GREENBOOK
adapting settlements for the future

Capricorn District Municipality

Climate Change Adaptation Plan: Draft 1

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Abbreviations

Abbreviation	Explanation
°C	Degree Celsius
AR5	Fifth Assessment Report
CABLE	CSIRO Atmosphere Biosphere Land Exchange model
CCAM	Conformal-cubic atmospheric model
CDM	Capricorn District Municipality
CDRF	Climate and Disaster Resilience Fund
CMIP5	Coupled Model Intercomparison Project 5
CoGTA	Department of Cooperative Governance and Traditional Affairs
CRVA	Climate Risk and Vulnerability Assessment
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEA	Department of Environmental Affairs
DM	District Municipality
DRR	Disaster Risk Reduction
DWS	Department of Water and Sanitation
EcVI	Economic Vulnerability Index
EnVI	Environmental Vulnerability Index
GCM	General circulation model
GRiMMS	Groundwater Drought Risk Mapping and Management System
GVA	Gross Value Added
GDP	Gross Domestic Product
IDRC	International Development Research Centre
IPCC	Intergovernmental Panel on Climate Change
km	Kilometre
l/p/d	Litres Per Person Per Day
LM	Local Municipality
MAR	Mean Annual Runoff
mm	Millimetre
NCCRP	National Climate Change Response Policy
NDMC	National Disaster Management Centre
PVI	Physical Vulnerability Index
RCP	Representative Concentration Pathways
SCIMAP	Sensitive Catchment Integrated Modelling and Prediction
SDF	Spatial Development Framework
SEVI	Socio-Economic Vulnerability Index
SPI	Standardised Precipitation Index
SPLUMA	Spatial Planning and Land Use Management Act, 2013 (Act No.16 of 2013)

THI	Temperature Humidity Index
WMAs	Water Management Areas
WMO	World Meteorological Organisation
WRYM	Water Resources Yield Model
WUI	Wildland-Urban Interface

Definitions

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 (GreenBook, 2021).
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).

Risk	The potential for consequences [= impacts] where something of value is at stake and where the outcome is uncertain, recognising the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard (DFFE, 2020, p. 11).
Hazard	The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources (DFFE, 2020, p. 11)..
Exposure	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 (DFFE, 2020, p. 11).
Vulnerability	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 (DFFE, 2020, p. 11).
Sensitivity	Factors that directly affect the consequences of a hazard. Sensitivity may include physical attributes of a system (e.g. building material of houses, type of soil on agriculture fields), social, economic and cultural attributes (e.g. age structure, income structure) (DFFE, 2020, p. 11).
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 (e.g., early warning systems in place) (DFFE, 2020, p. 11).

1. Introduction

This Climate Risk Profile report, along with the accompanying draft Climate Change Adaptation Plan, were developed specifically for Capricorn District Municipality, to aid its strategic climate change response agenda. Both documents primarily draw from the GreenBook, an open-access online planning support system that offers quantitative scientific evidence supporting local government's pursuit in planning and designing climate-resilient, hazard-resistant settlements. The GreenBook serves as an information-rich resource and planning support system for South African local governments, aiding them to better understand their risks and vulnerabilities in relation to population growth, climate change, exposure to hazards, and vulnerability of critical resources. Additionally, the GreenBook suggests suitable adaptation measures for implementation in cities and towns, enabling South African settlements to mitigate the impact of climate hazards on communities and infrastructure, while also contributing to developmental goals (See Green Book | Adapting settlements for the future).

Initially co-funded by the International Development Research Centre (IDRC) and the Council for Scientific and Industrial Research (CSIR) from 2016-2019, the GreenBook has seen an increase in supporting partners since 2019, furthering research, development, roll-out and uptake. Recently, Santam, the Climate and Disaster Resilience Fund (CDRF), and the CSIR established the GreenBook Roll-out Initiative to facilitate the uptake of the GreenBook and promote resilience-building within local government. The initiative targets to roll out the GreenBook to 32 District Municipalities by 2025, bolstering each District's climate change response and adaptation planning and implementation efforts through the GreenBook. Each of the Districts targeted for support is guided through a value-chain towards the implementation of climate change response and adaptation plans in municipalities (See Figure 1 below). As part of steps four and five, each target District Municipality is furnished with a draft GreenBook Climate Risk Profile report, as well as a draft Climate Change Adaptation Plan.

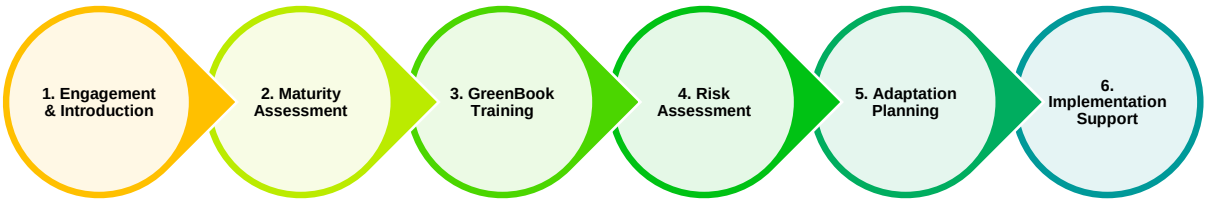

Figure 1: The value-chain towards the implementation of climate change response and adaptation in municipalities

The purpose and strategic objectives of the Climate Risk Profile and the Climate Change Adaptation Plan are to:

- Build and further the climate change response agenda;

- Inform strategy and planning in the district and local municipalities;
- Identify and prioritise risks and vulnerabilities;
- Identify and prioritise interventions and responses; and
- Guide and enable the mainstreaming of climate change response, particularly adaptation.

1.1. Municipal Context

The Capricorn District Municipality (CDM), situated in the Limpopo province, is a region named after the Tropic of Capricorn, which transects it. It spans an area of 16,970 square kilometres, constituting 12% of the province's total surface area. Encapsulated by Vhembe District to the north, Mopani District to the east, Sekhukhune District to the south, and Waterberg District to the west, the District represents the hub of economic development in the province. It houses the provincial capital, the City of Polokwane, and encompasses a national roadway (N1), along with several regional ones (R37, R71, R521).

The District is composed of four Local Municipalities: Blouberg, Lepelle-Nkumpi, Molemole, and Polokwane. Blouberg, positioned in the District's far north, hosts settlements like Senwabarwana, Helene Franz Hospital, GaMoreise, Ga-Machaba, Avon, Tolwe, and Alldays. The settlements of Magatle, Lebowakgomo, Motsereng, and Mathibela fall within the southern Lepelle-Nkumpi Local Municipality. On the District's northeastern edge, in Molemole Local Municipality, lie Matseke, Morbeng, Nthabiseng, Botlokwa (Mphakane), Ramokgopa, Ga-Phasha, Mogwadi, and Mohodi settlements. The City of Polokwane, nested between Molemole and Lepelle-Nkumpi Local Municipalities, accommodates Ga-Chuene, Bergnek, GaMokwane, Ga-Mangou, Mankweng, Polokwane, and Sebayeng settlements.

CDM houses a population of 1,372,355, with 1,260,931 individuals residing in settlements. From 2001 to 2011, the settlement-based populace saw a 6.97% increase, projected to rise by 14.48% by 2030. The leading economic sectors are Community services, Trade, and Finance, which account for 33%, 21%, and 19% of the District's Gross Value Added (GVA) respectively. The largest employers are the Manufacturing sector (27%), followed by the Wholesale and retail trade, catering and accommodation sector (24%), and the Finance, insurance, real estate, and business services sector (10%). Despite these, CDM grapples with a high unemployment rate of 37.20%, mainly due to low skill levels, with most households relying on social grants. Consequently, low educational attainment among the rural population posits the agricultural sector as a critical avenue for food security and job creation for semi- and unskilled job seekers.

Encompassing a diverse array of dams, natural water bodies, and forests, the Capricorn District is rich in biodiversity, hosting a variety of fauna and flora. Cultural heritage sites, such as the Greater Mapungubwe Heritage Route, the Mapungubwe World Heritage Site, Thulamela Archaeological Site, and a myriad of sites around Lake Fundudzi further enhance its diversity. Dominated by the Savanna biome (65% of the Municipal area), the District's biophysical environment also includes forest (4%), grassland (19%), and azonal (11%) biomes. The savanna

climate, characterised by high temperatures and relatively low precipitation, makes these areas particularly susceptible to wildfires during dry seasons.

1.1.1. Key Risks

Within the Capricorn District Municipality (CDM), the primary hydrometeorological hazards comprise:

- Wildfires: These include uncontrolled burning of vegetation in natural environments, escalated by climatic conditions such as heat, wind, and drought. They represent a substantial risk to biodiversity, human habitation, and infrastructure.
- Drought: This refers to the prolonged absence or marked deficiency of precipitation, leading to a severe water shortage that adversely affects the ecological system and agricultural activities.
- Flooding: Resulting from intense or prolonged precipitation, this hazard can lead to significant infrastructural damage, displacement of communities, increased health risks due to waterborne diseases, and disturbance of agricultural activities.
- Heat Stress: This pertains to conditions where extreme temperatures, often combined with elevated humidity, pose significant threats to human health, agricultural production, and the broader ecosystem.
- Severe Weather: This encompasses windstorms, hailstorms, frost, snow, lightning, and fog. These severe weather phenomena can inflict substantial damage to infrastructure, disrupt agricultural activities, pose safety risks, and even lead to fatalities.

The Capricorn District, settled within the Limpopo Province of South Africa, faces a multitude of climate-associated perils. These include escalating temperatures, severe drought, wildfires, as well as extreme weather conditions and flooding, all amplified by the global climate change phenomenon. The convergence of these threats constitutes significant risks to the district's socio-economic fabric, the livelihoods of its residents, and the ecological systems that support life in the area.

Increased temperatures and heat extremes, a characteristic feature of the district's Savanna biome, are some of the most dominant climate threats in the Capricorn District. The impact of these elevated temperatures extends beyond discomfort and heat-related illnesses. They are intrinsically linked with droughts, which lead to water scarcity, exerting a negative influence on agricultural practices and water supplies. Furthermore, these conditions exacerbate wildfires, posing substantial threats to the region's biodiversity, infrastructure, and human lives while also contributing to soil erosion and degradation, threatening agricultural productivity - a significant livelihood source for the district.

Several settlements within the district, including Polokwane, Sebayeng, and parts of Mankweng, are particularly prone to high risks of wildfires, heat stress, and flooding, owing to the unique geographic and climatic conditions in these areas. These locations, also expected to undergo

very high population growth pressure, underscore the escalating exposure of people to these climate hazards.

Additionally, a noteworthy aspect of the district's evolving climate risk landscape is the increasing water supply vulnerability. This trend, most prominent in areas witnessing significant population growth, manifests as a widening gap between water demand and supply. Here, populations rely on a combination of groundwater and surface water sources, both of which are susceptible to depletion in the face of climate change, particularly by 2050. This situation underscores the urgent need for diversifying water supply sources, enhancing groundwater recharge, and conserving available potable water in these regions.

In recent decades, most local municipalities within the Capricorn District have witnessed a downward trend in economic vulnerability, particularly between 1996 and 2011. This suggests a need for creating more resilient and diverse local economies to withstand the impacts of climate change better. However, rural-to-urban migration trends indicate a significant population decline in all local municipalities in the district, except the City of Polokwane. This observation, coupled with the prevalence of large numbers of socio-economically vulnerable populations in these municipalities, may offer insights into the factors driving this migration. The combination of these climate-related risks and socio-economic factors highlights the urgent necessity for the implementation of robust adaptation and resilience strategies in the Capricorn District.

1.1.2. Adaptation Goals and Priorities

The following Adaptation Goals have been identified for and validated by Capricorn District Municipality:

1. To prioritise the health and safety of communities in the face of a changing climate.
2. To reduce the exposure and vulnerability of human and natural systems to climate change and extreme weather events.
3. To ensure water security in the face of climate change.
4. To develop climate-resilient, low-carbon, diverse and inclusive rural economies that are socially responsible, environmentally sustainable and that provide job opportunities for unskilled, semi-skilled and skilled local residences.

The overarching adaptation goals have been distilled into the following strategic priorities which will guide adaptation planning:

1. Water resource management: Given the water scarcity challenges in the country, developing comprehensive strategies for water resource management is crucial. This includes investing in efficient water infrastructure, prioritising infrastructure maintenance, promoting water conservation practices, implementing rainwater harvesting systems, and exploring alternative water sources such as groundwater and wastewater reuse.

2. Ecosystem conservation: Protecting and restoring natural ecosystems, such as high priority biomes, wetlands, river ecosystems and riparian areas, to perform critical ecosystem services, enhance biodiversity, support water resource management, and provide natural buffers against climate-related hazards such as wildfires will have to become a priority.
3. Flood management: Developing effective flood management strategies to mitigate the risks associated with heavy rainfall events will need to become essential. This could involve improving stormwater drainage systems, restoring damaged and degraded ecosystems, creating floodplains and retention basins, and implementing advanced early-warning systems for flooding to protect vulnerable communities and infrastructure.
4. Fire management: Targeting fire prevention and strategies to mitigate the risks associated with wildfires is a priority. This could involve identifying areas for designated firebreaks, ensuring water reserves for fire-fighting, and developing advanced early-warning systems for fires to protect vulnerable communities and infrastructure.
5. Social equity and vulnerable populations: It is essential to ensure that adaptation efforts prioritise the needs of vulnerable populations, such as low-income communities and informal settlements. This could involve providing access to basic services, improving housing conditions, and implementing early-warning systems tailored to these communities.
6. Agriculture and food security: Given that food security is a potentially significant future climate change-related impact, developing a food security and agricultural policy that takes climate change impacts into consideration is crucial will be necessary. This includes increasing the resilience of the agricultural sector by supporting commercial and small-scale farmers across industries, promoting solutions to drought such as highly efficient irrigation systems, exploring alternative crop types, assessing livestock carrying capacity and implementing grazing management and fire management.

1.2. Outline of the Climate Change Adaptation Plan

The figure detailed below provides a schematic representation of the structure of the report, outlining the development process and constituent elements of the Climate Change Adaptation Plan for the District Municipality, informed by the GreenBook tool. The initial chapter delivers an overview of the GreenBook tool and a broad context of the District Municipality, alongside identification of key climate risks. Chapter 2 proceeds to delve into the intricacies of the adaptation planning process, detailing stakeholder engagement and providing an understanding of the climate policy landscape. Chapter 3 elucidates the Climate Risk Profile tailored for the District Municipality, including an analysis of climate hazards, impacts, and prioritised risks and vulnerabilities. In Chapter 4, the focus pivots to the Adaptation Programmes, Actions, and key activities tailored for the District Municipality, underpinned by the identified goals, priority risks, and developmental priorities of the district. Chapter 5, the final segment, presents a robust framework for the execution of the adaptation programmes and actions, specifying the pivotal departments for implementation, cost estimates, priority levels, indicators, and timelines. Additionally, Chapter 5 proposes strategies for integrating climate change considerations into

the District Municipality's operations, contemplating institutional arrangements, governance, information management, and funding mechanisms.

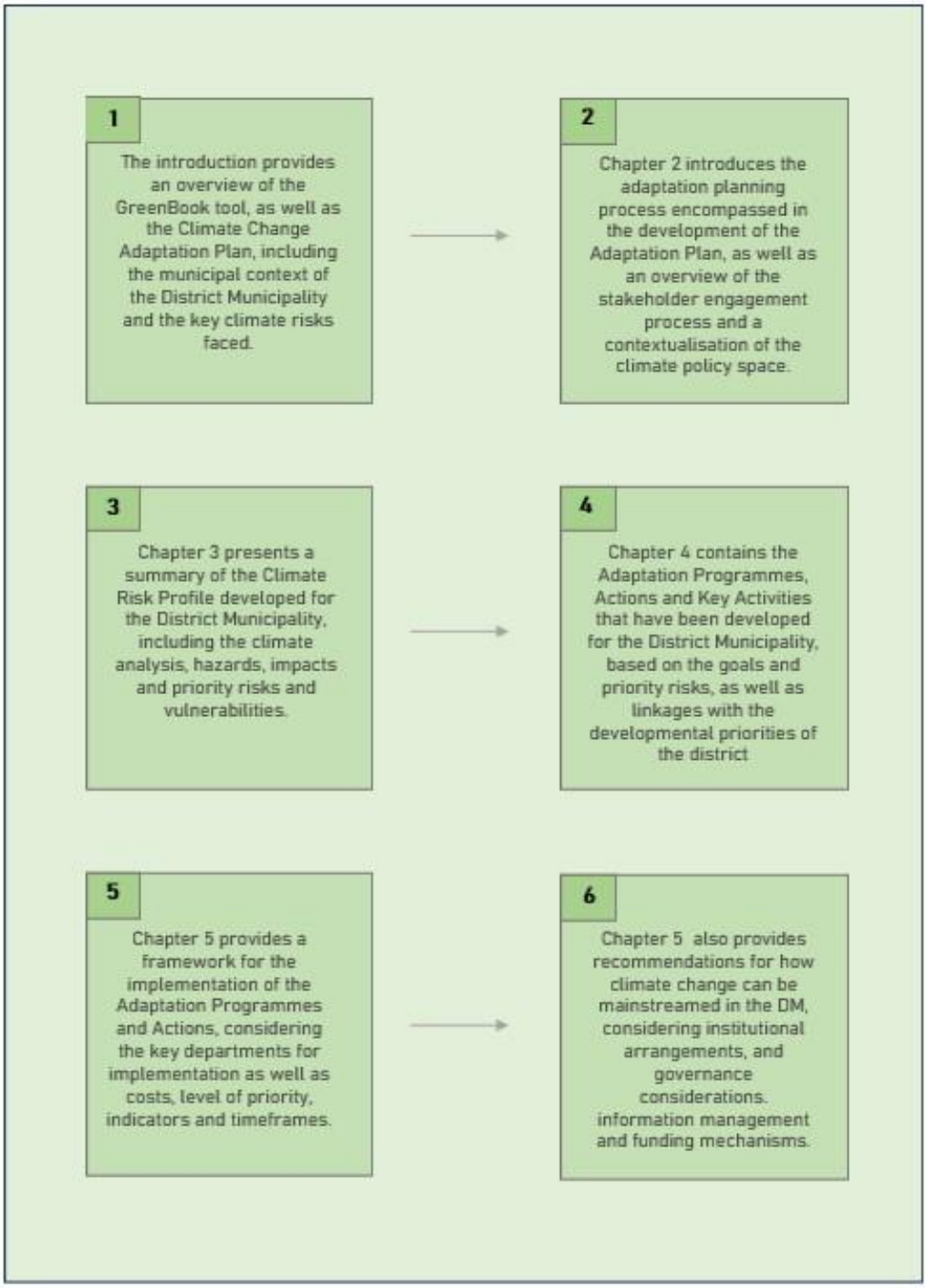

Figure 2: Outline of the climate change adaptation plan.

2. Climate Change Response

Climate change response encapsulates a two-pronged approach, as identified by the United Nations Framework Convention on Climate Change (UNFCCC) (IPCC, 2018), consisting of:

- Mitigation: A human intervention to reduce emissions or enhance the sinks of greenhouse gases.
- Adaptation: The process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities.

Climate change actions can either fall into one of these two broad categories, or they can encompass co-benefits of both adaptation and mitigation and fall into both categories. Adaptation and mitigation go hand-in-hand in terms of responding to the climate crisis. Mitigation encompasses the reduction of greenhouse gas emissions to curb global warming to 1.5 compared to pre-industrial levels, a target set by the Paris Agreement. Mitigating the causes of climate change is imperative as the rise in temperatures will worsen climate hazards, impacting health, livelihoods, food security, water supply, human security, and economic growth. Climate change adaptation entails altering our behaviour, systems, and ways of life to protect communities, economies, and the environment in which we live from the impacts of climate change. Climate change has resulted in changes in average temperatures, shifts in seasonality as well as increased frequency of extreme weather events. Climate change adaptation and mitigation are both equally important and time-sensitive and we need to do both. The more we reduce emissions right now, the easier it will be to adapt to the changes we can no longer avoid.

Generally, the distinction is made between adaptation approaches, namely anticipatory or reactive adaptation. Anticipatory adaptation refers to acting in preparation for climate change. Reactive adaptation refers to acting when climate change effects are experienced. Future climate trends remain uncertain, highlighting the need for a flexible response and the development of adaptation strategies for the medium and long term. It also follows that adaptation will require greater consideration of local context compared to mitigation strategies.

2.1. Integrated Climate Change Response

Climate change response entails both adaptation and mitigation and is a complex, cross-sectoral, multi-disciplinary process which requires a suitable and accepted approach to ensure success and to maintain consistency and continuity.

Supported by the GreenBook evidence base, the climate change response process is proposed as a point of reference for establishing an overarching approach to climate change response in the CDM and mainstreaming climate resilience into all municipal planning processes to:

- Facilitate the implementation of climate change response measures within existing sector plans and budgets; and

- Balancing the incremental costs with the municipal development objectives and the economic, environmental, and social benefits produced through integrated climate change response.

