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Bojanala Platinum District Municipality

Bojanala Platinum District Municipality

Adaptation Plan

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Title:	Bojanala Platinum Municipality: Adaptation Plan
Authors:	Daleen Lõtter, Amy Pieterse, Lethabo Chilwane & Willemien van Niekerk
Project lead:	Amy Pieterse (CSIR)
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List of Acronyms and Abbreviations

BPDM	Bojanala Platinum District Municipality
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFFE	Department of Forestry, Fisheries and the Environment
DM	District Municipality
DRR	Disaster risk reduction
IPCC	Intergovernmental Panel on Climate Change
LRT	Let's Respond Toolkit
SPLUMA	Spatial Planning and Land Use Management Act, 2013 (Act No.16 of 2013)

Glossary of Terms

Adaptation actions	A range of planning and design actions that can be taken by local government to adapt to the impacts of climate change, reduce exposure to hazards, and exploit opportunities for sustainable development (CSIR, 2023).
Adaptation planning	The process of using the basis of spatial planning to shape built-up and natural areas to be resilient to the impacts of climate change, to realise co-benefits for long-term sustainable development, and to address the root causes of vulnerability and exposure to risk. Adaptation planning assumes climate change as an important factor while addressing developmental concerns, such as the complexity of rapidly growing urban areas, and considers the uncertainty associated with the impacts of climate change in such areas – thereby contributing to the transformational adaptation of urban spaces. Adaptation planning also provides opportunities to climate proof urban infrastructure, reduce vulnerability and exploit opportunities for sustainable development (National Treasury, 2018; Pieterse, 2020).
Adaptive capacity	"The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences" (IPCC, 2022, p. 2899).
Climate change adaptation	"In human systems, the process of adjustment to **actual** or **expected** climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to **actual** climate and its effects; human intervention may facilitate adjustment to expected climate and its effects" (IPCC, 2022, p. 2898).
Climate change mitigation	"A human intervention to reduce emissions, or enhance the sinks, of greenhouse gases (GHGs)" (IPCC, 2022, p. 2915). The goal of climate change mitigation is to achieve a reduction of emissions that will limit global warming to between 1.5°C and 2°C above preindustrial levels (Behsudi, A, 2021).
Climate hazards	Climate hazards are a sub-set of natural hazards and a grouping of hydrological, climatological, and meteorological hazards. This includes the spatial extent and frequency of, among others, floods, fires, and extreme weather events such as extreme rainfall and extreme heat. Sometimes referred to as hydrometeorological hazards. The potential occurrence of a climate hazard may cause loss of life, injury, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources (IPCC, 2022). Climate hazards can increase in intensity and frequency with climate change (Pieterse et al., 2023).

Climate risk	Risk implies the potential for adverse consequences resulting from the interaction of vulnerability, exposure, and a hazard. Relevant adverse consequences include those on "lives and livelihoods, health and well-being, economic and sociocultural assets, [as well as] infrastructure and ecosystems" (IPCC, 2022, p. 144). In the IPCC's 6th Assessment Report, it is confirmed that risks may result from "dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system" (IPCC, 2022, p. 132).
Coping capacity	"The ability of people, institutions, organizations and systems, using available skills, values, beliefs, resources and opportunities, to address, manage, and overcome adverse conditions in the short to medium term" (IPCC, 2022, p. 2904).
Disaster risk reduction	"Denotes both a policy goal or objective, as well as the strategic and instrumental measures employed for anticipating future disaster risk; reducing existing exposure, hazard or vulnerability; and improving resilience" (IPCC, 2022, p. 2906).
Exposure	Exposure implies the physical exposure of elements to a climate hazard. It is defined as the "presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected [by climate hazards]" (IPCC, 2022, p. 2908).
Mainstreaming	The process of integrating climate change adaptation strategies and measures into existing planning instruments and processes as opposed to developing dedicated adaptation policies and plans (Pieterse et al., 2021).
Resilience	"The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure. Resilience is a positive attribute when it maintains capacity for adaptation, learning and/or transformation" (IPCC, 2022, pp. 2920–2921).
Sensitivity	"The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise)" (IPCC, 2022, p. 2922).
Vulnerability	Vulnerability is defined as the "propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm, and lack of capacity to cope and adapt" (IPCC, 2022, p. 2927). Vulnerability refers to the characteristics or attributes of exposed elements, i.e., elements that are exposed to potential climate-related hazards. Vulnerability is a function of sensitivity and (coping or adaptive) capacity (Pieterse et al., 2023).

1. Introduction

Climate change impacts vary widely from region to region in South Africa, and are reflected by floods, droughts, heatwaves, and coastal erosion, among others. These impacts directly threaten life, economic well-being, property, infrastructure, and ecosystems, as well as the ability of local government to provide public services. It is local government's responsibility and duty to provide leadership in planning and preparing to manage these risks for the sake of the well-being, safety, and security of individuals within their jurisdiction (SABS, 2023). The purpose of this document is to strengthen the capability of local government to prepare for climate change threats and associated risks.

The Climate Change Adaptation Plan and its accompanying Risk Profile report have been specifically drafted for the Bojanala Platinum District Municipality, with the aim of strengthening its strategic response to climate change. These documents derive their insights from the GreenBook (www.greenbook.co.za), a freely accessible online planning support system. The GreenBook is a unique and invaluable resource, providing quantitative scientific evidence to assist local governments in comprehending their climate risks. It plays a pivotal role in guiding the adaptation of settlements to withstand the impacts of both current and future climate challenges.

Designed as an information-rich tool, the GreenBook caters to South African local governments, offering insights into risks and vulnerabilities associated with population growth, climate change, exposure to hazards, and the vulnerability of critical resources. Moreover, the GreenBook not only diagnoses these challenges but also provides practical adaptation measures. These measures are essential for cities, towns, and settlements, empowering local government to mitigate the impacts of climate hazards on communities, the environment, the economy, and municipal assets and infrastructure, while aligning with broader developmental goals (refer to Green Book l Adapting settlements for the future).

The Climate Risk Profile report and the Climate Change Adaptation Plan serve distinct yet interlinked purposes and strategic objectives. They aim to:

1. Drive and advance the local climate change response agenda.
2. Provide a foundational framework for strategy and planning within the District Municipality.
3. Systematically identify and prioritise risks and vulnerabilities.
4. Pinpoint and prioritise targeted interventions and responses.
5. Facilitate the integration of climate change response, particularly adaptation, into mainstream policies and practices.

In essence, these documents are instrumental in equipping the Bojanala Platinum District Municipality with a comprehensive strategy to navigate the complexities of climate change, reduce vulnerability and exposure, and champion sustainable development.

The Adaptation Plan briefly outlines the policies constituting the framework for adaptation planning and implementation in South Africa. It then goes on to describe generic adaptation principles, approaches, pathways, and various categories of actions. Subsequently, the plan suggests a specific adaptation strategy for Bojanala Platinum District Municipality by aligning it with adaptation goals, programmes, and actions designed to address priority risks, as well as an implementation framework, designed to identify appropriate actors and enable the implementation of the strategy. Finally, the document concludes with

recommendations aimed at facilitating the integration of the proposed actions into broader initiatives, ensuring their effective mainstreaming.

1.1. Policy Framework

South Africa's institutional policy and legislative framework makes provision for climate change adaptation at all levels of government, with local governments increasingly identified as the primary drivers of climate change adaptation. For instance, there exists various national policy and legislative mechanisms that promote, necessitate, guide and/or regulate climate change adaptation at the local level. These include the Disaster Management Amendment Act, i.e. Act 16 of 2015, the Spatial Planning and Land Use Management Act (SPLUMA), i.e., Act No. 16 of 2013, the Climate Change Bill, i.e., B9 of 2022, the 2011 National Climate Change Response White Paper, as well as the 2019 National Climate Change Adaptation Strategy.

