In: Mucina L. & Rutherford M.C., editors. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Mucina L., Rutherford M.C. & Powrie L.W. 2006b. Chapter 13: Inland Azonal Vegetation. In: Mucina L. & Rutherford M.C., editors. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Myers N., Mittermeier R.A., Mittermeier C.G., Da Fonseca G.A.B. & Kent J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858. https://doi.org/10.1038/35002501 .

Nel J.L., Driver A., Strydom W., Maherry A., Petersen C., Hill L., Roux D.J., Nienaber S., Van Deventer H., Swartz E. & Smith-Adao L.B. 2011b. Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. WRC Report Number: TT 500/11. Water Research Commission, Pretoria.

Nel J.L., Murray K.M., Maherry A.M., Peterson C.P., Roux D.J., Driver A., Hill L., Van Deventer H., Funke N., Swartz E.R., Smith-Adao L.B., Mbona N., Downsborough L. & Nienaber S. 2011a. Technical Report for the National freshwater Ecosystem Priority Areas project. WRC Report Number: 1801/2/11. Water Research Commission, Pretoria.

Nicolson S.W. & Wright G.A. 2017. Plant-pollinator interactions and threats to pollination: perspectives from the flower to the landscape. *Functional Ecology* 31: 22-25.

Norman N. & Whitfield G. 2006. Geological Journeys: A Traveller's Guide to South Africa's Rocks and Landforms. Struik Publishers, Cape Town. ISBN: 1-77007-062-1.

Okes N., Ponsonby D.W., Rowe-Rowe D., Avenant N.L. & Somers M.J. 2016. A conservation assessment of *Aonyx capensis*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T., editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Palmer C., Palmer A., O'Keeffe J. & Palmer R. 1994. Macroinvertebrate community structure and altitudinal changes in the upper reaches of a warm temperate southern African river. *Freshwater Biology* 32: 337-347.

Parsons R.P. & Conrad J.E. 1998. Explanatory notes for the Aquifer Classification Map of South Africa. WRC Report Number: KV 116/98. Water Research Commission, Pretoria. ISBN: 1-86845-456-8.

Pereira-da-Conceicoa L.L. 2016. Phylogenetics and Historical Biogeography of the Teloganodidae (Ephemeroptera). PhD Thesis. Rhodes University, Grahamstown.

Picker M.D. & Griffiths C. 2011. Alien & Invasive Animals: A South African Perspective. Struik Random House, Cape Town. ISBN: 978-1-77007-823-9.

Pool-Stanvliet R., Duffell-Canham A., Pence G. & Smart R. 2017. The Western Cape Biodiversity Spatial Plan Handbook. CapeNature, Stellenbosch.

Procheş S. & Cowling R.M. 2006. Insect diversity in Cape fynbos and neighbouring South African vegetation. *Global Ecology and Biogeography* 15: 445-451.

Procheş S. & Cowling R.M. 2007. Do insect distributions fit our biomes? *South African Journal of Science* 103: 258-261.

Procheş S., Forest F., Veldtman R., Chown S.L., Cowling R.M., Johnson S.D., Richardson D.M. & Savolainen V. 2009. Dissecting the plant-insect diversity relationship in the Cape. *Molecular Phylogenetics and Evolution* 51: 94-99.

Raimondo D., Von Staden L., Foden W., Victor J.E., Helme N.A., Turner R.C., Kamundi D.A. & Manyama P.A. 2009. Red List of South African Plants. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.

Rebelo A.G., Boucher C., Helme N., Mucina L. & Rutherford M.C. 2006. Chapter 4: Fynbos Biome. In: Mucina L. & Rutherford M.C., editors. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Richardson D.M., Macdonald I.A.W., Holmes P.M. & Cowling R.M. 1992. Plant and animal invasions. In: Cowling R.M., editor. The Ecology of Fynbos: Nutrients, fire and diversity. Oxford University Press, Cape Town.

Rose R. & Conrad J. 2006. Table Mountain Group Aquifer: Round Five of the Pilot Phase Monitoring. GEOSS Report Number: G2006/05-1. Geohydrological and Spatial Solutions, Stellenbosch.

Samways M.J. & Simaika J.P. 2016. Manual of Freshwater Assessment for South Africa: Dragonfly Biotic Index. Suricata 2. South African National Biodiversity Institute, Pretoria. ISBN: 978-1-928224-05-1.

Samways M.J. 2006. National Red List of South African dragonflies (Odonata). *Odonatologica* 35: 341-368.

Samways M.J., Bazelet C.S. & Pryke J.S. 2010a. Provision of ecosystem services by large scale corridors and ecological networks. *Biodiversity and Conservation* 19: 2949-2962.

Samways M.J., Sharratt N.J. & Simaika J.P. 2010b. Effect of alien riparian vegetation and its removal on a highly endemic river macroinvertebrate community. *Biological Invasions* 13: 1305-1324.

Samways M.J., Hamer M. & Veldtman R. 2012. Chapter 11: Development and Future of Insect Conservation in South Africa. In: New T.R., editor. Insect

Conservation: Past, Present and Prospect. Springer, Dordrecht. ISBN: 978-94-007-2962-9.

Schoeman C. 2017. The Historical Overberg: Traces of the Past in South Africa's Southernmost Region. Zebra Press, Cape Town. ISBN: 9-78177-609-072-3.

Schulze R.E. & Horan M.J.C. 2007. Soils: Hydrological Attributes. In: Schulze R.E., editor. South African Atlas of Climatology and Agrohydrology. WRC Report Number: 1489/1/06. Water Research Commission, Pretoria.

Sekonya K.G. 2017. Development of a 6 MV tandem accelerator mass spectrometry facility and its applications. PhD Thesis. University of the Witwatersrand, Johannesburg.

Selb H. 2016. *Chrysoritis rileyi.* Southern African Lepidoptera Conservation Assessment (SALCA). Red List of South African Species. South African National Biodiversity Institute. URL: http://speciesstatus.sanbi.org/assessment/last-assessment/1208/. Accessed on 07 January 2020.

Skead C.J. 2011. Historical Incidence of the Larger Land Mammals in the Broader Western and Northern Cape. 2nd Edition. Centre for African Conservation Ecology, Nelson Mandela Metropolitan University, Port Elizabeth. ISBN: 192017687X.

Skelton P.H. & Swartz E.R. 2011. Walking the tightrope: trends in African freshwater systematic ichthyology. *Journal of Fish Biology* 79: 1413-1435.

Skelton P.H. 1987. South African red data book - fishes. South African National Scientific Programmes Report Number 137. Foundation for Research Development, Pretoria. ISBN: 0-7988-4107-9.

Skelton P.H. 2001. A complete guide to the freshwater fishes of Southern Africa. Struik Publishers, Cape Town.

Skowno A., Matlala M., Slingsby J., Kirkwood D., Raimondo D., Von Staden L., Holness S., Lotter M., Pence G., Daniels F., Desmet P., Dayaram A., Stewart W., Jewitt D., Escott B. & Driver A. 2020. The Terrestrial Red List of Ecosystems (RLE) South Africa 2020. Unpublished Technical Report. SANBI, Pretoria.

South African Bird Atlas Project (SABAP2). 2019. The 2nd South African Bird Atlas Project. http://sabap2.birdmap.africa/. Accessed on 04 November 2019.

South African History Online (SAHO). 2019. Grade 5 – Term 1: Hunter-gatherers and herders in South Africa. URL: https://www.sahistory.org.za/article/grade-5-term-1-hunter-gatherers-and-herders-southern-africa. Accessed on 14 July 2020.

South African National Biodiversity Institute (SANBI). 2006. Vegetation Map of South Africa, Lesotho and Swaziland [vector geospatial dataset] 2006. Available from the Biodiversity GIS website, downloaded on 19 March 2019. URL: http://bgis.sanbi.org/SpatialDataset/Detail/330.

South African National Biodiversity Institute (SANBI). 2015. Plant Red List Status: Red List of South African Plants version 2017.1. URL: http://redlist.sanbi.org/

South African National Biodiversity Institute (SANBI). 2018. Vegetation Map of South Africa, Lesotho and Swaziland [vector geospatial dataset] 2018. Available from the Biodiversity GIS website, downloaded on 19 March 2020. URL: http://bgis.sanbi.org/Projects/Detail/208.

South African National Biodiversity Institute (SANBI). 2019. National Biodiversity Assessment 2018: The status of South Africa's ecosystems and biodiversity. Synthesis Report. South African National Biodiversity Institute, Pretoria. URL: http://bgis.sanbi.org/Projects/Detail/221.

South African Weather Service. 2020. Unpublished Raw Data. Cape Town.

Strohbach B.J. & Kutuahuripa J.T. 2014. Vegetation of the eastern communal conservancies in Namibia: II. Environmental Drivers. *Koedoe* 56. DOI: https://doi.org/10.4102/koedoe.v56i1.1117.