CDM's approach to the climate change response process is conceptualized in the figure below:

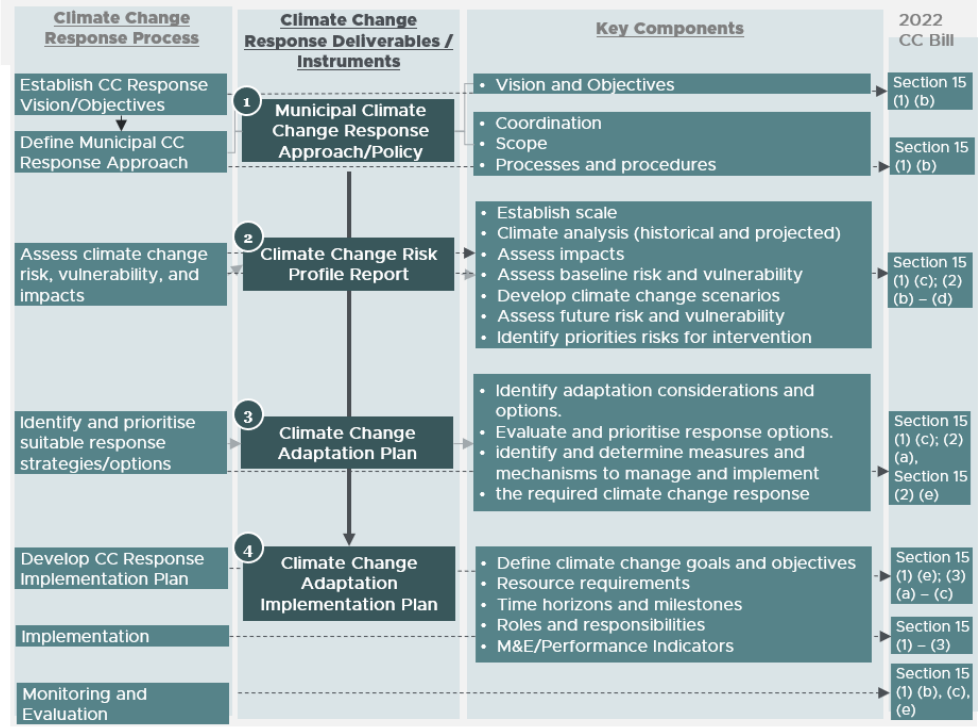

Figure 3: The municipal climate change response process (Brink and Modack, 2022)

Figure 3 illustrates the climate change response process proposed for the CDM, in accordance with the Climate Change Bill (B9-2022) requirements for local government. The development of the Adaptation Plan is a key component of the process outlined above. The specific Adaptation Approach applied in the development of the CDM Adaptation Plan is outlined below.

2.2. Adaptation Approach

The approach framing climate change adaptation in the GreenBook and in this plan is centred around reducing climate-related risk. Climate-related risk implies the potential for adverse consequences resulting from the interaction of vulnerability, exposure, and the occurrence of a climate hazard. "*Relevant adverse consequences include impacts on lives, livelihoods, health and wellbeing, economic, social and cultural assets and investments, infrastructure, services (including ecosystem services, ecosystems and species)*" (Chen, et al., 2021, p. 64).

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, 2022a, p. 2898) that may derive from unavoidable impacts of climate change such as extreme hazards. Through climate change adaptation, the components that make up risk can be reduced, including exposure and vulnerability. Climate change adaptation consists of measures that range from providing social protection after disasters, to retrofitting habitats or settlements with more resilient infrastructure, protecting coastlines from flooding, securing water resources to rely on during periods of drought, and improving crop production for dryland farming, among others. Although disaster risk reduction and climate change mitigation, form part the overall climate change response agenda, the focus of this plan is on adaptation.

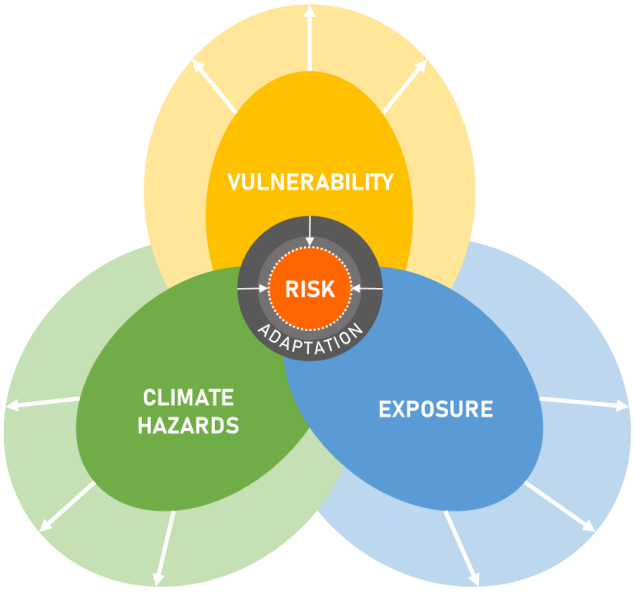

Figure 4: The interaction between the various components of risk, indicating the opportunity to reduce risk through adaptation (based on IPCC, 2014 and IPCC, 2021)

Adaptation planning uses the basis of spatial planning and climate change adaptation to shape built-up and natural areas to be resilient to the impacts of climate change and to realise co-benefits for long-term sustainable development to address root causes of vulnerability and exposure to risk. The process of climate change adaptation and planning is set out in Table 1.

The development of this Adaptation Plan follows this adaptation logic and adaptation planning process to ensure that the plan is aligned with local policy, current and future anticipated risks and vulnerabilities and that it is able to facilitate implementation and mainstreaming of climate change adaptation and resilience priorities into other planning processes and instruments.

Table 1: The adaptation planning process.

1. Understand your context	The Climate Risk Profile that unpacks climate hazards and vulnerability in your District Municipality. To be able to develop

	an appropriate adaptation plan, it is important to understand what contributes to risk and vulnerability.
2. Identify priority climate-related risks	Identify the climate hazards and impacts that pose the greatest risk within the District Municipality. Draw from both the Climate Risk Profile and local expert knowledge.
3. Identify adaptation goals	Identify adaptation goals to address priority risks that speak to policy goals within the District Municipality.
4. 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 risk and/or vulnerability. • Suggest a target or an indicator to measure progress. • Be assignable to a primary implementer. • Be realistic and achievable given available resources. • Consider co-benefits and other possible implications. • Include mitigation as far as it builds resilience or reduces exposure and vulnerability.
5. Mainstream adaptation actions into planning	Integrate adaptation goals, programmes, and actions into existing instruments and processes, particularly those related to development and planning. The aim is to ensure that climate change adaptation and resilience are an integral part of all planning.

2.2.1. Stakeholder Engagement Process

To construct a Climate Change Adaptation Plan resonating with the specific requirements of the District Municipality and appropriately addressing its significant risks, a stakeholder engagement component was factored into the adaptation planning process. The inaugural phase of stakeholder engagement integrated a Risk Profile Engagement, succeeded by an Implementation Engagement designed to shape the Adaptation Plan. Moreover, District Municipalities (DMs) participated in a capacity development workshop intended to facilitate their use of the GreenBook tool. Engagement invitations were disseminated to pertinent DM departments including, but not limited to, Environmental Management, Disaster Management, Spatial Planning, and Water and Sanitation.

The initial interaction between the DMs and the CSIR took the form of the Risk Profile engagement. This virtual meeting, spanning two hours, aimed to validate the primary risks and vulnerabilities identified for the DM through the GreenBook Municipal Risk Tool and encapsulated within the Risk Profile Report. The central outcome of this engagement was the delineation of climate change adaptation goals, tailored to address the significant risks

confronted by the DM, serving to inform the development of the preliminary Climate Change Adaptation Plan.

The subsequent DM engagement, the Implementation Engagement, was carried out virtually over a three-hour workshop. This engagement aimed to showcase the draft Climate Change Adaptation Plan, inclusive of the Adaptation Programmes and Actions, thereby allowing the DM to contribute comments. Additionally, the session incorporated a presentation on the Implementation Framework, established for the Adaptation Plan, along with a discourse on the integration of climate change adaptation within the district.

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

2.3. Policy Context

2.3.1. National Policy Context

South Africa's institutional policy and legislative framework make 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 of 2015, the Spatial Planning and Land Use Management Act (SPLUMA) of 2013, the Climate Change Bill (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 "*accommodates 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) as one of the key principles intended to guide municipal planning and development. The Climate

Change Bill sets out requirements 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, while also requiring every municipality to report on their climate change response needs and draft resultant climate change response assessments and implementation plans.

Furthermore, 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 targeted at municipalities, including the development and implementation of adaptation strategies and vulnerability reduction programmes for communities and individuals that are most at risk of 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.

The table that follows presents a summary of both international and national policy instruments relevant to climate change mitigation and adaptation. These policy instruments range from the United Nations Framework Convention on Climate Change (UNFCCC), which governs global action against climate change, to the South African National Climate Change Adaptation Strategy (NCCAS), aimed at enhancing the country's ability to meet its obligations under the Paris Agreement on Climate Change. Other key international instruments include the International Carbon Action Partnership (ICAP), the Sustainable Development Goals (SDGs), and the Convention on Biological Diversity. On the national front, the instruments such as the Climate Change Bill, the National Development Plan (NDP), the National Climate Change Response Policy (NCCRP), the National Environmental Management Act (NEMA), and the Amended Disaster Management Act are discussed. Each of these policy instruments plays a crucial role in shaping climate change response strategies, establishing frameworks for low-carbon, climate-resilient economies, and ensuring environmental sustainability while promoting socio-economic development.

Table 2: International and National Policy Context

International	
United Nations Framework Convention on Climate Change (UNFCCC)	The UNFCCC is the primary multilateral global treaty governing actions to combat climate change through adaptation and mitigation efforts.

International Carbon Action Partnership (ICAP)	The ICAP is an international forum for governments and public authorities that have implemented or are planning to implement carbon trading systems (ETS).
United Nations Sustainable Development Goals (SDGs)	The SDGs are a universal call to action consisting of 17 goals to end poverty, protect the planet and improve the lives and prospects of everyone globally.
Sendai Framework for Disaster Risk Reduction	This framework aims to substantially reduce disaster risk and losses in lives, livelihoods and health in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years.
Nationally Determined Contribution (NDC)	The Paris Agreement requests each Country to outline and communicate their post-2020 climate actions, known as their NDCs. NDCs embody efforts by each Country to reduce national emissions and adapt to the impacts of climate change.
Convention on Biological Diversity	The Convention on Biological Diversity is an international treaty designed to promote biodiversity conservation and ensure the equitable sharing of genetic resources.
National	
Climate Change Bill (2022)	The Climate Change Bill aims to enable the development of an effective climate change response and a long-term, just transition to a low-carbon and climate-resilient economy and society for South Africa in the context of sustainable development and to provide for matters connected in addition to that.
South Africa Low Emission Development Strategy 2050 (2020)	The South Africa Low Emissions Development Strategy (SA LEDS) aims to succinctly build upon this foundation and articulate the path going forward in order to place the country on a low carbon trajectory, while at the same time ensuring broader socio-economic development.
National Development Plan Chapter 5: "Transition to Low-Carbon Economy"	The NDP aims to eliminate poverty and reduce inequality by 2030. According to the Plan, South Africa can realise these goals by drawing on the energies of its people, growing an inclusive economy, building capabilities, enhancing the state's capacity, and promoting leadership and partnerships throughout society. Chapter 5 of the NDP outlines' ensuring environmental sustainability and an equitable transition to a low-carbon economy.

National Climate Change Adaptation Strategy (2020)	South Africa's National Climate Change Adaptation Strategy (NCCAS) supports the Country's ability to meet its obligation in terms of the Paris Agreement on Climate Change.
National Climate Change Response Policy	The NCCRP supports the national vision for a successful climate change response and long-term shift towards a lower-carbon and climate-resilient economy and society. It aims to manage efficiently climate change impacts through strategies that build and sustain South Africa's social, economic and environmental resilience, and the second is to stabilise greenhouse gas concentrations in the atmosphere.
National Environmental Management Act (NEMA)	The NEMA Act 107 of 1998 intends to provide for cooperative environmental governance by establishing principles for decision-making on matters affecting the environment. In addition, these institutions will promote cooperative governance and procedures for coordinating environmental functions by organs of state.
Just Transition Framework	This framework is a planning tool for achieving a just transition in South Africa, setting out the actions that the government and its social partners will take to achieve a just transition and the outcomes to be realised in the short, medium, and long term.
Disaster Management Act (2002)	The Disaster Management Act of 2002 provides for an integrated and coordinated disaster management policy that focuses on preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters and post-disaster recovery, including climate-related disasters.
Integrated Coastal Management Act (2008)	The ICM Act sets out a new approach to managing the nation's coastal resources to promote social equity and make best economic use of coastal resources, whilst protecting the natural environment.
National Veld and Forest Fire Act (1998)	The purpose of this Act is to prevent and combat veld, forest and mountain fires throughout the Republic and to provide for a variety of institutions, methods and practices for achieving this purpose.

2.3.2. Desired Adaptation Outcomes for Monitoring and Evaluating Climate Resilience

The development of Desired Adaptation Outcomes (DAOs) is a crucial objective that informs and directs the monitoring and evaluation of South Africa's progress towards a climate-resilient society. These DAOs are derived from sector-specific adaptation priorities, as outlined in

Chapter 5 of the National Climate Change Response White Paper (NCCRWP). To establish these outcomes, consultative sessions have been held with various departments including the Department of Environmental Affairs (Biodiversity branch), Department of Water and Sanitation (DWS), Department of Health (DOH), Department of Human Settlements (DHS), and the National Disaster Management Centre. During these consultations, the proposed DAOs were widely accepted. It is recommended that the CDM engages with the Desired Adaptation Objectives outlined below in the implementation and mainstreaming of the Climate Change Adaptation Plan

The Desired Adaptation Outcomes encompass various key aspects to monitor and evaluate climate resilience. These include:

1. Robust policies, programmes and actions for climate change adaptation.
2. Appropriate processes and mechanisms for coordinating climate change adaptation.
3. Accurate weather forecasting, reliable seasonal predictions, climate projections and effective early warning systems for extreme weather and other climate-related events.
4. Capacity development, education, and awareness programmes for climate change adaptation.
5. Resources and capacity to deliver climate change adaptation.
6. Climate change adaptation is fully integrated into development planning.
7. New technologies/knowledge developed for use in climate change adaptation and other cost-effective opportunities optimized.
8. Systems, resources, communities, and sectors are less vulnerable to climate change impacts.
9. Reduction in non-climate pressures and threats to human and natural systems.
10. Secure food, water, and energy supplies are available for all.

These DAOs form a holistic framework aimed at guiding the country's adaptation strategies. They ensure a robust response to climate change impacts while integrating adaptation into broader developmental planning, emphasizing capacity building, education, and the development of new adaptation technologies. Ultimately, the goal is to create a society that is resilient to climate change impacts, ensuring secure food, water, and energy supplies for everyone.

2.3.3. Local Policy Context

The District has developed the following Municipal Sector Plan linked to the Environment:

Table 3: CDM's Sectoral plans and linkage to climate change.

Plans	Status	When Due For Review	Climate Change Linkage
Spatial Development Framework (SDF)	26 May 2017	2022	In relation to CDM, the SDF must take into account future climate change scenarios to ensure the spatial arrangement of land use and development is resilient against climate impacts like flooding, heatwaves, or drought.

Water Services Development Plan	25 May 2018		The impact of climate change on water resources in the CDM, such as changing rainfall patterns and increased evapotranspiration, necessitates the integration of adaptive strategies in the Water Services Development Plan to ensure sustained water supply and sanitation services.
5-year Infrastructure Investment Plan	Not available		Infrastructure investment in the CDM needs to account for potential climate change effects, incorporating resilience and mitigation measures in infrastructure design and placement to reduce vulnerability to extreme weather events and changing climatic conditions.
Energy Master Plan	N/A	Not a District function	CDM's Energy Master Plan needs to shift towards renewable and energy-efficient solutions to decrease carbon emissions and mitigate climate change impacts while ensuring energy security amidst potential climate-induced disruptions.
Environmental Management Plan	2009 (all LMs)	Not Required (Currently in implementation phase)	This plan should incorporate climate change adaptation and mitigation strategies, aiming to reduce the Municipality's environmental footprint, enhance biodiversity, and bolster ecosystem resilience to climate change.
Strategic Environmental Assessment (SEA)	Polokwane & Molemole LMs - 2012/13 Blouberg LM - 2013/14 Aganang LM - 2014/15	2016/2017	The SEA should incorporate climate change impact assessments to inform environmental planning and decision-making processes in the Capricorn District Municipality, helping to minimise climate-related environmental risks.
Disaster Management Plan and Framework	2014		With the increased likelihood of climate-related disasters such as flooding and wildfires, the Disaster Management Plan and Framework need to incorporate climate change scenarios to enhance disaster preparedness and response strategies.
Poverty Alleviation and Gender Equity Plan	Not available		Climate change often exacerbates socioeconomic disparities. Therefore, these plans need to consider climate change's impacts on livelihoods and incorporate adaptive capacity-building measures, especially for vulnerable groups.
Risk Management Strategy	2009	Annually	Climate change introduces a plethora of risks to Capricorn District Municipality. These risks, including those related to infrastructure, natural resources, and human health, should be integrated into the Municipality's broader risk management strategy.
Communication Plan	2013	2018/19	Climate change awareness and education should be integral to the Municipality's communication plan to foster a community-wide understanding of climate change and encourage sustainable practices.
Public Participation Strategy			Encouraging public involvement in climate change mitigation and adaptation actions can improve the effectiveness of these strategies and foster community resilience.

Integrated Waste Management Plan	2006 (Aganang, Blouberg, Lepelle-Nkumpi & Molemole LM's)	2015/16	Considering climate change, this plan should focus on reducing waste, promoting recycling, and managing waste in a manner that reduces greenhouse gas emissions and other environmental impacts.
Integrated Transport Plan	December 2013		This plan needs to consider low-carbon transport solutions to reduce the Municipality's carbon footprint and to ensure the transport network's resilience to climate-induced disruptions.
Roads Master Plan	2017		The design and maintenance of roads should consider the impacts of climate change such as increased flooding or heatwaves to ensure continued serviceability under changing climate conditions.
Human Resource Strategy / Framework	June 2012		The Municipality's human resource strategy should include training and capacity building on climate change to equip the workforce with the knowledge and skills necessary to implement climate adaptation and mitigation measures.
Tourism Development Strategy	2015		Given that natural and cultural tourism resources could be affected by climate change, the tourism development strategy should consider sustainable and resilient tourism development practices.

Climate change, an incontrovertible global phenomenon, is widely acknowledged as one of the most formidable environmental and economic challenges of the present age. As such, the Capricorn District Municipality (CDM) faces profound uncertainties concerning the specific long-term local implications of climate change. These uncertainties are further compounded by constraints in institutional capacity and budgetary limitations.

However, local government can serve as a crucial bulwark in enhancing climate change resilience by effectively executing mandated duties. To achieve objectives of sustainable and equitable service provision, socio-economic development promotion, and assurance of a safe and healthy environment for all, strategic planning and appropriate response to climate change are imperatives. Anthropogenic climatic changes have already registered significant impacts on South African weather patterns, with the Capricorn district among the areas most susceptible to both current and future climate impacts. The projected future climatic changes are poised to have considerable implications on agriculture, livelihoods, and the sustainable growth and development of communities.

An increased global atmospheric concentration of greenhouse gases — Carbon dioxide (CO_2), Methane (CH_4), and Nitrous oxide (N_2O) — largely emitted through transportation and industrial processes dependent on fossil fuels, alter the thermodynamic exchanges underpinning long-term climate. This climate impact exhibits an inequitable global distribution. Coupled with heterogeneous community resilience, this engenders varying localised risk. In response, the

Capricorn District Municipality has crafted a Climate Change Response Strategy aimed at assessing and addressing the risks of climate change.

This strategy delineates CDM's approach to responding to climate change, with a view to bolstering the district's social, economic, and environmental resilience. It provides an exhaustive evaluation of Capricorn's current status and its strategic context, an analysis of present and projected future climate impacts, profiles of local municipality climate vulnerability, capacity and risk, and an implementation framework. This Strategy, currently undergoing review and soon to be updated with recent data and new projections, is guided by the principles established in the Constitution, Bill of Rights, the National Environmental Management Act, and the National Climate Change Response White Paper. It takes into account the following cross-cutting focus areas concerning CDM and its local municipalities:

- Energy Efficiency and Demand Side Management;
- Renewable Energy;
- Infrastructure Projects (encompassing transport, buildings, water management, wastewater treatment, and waste management);
- Economic Development;
- Natural Resource Management (including Agriculture);
- Disaster Management;
- Water Resource Management.

As a proactive response to the impacts of climate change, CDM has initiated a pilot renewable energy programme, which includes the construction of biodigesters in the Polokwane (Ga-Makgoba village) and Blouberg municipalities (Indermark and Avon village). The District Climate Change Response Strategy is currently under review and will soon be updated with the most recent data and new projections.

2.4. District Municipality Responsibilities

In South Africa, district municipalities play a significant role in climate change adaptation. While the specific powers and functions related to climate change may vary slightly between municipalities, there are several established responsibilities typically associated with district municipalities in South Africa which can be linked to climate change adaptation:

1. Climate Change Planning: District municipalities are responsible for developing and implementing climate change adaptation plans at the local level. These plans are required to assess the vulnerability of the district to climate change impacts and outline strategies and actions to minimize risks and enhance resilience.
2. Infrastructure Development: District municipalities are tasked with planning and coordinating the development of infrastructure. Infrastructure should be developed to be resilient to climate hazards as well as support resilience objectives as part of an integrated climate change adaptation approach. This includes the construction of

climate-resilient roads, bridges, and drainage systems that can withstand extreme weather events and reduces risk to vulnerable assets and communities.

3. Natural Resource Management: District municipalities are responsible for managing natural resources within their jurisdiction to support climate change adaptation. This involves conserving and protecting ecosystems, such as wetlands and forests, that provide a natural defence against climate impacts like flooding and erosion.
4. Disaster Risk Reduction: District municipalities have key responsibilities in disaster risk reduction, including preparedness, response, and recovery. They should play a role in establishing early warning systems, and emergency response plans, and coordinate efforts with other local government entities, provincial authorities, and national disaster management agencies.
5. Stakeholder Engagement: District municipalities facilitate stakeholder engagement processes to raise awareness about climate change adaptation and involve local communities, NGOs, businesses, and other relevant actors in decision-making processes. They often collaborate with local organizations to implement climate change adaptation projects and programs.
6. Capacity Building and Training: District municipalities are responsible for building capacity and providing training to local government officials, communities, and relevant stakeholders on climate change adaptation. This helps enhance their knowledge and skills in implementing climate-resilient practices and technologies.
7. Monitoring and Evaluation: District municipalities monitor the progress of climate change adaptation initiatives and evaluate their effectiveness. They collect data, measure key performance indicators, and assess the success of implemented strategies to ensure that adaptation measures are delivering the desired outcomes.

It is important to note that while district municipalities have a range of powers and functions related to climate change adaptation, collaboration with other levels of government, such as provincial and national authorities, is also crucial for effective climate action and coordination of resources and policies.

2.4.1. Power and Functions of the District Municipality

This section entails a high-level overview of the relevant power and functions of District Municipalities in South Africa that can be referenced to assign and assume responsibilities related to climate action. Due to the time- and resource-limited nature of this study this is by no means an exhaustive review.