While the **Disaster Management Amendment Act** requires each organ of state, as well as provincial and local government to identify measures for, as well as indicate plans to invest in, disaster risk reduction (DRR) and climate change adaptation. **SPLUMA** identifies the principles of (1) spatial resilience – which involves accommodating "flexibility in spatial plans, policies and land use management systems, to ensure sustainable livelihoods in communities most likely to suffer the impacts of economic and environmental shocks" (Republic of South Africa., 2013, p. 20) – some of which may be induced by the impacts of climate change, and (2) spatial sustainability, which sets out requirements for municipal planning functions such as spatial planning and land use management to be carried out in ways that consider protecting vital ecosystem features such as agricultural land, i.e., from both anthropogenic and natural threats, including the impacts of climate change, as well as in ways that consider current and future costs of providing infrastructure and social services in certain areas (e.g., uninformed municipal investments may lead to an increase in the exposure of people and valuable assets to extreme climate hazards) – amongst the key principles intended to guide municipal planning and development. The **Climate Change Bill** sets out climate change response requirements for all organs of state across all levels of government, as well as the institutional arrangements necessary to meet those requirements. Amongst them is the requirement for every District Intergovernmental Forum to serve as a Municipal Forum on climate change that coordinates climate response actions and activities in its respective municipality, as well as the requirement for every metropolitan and district municipality to report on their climate change response needs and draft resultant climate risk assessments, as well as climate change response and -implementation plans.

Moreover, the **National Climate Change Response White Paper** identifies local governments as critical role players that can contribute towards effective climate change adaptation through their various functions, including human settlement planning; urban development; municipal infrastructure and services provision; water and energy demand management; and local disaster response, amongst others. The **National Climate Change Adaptation Strategy** outlines several actions that are applicable at local government level, including the development and implementation of adaptation strategies and vulnerability reduction programmes for communities and individuals that are most at risk to the impacts of climate change; the development of municipal early warning systems; as well as the integration of climate change adaptation into municipal development plans and relevant sector plans.

1.2. Outline of the Climate Change Adaptation Plan

Figure 1 below outlines the structure of the report, and includes a description of the development process, and components, of the Climate Change Adaptation Plan for the Bojanala Platinum District Municipality. The first chapter introduces the District's Climate Change Adaptation Plan, and provides an overview of the national policy context for climate change adaptation planning and implementation, as well as an outline of the structure of the Adaptation Plan. Chapter 2 outlines the adaptation planning framework that forms the basis for the District's Climate Change Adaptation Plan, and consists of adaptation principles, an adaptation approach, as well as adaptation goals, programmes and actions. Chapter 3 provides a summary of the District Municipality's Climate Risk Profile report, which includes an overview of the climate projections, vulnerabilities and impacts identified for the District Municipality, as well as the key climate-related risks that need to be prioritised when undertaking climate change response. Chapter 4 outlines the adaptations goals, programmes and actions identified for the District Municipality, as informed by the key climate-related hazards facing the District. Chapter 5 provides a framework for the implementation of the adaptation programmes and actions identified for the Bojanala Platinum District Municipality, and considers the local government functions and actors (including nongovernmental actors) responsible for the implementation of the identified actions, as well as the costs and level of priority associated with each adaptation action. Chapter 6 provides recommendations on how the District Municipality can mainstream the identified programmes and actions into existing municipal processes and instruments, with the aim to ensure that climate change considerations are an integral part of all that local government is doing.

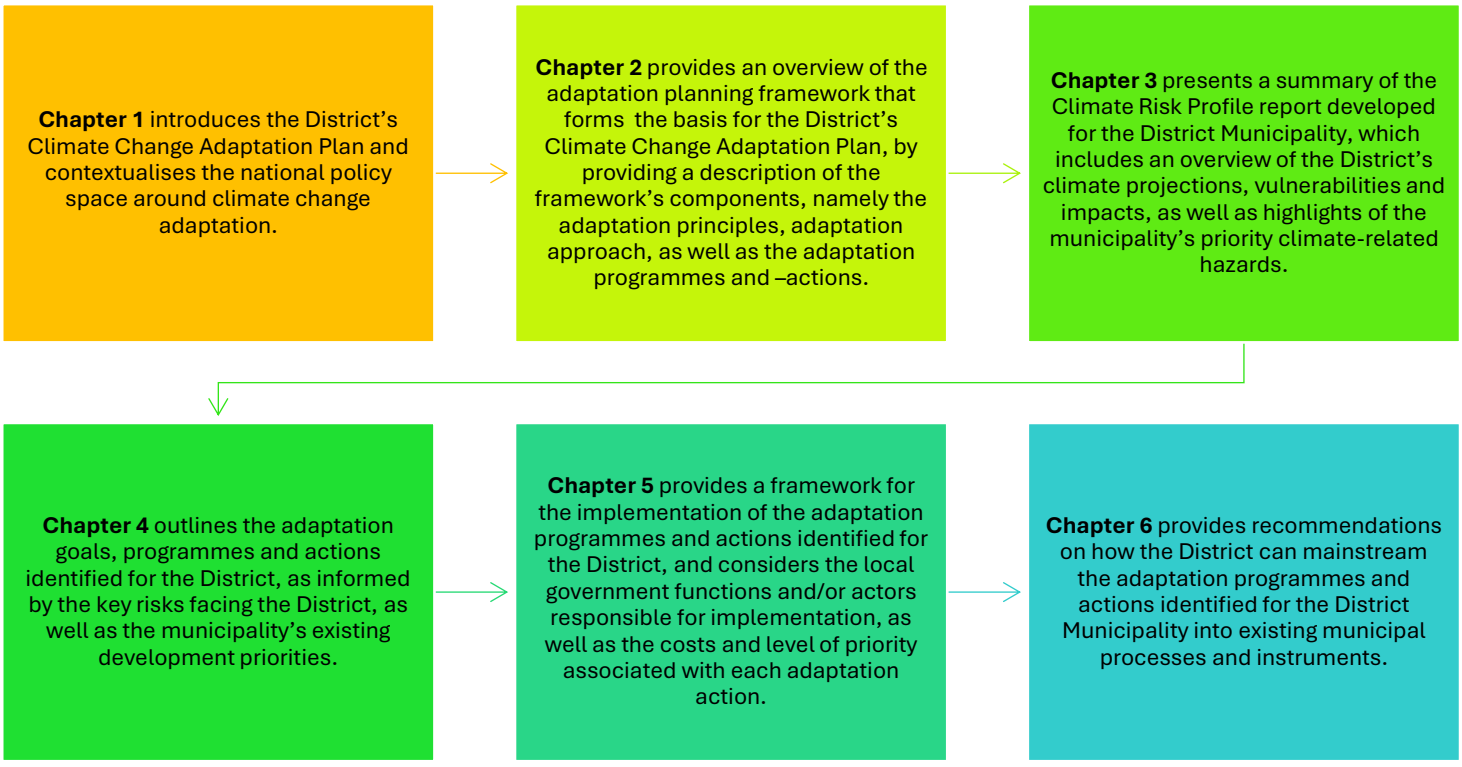

Figure 1: Outline of the Climate Change Adaptation Plan.

2. Adaptation Planning Framework

Climate change mitigation and adaptation refer to the two primary strategies aimed at addressing the adverse effects of climate change, i.e., by either delaying, reducing, redistributing, or avoiding the impacts. Although disaster risk reduction and climate change mitigation form part of the overall climate change response agenda, the focus of this plan is on adaptation.

Climate change adaptation aims to reduce climate-related risks by adjusting a system to the actual or anticipated climate and seeking "to moderate or avoid harm [and] exploit beneficial opportunities" (IPCC, 2022, p. 2898) that may derive from unavoidable impacts of climate change such as extreme hazards. The climate change adaptation agenda is concerned with adapting species, people, places, assets, and systems, to the impacts of actual or anticipated climate-related risks and implements various measures or actions to achieve this (Behsudi, 2021).

This section of the report outlines adaptation principles, drawing from the recommendations by the South African Bureau of Standards. It also presents a structured approach to selecting adaptation options, categorises adaptation actions, and explains the concept of an adaptation pathway.

2.1. Adaptation principles

The Bureau for Standards recently proposed the following principles that apply to local government when adapting to climate change (SABS, 2023):

i. **Accountability:** Local governments not only acknowledge but also assume responsibility for their climate change adaptation efforts. They willingly subject themselves to appropriate scrutiny and accept the duty to respond to this scrutiny.
ii. **Continual learning and improvement:** Recognising the uncertainties in knowledge and the dynamic nature of drivers of change, available knowledge and evidence, and the contextual factors, continual learning and improvement are essential for effective climate change adaptation.
iii. **Mainstreaming and embedding:** The effectiveness of climate change adaptation is maximised when integrated into local government operations, encompassing policies, plans, procedures, risk management, and implementation strategies.
iv. **Flexibility:** Embrace a flexible approach that considers technical, social, administrative, political, legal, environmental, and economic circumstances. This allows for the accommodation of a diverse range of data availabilities and technical and institutional capacities to meet goals and objectives.
v. **Practicality:** Set practical and achievable goals and objectives. Impractical targets may hinder the successful realisation of climate change adaptation benefits. Focus on easily measurable indicators/metrics with available underlying data and compare them across scales to avoid imposing additional burdens.
vi. **Prioritisation:** During the identification of adaptation plans and measures, prioritise areas based on the relative characteristics of climate change impacts (magnitude, likelihood, and urgency). Consider the capacities of stakeholders and the local government and community's ability to act.
vii. **Proportionality:** Undertake actions that are most effective under the current circumstances, including economic, social, cultural, and political contexts, capabilities, knowledge, and evidence base. Aspire for continual improvement in identifying and assessing adaptation measures.

viii. **Relevance:** Facilitate assessments that provide decision-makers and practitioners with meaningful information for adaptation planning, considering appropriate spatial scales and relevant time durations.

ix. **Transparency:** Ensure that reports and communications on climate change adaptation are openly, comprehensively, and understandably presented, providing accessible information for all interested parties (SABS, 2023).

