EFTEON Lowveld Cluster landscape proposal

Lowveld Sabie-Sand Catchment



OCTOBER 2020

LIST OF ABBREVIATIONS

| AHDSS | Agincourt Health & Socio-Demographic Surveillance System |
|----------|---|
| ARC | Agricultural Research Council |
| AWARD | Association for Water & Rural Development |
| BLM | Bushbuckridge Local Municipality |
| BNR | Bosbokrand/Bushbuckridge Nature Reserve |
| BRCNR | Blyde River Canyon Nature Reserve |
| BROWSE | Biodiversity Research on Wildlife & Savanna Ecosystems |
| CSIR | Council for Scientific & Industrial Research |
| DARDLEA | Department of Agriculture, Rural Development, Land & Env. Affairs |
| DEA | (former) Department of Environmental Affairs |
| DEFF | Department of Environment, Forestry & Fisheries |
| DSI | Department of Science & Innovation |
| DWS | Department of Water & Sanitation |
| EBP | Experimental Burn Plots |
| EFTEON | Expanded Freshwater & Terrestrial Environmental Observation Network |
| HHWRS | Hans Hoheisen Wildlife Research Station |
| GKNP | Greater Kruger National Park |
| GKSDP | Greater Kruger Strategic Development Plan |
| GLTP | Great Limpopo Transfrontier Park |
| ICMA | Inkomati-Usuthu Catchment Management Agency |
| IDP | Integrated Development Plan |
| K2C | Kruger2Canyons Biosphere Region |
| KNP | Kruger National Park |
| MLM | Mbombela Local Municipality |
| MGR | Manyeleti Game Reserve |
| MMGR | Mala Mala Game Reserve |
| MJGR | Miejane Game Reserve |
| MTPA | Mpumalanga Tourism & Parks Authority |
| NICD | National Institute for Communicable Diseases |
| NLM | Nkomazi Local Municipality |
| NWU | North-West University |
| OTS | Organization for Tropical Studies |
| REMP | River Ecostatus Monitoring Program |
| SAEO N | South African Environmental Observation Network |
| SANParks | South African National Parks |
| SAMRC | South African Medical Research Council |
| SAPRIN | South African Population Research Infrastructure Network |
| SAWC S | outhern African Wildlife College |
| SDF | Spatial Development Framework |
| SSW | Sabi Sand Wildtuin |
| SUCSES | Sustainability in Communal Socio-Ecological Systems |
| UNESCO | United Nations Educational, Scientific & Cultural Organization |
| UMP | University of Mpumalanga |
| UP | University of Pretoria |
| VCA | Vegetation Condition Assessment |
| Wits | University of the Witwatersrand |
| WRC | Wits Rural Campus |

TABLE OF CONTENTS

| Α. | GENE | ERAL DETAILS OF THE LANDSCAPE | 2 |
|----|-------|---|--------|
| 1 | . Lar | ndscape Name: Lowveld Sabie-Sand Catchment | 2 |
| 2 | . Spa | atial extent | 2 |
| В. | SUIT | ABILITY OF THE LANDSCAPE | 5 |
| 1 | . The | e general situational characteristics of the landscape | 5 |
| | 1.1. | Long-term scientific questions | 5 |
| | 1.2. | Spatial coverage and representativeness | 6 |
| | 1.3. | Opportunity to observe change processes | 6 |
| | 1.4. | Strategic importance: water, carbon and biodiversity | 7 |
| | 1.5. | Opportunity to observe coupled terrestrial and aquatic systems | 8 |
| | 1.6. | Socio-ecological systems in the South African development context | 9 |
| | 1.7. | Opportunity to act as a National Research Infrastructure | 9 |
| 2 | . The | e landscape location in the face of global change | 10 |
| | 2.1. | Presence of near-natural and modified land uses | 10 |
| | 2.2. | Altitudinal and climatic gradients and projected climate change impa | cts 11 |
| | 2.3. | Transition zones between biomes | 12 |
| | 2.4. | Expected development pathways in the landscape | 13 |
| 3 | . Log | jistical and operational suitability of the core and associated sites | 17 |
| | 3.1. | Security of tenure for operations | 17 |
| | 3.2. | Existing facilities for hydrological observations | 17 |
| | 3.3. | Suitability for deployment of micrometeorological observations | 18 |
| | 3.4. | Existing long-term observations or experiments | 19 |
| | 3.5. | Links to research or educational partner institutions | 26 |
| | 3.6. | Availability of support facilities for staff and visiting researchers | 30 |
| | 3.7. | Availability of residential facilities and other amenities | 32 |
| | 3.8. | Accessibility of the landscape | 32 |
| | 3.9. | Safety and potential security considerations | 33 |
| 4 | . Sta | keholder analysis | 33 |
| C. | REFE | RENCES | 37 |
| D. | APPE | NDIX 1: LIST OF COLLABORATORS | 41 |
| E. | APPE | NDIX 2: LETTERS OF SUPPORT | 43 |

A. GENERAL DETAILS OF THE LANDSCAPE

1. Landscape Name: Lowveld Sabie-Sand Catchment

2. Spatial extent

The Lowveld Sabie-Sand Catchment landscape of the Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON) Lowveld Cluster consists of the entire Sand River catchment, the savanna portion of the Sabie River catchment, and the Mjejane Game Reserve on the Crocodile River (as a satellite node further south) in Ehlanzeni District Municipality, eastern Mpumalanga Province (Figure 1). The landscape is flanked in the west by the Drakensberg escarpment, the Republic of Mozambigue in the east, and Limpopo Province in the north. It forms part of the Kruger2Canyons Biosphere Region ratified by United Nations Educational, Scientific and Cultural Organization (UNESCO). It covers an area of approximately 4,990 km² and includes most of the rural communal land and settlements of Bushbuckridge Local Municipality (BLM) (±1,910 km²) and ±100 km² of Mbombela Local Municipality (MLM) southeast of Hazyview. The landscape also features all of Bosbokrand/Bushbuckridge Nature Reserve (BNR) (±70 km²), most of the contiguous Sabi Sand Wildtuin (SSW) and Mala Mala Game Reserve (MMGR) (±580 km²), a small southern portion of Manyeleti Game Reserve (MGR) (±30 km²), and roughly 2,200 km² of the southern portion of the Kruger National Park (KNP). Approximately 60 km² in the northeast corner is covered by lowveld forestry plantations on state land that is currently being removed, rehabilitated, and incorporated into the Blyde River Canyon Nature Reserve (BRCNR). Mjejane Game Reserve (MJGR), which covers ±40 km², is open to the KNP in its northern edge along the Crocodile River. MJGR falls within Nkomazi Local Municipality (NLM). The proposal for this landscape was compiled by a community of stakeholder institutions active in the landscape (Appendix 1).



Figure 1. The Lowveld Sabie-Sand Catchment landscape.

Prominent land uses within this landscape (Figure 2) are:

- Conservation:
 - National park: KNP South African National Parks (SANParks)
 - Provincial reserves: BNR, MGR, BRCNR Mpumalanga Tourism and Parks Authority (MTPA)
 - Private reserves (SSW, which includes Londolozi, Djuma and Singita)
 - Community-owned reserves (MMGR, MJGR)
- Communal lands
 - o Rangelands
 - Subsistence/small-scale emerging agriculture, including localised irrigation schemes
- Residential (villages, peri-urban sprawl, and four small towns)
- State forestry

Upstream land uses west of the landscape include conservation (BRCNR), commercial forestry (pine and *Eucalyptus*) and agriculture (citrus and tropical fruit) in the upper reaches of the Sabie-Sand River catchment, and irrigated agriculture (mainly sugar cane and citrus) around MJGR.



Figure 2. Land use map of the Lowveld Sabie-Sand Catchment landscape (red outline). Private and provincial conservation areas adjacent to the Kruger National Park are hatched in green. (Source: GKSDP 2020a: Ehlanzeni Land Use)

B. SUITABILITY OF THE LANDSCAPE

1. The general situational characteristics of the landscape

1.1. Long-term scientific questions

The lowveld is one of the most dynamic socio-ecological systems in South Africa: a rapidly changing rural-urban transition zone abuts some of the most highly prized and profitable protected areas in the country, through which rivers run which are affected by forestry and agriculture upstream. The Lowveld Sabie-Sand Catchment landscape is already a sentinel landscape for long-term hydrological, ecological and social research, including internationally recognized research infrastructures such as long-term experiments in the KNP and the Agincourt Health and Socio-Demographic Surveillance System (AHDSS) in rural communities west of the KNP. As such, the Lowveld Sabie-Sand Catchment proposed here would be an ideal location for an EFTEON research landscape.

This landscape is highly suited to answer multiple inter-connected long-term research questions of national and international relevance, including:

- 1. How will the interaction between climate change and land transformation in rural areas influence human health and wellbeing?
- 2. How will the transformation of rural landscapes influence hydrological and biogeochemical cycles, biodiversity, and ecological processes in these systems?
- 3. Are there thresholds/feedbacks in the process of densification of human settlements where these changes become irreversible?
- 4. How does one define 'degradation' in a system as dynamic and resilient as the lowveld savanna of South Africa?
- 5. What will the impact of climate change, demographic and land use change be on the prevalence and distribution of emerging diseases for both animals and humans?
- 6. To what degree can progressive policy and land management mitigate undesirable environmental change (from drivers such as elevated CO₂ levels and nutrient deposition) in South Africa's lowveld savanna ecosystems?

Other beneficial information spin-offs include:

- 1. Better representation of savanna ecosystems in global earth system models.
- 2. Better quantification of nutrient deposition rates and impacts for the lowveld.

1.2. Spatial coverage and representativeness

This landscape is largely within the bushveld savanna although it interfaces with montane forests and grasslands on its western edge. Savannas cover a large land area in South Africa, so learning and insights from this iconic landscape could be used to help the management and sustainability of socio-ecological systems across the region. Moreover, savanna ecosystems are notoriously dynamic and resilient to disturbances - both natural and human. Understanding the limits to this resilience, and the degree to which their variability enables them to adapt to climate and land use change will be essential if South Africa is to both conserve our biodiversity and provide for our human populations.

The Lowveld Sabie-Sand catchment proposed here provides sufficient variation in land use types and land use intensities to investigate change in space, but what we require is a long-term research infrastructure that will allow us to quantify and learn about the temporal dynamics in this ecosystem. Biome edges are of particular interest in this context and we would be able to monitor the spatial and temporal stability of the transitions to forest and grassland biomes within this landscape.

1.3. Opportunity to observe change processes

The rural society in the landscape is undergoing multiple simultaneous transitions, including changing population structure fuelled by a rapidly declining fertility rate, steadily improving median socio-economic status, and rising incidence of cardiovascular disease associated with change in lifestyle and diet (Kahn et al. 2012; Kabudula et al. 2016). Land transformation is driven by urbanisation around small local towns and the expansion and coalescence of large village settlements. Meanwhile, agriculture, livestock grazing and intensive resource harvesting result in habitat modification in the remaining intact savanna vegetation in the communal rangelands. Between 1993 and 2006, settlement areas expanded by 40% and densified while human-impacted vegetation increased by 7% and intact vegetation declined by roughly the same amount (Coetzer et al. 2010). Moreover, significant transformation of riparian zones has also taken place through subsistence agriculture of moist foot-slopes, limited riparian zone protection outside of the protected areas, and in recent times, an almost exponential pressure in the form of riparian zone sand

extraction. These social and land use changes can be expected to continue and intensify over coming decades.

Being downstream of considerable pollution from the power stations and industrial areas of Gauteng and Mpumalanga means that our landscape is changing biogeochemically also – N and S deposition rates have increased and there is very little understanding of their long-term impacts on the freshwater and terrestrial components of this ecosystem. In a relatively recent study for the national energy utility ESKOM, Lorentz et al. (2013) found that atmospheric acid deposition was increasing, with loads of sulphate and base cations increasing exponentially. Limited experimentation has indicated that water availability limits the impact of nutrient deposition in semi-arid savannas (Wooly et al. 2011) and if this landscape were an EFTEON site we would be able to critically assess these findings both in natural and human-modified landscapes.

Moreover, the aim of the EFTEON landscapes is to observe change processes, and the existing wealth of baseline datasets provided by this landscape will help to provide rapid and effective information on change in this important and iconic South African vegetation type.

1.4. Strategic importance: water, carbon and biodiversity

The landscape includes a portion of the Mpumalanga Drakensberg Strategic Water Source Area against the escarpment in the north-west. At the core of this landscape is the Kruger National Park (KNP), which is itself within the Great Limpopo Transfrontier Park (GLTP). The KNP is an internationally significant conservation area by virtue of its size (~ 20,000 km²), its diverse habitats which support endangered species such as black rhino (*Diceros bicornis*) and wild dog (*Lycaon pictus*), its long history of scientifically based management (Carruthers 2017), and its economic contribution to the region and the national GDP (Chidakel et al. 2020). However, the KNP is one of only a handful of locations in Africa where biodiversity can be conserved at this scale. The Lowveld Sabie-Sand landscape provides an ideal context for innovative research to assess how human interventions can act to maintain and replicate key functional impacts of large-herbivore and predator assemblages in human managed landscapes. International efforts to draw down atmospheric CO₂ through altering land use and land cover have highlighted savanna ecosystems as having high carbon storage potential (https://www.bonnchallenge.org/). This result is controversial as it prioritises global climate mitigation over local livelihoods and subsistence, and it also is based on insufficient and erroneous information about the current carbon storage of savanna ecosystems, and their variability over time (Veldman et al. 2019). Eddy covariance sites such as that in the Skukuza area of the KNP are essential for informing this highly politicised debate – but due to the natural variability of these ecosystems, long term monitoring is required (this site was a sink for CO₂ in 5 out of the 15 years on record so far). Maintaining and benefiting from this existing eddy-covariance site is of national and international strategic importance.

1.5. Opportunity to observe coupled terrestrial and aquatic systems

We have intentionally used a catchment as the means of delineating the proposed landscape. Although the Sabie and Sand rivers are relatively short, both (i) flow through a range of different land uses, and (ii) are biologically rich. Upstream land uses have important impacts on stream flow and affect the aquatic and terrestrial communities downstream in the conservation areas. The Sabie itself is relatively pristine but faces growing anthropogenic pressures. By contrast, the Crocodile, historically a very biodiverse river system, has already seen the impacts of anthropogenic pressures: over-abstraction of water and deteriorating water quality due to mining, municipal wastewater, and agricultural flows (Riddell et al. 2019).

Well instrumented long-term research programs at catchment scale are required for making effective decisions to balance the competing water needs of agriculture, mining, human use and biodiversity. Both rivers are examples where co-operative management has enabled improved water provision and social coherence (Harwood et al. 2017; Tickner et al. 2020), but there are key unknowns related to baseflows and the increased dependency on groundwater which require substantial research and monitoring to resolve. This coupled aquatic-terrestrial landscape proposed for EFTEON would enable the monitoring and links to terrestrial and social communities required to make these catchments models of co-operative governance.

1.6. Socio-ecological systems in the South African development context

Development challenges in the lowveld are characteristic of those throughout South Africa: although household livelihoods are heavily dependent on remittances from migrant members, many households continue to rely on ecosystem services derived from the local environment in this socio-ecological system, especially for meeting basic domestic needs (Ragie et al. 2020). However, natural resources in these systems are under pressure, fuelled by both high demand from large rural communities and weakening traditional resource governance systems (Matsika et al. 2013; Findlay & Twine, 2018).

Unlike many other ecosystems globally, functioning savanna ecosystems are not necessarily incompatible with development goals: certain human activities can potentially maintain heterogeneity and replicate natural disturbance regimes. Data and research from this landscape could be pivotal in providing policy guidelines to minimise trade-offs in ecosystem services. This aligns with national government research objectives identified by the Climate Change Branch and Biodiversity Branch of the Department of Environment, Forestry and Fisheries (DEFF) and also the Global Change Challenge of the Department of Science and Innovation (DSI).

The protected areas in this landscape not only conserve biodiversity but also provide ecotourism revenue and jobs for local people. Economic development in this region is integrally associated with the fate of these conservation areas, and there are feedbacks between the social and ecological sub-systems (Swemmer et al. 2017).

1.7. Opportunity to act as a National Research Infrastructure

The EFTEON research platform would build on, complement, and synergize with a number of existing significant long-term environmental and human research platforms and programmes in the landscape (refer to Section 3). As mentioned above, some of these long-term datasets represent unique information on change and variability in savanna socio-ecological systems. Enabling these activities to continue, and expanding the range of institutions and people who have access to them, aligns with the goals of EFTEON.