According to South Africa's Local Government: Municipal Structures Act, the District Municipality has the following functions and powers:

a) Integrated development planning for the district municipality as a whole, including a framework for integrated development plans of all municipalities in the area of the district municipality.
b) Potable water supply systems.
c) Bulk supply of electricity, which includes for the purposes of such supply, the transmission, distribution and, where applicable, the generation of electricity.
d) Domestic waste-water and sewage disposal systems.
e) Solid waste disposal sites, in so far as it relates to—
    i. the determination of a waste disposal strategy;
    ii. the regulation of waste disposal;
    iii. the establishment, operation and control of waste disposal sites, bulk waste transfer facilities and waste disposal facilities for more than one local municipality in the district.
f) Municipal roads which form an integral part of a road transport system for the area of the district municipality as a whole.
g) Regulation of passenger transport services.
h) Municipal airports serving the area of the district municipality as a whole.
i) Municipal health services.
j) Fire-fighting services serving the area of the district municipality as a whole, which includes—
    i. planning, co-ordination and regulation of fire services;
    ii. specialised fire-fighting services such as mountain, veld and chemical fire services;
    iii. co-ordination of the standardisation of infrastructure, vehicles, equipment and procedures;
    iv. training of fire officers.
k) The establishment, conduct and control of fresh produce markets and abattoirs serving the area of a major proportion of the municipalities in the district.
l) The establishment, conduct and control of cemeteries and crematoria serving the [district as a whole] area of a major proportion of municipalities in the district.
m) Promotion of local tourism for the area of the district municipality.
n) Municipal public works relating to any of the above functions or any other functions assigned to the district municipality.
o) The receipt, allocation and, if applicable, the distribution of grants made to the district municipality.
p) The imposition and collection of taxes, levies and duties as related to the above functions or as may be assigned to the district municipality in terms of national legislation.

3. Summary of Climate Risk Profile

In alignment with worldwide patterns, Capricorn District Municipality (CDM) is grappling with the repercussions of climate change. These consequences are predicted to escalate the severity and recurrence of climate-related hazards in the future. Recognising the magnitude of this challenge, the municipality has underscored the importance of bolstering resilience and protecting its residents, natural resources, economic ventures, and livelihoods from the impacts of climate change.

The following sections offer a condensed examination of the climate vulnerability within CDM, and the priority risks and climate impacts that form the foundation for identifying appropriate climate change adaptation strategies.

3.1. Overview of Baseline and Future Climate Risk.

The development of baseline and future climate change scenarios was facilitated using an ensemble of six Coupled Model Intercomparison Project Phase 5 (CMIP5) General Circulation Models (GCMs). This ensemble was employed for both Representative Concentration Pathway (RCP) 4.5 and 8.5 scenarios. The use of multiple models provides a robust approach to the inherent uncertainty of individual models, helping create a more comprehensive picture of potential climate futures. RCP 4.5 and 8.5 represent contrasting emissions trajectories, the former representing a moderate emission scenario, and the latter a more extreme one, with a larger concentration of greenhouse gases by the end of the century.

In order to translate these global scale models into actionable information at a local level, regional climate modelling was employed. The Conformal Cubic Atmospheric Model (CCAM) was utilised to perform dynamic downscaling from a 50km resolution to an 8km resolution. This approach allows for higher-resolution climate data, which is essential in assessing localised impacts of climate change, such as those faced by the CDM.

The climate analysis to be conducted covers two distinct periods: the baseline period from 1961 to 1990, and the future period from 2021 to 2050. This bifurcated analysis allows for the consideration of long-term climate trends and anomalies, as well as the anticipation of future climatic conditions. It is instrumental in assessing climate vulnerabilities and planning adaptive strategies for the Capricorn District Municipality, thereby facilitating proactive climate change response planning.

3.1.1. Climate Analysis

3.1.1.1. Average Temperatures

The CDM currently encounters average annual temperatures ranging between 16 and 22 °C, with elevated averages concentrated near and along the north-western frontier of the District. These contemporary temperature norms provide an important baseline to gauge the relative changes brought forth by climate change and its impacts on the local environmental conditions, socio-economic activities, and the health of the resident populations.

However, under the Representative Concentration Pathway (RCP) 8.5 scenario, a high-emission trajectory, the District is projected to witness significant average annual temperature increases of approximately 2.5°C to 3°C by the mid-century mark. The most profound increases are anticipated predominantly in the western, central, and northern sectors of the District. These expected augmentations in temperature, resonating with global warming trends, portend significant alterations in the District's climate system, potentially exacerbating vulnerabilities in sectors like agriculture, health, and water resources, and necessitating comprehensive adaptation measures.

3.1.1.2. Rainfall

The CDM currently records an annual rainfall ranging between 248mm and 1273mm. Higher rainfall averages are predominantly observed in select pockets located along the southern boundary of the District. These precipitation patterns play a critical role in shaping the local hydrological cycles, affecting soil moisture content, groundwater recharge, surface water flows, and influencing the productivity of the agricultural sector, among other socio-environmental dynamics.

However, under the high emissions scenario (RCP 8.5), projections reveal a shift in the District's average annual rainfall by 2050. Specifically, a decrease of approximately 23mm is anticipated predominantly in the southern and western areas, while an increase of up to 93mm is projected mainly in the northern and eastern regions of the District. Blouberg Local Municipality is expected to experience modest increases of 56mm or more in average rainfall, while in Lepelle-Nkumpi Local Municipality, slight decreases of about 8.6mm to significant increases of up to 93mm are anticipated. Overall, the rest of the District will likely encounter similar to slightly higher average annual rainfall in the future, suggesting a potential shift towards marginally wetter conditions. These anticipated changes call for adaptive management strategies in sectors such as water resource management, agriculture, and disaster risk management.

3.1.2. Climate Hazards

A summary of the climate hazards is included below:

3.1.2.1. Drought

The Capricorn District Municipality (CDM) currently exhibits high susceptibility to drought events. This proneness to drought is observed across most parts of the District, posing significant challenges for water resource management, agricultural productivity, and the overall well-being of the local communities. These drought conditions also contribute to elevated wildfire risks and other related environmental and socio-economic impacts.

Looking forward, predictive climate models indicate that the entire District is likely to experience an increase in the intensity of droughts. This projected escalation underscores a pressing need for bolstered resilience measures and robust adaptation strategies. It necessitates the integration of drought management strategies into the district's long-term planning, particularly in sectors such as agriculture, water resources, and disaster risk management, to effectively mitigate the adverse impacts of exacerbated drought conditions.

3.1.2.2. Heat

The Capricorn District Municipality (CDM), particularly its northern regions, is already subject to significant heat stress, with an average of 61 to 75 very hot days per year. These very hot days are defined as those where the maximum temperature exceeds 35°C per General Circulation Model (GCM) grid point for the baseline period of 1961–1990. Further, the southern parts of the District, notably the settlements across the southwestern region of the Lepelle-Nkumpi local municipality, are also likely to experience an elevated number of very hot days, indicating a widespread occurrence of heat stress across the district.

Projected climate scenarios for the period 2021–2050 suggest an increase in the number of very hot days across areas that are currently prone to extreme heat. This intensification of heat stress, driven by climate change, could have profound implications for both the natural environment and the district's inhabitants. Particularly, urban zones with their heat-absorbing infrastructure could become especially vulnerable to the escalating temperatures, potentially exacerbating public health risks, energy demands, and overall living conditions. Therefore, effective heat mitigation and adaptation strategies are essential to ensure the sustainability of these areas and the well-being of their residents under the future climate scenarios.

3.1.2.3. Wildfire

Wildfire risk in the Capricorn District Municipality (CDM) is determined by a confluence of both the fire hazard intrinsic to specific fire-ecotypes, encompassing factors like likelihood and fire severity, and the socio-economic consequences associated with such incidents, notably potential economic and social losses. A number of settlements within the district face a pronounced wildfire risk, particularly on their wildland-urban interfaces. Key areas of concern

include Polokwane, along with various other settlements interspersed across the eastern and southern sectors of the city. Other vulnerable regions are situated in the western parts of the Lepelle-Nkumpi local municipality, along or near the borders of Molemole and Blouberg local municipalities, and further north, with two settlements including Alldays located in the Blouberg Municipality.

Looking into the future, projections suggest that these same settlements will likely face an escalation in the risk of wildfires. Such an increase is anticipated due to the predicted climate alterations, which are expected to favour conditions conducive to the ignition and spread of wildfires. This scenario underscores the importance of proactively implementing comprehensive wildfire management and adaptation strategies. These strategies should aim at mitigating the associated hazards, reducing the socio-economic impact, and enhancing the resilience of the affected communities and ecosystems to this significant climate change-induced threat.

3.1.2.4. Flooding

The flood hazard assessment within the Capricorn District Municipality (CDM) amalgamates diverse information sources, such as climatological data, recorded flood incidents, and the unique features of local water catchments that potentially affect flood occurrence. The flood hazard index in the District Municipality displays significant variation. Notably, certain areas within Polokwane and Lepelle-Nkumpi local municipalities present a medium to high flooding hazard. Conversely, most parts of the District Municipality feature a low to medium flooding hazard. Future climate change projections predict a decrease in the number of extreme rainfall days around the northern parts of Capricorn, which may moderate flooding risk in these areas.

However, the southern regions of the District Municipality are expected to witness an increase in the number of extreme rainfall days, thus heightening the risk of flooding. Two settlements, Sebayeng and Mankweng, situated to the east of Polokwane, could face a heightened risk of flooding by 2050. Similarly, the province's capital, Polokwane, is projected to confront a medium risk of flooding. These predictions suggest that climate change adaptations and flood risk reduction strategies must be an integral component of future urban planning and disaster management frameworks. These initiatives should aim to protect vulnerable communities, preserve critical infrastructures, and ensure sustainable socio-economic growth amidst a changing climate.

3.1.3. Climate Impacts

3.1.3.1. Water Resources

In South Africa, groundwater maintains a critical role in facilitating economic development and securing water stability in several rural and urban regions. Many of these areas rely wholly or

partially on groundwater supply. However, groundwater is a natural resource whose availability and distribution are significantly influenced by variations in climate.

In the context of the Capricorn District, towns display a mix of reliance on surface water and groundwater. The majority of settlements in Polokwane depend on a combination of both sources, while specific settlements spread across Lepelle-Nkumpi, Molemole, and Blouberg rely exclusively on groundwater. Currently, the groundwater recharge potential is high across the southwestern and southeastern parts of the District. Meanwhile, the central and northwestern sections of the District showcase a moderate recharge potential.

The outlook towards 2050, however, suggests a decrease in groundwater recharge potential for most parts of the District. Only a few areas scattered across the north and along the southwest and southeastern sections of the District may experience an exception to this trend. When considering the projected future groundwater recharge potential in conjunction with population growth, it is plausible that areas such as Polokwane and its surroundings, as well as parts of Mankweng, may face a high risk of groundwater depletion by 2050. Therefore, prudent water management strategies and sustainable development plans will be crucial to maintain water security in the Capricorn District in the face of climate change.

The current water supply vulnerability is depicted in Table 3, below.

Table 4: Current water supply and vulnerability across CDM.

Local Municipality	Water Demand per Capita (l/p/d)	Water Supply per Capita (l/p/d)	Current Water Supply Vulnerability
Blouberg	114.1	107.83	1.06
Lepelle-Nkumpi	98.94	105.22	0.94
Molemole	97.62	96.23	1.01
Polokwane	111.43	140.01	0.8

**Key: A water supply vulnerability score above 1 indicates that demand is more than supply, while a score below 1 indicates that supply is meeting demand.*

3.1.3.2. Sectors

The agricultural sector in the Capricorn District is a notable contributor to the local economy, providing jobs to 6.6% of the total workforce in the area. Thus, the potential implications of climate change and associated climate hazards on agriculture are significant, affecting over 23,000 individuals who are directly or indirectly involved in the sector. As such, assessing potential climate impacts on agriculture and developing suitable adaptive measures becomes vital for sustaining local livelihoods and maintaining the sector's economic contributions.

The future climate projections for the District indicate a generally hotter and potentially wetter climate. In the short term, these conditions could result in an increase in maize yield, a staple crop in the region, due to enhanced water availability and higher rates of photosynthesis under elevated CO2 concentrations. However, the long-term view towards 2050 suggests that heat stress could negatively impact production, undermining the initial benefits of the changing climate. Likewise, for the livestock sector, increased heat stress might result in reduced growth rates and reproduction performance, compromising the productivity of this agricultural subset.

3.1.4. Priority Risks and Vulnerabilities

3.1.4.1. Municipal

Municipal vulnerability is unpacked in terms of four vulnerability indices (Socio-Economic Vulnerability Index [SEVI], Economic Vulnerability Index [EcVI], Physical Vulnerability Index [PVI] and Environmental Vulnerability Index [EnVI]).

Each Local Municipality in the Capricorn District is provided a score out of 10 for each of the vulnerability indices. A score higher than 5 indicates an above national average, and a score lower than 5 indicates a below national average for vulnerability. Scores are provided for both 1996 and 2011, where a lower score in 2011 compared to 1996 indicates an improvement and a higher score indicates worsening vulnerability. Trend data are only available for Socio-Economic Vulnerability and Economic Vulnerability.

Table 5: Vulnerability indicators across Capricorn District Municipality

LOCAL MUNICIPALITY	SEVI 1996	SEV 2011	Trend	EcVI 1996	EcVI 2011	Trend	PVI	Trend	EnVI	Trend
Blouberg	6.03	5.93	↘	5.91	5.35	↘	6.63	N/A	3.64	N/A
Lepelle-Nkumpi	4.78	5.04	↗	5.99	8.78	↗	5.87	N/A	5.33	N/A
Molemole	5.08	5.01	↘	5.26	7.47	↗	6.67	N/A	3.82	N/A
Polokwane	4.19	3.19	↘	4.74	6.80	↗	7.22	N/A	6.17	N/A

Socio-economic vulnerability within the Capricorn DM has decreased (i.e., improved) across all Local Municipalities, except Lepelle-Nkumpi Local Municipality, between 1996 and 2011. The latter also has the highest economic vulnerability in the District and the fifth-highest score (out of a total of 22 Local Municipalities) in the province. The Local Municipality (i.e., Lepelle-Nkumpi) has the highest unemployment rate in the District (26.80 %), while the City of Polokwane recorded the District's lowest (16.60 %) rate of unemployment in the same period. Most Local Municipalities in Capricorn – with the exception of Blouberg – experienced a downward trend, in terms of economic vulnerability, between 1996 and 2011, thus making these Local Municipalities, particularly their economies, more susceptible to experiencing the negative impacts of external shocks.

Settlement

The unique set of six (6) indicators listed below highlights the multi-dimensional vulnerabilities of the settlements within the Mopani District and its Local Municipalities.

- Socio-Economic Vulnerability Index;
- Economic Vulnerability Index;
- Environmental Vulnerability Index;
- Growth-Pressure Vulnerability Index;
- Regional Economic Connectivity Vulnerability Index;
- Service Access Vulnerability Index.

Table 6: Anticipated settlement vulnerability for CDM and Local Municipalities.

Local Municipality	Anticipated Settlement Vulnerability
Blouberg	• The major settlements in this Local Municipality include Senwabarwana, Helene Franz Hospital, GaMoreise, Ga-Machaba, Avon, Tolwe and Alldays. • Alldays faces the highest growth pressure. • Avon and Ga-Machaba have a socio-economically vulnerable population as well as a highly vulnerable natural environment. • Traditional areas also face high environmental vulnerability. • Tolwe is the most remote settlement with very high regional connectivity vulnerability. • GaMoreise has a highly vulnerable economy. • Senwabarwana, Tolwe, Ga-Machaba and several traditional areas in Blouberg have high service access vulnerability.
Lepelle-Nkumpi	• Major settlements include Magatle, Lebowakgomo, Motserereng and Mathibela. • Parts of Lebowakgomo face a very high growth pressure and very high economic vulnerability. • The settlements of Magatle and several traditional areas in the Local Municipality have socio-economically vulnerable populations. • Magatle and Mathibela are remote settlements, with very high regional connectivity vulnerability. • Mathibela also has high environmental-, economic and service access vulnerability. • Magatle and several traditional areas have high economic vulnerability. • Motserereng and several traditional areas have high service access vulnerability.
Molemole	• Major settlements in this Local Municipality are Matseke, Morebeng, Nthabiseng, Botlokwa (Mphakane), Ramokgopa, Ga-Phasha, Mogwadi and Mohodi. • The highest growth pressure in the Local Municipality is Mogwadi.

	• The settlements of Morebeng, Botlokwa, Mohodi and several traditional areas have socio-economically vulnerable populations. • Morebeng, Nthabiseng and several traditional areas are remote settlements, with high regional connectivity vulnerability. • The settlements of Mohodi and Nthabiseng have high environmental vulnerability • Nthabiseng and Botlokwa (Mphakane) have highly vulnerable economies. • Mohodi also has high service access vulnerability.
Polokwane	• The major settlements in this Local Municipality are Ga-Chuene, Bergnek, GaMokwane, Ga-Mangou, Mankweng, Polokwane and Sebayeng. • Polokwane faces the highest growth pressure in the Local Municipality. • Parts of Ga-Chuene and several traditional areas have socio-economically vulnerable populations. • The settlements of Ga-Mangou and Sebayeng have high environmental vulnerability. • Ga-Mangou, Sebayeng and Bergnek and several traditional areas are remote and have very high regional connectivity vulnerability. • Parts of Ga-Chuene have high economic vulnerability, while the settlements of Bergnek and GaMokwane have high service access vulnerability.

The Capricorn District Municipality, comprising local municipalities including Blouberg, Lepelle-Nkumpi, Molemole, and Polokwane, each faces unique challenges in terms of their vulnerabilities to climate change impacts.

In Blouberg, prominent settlements such as Senwabarwana, Tolwe, and Ga-Machaba face high service access vulnerability, further exacerbated by increasing growth pressures, particularly in Alldays. Avon and Ga-Machaba struggle with socio-economic vulnerabilities and a fragile natural environment, which could heighten their susceptibility to climate change impacts. Similarly, traditional areas also face environmental vulnerabilities, with Tolwe additionally grappling with regional connectivity due to its remote location. The economy of Ga-Mareise is deemed highly vulnerable, suggesting potential economic challenges in adapting to climate change.

Lepelle-Nkumpi, on the other hand, has settlements like Lebowakgomo experiencing high growth pressure and substantial economic vulnerability. Similar to Blouberg, socio-economic vulnerabilities are present in Magatle and several traditional areas, which coupled with their regional connectivity vulnerability, due to remoteness, could hamper climate change adaptation.

Magatle and Mathibela are remote settlements, also facing environmental, economic, and service access vulnerabilities.

Molemole's key settlements, including Morbeng, Botlokwa, Mohodi, and several traditional areas, are characterised by socio-economically vulnerable populations. The regional connectivity vulnerability in Morbeng and Nthabiseng due to their remoteness, and the environmental vulnerability in Mohodi and Nthabiseng, could potentially complicate efforts towards building resilience. Mogwadi faces the highest growth pressure in Molemole, while Nthabiseng and Botlokwa (Mphakane) struggle with vulnerable economies, and Mohodi also deals with high service access vulnerability.

Lastly, Polokwane faces the most considerable growth pressure within its boundaries, with socio-economic vulnerabilities present in parts of Ga-Chuene and several traditional areas. The settlements of Ga-Mangou and Sebayeng contend with high environmental vulnerability, further compounded by regional connectivity vulnerability due to their remoteness. Economic vulnerability is noted in parts of Ga-Chuene, and service access vulnerability is high in Bergnek and GaMokwane.

In light of these vulnerabilities, it is crucial for the CDM to prioritise adaptive strategies that address these specific challenges within each local municipality to enhance resilience against climate change impacts.

4. Climate Change Adaptation Plan

4.1. Capricorn DM's Strategic Organisational Objectives and the Linkage to Climate Change Adaptation

Capricorn DM identified 5 key strategic organisational objectives to guide development in the municipality. Mainstreaming climate action should be considered as key a success factor in achieving these objectives as it can help promote sustainable socio-economic development by protecting the investments being made by Capricorn DM and supporting livelihood resilience. Table 7 provides an overview of the Capricorn DM's Development Priorities and Objectives and indicates potential linkages to climate action.

Table 7: CDM development priorities and objectives.

Development Priority	Link to Climate Change
To provide sustainable basic services and infrastructure development	Climate change adaptation can directly contribute to this objective by ensuring the services and infrastructure provided by the municipality are resilient to climate impacts. For example, the CDM can prioritise investments in water-efficient technologies and infrastructure given the increased risk of droughts due to climate change. Also, developing infrastructure with climate resilience in mind, such as flood-resistant roads or energy-efficient public buildings, can reduce the vulnerability of the municipality's services to climate-related hazards.
To improve spatial development and environmental management	Spatial planning and environmental management can play a key role in climate change adaptation. Spatial planning decisions, such as where to build new developments or infrastructure, can be influenced by climate change risk assessments to minimise exposure to climate-related hazards. Environmental management practices, such as preserving and restoring natural habitats, can enhance the district's resilience to climate change by protecting biodiversity and ecosystem services that naturally mitigate climate impacts.
To enhance financial viability and management	Adapting to climate change can lead to cost savings in the long run by reducing the risks and costs associated with climate-related damages. Climate change adaptation measures can also attract funding from international climate finance mechanisms, thus enhancing the financial viability of the municipality. Financial management practices can also integrate climate risk into budgeting and procurement processes to ensure that municipal resources are allocated in a way that builds resilience to climate change.
To enhance conditions for economic growth and job creation	Climate change adaptation can spur economic growth and job creation by promoting the development of new sectors and industries, such as renewable energy, sustainable agriculture, and climate-resilient construction. Skills training programs can be implemented to enable the local workforce to take advantage of these new job opportunities.

	Moreover, ensuring the resilience of key economic sectors to climate impacts can protect jobs and livelihoods in the district.
To increase the capacity of the district to deliver its mandate	Capacity building is crucial for effective climate change adaptation. The CDM can invest in training and resources to enhance the capacity of municipal staff to understand, plan for, and respond to climate change. This can include technical training on climate risk assessments, integrating climate considerations into planning and decision-making processes, and implementing and managing adaptation projects. Furthermore, increasing public awareness and understanding of climate change can enable community members to take action to adapt and increase their resilience.