These principles should be considered when formulating adaptation goals, programmes, and measures (also referred to as 'actions').

2.2. Adaptation approach

The approach that was followed to develop this adaptation plan revolves around comprehending the climate-related risks and implementing adaptive measures in response to these risks. Climate-related risk encompasses the potential for adverse consequences arising from the interplay of vulnerability, exposure, and the occurrence of climate hazards (IPCC, 2022). The components of risk are dynamic, with the occurrence of climate hazards influenced by both natural climate variability and anthropogenic climate change. The exposure of individuals, the built environment, and the natural surroundings to climate hazards is driven by both planned and unplanned development and growth. Vulnerability is the inherent characteristics that make systems sensitive to the effects and impacts of climate hazards.

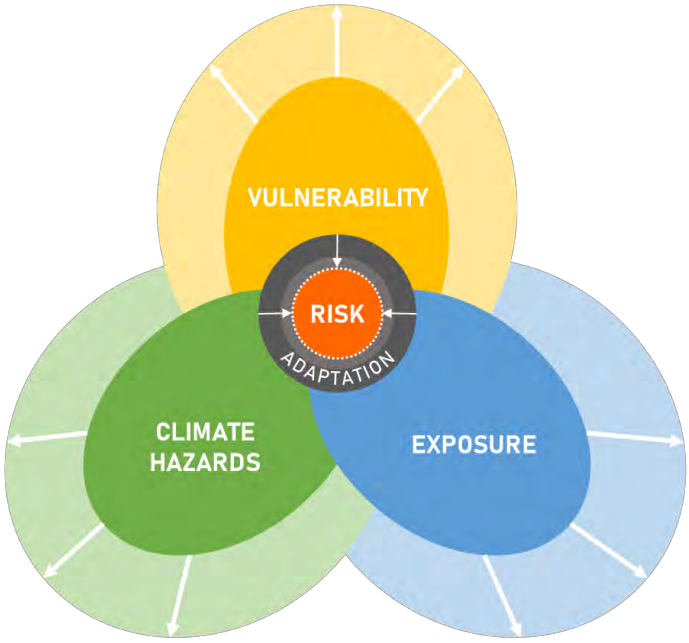

Figure 2: The interplay between hazards, vulnerability and exposure that determines risk (based in IPCC, 2014 and IPCC, 2021)

The inherent uncertainty in future climate trends underscores the necessity for a flexible response and the formulation of adaptable, medium to long-term adaptation strategies.

The approach followed in this plan involved the following steps:

i. Gain an understanding of climate risk in a specific geographic area.
ii. Identify priority climate hazards/zones based on the risk profile.
iii. Establish adaptation goals to mitigate the risk associated with priority hazards/zones.
iv. Develop adaptation programmes with measures/actions to achieve these goals.
v. Integrate climate considerations into other sector plans/instruments/strategies.

Refer to Table 1 for a more detailed description of this approach.

Table 1: The adaptation approach

Understand climate risk for a specific geographic area	A climate risk profile assesses risk by determining – in a specific geographic area and at a specific scale – the likelihood of a hazard to occur, the inherent vulnerability of various systems, and exposure of these systems to specific climate hazards. To be able to develop an appropriate adaptation plan, it is important to understand what contributes to risk and vulnerability.
Identify priority climate-related risks/zones	Identify the climate hazards and impacts that pose the greatest risk at present and in the future within a geographic area. If possible, also identify climate risk zones that need to be prioritised for intervention.
Establish adaptation goals	Identify adaptation goals to address priority risks/zones that speak to policy goals.
Develop adaptation programmes and actions	Develop adaptation programmes that speak to the identified adaptation goals and identify appropriate adaptation actions under each of the programmes that are mutually supportive. Adaptation actions should: • Be specific to a climate hazard/vulnerability/exposure. • Suggest a target or an indicator to measure progress. • Be assignable to a primary implementer. • Consider co-benefits and other possible implications. • Include mitigation as far as it builds resilience or reduces exposure and vulnerability.
Mainstream climate considerations into planning	Integrate evidence of climate risk, adaptation goals, programmes, and actions into existing instruments and processes. The aim is to ensure that climate change considerations are an integral part of all that local government is doing.

The primary aim of an adaptation plan is to address both current and anticipated future risks and vulnerabilities while also leveraging opportunities for long-term transformation and sustainable development.

2.3. Adaptation programmes and actions

An adaptation programme is a structured and systematic set of actions, initiatives, and interventions aimed at local governments to adapt their localities to the impacts of climate change. It involves the practical implementation of specific goals identified in the plan.

Broadly, adaptation actions include anticipatory and reactive measures. Anticipatory adaptation involves proactive measures taken in preparation for anticipated climate change impacts, while reactive adaptation entails responding to climate change effects as they are experienced. Furthermore, it facilitates the integration and prioritisation of climate change adaptation and resilience measures into various planning mechanisms and processes (CSIR, 2023).

A spectrum of adaptation actions is at the disposal of municipalities to enhance resilience and mitigate risks posed by changing climatic patterns and extreme weather events. Some of the categories of actions include:

- Infrastructure development, encompassing the construction of, for example, seawalls, levees, and storm surge barriers to protect against rising sea levels and extreme weather events. These engineered solutions provide immediate protection and buy time for longer-term adaptation efforts but are mostly very expensive to build.
- Green infrastructure initiatives offer sustainable and nature-based solutions. Municipalities can implement urban green spaces, green roofs, and permeable pavements to absorb excess water, reduce flooding, and mitigate the urban heat island effect. Such approaches not only enhance climate resilience but also contribute to improved air quality and overall urban liveability.
- Environmental protection such as restoring ecosystems like mangroves, dunes, and wetlands, not only provides natural buffers but also supports biodiversity.
- Integrated urban planning is essential to create climate-resilient municipalities. Land-use regulations should be adapted to consider climate risks, prioritising construction practices that enhance resilience. Elevating structures above projected flood- and sea levels and using climate-resilient materials in building design can minimise the impacts of flooding and storm damage.
- Early warning systems and emergency preparedness plans are critical tools to ensure swift responses to extreme weather events, minimising the impact on vulnerable communities.
- Innovative water management strategies are essential for municipalities facing changing precipitation patterns and increasing water scarcity. Diversifying water sources, implementing water efficiency measures, and investing in advanced stormwater management systems contribute to water security and sustainable resource use.
- Engagement and education are pivotal components of successful adaptation strategies. Empowering officials, and residents, to understand and respond to climate risks through awareness campaigns, education programmes, and participatory planning initiatives can enhance local adaptive capacity (CSIR, 2023).

Local governments must embrace a combination of structural, natural, and community-based approaches to build resilience and adaptive capacity, protect vulnerable communities, while ensuring long-term sustainability in the face of evolving climate challenges.

2.4. Stakeholder engagement process

To construct a Climate Change Adaptation Plan resonating with the specific requirements of the Bojanala Platinum District Municipality, while appropriately addressing its significant risks – a stakeholder engagement component was factored into the adaptation planning process, which gave district municipal officials and practitioners a platform to provide meaningful input on both the Risk Profile report and Adaptation Plan. The first stakeholder engagement focused on the Climate Risk Profile report of the District Municipality, with the aim of validating the climate-related risks identified for the District (as flagged in the Risk Profile report), while securing the District's confirmation of the adaptation goals proposed in response to the identified risks. The second engagement took place after a draft Climate Change Adaptation Plan was developed. As part of this engagement, each climate change adaptation programme identified under each goal, as well as each of the actions associated with the adaptation programmes, were intensely workshopped with the District and relevant local municipal officials/stakeholders, in an effort to gather comprehensive input that would help the project team finalise the document. Municipal officials and practitioners from various sector – particularly those sectors that are either most vulnerable to climate change impacts, or those that are well-positioned to respond to climate change, particularly through adaptation, namely disaster risk management – were present during these engagements. This was done in an effort to fulfil section 7.1 (a) of the Climate Change Bill, and to achieve a holistic response to climate change. All engagements took place virtually.

