GREENBOOK
adapting settlements for the future

Lejweleputswa District Municipality

Adaptation Plan

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List of Acronyms and Abbreviations

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
LDM	Lejweleputswa District Municipality
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, organisations 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 Lejweleputswa 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 Lejweleputswa 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 Lejweleputswa 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 Lejweleputswa 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 Lejweleputswa 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.

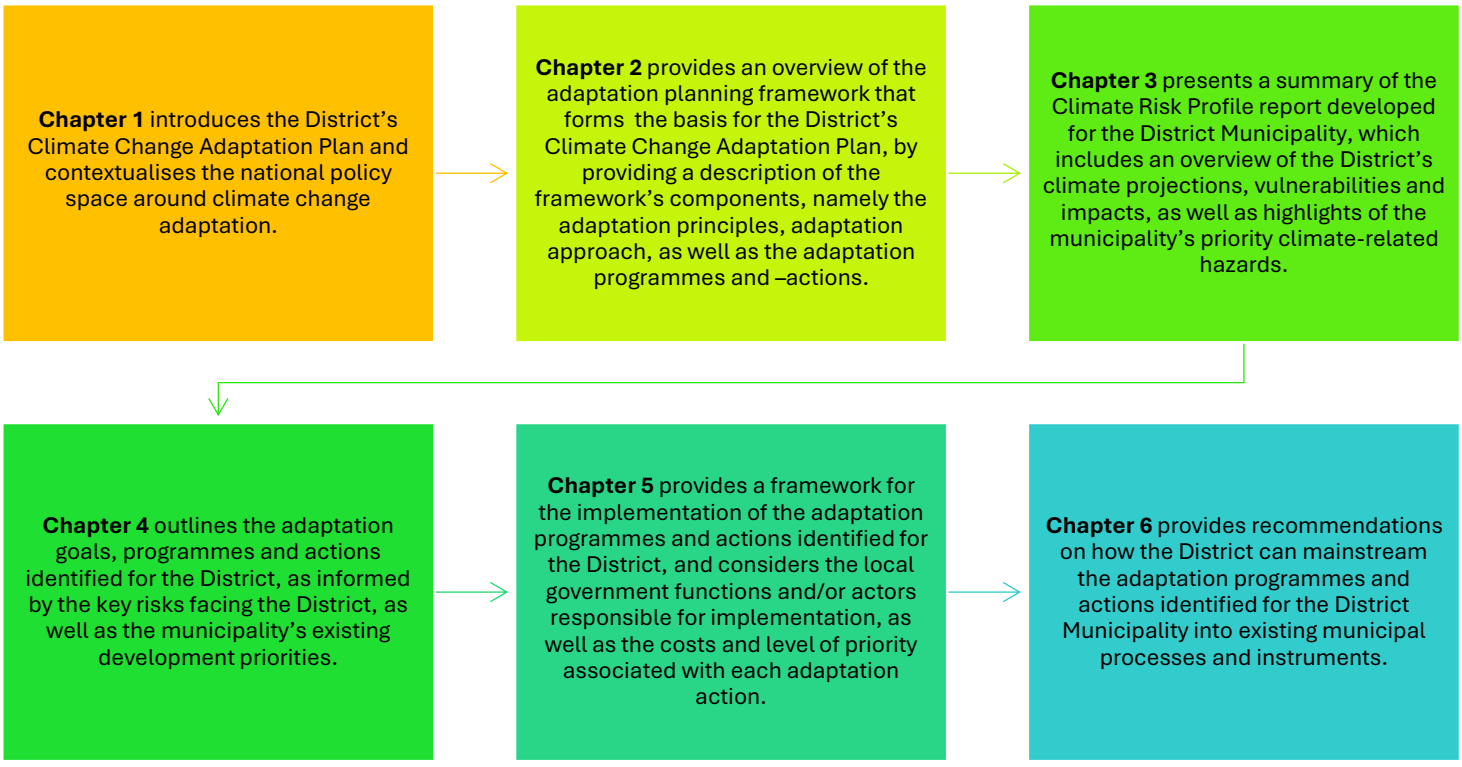

Figure 1: Outline of the Climate Change Adaptation Plan.

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; C40, 2020).

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.

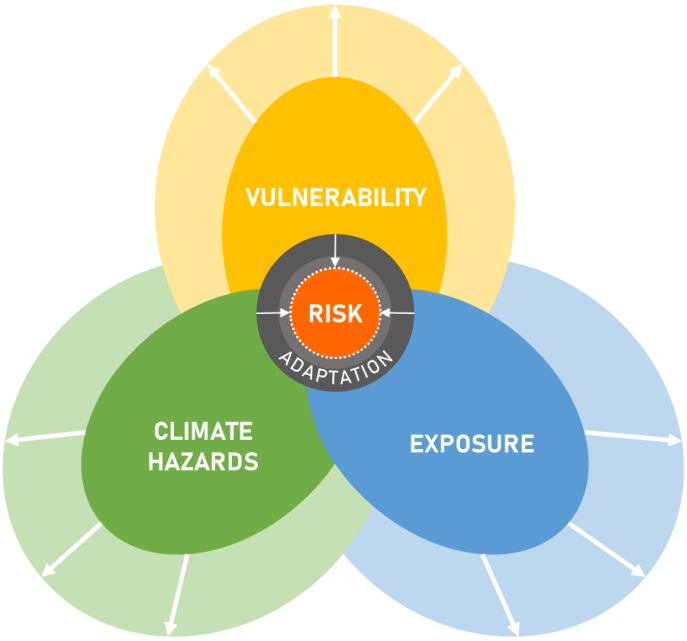

Figure 2: The interplay between hazards, vulnerability and exposure that determines risk (based in IPCC, 2014 and IPCC, 2021)

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 involves 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 Lejweleputswa 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 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 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 engagement on the development of Lejweleputswa District Municipality's Climate Change Adaptation Plan took place on Wednesday 26 June 2024. The meeting was attended by representatives from various departments in the district including municipal health services, environmental management, air pollution, waste management as well as representatives from Nala and Masilonyana LM's. Stakeholders from South Africa Local Government Association (SALGA) climate change and environmental management department as well as from Department Forestry Fisheries and Environment (DFFE) were also in attendance. 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 Lejweleputswa District Municipality.

This section of the Plan summarises the climate risk profile for Lejweleputswa 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

The primary climate projections for Lejweleputswa DM indicate generally hotter and wetter conditions, with an increase in extreme rainfall events. By 2050, temperatures across the district are expected to rise by up to 3.47°C. Average annual rainfall is projected to range from 88.16 mm to 253.94 mm. The number of very hot days could increase to as many as 46 in certain areas. In terms of wildfire risk, most settlements in Matjhabeng LM are projected to face a moderate risk by 2050, while settlements in Boshof, Hertzogville, Bultfontein,

Theunissen, Wisselsbron, and Brandford are expected to face a high risk. The change in the number of extreme rainfall days varies across the district, with Tokologo LM experiencing a slight decrease (-1.6 days) and Masilonyana and Matjhabeng LMs seeing an increase of up to 4 days. Projected flood risk is moderate for the settlements of Theunissen, Winberg, and Ventersburg. Most local municipalities (LMs) in the district, except for Masilonyana and Nala LM, currently struggle to meet water demand. The anticipated temperature increase will lead to higher mean annual evaporation, further straining water supply.

3.2. Priority climate-related hazards

The greatest climate risk facing the Lejweleputswa District is the increase in annual temperatures, with significant rises in heat extremes. By 2050, average annual rainfall is projected to range between 88.16mm and 253.94mm. Such variability in rainfall could significantly impact water availability, agriculture, ecosystems, and various socio-economic activities. The expected increase in days with heavy precipitation could lead to increased flooding, waterlogging, and damage to infrastructure across the district. Currently, most local municipalities (LMs) in the district already experience high water supply vulnerability. The impacts of climate change are anticipated to exacerbate this vulnerability, posing further challenges to water security in the district.