The advantage of linking these varied research/monitoring initiatives under one umbrella as an EFTEON landscape will be considerable. The range of institutions and disciplines involved currently in the landscape has so far proved unwieldly, and despite good intentions on the part of the individual researchers, effective integration and mobilisation has not yet been possible. With the advantage of an organised, co-ordinated effort linked with EFTEON we believe we could provide valuable and truly interdisciplinary insights about the challenges and threats to an iconic South African ecosystem.

Finally, one key challenge for the success of an EFTEON landscape will be attracting researchers to the site to make use of the infrastructure and data that it provides. With the proposed Lowveld Sabie-Sand landscape this network of researchers already exists, so the investment in infrastructure and support will definitely bear fruit. A hallmark of research in this landscape is the inclusion of postgraduate students who are embedded in the research programmes by a diverse range of national and international universities. Therefore, there is already a pipeline of students and invested researchers set up and the EFTEON infrastructure and associated data would expand the range postgraduate research projects possible and make an important contribution to the training of the next generation of South African scientists.

2. The landscape location in the face of global change

2.1. Presence of near-natural and modified land uses

This landscape is located in a part of the country where large state and private conservation areas abut densely populated rural former-homelands and commercial agriculture (see Figure 2). It therefore represents a context that will become increasingly common in South Africa and globally in decades to come; one of burgeoning human populations, transitioning from dense rural to that of an increasingly urbanised setting and human-modified landscapes hard-up against important protected areas. At the same time, the protected areas themselves represent a variety of intensities of human activities and impact, ranging from the natural/near-natural cover of the KNP, serving as a "background" site, through provincially-managed reserves with intermediate human impact, to intensively managed and utilized private and community-owned game reserves (Child et al. 2013). The landscape therefore

provides a natural experiment for investigating the impact of contrasting land uses on terrestrial and aquatic biodiversity and biogeochemical processes, as well as the influence of anthropogenic environmental change in modified landscapes on these processes in adjacent natural and near-natural systems. It also provides the opportunity to investigate the long-term impacts of anthropogenic environmental change on the delivery of ecosystem services, and the implications of these for human wellbeing, in changing rural socio-ecological systems.

2.2. Altitudinal and climatic gradients and projected climate change impacts

The Sabie-Sand River catchment spans an altitudinal and rainfall gradient ranging from 2,000 masl and 2,000 mm rainfall per year at the escarpment in the west to 150 masl and 400 mm/year on the eastern basalt plains. There is also a moderate north-south rainfall gradient, with a drier north due to the rain shadow induced by the Mpumalanga Drakensberg escarpment. These climatic gradients provide scope for "space-for-time" approaches to research on climate change impacts, to complement longitudinal observations.

Analysis of Skukuza (KNP) climate data over the period 1960-2009 shows an increase of 0.85°C in average minimum and maximum temperatures, and a roughly 50% increase in the numbers of days with a maximum temperature reaching or exceeding 35°C (van Wilgen & Herbst 2017). By contrast, no trend in annual rainfall was detected for Skukuza over the period 1910-2009, although the coefficient of variation in rainfall between years and the number of rain days both increased (van Wilgen et al. 2016; van Wilgen & Herbst 2017).

Climate projections indicate that Mpumalanga Province is likely to experience a climate future that is significantly hotter and potentially drier compared to the present-day (DEA TNC 2017). For the mid-future (2040-2060), temperature anomalies of 1-3°C and 2-5°C are projected under the A2 and RCP8.5 scenarios respectively (DEA LTAS 2013). This is supported by projections for the KNP, which indicate increases in mean annual temperature of between 1.3°C (best case) and 2.5°C (worst case) by 2050 (van Wilgen & Herbst 2017). These anomalies are well beyond the natural temperature variability of the region. Such a climate regime will also be associated with an increase in the

frequency of occurrence of heat-wave days and high fire-danger days (DEA TNC 2017). Rainfall projections for the region show high levels of uncertainty with some models projecting a decrease in precipitation in the long term, while others suggest a moderate increase in the total rainfall (DEA TNC 2017; van Wilgen & Herbst 2017). However, it is agreed that there will be greater variability in the rainfall pattern, with an increase in extreme rainfall events i.e. increased frequency of intense rainfall events and aridity of dry spells, thus placing a premium on herbaceous layer cover. The lowveld has already emerged as a focus area for drought studies (see e.g. recent Special Issue in African Journal of Range and Forage Science, vol 37, where all but one study was conducted in the lowveld). These projected changes in climate will have important implications for ecological processes such as primary production, fire regimes, nutrient cycling, hydrology, and erosion, as well as for species distributions and ecosystem assemblages. As an indication, recent RCP forced hydrological model studies suggest a 20-60% reduction in Mean Annual Runoff for the rivers of the lowveld, albeit with some potential increase in flood magnitude (Schulze & Davis, 2019).

Climate change will also have a significant impact on people living in the landscape. Many rural households depend on subsistence dryland agriculture to supplement their household food needs and are vulnerable to climate-related crop-failure (Pereira et al. 2014; Tibesigwa et al. 2016). Higher variability in rainfall and higher temperatures will thus threaten food security and nutrition in these areas. It will also become an increasingly important obstacle to small-scale and emerging farmers pursing farming as a livelihood. The landscape therefore provides a useful context for long-term research on the impacts of climate change on coupled terrestrial and aquatic systems in the savanna biome, and hence the delivery of ecosystem services, under different land use and management regimes.

2.3. Transition zones between biomes

This savanna landscape, with vegetation characterised by a co-dominance of trees and C4 grasses, interfaces with sub-humid montane forest and C3 grassland ecosystems in the biome transition zone along the Drakensberg escarpment. Being within the Strategic Water Source Areas (Le Maitre et al, 2018), these adjacent biomes are also the headwater sources of these river systems, providing their perenniality and including some unique ecosystems including swamp forest peatland in the upper Sand River catchment at the base of the escarpment. The vegetation within the Lowveld Sabie-Sand landscape, from the Drakensberg in the west to the lowveld areas in the east, as described by Mucina & Rutherford (2006), is diverse and includes elements of the following: Northern Mistbelt Forest and Northern Escarpment Quartzite Sourveld on the escarpment slopes at the head of the Sand River catchment, and Lowveld Riverine Forest, Legogogte Sour Bushveld, Pretoriuskop Sour Bushveld, Gabbro Grassy Bushveld, Granite Lowveld, Delagoa Lowveld, Tshokwane-Hlane Basalt lowveld and Northern Lebombo Bushveld in the lowveld.

2.4. Expected development pathways in the landscape

This landscape is nationally significant given the prominent role of conservation and eco-tourism in driving the local economy and socio-economic development and contributing to national GDP. The KNP alone attracts close to 2 million visitors per year (Swemmer et al. 2017). The landscape also includes other economically important conservation models such as private game reserves with high-end ecotourism lodges (e.g. Sabi Sand Wildtuin), as well as community-state partnership (e.g. Manyeleti Game Reserve) and community-owned (e.g. Mjejane and Mala Mala Game Reserve) conservation and tourism models. The Greater Kruger National Park (GKNP), consisting of the KNP and adjacent provincial and private game reserves, generated R5.8 billion in trip-related tourism revenue over the period April 2016/May 2017 (Chidakel et al. 2020). Roughly 85% of this was received in the local area. When factoring in multiplier effects, the contribution to national GDP was R6.6 billion. The conservation and eco-tourism sector is a major employer in the region, with the GKNP accounting for 10,388 jobs and R1.17 billion in wages and salaries annually (Chidakel et al. 2020). Approximately 80% of staff come from local communities, with every employee supporting an average of 4.3 dependents (Chidakel et al. 2020). The importance of the "green economy" and the linkages between human, environmental and economic health in the landscape were highlighted by the extent and severity of the socio-economic impacts of the COVID-19 lockdown, which brought the eco-tourism industry in the landscape to a standstill (Lowvelder, 23 June 2020).

The landscape falls entirely within the footprint of the Greater Kruger Strategic Development Plan (GKSDP), an integrated partnership programme initiated by SANParks, that seeks to "unlock significant, inclusive rural economic development in the Greater Kruger landscape while securing the ecological health and diversity of large, natural landscapes to ensure their sustainable use for the long term benefit of all" (GKSDP 2020b). The GKDSP classifies the Greater Kruger landscape into various cooperative zones (protected area management, ecological priorities, socio-economic development, and water priorities) for which appropriate programmes and priority actions have been identified. The Lowveld Sabie-Sand Catchment spans all of these cooperative zones (Figure 3).



Figure 3. Greater Kruger Strategic Development Programme priority zones in implementation clusters. The Lowveld Sabie-Sand Catchment is outlined in red. (Source: GKSDP 2020a: Implementation Clusters)

Most of the "lived-in" portion of the Lowveld Sabie-Sand Catchment comprises the over-crowded former-homeland areas and dormitory settlements of BLM and a small portion of MLM. The BLM was declared as a Presidential Development Node in 2001. The BLM Integrated Development Plan (IDP) places emphasis on tourism and agriculture development projects, development of a climate change adaptation and

mitigation strategy, and development of an environmental management plan as central components of the socio-economic development strategy for municipality (BLM IDP 2017).

The development pathway for BLM, as outlined in the BLM Spatial Development Framework (BLM SDF 2017), will entail a combination of i) developing and consolidating sustainable urban and rural nodes, ii) developing strategic transportation corridors, and iii) capitalizing on the natural resources and strategic location of the region to enhance the economic opportunities offered by agriculture (subsistence, small-scale/emerging and commercial) and tourism (BLM SDF 2017). As such, the envisaged spatial configuration of the landscape will consist of five settlement/village clusters with well connected, serviced and economically vibrant urban, rural service delivery, and agri-hub nodes, in a matrix of rangelands, agricultural land, and protected or scenic areas (Figure 4). State owned plantation forestry areas that form part of the Mpumalanga Strategic Water Source Areas are currently in the process of being incorporated into the Blyde River Canyon Nature Reserve (BRCNR) and is the site of one of the largest restoration initiatives in the country with alien plant removal having occurred since the early 2000s. The Lowveld Sabie-Sand Catchment landscape thus provides the opportunity to observe both urbanization and nature-based economic development in a multi-functional savanna landscape.



Figure 4. Spatial development plan for village/settlement clusters in Bushbuckridge Local Municipality (Source: BLM SDF (2017): 178)

Importantly, development plans for the region, including the GKSDP, Ehlanzeni District Rural Development Plan, Ehlanzeni District Spatial Development Framework, Ehlanzeni MTPA Bioregional Plan, Bushbuckridge Local Municipality Spatial Development Framework 2017/22, Bushbuckridge Integrated Development Plan 2018/2022, and DEA BLM Wildlife Economy Master Plan, all give prominence to the development challenges of urban sprawl and environmental degradation, as well as the importance of tourism, agriculture and sustainable natural resource use as important drivers of economic development in the region. EFTEON research infrastructure will thus generate valuable data for informing municipal land use and development planning, disaster risk management, and climate adaptation and mitigation in the region.

3. Logistical and operational suitability of the core and associated sites

3.1. Security of tenure for operations

The KNP will be the core site, and as a national park managed by SANParks, it is secure for long-term deployment of research infrastructure. Satellite sites will include private and provincial game reserves, restored forestry plantations, and communal lands. Key protected areas custodians beyond KNP, such as the MTPA, Sabie-Sand Wildtuin, Mala Mala Game Reserve and Mjejane Game Reserve have already expressed their commitment to this initiative. Custodians beyond the reserves, such as the BLM and DARDLEA, have also pledged their support. Many partners in this proposal already have longstanding relationships and research infrastructure with custodians in these satellite sites, such as the ARC with the private game reserves, Wits University with the rural communities in the Agincourt HDSS, and the UNESCO K2C Biosphere region with Common Property Associations in the upper Sand River catchment in the rehabilitated forestry areas.

3.2. Existing facilities for hydrological observations

Hydrometric infrastructure includes several gauging weirs in the Sabie-Sand and Crocodile Rivers. These are owned by the Department of Water and Sanitation (DWS) equipped with both Inkomati-Usuthu Catchment Management Agency (IUCMA) and the DWS dataloggers. Typically, these include pressure transducer-based flow measuring devices with real-time (unverified) telemetry systems, and in some cases also include water quality probes. Moreover, the IUCMA also ensures, through its catchment operations committee, that the water resources modelling is up to date and is used in real time applications (notably the WRSM2000 Pitman model and others).

The proposed landscape also includes the large Inyaka Dam owned by the DWS and operated by the IUCMA. This is used to provide domestic and agricultural water supplies and used to augment the environmental flow requirements in the Sabie River. Further, there are a number of other small dams within the Sand catchment including Casteel and Edinburgh Dams and the Dingleydale irrigation canals overseen by DARDLEA. A gauging weir at a rehabilitated wetland provides an opportunity for studying the hydrological of upper catchment wetlands, which play an important role in regulating the flows of the Sabie-Sand river.

The proposed landscape includes a groundwater monitoring network; SANParks manages a KNP-wide borehole network with the DWS, of which 5 sites fall directly within the proposed landscape. There are also monitoring wells outside of the KNP managed by the IUCMA, with further decommissioned wells that could be retrofitted with loggers for future monitoring within this EFTEON landscape. The SADC Groundwater Management Institute (SADC-GMI) provides a web-portal with the database of historical groundwater observations which will also be utilised in initial hydrocensus of the proposed landscape https://apps.geodan.nl/igrac/ggis-viewer/viewer/sadcgip/public/ default)

3.3. Suitability for deployment of micrometeorological observations

There are currently two flux towers in the landscape; one in Skukuza (KNP) which is 10 km south of the Sabie River, and the other in Agincourt village in Bushbuckridge. The Agincourt flux tower provides information on the human forcing/human-modified landscape against natural variations in Skukuza flux tower site. The two flux towers are on a flat terrain and the flux measurements are taken at a stationary point with instruments mounted at a site-specific height to ensure that the measurements are being made within the local surface layer. Both sites have demonstrated adequate mixing of eddies particularly for daytime measurements. The Skukuza flux tower stands exactly on the ecotone between a midslope fine-leafed Acacia Savanna (~ 10m) on clayey soil and ridgetop broad-leafed Combretum savanna (~ 8 m) on sandy soil (Scholes et al. 2001) at an altitude of 365 m above sea level.

The Skukuza tower is 22 m tall and the instruments are deployed at 17 m height giving the tower a footprint of about 500 m (Archibald et al. 2009). The measurements at 17 m height are much higher than the aerodynamics canopy height and can consider vegetation height (8-10 m) as relatively flat (the vertical structure of the vegetation is on a considerably smaller scale than their horizontal dimension) which meet the assumptions of horizontal heterogeneity and steady state conditions. Meanwhile the Agincourt instruments are deployed at 6 m and the tower stands exactly at the boundary between households and the agricultural field. Variations of surface properties in agricultural patch versus the household can affect turbulent exchange, especially the flux of momentum, of heat, or of mass (water vapour or trace gases).

However, in the absence of strong topography in Agincourt flux tower, it is possible to regard agricultural patches and household as relatively flat (i.e. their vertical structure is also on a considerably smaller scale than their horizontal dimension). Hence, it is permissible to assume that the flow over this site footprint is fairly uniform in its mean properties and the changes of surface roughness are relatively small (De Bruin et al. 1991; Schmid, 1997).

Both towers are powered by solar energy which is stored in batteries. It would be highly desirable to supplement these with additional towers in different savanna vegetation types in both conservation and rangeland areas. The gently undulating to flat topography of the landscape, particularly in the central and eastern parts, are conducive to the deployment of additional flux towers.

3.4. Existing long-term observations or experiments

A strength of this proposed landscape is the wealth of existing terrestrial, aquatic and social long-term observations or experiments with which the EFTEON investment would synergise and generate significant value-add. These are summarized below and in Figure 5.

i) Biophysical (terrestrial)

- Meteorological data: Over 100 years (starting in 1910) of climate records exist for the KNP (SANParks) (van Wilgen & Herbst 2017), with various private reserves also having considerable historical rainfall records. The IUCMA also operates its own rain gauge network in their Water Management Area which includes several sites within the proposed landscape.
- Southern Granite and Basalt Supersites (KNP: SANParks): These large long-term research sites were established in the KNP in 2013 to study and monitor ecological patterns and processes emerging under non-manipulated conditions on contrasting geologies (Smit et al. 2013). The sites were delineated according to sub-catchments. A broad suite of baseline data exists for the sites, including meteorological, hydrological, geological, pedological, vegetation, and fire data. Updates of available data sets and relevant publications for supersites are documented in Smit (2020). Datasets can be searched (using "supersite" as

search term) and downloaded from the SANParks data repository http://dataknp.sanparks.org/sanparks/). A recent paper (Janecke et al. 2020) provides a conceptual framework of the biotic and abiotic interactions on the Southern Granite Supersite.