The CSIR and the Bojanala District Municipality had its first engagement on the 19th April 2024, where the draft risk report for the District Municipality was discussed. During this meeting, members of the municipality representing departments of disaster risk reduction were present. The second engagement took place after a draft Climate Change Adaptation Plan was developed and shared with the district and its stakeholders for comments. This engagement with the Bojanala District Municipality took place on 16 August 2024. During the engagement there was representation from the CSIR. As part of this engagement, each climate change adaptation programme identified under each goal, as well as each of the actions associated with the adaptation programmes, were workshopped with the district and relevant local municipal officials and stakeholders, in an effort to gather comprehensive input that would help the project team finalise the document. Municipal officials and practitioners from various sectors – particularly those sectors that are either most vulnerable to climate change impacts, or those that are well-positioned to respond to climate change, particularly through adaptation, were present during these engagements. This was done to fulfil section 7.1 (a) of the Climate Change Bill, and to achieve a holistic response to climate change. All engagements took place virtually.

The stakeholder engagement process offered a platform to interact with District stakeholders, thus, promoting a more profound comprehension of the District Municipality's context. Feedback gleaned from these engagement procedures has been deliberated upon and woven into the final draft Climate Change Adaptation Plan.

3. Summary of Climate Risk Profile

A Climate Risk Profile Report was prepared by the team, designed to complement this Plan. The Climate Risk Profile report serves as an essential resource for understanding the risks associated with climate change in Bojanala Platinum District Municipality.

This section of the Plan summarises the climate risk profile for Bojanala Platinum District Municipality, drawing from the GreenBook Risk Profile Tool (available at: https://riskprofiles.greenbook.co.za/). Please consult the accompanying Climate Risk Profile Report for more detailed information.

3.1. Climate projections, vulnerabilities and impacts

Climate change projections show average annual temperature increases of between 2.8°C and 3.2°C across the district into the future, with the greatest increases expected in the northern areas of the district, most notably in the Moses Kotane LM. Similarly, the number of very hot days will also increase in these areas, while the eastern and southern parts of the district will also experience more heatwave days. Rainfall projections show a slight increase across most of the district, with Moses Kotane potentially receiving up to 110 mm more rainfall annually. Along with the increase in average rainfall, projections also predict an increase in extreme rainfall days, especially over the southern parts of the district, which could result in more flooding events. Although some increases in rainfall is predicted in the district, the increase in temperature and evapotranspiration will result in the occurrence of more frequent and intense droughts, especially in the Moses Kotane and Kgetlengrivier LM's. These conditions will also create a higher risk of veld fires.

These climate projections have implications for water resources, ecosystems and agriculture in the district. Droughts lead to decreased river flows, impacting reservoir levels and groundwater recharge. This directly reduces the amount of water available for various uses, including agriculture, irrigation, and domestic consumption. As water becomes scarcer, competition for its use intensifies between agriculture, industry, and households. This can lead to water restrictions and potential conflicts. Flooding can temporarily replenish water resources, but also damage water infrastructure like dams and canals. Additionally, floodwater runoff can carry pollutants into water sources, requiring additional treatment before use.

Economic and environmental vulnerability further compounds the effects of climate change. Economic vulnerability restricts a community's ability to adapt, which can lead to food insecurity, lost livelihoods, and damage to homes and infrastructure, further deepening poverty and hindering long-term recovery efforts. Degraded environments have limited capacity to mitigate climate impacts leading to a vicious cycle of environmental degradation and heightened vulnerability. Consequently, vulnerable communities reliant on these ecosystems for sustenance and livelihoods face even greater risks from climate change-induced disasters and disruptions.

Bojanala district show a high economic vulnerability compared to other districts in the North-West province. Rustenburg and Kgetlengrivier have the highest economic vulnerability in the District with Rustenburg LM having the 2nd highest economic vulnerability in the North-West Province. This is mainly due to rapid population growth in the Rustenburg and Madibeng LM's. Rustenburg LM had a growth rate of 3.0% between 2010 and 2022, a high population density (an average of 210 people per square km) and rising unemployment, all of which contribute to the economic vulnerability of the Rustenburg region. Environmental vulnerability has also increased over time due to expansion of settlement infrastructure, agriculture and mining activity, putting rivers, watercourses, streams, dams and wetlands under severe pressure of pollution and degradation.

3.2. Priority climate-related hazards

Droughts, extreme temperature, floods and wildfires are considered the most significant climate threats due to their potential for widespread disruption and long-term consequences for the Bojanala District. As the

Bojanala district is already considered water-scarce, projections of more frequent droughts make it a major threat, impacting water availability for agriculture, domestic use, and industry. Projected increases in extreme heat can further exacerbate drought conditions and can also be dangerous for human health and livestock. Heat stress and heat exhaustion are serious health problems, especially for infants, young children, and older adults. Rising temperatures can also create more favourable conditions for wildfires.

While droughts are a major concern, Bojanala can also experience increased extreme rainfall events leading to floods. This can damage infrastructure, disrupt livelihoods, and cause soil erosion. Flooding can also affect human health when water sources get contaminated with sewage and other pollutants, leading to outbreaks of waterborne diseases like diarrhoea and cholera. During the stakeholder engagement session there were requests to elaborate on the risk and impact of flooding in the District as well climate change impacts on human health. These comments were therefore considered as part of the adaptation goals and actions in this document.

4. Adaptation Goals, Programmes and Actions

The section outlines the adaptation plan using goals and measures designed to help Bojanala Platinum DM to adapt to the impacts of climate change. Based on the assessment of the potential risks and vulnerabilities posed by climate change, this plan was developed as a proactive strategy to mitigate these risks and enhance resilience.

4.1. Adaptation goals

Drawing upon the assessment of the current and projected climate-related risks and vulnerabilities outlined in the preceding section, the following adaptation goals for Bojanala Platinum DM were identified, prioritising those risks with the highest potential impact. These goals were validated by stakeholders during the engagements:

- Goal 1: To ensure water security in the face of climate change: Bojanala is already considered a water-scarce area. Projected population growth and worsening droughts will further strain the district's water supply. Developing comprehensive water resource management strategies is essential to ensure sustainable and equitable access to water for all users (domestic, agricultural, industrial) to secure a sustainable water future.
- Goal 2: Preserving ecological resilience, maintaining biodiversity, and safeguarding ecosystem services essential for human well-being. Protecting existing natural areas and restoring degraded ones strengthens their capacity to buffer against climate change effects. E.g. Wetlands provide natural flood management, as they can absorb excess rainfall, reduce runoff, and mitigate the risk of urban flooding—a threat exacerbated by climate-induced extreme weather events.
- Goal 3: To protect communities and increase the resilience of critical municipal infrastructure. This involves implementing proactive measures that enhance infrastructure design, maintenance, and operational practices, while integrating climate adaptation considerations into infrastructure planning and investment decisions.
- Goal 4: To enhance the resilience of the rural economy with a focus on the agricultural and tourism sector. This includes a focus on sustainability of food systems by implementing strategies that protect urban agricultural land, promote the establishment of food gardens, and support small-scale farmers. For tourism the aim is to develop and implement strategies that enhance the resilience of tourism

infrastructure, assets, and destinations, while promoting sustainable tourism practices that mitigate climate-related risks and maximize socio-economic benefits.

The adaptation programmes below identify the overarching programmes and their actions, necessary to achieve each one of the goals. Specific timeframes and responsibilities are allocated in the subsequent implementation framework.

4.2. Adaptation programme: Goal 1: Ensure water security in the face of climate change

Programme 1.1: Water conservation practices

The programme aims to implement strategies and measures to decrease the amount of water consumed by individuals, communities, industries, and agriculture, thereby enhancing water efficiency, resilience, and sustainability. It addresses water scarcity and stress exacerbated by climate change impacts such as altered precipitation patterns, increased evaporation rates, and prolonged droughts.