4. Adaptation Goals, Programmes and Actions

The section outlines the adaptation plan using goals and measures designed to help Lejweleputswa 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 Lejweleputswa DM were identified, prioritising those risks with the highest potential impact. These goals were validated by stakeholders during the nationwide engagements:

- Goal 1: To ensure water security for human consumption and irrigation under a changing climate.
- Goal 2: To increase the adaptive capacity of human settlements to climate change and extreme events.
- Goal 3: To maintain and increase resilience and reduce the vulnerability of ecosystems and people to the adverse effects of climate change.
- Goal 4: To increase resilience of the agricultural sector to more extreme events such as heatwaves and storms as well as indirect risks such as pests and diseases.
- Goal 5: To ensure that space is set aside for recreation, ecological support and stormwater management, and to guide decision making across all sectors.

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

To ensure water security for human consumption and irrigation under a changing climate.

Programme 1.1: Enhancing Water Resource Management and Infrastructure

This programme focuses on improving water resource management strategies and enhancing infrastructure resilience to ensure sustainable water supply for human consumption and irrigation amidst climate change impacts. It addresses climate risks such as increased temperatures, variability in precipitation patterns, and extreme rainfall events. The adaptation actions under this programme include:

- **Conducting comprehensive water resource assessments:** This involves conducting detailed hydrological studies and modelling to understand current and future water availability, taking into account projected climate changes such as increased temperatures, and altered precipitation patterns. Vulnerable areas and water sources at risk should be identified to prioritise intervention measures. A co-benefit is that the enhanced understanding of water resource dynamics will lead to improved planning for water allocation.
- **Retrofitting existing water storage facilities:** This involves upgrading existing reservoirs and dams to increase storage capacity and improve their resilience to extreme weather events, such as heavy rainfall and drought. It would be important to ensure that these structures can handle variability in water inflow and prolonged dry periods.
- **Upgrading pipelines and distribution systems:** This entails repairing and modernising water distribution networks to minimise leaks and inefficiencies. Smart water management technologies should be implemented to optimise water use and reduce losses.
- **Promoting water-saving practices and technologies:** This involves launching public awareness campaigns to educate residents and businesses about water conservation. Incentives should be provided for the adoption of water-saving devices such as low-flow faucets and efficient irrigation systems. A co-benefit of this is reduced water bills for consumers.

Programme 1.2: Climate-Resilient Infrastructure Development

This programme focuses on developing and upgrading infrastructure to enhance water security and resilience to climate change impacts such as increased floods and wildfires. It aims to ensure that water supply systems can withstand extreme weather events and provide reliable access to water for all users in the district. The adaptation actions under this programme include:

- **Upgrading water supply infrastructure:** This includes retrofitting and expanding existing water supply systems to improve capacity and reliability. Resilient pipelines, pumps, and storage facilities should be installed that can withstand extreme weather events.
- **Developing decentralised water supply systems:** This entails establishing community-based water supply systems, such as boreholes and wells, to reduce reliance on centralised infrastructure. The use of solar-powered water pumps to ensure sustainable and reliable water access should be promoted.
- **Strengthening flood and drought management systems:** This includes constructing and maintaining flood control structures, such as levees and drainage systems, to protect water resources. Drought management strategies, including water rationing and emergency water supply plans should be implemented.

- **Implementing wildfire risk management in catchments:** This involves conducting prescribed burns, vegetation management, and erosion control measures in critical catchments to reduce wildfire risks and protect water quality. Early warning systems should be established for wildfires to ensure timely response.
- **Enhancing monitoring and early warning systems:** This entails developing and implementing systems for real-time monitoring of water levels, quality, and climate conditions. Early warning systems to alert communities and water managers of impending water-related risks should be established.

Programme 1.3: Community Engagement and Capacity Building

This programme aims to build the capacity of communities in the district to manage water resources sustainably and adapt to climate change impacts. It focuses on education, awareness, and the involvement of local stakeholders in water management decisions. The adaptation actions under this programme include:

- **Conducting public awareness campaigns:** This involves educating communities about water conservation practices and the importance of sustainable water use. Integrate Traditional Ecological Knowledge (TEK) on water conservation practices to complement scientific evidence Various media channels can be used to disseminate information on water security and climate change.
- **Providing training and capacity building:** This entails organising workshops and training sessions for farmers, households, and local officials on water management and climate adaptation. Educational programs should blend indigenous knowledge with scientific understanding to enhance community resilience. Educational materials and resources to support capacity-building efforts should be developed.
- **Fostering community-based water management:** This entails establishing water user associations and committees to involve local stakeholders in water management decisions. Community-led initiatives for water conservation, rainwater harvesting, and watershed protection should be encouraged.
- **Promoting participatory water governance**: This involves facilitating regular consultations and dialogues between communities, government agencies, and other stakeholders. It should be ensured that the voices and needs of vulnerable and marginalised groups are considered in water management policies.

4.3. Adaptation programme: Goal 2

To increase the adaptive capacity of human settlements to climate change and extreme events.

Programme 2.1 Heatwave Preparedness and Response

This programme aims to reduce the vulnerability of human settlements to increasing temperatures and frequent heatwaves. It focuses on improving community resilience through education, infrastructure, and health services to mitigate the impacts of extreme heat. The adaptation actions under this programme include:

- **Conducting heat vulnerability assessments:** This entails identifying high-risk areas in the district and vulnerable populations such as the elderly, children, and outdoor workers. Areas with high heat exposure should be mapped to prioritise interventions.

- **Developing heatwave early warning systems:** This includes implementing systems to provide timely alerts about impending heatwaves. Multiple communication channels (SMS, radio, community announcements) should be used to reach all residents.
- **Establishing cooling centres:** This includes utilising community facilities such as libraries, schools, and recreation centres as cooling centres during heatwaves. These centres should be equipped with sufficient cooling mechanisms and drinking water.
- **Training healthcare workers and emergency responders:** This entails providing training on heat illness prevention, recognition, and treatment. Emergency services should be equipped with necessary supplies to handle heat-related emergencies.
- **Implementing urban greening initiatives:** This includes increasing tree planting and the creation of green spaces to reduce the urban heat island effect. The use of green roofs and walls in buildings to provide natural cooling should be encouraged.

Programme 2.2 Climate-Resilient Infrastructure and Urban Planning

This programme focuses on enhancing the resilience of urban infrastructure and incorporating climate adaptation into urban planning processes. It aims to ensure that human settlements can withstand increased temperatures, variable precipitation patterns, extreme rainfall, and flooding. The goal is to reduce vulnerabilities and improve the overall sustainability of urban environments. The adaptation actions under this programme include:

- **Conducting vulnerability assessments of critical infrastructure:** This entails assessing the resilience of healthcare facilities, schools, housing, and other critical infrastructure to climate impacts. Areas should be identified and prioritised for retrofitting and upgrades.
- **Implementing low-cost retrofitting measures:** This entails retrofitting existing buildings with improved insulation, reflective roofing materials, and enhanced drainage systems to handle increased rainfall and reduce flooding risks.
- **Updating zoning regulations and building codes:** This entails incorporating climate resilience measures into zoning regulations and building codes to guide sustainable development, provisions green spaces, stormwater management, and fire-resistant materials should be included.
- **Promotion of mixed-use development:** This involves encouraging the development of mixed-use areas that combine residential, commercial, and recreational spaces to reduce urban sprawl and enhance community resilience. These areas should include green spaces and infrastructure for stormwater management.

Programme 2.3 Water Security and Management

This programme aims to ensure a reliable and sustainable water supply for human consumption and irrigation under changing climate conditions. It addresses vulnerabilities related to water supply, including increased temperatures, variability in precipitation, and extreme rainfall, by implementing water conservation, management, and infrastructure improvements. The adaptation actions under this programme include:

- **Enhancing water conservation and efficiency:** This includes promoting the use of water-saving devices and appliances in households and businesses. Public education campaigns should also be conducted on the importance of water conservation.