- Skukuza string of the long-term Experimental Burn Plots (EBP) (KNP: SANParks): This fire experiment, involving different combinations of fire frequency and season, was established in 1954. Existing data sets include inter alia fire history, fuel loads, fuel moisture as well as woody vegetation surveys. Although somewhat dated, key findings from the EBPs can be found in van Wilgen et al. (2007).
- Nkhuhlu Long-term Herbivore Exclosure (KNP: SANParks): This 139 ha partial (excluding elephant and giraffe) and full exclosure (excluding all herbivores greater or equal to a hare) along a catena next to the Sabie river, was established in 2002 under the River Savanna Boundaries Program (Biggs, 2003). This includes various vegetation surveys (herbaceous and woody) collected over time (Wigley-Coetsee et al., in preparation). Various baseline (e.g. Siebert et al. 2008), remote sensing (e.g. Asner and Levick, 2012) and field-based studies (e.g. van Coller et al., 2013, Scogings et al. 2015) have been conducted on these sites.
- Vegetation Condition Assessment (VCA) sites (KNP: SANParks): Vegetation assessments of the herbaceous layer have regularly taken place at KNP since 1989. Long-term monitoring of the grass layer has shown that grass biomass (and to a lesser extent grass species composition) are relatively resilient to drought (Wigley-Coetsee & Staver 2020).
- Savanna Ecosystem Dynamics Programme (Agricultural Research Council (ARC)): This ongoing monitoring programme was established in 1989. It includes annual collection of woody and herbaceous vegetation in some 500 sites as well as geo-referenced animal number and type data, in KNP and adjacent protected areas in the landscape (SSW, MMGR, MGR). The database also includes environmental (e.g. rainfall) and management (e.g. stocking rate) data. This initiative provides valuable data on savanna dynamics under different management regimes (Peel et al. 2007; Buitenwerf et al. 2011)
- Mnisi Livestock Health and Demographic Surveillance System (University of Pretoria (UP)): Regular health and demographic monitoring of a population of

20,000 cattle in communities on the northern edge of the proposed landscape was undertaken at diptanks from 2012 to 2018.

- BROWSE (Biodiversity Research on Wildlife and Savanna Ecosystems) (University of Florida, Organization for Tropical Studies (OTS) and SANParks): This programme is monitoring long-term change in vegetation (structure and floristics) the consequences for faunal and floral communities in the KNP. Additionally, three 70m by 70m full and six partial (megaherbivore) exclosures have been built to examine the effects of fire and herbivory on vegetation dynamics. The data collected from 2013 onwards, also provides a useful yardstick against which we can assess the effects of drought and climate change.
- Long term biodiversity assessments (OTS): Sabie River and Granite Supersite in KNP including, but not limited to: large tree species demography, vegetation community dynamics and bird & small mammal diversity). Assessments include the influence of floods, fire and herbivory on community dynamics.
- Flux towers: The Skukuza flux tower was established 2000 (KNP, CSIR) and the Agincourt flux tower in 2016 (outskirts of Agincourt village, CSIR). The flux towers are equipped with eddy covariance system and various ancillary instruments for meteorologic parameters. The historic collected data include high temporal density measurements of wind speed and direction, four separate components of the surface radiation balance, air and soil temperature, relative humidity, energy, water and CO₂ flux. The flux tower sites are ideal for both long term and campaign mode observation of ecosystem changes under the influence of herbivory and climate change. The flux tower sites are powered by solar energy which is stored in batteries. Wet (rain) and dry (gas and aerosol) deposition of sulphur and nitrogen (in KNP), since 1999 (e.g. Conradie et al., 2016), as well as rain and aerosol chemistry (Maritz et al., 2019). Skukuza measurements were discontinued in 2015 but will be reinstated if this research infrastructure node is approved/supported.
- Nutrient cycling: Wet (rain) and dry (gas and aerosol) deposition of sulphur and nitrogen as well as rain and aerosol chemistry have been recorded in KNP since 1999 (Conradie et al., 2016, Maritz et al., 2019). Skukuza measurements were discontinued in 2015 but will be reinstated if this research infrastructure node is approved/supported.

ii) Biophysical (fresh water)

- River Ecostatus Monitoring Program (REMP): Several organisations within the landscape contribute to the national REMP in the Sabie-Sand and adjacent river systems, including the IUCMA, MTPA and SANParks. SANParks has a 10-year continuous quantitative record of river health within the confines of the KNP macro-invertebrates, diatoms and (ichthvofauna. river physico-chemical variables), with further historical data in various forms back to the 1960s. The IUCMA together with MTPA perform quantitative systemic river health analysis every three years and summarised in the Ecostatus Reports for example Roux et al. (2016). Much of this data is also captured in the Freshwater Biodiversity System (FBIS https://freshwaterbiodiversity.org/) and is being used in other hydroinformatics management tools under development. Significant research has been undertaken in this catchment through the Kruger National Park Rivers Research program (Breen et al. 2000) and subsequent research projects.
- River Water Quality and Base Flow data: (IUCMA, DWS, SANParks): IUCMA collects automated water quality (temperature, electrical conductivity, and a range of other parameters) and base-flow data in the Sabie-Sand and Crocodile Rivers. Most of the data is from 2019 onwards, although data from a few SANParks probes starts from 2017. IUCMA also collects broad spectrum monthly SANAS accredited water quality samples at key locations which builds on the National Chemical Monitoring Program data of DWS which for some stations have a water quality record commencing in the 1960s.
- Groundwater monitoring data: (KNP: DWS & SANParks): SANParks has been managing a KNP-wide borehole network with the DWS since 2007, of which 5 sites fall directly within the proposed landscape.
- FISHTRAC programme (University of Mpumalanga (UMP)): Water quality (three sites on the Sabie River) and fish behavioural ecology monitoring network (between lower Sabie and Mozambique) and fish movement/migration tracking systems operate within the KNP.
- Craigieburn Wetland Rehabilitation site: This was established under the Association for Water and Rural Development (AWARDs) Save the Sand program with a focus on integrated wetland management (Pollard et al, 2008; Pollard et al, 2010). This headwater wetland site was concurrently established as a hydrological

observatory focusing on the hydrodynamic response to technical rehabilitation interventions by the University of KwaZulu-Natal (Riddell et al, 2012; Riddell et al, 2013). SAEON continued the meteorological and piezometer measurements thereafter, and hydrodynamic observations now cover a continuous 15-year period.

 Southern Granite and Basalt Supersites: The KNP research supersites have a high density piezometric borehole network with data collected continuously since 2012.
See Riddell et al. (2020) for a conceptual framework of the surface-groundwater interactions in the Southern Granite supersite.

iii) Socio-economic

Agincourt Health and Socio-Demographic Surveillance System (AHDSS): Since 1992, the SAMRC/Wits Rural Public Health and Health Transitions Research Unit, from the School of Public Health at the University of the Witwatersrand, has been running the AHDSS. It is a robust research platform that enables the regular and standardised collection of longitudinal demographic, health and socio-economic data – during times of rapid social change – for a rural population now totalling approximately 118,000 people and 18,000 households in 31 villages located in the proposed Bushbuckridge in the proposed Lowveld Sabie-Sand Catchment. The backbone of the AHDSS is an annual census update - recently extended to 2 x telephonic and 1 x face-to-face round each year - in which the resident status/household membership (including temporary/labour migrants) and vital events (births, deaths) of all individuals are systematically updated for every household in the AHDSS site. Add-on modules are deployed with the census at varying frequencies, such as socio-economic status (annual) and food security (every three years), labour participation (every four years) and temporary migration (every 5 years) amongst others. To better understand the causes of death in the area, all households with reported deaths are revisited annually and a Verbal Autopsy interview is performed using a validated and standardised WHO questionnaire. The Agincourt Research Laboratory allows collection, processing and storage of biological samples close to the field operations. Samples are then shipped to different laboratories for analysis. The AHDSS research platform provides a foundation for observational and intervention studies focusing on

different stages along the life course (children, youth, adults, elders), evaluation of national policy at population, household and individual levels, and examination of household responses to shocks and stresses and the resulting pathways influencing health and wellbeing. Data are normally publicly available and there is a 1-in-10 sample of the entire HDSS dataset from a data portal to use as a guide of potential needed data, and there is the possibility to request more extensive data sets following a standard data agreement. The AHDSS is one of three founding nodes in the South African Population Research Network (SAPRIN), a National Research Infrastructure funded by the Department of Science and Innovation.

- Sustainability in Communal Socio-Ecological Systems (SUCSES) household panel study: Detailed livelihoods data, including income and expenditure, assets, natural resource use, agricultural activity, livestock ownership, and food security, have been collected in a panel of 590 rural households at regular intervals since 2010. The study is nested within the AHDSS. Data are available to collaborators according to a data agreement.
- Zoonotic tick-borne pathogen surveillance as a cause of febrile disease in rural communities (UP, National Institute for Communicable Diseases (NICD), University of Stellenbosch, Washington State University): This project builds on previous research findings and ongoing surveillance of febrile non-malarial disease in people the Mnisi community (2016-present). Ticks and blood samples of cattle, dogs and rodents are collected and screened for pathogens on a molecular level. Up to now several tick-borne pathogens that have either not yet been described for this area, as well as new hosts and novel pathogens have been identified. The samples are also opportunistically screened for a separate study.
- Influence of sociodemographic factors on infectious and zoonotic pathogen risk in a resource-limited community at the livestock-wildlife interface (UP, Ohio State University): This research started with compiling a One Health profile of the Mnisi community (2015). From there further research focused on investigate specific risk factors such as gender on the prevalence of zoonotic disease (2018-2019). Future research is planned to investigate other One Health issues such as the

management of disposable diapers, and antimicrobial resistance of microbes contaminating water systems.

 Livestock census of livestock, including cattle, small stock and pigs (Mpumalanga State Veterinary department): This monitoring throughout the Bushbuckridge area has been ongoing since the 1970's to present. The purpose of stock census is surveillance, particularly Foot-and-Mouth disease (FMD) in livestock. The KNP is the only endemic (infected) FMD area in South Africa, and Bushbuckridge and conservation areas bordering KNP fall within the FMD control zone. FMD control in the Bushbuckridge area has extremely important limiting effects on the socioeconomic development in the area, particularly in livestock and animal products due to trade and movement regulations.

Various data repositories exist for long-term research that includes the Lowveld Sabie-Sand landscape. A large range of meta-data and research output data from within SANParks is housed at http://dataknp.sanparks.org/sanparks/. SANParks also keeps track of scientific publications emanating from KNP, and as such a bibliography is available. Hydrological data are integrated in database systems including the IUCMA's own Zednet system (http://zednet.co.za/) as well as the DWS's HYDSTRA and WMS databases http://www.dwa.gov.za/Hydrology/ Default.aspx). The IUCMA also houses the HydroNet Water Control Room (https://www.hydronet.com/product/ cma-water-control-room/). An open access 1-in-10 data sample of health and socio-demographic of the AHSDSS is available from the SAMRC/Wits Agincourt Unit at https://www.agincourt.co.za, as is a bibliography of publications from the site.



Figure 5. Existing long-term observation sites and experiments, as well as partner institution nodes in the landscape.

3.5. Links to research or educational partner institutions

There is a well-established research network between the KNP (the core of the landscape) and both local and international researchers, including postgraduate students. This is illustrated by the 545 papers published by external researchers and SANParks staff on research conducted within the KNP over an 11-year period (2003-2013), represented over 1100 unique authors. KNP publishes an annual bibliography of scholarly articles published based on work conducted in the park as part of an Annual Research Report (see https://www.SANParks.org/scientific-services/virtual-library/reports). A range of universities and other research institutions are also actively involved in research beyond the border of the KNP in the landscape. For example, nearly 1,000 journal articles have been published on research in the AHDSS by Wits and partner institutions since 1992 (https://www.agincourt.co.za/?page_id=1818).

These networks of research and education institutions active in the landscape constitute a strong stakeholder and user community for the proposed EFTEON investment in the landscape, a number of whom are key collaborators in this proposal. In addition to direct linkages through research and postgraduate training, there is the potential to contribute to long term monitoring through education and training programmes, such as to collecting regular monitoring data through the running of skills training courses. By keeping the data relatively simple and having local experts and principle investigator constantly engaged, institutions such as Ezemvelo KZN Wildlife have been able to collect game census and elephant impact data through volunteer programmes. Additionally, OTS collect long-term data on the effects of fire and elephants on habitat heterogeneity and consequent effects on faunal and floral communities through running bi-annual biodiversity training courses in the Kruger Park. If structured effectively and funded, key biophysical, floral and faunal data could be collected regularly. Institutions such as the SAWC, W, UMP, K2C and OTS/Nsasani Trust could collaborate to run regular programmes to fill critical data gaps.

Below is a summary of partner research and education institutions involved in this proposal. They, in turn, have extensive research and training collaborations and networks involving many dozens of other institutions

The **University of the Witwatersrand (WITS)** has a long history of research in the landscape and has had a permanent presence in the lowveld since 1989, centred at the Wits Rural Campus (formerly known as the Wits Rural Facility). Wits scientists have played a leading role in research in and around the landscape in fields including savanna ecology, animal behavioural ecology, aquatic ecology, climate change, sustainable resource use, rural livelihoods, public health, human demography, and socio-economic development. Key university entities active in the landscape are the School of Animal, Plant and Environmental Sciences, the Global Change Institute, and the School of Public Health. The SAMRC/WITS Agincourt Unit has implemented the Agincourt Health and Socio-Demographic Surveillance System in the landscape since 1992. The Wits Rural Knowledge Hub at the Rural Campus integrates the research and teaching activities of the university in the region.

The relatively new (<8 years old) and growing **University of Mpumalanga (UMP)**, based in Mbombela on the former Lowveld College of Agriculture campus, is the closest university to the proposed site. The current expertise and research strengths at UMP are the form of water resource management, terrestrial biodiversity and conservation and agricultural entomology. The School of Biology and Environmental Sciences, within the Faculty of Agriculture and Natural Sciences, will be the main point of contact for the proposed site.

The Hans Hoheisen Wildlife Research Station (HHWRS), University of Pretoria (UP) is based at Orpen Gate, KNP. The facility is managed by the Faculty of Veterinary Science, and also run the Hluvukani Animal Clinic (HAC), a veterinary clinic in the local Mnisi Community, Bushbuckridge North. Research at the facility focuses on multidisciplinary approach to address the complex challenges and to develop sustainable solutions for the problems associated with livestock/wildlife/ human/ecosystem at the interface, through the Mnisi Community Programme. They work in close partnership with the NICD in surveillance programmes on zoonotic diseases in both the human, domestic animal and wildlife populations. The geographic location of HHWRS within the FMD control zone is in particular advantageous as processing of biological samples from within the FMD control zone is dictated by DAFF. HAC also serve as a training facility for undergraduate veterinary students, both local and international, whereas HHWRS has several ongoing postgraduate projects, including doctoral and postdoctoral studies, in collaboration with local and international institutes.

The **North-West University (NWU)**, as a partner in the international Deposition of Biogeochemically Important Trace Species (DEBITS) project, which is endorsed by the International Global Atmospheric Chemistry (IGAC) programme and the World Meteorological Organisation (WMO), will manage the deposition, as well as rain and aerosol chemistry measurements in the KNP. Researchers from North-West University have also been actively involved in research in the KNP exclosure experiments.

The **Skukuza Science Leadership Initiative** partners (OTS, Nsasani Trust and SANParks Scientific Services) have been running human capital development programmes in the environmental sector for 17 years. Coupled with the purpose-built campus, the staff are well trained in biodiversity monitoring training programmes and

Higher Education HCD programmes. The SSLI could provide a base from which to run operations from within the Kruger Park.

The Rangeland Ecology Division (Nelspruit) of the **Agricultural Research Council** (**ARC**) has managed the Savanna Ecosystem Dynamics Project in the lowveld since 1989. The project covers an area of some 450 00ha of the eastern lowveld between the Sabie and Letaba Rivers and includes some 800 vegetation-sampling sites, as well as an ongoing monitoring programme which is aimed at detecting vegetation change over time under different stocking rate and rainfall regimes. Relevant to this proposal, the ARC has vegetation monitoring plots in MGR, SSW and MMGR. The unit has well-established relationships with the managers of private reserves in the study area and collaborates with a range of local and international university research partners.

The **Council for Industrial and Scientific Research (CSIR)** is a world-class African research and development organisation that undertakes directed, multidisciplinary research and technological innovation that contributes to the improved quality of life of South Africans. The CSIR manages a network of flux observations including two eddy covariance flux towers that are within the Lowveld Sabie-Sand Catchment (i.e. Skukuza and Agincourt). The terrestrial flux measurement are geared toward understanding ecological processes in support of climate change research, but also to provide the general public with easy accessible visualizations of CO₂ fluxes at landscape and regional scale. Through various engagements with the local stakeholders, CSIR has established a good working relationship with the community of Agincourt and the Kruger National Park.