Actions:

- **Promote and implement water conservation practices** through the adoption of water-saving behaviours and technologies to reduce water wastage and optimize water use efficiency in households, businesses, and public institutions. E.g. the use of greywater from baths, sinks, and washing machines to be reused for watering gardens or flushing toilets. Use of water-efficient appliances such as low-flow showerheads, dual-flush toilets, and water-efficient washing machines to reduce household water consumption.
- **Rainwater harvesting:** Promote the collection and storage of rainwater for later use. Encourage individuals, communities, and municipalities to collect rainwater from rooftops and other surfaces. This harvested water can be used for various non-potable purposes, reducing pressure on freshwater
- **Develop and enforce leak detection and repair programmes** for water infrastructure. Systems such as smart water metering and leak detection systems can reduce water losses in distribution networks.
- **Alien invasive species clearing initiatives in catchment areas**: Alien invasive species often consume more water than native species and can disrupt local ecosystems. Their presence can lead to significant water losses in catchment areas, reducing the amount of water available for human use. Initiatives to clear these species can improve water availability and also benefit local biodiversity.
- **Water-efficient landscaping:** Encourage water-efficient landscaping practices in urban, suburban, and rural areas to reduce outdoor water demand. This could include promoting drought-tolerant native plants, mulching, soil moisture retention techniques, and efficient irrigation systems.

Programme 1.2: Diversification of water sources

The programme aims to enhance water security and resilience by reducing reliance on single water sources and expanding the range of available water resources.

Actions:

- **Conduct feasibility studies, hydrogeological assessments, and environmental impact assessments** to evaluate the potential of alternative water sources and determine the most suitable options for local conditions.

- **Wastewater recycling and reuse:** Implement systems to treat and reuse wastewater for non-potable purposes such as irrigation, industrial processes, and toilet flushing. This not only conserves water but also reduces the burden on wastewater treatment plants.

Programme 1.3: Expand, improve, protect and maintain water services infrastructure
The programme aims to increase the resilience of water services to climate change, by improving access to water infrastructure and improve reliability, reducing downtime, and minimizing service interruptions, thereby ensuring sustainable water supply for municipalities.

Actions:

- **Improve access to water infrastructure** in rural areas e.g. installing boreholes and wells with hand pumps or solar-powered pumps can provide a decentralized water source for rural communities.
- **Regular maintenance and inspection:** Implement regular maintenance schedules for water infrastructure, including pipelines, treatment plants, reservoirs, and pumping stations. Conduct routine inspections to identify and address potential issues before they escalate into larger problems. All water provision infrastructure should be maintained to ensure that it will be able to deal with extreme events such as flooding and drought and remain in functioning condition.
- **Invest in upgrading aging infrastructure** to improve reliability, efficiency, and resilience to climate change impacts.
- **Invest in public-private partnerships**: These can leverage private sector efficiency and innovation, providing funding and expertise to develop and maintain water infrastructure. PPPs can reduce costs while expanding water services.
- **Address human resources constraints** for effective water infrastructure management by providing training, capacity building, skills development and promoting equal opportunities for women, minorities, and underrepresented groups

Programme 1.4: Education and awareness raising around climate change and sustainable water use
This programme typically includes a range of actions and initiatives designed to inform, educate, and engage various stakeholders about the impacts of climate change and the importance of sustainable water management.

Actions:

- **Public awareness** campaigns to inform and educate the public about the impacts of climate change and the importance of sustainable water use. This can involve multimedia campaigns, social media outreach, and community events.
- **Partnerships and collaborations** with NGOs, community groups, educational institutions, and the private sector to amplify education and awareness efforts. Collaborative projects can help share resources, expertise, and reach a wider audience.
- **Community engagement activities** such as clean-up drives, tree planting events, and water conservation projects to raise awareness and encourage community involvement in climate action.

4.3. Adaptation programme: Goal 2: Preserving ecological resilience, maintaining biodiversity, and safeguarding ecosystem services essential for human well-being

Programme 2.1: Conservation and protection

The programme aims to conserve, protect and restore natural pen spaces, ecosystems and natural resources. Preserving and restoring healthy ecosystems is essential for effective flood management, drought resilience, and sustainable water provision. Conservation efforts and integrated watershed management approaches are critical for ensuring the continued functioning of these ecosystems and the services they provide.

Actions:

- **Enforce environmental regulations:** Effectively enforce existing environmental regulations to prevent illegal activities like illegal dumping, illegal wood harvesting, poaching and general overexploitation of natural resources.
- **Collaboration between departments**: Encourage collaboration between environmental, health, water, and planning departments to ensure holistic enforcement of environmental laws.
- **Provide training and capacity-building** programs for municipal staff on environmental legislation, compliance, and enforcement procedures. This will equip officials with the knowledge and skills needed to enforce regulations effectively.
- **Ensure that municipal by-laws align** with national environmental legislation, such as the National Environmental Management Act (NEMA). Municipalities should have clear, enforceable by-laws that cover waste management, air quality, water use, and biodiversity protection.
- **Implement strict penalties for non-compliance** with environmental laws, such as fines, suspensions, or legal action. The penalties should be sufficient to deter violations.
- **Encourage community involvement** in monitoring and reporting environmental violations. Establish channels for communities to report environmental breaches, such as illegal dumping, pollution, or habitat destruction.
- **Use the existing environmental management/biodiversity framework** to identify and prioritize valuable ecosystems to protect.

Programme 2.2: Restoration and rehabilitation

The programme aims to enhance the provision of ecosystem services such as water purification, soil retention, carbon sequestration, and flood regulation. Restoration efforts can help improve water quality, regulate water flow, and enhance groundwater recharge. These efforts contribute to water security by ensuring a reliable and sustainable supply of water for municipalities, particularly in the face of climate variability and increasing water stress.

Actions:

- **Develop capacity at local municipality** level to implement existing conservation plans.
- Education and awareness of the importance of protection of biodiversity: Communities should be informed of the importance of natural resources for their livelihoods, especially in the areas where communities are located next to wetlands.
- **Promote community-based restoration projects:** Engage local communities in restoration efforts, fostering a sense of ownership and promoting environmental stewardship.
- **Implement rehabilitation initiatives:** Undertake initiatives like tree planting, wetland restoration, and stream bank stabilization to improve the health and functionality of natural spaces.
- **Enforce the adherence to buffer zone around water areas and enforce restrictions:** To protect these water bodies (water ways, water bodies and wetlands), buffer zones around these features

should be treated with great care. Buffer zones around wetlands and water courses should be considered sensitive to development activities.

Programme 2.3: Reduce atmospheric emissions and improve air quality

This programme aims to enhance the overall quality of life for residents by improving air quality, which has direct health benefits, and by fostering a cleaner, more sustainable environment. It includes education and awareness programs to inform the community about the importance of reducing emissions and adopting more sustainable practices. Additionally, it involves monitoring and reporting mechanisms to track progress and ensure that the municipality is meeting its environmental and sustainability. Large industry has been identified as the major contributor of air pollution in the BPDM. BPDM is the main industrial hub of the province and most of the industries in the district are located in Rustenburg and Madibeng.

Actions:

- Strictly enforce municipal by-laws in terms of waste management and enforcing air quality standards, including inspections, fines for violations, and procedures for addressing complaints about air pollution.
- Monitor strategic important air quality parameters in the BPDM area by ensuring that they adhere to the requirements of air quality.
- Upgrade waste management facilities to improve the efficiency, effectiveness, and sustainability of waste management systems. This might involve upgrading equipment, improving waste sorting and processing technologies, or expanding capacity.
- Encourage and implement comprehensive waste reduction, recycling, and composting programs. This should have a special focus on the youth, especially at schools to minimize waste sent to landfills, which can produce methane, a potent GHG.

4.4. Adaptation programme: Goal 3: To protect communities and increase the resilience of critical municipal infrastructure

Programme 3.1: Identify and protect vulnerable communities

This programme aims to protect property, infrastructure and life from climate risks by identifying and prioritizing infrastructure and communities facing the most severe risks and those with limited capacity to adapt.

Actions:

- **Comprehensive vulnerability assessment:** Conduct detailed assessments to identify infrastructure and communities most susceptible to climate hazards like droughts, floods, heatwaves, and wildfires. Utilize spatial data analysis tools like Geographic Information Systems (GIS) to map vulnerable areas based on factors like elevation, proximity to water bodies, and historical climate data. Conduct community surveys and focus group discussions to understand local knowledge and perceptions of climate risks. Partner with research institutions or climate experts to access specialized knowledge and tools.
- **Prioritization and risk ranking**: Based on the vulnerability assessments, prioritize infrastructure and communities facing the most severe risks and those with limited capacity to adapt. Develop a risk matrix that considers the likelihood and severity of climate hazards, as well as the potential consequences for specific infrastructure and communities. Prioritize critical infrastructure like

hospitals, power plants, and water treatment facilities that require immediate attention. Identify vulnerable communities based on factors like poverty levels, access to essential services, and reliance on climate-sensitive livelihoods.