- **Developing and maintaining rainwater harvesting systems:** This includes implementing community-based rainwater harvesting projects. The installation of rainwater tanks in homes and public buildings should be encouraged.
- **Protecting and restoring water sources:** This includes establishing protection zones around critical water sources to prevent pollution. Engage in watershed management practices to maintain healthy water ecosystems.
- **Improving infrastructure for water storage and distribution:** This includes upgrading existing water storage facilities to increase capacity. Water distribution networks should be repaired and maintained to reduce leaks and inefficiencies.
- **Implementing sustainable irrigation practices:** This entails training farmers in water-efficient irrigation techniques. The use of drought-resistant crops to reduce water demand should be promoted. Indigenous knowledge can inform the selection of climate-resilient crops that reduce vulnerability to climate risks.
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Programme 2.4 Ecosystem-Based Adaptation

This programme focuses on using natural systems and processes to enhance the resilience of human settlements to climate change and extreme events. It includes actions to protect, restore, and sustainably manage ecosystems to provide critical services such as stormwater management, temperature regulation, and biodiversity support. The adaptation actions under this programme include:

- **Implementing green infrastructure projects:** This includes developing and maintaining green infrastructure such as parks, wetlands, and green roofs to manage stormwater, reduce flooding, and provide recreational spaces. A co-benefit of this is enhanced biodiversity, improved air quality, and recreational opportunities.
- **Restoring degraded ecosystems:** This entails engaging in reforestation, wetland restoration, and other ecosystem restoration projects to enhance natural resilience to climate impacts.
- **Promoting sustainable land use practices:** This includes encouraging sustainable agriculture, forestry, and land management practices that enhance soil health, reduce erosion, and support water retention.
- **Establishing buffer zones and corridors:** This entails creating buffer zones around critical natural areas and establishing ecological corridors to facilitate wildlife movement and reduce habitat fragmentation. These areas should be included in Spatial Development Framework.

Programme 2.5 Community Engagement and Capacity Building

This programme focuses on empowering communities to actively participate in adaptation efforts, enhancing local knowledge, and building capacities to respond to climate change impacts. The adaptation actions under this programme include:

- **Facilitating participatory climate risk assessments:** This includes engaging community members in identifying local climate risks and vulnerabilities. The recognition and inclusion of indigenous knowledge in identifying local climate risks and vulnerabilities should be advocated for. Participatory mapping and other tools can be used to gather community input.

- **Developing community resilience plans:** This entails collaborating with local stakeholders to create tailored resilience plans addressing specific climate risks. Plans should include clear roles and responsibilities for implementation.
- **Provide capacity-building workshops and training:** This includes offering training sessions on climate adaptation, disaster preparedness, and emergency response. The focus should be on empowering community leaders and local organisations.
  Provide Capacity-Building Workshops and Training for municipal officials: This includes offering training sessions to municipal officials responsible for Infrastructure Planning/Development and Management in relation climate resilient/smart practices to ensure effective integration of climate change adaptation related to infrastructure projects.
- **Strengthening social networks and support systems:** This includes promoting the formation of neighbourhood associations, peer support groups, and other community networks. Enhancing social cohesion will improve collective resilience to climate impacts.
- **Fostering partnerships and collaboration:** This involves building partnerships between government agencies, non-profit organisations, academic institutions, and private sector actors. Resources and expertise should be leveraged from multiple stakeholders for climate adaptation initiatives.

4.4. Adaptation programme: Goal 3

To maintain and increase resilience and reduce the vulnerability of ecosystems and people to the adverse effects of climate change.

Programme 3.1: Community Resilience and Adaptation

This programme aims to enhance community resilience to climate change impacts of extreme heat, focusing on vulnerable populations in the district. It includes measures to build adaptive capacity, improve livelihoods, and strengthen social cohesion. The adaptation actions under this programme include:

- **Conducting community Climate Risk Assessment and establishing early warning systems:**
  This action entails conducting of participatory climate risk assessments with communities in the district to identify vulnerable groups and areas susceptible to climate risks such as heat extremes and water supply vulnerabilities. This inclusive process will ensure that the insights, indigenous knowledge, and priorities of community members are incorporated into adaptation planning and decision-making. The second part of this action is to establish community-based early warning systems and disaster preparedness plans to reduce risks associated with extreme weather events such as heatwaves and climate-related hazards such as fires.
- **Supporting livelihood diversification and sustainable development:**
  This involves supporting sustainable livelihoods through diversified income-generating activities, such as eco-tourism, small-scale renewable energy projects, and climate-resilient agriculture. Training and capacity-building opportunities should be provided for community members involved in climate-smart practices, entrepreneurship, and natural resource management.
- **Strengthening social safety nets and adaptive social protection**
  This involves strengthening social safety nets and adaptive social protection mechanisms (e.g. child support grant, old age pension, disability grant etc.) to support vulnerable households affected by climate change impacts, including heat stress and water scarcity. Facilitate access to climate-resilient infrastructure, such as resilient housing, community centres, and emergency shelters, to enhance community resilience during extreme weather events.

- **Community Awareness and Education:** This involves conducting public awareness campaigns on climate change impacts, adaptation strategies, and sustainable lifestyles. Promoting environmental education in schools, community centres, and through local media to foster a culture of climate resilience and sustainable development.

Programme 3.2 Policy Integration and Governance for Climate Resilience

This programme focuses on integrating climate resilience into local governance structures and policies. It aims to enhance institutional capacity, promote adaptive governance, and ensure coordinated responses to climate change across sectors. The adaptation actions under this programme include:

- **Climate-Resilient Urban and Rural Planning:** This involves integrating climate considerations into urban and rural development plans, zoning regulations, and building codes to reduce heat island effects and enhance natural cooling. To foster green infrastructure development, such as parks, green roofs, and urban forests, to improve air quality, reduce flood risks, and enhance community well-being.
- **Strengthening Disaster Risk Management and Response:** This entails enhancing local disaster risk management plans to include climate change scenarios and adaptive responses. To establish multi-sectoral coordination mechanisms and contingency plans for rapid response to climate-related emergencies, including heatwaves and water shortages.
- **Promoting climate-resilient policies and regulations:** This involves advocating for policies that incentivise climate-resilient practices, such as renewable energy incentives, carbon pricing mechanisms, and green finance opportunities. Strengthening enforcement of environmental regulations and promoting sustainable resource use practices among businesses, industries, and agricultural sectors.
- **Capacity Building and Knowledge Sharing:** This involves providing training for local government officials, planners, and decision-makers on climate change adaptation strategies, climate science, and risk management. This can include fostering partnerships with academic institutions, research organisations, and civil society groups to exchange knowledge, data, and best practices in climate resilience.

Programme 3.3: Climate-Resilient Ecosystem Management

This programme focuses on conserving and restoring ecosystems to enhance their resilience to climate change impacts. It includes measures to protect biodiversity, manage natural resources sustainably, and mitigate the effects of climate change on ecosystems and biodiversity. The adaptation actions under this programme include:

- **Ecosystem vulnerability assessment and planning:** This involves conducting comprehensive assessments to identify ecosystems at risk from climate change impacts across the district including heat extremes and water supply vulnerability. This can be followed with the design of adaptive management plans tailored to each ecosystem type, incorporating strategies for habitat restoration, species conservation, and natural resource management.
- **Protected area expansion and management:** This entails expanding and effectively managing protected areas to safeguard biodiversity hotspots and critical habitats. Ecological connectivity should be enhanced between protected areas to facilitate species movement and adaptation to changing climatic conditions. It is important to identify these sites and to include them in Integrated

Development Plans and Spatial Development Frameworks to ensure that they are considered in development decisions and sufficiently protected from the impacts of climate change.