4.2. Climate Change Adaptation Vision

In the context of the Capricorn District Municipality (CDM), climate change resilience and mainstreaming would mean the integration of climate change response principles into all aspects of municipal planning, development, and operations. This approach resonates with the district's goals to prioritise the health and safety of communities in the face of a changing climate, reduce the exposure and vulnerability of human and natural systems to climate change, ensure water security, and develop climate-resilient, low-carbon, diverse, and inclusive rural economies.

Several practices could be considered as part of the shift towards a climate-resilient district in CDM:

- Adopting design standards and practices that consider future climate change impacts: In the realm of infrastructure, CDM could adopt design standards and practices that consider future climate change impacts, ensuring that infrastructure and settlements are resilient to these changes. This practice aligns directly with the goal to reduce the exposure and vulnerability of human systems to climate change and extreme weather events.
- Biodiversity conservation is critical: The preservation of green spaces and biodiversity forms a crucial aspect of a resilient economy. Given CDM's rich biodiversity, the protection and restoration of natural ecosystems such as high-priority biomes, wetlands, river ecosystems, and riparian areas will enhance biodiversity, support water resource management, and provide natural buffers against climate-related hazards such as wildfires.
- Water conservation and efficiency form a crucial pillar of resilience in CDM: By implementing strategies such as public awareness campaigns, leak detection and repairs, water metering and billing, and more importantly, investing in efficient water infrastructure, prioritising infrastructure maintenance, promoting water conservation practices, implementing rainwater harvesting systems, and exploring alternative water sources, the district can significantly contribute to water security in the face of climate change.

By adopting these practices, the Capricorn District Municipality would be taking important steps towards achieving its stated goals and positioning itself as a climate-resilient district that is prepared for the challenges of the future. These best practices are not exhaustive and could be complemented by other strategies tailored to the specific context and needs of the CDM. The key to success is integrating these principles into all aspects of municipal decision-making and operations and engaging the community in these efforts.

The proposed climate change response vision for the CDM reads as follows:

"To become a sustainable, low-carbon district that safeguards community health and safety amidst climate change, conserves natural resources, and promotes climate change mitigation and adaptation. Focusing on developing resilient, inclusive rural economies, the CDM collaborates with communities and stakeholders to secure water resources, conserve ecosystems, manage environmental risks, and ensure equitable opportunities for all residents, leading towards a prosperous future."

This vision centres on cultivating the Capricorn District Municipality (CDM) into a sustainable, low-carbon district capable of adapting to climate change challenges. The goal is to assure that communities are safe, thriving, and well-equipped to protect and preserve natural resources for future generations. The approach to climate change will hinge on innovative, cost-effective solutions that encourage sustainable development and economic growth, particularly in the creation of resilient, inclusive rural economies.

The key to manifesting this vision lies in cooperation with stakeholders, integrating climate change considerations into planning and decision-making processes. It is essential that all actions are underpinned by up-to-date scientific knowledge and best practices to construct a resilient and sustainable future for the district.

To realize this vision, it is crucial to establish a comprehensive list of climate actions for the CDM that tackle climate risks, sustainability, adaptation, community safety, and prosperity, along with natural resource preservation, innovation, collaboration, and resilience. These climate actions also present co-benefits, fostering equity, a just transition, and ensuring the health and resilience of people, natural resources, and the economy.

4.3. Climate Change Goals and Programmes

The process of identifying suitable adaptation actions for the Capricorn District commenced with a careful review of the outcomes of the district's Climate Change Risk profile. This analysis served as the foundation for devising specific Adaptation Goals, which aim to provide a contextually relevant approach to adaptation planning. Each goal further informed the development and classification of Adaptation Programmes. Subsequently, each programme was meticulously dissected to detail the key climate actions and supporting activities.

Among the most pressing risks faced across the Capricorn District are rising temperatures, heat extremes, and drought. Yet, these concerns may be partially mitigated by the forecasted slight increases in average annual rainfall. Certain settlements in the City of Polokwane, such as Polokwane, Sebayeng, and segments of Mankweng, are highly susceptible to wildfires, heat stress, and flooding. These areas, anticipating a surge in population growth, indicate the impending amplification of human exposure to these climate hazards.

To counter these climate risks, the following adaptive goals were put forward through the Risk Profile:

1. To prioritise the health and safety of communities in the face of a changing climate: Climate change can pose serious risks to public health and safety, such as increased heatwaves leading to heat-related illnesses, the spread of vector-borne diseases, and increased risks of extreme weather events causing physical harm. Prioritising health and safety in climate adaptation could involve implementing early warning systems for extreme weather events, ensuring access to climate-sensitive health services (such as heat illness prevention or disease surveillance), and improving emergency response capacity. Public education about the risks of climate change to health and safety is also crucial.
2. To reduce the exposure and vulnerability of human and natural systems to climate change and extreme weather events: Reducing exposure and vulnerability involves a combination of infrastructural, behavioural, and institutional changes. For human systems, this might involve building climate-resilient infrastructure, improving disaster risk reduction strategies, and enhancing social safety nets for the most vulnerable. For natural systems, this can involve protecting and restoring ecosystems that provide natural buffers against climate impacts, such as wetlands that absorb flood waters.
3. To ensure water security in the face of climate change: Climate change can exacerbate water scarcity, affecting both drinking water supplies and water for agriculture and industry. Ensuring water security under climate change may involve strategies like enhancing the efficiency of water use in all sectors, promoting water-saving technologies, improving the management and protection of water resources, investing in infrastructure for rainwater harvesting and wastewater recycling, and preserving ecosystems that provide natural water regulation services.
4. To develop climate-resilient, low-carbon, diverse and inclusive rural economies that are socially responsible, environmentally sustainable and that provide job opportunities for unskilled, semi-skilled and skilled local residences: A climate-resilient rural economy would be one that can absorb and recover from climate shocks, and that contributes minimally to climate change. This might involve promoting sustainable agricultural practices that are adaptive to changing climate conditions, investing in renewable energy sources, and encouraging diversification of the rural economy into sectors that are less climate-sensitive. Ensuring the economy is inclusive and provides job opportunities at all skill levels may involve training programs for local residents, policies to support small and medium enterprises, and efforts to ensure benefits of economic activities are equitably distributed.

The identification of adaptation actions followed a sequenced approach initiated by the outcomes of the CDM Climate Change Risk profile which informed the development of specific Adaptation Goals have been developed to guide a contextually relevant approach to adaptation planning. The Adaptation Goals informed the development of Strategic Adaptation Priorities to support the identification and categorisation of Adaptation Programmes. Each Programme was then unpacked to provide a detailed breakdown of the key climate actions and support activities.

Therefore, based upon the CC Risk Profile for CDM, the Climate Change Adaptation Plan is framed by the following Adaptation Goals:

- *To ensure water security in the face of climate change.*
- *To protect natural resources and ecosystems.*
- *To reduce the vulnerability and exposure of human and natural systems to climate change and extreme events.*
- *To increase the resilience of the agricultural sector.*

Capricorn DM's Climate Change Programmes:

1. Promote public health and safety in the face of climate change and extreme climate events.
2. Innovative urban and township design and development.
3. Public awareness campaigns - involve communities in, raise awareness of and conduct training on climate change.
4. Integrated approach to water augmentation, use, and management.
5. Protect and conserve water through monitoring mechanisms and water conservation through water conservation and water demand management (WCWDM).
6. Assessing the feasibility and sustainability of alternative water sources for climate change adaptation.
7. Implementing sustainable groundwater use and development strategy.
8. Conserve, protect and restore natural open spaces, ecosystems and natural resources.
9. Enhanced natural resource management and use of ecosystem services.
10. Integrate critical biodiversity areas and ecological support areas into the spatial framework.
11. Identify and Prioritise climate change risks and develop response measures for settlements.
12. Community-based adaptation in communities most at risk of climate-related hazards.
13. Climate-smart spatial planning for climate-resilient growth and development.
14. Advancing towards a climate-smart circular economy.
15. Climate-smart transport strategy for resilience and efficiency.
16. Climate-resilient agricultural innovation.
17. Low-carbon rural economy transformation.
18. Inclusive and diverse economic development.
19. Social responsibility and environmental stewardship.

4.4. Climate Change Goal 1: To Prioritise the Health and Safety of Communities in the Face of a Changing Climate.

Table 8: Climate change goal 1, outcome, linkage to district's strategic objectives.

Goal:	• Prioritize the health and safety of communities within Capricorn District Municipality against evolving climate conditions.
Outcome:	• Achievement of resilient communities that demonstrate safety, health, and effective adaptation to climate change implications. This includes a fortified healthcare system, sturdy infrastructure resistant to climate threats, and a community educated and prepared for the risks associated with climate change.
Linkage to CDM's Strategic Objectives	• SO1: To provide sustainable basic services and infrastructure development: By prioritizing health and safety in the context of climate change, the district would need to ensure that basic services such as water, sanitation, and healthcare are robust and adaptable to climate variations. Infrastructure development would need to incorporate climate resilience measures to withstand extreme weather events and other climate-induced hazards. • SO2: To improve spatial development and environmental management: The management of natural resources and the environment, including land use and conservation areas, plays a critical role in climate change adaptation. Ensuring the health and safety of communities might involve adjusting spatial development plans to minimize risks from climate hazards, such as flooding or heatwaves, and preserving natural areas that provide ecosystem services and act as buffers against climate impacts. • SO3: To enhance financial viability and management: Financial resources would need to be allocated efficiently to implement climate resilience measures and maintain the health and safety of communities. This could include investments in healthcare services, infrastructure upgrades, and climate adaptation projects, as well as the establishment of emergency funds for climate-related disasters. • SO4: To enhance conditions for economic growth and job creation: Climate change resilience can stimulate economic growth and job creation by promoting sectors that contribute to climate mitigation and adaptation. For instance, investments in renewable energy, sustainable agriculture, and green building can create jobs, stimulate local economies, and contribute to the health and safety of communities by reducing emissions and enhancing resilience. • SO5: To increase the capacity of the district to deliver its mandate: The goal aligns with this objective by highlighting the need for capacity building among local authorities and communities to understand, plan for, and manage climate change risks. This might involve training programs for municipal staff, educational campaigns for residents, and collaborations with other levels of government, academic institutions, and non-governmental

	organizations. Building these capacities will strengthen the district's ability to deliver on all its strategic objectives in a changing climate.

4.4.1. Rationale/Context

The CDM is rich in natural resources and ecosystems. The region is home to a diverse range of flora and fauna, including several species of endangered animals. The region's natural resources are critical for supporting the local economy, providing employment and promoting sustainable development. However, the region is also vulnerable to the impacts of climate change, such as drought and flooding, thus building climate resilience in CDM is essential for protecting its natural resources and ecosystems and in promoting sustainable economic growth.

4.4.2. Programme 1: Promote Public Health and Safety in the Face of Climate Change and Extreme Climate Events in Collaboration with the Department of Health

Promoting public health and safety in the face of climate change and extreme weather events, in collaboration with the Department of Health, is a fundamental climate change response programme for Capricorn DM. The impact of climate change and associated hazards can severely affect public health, necessitating the identification of potential health risks and the development of strategies to mitigate them.

A potential initiative under this programme could involve fostering knowledge and information exchange on public health and safety during extreme weather events. This initiative, carried out in partnership with the Department of Health, would involve creating robust platforms for sharing information and making decisions regarding public health and safety, particularly during climate-related emergencies.

Another possible initiative within this programme is the creation and execution of public health programmes that address climate-related health risks. These programmes could include measures to tackle increased air pollution, food insecurity, waterborne illnesses, and vector-borne diseases, all of which can be intensified by climate change. By promoting public health and safety, Capricorn DM can foster more resilient communities better equipped to manage the impacts of climate change. Additionally, promoting public health can yield a multitude of co-benefits, including enhanced economic productivity, increased social equity, and improved quality of life for residents.

Table 9: Programme 1: Promote public health and safety in the face of climate change and extreme climate events.

Programme 1: Promote the Public Health and Safety in the Face of Climate Change and Extreme Climate Events

ACTIONS	KEY ACTIVITIES
Promoting public health and safety in the face of climate change and extreme weather events, in collaboration with the Department of Health, is a fundamental climate change response programme for Capricorn DM.	• Conducting a health risk assessment in collaboration with the Department of Health to identify potential public health impacts of climate change. • Developing and implementing public health programmes, in partnership with the Department of Health, to address identified risks such as air pollution, food insecurity, and waterborne illnesses. • Creating effective platforms in tandem with the Department of Health for knowledge exchange and decision-making on public health and safety during climate-related emergencies. • Developing emergency response plans for extreme weather events in collaboration, in collaboration with the Department of Health addressing public health and safety concerns. • Educating the public about the health risks associated with climate change and the ways in which to mitigate those risks.
Implementing programmes focused on mitigating the impact of climate change and severe weather, particularly in climate-risk zones.	• Conducting vulnerability assessments to identify areas and communities most at risk f the impacts of climate change and severe weather events. • Developing and implementing early warning systems and emergency response plans to enable timely evacuation and disaster relief efforts. • Promoting nature-based solutions, such as restoration of wetlands, and green infrastructure, to help mitigate the impacts of climate change and severe weather events. • Encouraging the adoption of sustainable land use practices, such as low-impact development, agroforestry, and sustainable agriculture, to help build resilience in the face of climate change. • Providing education and awareness campaigns to inform residents and businesses about the risks of climate change and the actions they can take to mitigate their impacts. • Encouraging community participation in climate adaptation and resilience planning efforts, through stakeholder engagement and collaboration with local organisations and community groups. • Establishing partnerships with other municipalities, government agencies, and non-governmental organisations to leverage resources, share best practices, and coordinate efforts in addressing the impacts of climate change and severe weather.

4.4.3. Programme 2: Innovative Urban and Township Design and Development

Innovative urban and township design and development is an essential component of climate change response, as it helps to minimise the risk and impact of climate change on urban areas. One of the main activities of this programme is promoting innovative urban and township planning and design, which takes advantage of opportunities provided by the natural

infrastructure and economic growth-management strategies. This involves adopting an integrated approach to planning, which recognises the interconnectedness of social, economic and environmental factors. Furthermore, identifying ecological corridors or climate change corridors within the District Spatial Development Framework (DSDF) is also an important aspect of innovative urban and township design and development.

Overall, innovative urban and township design and development can play a critical role in building climate resilience in Capricorn DM. By integrating climate change considerations into urban planning and design, the municipality can create more liveable and sustainable communities, reduce vulnerability to climate change impacts, and promote economic development.

Table 10: Programme 2 - Innovative urban and township design and development.

Programme 6: Innovative Urban and Township Design and Development	
ACTIONS	ACTIVITIES
Innovative urban and township design and development is an essential component of climate change response, as it helps to minimise the risk and impact of climate change on urban areas.	• Promoting innovative urban and township planning and design, which takes advantage of opportunities provided by the natural infrastructure and economic growth-management strategies. • Identifying ecological corridors or climate change corridors within the District Spatial Development Framework (DSDF) is also an important aspect of innovative urban and township design and development. • Conducting comprehensive research on climate change and its potential impacts on urban areas, including projections of temperature increases, extreme weather events, and sea level rise. • Developing guidelines in collaboration with reliant government departments, for innovative urban and township design that take into account climate change risks, including those related to flooding, extreme heat, and drought. • Establishing partnerships and networks with key stakeholders in urban planning and design, including government agencies, non-governmental organisations and academic institutions, to promote knowledge sharing and collaboration. • Encouraging the use of green infrastructure in urban design, such as green roofs, permeable pavements, and rain gardens, to help manage stormwater and reduce the urban heat island effect.
Harnessing the potential of open spaces to absorb and mitigate the impacts of climate change.	• Conducting a green infrastructure assessment to identify natural areas that can provide climate benefits such as carbon sequestration, stormwater management, and temperature regulation. • Developing a plan to integrate green infrastructure practices into new development and redevelopment projects, such as using permeable pavement, green roofs, and bioswales to

	manage stormwater runoff and reduce the urban heat island effect. • Planting trees and other vegetation in strategic locations provides shade, reduces air pollution, and improves overall air quality. • Establishing community gardens and urban agriculture programmes to increase access to fresh, healthy food and provide opportunities for residents to engage with natural areas and learn about sustainable practices. • Protecting and enhancing existing natural areas by preserving wetlands, riparian corridors, and other important habitats. • Creating and maintaining trails, bike paths, and other recreational infrastructure to encourage outdoor activity and promote physical and mental health.

4.4.4. Programme 3: Public Awareness Campaigns – Involve Communities In, Raise Awareness Of and Conduct Training on Climate Change

A public awareness campaign can be an effective tool for promoting climate change education, awareness, and action. Through education, individuals and communities can better understand the impact of climate change which will better assist them in taking measures that will promote their health and safety in the face of climate change. Public awareness campaigns can involve a range of activities, such as community events, public meetings, online and social media outreach, educational programmes and training, and printed materials. In order to implement a successful public awareness campaign, it is important to engage and involve the community. This could involve working with local organisations, schools, and community groups to ensure that the campaign is relevant and accessible. Training programmes and educational resources could be provided to help community members understand the causes and impacts of climate change and how to take action to reduce their own carbon footprint. It is important to make the campaign inclusive and accessible to all members of the community, including those who may be at a disadvantage.

Table 11: Programme 3 - Public awareness campaigns - involve communities in, raise awareness of and conduct training on climate change.

Programme 3: Public Awareness Campaigns - Involve Communities In, Raise Awareness Of and Conduct Training On Climate Change.	
ACTIONS	KEY ACTIVITIES
Comprehensive community engagement and public awareness initiative on climate change.	• Organising community events to enhance climate change awareness and its impacts. • Designing and distributing educational materials on climate change, both physically (like pamphlets and brochures) and digitally, using an online and social media presence to boost outreach and engagement.

This initiative aims to raise awareness, educate, and involve the community in addressing climate change. By engaging local organisations, schools, and community groups, the programme will ensure that the campaign is inclusive, accessible, and relevant to all members of the community.	• Implementing training and education programmes for community members through workshops and seminars. • Holding public meetings and forums to discuss climate change, gather community input, and feedback. • Partnering with local organisations and community groups to ensure the campaign's relevance and accessibility. • Developing a comprehensive public awareness campaign tailored to the diverse needs of the municipality, including vulnerable populations. • Conducting community engagement and outreach activities to raise awareness of climate change impacts and teach communities about mitigation and adaptation strategies. • Providing capacity-building sessions for local leaders and stakeholders on topics such as sustainable energy practices and eco-friendly behaviours. • Utilising various media channels, including social media, print, radio, and television, to disseminate key messages and updates on climate change initiatives. • Fostering collaborations with educational institutions and other stakeholders to expand the campaign's reach. • Establishing feedback mechanisms to assess campaign effectiveness and identify improvement areas. • Using community feedback to refine the campaign and ensure it responds to their needs and concerns. • Building a network of community ambassadors to keep the climate change conversation alive and promote sustainable practices. • Developing partnerships with industry, research institutions, and government agencies to support the development and implementation of CCS technology.

4.5. Climate Change Goal 2: Ensure Water Security Under a Changing Climate.

Table 12: Climate change goal 2, outcome, linkage to district's strategic objectives.

Goal:	Enact strategies ensure universal water availability while minimizing water demand, usage, pollution, and waste in response to the climate change impacts on the water cycle.
Outcome:	Realization of a secure and efficient water supply for everyone, marked by a decrease in demand, waste, and pollution.
Linkage to CDM's Strategic Objectives	SO1: To provide sustainable basic services and infrastructure development as it involves ensuring water availability and infrastructure for the district's population. SO2: To improve spatial development and environmental management since efficient water resource management is an integral part of environmental sustainability. SO3: To enhance financial viability and management as it will require smart investments and effective financial management to implement the necessary water security measures. SO5: To increase the capacity of the district to deliver its mandate as achieving this goal will necessitate strengthening institutional capacity around water management in the face of climate change.

4.5.1. Rationale/Context:

The strategic priority to "*ensure water security under a changing climate*" is a cornerstone of the climate adaptation report. This decision is prompted by the intersection of climate change, infrastructural complications, groundwater dependency, and legal requirements within the Capricorn District, along with the unique landscape and resource profile of the area.

Capricorn District Municipality (CDM) lies within two significant water management areas (WMA), namely the Limpopo WMA and the Olifants WMA. These areas encompass numerous Fresh Water Priority Areas (FEPA), which contribute substantially to the surface and groundwater resources in the district. The northern and central half of the CDM, including the central section of the Limpopo WMA, hosts several of these FEPA catchments, providing essential water sources for the community. However, CDM's limited water resources present a significant challenge, particularly as climate change threatens to reduce groundwater recharge potential and disrupt surface water availability.

- The first significant issue is the ageing and inadequate infrastructure. The water and sanitation framework, particularly within Blouberg LM, Lepelle-Nkumpi LM, and Molemole LM, is in a deteriorating state. This aged infrastructure leads to substantial water losses, necessitating significant replacements and upgrades. With a changing climate, these challenges may intensify, imposing further stress on the already strained infrastructure.
- Secondly, there is a significant concern over water access and equity. The provision of safe drinking water, a fundamental human right enshrined in Section 27 of the South African

Constitution, is vital for public health and socio-economic stability. However, the CDM, in its capacity as the Water Services Authority (WSA), faces a considerable discrepancy in water access throughout the district. A staggering 24% of households lack access to piped (tap) water, and 27.7% depend on alternative sources such as boreholes.

- Another key issue is the over-reliance on groundwater. Many settlements within the CDM, especially in Blouberg and Molemole, depend exclusively on groundwater sources. This reliance may currently be sustainable considering present recharge rates. However, the anticipated reduction in groundwater recharge potential by 2050, primarily due to climate change, could cause significant water scarcity in these areas. The threat is further amplified by the region's projected population growth.
- Finally, there is a matter of regulatory compliance. The CDM, as a WSA, must ensure the provision of clean and safe drinking water while meeting the standards outlined by the South African National Standards (SANS 241). However, in the face of climate change, achieving these standards may become progressively challenging, especially considering the current state of the district's water infrastructure and supply systems.