- **Developing and implementing an early warning system** to help communities prepare for and respond to climate change risks.
- **Establishing partnerships** with local stakeholders, such as community groups and NGOs, to build local capacity for climate change adaptation and resilience. This involves collaboration with communities, businesses, and other stakeholders to develop and implement adaptation strategies. Organize workshops and public meetings to raise awareness of climate risks and encourage participation in adaptation planning. Provide training and capacity building programs to equip local communities with the skills and knowledge to adapt to climate change. Encourage partnerships with the private sector to leverage resources and expertise for adaptation projects.

Programme 3.2: Manage stormwater runoff appropriately.

Climate change is bringing more frequent and intense rainfall events, leading to increased stormwater runoff. A key adaptation goal for stormwater runoff management is to upgrade traditional drainage systems to handle increased flow during heavy rain events and mimic natural systems to lessen the burden on traditional drainage systems.

Actions:

- **Implement regular inspection, and maintenance programs for stormwater and road infrastructure**.
- **Upgrade stormwater drainage systems,** including culverts, channels, and retention ponds, to accommodate increased stormwater runoff resulting from extreme weather events.
- **Water Sensitive Design (WSD):** Adopt water-sensitive design principles and practices to integrate stormwater management with urban planning and design, incorporating features such as water-sensitive streetscapes, green corridors, and sustainable drainage systems to enhance water quality and mitigate urban heat island effects.

Programme 3.3: Protect human health.

This programme aims to enhance the resilience of communities and health systems to climate change impacts, reducing vulnerability and protecting human health from climate-related hazards.

Actions:

- **Assessing climate health risks:** Conduct assessments to identify climate-related health risks and vulnerabilities in communities, including exposure to extreme heat, air pollution, vector-borne diseases, waterborne diseases, and food insecurity.
- **Heatwave preparedness and response:** Develop heatwave early warning systems to alert communities and health authorities to extreme heat events. Implement heat health action plans that include measures such as providing cooling centers, distributing heat warnings, and educating vulnerable populations on heat-related risks and preventive measures.
- **Vector and waterborne disease control:** Improve water sanitation and hygiene practices to reduce the risk of waterborne diseases, such as cholera and diarrheal diseases, by ensuring access to clean water, promoting handwashing, and improving sanitation infrastructure.

- **Community engagement and education:** Engage with communities to raise awareness about climate-related health risks, empower individuals to take preventive measures, and promote community-based adaptation actions. Provide health education and outreach programs to vulnerable populations, including children, the elderly, and people with chronic illnesses, to build resilience and reduce health risks associated with climate change.

Programme 3.4: Integrated Fire Management for Climate Resilience
This programme aims to minimize the occurrence and impact of wildfires, protect communities, ecosystems, and infrastructure, and enhance resilience to increasing fire risk.

Actions:

- **Risk assessment and mapping:** Conduct comprehensive risk assessments to identify areas prone to wildfires, considering factors such as climate conditions, vegetation types, topography, and human activities. Develop wildfire risk maps to prioritize areas for mitigation measures and emergency preparedness planning.
- **Fire prevention and mitigation:** Implement measures to prevent wildfires, such as enforcing fire bans during periods of high fire danger, regulating land-use practices, and conducting prescribed burns to reduce fuel loads. Implement fuel management strategies, such as creating firebreaks, thinning dense vegetation, and removing flammable debris, to reduce the intensity and spread of wildfires.
- **Emergency preparedness and response:** Develop and implement wildfire response plans that outline roles and responsibilities, communication protocols, evacuation procedures, and coordination mechanisms among relevant stakeholders. Conduct training exercises and drills for emergency responders, community members, and other stakeholders to ensure effective wildfire response and evacuation procedures.
- **Community engagement and education:** Engage with communities to raise awareness about wildfire risks, prevention measures, and evacuation procedures. Provide training and educational programs on fire safety, including safe burning practices, home fire prevention, and wildfire preparedness, targeting vulnerable populations and high-risk areas.
- **Protect key infrastructure:** Implement land-use planning measures to allow for defensible space around structures, avoid locating critical infrastructure and residential developments in high-risk wildfire areas.
- **Ecosystem management and restoration:** Restore and manage ecosystems to reduce wildfire risk and enhance ecological resilience, including controlled burns, forest thinning, and invasive species management. Promote biodiversity conservation and habitat restoration to improve ecosystem health and reduce the spread of wildfires.

4.5. Adaptation programme: Goal 4: To enhance the resilience of the rural economy with a focus on the agricultural and tourism sector

Programme 4.1: Enhancing food security and agricultural resilience:
This programme aims to enhance the resilience and sustainability of agricultural systems, ensure food security, and support the livelihoods of farmers and rural communities.

Actions

- **Protecting high value and urban agricultural land and food gardens:** Non-agricultural land uses should be limited or not allowed on high potential agricultural land, in order to ensure the conservation and protection of such land for agricultural production.
- **Identify areas** where conflicts between agriculture, mining, urban development and nature conservation might be expected in the future. Using GIS the municipality can map high potential agricultural land, important mining areas and critical biodiversity areas.
- **Strengthening local food networks:** Establish and promote local food networks, cooperatives, and supply chains that connect farmers directly with consumers, restaurants, schools, and institutions to increase access to fresh, locally grown produce. Support local food production by supporting small-scale farmers, urban agriculture initiatives, and community gardens
- **Create markets and improve market infrastructure and access for farmers.** Support local farmers, fresh produce markets, and food hubs. Invest in the development and improvement of market infrastructure, e.g. storage facilities, cold storage, and transportation networks. Promote the consumption of locally grown produce through marketing campaigns, public awareness initiatives, and consumer education programs that highlight the benefits of buying fresh, seasonal, and locally sourced foods.

Programme 4.2: Provide climate information, technical assistance, and capacity-building to the agricultural sector

This programme aims to provide small-scale farmers with access to timely and localized climate information, weather forecasts, and agronomic advisories through mobile technology, extension services, and community-based networks to support informed decision-making and risk management. It also focusses on strengthening capacity-building programs to empower small-scale farmers with knowledge, skills, and resources to adopt climate-smart agricultural practices, improve crop management techniques, and enhance adaptive capacity.

Actions:

- Create local centers equipped with the latest climate data and forecasts, accessible to the public and particularly targeting local farmers and community leaders.
- Develop and disseminate easy-to-understand climate bulletins that provide updates on weather patterns, climate risks, and adaptation tips.
- Implement capacity-building programs to enhance the knowledge and skills of small-scale farmers in areas such as crop diversification, sustainable farming techniques, and efficient water use.

Programme 4.3: Sustainable development of a resilient tourism industry

This programme aims to enhance the resilience of tourism-dependent communities, businesses, and natural assets to the impacts of climate change, while promoting sustainable tourism practices that mitigate further environmental degradation.

Actions

- **Integrate climate change considerations into tourism planning and development processes.** The development. This includes the development of plans and strategies that support the adoption of sustainable tourism practices that minimize carbon emissions, minimize water usage, promote renewable energy sources, and encourage waste reduction within the tourism sector.

- **Upgrade and maintain tourism infrastructure and services**: Invest in climate-resilient tourism infrastructure and services, including accommodation facilities, transportation networks, visitor centres, and recreational amenities.
- **Protect tourism based natural assets**: Strengthen the management and protection of biodiversity-rich areas, including national parks, nature reserves, and protected areas, to safeguard critical habitats, species, and ecosystem services.

5. Implementation Framework

The implementation framework summarises the adaptation plan and indicate responsibilities, timeframes, and priorities.