Swanepoel L.H., Balme G., Williams S., Power R.J., Snyman A., Gaigher I., Senekal C., Martins Q. & Child M.F. 2016. A conservation assessment of *Panthera pardus*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T., editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Swartz E., Impson D. & Cambray J. 2007. *Galaxias zebratus*. The IUCN Red List of Threatened Species 2007: e.T8816A12934076. URL: https://www.iucnredlist.org/species/8816/12934076.

Swartz E.R., Skelton P.H. & Bloomer P. 2009. Phylogeny and biogeography of the genus *Pseudobarbus* (Cyprinidae): Shedding light on the drainage history of rivers associated with the Cape Floristic Region. *Molecular Phylogenetics and Evolution* 51: 71-84.

Taylor A., Cowell C., Drouilly M., Schulze E., Avenant N., Birss C. & Child M.F. 2016. A conservation assessment of *Pelea capreolus*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T., editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Taylor M.R., Peacock F. & Wanless R.M., editors. 2015. The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

Turner A.A. & Channing A. 2017. Three new species of *Arthroleptella* Hewitt, 1926 (Anura: Pyxicephalidae) from the Cape Fold Mountains, South Africa. *African Journal of Herpetology* 66: 53-78. DOI: 10.1080/21564574.2017.1324918.

Turner A.A. & Measey J. 2017. *Capensibufo magistratus*. Red List of Threatened Species. South African National Biodiversity Institute. URL: http://speciesstatus.sanbi.org/assessment/last-assessment/879/. Accessed on 06 January 2020.

Underhill L.G., Loftie-Eaton M. & Navarro R. 2018. Dragonflies and damselflies of the Western Cape – OdonataMAP report, August 2018. *Biodiversity Observations* 9.7:1-21.

Urban Dynamics Western Cape (UDWC). 2012. Theewaterskloof Municipality Spatial Development Framework: Volume II: Development Strategy and Proposals. Compiled for the Theewaterskloof Municipality. Theewaterskloof Municipality, Caledon.

Van Der Merwe C.V. 1977. 'n Plantegroei beskrywing van die Vrolijkheid Natuurbewaringstasie. Unpublished report. Department of Nature and Environmental Conservation, South Africa.

Van Deventer H., Smith-Adao L., Mbona N., Petersen C., Skowno A., Collins N.B., Grenfell M., Job N., Lötter M., Ollis D., Scherman P., Sieben E. & Snaddon K. 2018. South African National Biodiversity Assessment 2018: Technical Report. Volume 2a: South African Inventory of Inland Aquatic Ecosystems (SAIIAE), Version 3. CSIR Report Number: CSIR/NRE/ECOS/IR/2018/0001/A. Council for Scientific and Industrial Research and South African National Biodiversity Institute, Pretoria. SANBI URL: http://hdl.handle.net/20.500.12143/5847.

Van Wilgen B.W. & De Lange W.J. 2011. The Costs and Benefits of Biological Control of Invasive Alien Plants in South Africa. *African Entomology* 19: 504–514.

Van Wilgen B.W. & Forsyth G.G. 2008. The historical effects and future management of fire regimes in the Fynbos Protected Areas of the Western Cape Province. CSIR Report Number: CSIR/NRE/ECO/ER/2008/0078/C. Council for Scientific and Industrial Research, Stellenbosch.

Van Wilgen B.W. 1984. Fire climates in the Southern and Western Cape Province and Their Potential Use in Fire Control and Management. *South African Journal of Science* 80: 358-362.

Van Wilgen B.W., Bond W.J. & Richardson D.M. 1992. Ecosystem management. In: Cowling R.M., editor. The Ecology of Fynbos: Nutrients, fire and diversity. Oxford University Press, Cape Town.

Van Wilgen B.W., Reyers B., Le Maitre D.C., Richardson D.M. & Schonegevel L. 2008. A biome-scale assessment of the impact of invasive alien plants on ecosystem services in South Africa. *Journal of Environmental Management* 89: 336-349.

Van Wilgen B.W., Richardson D.M., Le Maitre D.C., Marais C. & Magadlela D. 2001. The Economic Consequences of Alien Plant Invasions: Examples of Impacts and Approaches to Sustainable Management in South Africa. *Environment, Development and Sustainability* 3: 145-168.

Veldtman A. & Mdlangu T. 2016. A field guide for the identification of biological control agents for Australian *Acacias*. Internal Guide. CapeNature, Cape Town.

Veldtman R., Addison P. & Tribe G.D. 2012. Current status and potential future impact of invasive vespid wasps (*Vespula germanica* and *Polistes dominulus*) in South Africa. *IOBC/WPRS Bulletin* 75: 217-221.

Vlok J.H.J. & Yeaton R.I. 1999. The effect of overstorey proteas on plant species richness in South African mountain fynbos. *Diversity and Distributions* 6: 233-242.

Vlok J.H.J. & Yeaton R.I. 2000. Competitive interactions between overstorey proteas and sprouting understorey species in South African mountain fynbos. *Diversity and Distributions* 6: 273-281.

Western Cape Government (WCG). 2018a. Socio-Economic Profile (SEP): Cape Winelands District Municipality. Western Cape Government, Cape Town.

Western Cape Government (WCG). 2018b. Socio-Economic Profile (SEP): Overberg District Municipality. Western Cape Government, Cape Town.

Western Cape Government (WCG). 2018c. Socio-Economic Profile (SEP): Langeberg Municipality. Western Cape Government, Cape Town.

Western Cape Government (WCG). 2018d. Socio-Economic Profile (SEP): Breede Valley Municipality. Western Cape Government, Cape Town.

Western Cape Government (WCG). 2018e. Socio-Economic Profile (SEP): Theewaterskloof Municipality. Western Cape Government, Cape Town.

Western Cape Government (WCG). 2019. Protecting bees in the Western Cape. URL: https://www.westerncape.gov.za/general-publication/protecting-bees-western-cape. Accessed on 06 January 2020.

Weyl O.L.F., Finlayson B., Impson N.D., Woodford D.J. & Steinkjer J. 2014. Threatened endemic fishes in South Africa's Cape Floristic Region: A new beginning for the Rondegat River. *Fisheries* 39: 270-279.

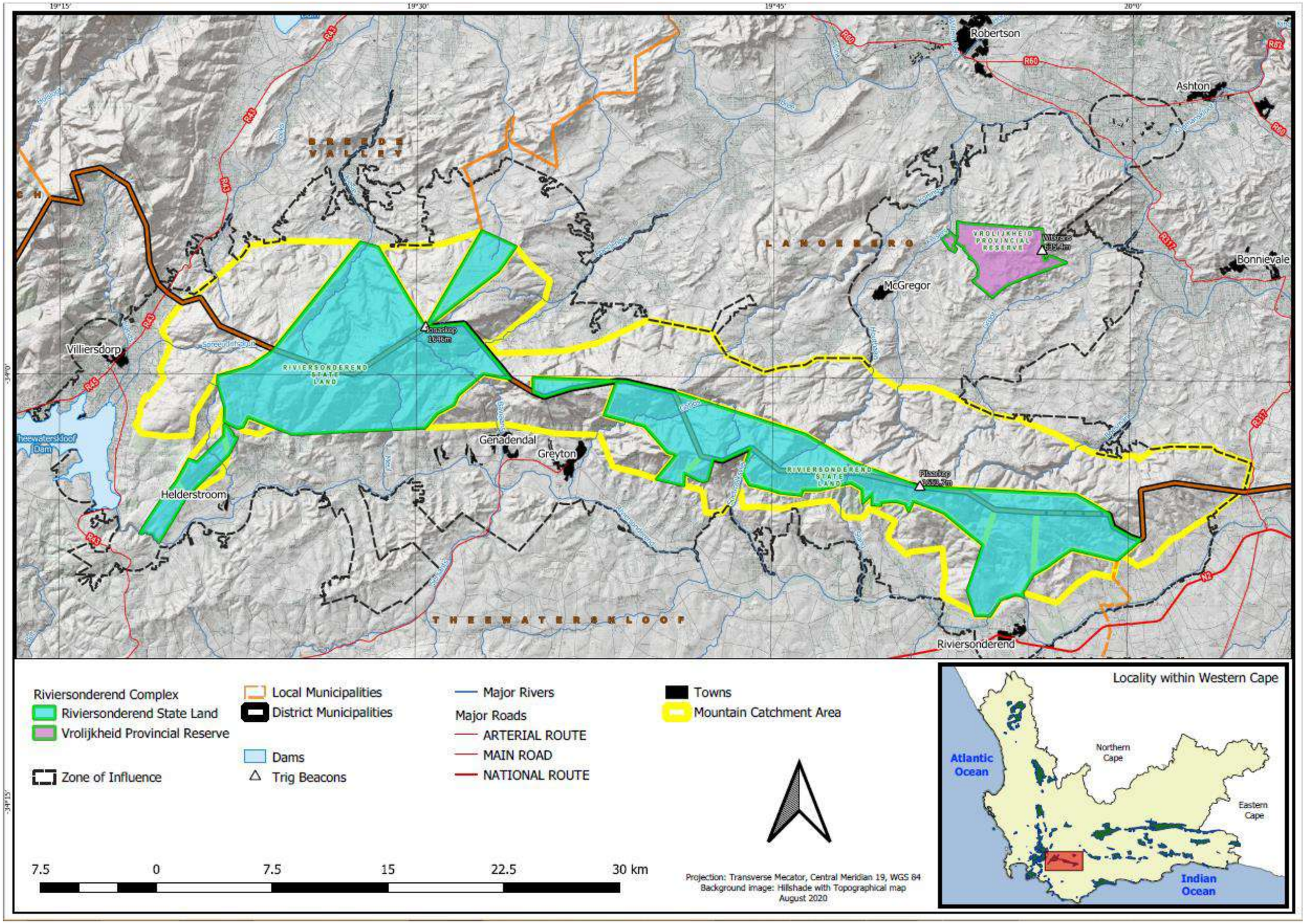
Wilson B., MacFadyen D., Palmer G. & Child M.F. 2016. A conservation assessment of *Graphiurus ocularis*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T., editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