Given these complexities, ensuring water security under a changing climate becomes an undeniable strategic priority. Climate adaptation measures need to address these interconnected issues, such as infrastructure updating and maintenance, improved water access and equity, sustainable groundwater extraction management, and strategy development to mitigate the impacts of climate change. This initiative demands a robust long-term plan, considerable investment, and an unwavering focus on sustainability and resilience. Several programmes have been identified through which it will aim to achieve the goal and targets of this outcome:

4.5.2. Programme 4: Adopt an Integrated Approach to Water Augmentation, Water Use and Water Management.

The programme titled "*adopt an integrated approach to water augmentation, water use and water management*" seeks to address the water resources' limitations in the Capricorn District Municipality (CDM). As per the Capricorn District Bioregional Plan (2020), CDM is located within two of the water management areas (WMA), the Limpopo WMA and the Olifants WMA, which comprise numerous Fresh Water Priority Areas (FEPA). However, the district has a limited supply of surface and groundwater resources. The programme aims to create a comprehensive strategy to manage these resources efficiently, improve water use, and ensure long-term sustainability amid climate change.

- The first component of the programme is the Water Sensitive Urban Design (WSUD). This strategy integrates the water cycle into urban landscapes to increase water availability and improve its quality. Considering the significant number of FEPA catchments in the district, including River FEPAs, Phase 2 FEPAs, Fish Support Areas, and Upstream Management Areas, WSUD principles can effectively leverage these resources to augment water supply.

- Addressing human resources constraints for effective water management is another critical step. Given the region's complex water management scenario, encompassing numerous FEPA wetlands and wetland clusters, an adequate and skilled workforce is crucial for efficient management. This action involves identifying workforce gaps, training existing staff, and recruiting additional personnel as necessary.
- Reviewing the Bulk Water Master Plan is also integral to the programme. Regularly updating this strategic document is critical, especially given the dynamic nature of water resources within the district, the changing climate, and shifts in water demand projections.
- Finally, the development of a Water Safety Plan (WSP) is necessary to ensure safe drinking water from the source to the tap. In a region with both the Limpopo WMA and the Olifants WMA within its boundaries, potential risks to water quality are varied and significant. Implementing a comprehensive WSP can safeguard public health, meet regulatory requirements, and boost consumer confidence in the water supply.

In summary, the proposed programme aspires to cultivate a holistic approach to water management, considering all aspects of the water cycle, from supply to disposal. It focuses on enhancing the resilience and sustainability of the district's water resources amidst changing climate conditions, a growing population, and an ageing infrastructure.

Table 13: Programme 4 - Integrated approach to water augmentation, use, and management.

Programme 4: Integrated Approach to Water Augmentation, Use, and Management.	
ACTIONS	KEY ACTIVITIES
Water-sensitive urban design (WSUD).	• Implementing green infrastructure. To maintain water services efficiently, the municipality can introduce green infrastructure to capture, store, and treat stormwater while improving air quality and biodiversity within the community. • Promoting water reuse. Identify and implement opportunities for using treated wastewater for non-potable purposes such as irrigation, industrial processes, and toilet flushing. This will ensure the sustainable use of water resources. • Encouraging water-efficient design: Ensure equitable water services, buildings and infrastructure could be designed to minimise water use through the use of low-flow fixtures, water-efficient landscaping, and water recycling systems. • Managing urban runoff: Assess the feasibility of capturing and re-use of stormwater. • Educating and engaging stakeholders: Promote awareness of the benefits of WSUD and to encourage participation in the design and implementation of WSUD projects. This will ensure that the community is well-informed and actively involved in sustainable water usage initiatives.
Addressing human resources constraints for effective water management.	• Advocate for and secure funding for a dedicated water resources manager position: Highlighting the crucial role of a water resources manager in addressing drought and other

	water-related challenges in the municipality. This would help to ensure the efficient provision of water services. • Recruit and train a qualified water resources manager: By implementing a transparent recruitment process to select a skilled and experienced water resources manager, the municipality can ensure they have the necessary skills and knowledge to effectively manage water resources. • Strengthen collaboration and communication between the water resources manager and other relevant water management departments: Establishing a cross-functional working group to facilitate communication, collaboration, and information sharing between the water resources manager and other departments responsible for water management.
Review bulk water master plan.	• Understanding the current water landscape: The initial stage will involve mapping out the current water resources and needs, which includes municipal, industrial, and agricultural sectors. It is crucial to integrate climate change projections into this analysis to anticipate future shifts in water supply and demand. • Exploring New water sources: The updated plan should investigate potential new sources of water, such as surface water, groundwater, and seawater desalination. This evaluation will take into account factors like cost, feasibility, and environmental impact for each potential source. • Evaluating infrastructure requirements: The plan should conduct an in-depth review of the existing water-related infrastructure, including water treatment facilities, pipelines, and storage units. The aim is to pinpoint areas that may need additional infrastructure to cater to future demands. • Setting goals and formulating strategies: The plan will clear water usage goals and devise strategies to curb water consumption and augment efficiency. These strategies may involve initiatives like water metering, leak detection, and public education drives. • Execution of the plan: The final stage will involve the roll-out of the plan. Regular monitoring and evaluation will be integral to ensure that the set targets are being met and necessary adjustments are made to the plan as needed. This stage may also necessitate funding for new infrastructure, fostering partnerships with relevant organisations, and ensuring stakeholder alignment with the plan's objectives.
Developing a water safety plan (WSP).	• Conducting a risk assessment: Assess the risks that can affect the quality and safety of the water supply, including natural hazards and man-made threats. • Determining control measures: Identify control measures that can be implemented to reduce risks and enhance the safety of

	the water supply, such as disinfection, filtration, and monitoring. • Developing an emergency response plan: Develop a plan for responding to incidents that could affect the water supply, such as natural disasters or system failures. • Implementing monitoring and reporting: Establish a monitoring programme to ensure that the water supply remains safe and of good quality. The results of monitoring should be reported to relevant authorities and stakeholders. • Training and educating staff: Ensure that all staff involved in the water supply system are trained on WSP development and implementation, including risk assessment, control measures, and emergency response. • Reviewing and updating the plan regularly: The WSP should be reviewed and updated periodically to ensure that it remains relevant and effective in addressing emerging risks and challenges.

4.5.3. Programme 5: Water Conservation and Demand Management

The programme, "water conservation and demand management", as suggested by its title, aims to promote efficient water use and decrease wastage to ensure long-term water security in the Capricorn District. This approach is crucial given the ageing infrastructure, discrepancies in water access, over-reliance on groundwater, effects of climate change, and regulatory compliance demands in the district.

- Implementing monitoring mechanisms and protecting water sources by reducing pollution: Effective water management necessitates continuous and accurate monitoring of water sources. This involves not only keeping track of water levels and usage but also monitoring water quality. Monitoring can help detect any pollution that could compromise water safety and lead to violations of South African National Standards (SANS 241). Further, mechanisms need to be put in place to prevent pollution, including policies and regulations aimed at industries and other potential sources of contamination.
- Implementing water conservation measures: This involves developing and promoting practices and technologies to reduce water use and waste. This could include public awareness campaigns to encourage water-saving behaviours, leak detection and repair programmes to reduce losses from the ageing water infrastructure, and the promotion of water-efficient appliances and fixtures in both residential and commercial settings.
- Alien invasive species clearing initiatives in catchment areas: Alien invasive species often consume more water than native species and can disrupt local ecosystems. Their presence can lead to significant water losses in catchment areas, reducing the amount of water available for human use. Initiatives to clear these species can improve water availability and also benefit local biodiversity.
- Enforce 'green' approaches in residential areas and developments: 'Green' approaches incorporate environmentally-friendly practices into everyday living and urban planning. In

terms of water, this could involve rainwater harvesting, greywater recycling, and sustainable landscaping practices that reduce water demand. For new developments, this could mean ensuring that buildings are designed to be water-efficient and that water-sensitive urban design principles are followed.

In conclusion, *Programme 2: Water Conservation and Demand Management* calls for a holistic and concerted effort to manage water demand and promote sustainable practices to ensure water security in the Capricorn District. These efforts align with the district's strategic priority of ensuring water security under a changing climate and will require careful planning, enforcement, and a strong commitment to sustainability and resilience.

Table 14: Programme 5 - Protect and conserve water through monitoring mechanisms and water conservation through water conservation and water demand management (WCWDM).

Programme 5: Protect and Conserve Water Through Monitoring Mechanisms and Water Conservation through Water Conservation and Water Demand Management (WCWDM).	
ACTIONS	KEY ACTIVITIES
Implementing monitoring mechanisms and protecting water sources by reducing pollution.	• Water quality monitoring: Implement a regular testing schedule to monitor the health of water sources and identify potential pollution sources. This will support the mandate of providing and maintaining efficient and sustainable water services. • Buffer zone establishment: Create and manage buffer zones around water sources, such as rivers and wetlands, to protect them from pollution. The design of these zones should prevent runoff from agricultural and urban areas from entering the water sources, supporting the district government's role in coordinating and integrating water management efforts. • Sustainable agricultural practices promotion: Facilitate awareness campaigns, training, and capacity-building programmes to encourage farmers to use environmentally friendly fertilizers and pesticides. This contributes to the provincial government's mandate of developing and implementing plans and programmes for the sustainable use of water resources. • Effluent discharge regulation: Develop by-laws and regulations to control the discharge of industrial and domestic effluent municipal sewer system. Regular monitoring of industries will ensure compliance, supporting the mandate of ensuring activities do not negatively impact water resources. • Responsible waste disposal advocacy: Further provide facilities for the disposal of hazardous waste and improve public awareness campaigns on the importance of responsible waste disposal. This will help reduce the risk of water source pollution and aligns with the broader mandate of protecting water resources.

Implementing water conservation measures.	• Increase public awareness campaigns: Engagement with the public through campaigns, workshops, and educational programmes that promote water conservation practices. • Improve leak detection and repairs: enhance efforts to identify and repair leaks in water supply systems and infrastructure to prevent water loss. • Continue water metering and billing: Persist with the installation of water meters and implement billing systems that charge consumers based on the amount of water used, as a means to encourage water conservation. Water-efficient infrastructure: The municipality can install water-efficient fixtures and appliances, such as low-flow showerheads, faucets, and toilets and in municipal buildings. • Greywater recycling: Promote the use of greywater for irrigation and other non-potable uses to reduce demand on the municipal water supply. • Water restrictions: Implement water restrictions during times of drought or water scarcity to limit water use and prevent wastage. • Reclaimed water systems: Install and operate reclaimed water systems that treat wastewater for non-potable uses like irrigation, industrial processes, or firefighting. • Rainwater harvesting: Encourage the installation of rainwater harvesting systems in households and municipal buildings to capture and store rainwater for non-potable uses like irrigation, cleaning, or flushing toilets.
Alien invasive species clearing initiatives in catchment areas.	• Stakeholder collaboration and equitable contribution: Recognising that catchment areas fall outside CDM boundaries and that various water users utilise the it is essential to collaborate with all stakeholders to determine an equitable contribution from all parties to manage catchments. • Identifying and mapping invasive species: A comprehensive survey of invasive species within the catchment areas can be conducted in partnership with relevant stakeholders to identify and map the areas affected by invasive species. • Removal and control of invasive species: This involves the collaborative removal and control of invasive species using various techniques such as mechanical, chemical, and biological control methods, with contributions from all stakeholders. • Rehabilitation of cleared areas: After the removal of invasive species, the cleared areas need to be rehabilitated. This can be done through the restoration of indigenous vegetation and the implementation of erosion control measures, with support from all involved stakeholders. • Education and awareness: Education and awareness campaigns can be implemented in coordination with stakeholders to increase the understanding of the negative impacts of invasive

	species on catchment areas, and to promote responsible behaviour in preventing the spread of invasive species. • Monitoring and evaluation: The effectiveness of invasive species control measures can be monitored and evaluated in partnership with stakeholders to ensure the long-term sustainability of the project, and to assess the contributions and impact of each stakeholder.
Enforce 'green' approaches in residential areas and developments.	• Developing and implementing guidelines and standards for sustainable residential and commercial development. • Enforcing compliance with building codes and regulations that promote sustainable water use practices, such as the installation of low-flow fixtures and rainwater harvesting systems. • Providing incentives for property owners to invest in green infrastructure and technologies that reduce water consumption and improve water efficiency. • Conducting public awareness campaigns to educate residents on the importance of water conservation and the benefits of green infrastructure. • Implementing water-efficient landscaping practices, such as xeriscaping, in public spaces and parks to reduce water use and promote sustainable development.

4.5.4. Programme 6: Assessing Alternative Water Sources

The programme "assessing alternative water sources" is a direct response to the complex challenges outlined in the climate adaptation report and is an integral part of the strategic priority to "*ensure water security under a changing climate*". The programme recognises that ensuring water security in the face of climate change and growing demand will require a diversification of water sources.

- Firstly, water resource management planning is a fundamental action that involves understanding the existing water resources, their usage, challenges, and potential for augmentation. This will entail a thorough review of surface and groundwater availability, projected demands, potential impacts of climate change, and infrastructure capacity. The plan will provide a comprehensive understanding of the current state of water resources in the district and will serve as a foundation for the rest of the activities in the programme.
- The second activity, investigating alternative water sources, acknowledges the risks of over-reliance on any single water source, particularly groundwater, as is currently the case in parts of the Capricorn District. In the face of changing climate and potential reduction in groundwater recharge potential, alternative water sources such as desalination, new groundwater sources, and wastewater reuse need to be investigated. Each of these options has its own set of advantages and challenges, and their feasibility will depend on a variety of factors including cost, environmental impacts, and technological requirements.

- Once potential alternative sources have been identified and assessed, the next step is investing in these alternative water sources. This involves not just financial investment, but also planning and building the necessary infrastructure and implementing the technology needed to extract, treat, and distribute these alternative sources. This might include constructing desalination plants, drilling new boreholes, or upgrading wastewater treatment facilities.
- Finally, an essential part of this programme is to develop and implement a Treated Effluent Reuse Strategy For Sustainable Water Management. Wastewater reuse involves treating wastewater to a standard where it can be safely used again, which can significantly contribute to water conservation efforts. The development and implementation of a strategy for reusing treated effluent will involve identifying potential uses, developing treatment and distribution systems, and ensuring compliance with health and safety standards.

In conclusion, the programme "*assessing alternative water sources*" is a proactive and forward-thinking response to the complex water security challenges in the Capricorn District. It recognises the need to diversify water sources, invest in alternative options, and promote sustainable practices such as wastewater reuse, and it plays a crucial role in the district's strategy to ensure water security under a changing climate.

Table 15: Programme 6: Assessing the feasibility and sustainability of alternative water sources for climate change adaptation.

Programme 6: Assessing the Feasibility and Sustainability of Alternative Water Sources for Climate Change Adaptation.	
ACTIONS	POSSIBLE KEY ACTIVITIES
Water resource management planning.	• Conducting a water resource assessment: A comprehensive assessment of the existing water resources should be conducted to determine the available water sources, water quality, and quantity. • Identifying water demands: Understanding the current and future water demands of the municipality, including domestic, industrial, and agricultural water use, is crucial for developing a water resource management plan. • Developing a drought management plan: Droughts can have a significant impact on water resources, so developing a drought management plan can help to prepare for and mitigate the impacts of drought. • Developing water conservation strategies: Water conservation strategies can help to reduce water demand and optimize the use of available water resources. • Engaging stakeholders: Stakeholder engagement is critical for the successful development and implementation of a water resource management plan. It is important to engage with all relevant stakeholders, including the community, industries, and

	agricultural sectors, to ensure that their needs are considered in the plan
Investigating alternative water sources. *(This activity involves identifying potential alternative water sources, such as desalination, groundwater, and wastewater reuse).*	• Feasibility studies: Conduct feasibility studies to identify and assess the viability of various alternative water sources, such as rainwater harvesting, groundwater extraction, and stormwater capture. • Hydrological assessments: Undertaking hydrological assessments to determine the water availability and potential yield of alternative water sources, such as aquifers and rivers. • Cost-benefit analysis: Conducting cost-benefit analysis of alternative water sources to determine the economic and environmental costs and benefits of investing in them. • Water quality assessments: Conducting water quality assessments to determine the suitability of alternative water sources for various uses, such as drinking water, irrigation, and industrial processes. • Stakeholder engagement: Engaging with stakeholders, including communities, businesses, and other water users, to identify their water needs and preferences and to get their input on the development of alternative water sources. • Regulatory compliance: Ensuring that any proposed alternative water sources comply with relevant regulations and standards, such as those related to water quality, health and safety, and environmental impact. • Implementation planning: Develop implementation plans for any viable alternative water sources, including detailed designs, procurement of equipment, and construction and operational plans.
Investing in alternative water sources. *(Once alternative water sources have been identified, the programme will invest in the infrastructure and technology needed to extract, treat, and distribute these water sources. This may include building desalination plants, drilling new boreholes, and upgrading*	• Researching and evaluating potential alternative water sources: This may involve identifying and assessing the feasibility of various water sources, such as desalination, wastewater reuse, rainwater harvesting, or groundwater. • Developing infrastructure for alternative water sources: This may involve the construction of treatment plants and pipelines necessary for the collection, treatment, and distribution of alternative water sources. • Developing partnerships and collaboration: This may involve partnering with other stakeholders, such as neighbouring municipalities, government agencies, and private sector entities, to develop and implement alternative water source projects. • Identifying and securing funding: This may involve identifying and securing funding from various sources, such as grants, loans, or public-private partnerships. • Educating and raising public awareness: This may involve educating and raising public awareness about the importance of alternative water sources, how they work, and their benefits, to

wastewater treatment facilities).	encourage community support and participation in the development and implementation of these projects.
Develop and implement a treated effluent reuse strategy for sustainable water management.	• Assessing the feasibility and potential benefits of a treated effluent reuse strategy for the CDM. • Identifying and prioritising potential sites for treated effluent reuse, including public spaces, industrial sites, and agriculture. • Developing a comprehensive treated effluent reuse plan, including infrastructure and system requirements, stakeholder engagement, and potential risks and mitigation strategies. • Conducting a cost-benefit analysis of the treated effluent reuse plan and identifying potential funding sources. • Building and implementing the treated effluent reuse infrastructure, including treatment facilities and distribution systems. • Conducting monitoring and evaluation activities to assess the effectiveness of the treated effluent reuse strategy and identify opportunities for improvement.

4.5.5.Programme 7: Groundwater Management

The Programme: "*groundwater management*" is designed to address the pressing issues surrounding water security under a changing climate in the CDM. The goal of this programme is to ensure a sustainable, efficient, and equitable management of the groundwater resources, which are vital for the district's population, especially those living in areas that are highly dependent on groundwater like Blouberg and Molemole.

- Conducting groundwater resource assessments: Given the potential reduction in groundwater recharge due to climate change and increasing demand, it's important to accurately assess the availability and quality of groundwater. These assessments will provide a clear understanding of the current state of groundwater resources, serving as the basis for all subsequent management actions.
- Establishing sustainable groundwater use policies and guidelines: Based on the assessment findings, the district can formulate and implement policies and guidelines to promote efficient and effective use of groundwater. These regulations may include, for instance, restrictions on groundwater extraction during certain periods or for certain purposes to avoid overuse and depletion.
- Implementing groundwater monitoring programmes: Constant monitoring of groundwater levels and quality is essential to ensure the sustainability of these resources. Monitoring helps in early detection of potential problems like falling water levels, contamination, or over-extraction, allowing for timely interventions.
- Promoting groundwater conservation and efficiency: Encouraging the adoption of water-saving technologies and practices can significantly reduce the pressure on groundwater resources. This could involve promoting the use of water-efficient appliances and fixtures,

advocating for water-wise behaviours, or implementing agricultural practices that conserve water.

- Developing groundwater recharge and artificial recharge strategies: Enhancing the natural replenishment of aquifers or creating artificial means to recharge groundwater resources can help offset the predicted decrease in recharge rates due to climate change. Techniques might include the construction of recharge basins, or the redirection of runoff or treated wastewater into aquifers.
- Implementing land-use planning and zoning regulations: Protecting groundwater resources from pollution and overuse can also involve managing land use. Regulations can be established to prevent activities that might contaminate or excessively draw on groundwater in certain areas, like industrial operations or intensive agriculture.
- Developing an Information Management System for Groundwater Data: Accurate, accessible data on groundwater is crucial for informed decision-making. A robust information management system can provide updates to water users, decision-makers, and the public, supporting transparency and collaborative efforts towards groundwater sustainability.

The combination of these actions under the "*groundwater management*" programme presents a comprehensive approach to ensure water security under a changing climate. By addressing issues like infrastructural complications, groundwater dependency, and legal requirements, this programme supports the broader strategic priority of ensuring water security in the CDM.

Table 16: Programme 7 - Implementing sustainable groundwater use and development strategy.

Programme 7: Implementing Sustainable Groundwater Use and Development Strategy.	
ACTIONS	POSSIBLE KEY ACTIVITIES
Conducting groundwater resource assessments to establish the availability and quality of groundwater in the CDM area.	• Desk-based research: Conduct a review of existing literature, data, and reports to gain an understanding of the historical and current state of groundwater resources in the area, as well as any previous studies that have been conducted. • Field investigations: Collect and analyse data from monitoring wells, boreholes, and other sources to determine the quantity and quality of groundwater in the area. This may involve drilling new boreholes or installing monitoring wells to collect data on groundwater levels, water quality, and other relevant parameters. • Hydrogeological modelling: Develop and use computer models to simulate the behaviour of groundwater resources in the area, including the movement of water through the aquifers and the interaction between surface water and groundwater. • Stakeholder engagement: Engage with local communities, water users, and other stakeholders to understand their needs and concerns related to groundwater resources in the area. • Developing a groundwater management plan: Use the data collected and the models developed to develop a plan for the

	sustainable management and use of groundwater resources in the CDM area. This may include measures such as setting sustainable yield limits, establishing groundwater protection zones, and implementing monitoring programmes to track the status of the resource over time.
Establishing sustainable groundwater use policies and guidelines to promote efficient and effective groundwater management.	• Conduct a review of existing policies and guidelines related to groundwater use to identify gaps and areas for improvement. • Consider local conditions and needs, developing new policies and guidelines that promote sustainable and efficient groundwater management. • Develop a stakeholder engagement process to gather input from water users, industry representatives, and other stakeholders in developing sustainable groundwater use policies and guidelines. • Establish mechanisms for ongoing review and revision of policies and guidelines to ensure they remain relevant and effective in promoting sustainable groundwater use.
Implementing groundwater monitoring programmes to monitor water levels, water quality, and potential pollution sources, enabling early detection of potential problems and timely intervention.	• Install and maintain a network of groundwater monitoring wells and equipment to collect data on groundwater levels, water quality, and potential pollution sources. • Conduct regular field visits to measure and record groundwater levels and collect water quality samples for laboratory analysis. • Analyse data collected from monitoring programmes to detect changes in groundwater levels, identify trends in water quality, and assess the impact of potential pollution sources. • Develop and implement early warning systems to alert water users and decision-makers to potential problems, enabling timely intervention. • to promote awareness and informed decision-making, providing regular reports on groundwater conditions and trends to water users, decision-makers, and the public. • Collaborate with other agencies and stakeholders to share data and coordinate monitoring efforts to ensure comprehensive coverage of the groundwater resources.
Promoting groundwater conservation and efficiency by encouraging the adoption of water-saving technologies and practices in all sectors.	• Encourage water conservation pricing mechanisms, such as tiered water rates, incentivise water users to reduce their water use, water-efficient irrigation systems, drought-resistant crops, and low-flow fixtures. • Develop and implementing water conservation standards for new and existing municipal buildings and properties. • Encourage the adoption of water reuse and recycling technologies to reduce the demand for fresh groundwater resources. • Promote the use of rainwater harvesting systems in households, buildings, and public spaces to reduce the demand for groundwater resources.