5.1. Implementation framework: Goal 1: Ensure water security in the face of climate change

Adaptation programme 1.1: Water conservation practices				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. **Promote and implement water conservation practices** through the adoption of water-saving behaviours and technologies to reduce water wastage and optimize water use efficiency in households, businesses, and public institutions.	Drought	DM technical services of water and sanitation LM: Environment-Water and sanitation Department of Water and Sanitation (DWS)	Short term (<5 years)	High priority
ii. **Rainwater harvesting:** Promote the collection and storage of rainwater for later use.	Drought	DM technical services of water and sanitation Department of Water and Sanitation (DWS)	Medium term	High
iii. **Develop and enforce leak detection and repair programmes** for water infrastructure. Systems such as smart water metering and leak detection systems can reduce water losses in distribution networks.	Drought	DM Health and Environmental Services, Water and Sanitation	Medium to long term	High
iv. **Alien invasive species clearing initiatives in catchment areas**: Alien invasive species often consume more water than native species and can disrupt local ecosystems.	Drought	DM Urban planning, DM Health and Environmental Services, Water and Sanitation NW province Dept of environment	medium term (5-10 years	Medium

		DFFE (Working for Water and Wetlands Programmes) LM Environmental		
v. **Water-efficient landscaping:** Encourage water-efficient landscaping practices in urban, suburban, and rural areas to reduce outdoor water demand. This could include promoting drought-tolerant native plants, mulching, soil moisture retention techniques, and efficient irrigation systems.	Drought	DM Urban planning, DM Health and Environmental Services,		

Adaptation programme 1.2: Assess the feasibility of alternative water sources.				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct feasibility studies, hydrogeological assessments, and environmental impact assessments to evaluate the potential of alternative water sources and determine the most suitable options for local conditions.	Drought	*DM technical services of water and sanitation* Health and Environmental Services, *Department of Water and Sanitation (DWS)*	Long term	High
ii. Implement and expand treated wastewater reuse and recycling programs to reclaim and treat wastewater effluent to a quality suitable for non-potable uses, such as irrigation, industrial processes, and groundwater recharge.	Drought	*DM technical services of water and sanitation* *LM Water sanitation* *Department of Water and Sanitation (DWS)*	Long term	High

Adaptation programme 1.3: Expand, improve, protect and maintain water services infrastructure				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. **Improve access to water infrastructure** in rural areas e.g. installing boreholes and wells with hand pumps or solar-powered pumps can provide a decentralized water source for rural communities.	Drought, Flooding	*DM technical services of water and sanitation* Health and Environmental Services, *LM Water and sanitation* *Department of Water and Sanitation (DWS)*	Short, medium and long term	High
ii. **Regular maintenance and inspection:** Implement regular maintenance schedules for water infrastructure, including pipelines, treatment plants, reservoirs, and pumping stations.	Drought, Flooding	*DM technical services of water and sanitation*	Long terms	High
iii. **Invest in upgrading aging infrastructure** to improve reliability, efficiency, and resilience to climate change impacts.	Drought, Flooding	*DM technical services of water and sanitation*	Short term	High
iv. **Invest in public-private partnerships**: These can leverage private sector efficiency and innovation, providing funding and expertise to develop and maintain water infrastructure. PPPs can reduce costs while expanding water services.	Drought, Flooding	*DM technical services of water and sanitation* Health and Environmental Services, *LM Water and sanitation*	Medium	Medium
v. **Address human resources constraints** for effective water infrastructure management by providing training, capacity building, skills development and promoting equal opportunities for women, minorities, and underrepresented groups	Drought, Flooding	*DM technical services of water and sanitation* Health and Environmental Services, *LM Water and sanitation*	Medium	Medium

Programme 1.4: Education and awareness raising around climate change and sustainable water use				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Public awareness campaigns to inform and educate the public about the impacts of climate change and the importance of sustainable water use. This can involve multimedia campaigns, social media outreach, and community events.	Drought, Flooding	*DM technical services of water and sanitation* Health and Environmental Services, *Department of Water and Sanitation (DWS)* *DM Departments working together.* DFFE, DEDECT, BDM, and LM's Tourism and Parks Board	Short, medium and long term	High
ii. Partnerships and collaborations with NGOs, community groups, educational institutions, and the private sector to amplify education and awareness efforts. Collaborative projects can help share resources, expertise, and reach a wider audience.	Drought, Flooding	*DM technical services of water and sanitation*	Long terms	Medium
iii. Community engagement activities such as clean-up drives, tree planting events, and water conservation projects to raise awareness and encourage community involvement in climate action.	Drought, Flooding	*DM technical services of water and sanitation*	Short term	High

5.2. Implementation framework: Goal 2: Preserving ecological resilience, maintaining biodiversity, and safeguarding ecosystem services essential for human well-being

Adaptation programme 2.1: Conservation and protection of natural resources				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. **Enforce environmental regulations:** Effectively enforce existing environmental regulations to prevent illegal activities like illegal dumping, illegal wood harvesting, poaching and general overexploitation of natural resources.	Flooding, heat stress, drought	DM Health and Environmental Services DFFE, DEDECT, BDM, and LM's Tourism and Parks Board	Short term	High
i. **Encourage collaboration between different departments in municipalities**: Encourage collaboration between environmental, health, water, and planning departments to ensure holistic enforcement of environmental laws.	Flooding, heat stress, drought	LM's and DM Health and Environmental Services	Long term	High
iii. **Provide training and capacity-building programs for municipal staff** on environmental legislation, compliance, and enforcement procedures. This will equip officials with the knowledge and skills needed to enforce regulations effectively.	Flooding, heat stress, drought	LM's and DM Health and Environmental Services	Medium term	High
iv. **Ensure that municipal by-laws align with national environmental legislation**, such as the National Environmental Management Act (NEMA). Municipalities should have clear, enforceable by-laws that cover waste management, air quality, water use, and biodiversity protection.	Flooding, heat stress, drought	LM's and DM Health and Environmental Services	Medium term	Medium

v. **Implement strict penalties** for non-compliance with environmental laws, such as fines, suspensions, or legal action. The penalties should be sufficient to deter violations.	Flooding, heat stress, drought	LM's and DM Health and Environmental Services	Short term	Medium
vi. **Encourage community involvement** in monitoring and reporting environmental violations. Establish channels for communities to report environmental breaches, such as illegal dumping, pollution, or habitat destruction.	Flooding, heat stress, drought	LM's and DM Health and Environmental Services	Long term	Medium
vii. **Use the existing environmental management/biodiversity framework** to identify and prioritize valuable ecosystems to protect.	Flooding, heat stress, drought	LM's and DM Health and Environmental Services	Medium	High

Adaptation programme 2.2: Restoration and rehabilitation				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. **Develop capacity at local municipality** level to implement existing conservation plans.	Flooding, heat stress, drought	LM's and DM Health and Environmental Services	Short term	High
ii. **Education and awareness** of the importance of protection of biodiversity: Communities should be informed of the importance of natural resources for their livelihoods, especially in the areas where communities are located next to wetlands.	Flooding, heat stress, drought	LM's and DM Health and Environmental Services	Medium term	High
iii. **Promote community-based restoration projects:** Engage local communities in restoration efforts, fostering a sense of	Flooding, heat stress, drought	LM's and DM Health and Environmental Services	Medium term	Medium

	ownership and promoting environmental stewardship.				
iv.	**Implement rehabilitation initiatives:** Undertake initiatives like tree planting, wetland restoration, and stream bank stabilization to improve the health and functionality of natural spaces.	Flooding, heat stress, drought	DM Health and Environmental Services DFFE, DEDECT, BDM, and LM's Tourism and Parks Board		High

Adaptation programme 2.3: Reduce atmospheric emissions and improve air quality				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Strictly enforce municipal by-laws in terms of waste management and enforcing air quality standards, including inspections, fines for violations, and procedures for addressing complaints about air pollution.	Air quality	DM Health and Environmental Services DFFE, DEDECT, BDM (AEL's), and LM's	Short term	High
ii. Monitor strategic important air quality parameters in the BPDM area by ensuring that they adhere to the requirements of air quality.	Air quality	BPDM and LM's (Rustenburg monitoring stations) DFFE, DEDECT, private sector Madibeng (DFFE)	Medium term	High
iii. Encourage and implement comprehensive waste reduction, recycling, and composting programs. This should have a special focus on the youth, especially at schools to minimize waste sent to landfills, which can produce methane, a potent GHG.	Air quality and pollution	DM Health and Environmental Services and LM's Province DEDECT	Medium term	Medium
iv. Upgrade waste management facilities to improve the efficiency, effectiveness, and	Air quality and pollution	DM Health and Environmental Services and LM's	Medium	High

sustainability of waste management systems. This might involve upgrading equipment, improving waste sorting and processing technologies, or expanding capacity.		Province DEDECT		

5.3. Implementation framework: Goal 3: To protect communities and increase the resilience of critical municipal infrastructure