World Wide Fund – South Africa (WWF-SA). 2013a. An Introduction to South Africa's Water Source Areas. WWF-SA Report 2013. World Wide Fund for Nature – South Africa, Cape Town.

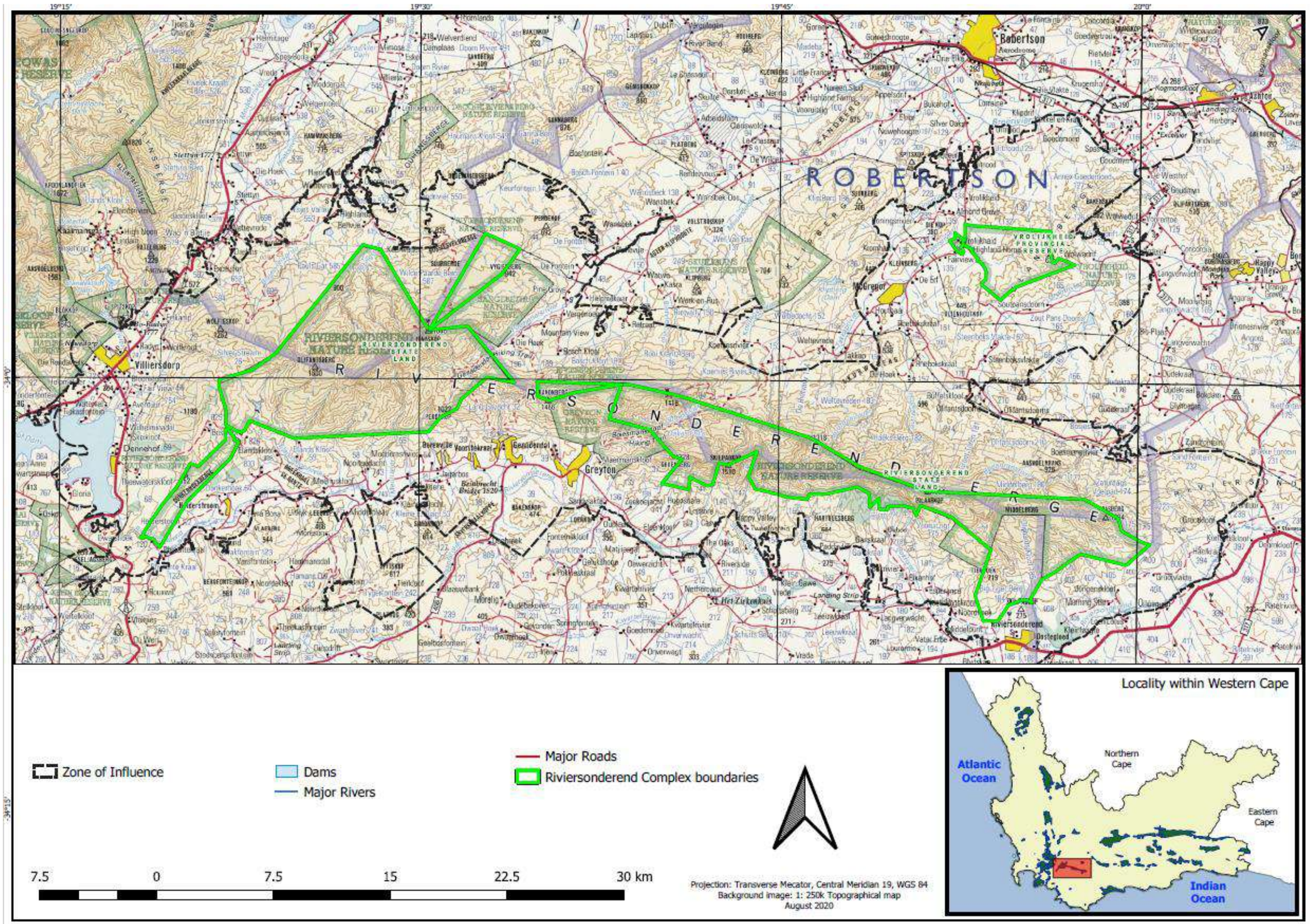
World Wide Fund – South Africa (WWF-SA). 2013b. Defining South Africa's Water Source Areas. WWF-SA Report 2013. World Wide Fund for Nature – South Africa, Cape Town.

Xplorio. 2020. History of Riviersonderend. URL: https://xplorio.com/riviersonderend/en/about/history/. Accessed on 14 July 2020.

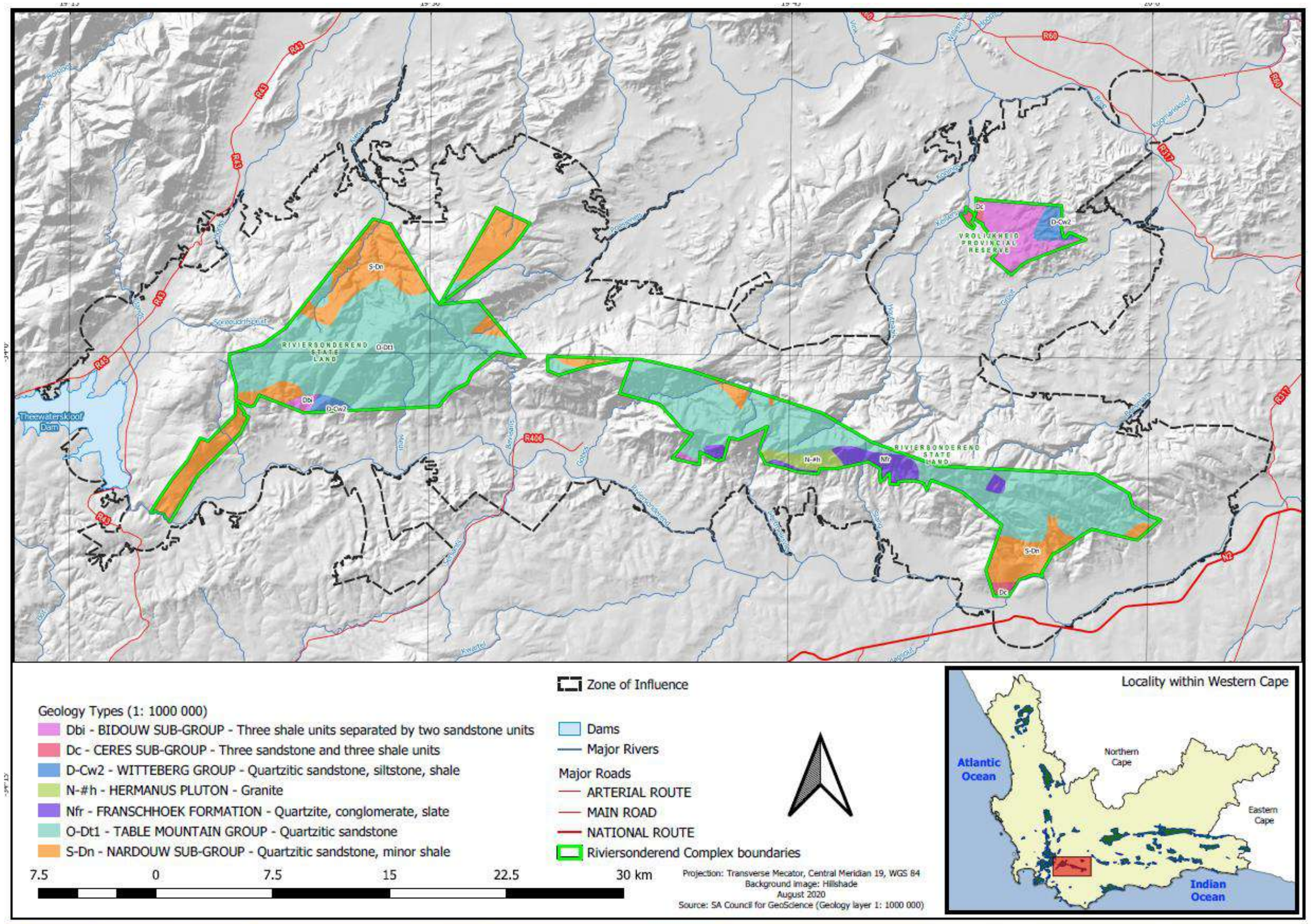
APPENDIX 1 Maps of the Riviersonderend Complex.