Developing groundwater recharge and artificial recharge strategies to enhance aquifer recharge rates and improve groundwater storage capacity.	• Conduct studies to identify suitable sites for groundwater recharge, including areas with high permeability, favourable soil conditions, and sufficient rainfall. • Identify potential sources of water for recharge, such as stormwater runoff, treated wastewater, and excess surface water. • Develop and implement recharge infrastructure, such as recharge basins, injection wells, and spreading grounds. • Monitoring and evaluating the effectiveness of recharge strategies, including assessing changes in water levels, water quality, and aquifer storage capacity. • Developing outreach and education programmes to promote groundwater recharge benefits and encourage participation from stakeholders, such as farmers, local governments, and water users.
Implementing land-use planning and zoning regulations to protect groundwater resources from pollution and overuse.	• Conduct a groundwater vulnerability assessment to identify areas where groundwater resources are most at risk from pollution and overuse. • Develop and enforce land-use planning and zoning regulations that limit activities that may threaten groundwater quality, such as restricting the construction of hazardous waste facilities near groundwater sources. • Establish setback requirements that limit the distance between certain land uses and groundwater sources. • Develop best management practices for land uses that have the potential to impact groundwater quality, such as agriculture, mining, and construction. • Encourage the adoption of sustainable development practices that reduce the demand for groundwater, such as green roofs, rainwater harvesting, and greywater recycling. • Establish monitoring programmes to track changes in groundwater quality and quantity over time, and to detect and respond to potential threats to groundwater resources. • Providing education and outreach to stakeholders, including landowners, developers, and the public, about the importance of protecting groundwater resources and the regulations and guidelines in place to do so.
Develop an information management system for groundwater data to provide accurate and timely information to water users, decision-makers, and the public.	• Conduct a comprehensive inventory of all groundwater monitoring wells in the CDM area and assess their condition and functionality. • Establish a standard methodology for groundwater data collection, analysis, and reporting to ensure consistency and accuracy of information. • Develop a database and web-based portal for storing and accessing groundwater data, including water levels, quality, and other relevant information.

	• Establish protocols for sharing groundwater data among relevant stakeholders, including water users, regulators, researchers, and the public. • Develop data visualisation tools and models to help decision-makers interpret and use groundwater data effectively. • Establish procedures for quality control and quality assurance to ensure the accuracy and reliability of groundwater data. • Provide training and technical assistance to water users, regulators, and other stakeholders on collecting, analysing, and using groundwater data effectively. • Conduct regular reviews and updates of the groundwater information management system to ensure that it remains current, relevant, and effective.

4.6. Climate Change Goal 3: To Reduce the Vulnerability and Exposure of Human and Natural Systems to Climate Change and Extreme Events.

Table 17: Climate change goal 3, outcome, linkage to district's strategic objectives.

Goal:	Mitigate the Vulnerability and Exposure of Human and Natural Systems to Climate Change and Extreme Events within Capricorn District Municipality.
Outcome:	Achievement of strengthened resilience of human and natural systems against the impacts of climate change and extreme events. This includes implementing measures for disaster risk reduction, adaptive capacity building, and protective mechanisms for natural systems.
Linkage to CDM's Strategic Objectives	SO1: By enhancing infrastructure resilience, this goal contributes to the provision of sustainable basic services and infrastructure development. SO2: By safeguarding natural systems, this goal aligns with improved spatial development and environmental management. SO4: By reducing vulnerability to climate change and extreme events, this goal can indirectly enhance conditions for economic growth, as disruptions due to extreme weather events would be minimized. SO5: By building adaptive capacity, this goal aligns with increasing the capacity of the district to deliver its mandate.

4.6.1. Rationale/Context

The goal "*climate change goal 3: to reduce the vulnerability and exposure of human and natural systems to climate change and extreme events*" is of strategic significance for the Capricorn District Municipality (CDM) for several reasons:

From the human system perspective, the Capricorn district is under pressure from various aspects such as urban sprawl, illegal mining activities, overutilization of groundwater sources, pollution from sewage treatment facilities, and inadequate waste management infrastructure.

These activities exacerbate the district's vulnerability to climate change. For instance, the dependence on groundwater sources can be problematic in the face of changing rainfall patterns and extended drought periods predicted due to climate change. Moreover, inadequate waste management and pollution can degrade the quality of available water resources, further straining the district's water security. Additionally, deforestation and energy efficiency concerns underline the need to promote sustainable practices and renewable energy options to decrease the district's carbon footprint and mitigate its contributions to climate change.

From the natural systems perspective, the Capricorn district hosts a wide range of ecosystems that are home to many threatened species of flora and fauna, making it a biodiversity hotspot. However, these ecosystems are under pressure from human activities such as agricultural expansion, human settlement expansion, and new mining developments. Moreover, the potential impacts of climate change, including changes in rainfall patterns and increases in extreme weather events, could further stress these ecosystems. Threats like deforestation, control of alien and invader plant species, illegal hunting, and poaching not only risk the district's biodiversity but also destabilize these ecosystems, decreasing their resilience to climate change.

Moreover, the lack of public awareness of environmental matters, limited funding towards waste and environmental functions, inadequate environmental management tools, and unenforced Municipal By-laws exacerbate the vulnerability of both human and natural systems.
Thus, focusing on reducing the vulnerability and exposure of human and natural systems to climate change and extreme events is a strategic goal for CDM. It necessitates an integrated and strategic response that involves not just mitigating the impacts of climate change, but also building resilience within these systems, strengthening environmental laws, raising public awareness, and fostering more sustainable practices at every level. This approach is essential for the district's long-term socio-economic stability, public health, and environmental conservation.

4.6.2. Programme 8: Conserve, Protect and Restore Natural Open Spaces, Ecosystems with Climate Change Adaptation Benefits

Programme: "*Conserve, protect and restore natural open spaces, ecosystems with climate change adaptation benefits*" is a strategic initiative designed to enhance the resilience of the Capricorn District Municipality (CDM) to climate change. It is grounded in the understanding that 8 thorough inventory and evaluation of the district's natural resources, including its diverse ecosystems like savanna, grasslands, indigenous forests, mountain escarpments, and wetlands. The aim is to identify key areas of ecological importance, assess their current state, and ensure their preservation and restoration. This is particularly important considering the pressures exerted on these ecosystems by agricultural expansion, human settlement expansion, and mining developments. By conserving and restoring these ecosystems, CDM can support

biodiversity, enhance ecosystem services, and improve the district's resilience to climate change.

- Harnessing the potential of open spaces to absorb and mitigate the impacts of climate change: Natural open spaces, such as grasslands and wetlands, can serve as effective carbon sinks, absorbing CO2 from the atmosphere and mitigating the effects of climate change. They can also help in flood control, water purification, and providing habitat for wildlife. Thus, protecting and leveraging these open spaces can offer significant climate adaptation benefits.
- Implementing programmes focused on mitigating the impact of climate change and severe weather, particularly in climate-risk zones: This involves developing and executing targeted programmes to lessen the impacts of climate change, especially in areas most vulnerable to climate risks. These could include areas experiencing uncontrolled urban sprawl, regions where illegal mining is prevalent, or zones with heavy dependence on groundwater sources. The programmes could range from initiatives for better waste management and enforcement of environmental regulations to efforts to control deforestation and manage alien plant species.

In summary, the programme is a comprehensive effort to protect the CDM's rich natural heritage and use it as a means to adapt to climate change. It's not just about conservation for conservation's sake, but recognizing the essential role that ecosystems play in climate regulation, and integrating this understanding into the district's overall climate adaptation strategy.

Table 18: Programme 8: Conserve, protect and restore natural open spaces, ecosystems and natural resources.

Programme 8: Conserve, Protect and Restore Natural Open Spaces, Ecosystems and Natural Resources.	
ACTIONS	KEY ACTIVITIES
Assessing natural resources and ensuring that natural open spaces, ecosystems, and resources are conserved, protected and restored.	• Conduct a comprehensive inventory of natural resources, including land, water, and biological resources, to identify areas of high conservation value and areas of concern. • Assess the current state of natural open spaces, ecosystems, and resources to determine their condition and any threats or vulnerabilities they may face due to climate change. • Develop conservation plans and management strategies for high conservation value areas, ensuring that they are integrated into municipal spatial plans and protected through legislation, policy and land use management. • Implement measures to restore degraded natural open spaces and ecosystems, such as wetlands and riparian areas, to improve their function and resilience in the face of climate change.

	• Establish protected areas and ensure that they are managed effectively to ensure the conservation of natural resources and ecosystems.
Harnessing the potential of open spaces to absorb and mitigate the impacts of climate change.	• Conducting a green infrastructure assessment to identify natural areas that can provide climate benefits such as carbon sequestration, stormwater management, and temperature regulation. • Developing a plan to integrate green infrastructure practices into new development and redevelopment projects, such as using permeable pavement, green roofs, and bioswales to manage stormwater runoff and reduce the urban heat island effect. • Planting trees and other vegetation in strategic locations provides shade, reduces air pollution, and improves overall air quality. • Establishing community gardens and urban agriculture programmes to increase access to fresh, healthy food and provide opportunities for residents to engage with natural areas and learn about sustainable practices. • Protecting and enhancing existing natural areas by preserving wetlands, riparian corridors, and other important habitats. • Creating and maintaining trails, bike paths, and other recreational infrastructure to encourage outdoor activity and promote physical and mental health.
Implementing programmes focused on mitigating the impact of climate change and severe weather, particularly in climate-risk zones.	• Conducting vulnerability assessments to identify areas and communities most at risk from the impacts of climate change and severe weather events. • Developing and implementing early warning systems and emergency response plans to enable timely evacuation and disaster relief efforts. • Promoting nature-based solutions, such as restoration of wetlands, and green infrastructure, to help mitigate the impacts of climate change and severe weather events. • Encouraging the adoption of sustainable land use practices, such as low-impact development, agroforestry, and sustainable agriculture, to help build resilience in the face of climate change. • Providing education and awareness campaigns to inform residents and businesses about the risks of climate change and the actions they can take to mitigate their impacts. • Encouraging community participation in climate adaptation and resilience planning efforts, through stakeholder engagement and collaboration with local organisations and community groups. • Establishing partnerships with other municipalities, government agencies, and non-governmental organisations to leverage resources, share best practices, and coordinate efforts in addressing the impacts of climate change and severe weather.

4.6.3. Programme 9: Enhanced Natural Resource Management

The "*enhanced natural resource management*" initiative aims to reinforce the sustainable use and conservation of Capricorn District Municipality's (CDM's) natural resources, emphasizing water quality, soil health, biodiversity, and stakeholder cooperation.

- Ensuring the quality of water resources: Water resources are essential for sustaining ecosystems, human health, and socio-economic development in the Capricorn District. Given the potential impacts of climate change on rainfall patterns, threats from pollution, and overutilization of groundwater sources, it's critical to monitor and manage the quality of water resources in the area. Actions may include regular water quality testing, improving wastewater treatment facilities, and promoting water conservation practices.
- Monitoring and preventing soil erosion: Healthy soil ecosystems are vital for maintaining biodiversity, sustaining agricultural productivity, and preserving water quality. Uncontrolled urban sprawl, deforestation, and illegal mining activities contribute to soil erosion in the district. Strategies to combat this might involve land use planning, reforestation efforts, and enforcing regulations to limit damaging activities.
- Providing training on biodiversity and natural resource management regulations and guidelines: With limited public awareness on environmental matters and inadequate environmental management tools, there is a clear need for improved understanding and enforcement of biodiversity and natural resource management regulations. Training municipal staff and stakeholders can build their capacity to understand and apply these regulations, thus ensuring more effective compliance and resource management.
- Establishing a District Environmental Management Forum (DEMF): Collaboration and coordination across various sectors and organizations are key to successful natural resource management. A DEMF could serve as a platform for these entities to share information, align their efforts, and jointly address the district's environmental challenges. It can facilitate joint initiatives such as control of alien and invader plant species, fire management, and exploration of energy efficiency and alternative energy sources.

In sum, the "*enhanced natural resource management*" initiative aims to safeguard the CDM's vital natural resources, both for their intrinsic ecological value and for their role in supporting human health and economic development in the face of climate change. This requires a multi-pronged approach that combines direct conservation measures with capacity building, regulation, and collaboration.

Table 19: Programme 9: Enhanced natural resource management and use of ecosystem services.

Programme 9: Enhanced Natural Resource Management and Use of Ecosystem Services	
ACTIONS	ACTIVITIES
Ensuring the quality of water resources is critical to the sustainable development of CDM, as they play a vital role in maintaining the health of ecosystems, human health, and socio-economic development.	• Conducting regular water quality monitoring to track the levels of various pollutants, including pathogens, nutrients, and chemicals, in water bodies. • Developing and implementing pollution prevention measures to reduce the number of pollutants entering water sources, such as through agricultural and industrial runoff or sewage discharge. • Encouraging the use of environmentally-friendly practices in households, businesses, and industries to reduce the discharge of pollutants into water resources. • Developing and implementing water treatment technologies to remove pollutants from wastewater before discharge or reuse. • Creating public awareness campaigns to educate the public about the importance of protecting water resources and reducing their impact on the environment. • Participating in the development and implementation of regulations and policies to manage and regulate the use of water resources, particularly in areas where water scarcity is a concern. • Collaborating with neighbouring municipalities and stakeholders to manage shared water resources and prevent transboundary pollution.
Monitoring and preventing soil erosion is crucial to ensure the long-term health and productivity of natural ecosystems, as well as to maintain the quality of water resources. (*Preventing soil erosion requires a multifaceted approach that involves monitoring, planning, and implementing strategies that protect natural resources).*	• Conducting soil erosion risk assessments on municipal land to identify areas that are most vulnerable to erosion and prioritise action. • Developing and implementing erosion control plans to minimise soil erosion, such as the use of vegetation cover. • Promoting the use of sustainable land use practices that preserve natural vegetation and minimise soil disturbance. • Monitoring soil erosion levels through regular assessments and surveys, and implementing remedial measures where necessary. • Educating the public about the importance of preventing soil erosion and promoting sustainable land use practices through outreach and education campaigns.
Provide training to municipal staff and stakeholders on	• Developing a training programme that covers key biodiversity and natural resource management regulations and guidelines, as well as the penalties for non-compliance.

biodiversity and natural resource management regulations and guidelines. *(Providing training to municipal staff and stakeholders on biodiversity and natural resource management regulations and guidelines is an important aspect of ensuring compliance with these regulations. The training can help to build capacity and knowledge of these regulations, ensuring that those involved in natural resource management have the skills and understanding needed to comply with the regulations and guidelines effectively).*	• Identifying the staff and stakeholders that require training based on their roles and responsibilities in natural resource management. • Delivering the training through a variety of methods, including workshops, seminars, and online courses. • Evaluating the effectiveness of the training programme through feedback from participants and monitoring compliance with regulations after the training has been delivered. • Updating the training programme regularly to reflect changes to regulations and guidelines and new developments in natural resource management practices. • Providing ongoing support and guidance to staff and stakeholders to ensure they have the necessary resources to comply with regulations and guidelines
Establish a District Environmental Management Forum (DEMF) to enhance collaboration and coordination between Sectoral Departments, Conversation Organisation and agencies related to natural resource management.	• Identifying key stakeholders to participate in the forum, such as municipal departments, conservation organisations, and other relevant agencies. • Developing a forum structure, including goals, objectives, and a work plan. • Conducting regular meetings to discuss progress, challenges, and opportunities related to natural resource management. • Coordinating joint efforts on natural resource management, such as collaborative projects or initiatives. • Identifying and leveraging resources to support the goals and objectives of the Forum. • Tracking progress and assessing the impact of the forum on natural resource management. • Updating the forum structure and work plan as needed to ensure continued effectiveness and relevance. • Attach Key Performance Indicators (KPIs) for various sectoral departments to the attendance of the Forum.

4.6.4. Programme 10: Integration of Ecological Support Areas and Ecosystem Services into SDFs

The programme *"integration of ecological support areas and ecosystem services into spatial development frameworks (SDFs)"* aims to explicitly incorporate the value of ecosystems and biodiversity into the planning and management of the CDM's physical space.

- Ensuring critical biodiversity and ecological support areas are integrated into municipal spatial plans at all scales: The Capricorn District is home to diverse and threatened ecosystems and these areas of high ecological value need protection. Integrating them into spatial plans ensures that as the district develops, these areas are not infringed upon or degraded. It includes proper land-use planning, limiting expansions that threaten biodiversity, and zoning protections for these areas.
- Identifying and mapping natural open spaces, ecosystems, and natural resources, and integrating inventories in the SDF and the open space framework: A comprehensive understanding of the location and extent of the district's natural resources is key for their protection. This includes mapping the savanna, grasslands, forests, and wetlands, along with important species habitats like the Cape Vulture breeding colonies. Incorporating this data into the SDF and the open space framework assists in creating informed decisions about land use and development.
- Identifying undeveloped open space with potential for green infrastructure: Green infrastructure includes any natural or semi-natural systems that provide utility services, like water purification, flood mitigation, and carbon sequestration. Identifying areas that can serve these purposes, such as wetlands for water filtration or forests for carbon sequestration, can help the district leverage its natural resources for both ecological and human benefits.
- Assessing the value of open spaces and ecosystem services: Beyond their intrinsic value, ecosystems provide a multitude of services, from food and water to climate regulation and recreational spaces. Assessing the value of these services can help justify and guide conservation efforts. It also raises awareness of the importance of these resources, counteracting the current lack of public awareness on environmental matters.

Through these actions, the CDM can aim to conserve its ecological richness, ensure the sustainable use of its natural resources, and enhance the resilience of its ecosystems and communities in the face of climate change and other threats. These efforts will contribute to achieving *climate change goal 3: to reduce the vulnerability and exposure of human and natural systems to climate change and extreme events.*

Table 20: Programme 10 - Integrate critical biodiversity areas and ecological support areas into the spatial framework.

Programme 10: Integrate Critical Biodiversity Areas and Ecological Support Areas into the Spatial Framework.	
ACTIONS	KEY ACTIVITIES
Ensuring critical biodiversity and ecological support areas are integrated into municipal spatial plans at all scales. *(This involves identifying areas of high ecological value and ensuring that they are given due consideration in the municipality's spatial planning activities).*	• Conduct a comprehensive analysis of existing municipal spatial plans and policies to determine where critical biodiversity and ecological support areas are currently included or excluded. • Identify critical biodiversity areas and ecological support areas within the municipality, using relevant data and information sources, such as aerial imagery, ecological surveys, and other mapping tools. • Analyse and map the spatial distribution of critical biodiversity areas and ecological support areas to determine their location and extent, as well as any potential threats or vulnerabilities. • Conduct stakeholder consultations with relevant departments, experts, and community members to gather input and feedback on the inclusion of critical biodiversity and ecological support areas in municipal spatial plans. • Develop policies, guidelines, and standards for the inclusion of critical biodiversity and ecological support areas in municipal spatial plans, including considerations for zoning, land use, and development regulations. • Integrate critical biodiversity and ecological support areas into the municipal spatial plans at all relevant scales, such as the Spatial Development Framework, Open Space Framework, and other relevant plans. • Monitor the implementation and effectiveness of the policies and guidelines for the inclusion of critical biodiversity and ecological support areas in municipal spatial plans and make adjustments as needed to ensure their continued protection and conservation.
Identifying and mapping natural open spaces, ecosystems, and natural resources, and integrating inventories in the Spatial Development Framework and the open space framework.	• Conducting surveys and assessments of the natural resources and ecosystems in the municipality. • Collecting and analysing data on the location, size, and ecological value of open spaces and natural resources, such as wetlands, and water bodies. • Identifying areas of high ecological value, such as critical habitats for threatened or endangered species, and designating them as protected areas. • Mapping the location and extent of identified open spaces, ecosystems, and natural resources, using geographic information system (GIS) technology or other mapping tools. • Integrating the mapping and inventory information into the Spatial Development Framework, open space framework, and other relevant plans, to guide future development and land-use decisions.

	• Updating the mapping and inventory information regularly to ensure it remains accurate and up-to-date with any changes in the natural environment.
Identifying undeveloped open space with potential for green infrastructure.	• Conducting an inventory of undeveloped open spaces within the municipality. • Evaluating the potential for green infrastructure development in identified spaces. • Assessing the suitability of undeveloped open spaces for different types of green infrastructure (e.g., parks, urban forests, green roofs, bioswales). • Considering factors such as land ownership, existing land use, soil conditions, topography, and hydrology when identifying undeveloped open spaces with potential for green infrastructure. • Prioritising undeveloped open spaces based on their potential to provide multiple benefits, such as biodiversity conservation, climate change mitigation and adaptation, and public health and well-being. • Engaging with stakeholders and the public to gather input and support for identifying and prioritising undeveloped open spaces with the potential for green infrastructure.
Assessing the value of open spaces and ecosystem services.	• Conducting ecological assessments to determine the ecological value of open spaces and ecosystems. • Identifying the ecosystem services these areas provide, such as carbon sequestration, water filtration, and habitat provision. • Assessing the potential impacts of development or other human activities on these ecosystem services and the overall ecological value of the areas. • Using this information to inform decisions about land use and development ensures that these areas' ecological value is protected and enhanced. • Developing policies and regulations to protect and manage these areas, such as zoning restrictions or conservation easements.