Adaptation programme 3.1: Identify and protect vulnerable communities.				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct detailed assessments to identify infrastructure and communities most susceptible to climate hazards like droughts, floods, heatwaves, and wildfires.	Flooding, heat stress, drought	DM Community Development: Health and Environmental Services LM's Disaster management, fire services	Short term	High
ii. Prioritize infrastructure and communities facing the most severe risks and those with limited capacity to adapt.	Flooding, heat stress, drought	DM Community Development: Health and Environmental Services	Medium term	High
iii. Develop and implement an early warning system to help communities prepare for and respond to climate change risks.	Flooding, heat stress, drought	DM Community Development: Health and Environmental Services	Medium term	Medium
iv. Establish partnerships with local stakeholders, such as community groups and NGOs, to build local capacity for climate change adaptation and resilience.	Flooding, heat stress, drought	DM Community Development: Health and Environmental Services	Short term	Medium

Adaptation programme 3.2: Manage stormwater runoff appropriately

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Implement regular inspection, and maintenance programs for stormwater and road infrastructure.	Floods	*DM technical services of water and sanitation*	Short term	High
ii. Upgrade stormwater drainage systems, to accommodate increased stormwater runoff	Floods	*DM technical services of water and sanitation*	Medium term	Medium
iii. Adopt water-sensitive urban design principles and practices such as permeable pavements, green roofs and rain gardens to enhance water quality and mitigate urban heat island effects.	Floods	*DM technical services of water and sanitation*	Long term	Medium

Adaptation programme 3.3: Protect human health				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct assessments to identify climate-related health risks and vulnerabilities in communities.	Flooding, heat stress, drought	DM Community Development: Health and Environmental Services	Short term	High
ii. Develop heatwave early warning systems to alert communities and health authorities to extreme heat events.	Heat stress	DM Community Development: Health and Environmental Services	Medium term	High
iii. Improve water sanitation and hygiene practices to reduce the risk of waterborne diseases, such as cholera and diarrheal diseases.	Flooding	DM Community Development: Health and Environmental Services	Short term	High
iv. Provide health education and outreach programs to vulnerable populations, including children, the elderly, and people with chronic illnesses.	Flooding, heat stress, drought	DM Community Development: Health and Environmental Services	Medium term	High

Adaptation programme 3.4: Integrated Fire Management for Climate Resilience

Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
i. Develop wildfire risk maps to prioritize areas for mitigation measures and emergency preparedness planning.	Fire risk	DM Community Development: Fire Services	Medium term	High
ii. Implement measures to prevent wildfires, such as enforcing fire bans during periods of high fire danger, regulating land-use practices, and conducting prescribed burns to reduce fuel loads	Fire risk	DM Community Development: Fire Services	Short term	High
iii. Develop and implement wildfire response plans that outline roles and responsibilities, communication protocols, evacuation procedures, and coordination mechanisms among relevant stakeholders.	Fire risk	DM Community Development: Fire Services	Medium term	Medium
iv. Engage with communities to raise awareness about wildfire risks, prevention measures, and evacuation procedures and provide training and educational programs on fire safety	Fire risk	DM Community Development: Fire Services	Medium term	Medium
v. Implement land-use planning measures to allow for defensible space around structures, avoid locating critical infrastructure and residential developments in high-risk wildfire areas.	Fire risk	DM Community Development: Fire Services	Long term	Medium

5.4. Implementation framework: Goal 4: To enhance the resilience of the rural economy with a focus on the agricultural and tourism sector

Adaptation programme 4.1: Enhancing food security and agricultural resilience				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**

i. Protecting high value and urban agricultural land and food gardens: Non-agricultural land uses should be limited or not allowed on high potential agricultural land, in order to ensure the conservation (rezoning) and protection of such land for agricultural production.	Flooding, heat stress, drought	DM Tourism, Agriculture, Local Economic Development LM's Town planning	Short term	High
ii. Identify areas where conflicts between agriculture, mining, urban development and nature conservation might be expected in the future. Using GIS the municipality can map high potential agricultural land, important mining areas and critical biodiversity areas.	Flooding, heat stress, drought	DM Tourism, Agriculture, Economic Development	Medium term	Medium
iii. Strengthening local food networks: Establish and promote local food networks, cooperatives, and supply chains that connect farmers directly with consumers, restaurants, schools, and institutions to increase access to fresh, locally grown produce. Support local food production by supporting small-scale farmers, urban agriculture initiatives, and community gardens	Flooding, heat stress, drought	DM Tourism, Agriculture, Economic Development	Short term	Medium
iv. Create markets and improve market infrastructure and access for farmers. Support local farmers, fresh produce markets, and food hubs. Invest in the development and improvement of market infrastructure, e.g. storage facilities, cold storage, and transportation networks.	Flooding, heat stress, drought	DM Tourism, Agriculture, Economic Development	Short term	Medium

Adaptation programme 4.2: Provide climate information, technical assistance, and capacity-building to the agricultural sector

Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
i. Create local centers equipped with the latest climate data and forecasts, accessible to the public and particularly targeting local farmers and community leaders.	Flooding, heat stress, drought	DM Tourism, Agriculture, Economic Development	Short term	High
ii. Develop and disseminate easy-to-understand climate bulletins that provide updates on weather patterns, climate risks, and adaptation tips.	Flooding, heat stress, drought	DM Tourism, Agriculture, Economic Development	Medium term	High
iii. Implement capacity-building programs to enhance the knowledge and skills of small-scale farmers in areas such as crop diversification, sustainable farming techniques, and efficient water use.	Flooding, heat stress, drought	DM Tourism, Agriculture, Economic Development	Medium	High

Adaptation programme 4.3: Sustainable development of a resilient tourism industry				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
iv. Integrate climate change considerations into tourism planning and development processes. Adopt sustainable tourism practices that minimize carbon emissions, conserve natural resources, protect biodiversity.	Flooding, heat stress, drought	DM Tourism, Agriculture, Economic Development	Short term	High
v. Upgrade and maintain tourism Infrastructure and Services: Invest in climate-resilient tourism infrastructure and services, including accommodation	Flooding, heat stress, drought	DM Tourism, Agriculture, Economic Development	Medium term	High

	facilities, transportation networks, visitor centers, and recreational amenities.				
vi.	Protect tourism based natural assets: Strengthen the management and protection of biodiversity-rich areas, including national parks, nature reserves, and protected areas, to safeguard critical habitats, species, and ecosystem services.	Flooding, heat stress, drought	DM Tourism, Agriculture, Economic Development	Medium term	Medium

6. Recommendations for Mainstreaming

Mainstreaming is the process of integrating climate change considerations into existing sectoral plans, other instruments and decision-making processes across various sectors and levels of governance. It involves recognising that climate change impacts and risks cut across multiple sectors and require a holistic approach to address effectively. Mainstreaming supports and enables the implementation of climate adaptation measures.

Mainstreaming climate change involves several key elements, and recommendations are made in terms of each of these:

- **Policy integration**: Embedding evidence of climate change, as well as climate change adaptation and mitigation considerations into sectoral policies and strategies, such as those related to disaster risk management, energy, water resources, transportation, and urban planning. This ensures that climate change is not treated as a standalone issue but is instead integrated into broader development agendas.
- **Institutional integration**: Incorporating climate change responsibilities and expertise within departments. This may involve establishing a dedicated but decentralised climate change unit, as well as fostering collaboration and coordination among departments and relevant external stakeholders. Incorporating climate response outcomes in the KPIs of all relevant departments, will ensure that progress towards climate goals can be tracked and measured.
- **Capacity building**: Enhancing the knowledge, skills, and capacities of politicians, decision-makers, and practitioners to understand and address climate change effectively. This includes providing training, technical assistance, and access to relevant information and tools, such as the GreenBook. By improving their understanding of climate change and the need for adaptation, these groups can better integrate climate considerations into their work.
- **Budgeting and financing**: Allocating resources and funding to support climate change adaptation and mitigation activities within existing budgets and financing mechanisms. This may involve reallocating funds from other priorities, leveraging external sources of finance, or integrating climate considerations into budget planning processes. Various funding mechanisms are available to support climate change response initiatives, including national and international grants, public-private partnerships, and municipal budgets.
- **Establishing networks and partnerships:** Establishing networks or partnerships with civil society organisations, research councils, the private sector, different spheres of government, and other relevant entities could bolster climate adaptation efforts.
- **Monitoring and evaluation**: Establishing systems for monitoring and evaluating the effectiveness of mainstreaming efforts and tracking progress towards climate-related goals and targets. This helps ensure accountability and facilitates learning and adaptation over time.

Climate change mainstreaming is essential for building resilience and promoting sustainable development in the face of climate change. By integrating climate considerations into decision-making processes and actions across sectors, mainstreaming helps minimise future risks, maximise opportunities for adaptation and mitigation, and enhance overall resilience to climate change impacts.

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