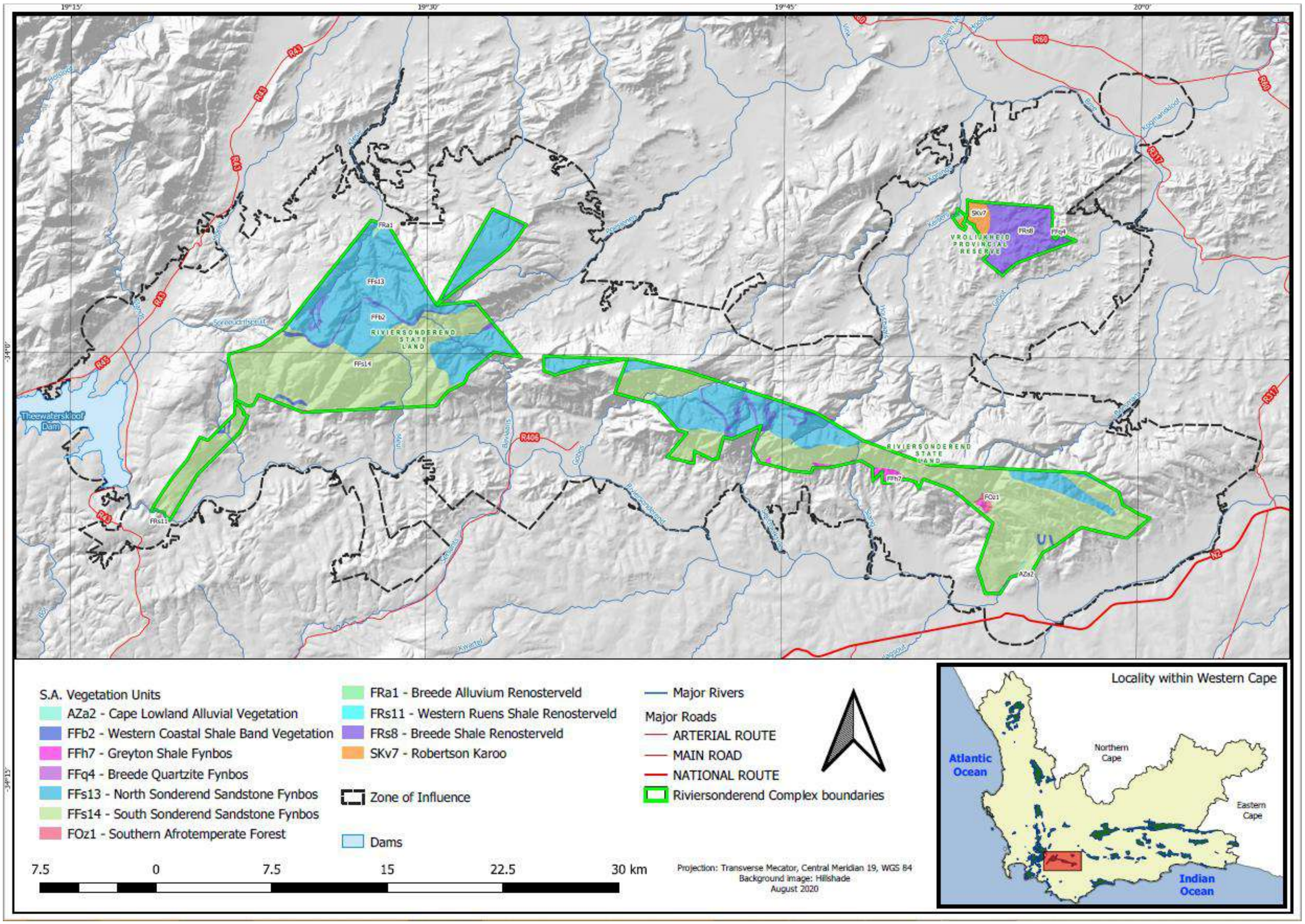
Map 1: Location and extent of the Riviersonderend Complex.



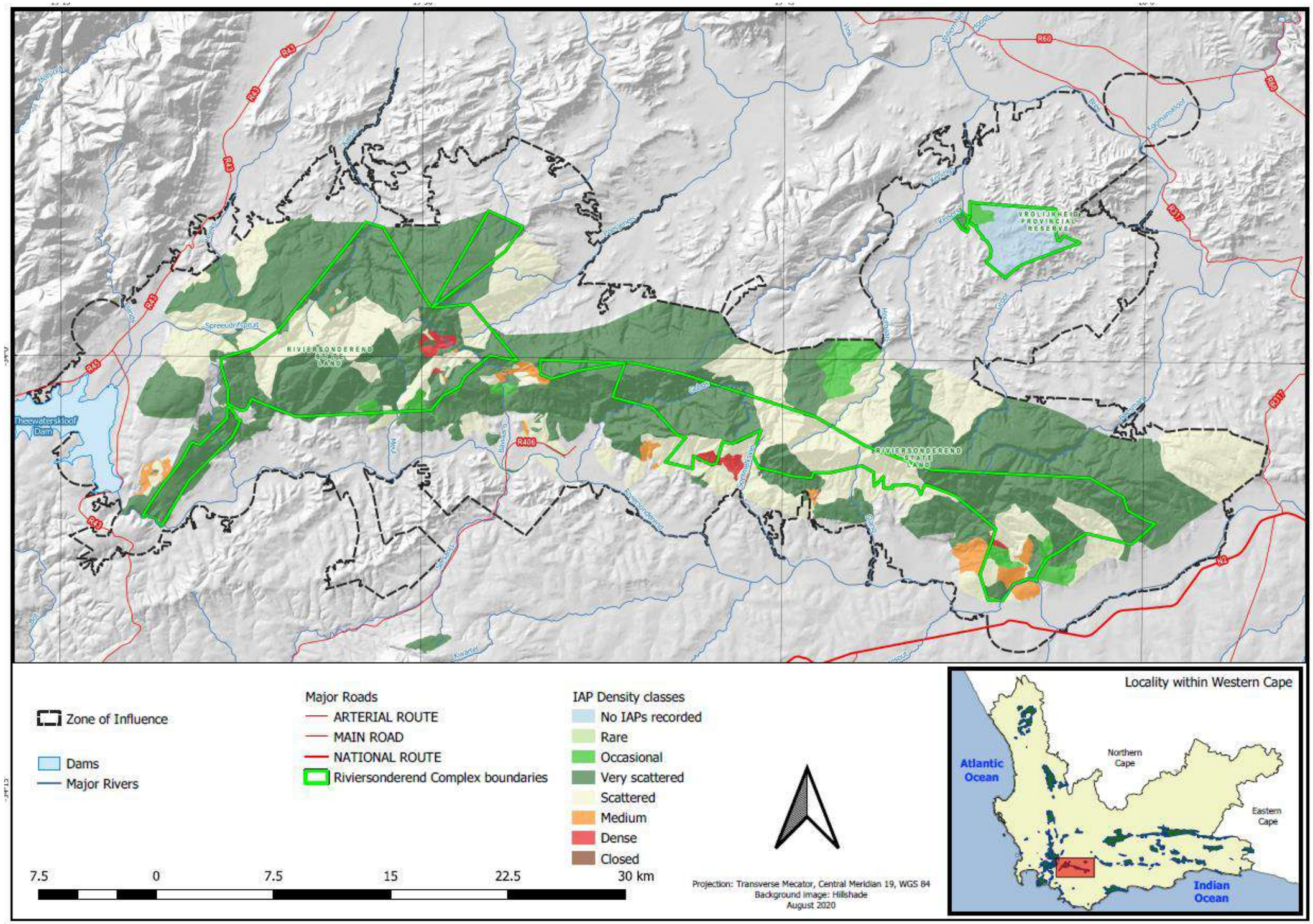
Map 2: Topography of the Riviersonderend Complex.