The Ndlovu Node of the **South African Environmental Observation Network (SAEON)** is located near to the landscape and maintains a number of long-term research projects in and adjacent to the landscape. These include hydrological monitoring of the headwater wetland at the Craigieburn site, and a recent project to study the effects of rehabilitation of abandoned plantations on vegetation and hydrology, on the north-western boundary of the landscape. Other long-term projects located just to the north of the landscape may be valuable for informing and interpret future EFTEON research, particularly the monitoring of fuelwood harvesting around

rural villages, and studies of the impact of land management and climate on the demography of dominant woody plant species in semi-arid savannas.

The **Southern African Wildlife College (SAWC)** is a credible and long-standing nongovernment conservation organisation, provisionally registered with the Department of Education and Training as a private higher education institution. The SAWC delivers training to conservation professionals, communities and other stakeholders in a 'learning-by-doing' approach and at the same time monitors and analyses the impacts this training has on the conservation industry and community members' livelihoods. Our approach, as well as the physical positioning of the SAWC campus in a wildlife area with neighbouring communities that fall within the Sabie-Sand Catchment, makes the SAWC ideal for training, skills development and applied research within the landscape. Of particular relevance to this proposal, we are developing an Integrated Information Management System for data sharing and communication that could also be of use to the EFTEON initiative.

The **Kruger2Canyons Biosphere Region (K2C)** is involved in data collection and capacity-building through its Environmental Monitor Programme, funded by the DEFF Expanded Public Works Programme. K2C employs nearly 300 Environmental Monitors recruited from local communities who are nested in host institutions in the biosphere region, including research, conservation and non-governmental organizations. The Environmental Monitors assist host institutions with collection of a wide range of environmental and socio-ecological data in support of biodiversity conservation and ecosystem services.

3.6. Availability of support facilities for staff and visiting researchers

Partner institutions can provide support facilities (subject to availability), at the following nodes located either within, or less than 80 km (straight line) from, the landscape core:

- Skukuza (KNP Scientific Services, SANParks)
 - Researchers from registered projects have access to:
 - Laboratory space, including general laboratory, preparation room and analytical laboratory (for more details on services available, refer to https://www.sanparks.org/scientific-services/nodes/savanna-grasslandresearch-unit/laboratory)

- o Biological reference collection
- o Communal visitor office with wifi service
- Game guards for protection during field work
- Short-term self-catering research accommodation at subsidised rates
- For more details, see https://www.sanparks.org/scientificservices/research-applications/researchers-logistical-support
- Skukuza Science Leadership Initiative campus (OTS, Nsasani Trust and SANParks)
 - o Biodiversity inventory laboratory
 - \circ Laboratory
 - Library with wifi
 - \circ Lecture theatre for 50 pax
 - Accommodation (40 pax)
- University of Mpumalanga Mbombela campus (Faculty of Agriculture and Natural Sciences)
 - Collaborating and/or visiting scientists, researchers and students have opportunities to utilise office and laboratory infrastructure at the University of Mpumalanga, Mbombela campus.
 - \circ $\;$ This includes access to meeting venues and associated hosting facilities.

• Hans Hoheisen Wildlife Research Station (UP)

- o General laboratories available for soil and vegetation samples
- \circ Laboratory equipment available depending on what project requires
- o Dirty laboratory
- o Clean laboratories for microbiology, including water samples
- PCR equipment for molecular analysis
- Biobank long term storage for biological samples, including -20°C
- Walk in fridges
- Office space with Wifi
- o Library
- Auditorium accommodating 120 pax
- Conference room for 10 pax
- Catering kitchen
- Self-catering accommodation for visiting researchers up to 6 pax
- Camp sites available if project want to erect a long-term safari tent

• Wits Rural Campus (Wits University)

- Laboratory for processing soil and vegetation samples
- Drying oven and basic laboratory equipment
- Office space with wifi
- Well-equipped conference (100+ pax) and meeting (20 pax) rooms

 Catered and self-catering visitor accommodation ranging from dormitories and rustic huts to en-suite units and flatlets (total of 340 beds)

• The Southern African Wildlife College:

- Well-equipped venues for meetings and courses,
- o Campus and field area well suited for field courses and training.
- Basic lab facilities include wifi, a drying oven, microscope, water testing equipment and equipment for collecting various animal taxa.
- Game guards (subject to availability).
- Catered visitor accommodation ranging from basic tents, to en-suite tents and rooms.
- $\circ\,$ Rooms in research house for visiting researchers (catered or self-catering)

3.7. Availability of residential facilities and other amenities

There is staff housing and longer-term visitor accommodation (subject to availability) at the Wits Rural Campus. The Skukuza staff village is currently full to capacity for permanent staff accommodation, but shorter-term accommodation at subsidized rates in a research camp is available (subject to availability). The SAWC has research and visitor accommodation, subject to availability. Local towns within 40 km of the perimeter of the landscape include Hazyview, Whiteriver, Mbombela (Nelspruit), and Hoedspruit. These all have amenities and services such as shops, banks, mechanics, primary and high schools, churches, sports facilities, and either a hospital or a clinic.

3.8. Accessibility of the landscape

The landscape is easily accessed by tarred national (N4) and secondary arterial routes (R40, R536). The communal lands are accessed by both tarred and dirt roads, and the KNP has a network of tarred and well-maintained dirt roads. The remaining conservation areas have well-maintained dirt roads. The landscape can be accessed from three airports: Kruger Mpumalanga International (Mbombela, 25 km from the south-west edge of the landscape); Skukuza Airport (Skukuza, in the core of the landscape) and Eastgate Airport (Hoedspruit, 25 km north of the landscape). Car rental services are available at all three airports.

3.9. Safety and potential security considerations

The danger of theft of equipment is low in KNP and most of the other game reserves, but animal damage needs to be taken into consideration in the design and installation of infrastructure in these sites. Safety of researchers and technical personnel from wild animals is mitigated through availability of armed game guards in the protected areas. Outside of the protected areas or private land, close cooperation with Traditional Authorities, Community Development Forums, government departments, and other local stakeholders, will be important for ensuring the safety of research personnel and equipment. Fortunately, partner institutions in this proposal have been conduction research in these areas for many years, and have a wealth of local experience, relationships, and networks in this regard. The cumulative social capital of the collaborators in this landscape is a particular strength of this proposal.

4. Stakeholder analysis

The relevant direct stakeholder communities of the Lowveld Sabie-Sand Catchment are summarized in Table 1. These are clustered by sector. In addition to these, we have also identified a number of indirect decision-making and policy-making stakeholders that relate to human health and social development, given the profound implications of global change for people's wellbeing, livelihoods and food security. These indirect stakeholders include the national Department of Health (DOH), Department of Social Development (DSD), Department of Planning, Monitoring and Evaluation (DPME), and StatsSA.

We have engaged with key direct stakeholders within the landscape, and collaborators in this proposal have relationships and engagement processes with many of the remaining local stakeholders. SANParks has a number of platforms for engagement with stakeholders, most notably through the seven People and Parks Forums which encompass communities within a 20 km radius of the western and southern KNP boundary. Relevant to this proposal, there are two of these forums in Bushbuckridge Local Municipality, one in Mbombela Local Municipality and one in Nkomazi Local Municipality. The IUCMA hosts catchment management forums, one each for the Sabie, Sand and Crocodile Rivers. The SAMRC/Wits Agincourt Unit has a stakeholder engagement strategy that involves annual research feedback meetings in all 31

villages in the AHDSS, as well as ongoing engagement with community leaders, a community advisory board (CAB), and relevant municipal, district and provincial government departments. As a Biosphere, the K2C places a strong emphasis on partnerships and currently engages with a number of stakeholders and community groups which includes traditional authorities and Communal Property Associations (CPAs). In addition, the K2C has a network of community-based Environmental Monitors who are active in their community and act as a central point for creating awareness, undertaking monitoring and linking to community groups. Another important forum is the BRCNR co-management committee represented by four CPAs who have claimed the BRCNR and together with MTPA is managing the BRCNR. The SAWC's Rural Initiative for a Sustainable Environment (RISE) focuses on the engagement with communities in order to improve the use of natural resources for the benefit of the people and the environment. DARDLEA also hosts a Provincial Climate Change Forum. These various local engagement fora provide valuable platforms where the EFTEON processes may be further communicated with stakeholders.

We have received letters of support (see Appendix 2) from the following stakeholders (in alphabetical order per category):

Research and education institutions

- Agricultural Research Council
- Council for Scientific and Industrial Research
- North-West University
- Organization for Tropical Studies/ Nsasani Trust
- South African Population Research Infrastructure Network
- Southern African Wildlife College
- University of Pretoria (Hans Hoheison Wildlife Research Station)
- University of Mpumalanga
- University of the Witwatersrand
 - o Office of the Deputy-Vice Chancellor for Research & Postgraduate Affairs
 - Rural Public Health & Health Transitions Research Unit (Agincourt)

Individual scientists

- Prof. Barend Erasmus (University of Pretoria)
- Prof. Kate Parr (University of Liverpool, UK)
- Prof. Christiane Schmullius (Friedrich-Schiller-University Jena, Germany)
- Dr. Frances Siebert (North-West University)
NGOs

- Association for Water and Rural Development
- Conservation South Africa
- Kruger2Canyons Biosphere Region
- World Wide Fund for Nature

Regulatory Bodies

- Inkomati-Usutu Catchment Management Agency
- Department of Rural Development Land and Environmental Affairs

Land custodians

- Mala Mala Game Reserve
- Mjejane Game Reserve
- Mpumalanga Tourism and Parks Authority
- Sabi Sand Wildtuin
- SANParks

Communities and relevant authorities:

- Agincourt Community Advisory Board (representing communities in Amashangana, Hoxani, and Jongilanga Traditional Authorities).
- Bushbuckridge Local Municipality

Table 1. Summary of stakeholder analysis for the Lowveld Sabie-Sand Catchment landscape.

Research/academic institutions

With a local presence/infrastructure University of Mpumalanga (UMP) University of Pretoria (UP) University of the Witwatersrand (Wits) South African Population Research Infrastructure Network (SAPRIN) Agricultural Research Council (ARC) Council for Scientific & Industrial Research (CSIR) South African Environmental Observation Network (SAEON) Organization for Tropical Studies (OTS) Nsasani Trust Southern African Wildlife College (SAWC) Nationally - all other SA universities International universities - various

Conservation authorities/custodians

SANParks **Provincial** Mpumalanga Tourism & Parks Authority (MTPA) **Private** Mjejane Game Reserve (MJGR) Mala Mala Game Reserve (MMGR) Sabi Sand Wildtuin (SSW)

Traditional Authorities

Amashangana Hoxani Jongilanga Nkambeni Malele Mathibela Mnisi Moreipuso Sethlare Thabakgolo

Non-Governmental Organizations

Association for Water & Rural Development (AWARD) Conservation South Africa (CSA) Inkomati-Usuthu Catchment Management Agency (IUCMA) Kruger2Canyons Biosphere Region (K2C) World Wide Fund for Nature (WWF)

Government departments

National Department of Agriculture, Land Reform and Rural Development (DALRRD) Department of Environment, Forestry and Fisheries (DEFF) Department of Science and Innovation (DSI) Department of Water & Sanitation (DWS) Provincial (Mpumalanga) Department of Agriculture, Rural Dev., Land and Envir. Affairs (DARDLEA)

Municipalities

District municipality Ehlanzeni Local municipalities Bushbuckridge Nkomazi Mbombela

Communal Property Associations

Sethlare Mahubahuba Maorabjang Moletele

C. REFERENCES

- Archibald, S.A., Kirton, A., van der Merwe, M.R., R. J. Scholes, R. J., C. A. Williams, C. A. & Hanan, N. (2009). Drivers of inter-annual variability in Net Ecosystem Exchange in a semi-arid savanna ecosystem, South Africa. *Biogeosciences*, 6(2):251–266.
- Asner, G. P., & Levick, S. R. (2012). Landscape-scale effects of herbivores on treefall in African savannas. *Ecology letters*, **15(11)**: 1211-1217.
- Biggs, H. C. (2003). Integration of science: successes, challenges, and the future. *The Kruger experience: Ecology and management of savanna heterogeneity*, 469-487.
- BLM IDP (2017). *Final Integrated Development Plan 2018-2022*. Bushbuckridge Local Municipality
- BLM SDF (2017). *Spatial Development Framework 2017-2022*. Bushbuckridge Local Municipality
- Breen, C., M. Dent, J. Jaganyi, B. Madikizela, J. Maganbeharie, A. Ndlovu, J. O'Keefe, K. Rogers, M. Uys, & F. Venter. (2000). *The Kruger National Park Rivers Research Programme* Water Research Commission, Report TT130/2000
- Buitenwerf, R., Swemmer, A. M., & Peel, M. J. S. (2011). Long-term dynamics of herbaceous vegetation structure and composition in two African savanna reserves. *Journal of Applied Ecology*, **48(1)**: 238–246.
- Carruthers, J. (2017). *National park science: a century of research in South Africa*. Cambridge University Press.
- Chidakel, A., Eb, C., & Child, B. (2020). The comparative financial and economic performance of protected areas in the Greater Kruger National Park, South Africa: functional diversity and resilience in the socio-economics of a landscape-scale reserve network. *Journal of Sustainable Tourism*, **28(8)**: 1100–1119.
- Child, M.F., Peel, M.J., Smit, I.P. & Sutherland, W.J., 2013. Quantifying the effects of diverse private protected area management systems on ecosystem properties in a savannah biome, South Africa. *Oryx*, **47(1)**: pp.29-40.
- Coetzer, K. L., Erasmus, B. F. N., Witkowski, E. T. F., & Bachoo, A. K. (2010). Land-cover change in the Kruger to Canyons Biosphere Reserve (1993–2006): A first step towards creating a conservation plan for the subregion. *South African Journal of Science*, **106(7/8):** 1–10.
- Conradie, E.H., Van Zyl, P.G., Pienaar, J.J., Beukes, J.P., Galy-Lacaux, C., Venter, A.D. & Mkhatshwa, G.V. (2016) The chemical composition and fluxes of atmospheric wet deposition at four sites in South Africa. *Atmospheric Environment*, **146**:113-131.
- DEA LTAS. (2013). *Long Term Adaptation Scenarios: Flagship Research Programme.* Pretoria: Department of Environmental Affairs.
- DEA TNC. (2017). Draft South Africa's Third National Communication under the United Nations Framework Convention on Climate Change. Pretoria: Department of Environmental Affairs.
- De Bruin, H.A.R., Bink, N.J., Kroon, L.J.M., 1991. Fluxes in the surface layer under advective conditions. In: Schmugge, T.J., Andre, J.C. (Eds.), Land Surface Evaporation-Measurement and Parameterization. Springer, New York, pp. 157-169.
- Findlay, S. J., & Twine, W. C. (2018). Chiefs in a democracy: A case study of the 'new" systems of regulating firewood harvesting in post-Apartheid South Africa.' *Land*, **7(1)**

- GKSDP (2020a) Greater Kruger Strategic Development Framework Detailed Cluster Analysis (based on Greater Kruger Vulnerability Assessment, 2018). Report commissioned by SANParks.
- GKSDP (2020b) Greater Kruger Strategic Development Programme Decision-makers summary. Report commissioned by SANParks.
- Harwood, A., Johnson, S., Richter, B., Locke, A., Yu, X. & Tickner, D. 2017. *Listen to the river: Lessons from a global review of environmental flow success stories*, WWF-UK, Woking, UK
- Janecke, B.B., Van Tol, J.J., Smit, I.P.J. Van Aardt, A.C., Riddell, E.S., Seaman, M.T., Swart, W.J., du Preez, P.J., & le Roux, P.A.L. (2020). Biotic and abiotic connections on a granitic catena: Framework for multidisciplinary research, *Koedoe* **62(2)**
- Kabudula C.W., Houle B., Collinson M.A., Kathleen K., Tollman S., & Clark S. (2016).
 Assessing changes in household socioeconomic status in rural South Africa, 2001-2013: a distributional analysis using household asset indicators. *Social Indicators Research*; **129**: 1-27
- Kahn K, Tollman SM, Collinson MA, Clark SJ, Twine R, Clark BD, et al. (2007). Research into health, population and social transitions in rural South Africa: data and methods of the Agincourt Health and Demographic Surveillance System. *Scandinavian Journal of Public Health*, **69**: 8-20
- Le Maitre, D.C., Seyler, H., Holland, M., Smith-Adao, L., Nel, J.L., Maherry, A. and Witthüser, K. (2018). *Identification, Delineation and Importance of the Strategic Water Source Areas of South Africa, Lesotho and Swaziland for Surface Water and Groundwater.* Water Research Commission, Report No. TT 743/1/1,
- Lowvelder, https://lowvelder.co.za/627152/pilane-calls-for-urgent-intervention-tosalvage-sinking-tourism-industry, 23 June 2020.
- Lorentz, S.A., Blight, J., Snyman, N. (2013). An Investigation into the Effects of Atmospheric Pollutants on the Soil-Water-Ecosystem Continuum in the Eastern Regions of South Africa. Water Research Commission, Report No K5/1697/1/11
- Matsika, R., Erasmus, B. F. N., & Twine, W. C. (2013). Double jeopardy: The dichotomy of fuelwood use in rural South Africa. Energy Policy, **52**:716–725.
- Mbiba, M., Collinson, M., Hunter, L., & Twine, W. (2019). Social capital is subordinate to natural capital in buffering rural livelihoods from negative shocks: Insights from rural South Africa. *Journal of Rural Studies*, **65**: 12–21.
- Mucina, L. & Rutherford, M. C. (2006) *The vegetation of South Africa, Lesotho and Swaziland*. Pretoria: South African Biodiversity Institute.
- Maritz, P., Beukes, J.P., Van Zyl, P.G., Liousse, C., Gardrat, E., Ramandh, A. & Mkhatshwa, G.V. (2019) Temporal and source assessments of organic and elemental carbon at sites in the northern South African interior, *Journal of Atmospheric Chemistry*, **76**:263–287.
- Mucina, L. &Rutherford, M.C. (2006). The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. SANBI, Pretoria
- Peel, M. J. S., Kruger, J. M., & MacFadyen, S. (2007). Woody vegetation of a mosaic of protected areas adjacent to the Kruger National Park, South Africa. *Journal of Vegetation Science*, **18**: 807–814.