4.6.5. Programme 11: Identify and Prioritise Climate Change Risks and Develop Response Measures for Settlements.

The programme "*identify and prioritise climate change risks and develop response measures for settlements*" aims to better understand, prepare for, and respond to the threats posed by climate change in CDM especially considering its predominantly rural setting and reliance on subsistence farming. The following actions would contribute to this programme:

- Conducting a vulnerability assessment to identify the populations and locations most at risk of climate change impacts: This assessment would help identify communities that are particularly vulnerable to climate change, due to factors such as their geographic location,

reliance on natural resources, or lack of access to information and resources. In the context of the CDM, this might include farming communities that depend on consistent rainfall patterns or low-lying settlements that are susceptible to flooding.

- Developing and implementing an early warning system to help communities prepare for and respond to climate change risks: Early warning systems can give communities the time they need to take preventive measures or evacuate, potentially saving lives and reducing economic loss. This could be particularly useful in the face of extreme weather events like droughts, hail storms, and floods that are predicted to become more common due to climate change.
- Establishing partnerships with local stakeholders, such as community groups and NGOs, to build local capacity for climate change adaptation and resilience: Given the significant role that subsistence farming plays in local communities, partnerships could focus on strategies for climate-resilient agriculture. This might involve sharing information on climate-smart farming practices, introducing drought-resistant crops, or supporting farmers to diversify their livelihoods to reduce their vulnerability to climate impacts.
- Developing and implementing land use planning and zoning regulations that take into account the potential impacts of climate change, including flooding: Land use planning can help reduce vulnerability to climate change, for example by preventing development in flood-prone areas or protecting areas that provide crucial ecosystem services. In the CDM, these regulations would need to balance the protection of biodiversity and ecosystem services with the needs of rural communities, for instance by protecting areas of high ecological value from agricultural expansion.

In sum, this programme aims to enable the CDM to proactively respond to the challenges posed by climate change, rather than reacting to disasters after they have occurred. This involves understanding and prioritising climate risks, developing strategies to address these risks, and building the capacity of local communities to adapt to changing conditions.

Table 21: Programme 11 - Identify and Prioritise climate change risks and develop response measures for settlements.

Programme 11: Identify and Prioritise Climate Change Risks and Develop Response Measures for Settlements.	
ACTIONS	KEY ACTIVITIES
Conducting a vulnerability assessment to identify the populations and locations most at risk of climate change impacts.	• Analysing climate data to determine the frequency and severity of extreme weather events. • Assessing the vulnerability of infrastructure to flooding. • Mapping areas with high concentrations of vulnerable populations.
Developing and implementing an early	• Installing weather monitoring systems to provide real-time data on extreme weather events.

warning system to help communities prepare for and respond to climate change risks.	• Developing protocols for disseminating warnings to the public. • Establishing community response plans for different types of extreme weather events.
Establishing partnerships with local stakeholders, such as community groups and NGOs, to build local capacity for climate change adaptation and resilience.	• Building partnerships with community groups to identify local needs and priorities for adaptation and resilience measures. • Providing capacity-building training to community members on disaster preparedness and response. • Collaborating with local NGOs to implement small-scale adaptation measures, such as rainwater harvesting and urban agriculture.
Developing and implementing land use planning and zoning regulations that take into account the potential impacts of climate change, including, and flooding.	• Analysing maps of projected climate change impacts to identify areas at risk. • Developing land use and zoning regulations to ensure that settlements are built in safe and sustainable locations. • Providing technical assistance and support to developers to ensure that new projects are designed to withstand climate change impacts.

4.6.6. Programme 12: Community-Based Adaptation in Communities Most at Risk of Climate-Related Hazards

The "*community-based adaptation in communities most at risk of climate-related hazards*" programme aims to help communities in the Capricorn District Municipality (CDM), particularly those most vulnerable to the impacts of climate change, adapt and build resilience. This involves understanding the specific risks that these communities face, developing strategies to reduce these risks, and building the capacity of community members to implement these strategies. The key activities are:

- Conducting granular risk and vulnerability assessments in communities to identify drivers of risk and develop appropriate adaptation measures: In the context of the CDM, this might involve assessing how climate change could impact rainfall patterns and thus the viability of subsistence farming, or how increased frequency and intensity of extreme weather events might affect local communities. The insights from these assessments would be used to develop tailored adaptation measures, such as introducing climate-resilient crops or improving local infrastructure to better withstand extreme weather events.
- Developing and implementing community-based adaptation measures to reduce risks and build resilience falls under the purview of relevant departments, including the Department of Forestry, Fisheries, and the Environment (DFFE) at the national level: These departments would likely be involved in implementing adaptation measures that align with their

respective mandates. For example, the DFFE might focus on promoting climate-smart agricultural practices, enhancing food security through sustainable fisheries, or conserving local forests as a means of sequestering carbon and protecting biodiversity.

- Providing training and education to build community capacity and promote sustainability: This could involve educating community members about the risks of climate change and how to mitigate them, training farmers in climate-resilient agricultural practices, or sharing information about sustainable natural resource management. In a district like CDM where public awareness of environmental matters has been identified as a challenge, this education and training could be crucial for promoting sustainability and resilience.

Overall, this programme would help to ensure that local communities are not only able to withstand the impacts of climate change but also to thrive in the face of these challenges. By empowering communities to take a leading role in adaptation efforts, this programme could also help to ensure that the benefits of these efforts are felt at the local level, supporting the well-being of the most vulnerable populations.

Table 22: Programme 12 - Community-based adaptation in communities most at risk of climate-related hazards.

Programme 12: Community-Based Adaptation in Communities Most at Risk Of Climate-related Hazards.	
ACTIONS	KEY ACTIVITIES
Conducting granular risk and vulnerability assessments in communities to identify drivers of risk and develop appropriate adaptation measures.	• Identifying populations most at risk in the community, such as the elderly, children, and those with chronic illnesses, and developing strategies to protect them. • Assessing and mapping the distribution of the drivers of risk and burnability across communities related to exposure and sensitivity to climate hazards.
Developing and implementing community-based adaptation measures to reduce risks and build resilience falls under the purview of relevant departments, including the Department of Forestry, Fisheries, and the Environment (DFFE) at the national level, These departments play a crucial role in	• Support the DFFE and Province and Agriculture extension services to promote the use of climate-smart agricultural practices, such as rainwater harvesting, crop diversification, and soil conservation techniques, to improve food security and build community resilience. • Partnering with stakeholders (such as Provincial Departments and the National Department of Human Settlement) to build water security through the installation of rainwater harvesting systems, greywater recycling systems, and other water management strategies. • Supporting national and provincial initiatives to encourage the establishment of community gardens and promote sustainable agricultural practices that enhance community resilience and increase food security.

promoting climate-smart agricultural practices, enhancing food security, and building community resilience.	
Providing training and education to build community capacity and promote sustainability.	• Providing training and education to community members on climate change impacts and adaptation strategies. • Building local capacity to design, implement, and monitor adaptation measures. • Promoting sustainable land-use practices and sustainable resource management to reduce pressure on natural resources and build community resilience.

4.6.7. Programme 13: Climate Resilient Spatial Planning

The "*climate resilient spatial planning*" programme is designed to integrate climate change considerations into the spatial planning process within the CDM. This approach is key to making communities more resilient to climate change impacts and ensuring sustainable development. Here's a closer look at each action:

- Ensure that spatial planning frameworks consider a long-term view of climate hazards and incorporate natural infrastructure: This would involve taking into account climate change projections when developing spatial plans, such as identifying areas that may be at risk of increased flooding due to changing rainfall patterns. Incorporating natural infrastructure (like wetlands, which can absorb excess water and reduce flood risks) into these plans can also enhance resilience to climate change impacts.
- Develop local-level climate-resilient planning mechanisms - Precinct Plans: These are more detailed, local-level plans that take into account specific climate risks in a particular area or precinct. This could be particularly important in the Capricorn District, given the diversity of its ecosystems and the variety of risks they face.
- Ensure collaborative strategic planning that incorporates all relevant departments (in both strategic planning and project implementation): By involving all relevant departments in the planning process, it's more likely that all potential impacts of climate change are considered, and that plans are implemented effectively. For example, the Department of Agriculture might provide input on how changing rainfall patterns could affect agricultural areas, while the Department of Water and Sanitation might advise on potential impacts on water availability.
- Create mechanisms to strengthen public participation in planning and decision-making processes: This would involve engaging local communities in the planning process, potentially through public consultations or community meetings. This could help to ensure that the needs and knowledge of local communities are incorporated into spatial plans, and that these plans are supported and understood by those they affect.

- To identify climate risk zones and hotspots that affect vulnerable municipal infrastructure and assets, CDM could undertake various activities: These activities might include mapping areas at risk of climate impacts, such as flood zones or areas susceptible to drought. By identifying these risk zones, the municipality can prioritize interventions in these areas and ensure that infrastructure and assets are made more resilient to climate impacts.

Overall, the "*climate resilient spatial planning*" programme aims to ensure that the Capricorn District is prepared for the impacts of climate change and that its development is sustainable and resilient. It represents a comprehensive, integrated approach to spatial planning that recognizes the reality of climate change and the importance of building resilience at the community level.

Table 23: Programme 13 - Climate-smart spatial planning for climate-resilient growth and development.

Programme 13: Climate-Smart Spatial Planning For Climate-Resilient Growth and Development.	
ACTIONS	POSSIBLE KEY ACTIVITIES
Ensure that spatial planning frameworks consider a long-term view of climate hazards and incorporate natural infrastructure.	• Conduct a review of current spatial planning frameworks. • Identify climate hazards and vulnerable areas in the municipality. • Develop guidelines for climate-resilient spatial planning. • Identify natural infrastructure assets that can be incorporated into spatial planning frameworks.
Develop local-level climate-resilient planning mechanisms - Precinct Plans.	• Conduct vulnerability assessments to identify areas at risk of climate hazards. • Develop climate-resilient precinct plans that incorporate the needs and concerns of the community. • Ensure that the precinct plans are adaptable to the impacts of climate change.
Ensure collaborative strategic planning that incorporates all relevant departments (in both strategic planning and project implementation).	• Identify relevant departments and stakeholders. • Establish a coordination mechanism for collaborative strategic planning. • Develop guidelines for collaboration and coordination in strategic planning and project implementation. • Conduct regular reviews and assessments of the collaboration mechanism to ensure its effectiveness.
Create mechanisms to strengthen public participation in planning and decision-making processes.	• Ensure that the public has access to information about spatial planning frameworks and other climate change response initiatives. • Ensure that public feedback is incorporated into the decision-making process.

To identify climate risk zones and hotspots that affect vulnerable municipal infrastructure and assets, CDM could undertake various activities.	• Conducting vulnerability assessments for critical infrastructure and assets. • Analysing historical climate data to identify areas that have been particularly vulnerable in the past. • Developing climate models to assess future risks and understand the potential impacts of climate change. • Mapping vulnerable infrastructure and assets to understand where they are located in relation to climate risk zones and hotspots. • Identifying risks and prioritising action based on the level of vulnerability and potential impact of climate change on infrastructure and assets. • Developing and implementing strategies to manage risks and protect infrastructure and assets from climate change impacts.

4.7. Climate Change Goal 4: To Develop Climate-Resilient, Low-Carbon, Diverse and Inclusive Rural Economies that are Socially Responsible, Environmentally Sustainable and that Provide Job Opportunities for Unskilled, Semi-Skilled And Skilled Local Residences.

Table 24: Climate change goal 4, outcome, linkage to district's strategic objectives.

Goal:	• Foster Climate-Resilient, Low-Carbon, Diverse, and Inclusive Rural Economies, Promoting Social Responsibility, Environmental Sustainability, and Employment Opportunities for Unskilled, Semi-Skilled, and Skilled Residents in Capricorn District Municipality.
Outcome:	• The realisation of robust rural economies within the Capricorn District Municipality that are resilient to climate change impacts, operate on low-carbon principles, embrace diversity and inclusivity, uphold social responsibility and environmental sustainability, and generate job opportunities across different skill levels.
Linkage to CDM's Strategic Objectives	• SO1: By fostering climate-resilient economies, this goal supports the provision of sustainable basic services and infrastructure development, which are integral to a thriving economy. • SO2: By advocating for environmentally sustainable practices, this goal contributes to improved spatial development and environmental management. • SO3: By cultivating diverse and inclusive rural economies, this goal enhances the district's financial viability and management through diversified income sources and increased fiscal stability. • SO4: By generating job opportunities for unskilled, semi-skilled, and skilled residents, this goal directly enhances conditions for economic growth and job creation. • SO5: By aiming for low-carbon and socially responsible operations, this goal increases the capacity of the district to deliver its mandate in a sustainable and equitable manner.

4.7.1. Rationale/Context

In the face of climate change and other environmental challenges, it is critical for communities like the Capricorn District Municipality (CDM) to adopt strategies that promote sustainability, resilience, and inclusivity. The outlined goal demonstrates alignment with the identified needs through several critical components:

- Climate resilience: The effects of climate change, such as increased frequency and intensity of droughts, can severely impact agricultural productivity. Developing climate-resilient agricultural practices, such as drought-resistant crops and efficient irrigation systems, can help safeguard the district's agricultural potential, and thus its economy and food security.
- Low-carbon operations: Climate change is largely driven by carbon emissions, primarily from burning fossil fuels. By promoting low-carbon operations in agriculture, mining, and other industries, the CDM can contribute to global efforts to mitigate climate change. This could include, for example, adopting renewable energy technologies and implementing sustainable mining techniques.
- Diverse and inclusive economies: Economic diversification can help the CDM withstand shocks to any single sector, making it more resilient overall. By promoting inclusivity and job opportunities for all skill levels, the district can also ensure that the benefits of economic growth are shared widely among its residents, reducing inequalities.
- Social responsibility and environmental sustainability: The illegal dumping, littering, and burning of waste pose serious threats to the environment, public health, and the district's natural beauty, which is key to its tourism sector. By promoting social responsibility and environmental sustainability, the CDM can protect its natural resources, biodiversity, and ecosystems, which are the foundation of its rural economies.
- Job opportunities for different skill levels: By creating job opportunities for unskilled, semi-skilled, and skilled local residents, the district can not only improve living standards and reduce unemployment but also harness the talents and energies of its people to build a more sustainable, resilient, and prosperous community.

Therefore, this goal is strategic for CDM as it addresses the critical issues faced by the community, aligns with global efforts to combat climate change, and lays the foundation for a sustainable, inclusive, and prosperous future.

4.7.2. Programme 14: Advancing Towards a Climate-Smart Circular Economy

The programme "*advancing towards a climate-smart circular economy*" in the context of Capricorn District Municipality (CDM) and its predominantly rural nature represents a strategic effort to address waste management challenges and contribute to climate change mitigation.

Historically, the waste disposal practices within the CDM have shown signs of gradual improvement. In a span of twenty years, the proportion of households having their refuse collected by local authorities or private companies has increased from 14% to 30%. Despite this

positive trend, the remaining 70% of households either depend on personal dumps or have no designated waste disposal methods at all. Practices such as littering, illegal dumping, and burning of waste have been a growing concern for the District.

To tackle this issue, the CDM has earmarked a budget for waste equipment and community-led waste collection and litter-picking projects. There's also backing from the National Department of Forestry, Fisheries and the Environment, who have plans to further support cleaning programmes in the district between till 2025.

The programme includes the following actions:

- Shift towards a circular economy: This action involves developing policies and strategies to promote the reuse and recycling of waste materials. It encourages businesses and individuals to move away from the traditional linear economy model of 'take, make, dispose of' and instead embrace a circular economy model, where waste is minimized and resources are utilized to their fullest potential.
- Climate-smart waste management: This action focuses on implementing waste management strategies that align with climate change mitigation efforts. For example, reducing waste-burning practices which contribute to greenhouse gas emissions and instead promoting composting or other climate-smart waste disposal methods.
- Staff training and capacity building: Given the complexity of waste management and the role it plays in climate change mitigation, there's a need for adequately trained personnel. This activity involves the creation and delivery of tailored training programmes for municipal staff to enhance their understanding and ability to implement climate-smart waste management practices effectively.
- Improved waste collection and transportation: Enhancing the efficiency and coverage of waste collection services, particularly in underserved rural areas. This includes investing in better waste collection equipment and vehicles and refining waste transportation routes for improved service delivery.
- Public awareness and illegal dumping reduction: This involves running public awareness campaigns to educate the local communities about the environmental and health risks of improper waste disposal and the benefits of responsible practices. It also includes enforcing stronger penalties for illegal dumping to deter such practices.

By implementing these actions under the programme "*advancing towards a climate-smart circular economy*", the CDM aims to create a climate-resilient, low-carbon, and socially responsible local economy.

Table 25: Programme 14 - Advancing towards a climate-smart circular economy.

Programme 14: Advancing Towards a Climate-Smart Circular Economy.	
ACTIONS	KEY ACTIVITIES
Shift towards a circular economy.	• Develop and implement a circular economy policy and action plan, involving stakeholder engagement and public consultation. • Conduct a comprehensive waste audit to pinpoint opportunities for materials recovery and recycling. • Develop and implement circular economy strategies like waste reduction targets, recycling programs, and product stewardship initiatives. • Support local businesses and industries to adopt circular economy practices, such as resource sharing and reuse, and closed-loop supply chain development. • Promote green procurement policies, purchasing products made from recycled materials to support the growth of circular markets. • Collaborate with local research institutions for innovative circular economy solutions and technology development. • Develop education and outreach programs to raise awareness and engage the community in the shift towards a circular economy.
Climate-smart waste management.	• Conduct a feasibility study to identify innovative waste processing technologies. • Develop recycling programs that incentivise households and businesses to recycle, such as offering discounts or rebates based on the amount of waste recycled. • Establish dedicated recycling centres across CDM to facilitate easier access for residents and businesses. • Monitor and evaluate the impact of these innovations on waste reduction and recycling rates, adjusting the program for maximum effectiveness.
Staff training and capacity building.	• Identify key areas of knowledge and skills required for effective waste management, such as waste collection, separation, and processing procedures. • Develop and implement a comprehensive training program for waste management staff. • Provide ongoing support and resources for staff to continue learning and improving their skills • Regularly review and update the training program to ensure its relevance and effectiveness.
Improved waste collection and transportation.	• Carry out an assessment of the existing waste collection and transportation infrastructure to identify areas for improvement. • Develop a plan for upgrading this infrastructure, such as purchasing new, more efficient compactor trucks

	• Implement the plan, monitor its effectiveness, and make necessary adjustments over time. • Conduct routine maintenance on the infrastructure to ensure it remains in good condition and operates efficiently.
Public awareness and illegal dumping reduction.	• Develop a public awareness campaign to educate residents about the importance of responsible waste disposal and the dangers of illegal dumping. • Organise community clean-up events in areas affected by illegal dumping to foster a sense of community pride and responsibility. • Work with law enforcement to increase patrols in areas known for illegal dumping and impose penalties for those caught in the act. • Monitor and evaluate the impact of these activities on rates of illegal dumping, adjusting the strategy as necessary to achieve maximum effectiveness.

4.7.3. Programme 15: Climate-Smart Transport Strategy for Resilience and Efficiency

The Climate-Smart Transport Strategy for Resilience and Efficiency programme within the Capricorn District Municipality (CDM) context aims to improve accessibility, affordability, and resilience of transport infrastructure and services, while mitigating their environmental impact. The programme takes into consideration the unique challenges faced by the region including poor road conditions, oversupply of taxis in urban areas with insufficient service in rural areas, the inability of the transport system to meet basic accessibility needs, unaffordability of transport services for vulnerable populations, lack of flexibility in response to customer demands, and inadequate infrastructure development.

- Establish a Baseline and Assess Vulnerability: This action entails understanding the current state of the transport system in both urban and rural areas. This includes evaluating the number of taxis, condition of roads, accessibility of the transport system, and affordability of services. This baseline will inform vulnerability assessments, considering how climate change could exacerbate these existing challenges - for example, how more frequent extreme weather events might further degrade road conditions.
- Develop and Implement a Low-Carbon, Inclusive Transport Plan: This action will focus on designing a transport system that addresses the region's specific challenges. Solutions may include improving the distribution of taxis between urban and rural areas, developing more flexible transport services that can better meet varying customer needs, and increasing affordability for vulnerable groups such as pensioners and school learners. Importantly, these solutions will be designed with a low-carbon framework, promoting the use of energy-efficient vehicles, optimizing routes for fuel efficiency, and encouraging public transit, walking, or cycling where feasible to reduce carbon emissions.
- Enhance the Resilience of Local Transport Infrastructure to Climate Shocks: Given the region's poor road conditions, this action is crucial. It involves strengthening transport

infrastructure, such as roads and taxi stands, to withstand the impacts of climate change, including more frequent or intense floods, storms, or heatwaves. This may involve using climate-resilient materials in road construction, improving drainage to prevent flood damage, or building shade structures at taxi stands to protect against heat.

- Monitor, Evaluate, and Continually Improve the Transport Plan and Infrastructure Resilience: Finally, the programme will ensure a cycle of continuous improvement through regular monitoring and evaluation. This will involve tracking the performance of the new transport plan, assessing how well the improved infrastructure is withstanding climate shocks, and making necessary adjustments. This ongoing process will ensure that the transport system remains resilient to climate change, continues to meet the needs of the community, and contributes to the overall goal of creating a climate-resilient, low-carbon, diverse, and inclusive rural economy.

Table 26. Programme 15 - Climate-smart transport strategy for resilience and efficiency.