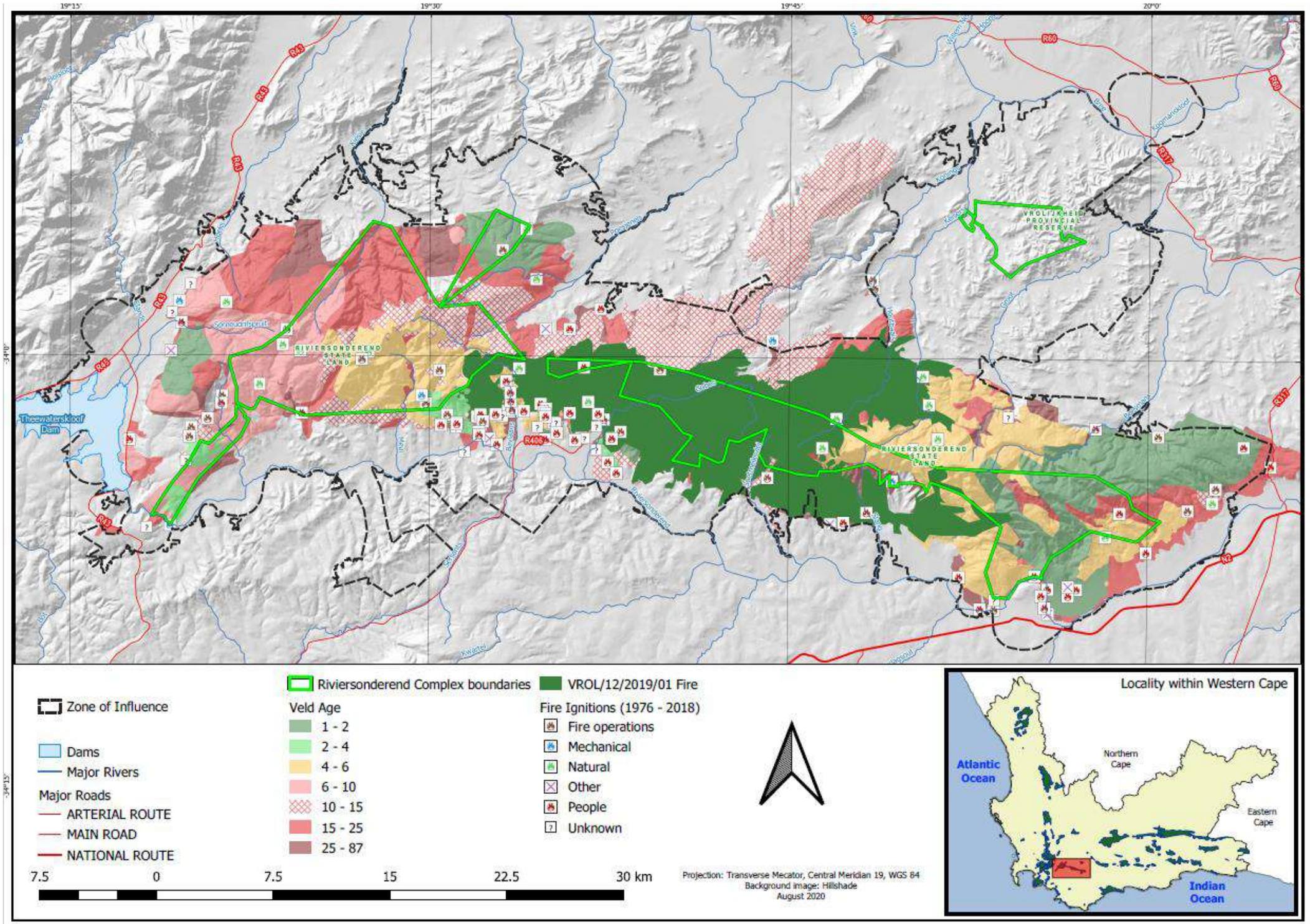
Map 3: Geology of the Riviersonderend Complex.



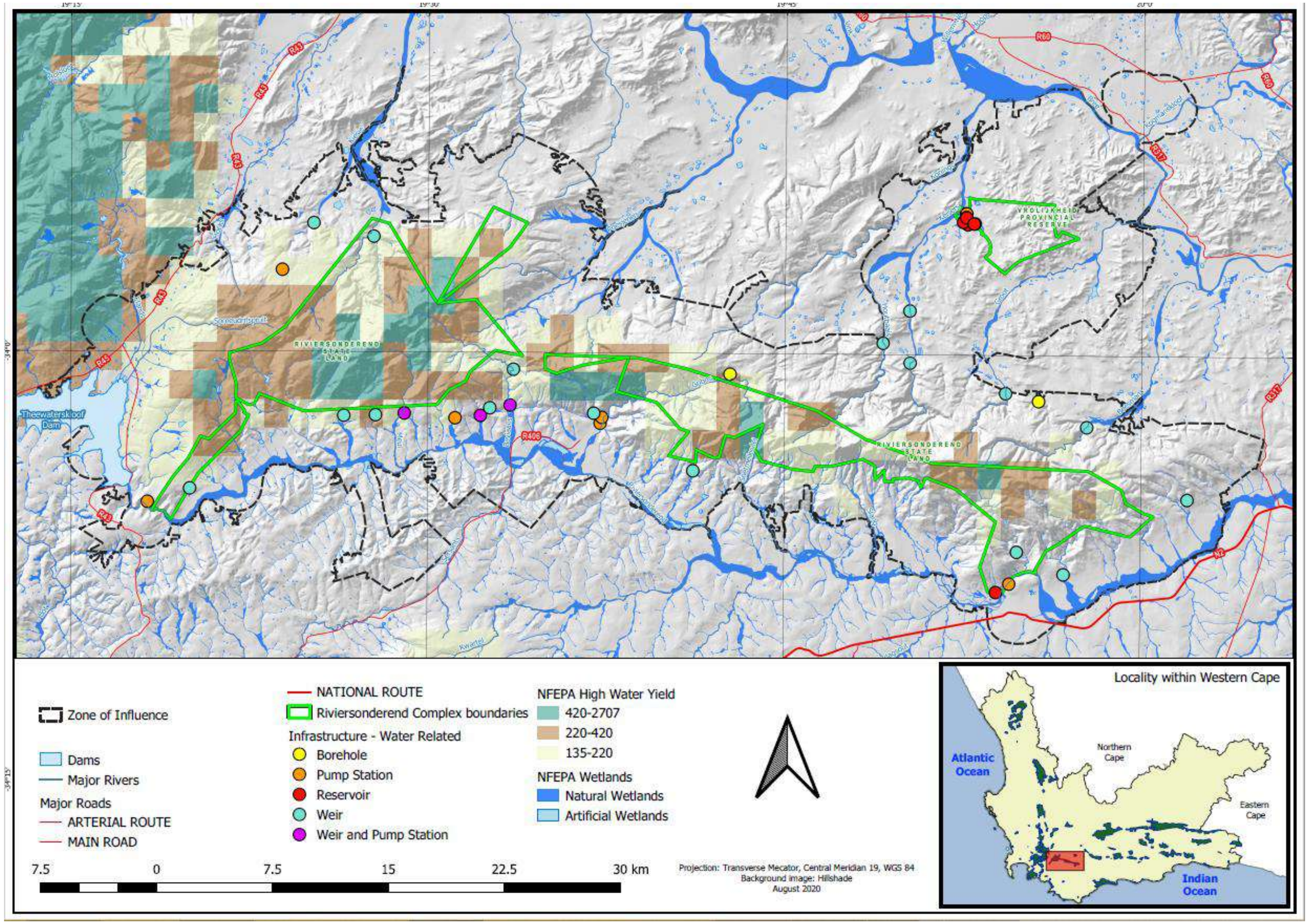
Map 4: Vegetation of the Riviersonderend Complex.