- **Promotion of climate-smart agriculture:** This involves introducing climate-resilient agricultural practices, such as agroforestry and sustainable land management techniques, to reduce soil erosion and enhance carbon sequestration.
- **Implementing integrated water resource management:** This involves the implementation of catchment management plans that prioritise ecosystem health while ensuring sustainable water supply for communities and agriculture. Multi-stakeholder partnerships should be fostered to promote efficient water use, recharge groundwater resources, and protect water quality in vulnerable areas.

4.5. Adaptation programme: Goal 4

To increase resilience of the agricultural sector to more extreme events such as heatwaves and storms as well as indirect risks such as pests and diseases.

Programme 4.1 Climate-Resilient Agricultural Practices

This programme aims to promote agricultural practices that enhance the resilience of crops and livestock to climate extremes. It includes implementing techniques that improve soil health, water efficiency, and pest management, ensuring that agriculture can thrive despite adverse climate conditions. The adaptation actions under this programme include:

- **Implementing conservation agriculture techniques:** This includes promoting practices such as minimal soil disturbance, permanent soil cover, and crop rotation to improve soil health and water retention.
- **Adopting drought-resistant crop varieties:** This entails introducing and supporting the use of drought-resistant and heat-tolerant crop varieties to ensure productivity during periods of water scarcity and high temperatures. The co-benefits of this are sustained agricultural yields and reduced irrigation needs.
- **Implementing Integrated Pest Management (IPM):** This involves developing and promoting IPM strategies that combine biological, cultural, physical, and chemical tools to manage pests and diseases sustainably.
- **Utilising shade structures and windbreaks:** This involves establishing shade structures and windbreaks to protect crops from heatwaves and storms, and to reduce soil moisture loss.

Programme 4.2 Water Management and Conservation

This programme focuses on efficient water use and conservation strategies to address the vulnerability of water supply in agriculture. It includes actions to optimise irrigation, harvest rainwater, and manage water resources sustainably. The adaptation actions under this programme include:

- **Installing efficient irrigation systems:** This includes promoting the use of drip irrigation and other water-efficient systems to minimise water use and maximise crop yields.
- **Developing rainwater harvesting systems:** This entails implementing rainwater harvesting infrastructure on farms to collect and store rainwater for irrigation and other agricultural uses.

- **Promoting water-saving practices:** This includes educating farmers on practices such as mulching, contour farming, and the use of cover crops to conserve soil moisture. Co-benefit are improved soil health and reduced water needs.
- **Constructing farm ponds and reservoirs:** This entails supporting the construction of small-scale ponds and reservoirs on farms to store runoff water for irrigation and livestock use.

Programme 4.3 Livestock and Pasture Management

This programme aims to improve the resilience of livestock and pasture systems to climate extremes. It includes actions to enhance feed availability, protect animals from heat stress, and manage pastureland sustainably. The adaptation actions under this programme include:

- **Improving pasture management practices:** This involves implementing rotational grazing and other sustainable pasture management techniques to maintain pasture health and productivity. Co-benefits are improved soil health and pasture resilience.
- **Enhancing livestock housing and shelter:** This involves constructing or retrofitting livestock housing to provide adequate ventilation, shade, and protection from extreme weather.
- **Developing feed and fodder banks:** This entails establishing feed and fodder banks to ensure a stable supply of animal feed during periods of drought or extreme weather.
- **Implementing heat stress management practices:** This entails introducing practices such as providing cool drinking water, shade structures, and cooling systems for livestock during heatwaves. Co-benefits are enhanced animal productivity and health.

Programme 4.4 Capacity building and Knowledge Sharing

This programme focuses on enhancing the knowledge and skills of farmers and agricultural stakeholders to adapt to climate change. It includes training, education, and the dissemination of best practices and innovations. The adaptation actions under this programme include:

- **Conducting climate resilience training for farmers:** This entails organising workshops and training sessions to educate farmers on climate-resilient practices, technologies, and strategies.
- **Developing and disseminating climate information services:** This includes establish systems to provide timely and accurate climate forecasts and advisories to farmers to inform decision-making. Co-benefits are enhanced preparedness and risk management.
- **Promoting farmer-to-farmer knowledge exchange:** This involves facilitating networks and platforms for farmers to share experiences and best practices in climate-resilient agriculture.
- **Establishing agricultural extension services:** This includes strengthening agricultural extension services to provide ongoing support and advice to farmers on adapting to climate change.

4.6. Adaptation programme: Goal 5

To ensure that space is set aside for recreation, ecological support and stormwater management, and to guide decision making across all sectors.

Programme 5.1 Integrated Urban Green Spaces

This programme aims to develop and maintain green spaces within urban areas of the district to provide recreational opportunities, support local ecosystems, and manage stormwater. It focuses on integrating green spaces into urban planning and ensuring their multifunctional use to address climate risks. The adaptation actions under this programme include:

- **Developing green infrastructure plans:** This entails identifying suitable areas for parks, community gardens, and natural reserves within urban settings of the district. Green spaces should be incorporated into urban development plans to ensure balanced growth and ecological support. Municipal greening and Open Space Management Plas should be developed and prioritised as crucial support elements for green infrastructure development.
- **Implementing urban greening initiatives:** This involves planting indigenous trees and vegetation in public spaces, streets, and residential areas to provide shade and reduce urban heat island effects. Creating green roofs and walls on public and private buildings can enhance biodiversity and cooling.
- **Promoting community involvement:** This involves engaging local communities in the planning, development, and maintenance of green spaces. Volunteer groups and partnerships with local organisations can be established to support greening projects.
- **Enhancing Recreational Facilities:** This involves developing and upgrading parks, playgrounds, and sports facilities to provide recreational opportunities for all age groups. Ensure accessibility of green spaces to promote physical activity and well-being.
- **Support Biodiversity:** This entails creating habitats for local wildlife within urban green spaces to promote biodiversity. Conservation projects can be implemented to protect indigenous species and restore natural ecosystems.

Programme 5.2: Stormwater Management and Water Conservation

This programme focuses on improving stormwater management and water conservation practices to reduce vulnerability to water supply issues and enhance urban resilience. It aims to integrate sustainable water practices into urban planning and development. The adaptation actions under this programme include:

- **Developing comprehensive stormwater management plans:** This includes assessing current stormwater management systems and identifying areas for improvement. Sustainable drainage systems (SuDS) can be designed and implemented to manage stormwater effectively.
- **Promoting rainwater harvesting**: This involves installing rainwater harvesting systems in public buildings, schools, and residential areas to capture and store rainwater. The use of harvested rainwater for irrigation, flushing toilets, and other non-potable uses should be encouraged.
- **Implementing permeable surfaces:** This involves replacing traditional pavements with permeable materials in public spaces, parking lots, and walkways to allow water infiltration. The use of permeable surfaces should be promoted in new developments to reduce runoff and enhance groundwater recharge.

- **Constructing wetlands and retention ponds:** This involves creating artificial wetlands and retention ponds to manage stormwater, reduce flooding, and support local ecosystems. These features can be integrated into urban parks and recreational areas to provide multiple benefits.
- **Conducting public awareness campaigns:** This includes educating residents and businesses about the importance of water conservation and sustainable stormwater management practices. Simple water-saving measures and the benefits of rainwater harvesting should be promoted.

Programme 5.3 Climate Resilient Urban Planning

This programme aims to integrate climate resilience into urban planning processes to ensure that urban development considers climate risks and supports ecological balance. It focuses on guiding decision-making across sectors to promote sustainable and resilient urban growth. The adaptation actions under this programme include:

- **Updating zoning regulations and building codes:** This includes incorporating climate resilience measures into zoning regulations and building codes to guide sustainable development. New developments should include provisions for green spaces, stormwater management, and energy efficiency.
- **Conducting climate risk assessments:** This involves assessing the vulnerability of urban areas to climate risks such as heat extremes and water supply issues. Assessment results should be used to inform urban planning and development decisions.
- **Promoting mixed-use development**: This includes encouraging the development of mixed-use areas that combine residential, commercial, and recreational spaces to reduce urban sprawl and enhance community resilience. These areas should include sufficient green spaces and infrastructure for stormwater management.
- **Enhancing public transportation and non-motorised mobility:** This entails developing and improving public transportation systems to reduce reliance on private vehicles and lower urban heat generation. Safe and accessible pathways should be created for pedestrians and cyclists to promote sustainable mobility.
- **Fostering cross-sector collaboration:** This involves establishing partnerships between government agencies, non-profit organisations, businesses, and community groups to support integrated urban planning and development. Regular stakeholder meetings to coordinate efforts and share best practices should be facilitated.