- Pereira, L. M., Cuneo, C. N., and Twine, W. C. (2014). Food and cash: understanding the role of the retail sector in rural food security in South Africa. *Food Security*, 6(3), 339– 357.
- Pollard, S., Biggs, H., & du Toit, D. (2008). Towards a socio-ecological systems view of the Sand River Catchment, South Africa: An exploratory resilience analysis. Water Research Commission, Report No TT 364/08
- Pollard, S., T. Cousins, D. Kotze, C. Davis, E. Riddel, D. du Toit, E. Chuma, B. B. Mkhabela, & Addy, S, (2010). Sustainability indicators in communal wetlands and their catchments lessons from Craigieburn wetland, Mpumalanga. Water Research Commission, Report 1709/1/10
- Ragie, F.H., Olivier, D.W., Hunter, L.M, Erasmus, B.F.N., Vogel, C., Collinson, M. & Twine,
 W. (2020) A portfolio perspective of rural livelihoods in Bushbuckridge, South Africa.
 South African Journal of Science, 116 (9): 1-8.
- Riddell, E. S., Govender, D., Botha, J., Sithole, H., Petersen, R. M., & Shikwambana, P. (2019). Pollution impacts on the aquatic ecosystems of the Kruger National Park, South Africa. *Scientific African*, 6: e00195
- Riddell, ES., Everson, C., Clulow, A., & Mengistu, M (2013) The hydrological characterisation and water budget of a South African rehabilitated headwater wetland system. *Water SA* **39(1):** 57-66
- Riddell, ES., Lorentz, SA., & Kotze, DC. (2012) The hydrodynamic response of a semiarid headwater wetland to technical rehabilitation interventions. *Water SA* **38(1):** 55-66.
- Riddell, E., Nel, J., Van Tol, J., Fundisi, D., Jumbi, F., Van Niekerk, A. et al., 2020, Groundwater–surface water interactions in an ephemeral savanna catchment, Kruger National Park. *Koedoe*, 62(2): 1583.
- Roux, F., Diedericks, G., Kleyhans, C. J., Thirion, C., Hoffman, A. C. & Selepe, M. (2016) *Ecostatus of the Sabi-Sand River Catchment, Inkomati River System Phase II.* Report to the Inkomati-Usuthu Catchment Management Agency.
- Scholes, R.J.R. et al. (2001). The environment and vegetation of the flux measurement site near Skukuza, Kruger National Park. *Koedoe*, 44(1), pp. 73–84.
- Schulze R. E. & Davis N.S. (2019). Development of a Framework and Methodology for Undertaking a Risk and Vulnerability Assessment in All Nine Water Management Areas of South Africa. Practitioners' Handbook for Undertaking Current and Projected Future Climate Related Risk and Vulnerability Modelling Assessments. Schulze and Associates, Pietermaritzburg, Report to GIZ, Pretoria.
- Schmid, H.P. (1997). Experimental design for flux measurements: matching scales of observations and fluxes. *Agricultural and Forest Meteorology*. **87**: 179–200.
- Scogings, P. F., Hattas, D., Skarpe, C., Hjältén, J., Dziba, L., Zobolo, A., & Rooke, T. (2015). Seasonal variations in nutrients and secondary metabolites in semi-arid savannas depend on year and species. *Journal of Arid Environments*, **114**: 54–61.
- Smit, I. P. J., Riddell, E. S., Cullum, C., & Petersen, R. (2013). Kruger National Park research supersites: Establishing long-term research sites for cross-disciplinary, multiscaled learning. *Koedoe*, **55(1):** 1–7.
- Siebert, F., & Eckhardt, H. C. (2008). The vegetation and floristics of the Nkhuhlu exclosures, Kruger National Park. *Koedoe*, **50(1)**: 126-144.

- Smit, I. P. J., Riddell, E. S., Cullum, C., & Petersen, R. (2013). Kruger National Park research supersites: Establishing long-term research sites for cross-disciplinary, multiscaled learning. *Koedoe*, **55(1):** 1–7.
- Smit, I.P.J, Roux, D.J., Swemmer, L.K., Boshoff, N. and Novellie, P. (2017) Protected areas as outdoor classrooms and global laboratories: Intellectual ecosystem services flowing to-and-from a National Park. *Ecosystem Services*, **28**: 238-250.
- Smit, I.P.J. (In Press). Integrating multi-scaled and multidisciplinary studies: A critical reflection on the Kruger National Park research supersites. *Koedoe*
- Swemmer, L., Mmethi, H., & Twine, W. (2017). Tracing the cost/benefit pathway of protected areas: A case study of the Kruger National Park, South Africa. *Ecosystem Services*, **28**: 162–172.
- Tibesigwa, B., Visser, M., Collinson, M., & Twine, W. (2016). Investigating the sensitivity of household food security to agriculture-related shocks and the implication of social and natural capital. *Sustainability Science*, **11**: 193–214.
- Tickner, David, Jeffrey J. Opperman, Robin Abell, Mike Acreman, Angela H. Arthington, Stuart E. Bunn, Steven J. Cooke et al. (2020). Bending the curve of global freshwater biodiversity loss: an emergency recovery plan. *Bioscience* **70(4)**: 330-342.
- van Coller, H., Siebert, F., & Siebert, S. J. (2013). Herbaceous species diversity patterns across various treatments of herbivory and fire along the sodic zone of the Nkuhlu exclosures, Kruger National Park. *Koedoe*, **55(1)**: 01-06.
- van Wilgen, N. J., Goodall, V., Holness, S., Chown, S. L., & Mcgeoch, M. A. (2016). Rising temperatures and changing rainfall patterns in South Africa's national parks. *International Journal of Climatology*, **36(2):** 706–721.
- van Wilgen, B.W., Govender, N. & Biggs, H.C., 2007. The contribution of fire research to fire management: a critical review of a long-term experiment in the Kruger National Park, South Africa. *International Journal of Wildland Fire*, **16(5)**: 519-530.
- van Wilgen, N.J. & Herbst, M. (eds.) 2017. *Taking stock of parks in a changing world: The SANParks Global Environmental Change Assessment*, SANParks, Cape Town.
- Veldman, J.W., Aleman, J.C., Alvarado, S.T., Anderson, T.M., Archibald, S., Bond, W.J., Boutton, T.W., Buchmann, N., Buisson, E., Canadell, J.G. & de Sá Dechoum, M., (2019). Comment on "The global tree restoration potential". *Science*, **10(1126)**:
- Wigley-Coetsee, C. & Staver, A.C. 2020 Grass community responses to drought in an African savanna. *African Journal of Range and Forage Science* **37**:43-52.
- Woolley, L.A., Hedin, L., February, E. & Govender, N., 2011. Ecosystem level N and P effects on carbon assimilation and growth by savanna shrubs. In *Ecological Society of America (2011) Conference*

D. APPENDIX 1: LIST OF COLLABORATORS

Convenor: Prof. Wayne Twine, Wits Rural Knowledge Hub & School of Animal, Plant & Environmental Sciences, University of the Witwatersrand, wayne.twine@wits.ac.za

Prof. Sally Archibald, School of Animal, Plant & Environmental Sciences, University of the Witwatersrand, sally.archibal@wits.ac.za

Prof. J. Beukes, Atmospheric Chemistry Research Group, North-West University, Potchefstroom, Paul.Beukes@nwu.ac.za

Prof. Mark Collinson, South African Population Research Network & SAMRC/Wits Rural Health and Health Transitions Research Unit (Agincourt), mark.collinson@wits.ac.za

Prof Alan Gardiner, Applied Learning Unit: Southern African Wildlife College, agardiner@sawc.org.za

Prof. Xavier Gomez-Olive, SAMRC/Wits Rural Health and Health Transitions Research Unit (Agincourt), f.gomez-olivecasas@wits.ac.za

Dr. Cleo Graf, Applied Learning Unit: Southern African Wildlife College, cgraf@sawc.org.za

Mr. Peter Hamming, Applied Learning Unit: Southern African Wildlife College, phamming@sawc.org.za

Dr. Laurence Kruger, Organization for Tropical Studies, University of Cape Town laurence.kruger@tropicalstudies.org

Dr Brian Mantlana, Council for Scientific and Industrial Research, bmantlana@csir.co.za

Dr. Mohau Jacob Mateyisi, Council for Scientific and Industrial Research, mmateyisi@csir.co.za

Dr. Gordon O'Brien, School of Biology and Environmental Sciences, University of Mpumalanga, gordon.obrien@ump.ac.za

Prof. Daniel Parker, School of Biology and Environmental Sciences, University of Mpumalanga, daniel.parker@ump.ac.za

Dr. Mike Peel, Agricultural Research Council, mikep@arc.agric.za

Dr. Abel Ramoelo, Scientific Services, South African National Parks (SANParks), abel.ramoelo@SANParks.org

Dr. Eddie Riddell, SANParks Scientific Services, Skukuza, Eddie.Riddell@SANParks.org

Mr. Peter Scott, Mjejane Game Reserve, peter@mjejane.com

Dr. Izak Smit, SANParks Scientific Services, Skukuza, Izak.smit@SANParks.org

Dr. Anthony Swemmer, South African Environmental Observation Network (SAEON), tony@saeon.ac.za

Mr. Nick Theron, K2C BR, nicktheron@kruger2canyons.org

Ms. Marie-Tinka Uys, K2C BR, info@kruger2canyons.org

Mr. Wehncke van der Merwe, K2C BR, wehncke@kruger2canyons.org

Dr. Ilana van Wyk, Research coordinator: Hans Hoheisen Wildlife Research Station, University of Pretoria, Ilana.vanwyk@up.ac.za

Prof. P. van Zyl, Atmospheric Chemistry Research Group, North-West University, Potchefstroom, pieter.vanzyl@nwu.ac.za

Dr. Corli Wigley-Coetsee, SANParks Scientific Services, Skukuza, corli.wigley-coetsee@sanparks.org

E. APPENDIX 2: LETTERS OF SUPPORT

- a. Research and education institutions and individuals
- b. Non-Governmental Organisations
- c. Regulatory bodies
- d. Land custodians
- e. Community representatives and relevant local authorities

a. Research and education institutions and individuals



ARC-ANIMAL PRODUCTION INSTITUTE

P.O. Box 1200, Nelspuit, 1200, South Africa Tel: (013) 753 7147 Fax: (013) 753 7039 (Int: +2712) E-Mail: mikep@arc.agric.za Web site: www.arc.agric.za

Enquiries / Navrae Ref..no / Verw. nr EFTEON INITIATIVE

15/09/20

EFTEON LANDSCAPE PROPOSAL EVALUATION PANEL

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you on behalf of the Agricultural Research Council's Animal Production Institute (Rangeland Ecology Division) to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

The Rangeland Ecology Division (Nelspruit) has managed the Savanna Ecosystem Dynamics Project in the lowveld since 1989. The project covers an area of some 450 00ha of the eastern lowveld between the Sabie and Letaba Rivers. The focus includes around 500 annually monitored vegetation-sampling sites, as well as an ongoing monitoring programme which is aimed at detecting vegetation change over time under different management and environmental (soils and rainfall) regimes. For example, we have geo-referenced animal number and type data obtained from helicopter counts dating back to 1992. Using the above data, the objective is to promote responsible land use management where opportunities are grasped and risks avoided. Relevant to this proposal, the ARC programme described above is ongoing in the Sabi Sand Wildtuin and Mala Mala Game Reserve with data for the Manyeleti GR as well. The unit has well-established relationships with the landowners and managers of private reserves in the study area, and collaborates with a wide range of local and international university research partners.

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because of the diversity of land uses and stakeholder interests, particularly the critical driver, water. The EFTEON research infrastructure in the landscape would be useful for investigating how different land use options and objectives affect the structure and functioning of this savanna system in terms of maintaining biodiversity and long term sustainability of resources.

As a research institution active in the landscape, the Agricultural Research Council would benefit from such research infrastructure and associated data. Financial and manpower resources are limiting among most institutions and it is imperative that we use the pooled expertise and infrastructure of the various partners in a synergistic manner to the benefit of the region.

The ARC, Animal Production Unit (Rangeland Ecology) hereby undertakes to support the EFTEON Lowveld Sabie-Sand Catchment landscape in whatever way we can.

Yours sincerely

Mili Per

(DR. MIKE PEEL: Specialist Scientist; Pr. Sci.Nat.; M.G.S.S.A.)



CSIR P O Box 395 Pretoria 0001 South Africa Tel: 0128417226

> Cell: 0715189137 Email: BMantlana@csir.co.za

> > 2 October 2020

EFTEON landscape proposal evaluation panel

Dear colleagues

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you on behalf of the Council of Scientific and Industrial Research (CSIR) to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

The CSIR flux observation network consists of two (i.e. Skukuza and Agincourt) eddy covariance flux towers that are within the Lowveld Sabie-Sand Catchment. These flux tower sites are in the savanna biome which occupies 46% of the southern African area (i.e. dominant vegetation in Botswana, Namibia and Zimbabwe) and 34% in South Africa. The Skukuza flux tower is one of the longest running flux tower in Africa and it has been used as a reference site for the study of land use and management impacts since the year 2000. The Agincourt flux tower has been in operation on the southern edge of Agincourt village since 2016 and it also provides energy, water and CO₂ fluxes reflective of the human forcing/human-modified landscape against natural variations in the Skukuza flux tower site which has a unique internal dynamics due to the influence of large herbivores such as elephants. These two flux towers, owing to their geographical location, have demonstrated comparative advantage in the dynamics of coupled social-ecological systems research and they are ideal for long term studies of complex ecological, wildlife and social interactions and feedbacks in the phase of land use and management practises. Data products from these flux towers can also be used for understanding the response of landscape processes and organization to climate change and the associated extremes. The observational design of these flux towers is also ideal for multidisciplinary approach to study ecological processes from ecophysiology (leaf level) to the landatmospheric flux coupling (local landscape) and land management impact.

The landscape on which the flux towers are located has attracted research efforts and collaborations from multiple scientific disciples of which a large body of literature and historical data exist. Moreover, through various engagements with the local stakeholders, CSIR has established a good working relationship with the community of Agincourt and the Kruger National Park. The running of these flux towers has been co-funded by the government through the Department of Science and Technology (DST) parliamentary grant as well as by Institute of Climate-Smart Agriculture (EMSAfrica).



CSIR P O Box 395 Pretoria 0001 South Africa Tel: 0128417226

> Cell: 0715189137 Email: BMantlana@csir.co.za

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because it allows investigation of long-term socio-ecological change in the context of a heterogeneous, lived-in savanna landscape with a gradient of human densities and landscape transformation. This is a rapidly transforming landscape within the catchments of two large river systems.

As a research institution active in the landscape, CSIR would benefit from such research infrastructures and harmonization in the methodologies employed across all the six EFTEON landscapes which meet the evolving needs of the South African Science community. By having EFTEON manage the flux towers, CSIR will have an opportunity to invest its funding in education and training, aiming to further develop modelling capacity. In addition, the multi-functionality of the landscapes targeted by EFTEON (cutting across nature reserves, communal areas and aquatic environments) will offer more research opportunities for CSIR to meet its key values for Human Capital Development (HCD) through recruiting postgraduate students and generating new knowledge, science and technology through research.