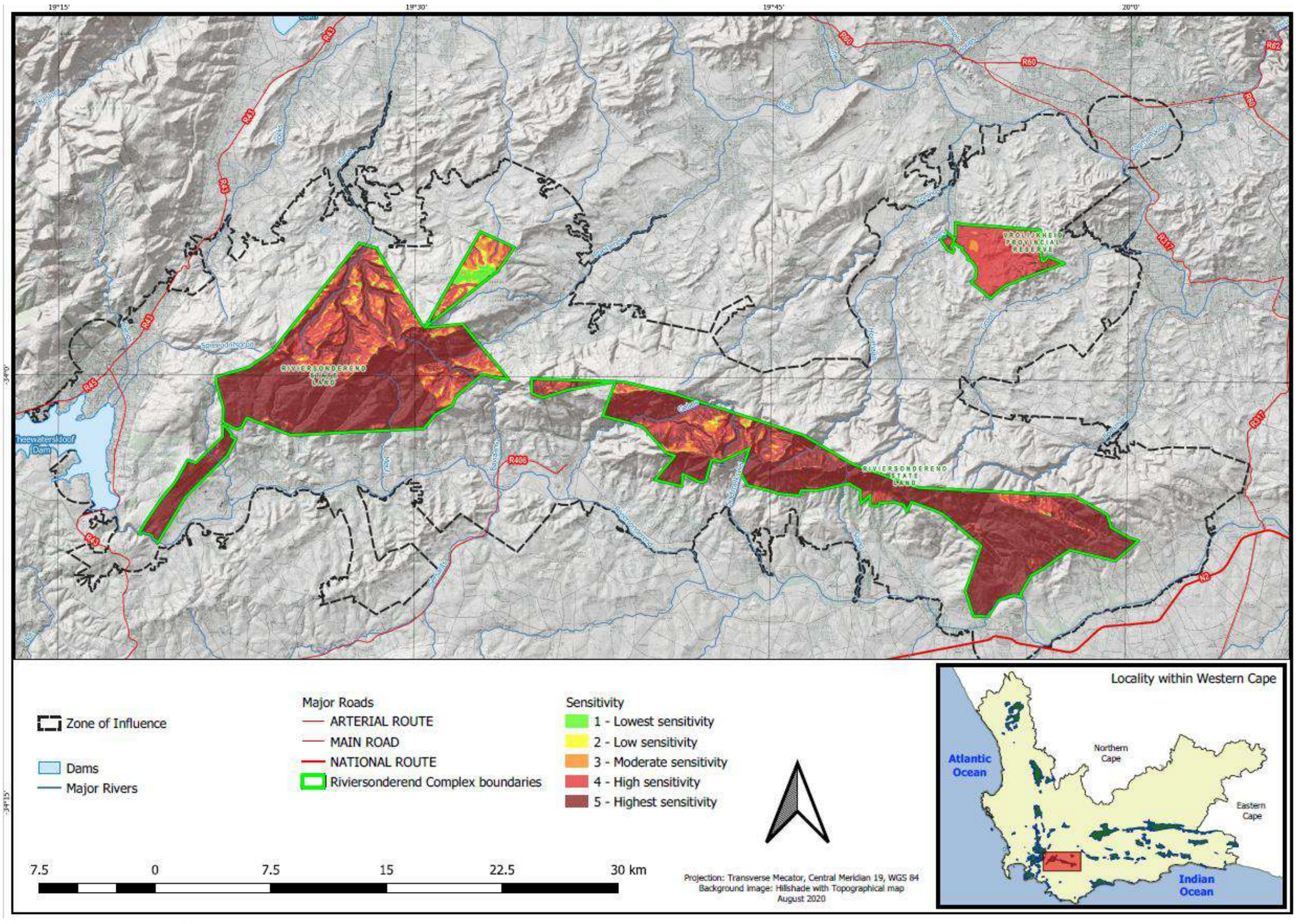
Map 5: Invasive Alien Plants of the Riviersonderend Complex.



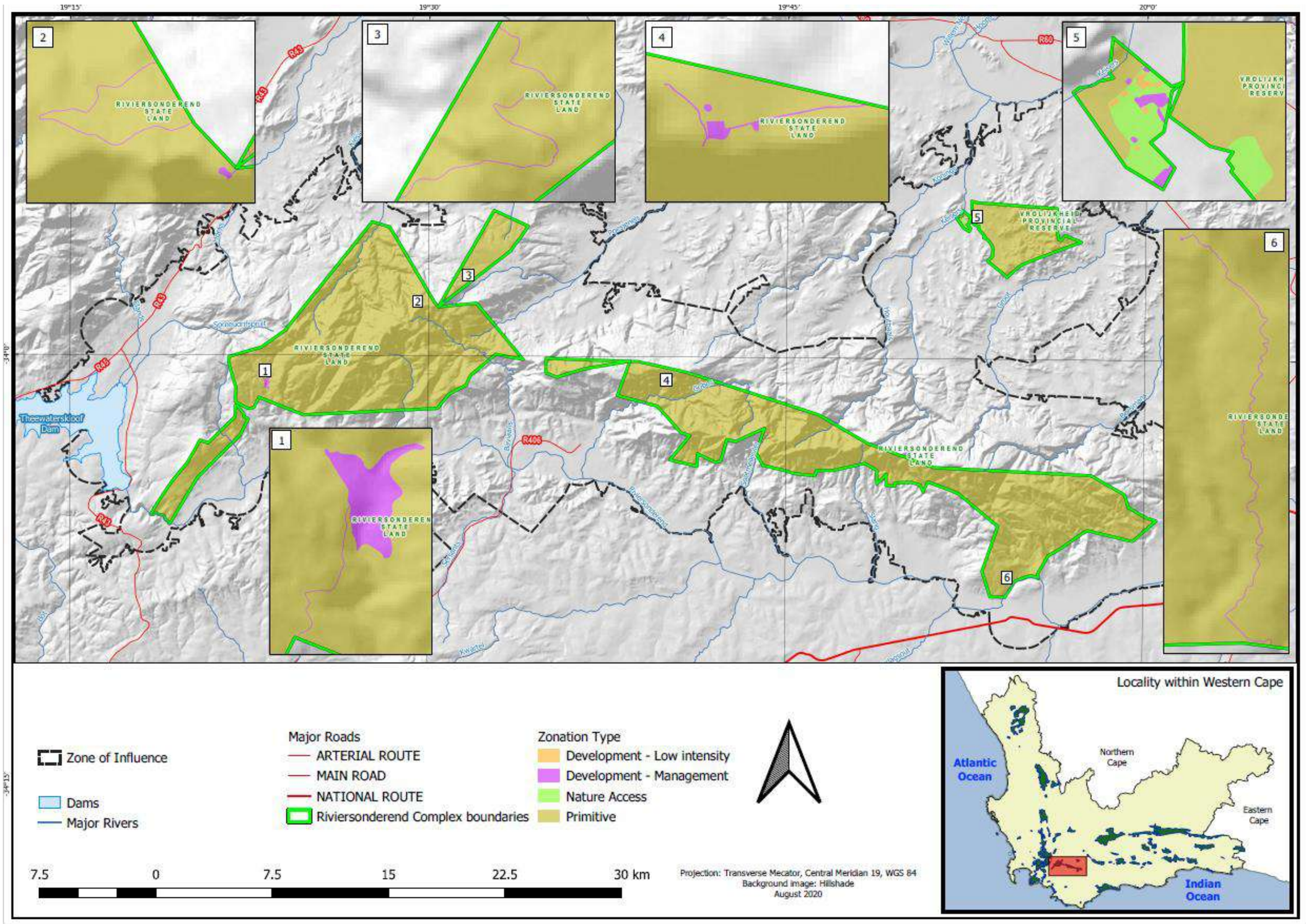
Map 6: Veld age and ignition points of the Riviersonderend Complex.



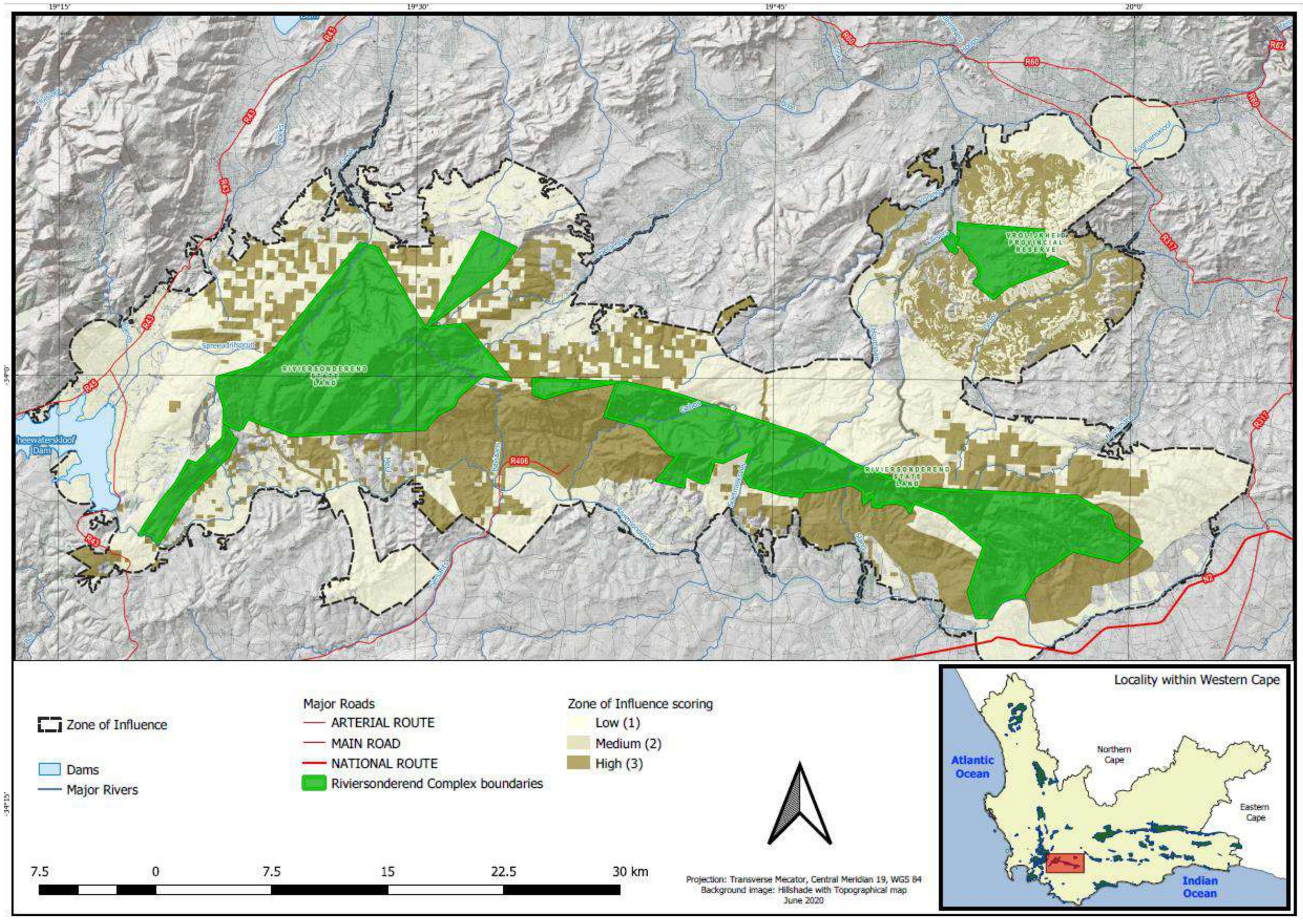
Map 7: Aquatic systems of the Riviersonderend Complex.