5. Implementation Framework

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

5.1. Implementation framework: Goal 1

Goal 1: To ensure water security for human consumption and irrigation under a changing climate.

Adaptation programme 1.1: Enhancing Water Resource Management and Infrastructure				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct comprehensive water resource assessments. In this action hydrological studies and modelling are conducted to understand water availability under changing climate conditions.	Future water supply vulnerability Increase in extreme heat days Increased variability in annual rainfall	Project Management and Public Works: water directorate in collaboration with environmental agencies Technical Services for local municipalities	Short term (< 5 years)	High
i. Retrofit existing reservoirs and dams. In this action existing reservoirs and dams are retrofitted to increase storage capacity.	Future water supply vulnerability Increase in extreme heat days	Project Management and Public Works in collaboration with water utility company Central Water Services	Medium term (5-10 years)	High
iii. Upgrade pipelines and distribution systems. In this action water distribution networks should be repaired and modernised to minimise leaks and inefficiencies. Smart water management technologies should be implemented to optimise water use and reduce losses.	Future water supply vulnerability Increase in extreme heat days Increase in extreme rainfall	Infrastructure Department Technical Services for local municipalities	Medium term (5-10 years)	Medium
iv. Promote water-saving practices and technologies. In this action public awareness campaigns are launched to educate residents and businesses about water conservation.	Future water supply vulnerability Increase in extreme heat days Increase in extreme rainfall	Environmental Health and Emergency Services Local Water Authority: Technical Services	Short term (< 5 years)	High

Adaptation programme 1.2: Climate-Resilient Infrastructure Development				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Upgrade water supply infrastructure In this action an assessment of current water supply infrastructure is conducted. Plans for retrofitting and expanding infrastructure should be developed. The upgraded infrastructure should be regularly monitored for performance and resilience.	Increased variability in annual rainfall Rapid population growth Increase in temperature Increase in extreme rainfall	Department of Water and Sanitation supported by Technical Services in local municipality	Short term (< 5 years)	High
ii. Develop decentralised water supply systems In this action municipalities engage with communities to identify their water needs. Suitable sites are then identified for decentralised water systems. Designs for boreholes, wells, and solar-powered pumps should be developed. Community members should be trained on maintenance and operation. The system should be regularly monitored for performance and sustainability.	Increased variability in annual rainfall Rapid population growth Increase in temperature Increase in extreme rainfall	Technical Services Department in local municipality	Medium term (5-10 years)	Medium
iii. Strengthen flood and drought management systems In this action assessments are conducted to identify flood and drought-prone areas. Plans for flood control structures and drought management strategies should be developed. Policies for water rationing and emergency supply during droughts and water outages should be developed.	Increased variability in annual rainfall Rapid population growth Increase in temperature Increase in extreme rainfall	Disaster Management Department Technical Services in local municipality	Medium term (5-10 years)	High
iv. Enhance monitoring and early warning systems	Increased variability in annual rainfall Rapid population growth Increase in temperature	Technical Services Department	Short (< 5 years)	High

In this action suitable technologies for real-time monitoring of water levels, quality and climate conditions are identified. Comprehensive monitoring and early warning systems should be designed. The systems should be monitored and maintained regularly to ensure functionality.	Increase in extreme rainfall			

Adaptation programme 1.3: Community Engagement and Capacity Building				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct public awareness campaigns In this action informative material on water conservation and climate change is created. A media strategy should be developed using social media, local radio, TV, and print media.	Increased variability in annual rainfall Increase in temperature Increase in extreme rainfall	Disaster Management Department supported by Community Development Department	Short term (< 5 years)	High
ii. Provide training and capacity building In this action training needs among target groups are identified. Training modules and materials should be developed. Workshops and training sessions should be conducted, and education materials and resources provided.	Increased variability in annual rainfall Increase in temperature Increase in extreme rainfall	Corporate Services Department Community Development Department Technical Services Department	Medium term (5 to 10 years)	High
iii. Foster community-based water management In this action the establishment of water user associations and committees are facilitated. Community-led initiatives for water conservation, rainwater harvesting, and watershed protection should be supported. The progress and effectiveness of community-based project should be tracked.	Increased variability in annual rainfall Increase in temperature Increase in extreme rainfall	Community Development Department Technical Services Department	Medium term (5-10 years)	Medium
iv. Implement wildfire risk management in catchments.	Increase in wildfire risk Increase in temperature	Disaster Management: Fire unit in collaboration with Fire Protection Association (FPA)	Medium term (5-10 years)	Medium

In this action prescribed burns, vegetation management and erosion control measures are conducted in critical catchments to reduce wildfire risk and protect water quality. Early warning systems for wildfires should be established to ensure timely response.		Environmental Management		
v. Promote participatory water governance. In this action key stakeholders and vulnerable groups are identified. A framework for regular consultations and dialogues should be developed. It should be ensured that participatory governance is integrated into water management policies.	Increased variability in annual rainfall Increase in temperature Increase in extreme rainfall	Technical Services Department Other government agencies	Long term (10 + years)	High

5.2. Implementation framework: Goal 2

Goal 2: To increase the adaptive capacity of human settlements to climate change and extreme events.

Adaptation programme 2.1: Heatwave Preparedness and Response				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct heat vulnerability assessment. In this action high risk areas and vulnerable populations such as the elderly, children, and outdoor workers are identified. Areas with high heat exposure should be mapped to prioritise interventions.	Increase in extreme heat days. Increased heat stress	Environmental Health and Emergency Safety Department in collaboration with local communities Disaster Management Department	Short term (< 5 years)	High
ii. Develop heatwave early warning systems. In this action systems to provide timely alerts about impending heatwaves are implemented. Multiple communication channels (SMS, radio, community announcements) can be used to reach all residents.	Increase in extreme heat. Increased heat stress Increase in heat stroke and other heat related illnesses.	Environmental Health and Emergency Safety Department in collaboration with IT services, community outreach and media relations.	Short term (< 5 years)	High

iii. Establish cooling centres. In this action community facilities such as libraries, schools, and recreation centres are utilised as cooling centres during heatwaves. These centres should be equipped with sufficient cooling mechanisms and drinking water.	Increase in extreme heat. Increased heat stress Increase in heat stroke and other heat related illnesses.	Environmental Health and Emergency Safety Department Disaster Management	Short term (< 5 years)	High
iv. Train healthcare workers and emergency responders. In this action training is provided to healthcare workers and emergency responders on heat illness prevention, recognition and treatment. Emergency services should be equipped with necessary supplies to handle heat-related emergencies.	Increase in extreme heat. Increased heat stress Increase in heat stroke and other heat related illnesses.	Environmental Health and Emergency Safety Department Department of Health	Short term (< 5 years)	High
v. Implement urban greening initiatives. In this action tree planting and creation of green spaces are increased to reduce the urban heat island effect. The use of green roofs and walls should be encouraged to provide natural cooling.	Increase in extreme heat. Increased heat stress Increase in heat stroke and other heat related illnesses.	Urban Planning Department in collaboration with environmental department Parks and recreation	Medium term (5-10 years)	Medium