CSIR hereby undertakes to support the EFTEON Lowveld Sabie-Sand Catchment landscape in whatever way we can.

Yours sincerely

ch. 8. Mar

Brian Mantlana Impact Area Manager: Holistic Climate Change Smart Places Cluster CSIR, Pretoria



NWU[®] Chemical Resource Beneficiation

North-West University, Hoffman street, Potchefstroom, South Africa 2531

Tel: +27-(0)18-299-2000 Fax: +27-(0)18-299-2999 Web: http://www.nwu.ac.za

Research Focus Area for Chemical Resource Beneficiation Tel: +27-(0)18-299-1669 E-mail: manie.vosloo@nwu.ac.za

EFTEON Network landscape evaluation committee

5 October 2020

Dear Prof/Dr/Madam/Sir

PARTICIPATION OF THE ATMOSPHERIC CHEMISTRY RESEARCH GROUP AT THE NORTH-WEST UNIVERSITY IN EFTEON LOWVELD SABIE-SAND CATCHMENT

This letter serves to confirm the readiness of the Atmospheric Chemistry Research Group (ACRG) at the North-West University (NWU), co-managed by Profs JP Beukes and PG van Zyl, to participate in the activities of the Expanded Freshwater and Terrestrial Environmental Observation (EFTEON) Network Landscape to be hosted in the Sabie-Sand catchment. More specifically, the ACRG will recommence with sulphur (S) and nitrogen (N) deposition measurments in this network landscape.

If more information is required, please do not hesitate to contact me immediately.

Sincerely

HUM Vosloo

Prof HCM Vosloo Director: CRB





25 September 2020

EFTEON landscape proposal evaluation panel

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you on behalf of the Organization for Tropical Studies and Nsasani Trust to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

Over the last 17 years, OTS has conducted long term biodiversity research in the Kruger Park, focusing on the southern Supersites and Sabie River. Taxa include woody plants, small mammals, birds and bats. We partner with the University of Florida and SANParks Scientific Services in running the long term exclosures on the southern Basalts (3 full exclosures, 6 partial megaherbivore exclosures and 17 control sites. As part of the Skukuza Science Leadership Initiative (OTS, Nsasani Trust and SANParks SS), we have constructed a purpose built research and education centre in Skukuza with a library, laboratory, lecture theatre, workshop (to build research infrastructure) and accommodation for students and researchers alike.

To date, OTS has run over 70 Human Capital Development programmes for international and local students including semester-long study abroad undergraduate programmes, 30 day Global Health courses and Biodiversity and Science Leadership training courses for early career conservation practitioners.

The Nsasani Trust has now run over 100 HCD Science Leadership courses for high school students, teachers and early career conservation students, focusing largely on local students.

Community engagement: We work with a range of international and local universities, conservation NGOs and local conservation agencies in delivering these courses whilst collecting much needed long term data. Our local students primarily come from areas around the Kruger Park, so we

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because of the ecological suitability (covers key ecological gradients), the land use change gradients, land management gradients as well as the intimate relationship between conservation agencies, communities and academic institutions. The EFTEON research infrastructure in the landscape would be useful for scaling up our investigations into the following:

a) The effect of fire and megaherbivores, climate change and drought on faunal and floral diversity and ecosystem functioning;

- b) The effects of flooding and megaherbivores on riparian floral and faunal communities
- c) How land use change affects biodiversity, ecosystem services and the environmental consequences by assessing one health indicators.

As an academic and research institution active in the landscape, OTS and Nsasani Trust would benefit from such research infrastructure and associated data as it would establish a fantastic platform for collaborative research, enhancing datasets and exchange between students and academics. Additionally, our education programmes and graduate students would benefit enormously from engaging with a variety of potential collaborators which would improve learning, enhance research output and build future collaborations.

The Organization for Tropical Studies and Nsasani Trust hereby undertakes to support the EFTEON Lowveld Sabie-Sand Catchment landscape in whatever way we can.

Yours sincerely

Laurence Kruger, PhD Curriculum Director Organization for Tropical Studies/University of Cape Town Director, Nsasani Trust Skukuza, Mpumalanga, 1350 South Africa Email Address: <u>laurence.kruger@tropicalstudies.org</u> Laurence.kruger@uct.ac.za

Tel: Mobile: +27 13 735 5854 +27 82 4226225



28 Sept 2020

To whom it may concern,

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you as Director of the South African Population Research Infrastructure Network (SAPRIN) to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment in Mpumalanga Province as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

SAPRIN is a national research infrastructure established under the South African Research Infrastructure Roadmap (SARIR). As such, it is a sister research infrastructure to EFTEON. SAPRIN is funded by the Department of Science an Innovation (DSI) and is hosted by the South African Medical Research Council (SAMRC). It draws together a network of the three original rural health and demographic surveillance system (HDSS) nodes, to which two additional urban HDSSs have been added. HDSS nodes in the SAPRIN network implement a standard protocol for the prospective and longitudinal collection of population, health and socio-economic data in geographically defined sections of impoverished and developmentally-constrained communities. The Agincourt HDSS in Bushbuckridge, Mpumalanga Province, is one of the three existing SAPRIN nodes.

We welcome and encourage the establishment of the EFTEON Lowveld Sabie-Sand Catchment landscape, which overlaps with the SAPRIN Agincourt HDSS node. This would provide opportunities for strategically significant synergies between the two research infrastructures in the Mpumalanga lowveld, particularly in terms bringing together the diverse data sets needed to understand complex relationships between humans and the environment. This would broaden the scope for interdisciplinary research by the scientific community that can inform pro-poor health and wellbeing interventions in the context of environmental change in the region. Not only would these synergies lead to better science, but they would also enhance the cost-effectiveness of the research infrastructures in the landscape.

SAPRIN therefore fully supports this proposal.

Regards

Flerbot

Dr AJ Herbst Director: South African Population Research Infrastructure Network (SAPRIN)

Funded by:



science & innovation Department: Science and Innovation

REPUBLIC OF SOUTH AFRICA





Office:

Director: Dr AJ Herbst SAMRC Durban Office 491 Peter Mokaba Ridge Rd Overport, Durban 4091 Tel: +27 31 203 4727 Email: saprin@mrc.ac.za



Registered as an incorporated association for Section 21 of the Companies Act 61 of 1973 Registration Number 1996/005726/08. 046-675-NPO. 930016093-PBO

2020.09.21

EFTEON landscape proposal evaluation committee

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you on behalf of the Southern African Wildlife College (SAWC) to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

The Southern African Wildlife College was established in 1996 by the World Wide Fund for Nature, South Africa (WWF-SA) in close cooperation with interested and affected parties in southern Africa, including national and provincial government departments, other conservation agencies and the Southern African Development Community (SADC). The SAWC is an independent SADC training institution and does not receive a government subsidy.

The SAWC is currently provisionally registered with the Department of Education and training as a private Higher Education Institution under the Higher Education Act, 1997. The registration number with the Department of Education is Reg. No. 2008/FE08/003.

Recognised by the South African Department of Environmental Affairs, as a credible and long standing non-government conservation organisation (NGO), the SAWC is an approved project for Socio Economic Development under the Broad-based Economic Empowerment Act 53 of 2003 and the Codes of Good Practice on Broad-based Economic Empowerment. SAWC is registered as a VAT vendor with the South African Revenue Services (SARS) - VAT Registration No: 4370159610 and Tax Reference No: 9508059640.

In striving to inspire every person we train and engage with to conserve out natural world, we are innovative, transformative and solutions driven. Our purpose is to promote through leadership and equip people with the necessary knowledge and applied skills to conserve and protect Africa's natural resources and its biodiversity. We do this in responsible, inclusive and economically sustainable ways. The major stakeholders include conservation

Directors: Mr. F.G. Mketeni (Chairperson), Mr. S. Abrahams, Mrs. L.M. Lynch, Mr. S.M. Munzhedzi, Mr. W. Myburgh, Mr. A.H. Parker, Dr. G. Raven, Prof. B.K. Reilly, Mrs. T. Sowry, Mr. C. Weber.

Private Bag X3015, Hoedspruit 1380, South Africa Telephone: +27 (015) 793 7300 e-mail: info@sawc.org.za www.wildlifecollege.org.za

agencies, tourism and hospitality sectors, local communities and private business. Since inception, more than 17,000 students from 26 countries in Africa, but mostly from countries in the SADC region, have received training in natural resource management through the SAWC. By expanding its reach and becoming involved in training ventures and projects offsite the College has also capacity-built over 2000 previously disadvantaged South Africans.

Conservation: The Southern African Wildlife College aims through cutting edge, hands-on training programmes, to produce highly competent and motivated conservation practitioners. They are then able to apply these conservation techniques in their areas in order to sustain its associated fauna and flora. In striving to develop the potential of its students, the College delivers on its mandate to equip students to deal with the key challenges facing conservation. The SAWC delivers training to conservation professionals, communities and others in a 'learning-by-doing' approach and at the same time monitors and analyses the impacts this training has on the conservation industry and community members' livelihoods. This approach has led to research and innovation being part of our core structure. It also means we run needs based short courses and specially developed modules in our higher and further education programs. Our learning by doing approach, through the SAWC Applied Learning Unit, offers great opportunities for applied research into these innovations and practices. This philosophy, as well as the physical positioning of the SAWC campus, in a wildlife area, with neighbouring communities that fall within the Sabie Catchment study area, makes the College ideal for both training & applied research.

Much of our work and research is to help improve the use of natural resources by ourselves, our neighbouring communities and communities in other countries. With this in mind our latest work and research has focused on i) an Integrated Information Management System for data sharing and communication structures, we have already started this for the One Health program which encompasses various universities, this could also be of use for the Efteon project ii) a standardized technological approach across reserves and the landscape which will allow meta-analysis and management in the wider landscape (using applicable software such as, QGIS, SMART and/or Earth Ranger). iii) Governance issues in communities and iv) the better use of water especially through recycling. In regard to the third point a training section of the College, the Rural Initiative for a Sustainable Environment (RISE), focuses on the engagement with communities in order to improve the use of natural resources for the benefit of the people and the environment. i) governance issues in communities and ii) the better use of water especially through recycling. In regard to the first point, a training section of the College, the Rural Initiative for a Sustainable Environment (RISE), focuses on the engagement with communities in order to improve the use of natural resources for the benefit of the people and the environment.

As a stakeholder in the landscape, SAWC would benefit from such research infrastructure and associated data. The information collected would help us with making more informed decisions on what skill development is required for the future. We can also offer value to the landscape and our partners by offering relevant and current training based on local research findings.

TRAINING BEYOND BOUNDARIES

Directors: Mr. F.G. Mketeni (Chairperson), Mr. S. Abrahams, Mrs. L.M. Lynch, Mr. S.M. Munzhedzi, Mr. W. Myburgh, Mr. A.H. Parker, Dr. G. Raven, Prof. B.K. Reilly, Mrs. T. Sowry, Mr. C. Weber.

Private Bag X3015, Hoedspruit 1380, South Africa Telephone: +27 (015) 793 7300 e-mail: info@sawc.org.za www.wildlifecollege.org.za

SAWC hereby undertakes to support the EFTEON Lowveld Sabie-Sand Catchment landscape in whatever way we can.

Yours sincerely

Obratine

Alan Gardiner

Head: Applied Learning Unit alagar@sawc.org.za

TRAINING BEYOND BOUNDARIES

Directors: Mr. F.G. Mketeni (Chairperson), Mr. S. Abrahams, Mrs. L.M. Lynch, Mr. S.M. Munzhedzi, Mr. W. Myburgh, Mr. A.H. Parker, Dr. G. Raven, Prof. B.K. Reilly, Mrs. T. Sowry, Mr. C. Weber.

Private Bag X3015, Hoedspruit 1380, South Africa Telephone: +27 (015) 793 7300 e-mail: info@sawc.org.za www.wildlifecollege.org.za



Mnisi Community Programme



Hans Hoheisen Wildlife Research Station

UNIVERSITEIT VAN PRETORIA UNIVERSITY OF PRETORIA YUNIBESITHI YA PRETORIA

12 September 2020

To Whom It May Concern,

LETTER OF SUPPORT: Proposal for the Lowveld Cluster Landscape as an EFTEON Landscape

On behalf of the Hans Hoheisen Wildlife Research Station (HHWRS), University of Pretoria, I herewith provide in principle support for the proposal indicated above.

The proposed research objectives of the EFTEON Lowveld region align with the research theme of the HHWRS, namely One Health at the human/domestic animal/wildlife interface. Through the Mnisi Community Programme, research at HHWRS, both long-term and short term projects have focussed on improving community health and well-being through improving animal health and production. Vector-borne diseases, as well as zoonotic disease such as Rabies are found to be off particular relevance in the Mnisi community.

To support the research at HHWRS, facilities here include laboratories, including dirty laboratory, microbiology, molecular biology, parasitology and a BSL2+ laboratory for controlled infectious diseases such as Foot-and-Mouth Disease and Bovine Tuberculosis. The Biobank, which includes -20°C freezers, is a particularly valuable resource for retrospective research in wildlife diseases, as well as livestock.

The impact of demographic, environmental and technological changes on the threat of emerging diseases, both regionally and globally, is well recognized and of particular relevance to resource limited populations at the interface with wildlife. The data proposed to be collected by the EFTEON project in the Lowveld region will be of significant value and complementary to ongoing and future research at HHWRS on specifically vector-borne diseases, but also other emerging diseases.

We also hope to contribute to the EFTEON project in the Lowveld through our own complementary research at HHWRS, as well as availing our laboratory facilities to the EFTEON researchers.

Please accept our letter of support on this application.

Kind regards,

lung

Dr. Ilana van Wyk Research Coordinator: Mnisi Community Programme Hans Hoheisen Wildlife Research Centre

Hans Hoheisen Wildlife Research Station University of Pretoria Private bag X04, ONDERSTEPOORT 0110 Republic of South Africa E-mail: ilana.vanWyk@up.ac.za

www.up.ac.za



21 September 2020

EFTEON LANDSCAPE PROPOSAL EVALUATION COMMITTEE

RE: SUPPORT FOR EFTEON LANDSCAPE PROPOSAL: LOWVELD SABIE-SAND CATCHMENT

To whom it may concern,

I write to you on behalf of the School of Biology and Environmental Sciences, University of Mpumalanga to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

The University of Mpumalanga (UMP) is a new South African University, located in Mbombela, Mpumalanga. The university was established in 2013 and now offers 26 qualifications, to a total of 4200 students in 2020 and is still growing rapidly. Within the Faculty of Agriculture and Natural Sciences our university undertakes a range of terrestrial and aquatic ecosystem research on multiple spatial scales considering regional landscapes. We are concerned with our natural environment and the vulnerable human communities who depend on these systems. We have researchers with expertise in agriculture, social environmental sciences, environmental and ecological sciences, ecological risk assessments and terrestrial and aquatic resource management. We have numerous local and international collaborations and work closely with local regulators, conservationists, governments and various local formal and informal communities and the private sector in our regional research. Our applied research focus area includes the greater Inkomati Catchment within which UMP is located and the Mpumalanga region.

We believe that the Lowveld Sabie-Sand Catchment which is located within our focused area is highly suitable as an EFTEON infrastructure landscape because it is representative of our regional vulnerable ecosystems and the people who depend on these ecosystems. This case study will support the sustainable management of the resources and the communities of this area and facilitate the expansion of the research into the greater region.

As a stakeholder in the landscape, the UMP would benefit from such research infrastructure and associated data through the facilitation of the regional research and student training and contribute to the effectivity of the UMP to contribute to the sustainable management of terrestrial and aquatic ecosystems in the Sabie-Sand Catchment and greater Inkomati Catchment, and the sustainability of the vulnerable communities who depend on these resources. The University of Mpumalanga hereby undertakes to support the EFTEON Lowveld Sabie-Sand Catchment landscape in whatever way we can.

Mbombela Campus (Main Campus)

University of Mpumalanga, Private Bag x 11283, Mbombela, 1200 c/o D725 and R40, Riverside, Mbombela, South Africa, 1200 Tel: +27 13 002 0001

Siyabuswa Campus

Bhekimfundo Drive, Siyabuswa, South Africa, 0472 Tel: +27 13 590 0590 **General enquiries** (Switchboard) Tel: +27 13 002 0001 Email: info@ump.ac.za Web: www.ump.ac.za Yours sincerely

For any more information please contact us. Kind regards,

Ì

Prof. Daniel Parker



EFTEON landscape proposal evaluation committee

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

On behalf of the University of the Witwatersrand (Wits), I express my support for the proposal to develop the Lowveld Sabie-Sand Catchment in Mpumalanga Province as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

Wits has a long history of conducting high quality research in the lowveld, especially in the fields of environmental sciences, public health, demography, and rural livelihoods, anchored at the Wits Rural Campus (WRC) and the Agincourt Health and Socio-Demographic System (AHDSS).