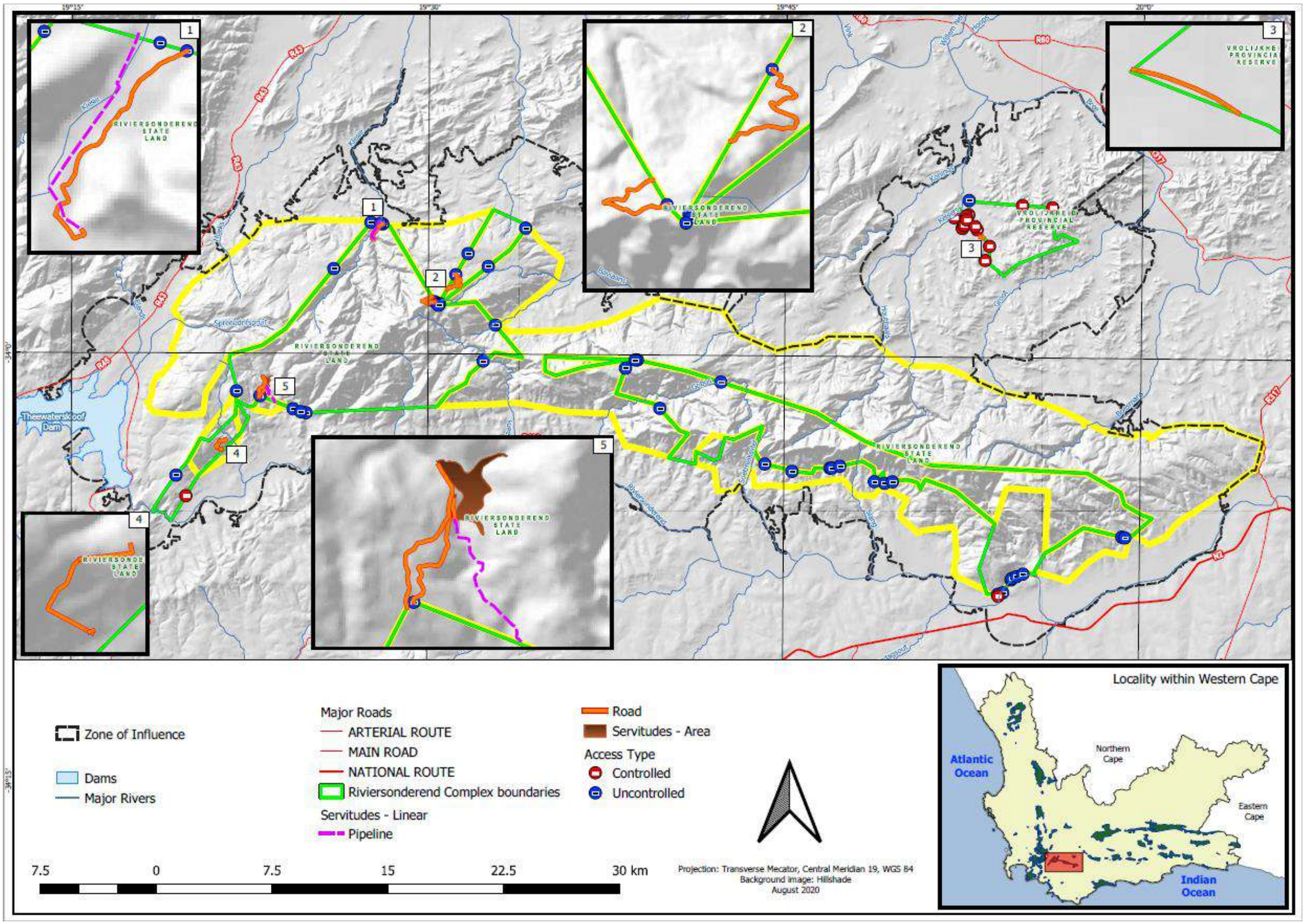
Map 8: Sensitivity of the Riviersonderend Complex.



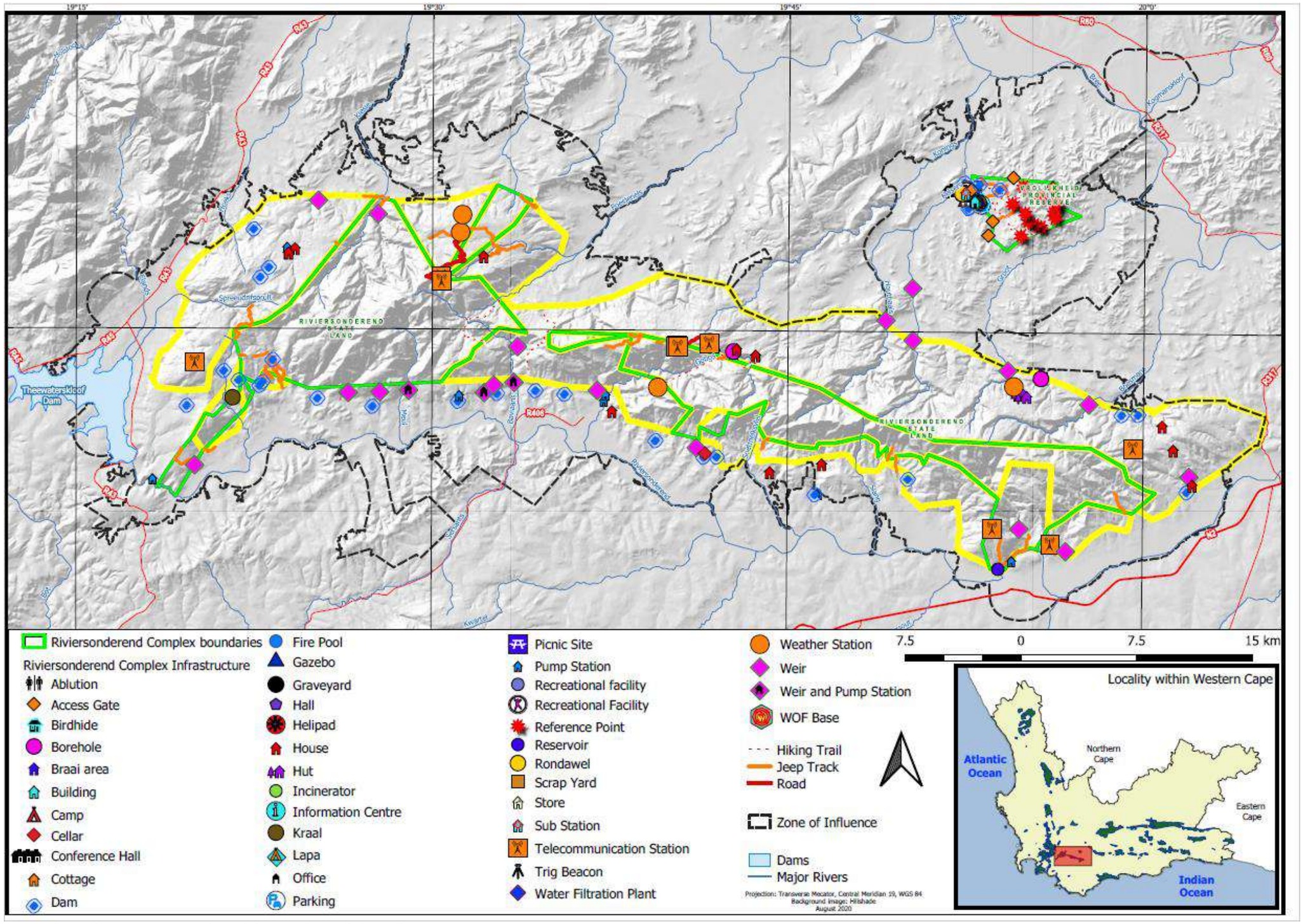
Map 9: Zonation of the Riviersonderend Complex.