Adaptation programme 2.2: Climate-Resilient Infrastructure and Urban Planning				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct vulnerability assessments of critical infrastructure. In this action the resilience of healthcare facilities, schools, housing, and other critical infrastructure to climate impacts are assessed. Areas should be identified and prioritised for retrofitting and upgrades.	Increased temperatures Increase in extreme heat days Increase in extreme rainfall days Increased variability in annual rainfall	Project Management and Public Works Department Disaster Management Local Municipalities: Technical Services Infrastructure Department	Short term (< 5 years)	High
ii. Implement low-cost retrofitting measures.	Increase in extreme rainfall days	Project Management and Public Works Department	Medium term (5-10 years)	High

In this action existing buildings are retrofitted with improved insulation, reflective roofing materials, and enhanced drainage systems to handle increased rainfall and reduce flooding risks.	Increased temperatures Increased flood risk	Infrastructure Department Disaster Management		
iii. Update Zoning Regulations and Building Codes. In this action climate resilience measures are incorporated into zoning regulations and building codes to guide sustainable development. Provisions for green spaces, stormwater management, and fire-resistant materials should be included.	Increase in extreme rainfall events Increased wildfire risk	Urban Planning and Development in collaboration with relevant stakeholders Disaster Management Urban development and planning Infrastructure Department	Medium term (5-10 years)	High
iv. Promote mixed-use development. In this action the development of mixed-use areas that combine residential, commercial, and recreational spaces to reduce urban sprawl and enhance community resilience are encouraged. These areas should include green spaces and infrastructure for stormwater management.	Urban sprawl Increase in extreme heat days	Urban Development and Planning Department	Long term (> 10 years)	Medium

Adaptation programme 2.3: Water Security and Management				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Enhance water conservation and efficiency. In this action the use of water-saving devices and appliances in households and businesses are promoted. Public education campaigns should be conducted on the importance of water conservation.	Increased temperatures Increase in annual rainfall variability Future water supply vulnerability	Project Management and Public Works Department: Water Directorate Disaster Management Local municipalities: Technical Services Environmental Department Local Business	Short term (< 5 years)	High
ii. Develop and maintain rainwater harvesting systems.	Increase in annual rainfall variability	Environmental Health and Emergency Safety Disaster Management	Medium term (5-10 years)	High

In this action community-based rainwater harvesting projects are implemented and the installation of rainwater tanks in homes and public buildings are encouraged.	Increase in extreme rainfall days Future water supply vulnerability	Local municipalities: Technical Services Local Business		
iii. Protect and restore water sources. In this action protection zones are established around critical water sources to prevent pollution and watershed management practices are engaged in to maintain healthy water ecosystems.	Increase in annual rainfall variability Water quality degradation Pollution Water lettuce clogging river systems	Environmental Health and Emergency Safety Local municipalities: Technical Services	Medium term (5-10 years)	High
iv. Improve infrastructure for water storage and distribution. In this action existing water storage facilities are upgraded to increase capacity and repair water distribution networks to reduce leaks and inefficiencies.	Increase in annual rainfall variability Increase in extreme rainfall days Future water supply vulnerability	Project Management and Public Works Department: Water Directorate Local municipalities: Technical Services Infrastructure Department	Medium (5-10 years) to long term (> 10 years)	Medium
v. Implement sustainable irrigation practices. In this action training workshops are organised for farmers on water-efficient irrigation techniques Information should be provided on drought resistant crops. The adoption of sustainable irrigation practices should be monitored and evaluated.	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Department of Agriculture DWS Agricultural extension services	Medium term (5-10 years)	High

Adaptation programme 2.4: Ecosystem-Based Adaptation				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Implement Green Infrastructure Projects. In this action green infrastructure such as parks, wetlands, and green roofs are developed and maintained to manage stormwater, reduce flooding, and provide recreational spaces.	Increased flood risk Increase in extreme rainfall days Increase in annual rainfall variability	Parks and Recreation Environmental Health and Emergency Services Department Disaster management	Medium term (5-10 years)	High

ii. Restore degraded ecosystems. In this action reforestation, wetland restoration, and other ecosystem restoration projects are engaged in enhancing natural resilience to climate impacts.	Biodiversity Loss Water quality degradation	Environmental Health and Emergency Services Department Environmental Department	Long term (> 10 years)	High
iii. Promote sustainable land use practices. In this action sustainable agriculture, forestry, and land management practices that enhance soil health, reduce erosion, and support water retention are encouraged.	Increase in extreme rainfall Increase erosion Soil degradation Increase fire risk	LED and Tourism Directorate: Agricultural Development Unit Environmental Health and Emergency Safety Department	Medium term (5-10 years)	Medium
iv. Establish buffer zones and corridors. In this action buffer zones are created around critical natural areas and ecological corridors are established to facilitate wildlife movement and reduce habitat fragmentation.	Habitat fragmentation Biodiversity loss Impact of heat extremes, extreme rainfall on wildlife	Environmental Health and Emergency Safety Department in collaboration with ecologist, botany experts Environmental Department	Long term (> 10 years)	Medium

Adaptation programme 2.5: Community Engagement and Capacity Building				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Facilitate participatory climate risk assessments. In this action community workshops are organised to facilitate climate risk assessments. Participatory tools such as mapping exercises and surveys can be used to gather data. Data should be compiled and analysed to identify key risks and vulnerabilities.	Increase in heat extremes. Extreme population growth projections. Increase in extreme rainfall events	Community Development Services Disaster Management Department Environmental Department	Short term (< 5 years)	High
ii. Develop community resilience plans. In this action stakeholder meeting are conducted to develop resilience plans. Roles and responsibilities should be defined for local	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Disaster Management supported by community development services	Short term (< 5 years)	High

agencies and community members. Resilience plans should be integrated into broader municipal planning processes (e.g. IDP, SDF).				
iii. Provide capacity-building workshops and training. In this action curriculum and materials for capacity building workshops are developed. Training sessions should be scheduled and conducted for community leaders. Ongoing support and resources should be provided for local organisations.	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Disaster Management Supported by local NGOs and community members	Medium term (5-10 years)	High
iv. Provide capacity-building workshops and training to municipal officials. In this action curriculum and materials for capacity building workshops are developed for municipal officials on climate change adaptation, disaster preparedness, and emergency response, and how it relates to infrastructure projects	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Municipality in collaboration with educational institutions	Medium term (5-10 years)	High
v. Strengthen social networks and support systems. In this action the creation of neighbourhood associations and peer support groups and other community networks are facilitated. Social cohesion should be enhanced to improve collective resilience to climate change.	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Community Services Department Disaster Management Local NGOs	Medium term (5-10 years)	Medium
vi. Foster partnerships and collaboration. In this action potential partners are identified from various sectors (government agencies, NPOs, academic institutions and private sector actors). Formal agreements and collaborative agreements should be established. Joint projects and initiatives focused on climate adaptation should be coordinated.	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Local Economic Development Technical Services Town planning Municipal Manager	Long term (10+ years)	Medium

5.3. Implementation framework: Goal 3

Goal 3: To maintain and increase resilience and reduce the vulnerability of ecosystems and people to the adverse effects of climate change.