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because it provides a living laboratory for investigating and understanding the complex relationships between humans and nature across a heterogenous landscape in the face of global change. This is supported by a critical mass of diverse research endeavours in the landscape, to which Wits has made a substantial contribution over many years.

Wits researchers and postgraduate students will both benefit from, and be able to contribute to, longterm research using the EFTEON research infrastructure in the landscape. Our School of Animal, Plant and Environmental Sciences is internationally recognised for research in savanna ecology and biodiversity, aquatic biology, and sustainable natural resource use. The Wits Global Change Institute plays a leading role in research on adaptation to, and mitigation of, climate change, coupling ecosystem integrity and human wellbeing, linking people, practice and policies, and building resilience. The AHDSS, which is operated by the Medical Research Council/Wits School of Public Heath Agincourt Unit, is an advanced research platform in the nominated landscape that enables longitudinal health, population and socio-ecological research. It is one of three national nodes of the South African Population Research Infrastructure Network (SAPRIN) funded by the national Department of Science and Innovation (DSI). The Wits Rural Knowledge Hub at the WRC serves as a nexus for integrating the various Wits research and teaching activities in the lowveld.

Private Bag 3, WITS, 2050, South Africa | T +27 11 717 1152 | E joao.rodrigues@wits.ac.za | www.wits.ac.za



Wits University will support the EFTEON Lowveld Sabie-Sand Catchment landscape in whatever way we can. Operationally, we offer the use of our facilities at the Wits Rural Campus to EFTEON, subject to availability. These include visitor accommodation, meeting and dining facilities, an ecology laboratory, staff housing and office space, all set in an attractive bushveld setting.

Yours sincerely

Professor João Rodrigues Acting Deputy Vice-Chancellor(Research and Postgraduate Affairs)

Date: 25th September 2020



MRC/Wits Rural Public Health and Health Transitions Research Unit (Agincourt)

School of Public Health, University of the Witwatersrand, 27 St Andrew's Road, Parktown, Johannesburg, South Africa, 2193 Tintswalo Hospital, Main Road, Acomhoek, Mpumalanga, South Africa, 1360 Te lephone: +27 11 717 2085 (Johannesburg) | +27 13 795 5076 (Acomhoek) | www.agincourt.co.za | twitter @AgincourtHDSS

29 September 2020

EFTEON landscape proposal evaluation panel

Dear Colleagues

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you as Director of the SAMRC/Wits Rural Public Health and Health Transitions Research Unit (Agincourt) which runs the Agincourt Health and Socio-Demographic Surveillance System (AHDSS) in Bushbuckridge, Mpumalanga Province. On behalf of the Unit, I wish to express my enthusiastic support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

The AHDSS was established in 1992 to support district health systems development led by the postapartheid Department of Health. It is a robust research platform that enables the regular and standardised collection of longitudinal demographic, health and socio-economic data – during times of rapid social change – for a rural population now totalling approximately 118,000 people and 18,000 households in 31 villages located in the proposed Lowveld Sabie-Sand Catchment. The backbone of the AHDSS is an annual census update – recently extended to 2 x telephonic and 1 x face-to-face round each year – in which the resident status/household membership (including temporary/labour migrants) and vital events (births, deaths, cause-of-death) of all individuals are systematically updated. Add-on modules are deployed with the census at varying frequencies, such as socioeconomic status (annual) and food security (every three years). The research platform provides a foundation for observational and intervention studies focusing on different stages along the life course (children, youth, adults, elders), evaluation of national policy at population, household and individual levels, and examination of household responses to shocks and stresses and the resulting pathways influencing health and wellbeing. The AHDSS is one of three founding nodes in the South African Population Research Network (SAPRIN), a National Research Infrastructure.

A growing portfolio of socio-ecological research has been enabled by the MRC/Wits-Agincourt Unit and AHDSS through collaboration with colleagues from the environmental sciences at Wits and environmental sociology at the University of Colorado, USA. Early work demonstrated the environmental dimensions of HIV/AIDS, particularly highlighting how the pandemic reshaped household natural resource use patterns. Building on this and related work, the SUCSES household livelihoods cohort of 590 households nested in the AHDSS was established in 2010 to enable the longitudinal investigation of human-environment relationships. Enabled by the AHDSS research infrastructure, this ongoing socio-ecological research is providing new insights into patterns and determinants of household resource use, the contribution of natural resources to rural livelihood security and resilience, and the impacts of environmental change and extreme events on human wellbeing. The Agincourt Unit also played an instrumental role in the establishment of the Agincourt Flux Tower in the AHDSS site by assisting with the necessary community engagement processes.









The Lowveld Sabie-Sand Catchment is an ideal setting for long-term research in a lived-in landscape, with the densely populated former-homeland region of Bushbuckridge surrounded by conservation areas of national and international significance. The AHDSS provides nearly 30 years of longitudinal health, population and socio-economic data on a rural population in this landscape, and will continue to enable the collection of such data for decades to come. A 1-in-10 sample of the entire AHDSS dataset is publicly available from our data portal, and more extensive data sets are available, by data agreement, via SAPRIN. The presence of the AHDSS within this landscape thus provides unparalleled opportunities for linking long-term health and socio-demographic surveillance with environmental observation to build on, broaden and deepen existing research on relationships between environmental change and human health and wellbeing.

I therefore fully endorse the proposal for the EFTEON Lowveld Sabie-Sand Catchment landscape and would be glad to respond to any queries.

Yours sincerely

Colouran

Stephen Tollman, Research Professor

Director: MRC/Wits Rural Public Health and Health Transitions Research Unit Head, Health and Population Division, School of Public Health University of the Witwatersrand

Copy: Prof. Wayne Twine



Faculty of Natural and Agricultural Sciences

4 October 2020

The Evaluation Panel: EFTEON landscape proposal

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you to express my support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

From 2003 – 2019, this area was the primary focus for most of my research on savannah rangeland dynamics, global change impacts, and rural sustainability studies. Twenty-one postgraduate degrees with 31 papers associated with these studies, relied completely on the data, networks, and communities of practice active in this area. This level of research activity is true for a large number of researchers in this area, that means the required baselines, and many of the detailed systems' knowledge already exist for future studies.

In addition to the research intensity in this landscape, the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape. It provides a practical laboratory to explore the patterns and consequences of urban and rural development, which is extremely relevant not just to the rest of South Africa, but also the rest of the continent. The perceived conflicts of conservation with development plays out here on a daily basis, and the existing collaborative research platforms that already exist here (e.g. SAPRIN Rural node, Kruger-to-Canyons Biosphere reserve, and several established NGOs) provides an invaluable opportunity to steer development trajectories, based on good and inclusive science, to more sustainable futures.

Environmental change research needs long-term data, and it needs to cover environmental, social, and economic data. The proposal builds on one-of-a-kind long-term data already in place, and the additional EFTEON infrastructure will ensure it is properly curated, archived, and made available for a larger community of researchers.

I not only support the proposal, I know that it is an important investment to continue the research intensity and long term data that already exist in this area.

Yours sincerely

BAllon

Prof Barend F N Erasmus Dean

> Fakulteit Natuur- en Landbouwetenskappe Lefapha la Disaense tša Tlhago le Temo



Dr Catherine Parr Professor in Tropical Ecology

School of Environmental Sciences Nicholson Building Liverpool, L69 3GP

T 0151 795 4382 E kate.parr@liverpool.ac.uk

www.liverpool.ac.uk

30 September 2020

EFTEON landscape proposal evaluation panel

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I am writing to express my full support and enthusiasm for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

I have been working in this region for more than 20 years and the region is a key field location for my research and many of my students'. My research principally focuses on understanding the impact of fire on biodiversity, and the value of dominant social insects for ecosystem structure and functioning. My field sites have included those in Kruger National Park (e.g. Experimental Burn Plots (EBPs)), and those outside formal conservation areas – e.g. Wits Rural Facility, and wider landscape around Bushbuckridge.

The Lowveld Sabie-Sand Catchment is ideal as an EFTEON infrastructure landscape because it encompasses a diverse, dynamic range of landscape types – from highly transformed, to natural savanna systems under different management – and thus enables a suite of applied and more theoretical ecological questions and challenges to be addressed. The proposed EFTEON landscape is rich in biodiversity and has major scientific investment to-date. Consequently, there is a wealth of existing data on which to build long-term environmental and socio-ecological research. Existing opportunities include several world-leading long-term experiments (e.g. EBPs, large herbivore exclosures), and excellent coverage from remotely sensed data. This wealth of data presents a considerable opportunity to bring together data from different studies; it is likely the sum is greater than the parts.

Importantly, the EFTEON Environmental and Socio-Ecological Research Infrastructure landscape will enable long-term research. Long-term data are particularly valuable, but generally scarce; this is of particular concern in event-driven systems such as the lowveld savanna. For example, to understand the consequences of droughts, long-term data are essential. The development of the Lowveld Sabie-Sand Catchment as a long term Research Infrastructure landscape is, therefore, a rare and important opportunity.

My research group and collaborators continue to work in the region, and increasingly plan to expand our work to socio-ecological systems quantifying the value of biodiversity across the region. The prospect of long-term continuous automated measurements (e.g. metereological and phenological), as well as repeated biotic measurements (biodiversity), combined with socio-ecological surveys and remotely sensed data is exciting and would likely form the basis for many new multidisciplinary studies.

Ultimately, the proposed EFTEON will strengthen our understanding of this critically important savanna landscape – for both humans and nature. This Network is, in my opinion, urgently needed and essential given how rapidly our world is changing.

I hope you will support this EFTEON Network.

Yours faithfully,

Pan .

Catherine L. Parr (Professor)



FRIEDRICH-SCHILLER-**UNIVERSITÄT**

JENA Faculty of Chemistry and Earth Sciences **Department for Earth Observation**

Friedrich-Schiller-University Jena · Institute of Geography 07737 Jena

Prof. Wayne Twine School of Animal, Plant & Environmental Sciences University of the Witwatersrand c/o Wits Rural Campus Private Bag X420 Acornhoek, 1360 South Africa

Prof. Dr. Christiane Schmullius Full Professor

Löbdergraben 32 07743 Jena

Telefon: Telefax: E-Mail:

0 36 41 9-48880 /-81 0 36 41 9-48882 c.schmullius@uni-jena.de

Jena, 28. September 2020

Letter of support for EFTEON landscape proposal (Lowveld Sabie-Sand Catchment)

Dear Prof. Twine,

thank you very much for your invitation to help establishing the Lowveld Sabie-Sand Catchment "research landscape" recognized by the funding EFTEON programme, the South African Environmental Observation Network (SAEON) and the National Research Foundation of South Africa. With this letter, the Department for Earth Observation, Friedrich-Schiller-University Jena (FSU), confirms to fully support the landscape proposal and the long-term research to be conducted in the Lowveld Sabie-Sand Catchment. More specifically, the FSU will contribute to this initiative with a range of remote sensing data and products over selected area, such as the Agincourt and Skukuza flux tower sites. These include, but are not limited to, multispectral, thermal and radar-based satellite time series, a digital elevation model and historical aerial photographs. We trust that these and other information layers will provide the scientific basis for investigating the status and dynamics of different land surface parameters and will help gaining a better understanding of the Lowveld Sabie-Sand Catchment.

Yours sincerely,

Ch. Sdeller

Prof. Dr. Christiane Schmullius



Private Bag X6001, Potchefstroom South Africa 2520

Tel: 018299-2374 Web: http://www.nwu.ac.za

School of Biological Sciences Unit for Environmental Sciences and Management Email:frances.siebert@nwu.ac.za

30 September 2020

EFTEON landscape proposal evaluation panel

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you to express my support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

Ecologists at the North-West University are actively involved in research related to long-term monitoring and vegetation dynamics within the proposed Lowveld Sabie-Sand Catchment landscape, which briefly include the following:

- Herbaceous species and functional composition at Welverdiend communal village;
- Long-term monitoring of vegetation at the Nkuhlu exclosures along the Sabie River in the Kruger National Park:
- Riparian woody vegetation recovery after the 2000 flood along the Sabie River.

The Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because of an extensive research history across various disciplines in the area, of which the majority of data are properly archived. This wealth of data serves as a strong basis for long-term monitoring programmes with the aim to assess global change effects. Existing infrastructure, such as the Nkuhlu long-term exclosures experimental site and the Skukuza Flux-tower; long-term fixed plots for observational studies, such as the experimental burning plot experiments inside the KNP and several SAEON sites within the Greater KNP will complement the overall data pool for long-term observational research.

The establishment of research infrastructure and observational data will benefit all research that was designed with the view to investigate temporal change, and/or change in response to severe stress events, such as droughts and floods. The already established vegetation monitoring sites from my research lab at Welverdiend, the Nkuhlu exclosures site, as well as along the Sabie River from Kruger Gate to Lower Sabie, will benefit from long-term monitoring as well as from data inputs from flux-towers and meteorological sites to address questions related to ecosystem resilience in the face of global change.

Well established research on (i) landscape heterogeneity, (ii) diversity of flora and fauna in both terrestrial and aquatic ecosystems, (iii) soil biogeochemical properties, (iv) hydrology, (v) plant-animal-human interactions, as well as (vi) socio-ecological gradients, provides evidence of an extensive network of scientists that will support the long-term sustainability of data inputs into the Lowveld Sabie-Sand catchment Landscape.

Yours sincerely,

iebert

Dr Frances Siebert Ecologist 082 447 8727

b. Non-Governmental Organisations



1st October 2020

EFTEON landscape proposal evaluation panel

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you as director of the Association for Water and Rural Development (AWARD) to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

AWARD is a non-profit organisation specialising in multi-disciplinary, participatory, research-based project implementation aimed at addressing issues of sustainability, inequity and poverty. We have been active in the lowveld for over 20 years, working primarily on integrated water management, but also more recently on climate change, natural resource degradation and livelihoods. We work at multiple scales, from local communities, to local municipalities, national policy. Of relevance to this proposal, AWARD lead the Save the Sand Project, a collaborative Integrated Catchment Management pilot for rehabilitation and sustainability of the Sand River catchment, in the late 1990's.

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because it constitutes a dynamic socio-ecological system in which coupled human-environment and terrestrial-aquatic systems can be studied in the context of global change, in order to provide long-term data and insights to inform policy and practice for sustainable development in the region.

We therefore fully endorse this proposal for EFTEON to invest in research infrastructure in the nominated landscape, especially since it will synergise with, and add value to, existing applied research initiatives in the region, including our own.

Yours sincerely

Dr. Sharon Pollard Director


Heritage House | Suite 301 3rd Floor 20 Dreyer Street | Claremont | 7735 Telephone: +27 (21) 100 3950

www.conservation.org/southafrica

23-09-2020

Attention: EFTEON Landscape Proposal Evaluation Committee

To whom it may concern

Support for EFTEON Landscape Proposal: Lowveld Sabie-Sand Catchment

Conservation South Africa would like to to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure Landscape by EFTEON.

Conservation South Africa (CSA), as a local affiliate of Conservation International (CI), is committed to helping societies adopt a more sustainable approach to development—one that considers and values nature at every turn and improves human well-being through the conservation of healthy ecosystems and the goods and services they provide. CSA seeks to influence policy, develop markets, engage the private sector and support communities to develop and implement conservation- based economic growth models and long-term human well-being.

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because of the Link between Strategic Water Source areas in the upper catchment, local communities living within the catchment and the high value protected areas in the region. While land degradation is widespread across the whole country, CSA and partners work in the biomes with the highest potential for degradation as the result of poor land management that also contain ecosystems with a high potential to act as carbon sinks – the catchment areas of the Lowveld Sabie-Sand Catchment has been identified as important from an Ecosystem Based Adaptation and Mitigation learning site (both nationally and internationally). The catchment's geography and socio-economic structure makes it an excellent learning and demonstration site for areas across Southern Africa.

As a stakeholder in the landscape, Conservation South Africa would benefit from such research infrastructure and associated data would help monitor existing implementation and also guide future projects and opportunities in these high value ecosystems.

Conservation South Africa hereby undertakes to support the EFTEON Lowveld Sabie-Sand Catchment landscape in whatever way we can.

Yours sincerely

Julia Levin, Country Director

Khusel'Indalo South Africa NPC T/A Conservation South Africa PBO 9300 33503 | Company Registration Number | 2010/000325/08 Directors: JN Levin, OC Henderson, SN Susman, RJ Khoza, L Pityana-Ndlovu, M O'Brien-Onyeka' S Muttlulingam; L Gillespie-White; PP Lolwana



KRUGER TO CANYONS BIOSPHERE REGION

21 September 2020

EFTEON landscape proposal evaluation committee

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you on behalf of Kruger to Canyons Biosphere Region (K2C BR) NPC to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

The K2C BR endeavours to reconcile biodiversity conservation with the development of people, as the custodians of their land and resources through collaborative partnerships. A Biosphere designation is given by UNESCO to special landscapes where people are collaborating to ensure environmental integrity, as the basis for their economic development, is secured. As such, credible data plays an important role to feedback to communities, government and private sector.