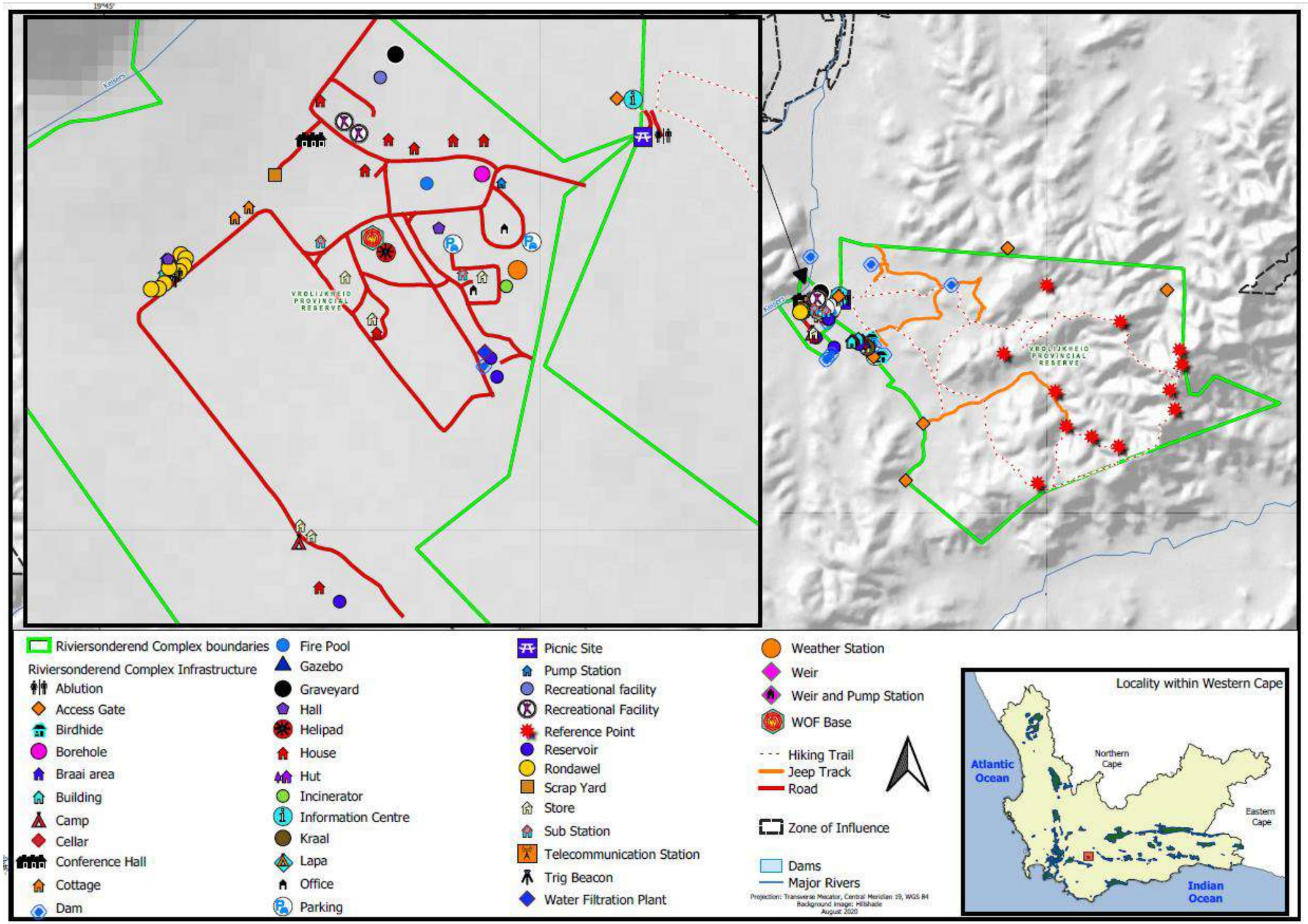
Map 10: Zone of Influence around the Riviersonderend Complex.



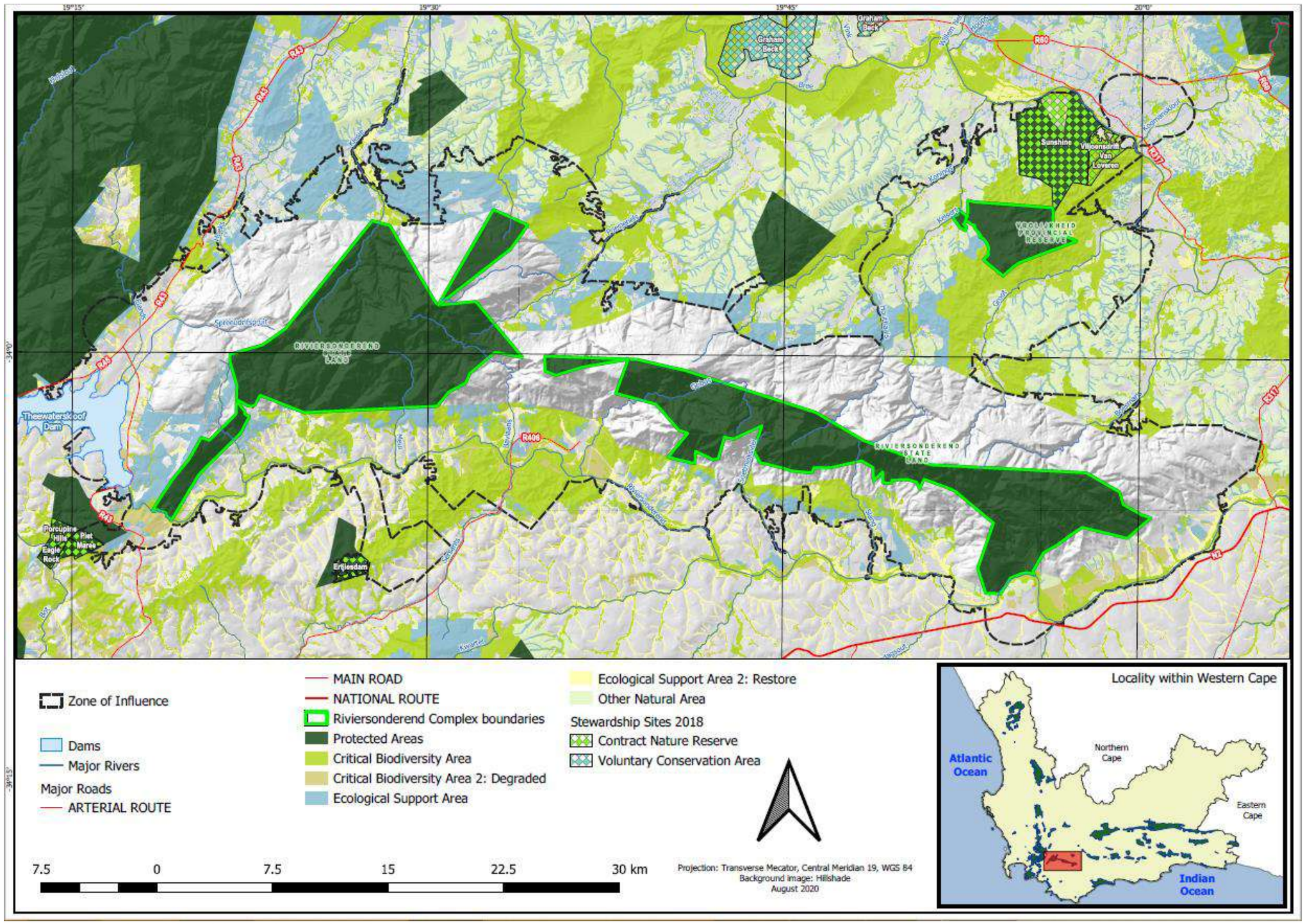
Map 11: Access and servitudes in the Riviersonderend Complex.



Map 12a: Infrastructure on the Riviersonderend Complex.



Map 12b: Infrastructure on the Vrolijkheid Provincial Reserve.



Map 13: Expansion of the Riviersonderend Complex.

APPENDIX 2 Stakeholder Engagement Report for Riviersonderend Complex.

RIVIERSONDEREND COMPLEX

PART OF THE CAPE FLORAL REGION PROTECTED AREAS WORLD HERITAGE SITE

Western Cape, South Africa

STAKEHOLDER ENGAGEMENT PROCESS REPORT

COMPILED BY FOOTPRINT ENVIRONMENTAL SERVICES

DATE: DECEMBER 2020