Adaptation programme 3.1: Community Resilience and Adaptation				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct climate risk assessments and establish early warning systems. In this action participatory climate risk assessments are conducted with communities to identify vulnerable groups and areas. Community-based early warning systems and disaster preparedness plans should be established.	Increase in extreme heat days. Rapid population growth Increased heat stress	Local Municipality disaster management Disaster Management and Environmental Services in collaboration with local NGOs	Short term (<5 years)	High
ii. Support livelihood diversification and sustainable development. In this action potential income-generating activities (eco-tourism, renewable energy projects) should be identified. Micro-loans and grants should be provided for small businesses. The impact of supported activities should be monitored and evaluated.	Increase in extreme heat days. Rapid population growth	Local Economic Development (LED) SALGA (Northern Cape renewable energy project)	Medium term (5-10 years)	High
iii. Support livelihood diversification and sustainable development. In this action training programs on climate-smart agriculture and entrepreneurship should be developed and presented. For technical support municipalities can partner with local universities and NGOs. Demonstration sites should be established for hands on learning.	Increase in extreme heat days. Rapid population growth	Local Economic Development in collaboration with local tertiary institutions and NGOs Agricultural department	Medium term (5 - 10 years)	High
iv. Strengthen social safety nets and adaptive social protection. In this action current social safety net programs should be assessed, and gaps identified. Adaptive social protection schemes (e.g., cash transfers,	Increase in extreme heat days. Rapid population growth	Community Development Services supported by Housing department and disaster management department	Medium term (5-10 years)	Medium

food aid) should be designed and implemented. Programs should be monitored and adjusted based on feedback and changing needs.				
v. Facilitate access to climate-resilient infrastructure. In this action infrastructure needs such as resilient housing, community centres etc. need to be identified. Funding should be secured for infrastructure projects. Communities should be engaged in the planning and construction process.	Increase in extreme heat days. Rapid population growth	Basic services and infrastructure department supported by housing department, disaster management	Medium term (5-10 years)	Medium
vi. Conduct community awareness and education campaigns. In this action educational materials on climate change and adaptation should be developed and disseminated. Community events, workshops, and campaigns should be organised. Partner with local media for broader reach.	Increase in extreme heat days. Rapid population growth	Community Development services by supported by Disaster Management and Housing department and Infrastructure department	Short term (< 5 years)	High
vii. Promote environmental education. In this action climate education should be integrated into school curricula. Environmental clubs and activities can be established in schools. Community-based learning programs and resources should be encouraged.	Increase in extreme heat days. Rapid population growth	Municipal health services (awareness campaigns), community development services in collaboration with local media, DFFE	Short term (< 5 years)	High

Adaptation programme 3.2: Policy Integration and Governance for Climate Resilience				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Integrate climate resilient urban and rural planning. In this action zoning regulations and building codes are reviewed and updated to include	Increased temperature Increase in extreme heat days. Rapid population growth	Urban/town planning and development in local municipality supported by human settlement development	Short term for planning and regulation updates and medium term (5-10 years) for	High

climate resilience measures. Areas should be identified and prioritised for green infrastructure projects. Funding for green infrastructure projects can be secured through grants and public-private partnerships. Green Fund			infrastructure development	
i. Enhance local disaster risk management plans. In this action a review of existing disaster risk management is conducted with any gaps related to climate change identified. Updated plans incorporating climate scenarios and adaptive measures should be developed and implemented.	Increase in extreme heat days. Increased heat stress	Disaster Management in collaboration with environmental services department any unit dealing with environmental aspects	Short term (<5 years)	High
ii. Establish multi-sectoral coordination mechanisms. In this action a coordination committee is established which include all relevant sectors (health, environment, infrastructure). Regular training and simulation exercises should be conducted for emergency responders and community volunteers.	Increase in extreme heat days. Increased heat stress	Disaster Management in collaboration with emergency services	Short term (< 5 years)	High
iii. Promote climate-resilient policies and regulations. In this action policy proposals are developed for renewable energy incentives, carbon pricing mechanisms, and green finance opportunities. Capacity for monitoring and enforcing environmental regulations should be increased.	Increase in extreme heat days. Increased heat stress	Environmental Department in collaboration with LED, Agriculture and Industry	Medium term (5-10 years)	Medium
iv. Provide capacity building and knowledge sharing opportunities. In this action training programs on climate science, risk management and adaptation strategies are developed and implemented. Partnerships should be established with	Increase in extreme heat days. Increased heat stress	Human Resources and Training Department and Urban/town Planning Department in collaboration with academic institutions,	Short term for initial training programs and long term for ongoing capacity building	High

universities and research institutions for knowledge exchange		research organisations and civil society groups		

Adaptation programme 3.3 Climate-Resilient Ecosystem Management				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct ecosystem vulnerability assessments. In this action ecosystem vulnerability assessments are conducted to identify ecosystems at risk form climate change impacts. Tailored management plans be developed for each identified ecosystem. Plans should be reviewed and updated periodically based on monitoring data.	Increase in extreme heat days. Increased heat stress	Environmental Services Department Technical Services Department (water unit)	Short term (< 5 years) for assessment and planning and medium term (5-10 years) for implementation of management plans	High
ii. Expand and manage protected areas. In this action new areas for protection are identified based on biodiversity value and climate vulnerability. Management plans should be developed and implemented for protected areas. Ecological connectivity should be promoted through habitat corridors.	Increase in extreme heat days. Increased heat stress	Environmental Services Department Town Planning	Medium term for expansion and initial management and long term (10+ years for ongoing management)	High
iii. Introduce climate-resilient agricultural practices. In this action training sessions are conducted for farmers on climate-smart agricultural practices. Agroforestry and sustainable land management techniques should be promoted.	Increase in extreme heat days. Increased heat stress	Department of Agriculture	Short term for initial implementation. Long term for widespread adoption.	Medium
iv. Implement integrated water resource management. In this action catchment management plans are developed and implemented. Multi-stakeholder	Increase in extreme heat days. Reduction in annual rainfall	Technical services Environmental Department NRM Water Service Authorities Water Services Providers	Medium term (5-10 years)	High

partnerships should be established for water management. Water conservation practices and technologies should be promoted.		Water Management Agencies		

5.4. Implementation framework: Goal 4

Goal 4: To increase resilience of the agricultural sector to more extreme events such as heatwaves and storms as well as indirect risks such as pests and diseases.

Adaptation programme 4.1: Climate-Resilient Agricultural Practices				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Implement conservation agriculture techniques. In this action practices such as minimal soil disturbance, permanent soil cover, and crop rotation to improve soil health and water retention are promoted.	Reduced crop yields Soil degradation Water scarcity	LED and Tourism Directorate: Agricultural development unit Agricultural Department	Short term (< 5 years)	High
ii. Adopt drought-resistant crop varieties. In this action the use of drought-resistant and heat-tolerant crop varieties are introduced to ensure productivity during periods of water scarcity and high temperatures.	Heat stress Reduced crop yields	LED and Tourism Directorate: Agricultural development unit Agricultural Department Universities Research institutions	Medium term (5-10 years)	High
iii. Implement Integrated Pest Management (IPM). In this action IPM strategies that combine biological, cultural, physical, and chemical tools to manage pests and diseases sustainably are developed and promoted.	Pest and disease outbreak Reduced crop yield	LED and Tourism Directorate: Agricultural development unit Agricultural Departments Universities Research institutions	Short term (< 5 years)	Medium
iv. Utilise shade structures and windbreaks. In this action shade structures and windbreaks are established to protect crops from heatwaves and storms, and to reduce soil moisture loss.	Heatwaves Soil erosion	LED and Tourism Directorate: Agricultural development unit	Medium term (5-10 years)	Medium

Adaptation programme 4.2: Water Management and Conservation				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Install efficient irrigation systems. In this action the use of drip irrigation and other water-efficient systems to minimise water use and maximise crop yields are promoted.	Water scarcity Drought	LED and Tourism Directorate: Agricultural development unit Department of Water Affairs	Short term (< 5 years)	High
ii. Develop rainwater harvesting systems. In this action rainwater harvesting infrastructure is implemented on farms to collect and store rainwater for irrigation and other agricultural uses.	Water scarcity Increased variability in rainfall	LED and Tourism Directorate: Agricultural development unit Technical Services	Medium term (5-10 years)	High
iii. Promote water-saving practices In this action farmers are educated on practices such as mulching, contour farming, and the use of cover crops to conserve soil moisture.	Water scarcity Soil erosion	LED and Tourism Directorate: Agricultural development unit	Short term (< 5 years)	High
iv. Construct farm ponds and reservoirs. In this action the construction of small-scale ponds and reservoirs on farms to store runoff water for irrigation and livestock use are supported.	Increased variability in annual rainfall Water scarcity	LED and Tourism Directorate: Agricultural development unit Agricultural department	Medium term (5-10 years)	High