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape.

As a stakeholder in the landscape, k2C BR NPC would benefit from such research infrastructure and associated data to inform our work.

K2C BR NPC hereby undertakes to support the EFTEON Lowveld Sabie-Sand Catchment landscape in whatever way we can.

Yours sincerely

MT Uys K2C BR NPC COO

The Kruger to Canyons (K2C) Biosphere Region is registered by the United Nations Education, Scientific and Cultural Organisation (UNESCO) as an official Biosphere Reserve within their Man and the Biosphere (MaB) Programme.



WWF South Africa

World Wide Fund For Nature

Head Office:

Boundary Terraces

Mariendahl Lane

NEWLANDS 7700 P O Box 23273 CLAREMONT 7735 Tel: +27 21 657 6600 Fax: 086 535 9433

Bridge House, 1st Floor

Reg. No: 003-226 NPO VAT No: 4820122481 Web: www.wwf.org.za PBO No.: 130002490

Khetha Office: M15 Bagdad Centre White River, R40 1240





30 September 2020

To: EFTEON landscape proposal evaluation panel Re: Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

To whom it may concern

I write to you on behalf of WWF SA (Khetha programme) to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

The Khetha programme works in the Greater Kruger and Mozambican landscapes to improve the relationship between people and protected areas, with the long-term aim to reduce the impact of Illegal Wildlife Trade on people and key species. We work with several stakeholders and communities in the Sabie-Sand Catchment and water availability and management is a critical and growing concern in the area.

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because of the growing water scarcity and other ecological problems in the area (sand mining, pollution, waste management, etc). Ecosystem health and infrastructure has an impact on both communal land and protected areas and is a direct threat (or opportunity) to and for sustainable rural livelihoods.

As a stakeholder in the landscape, we would benefit from such research infrastructure and associated data, most specifically, data emerging from socio-ecological surveys and spatial data (remote sensing), since it could help us plan and priorities our interventions in the catchment in a more evidence-based manner.

We look forward to supporting and learning from the EFTEON Lowveld Sabie-Sand Catchment landscape initiative.

Yours sincerely Lindie Botha

2 Botha.

WWF South Africa – Khetha Programme Programme Manager: Implementation and Evaluation Tel: 0725005623

c. Regulatory bodies



Reference: 14/1/2/6 Enquiries: Dr T Sawunyama Email: sawunyamat@iucma.co.za Date: 21 September 2020

EFTEON landscape proposal evaluation committee

To whom it may concern

Ref.: Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you on behalf of Inkomati-Usuthu Catchment Management Agency (IUCMA) to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

IUCMA is the water resource management authority established in terms of Section 78 of the National Water Act 36 of 1998 (NWA), to perform water resource management at local level within the Inkomati-Usuthu Water Management Area (WMA) in South Africa. The management of the resources entails protection, use, development, conservation, management and control of water resources within the WMA as contemplated in the NWA. The 2015/2016 drought has affected the water availability in the basin, and it is still experiencing it to date and most dams have not recovered from this drought.

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because on current river flow operational challenges, as there are competing users such domestic, irrigation and ecological flow requirements. As a stakeholder in the landscape, IUCMA would benefit from such research infrastructure and associated data such as 1) Continuous automated measurements (atmospheric, meteorological, phenological, and hydrological), 2) Repeated manual measurements (biodiversity, productivity, soils), 3) Socio-ecological surveys, and 4) Spatial data (remote sensing).

IUCMA hereby undertakes to support the EFTEON Lowveld Sabie-Sand Catchment landscape in whatever way we can.

Your sincerely,

DR JENNIFER MOLWANTWA ACTING CHIEF EXECUTIVE OFFICER

Ms TP Nyakane-Maluka (Chairperson) | Mr MS Mthembu (Deputy Chairperson) | Mr M Gangazhe | Dr TM Kelly | Adv MB Shabangu Ms LM Sikhakhane | Mr PA Tshabangu | Ms SD Wiggins | Ms LC Zulu | Dr TK Gyedu-Ababio (Ex-Officio)

d. Land custodians

EFTEON landscape proposal evaluation panel

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you on behalf of MalaMala Game Reserve to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

MalaMala is a Private Game Reserve situated between the Sabi Sand Wildtuin and the Kruger National Park.

MalaMala is owned by the Nwandlamhari CPA and managed by MalaMala Game Reserve PTY LTD.

MalaMala has access to approximately 24km of the Sand River.

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because due to the wide variety of Land Use activities that take place along the course of the catchment before continuing for an extensive distance within a protected area.

The Uptream Activities have the potential for a very beneficial or devastating impact on the protected area.

As a land custodian in the landscape, MalaMala Game Reserve Pty Ltd hereby indicates our support for the long-term deployment of appropriate research infrastructure on land under our custodianship, as a partner in this initiative. Any construction of permanent infrastructure will however require consultation and approval by the Nwandlamhari CPA who own the property.

Yours sincerely



Reg 2009/016655/08

Home Owners Association P.O. Box 95 Hectorspruit 1330

Tel. 013 792 7000 Fax. 013 729 7015 Web: www.mjejanegamereserve.com

28 September 2020

EFTEON landscape proposal evaluation panel

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you on behalf of Mjejane Game Reserve to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

Mjejane Game Reserve is a newly established community owned game reserve situated on the southern side of the KNP's Crocodile River as an island in a highly transformed environment. The noble nature of this EFTEON project will most definitely support and objectively keep track of environmental changes and associated challenges caused by human action. We are also concerned about the long-term changes and what these cumulative impacts might have on biodiversity and the general health of the Nkomazi region.

We believe that Mjejane Game Reserve, situated within the Lowveld Sabie-Sand Catchment, is highly suitable as an EFTEON infrastructure landscape site because:

 Mjejane Game Reserve is situated in a rural and agricultural hub where environmental transformation, such as urbanisation and deforestation, is at the order of the day.

- The primary land use type for Mjejane was agriculture, before it was transformed to a game reserve of which the official Protected Area status is still outstanding.
- There is no existing long-term scientific monitoring network/system currently in place representing the Nkomazi area and maybe even the extreme southerly parts of the KNP.
- The increase in the elephant population and the pressure they exert on the woody component at Mjejane is very visible. Mature Knob thorn and Marula trees are disappearing at an alarming rate. The indirect impact of their feeding behaviour might have an adverse impact on vulture, ground hornbill and other raptor nesting sites. The changes in the vegetation structure might also impact on animals such as black rhinos, with very specific habitat needs.
- The region is further subject to possible air pollution given the commercial mono culture sugar cane industry and refinery factory situated just outside Malalane.
- The use of significant amounts of pesticides in the agricultural industry might also a be a contributing factor impacting biodiversity.
- Alien Plants are thriving in the sub-tropical lowveld climate and their presence and possible adverse impact on indigenous species is also a concern.
- Recent talks about mining activities adjacent KNP is another concern and an activity falling outside the ambit of a compatible land use activity.

As a land custodian in the landscape and part of the Greater Limpopo Trans Frontier Conservation Area, Mjejane Game Reserve hereby indicates our support for the longterm deployment of research infrastructure on land under our custodianship.

Yours sincerely,

Peter Scott: Conservation Manager

CC: Kobus Havemann: General Manager



Unit: MTPA Scientific Services Enquiries: J. Eksteen E-mail: johan.eksteen@mtpa.co.za Tel 013- 759 5510

EFTEON landscape proposal evaluation panel

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you on behalf of the Mpumalanga Tourism & Parks Agency (MTPA) to express our support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON.

The MTPA was established in terms of the Mpumalanga Tourism and Parks Agency Act of 2005, Act No. 5 of 2005. Section 3 of the MTPA Act defines the Objects of the Agency as follows: The objects of the Agency shall be to provide for the sustainable management and promotion of tourism and nature conservation in the Province and to ensure the sustainable utilization of natural resources. As part of its duties, the Agency shall: Provide for effective management and conservation of biodiversity and ecosystems within the Province;

We believe that the Lowveld Sabie-Sand Catchment is highly suitable as an EFTEON infrastructure landscape because it will support long-term research on coupled social-ecological systems by a well represented the research community

As a management authority of protected areas in the landscape, the MTPA hereby indicates our support for the long-term deployment of research infrastructure on land under our custodianship.

Yours sincerely.

Kind Regards

MR. J.JEKSTEEN Manager Scientific Services DATE: 02 October 2020





Portion 4 of Lisbon 297 KU Shaws Gate P O Box 105, Skukuza,1350

| Tel: | +27 13 735 5102 |
|--------|--------------------------|
| Fax: | +27 13 735 5994 |
| Email: | sswoffice@sabisand.co.za |
| Web: | www.sabisand.co.za |
| | |

Dear University of Witwatersrand - Wits Rural Knowledge Hub

I write on behalf of the Sabi Sand Wildtuin protected area in support of your proposal of the "Lowveld Sabie-Sand Catchment" in the Mpumalanga Province, South Africa, as one of the National EFTEON landscapes.

We strongly support this proposal and the focus on Integrated Catchment Management. We have recognised the Sabie and Sand river catchments within the Sabi Sand Wildtuin zone of influence and thus the project aligns strongly with the Sabi Sands Wildtuin Protected Area Management Plan.

We look forward to working with you in improving water security through the proposed partnership model.

Sincerely,

. 0507. 90.90

Iai∱ Olivier Warden Sabi Sand Wildtuin To develop, manage and promote a system of national parks that represents the biodiversity and heritage assets by applying best practice, environmental justice, benefit sharing and sustainable use.

Private Bag X402 **Scientific Services** South African National Parks Skukuza addo elephant 1350 South Africa 28 September 2020

South African NATIONAL PARKS

augrables falls

bontebok

camdeboo

golden gate highlands

table mountain

ankwa karoo

ai-lais/richtersveld

agulhas

To whom it may concern

EFTEON Site Selection Committee

RE: Letter of support for Lowveld Sabie-Sand catchment EFTEON site nomination

I would hereby like to pledge the support of South African National Parks (SANParks) to the proposal of the Lowveld Sabie-Sand catchment site as one of the six EFTEON sites to be selected in South Africa. The proposed site includes a section of the central and southern Kruger garden route National Park (KNP), where SANParks is the management authority.

The proposed site is highly suitable considering the objectives of EFTEON with the juxtaposition of different land-uses (state-owned protected area, private protected areas, karoo communal rangelands, villages, commercial agriculture and forestry), and the inclusion of three perennial rivers (Sabie, Sand and Crocodile) providing an excellent example of a social-kgalaged transfrontier ecological "lived in landscape", with important terrestrial and freshwater elements, within the savanna biome. The proposed site has over the years evolved to become one of the most kruger researched regions in the country and has a rich history of longitudinal data collection and longterm experiments, complemented by well-maintained instrumentation. A well-established and menuncubwe well integrated research community already exists in this region, which includes researchers from various universities in South Africa and also a significant presence of international marakele research collaborators from some of the top universities globally. Considering the rural setting, the landscape also has a surprisingly large compliment of applied social and ecological scientists that are full-time resident in or close to the site (e.g. SANParks Scientific Services, mokala Wits rural facility, University of Pretoria's Hans Hoheisen research station, Kruger2Canyon offices, NRF's SAEON Ndlovu node, Skukuza Science Leadership Initiative, AWARD, mountain zebra University of Mpumalanga). These embedded scientists play a critical role, not only as knowledge conduits and connectors for visiting scientists, but also to ensure continuity in the namagua learning and maintaining long-term datasets and perspectives.

If the Lowveld Sabie-Sand catchment site is selected as an EFTEON site, SANParks will support the initiative and be an active and engaged partner. Over and above the intellectual infrastructure (i.e. resident scientists and biotechnicians), KNP also has well developed data and physical infrastructure. Long-term datasets from the KNP are archived on a central data repository, which includes data from long-long monitoring initiatives (e.g. vegetation condition west coast assessments; herbivore aerial surveys; groundwater and river monitoring) and from a range of long-term experiments (including fire, herbivore and non-manipulated experimental sites).

643 Leyds Street MUCKLENEUK 0002

P.O. Box 787 PRETORIA 0001

Tel: 012 426-5000

central reservations: 012 428 9111 reservations@sanparks.org www.sanparks.org

To develop, manage and promote a system of national parks that represents the biodiversity and heritage assets by applying best practice, environmental justice, benefit sharing and sustainable use.

KNP also has a well-equipped laboratory and subsidised research accommodation to enable research to take place. These datasets and facilities are made available to researchers once they have registered their projects with SANParks through a simple and well-managed project registration process that has been running for many years.

We are excited about the possibility of south-central KNP, as part of the Lowveld Sabie-Sand agulhas catchment, becoming an EFTEON site. This will further enhance and develop this region as a research platform of global importance. The EFTEON objectives are closely aligned with the augrables falls 11 key social-ecological themes identified in the 10-year SANParks Research Strategy (2019-2029), and we are confident, knowing the site, the infrastructure and the people involved, that bontebok this endeavour, if successful, will be of benefit to South Africa and the global science community in terms of advancing our understanding of complex socio-ecological systems, to better enable human -nature systems to thrive.

Yours sincerely,

D.govender

Dr Danny Govender General Manager: Scientific Services (Savanna and Grassland) South African National Parks



addo elephant

camdeboo

garden route

golden gate highlands

karoo

kgalagadi transfrontier

kruger

mapungubwe

marakele

mokala

mountain zebra

namagua

table mountain

tankwa karoo

west coast

ai-lais/richtersveld

643 Leyds Street MUCKLENEUK 0002

P.O. Box 787 PRFTORIA 0001

Tel: 012 426-5000

central reservations: 012 428 9111 reservations@sanparks.org www.sanparks.org

e. Community representatives and relevant local authorities



MRC/Wits Rural Public Health and Health Transitions Research Unit (Agincourt) Community Advisory Board

MRC/Wits-Agincourt Unit, near Agincourt Health Centre, Agincourt Village, Bushbuckridge, 1280, Mpumalanga, South Africa Telephone: +27 769387479 | +27 13 708 0003 | www.agincourt.co.za | twitter@agincourthdss

23 September 2020

EFTEON landscape proposal evaluation committee

To whom it may concern

Support for EFTEON landscape proposal: Lowveld Sabie-Sand Catchment

I write to you as a member of the MRC/Wits Agincourt Unit Community Advisory Board (CAB). We are a democratically elected body that represents 31 rural communities in all research activities in the Agincourt Health and Socio-Demographic Surveillance System.

I hereby express the CAB's support for the proposal to develop the Lowveld Sabie-Sand Catchment as a long term Environmental and Socio-Ecological Research Infrastructure landscape by EFTEON. We work closely with the MRC/Wits Agincourt Unit and recognise the value of long-term research in our communities.

The CAB supports the development of EFTEON research infrastructure in our communities, in consultation with our local leaders and other community stakeholders. One of our villages, Agincourt, already hosts a Flux Tower, which is maintained by the CSIR. We will support the EFTEON Lowveld Sabie-Sand Catchment in whatever way we can.

Yours sincerely

Simon Mgabe Newington B 076 852 6935











Tel: 013 004 0291/92/95

Email:info@bushbuckridge.gov.za

Private Bag x 9308 Bushbuckridge 1280 R533 Graskop Road opp. Mapulaneng DLTC Bushbuckridge Co-ordinates: 31°3'59.796"E 24°50'24.3304"S

Website: www.bushbuckridge.gov.za

ENQ: S Mogakane Cell no: 079 874 3303 06 October 2020

Wits Rural Facility Private Bag x 420 Acornhoek 1360

Attention: Prof. Wayne Twine

SUPPORT FOR EFTEON LANDSCAPE PROPOSAL: LOWVELD SABIE-SAND CATCHMENT

The Bushbuckridge Local Municipality (BLM) supports the proposal for EFTEON to invest in the long term Environmental and Socio-Ecological Research Infrastructure in the Lowveld Sabie-Sand Catchment.

The Integrated Development Plan, Spatial Development and Environment Management Frameworks identified tourism, agriculture and sustainable use of our water resources as important drivers of development in our municipality. The Bushbuckridge Local Municipality would therefore benefit from the environmental and socio-ecological data that would be provided by the EFTEON research infrastructure in the jurisdiction of our municipality. This will be useful in assisting the municipality with land use planning, disaster risk management, and implementing the climate change adaptation and mitigation strategy.

The Bushbuckridge Local Municipality supports the deployment of EFTEON Research Infrastructure within the municipality, in consultation with the relevant structures, traditional authorities and other local stakeholders.

Yours sincerely,

CX

MUNICIPAL MANAGER