Adaptation programme 4.3: Livestock and Pasture Management				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Improve pasture management practices. In this action rotational grazing and other sustainable pasture management techniques are implemented to maintain pasture health and productivity.	Increase in temperature Heatwaves	LED and Tourism Directorate: Agricultural development unit	Short term (< 5 years)	High

ii. Enhance livestock housing and shelter. In this action livestock housing is constructed or retrofitted to provide adequate ventilation, shade, and protection from extreme weather.	Increase in temperature Heatwaves	LED and Tourism Directorate: Agricultural development unit Agricultural Department	Medium term (5 – 10 years)	High
iii. Develop feed and fodder banks. In this action feed and fodder banks are established to ensure a stable supply of animal feed during periods of drought or extreme weather.	Increase in temperature Increase in extreme rainfall Increase in extreme heat days	LED and Tourism Directorate: Agricultural development unit Agriculture Department	Medium term (5-10 years)	Medium
iv. Implement heat stress management practices. In this action practices such as providing cool drinking water, shade structures, and cooling systems for livestock during heatwaves are introduced.	Increase in temperature Increase in heat days Heatwaves	LED and Tourism Directorate: Agricultural development unit Agricultural department	Short term (< 5 years)	High

Adaptation programme 4.4: Capacity building and Knowledge Sharing				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct climate resilience training for farmers. In this action workshops and training sessions are organised to educate farmers on climate-resilient practices, technologies, and strategies.	Increase in extreme rainfall Increase in extreme heat days	LED and Tourism Directorate: Agricultural development unit Agricultural department	Short term (< 5 years)	High
ii. Develop and disseminate climate change information. In this action systems are established to provide timely and accurate climate forecasts and advisories to farmers to inform decision-making.	Increase in extreme rainfall Increase in extreme heat days Increased variability in annual rainfall	LED and Tourism Directorate: Agricultural development unit in collaboration with South African Weather Service, local media and ICT services to broadcast information	Medium term (5-10 years)	High

iii. Promote farmer to farmer knowledge exchange. In this action networks and platforms for farmers to share experiences and best practices in climate-resilient agriculture are facilitated.	Increase in extreme rainfall Increase in extreme heat days Increased variability in annual rainfall	LED and Tourism Directorate: Agricultural development unit	Short term (< 5 years)	Medium
iv. Establish agricultural extension services. In this action agricultural extension services to provide ongoing support and advice to farmers on adapting to climate change are strengthened.	Increase in extreme rainfall Increase in extreme heat days Increased variability in annual rainfall	Agricultural Extension Services Agricultural department	Medium term (5-10 years)	High

5.5. Implementation framework: Goal 5

Goal 5: To ensure that space is set aside for recreation, ecological support and stormwater management, and to guide decision making across all sectors.

Adaptation programme 5.1: Integrated Urban Green Spaces				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Develop green infrastructure plans. In this action spatial analysis is conducted to identify potential green infrastructure sites. The district and its municipalities can collaborate with stakeholders to integrate green spaces into urban development plans. Funding and resources should be secured for green infrastructure projects.	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Town planning Parks and recreation	Short term (< 5 years)	High
ii. Implement urban greening initiatives. In this action a comprehensive urban greening strategy is developed. Key areas should be identified for tree planting and vegetation projects. Green roof and wall initiatives should be implemented in collaboration with building owners and developers.	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Environmental Services in collaboration with public works (building unit) and community services department Town planning	Medium term (5-10 years)	High

iii. Promote community involvement. In this action community meetings and workshops are organised to gather input and build support for green space projects. Volunteer programs should be created for community members to participate in greening initiatives. Municipalities can partner with local organisations and schools to promote environmental stewardship.	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Community Services Department in collaboration with Parks and recreation and Public Relations Department	Short term (0-5 years)	Medium
iv. Enhance recreational facilities. In this action parks, playgrounds and sport facilities are developed and upgraded to provide recreational opportunities for all age groups. Green spaces should be accessible to all to promote physical activity and well-being.	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Parks and Recreation in collaboration with Public Works department and Community Services Department	Medium term (5-10 years)	High
v. Support biodiversity. In this action areas for habitat creation and restoration are identified and prioritised. Conservation projects to support indigenous wildlife and plant species should be developed and implemented. The effectiveness of biodiversity initiatives should be monitored and evaluated.	Increase in heat extremes. Reduction in annual precipitation Extreme population growth projections.	Environmental Services Department supported by Parks and Recreation and Urban/town Planning and Development.	Long term (10+ years)	Medium

Adaptation programme 5.2: Stormwater Management and Water Conservation				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Develop stormwater management plans. In this action thorough assessments of existing stormwater management infrastructure are conducted. Plans for sustainable drainage systems, including green roofs, rain gardens and	Reduction in annual precipitation Extreme population growth projections. Increase in extreme rainfall	Technical Services Department supported by Public Works department and development and town planning department.	Short term (0-5 years)	High

permeable pavements should be developed and implemented.				
ii. Promote rainwater harvesting. In this action suitable locations for rainwater harvesting systems are identified. Incentives and technical support for installing rainwater harvesting systems should be provided. Workshops and training sessions should be conducted to educate the public on the benefits and use of harvested rainwater.	Reduction in annual precipitation Extreme population growth projections. Increase in extreme rainfall	Public Works Department supported by Community services Department Technical Services	Medium term (5-10 years)	Medium
iii. Implement permeable surfaces. In this action areas where permeable surfaces can be implemented are identified. Guidelines and regulation to promote permeable materials in new developments should be developed. The effectiveness of permeable surfaces in reducing runoff and improving groundwater recharge should be monitored.	Increase in extreme rainfall Increased variability in annual rainfall	Development and Town Planning Technical Services Building unit Infrastructure Department	Medium term (5-10 years)	High
iv. Construct wetlands and retention ponds. In this action feasibility studies are conducted to identify suitable locations for wetland and retention ponds. Wetlands and retention ponds should be designed and constructed in collaboration with ecologists, environmental scientists and landscape architects.	Increase in extreme rainfall Increased variability in annual rainfall	Environmental Services Department supported by Parks and Recreation and Town Planning	Long term (10+ years)	Medium
v. Conduct public awareness campaigns. In this action educational material on water conservation and stormwater management is developed and distributed. Community events, workshops and seminars should be organised to raise awareness. Social media, local media and community networks can be used to disseminate information widely.	Increase in extreme rainfall Increased variability in annual rainfall	Public relations department supported by environmental services and community services department	Short term (< 5 years)	High

Adaptation programme 5.3: Climate Resilient Urban Planning				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Update zoning regulations and building codes. In this action existing zoning regulations and building codes are updated and reviewed. Stakeholders (developers, architects, community members) should be engaged in the review process. Updated regulations and codes should be implemented and enforces. Training sessions should be conducted for developers and builders on new requirements.	Increase in extreme rainfall Increased variability in annual rainfall	Development and Town Planning Department with support from environmental services, public works and legal department	Short term (< 5 years)	High
ii. Conduct climate risk assessments. In this action key climate risks and vulnerable urban areas are identified. Comprehensive climate risk assessments should be conducted. A database of risk assessment results should be developed. Finding should be integrated into urban planning and development policies.	Increase in extreme rainfall Increased variability in annual rainfall	Development and Town Planning Department	Medium term (5-10 years)	Medium
iii. Enhance public transportation. In this action assessments of the current public transportation are conducted. Plans for expanding and improving public transportation systems should be developed. The construction of bike lanes, pedestrian pathways and green corridors should be promoted. Public awareness campaigns on the benefits of public transportation and non-motorised mobility should be implemented.	Reduced carbon emissions	Transportation Department supported by development and town planning, environmental services and Public Works Department	Long term (10 + years)	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. The South African Weather Services (SAWS) is currently implementing a pilot project in the Lejweleputswa District named Integrated Climate-driven Multi-Hazard Early Warning System (ICMHEWS). This initiative aims to enhance climate adaptation and disaster risk reduction through several support measures, including the establishment of an Early Warning Control Room.
- **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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