Programme 15: Climate-Smart Transport Strategy for Resilience and Efficiency.	
ACTIONS	POSSIBLE KEY ACTIVITIES
Establish a baseline and assess vulnerability.	• Establish a transport working group involving representatives from various municipal departments, transport operators, and civil society organizations. • Collect and analyze data on travel patterns, transportation infrastructure, and emissions from transportation. • Conduct a vulnerability assessment of the transport system to climate change impacts, such as flooding and extreme weather events.
Develop and implement a low-carbon, inclusive transport plan.	• Develop a vision and goals for the transport system that align with climate change objectives and social equity considerations. • Identify low-carbon mobility options and design measures to promote their adoption, such as expanding cycling infrastructure and improving public transportation services. • Improve the efficiency of the transportation system, for example by optimizing routes and schedules, implementing intelligent transportation systems, and promoting the use of alternative fuels. • Ensure the accessibility and social equity of the transport system by providing accessible public transportation services, integrating land use and transportation planning, and implementing measures to address the needs of disadvantaged communities.
Enhance the resilience of local	• Conduct climate change risk assessments specifically for the local transport network.

transport infrastructure to climate shocks.	• Develop robust climate resilience plans and strategies tailored to municipal local transport systems. • Implement diligent monitoring and maintenance programmes for municipal transport infrastructure. • Invest in innovative technologies that enhance the resilience of the local transport network.
Monitor, evaluate, and continually improve the transport plan and infrastructure resilience.	• Monitor and evaluate the transport plan at regular intervals to ensure that it remains relevant and effective. • Continually evaluate the effectiveness of existing climate resilience strategies and identify areas for improvement. • Promptly develop and implement action plans to address identified areas of improvement.

4.7.4.Programme 16: Climate-Resilient Agricultural Innovation

The Climate-Resilient Agricultural Innovation programme within the Capricorn District Municipality (CDM) is designed to address the specific climate change challenges faced by the agricultural sector within the district, while maximizing agricultural productivity, sustainability, and resilience. CDM, as a predominantly rural region, relies heavily on agriculture. As such, the impacts of climate change such as higher temperatures, changes in precipitation patterns, and increased frequency of extreme weather events pose a significant threat to food security and livelihoods within the district.

The outlined actions under this programme aim to address these challenges and transform the agriculture sector in CDM to become more climate-resilient:

- Invest in research and development for drought-resistant and climate-resilient crop varieties: This action aims to foster innovation in agricultural practices that are tailored to the changing climate conditions in CDM. By investing in research and development, the district can introduce new drought-resistant and climate-resilient crop varieties that are well-adapted to local conditions, thus ensuring consistent yields and income for farmers even under harsh climatic conditions.
- Establish Agri-Parks as hubs of innovation for climate-resilient agricultural techniques: The establishment of Agri-Parks seeks to create centres for the demonstration and dissemination of innovative climate-resilient agricultural techniques. These parks can serve multiple purposes, such as training centres for farmers, sites for testing and demonstrating new farming methods and technologies, and platforms for logistics support and marketing assistance. This approach helps to equip local farmers with practical skills and knowledge to adapt their farming practices to the impacts of climate change.
- Develop and implement water conservation strategies: With changing rainfall patterns and rising temperatures, water scarcity is a critical challenge for agriculture in CDM. This action focuses on the development and implementation of efficient irrigation techniques, such as

drip irrigation and precision sprinklers, and rainwater harvesting systems. Such techniques can help farmers make the most of the available water resources, thereby enhancing the resilience of their farms to water scarcity and reducing the impact on local water supplies.

In conclusion, the Climate-Resilient Agricultural Innovation programme aims to leverage innovation, training, and smart water management to help the agricultural sector within CDM adapt to and mitigate the impacts of climate change. This in turn will protect and enhance local livelihoods, contribute to food security, and promote sustainable and resilient rural development.

Table 27: Programme 16 - Climate-resilient agricultural innovation.

Programme 16: Climate-Resilient Agricultural Innovation.	
ACTIONS	ACTIVITIES
Invest in research and development for drought-resistant and climate-resilient crop varieties.	• Identify suitable local and international partners for R&D collaboration. • Allocate resources for research initiatives, including establishing state-of-the-art laboratories. • Organize workshops and conferences to share findings and advancements in drought-resistant crop research. • Coordinate field trials of new drought-resistant crop varieties across various regions of the CDM.
Establish Agri-Parks as hubs of innovation for climate-resilient agricultural techniques, offering training, logistics support, and marketing assistance.	• Identify suitable locations within the district for the development of Agri-Parks. • Establish partnerships with agricultural experts, local farmers, and NGOs to support the development of the Agri-Parks. • Develop and deliver training programs focusing on climate-resilient agricultural techniques. • Set up logistics infrastructure, such as storage facilities and transport networks, within the Agri-Parks. • Implement marketing initiatives to promote the products of the Agri-Parks on both local and international markets.
Develop and implement water conservation strategies, such as efficient irrigation techniques and rainwater harvesting, to mitigate water scarcity in agriculture.	• Conduct surveys to assess the current water usage and identify opportunities for water conservation. • Develop guidelines for efficient irrigation techniques, such as drip irrigation and precision sprinklers. • Install rainwater harvesting systems in agricultural fields and provide training on their usage and maintenance. • Launch awareness campaigns to educate farmers about the importance of water conservation in agriculture. • Monitor and assess the effectiveness of the implemented water conservation strategies and make necessary improvements based on feedback and outcomes.

4.7.5. Programme 17: Low-Carbon Rural Economy Transformation

The *low-carbon rural economy transformation programme* in the Capricorn District Municipality (CDM) is a strategic initiative aimed at transitioning the local economy towards more sustainable, low-carbon practices. The district is home to a range of industries, including agriculture, mining, and local businesses, many of which rely heavily on carbon-intensive practices. This programme aims to address these challenges and promote environmental sustainability while also supporting economic growth and job creation.

Given the rural nature of the CDM, it's crucial to implement strategies that respect the local context while seeking to reduce the region's overall carbon footprint. Here are the key actions associated with this program:

- Promote the use of renewable energy technologies in agricultural, mining, and local industries to reduce carbon emissions: This involves advocating for and facilitating the adoption of renewable energy technologies such as solar power, wind power, and bioenergy across key sectors. Such a transition not only contributes to reducing carbon emissions but also can lead to cost savings in the long run, thus promoting sustainable economic development. For example, solar-powered irrigation systems could be introduced in the agricultural sector, while the mining industry could switch to renewable power for its operations.
- Establish incentives for businesses in the district to switch to low-carbon operations: Incentives like subsidies or tax reductions can encourage businesses to adopt green technologies and reduce their carbon footprints. This activity entails the creation of a favourable policy and economic environment that motivates local enterprises to transition towards low-carbon operations. This could involve financial support for installing renewable energy systems, upgrading to energy-efficient machinery, or implementing waste reduction and recycling measures.
- Introduce sustainable mining techniques that minimize environmental impact and carbon footprint: Mining is often a significant part of rural economies but can be detrimental to the environment if not properly managed. This activity involves the promotion and implementation of sustainable mining practices, which could include improved waste management, water conservation, land rehabilitation, and the use of energy-efficient technologies. This not only minimizes the environmental impact but also ensures the long-term sustainability of the mining sector in the district.

Overall, the Low-Carbon Rural Economy Transformation programme seeks to balance economic development with environmental stewardship, contributing to the resilience and sustainability of the Capricorn District Municipality.

Table 28. Programme 17 - Low-carbon rural economy transformation.

Programme 17: Low-Carbon Rural Economy Transformation.	
ACTIONS	ACTIVITIES
Promote the use of renewable energy technologies in agricultural, mining, and local industries to reduce carbon emissions.	• Organize seminars and workshops to educate industry leaders about the benefits and practical application of renewable energy technologies. • Create partnerships with renewable energy companies to facilitate access to these technologies in the district. • Launch an awareness campaign promoting renewable energy use and its benefits to the environment and public health. • Implement pilot projects demonstrating the effectiveness of renewable energy technologies in agricultural and industrial contexts.
Establish incentives for businesses in the district to switch to low-carbon operations, such as subsidies or tax reductions for green technology adoption.	• Investigate a comprehensive incentive scheme, including subsidies, tax reductions, and grants for businesses adopting low-carbon operations. • Establish a platform for businesses to apply for these incentives and access support. • Conduct regular assessments to ensure the effectiveness of the incentives in promoting low-carbon operations. • Publicize success stories of businesses that have made significant transitions to low-carbon operations to encourage others.
Introduce sustainable mining techniques that minimize environmental impact and carbon footprint.	• Collaborate with mining experts and environmental scientists to identify and develop sustainable mining practices suitable for the district. • Organize training programs for miners and mining companies on sustainable mining techniques. • Set regulations and guidelines for mining operations to adhere to sustainable practices. • Conduct regular site inspections and audits to ensure the implementation and adherence to sustainable mining practices. • Implement a system to regularly assess and report on the environmental impact of mining operations in the district.

4.7.6. Programme 18: Inclusive and Diverse Economic Development

The Inclusive and Diverse Economic Development programme under Capricorn District Municipality (CDM) aims to foster an economy that provides opportunities for all citizens, irrespective of their skill level, and reduces dependence on a single sector by promoting economic diversity. This strategy is particularly important in a rural context like the CDM, where

income sources may be limited and primarily concentrated in specific sectors such as agriculture or mining. Here are the key actions associated with this program:

- Implement skills training programs aimed at different levels to facilitate diverse job creation: This action aims to equip the residents of the CDM with skills that are relevant to various sectors including agriculture, mining, tourism, and others. For unskilled workers, this could mean providing foundational training in these industries, whereas semi-skilled and skilled workers might receive more specialized training. The goal is to create a diverse workforce that can contribute to and benefit from the economic growth of the district.
- Develop policies to support the growth of Small and Medium-sized Enterprises (SMEs): SMEs are often the backbone of rural economies, providing local employment and contributing to community development. Policies could be designed to provide financial, technical, and logistical support to SMEs in key sectors such as agricultural value addition, mining services, and tourism. This support could include access to capital, business mentorship, streamlined regulatory processes, or networking opportunities.
- Introduce economic diversification initiatives that can create new industries: Diversifying the economy helps to make it more resilient to shocks and provides more job opportunities for local residents. This activity would involve identifying and fostering growth in potential new industries, such as eco-tourism, renewable energy, and organic farming. For instance, the unique local biodiversity of the CDM could be harnessed to develop a thriving eco-tourism industry, while its abundant sunshine makes it well-suited for solar energy generation.

Together, these actions under the Inclusive and Diverse Economic Development programme aim to create a resilient, diverse, and inclusive economy that supports sustainable development in the CDM. By focusing on skills training, SME development, and economic diversification, this programme works to ensure that economic growth in the district is broadly shared and benefits all residents.

Table 29: Programme 18 - Inclusive and diverse economic development.

Programme 18: Inclusive and Diverse Economic Development	
ACTIONS	ACTIVITIES
Implement skills training programs aimed at different levels (unskilled, semi-skilled, skilled) to facilitate diverse job creation in agriculture, mining, tourism, and other sectors.	• Identify skill gaps and training needs in the various sectors. • Partner with local educational institutions or training providers to develop tailored training programs. • Promote the programs and recruit participants from the local community. • Implement the training programs, with regular monitoring and evaluation to ensure they meet the needs of the participants and employers. • Establish pathways for program graduates to find employment or start their own businesses in the relevant sectors.
Develop policies to support the growth of	• Research the challenges and opportunities facing SMEs in the target sectors.

Small and Medium-sized Enterprises (SMEs) in sectors such as agricultural value addition, mining services, and tourism.	• Develop policy proposals to address these challenges and opportunities, such as tax incentives, grants, loans, or business development services. • Engage with stakeholders, including SMEs and industry groups, to refine the policy proposals. • Formalize and communicate the new policies, with clear guidelines on how SMEs can benefit from them. • Regularly evaluate the effectiveness of the policies and adjust them as needed based on feedback and outcomes.
Introduce economic diversification initiatives that can create new industries, such as eco-tourism, renewable energy, and organic farming, while reducing dependence on any single sector.	• Conduct market research to identify potential new industries that align with the district's resources, capabilities, and strategic priorities. • Develop a detailed plan for each initiative, including the resources needed, the potential benefits, and the steps to implement it. • Engage with stakeholders, including local businesses, investors, and community groups, to gain their support and input for the initiatives. • Launch the initiatives, with ongoing monitoring and evaluation to measure their success and identify areas for improvement. • Use the results of the initiatives to attract more investment and participation in these new industries, further diversifying the district's economy.

4.7.7. Programme 19: Social Responsibility and Environmental Stewardship

Within the context of Capricorn District Municipality (CDM), the Social Responsibility and Environmental Stewardship program aims to foster a culture of care and respect for the environment among the local community, businesses, and other stakeholders. It seeks to safeguard the natural resources, biodiversity, and ecosystems in the district by promoting responsible practices and mitigating environmental degradation. Here are the key activities that this program involves:

- Develop and implement environmental protection regulations: In line with CDM's commitment to environmental stewardship, new regulations may be established to protect the region's natural resources, biodiversity, and ecosystems. These regulations could cover a variety of areas, such as waste management, water use, land management, and the use of harmful chemicals. Implementation would involve enforcing these regulations and ensuring businesses and individuals adhere to them.
- Launch community awareness campaigns: Raising awareness about the importance of environmental sustainability and responsible practices is crucial for instilling a culture of environmental stewardship in the district. This could involve conducting educational campaigns about the impacts of activities in sectors such as agriculture, mining, and tourism on the environment, and advocating for more sustainable practices in these sectors. These

campaigns could take various forms, such as workshops, seminars, social media initiatives, and community meetings.

- Establish partnerships with local communities, businesses, and NGOs: Partnerships are a key aspect of the program, enabling collaborative work on socially responsible initiatives. These could include reforestation projects, cleanup drives, and the promotion of community-based tourism that respects local cultures and environments. These initiatives not only contribute to environmental conservation but also help to create a sense of community ownership over the district's natural resources.

Overall, the Social Responsibility and Environmental Stewardship program emphasizes the importance of working together to care for and sustainably use the natural resources in the Capricorn District. It reflects a commitment to balancing economic development with environmental preservation and ensuring the district remains a great place to live, work, and visit for generations to come.

Table 30: Programme 19 - Social responsibility and environmental stewardship.

Programme 19: Social Responsibility and Environmental Stewardship	
ACTIONS	ACTIVITIES
Develop and implement environmental protection regulations to safeguard natural resources, biodiversity, and ecosystems.	• Establish a task force to assess current environmental conditions and threats to biodiversity and ecosystems. • Research and draft a comprehensive set of regulations, including penalties for non-compliance to by-laws. • Open public consultations to ensure the proposed regulations are acceptable to local communities and businesses. • Formalize the regulations and communicate them clearly to all stakeholders. • Monitor compliance and enforce penalties for non-compliance where necessary.
Launch community awareness campaigns to highlight the importance of environmental sustainability and responsible practices in agriculture, mining, and tourism.	• Identify key messages and audiences for the awareness campaign. • Develop campaign materials tailored to each audience group (e.g., farmers, miners, tourism operators, the general public). • Deploy the campaign through various channels, such as local media, community meetings, and social media. • Measure the effectiveness of the campaign through surveys or interviews to assess changes in awareness or behaviour. • Make necessary adjustments to future campaigns based on the feedback received.
Establish partnerships with local communities, businesses, and NGOs to engage in socially	• Identify potential partners who have shared interests in environmental and social responsibility. • Conduct outreach to these potential partners and discuss the potential for collaboration on various initiatives.

responsible initiatives such as reforestation, clean-up drives, and community-based tourism.	• Develop mutually beneficial partnership agreements outlining the roles, responsibilities, and goals of each partner. • Jointly plan and execute initiatives like reforestation projects, clean-up drives, and community-based tourism ventures. • Regularly review and assess the partnership's impact on local social and environmental conditions.

5. Implementation Framework

	Key Risk/Vulnerability Addressed	Responsible Department	Target	Implications and costs	Timeframe			Priority Level
					0-2 years	3- 5 years	6 – 10 years	
Adaptation Goal: To ensure water security in the face of Climate Change.								
Adaptation Programme 1: Integrated Approach to Water Augmentation, Use and Management.								
Water Sensitive Urban Design (WSUD	Drought	Water and Sanitation	Year 0-2: Completed feasibility studies and preliminary design, private sector uptake of water re-use technologies. Year 3 – 5: Green infrastructure pilot projects, all new residential development applying water efficient designs. Year 6-10: Scaling green infrastructure	High	Feasibility studies and design. Promotion of water reuse and water-efficient design.	Implementation of green infrastructure stormwater attenuation.	Implementation of green infrastructure stormwater attenuation.	High
Addressing Human Resources Constraints for Effective Water Management	Drought	Water and Sanitation	Year 0-2: Complete needs assessment, assign funds implement WRM KPI's Year 3-5: Recruit water resource manager and	Low	Advocate for and secure funding for a dedicated water resources manager position and	Recruit a qualified water resources manager.	Maintain	High

			establish partnerships.					
Review Bulk Water Master Plan	Drought	Water and Sanitation	Year 0-2: Status quo assessment, Develop Plan, Assign budget. Year 3-5: Implement	Medium	Status Quo Assessment and Plan Development	Execution of the Bulk Water Master Plan	Maintain	High
Developing a Water Safety Plan (WSP)	Drought	Water and Sanitation	Year 0 – 2: Develop Emergency Response Plan Year 3-5: Implementation and Review. Improved Blue Drop Scores. Year 6-10: Review of plan and continuous improvement.	Medium	Development and Implementation of a Water Safety Plan	Implementation, Monitoring and Evaluation	Execution of the Bulk Water Master Plan	
Adaptation Programme 2: Protect and Conserve Water Through Monitoring Mechanisms and Water Conservation through Water Conservation and Water Demand Management (WCWDM).								
Implementing monitoring mechanisms and protecting water sources by reducing pollution.	Drought	Water and Sanitation	Year 0 – 2: Develop monitoring schedule, establish buffer zone and integrate in spatial frameworks Year 3-5: Implement by-laws	Medium	Implement a regular water quality monitoring schedule, create and manage municipal buffer zones and develop by-laws to regulate effluent discharge.	Implement	Implement	High
Implementing water conservation measures.	Drought	Water and Sanitation	Year 0-2: Achieve set number of awareness campaigns and loss reduction.	Low to High	Establish targets for awareness campaigns and loss reduction. Feasibility Studies and pilot projects	Water re-use systems installed on municipal property.	Large scale water re-use systems implement for non-potable uses.	High

			Year 3-5: Implement greywater-based irrigation on municipal land. Year 6-10: Large scale re-use systems operational.					
Alien Invasive Species Clearing Initiatives In Catchment Areas.	Flooding	Water and Sanitation	Year 0-2: Mapp alien invasive hotspots. Continue current operation and campaigns. Source funds. Year 3-5: Scale alien invasive clearing and establish green economy initiatives. Year 6-10: Self-sustaining operations in key areas.	Medium	Identify, map and control areas containing alien invasive species.	Scale	Scale	
Enforce 'Green' Approaches in Residential Areas and Developments.	Drought	Water and Sanitation	Year 0-2: Guidelines developed for residential and commercial development Year 3-5: Establish technical and funding partnerships in order to establish	Low	Developing and implement guidelines and standards for sustainable residential and commercial development	Incentive programme. Enforcement	Enforcement.	

			incentive programme.					
Adaptation Programme 3: Assessing the Feasibility and Sustainability of Alternative Water Sources for Climate Change Adaptation.								
Water Resource Management Planning	Drought	Water and Sanitation	Year 0-2: Status quo assessment of water resources. Integrated drought management plan developed.	Medium	Conduct a water resource assessment, develop a drought management plan and develop and implement water conservation strategies.	Implement	Implement	Medium
Investigating alternative water resources	Drought	Water and Sanitation	Year 0-2: Completion of feasibility studies Year 3-5: Pilot project implemented.	Medium	Conduct a feasibility study to identify alternate water sources, and undertake hydrological assessments to determine water availability and potential yield of alternative water sources.			High
Investing in alternative water resources	Drought	Water and Sanitation	Year 3 – 5: Pilot Projects Year 6 – 10: Scaling	High		Implement	Implement	
Develop and Implement a Treated Effluent Reuse Strategy For Sustainable Water Management.	Drought	Water and Sanitation	Year 0-2: Develop Strategy and Resource. Year 3 – 5: Implement	Medium	Developing a comprehensive treated effluent reuse plan, including infrastructure and system requirements, stakeholder engagement, and	Implement	Implement	

					potential risks and mitigation strategies.			
Adaptation Programme 4: Implementing Sustainable Groundwater Use and Development Strategy								
Conducting Groundwater Resource Assessments to Establish the Availability and Quality of Groundwater in the CDM Area.	Drought	Water and Sanitation	Year 0-2: Completion of groundwater management plan.	Medium	Develop a groundwater management plan	Implement	Implement	Medium
Establishing Sustainable Groundwater Use Policies and Guidelines to Promote Efficient and Effective Groundwater Management.	Drought	Water and Sanitation	Year 0 – 2: Updated policy and guidelines. Year 3 – 5: Source Additional funding and partnerships for for enforcement.	Medium	Conduct a review of existing policies and guidelines related to groundwater use to identify gaps and areas for improvement.	Implement	Implement	Medium
Implementing Groundwater Monitoring Programmes to Monitor Water Levels, Water Quality, and Potential Pollution Sources, Enabling Early Detection of Potential	Drought	Water and Sanitation	Year 0 – 2: Establish partnerships with irrigation boards and large water users.	Medium	Establish Partnerships	Install and maintain a network of groundwater monitoring wells and equipment to collect data on groundwater levels, water quality, and potential pollution sources.		High

Problems and Timely Intervention.								
Promoting Groundwater Conservation and Efficiency by Encouraging the Adoption of Water-Saving Technologies and Practices in all Sectors.	Drought	Water and Sanitation	Year 0-2: Awareness campaigns. Year 3 -5: Launch technical partnership with speres of government or private sector to promote water efficient technologies.	Medium	Develop and implement water conservation standards for new and existing municipal buildings and properties and encourage the adoption of water reuse/recycling technologies.	Establish technical support structure.	Maintain	
Developing Groundwater Recharge and Artificial Recharge Strategies to Enhance Aquifer Recharge Rates and Improve Groundwater Storage Capacity.	Drought	Water and Sanitation	Year 0-2: Feasibility and recharge sites established. Year 3-5: Recharge infrastructure established	Medium	Conduct studies to identify suitable sites for groundwater recharge, including areas with high permeability, favourable soil conditions, and sufficient rainfall.	Implement	Maintain	Medium
Implementing Land-Use Planning and Zoning Regulations to Protect Groundwater Resources from Pollution and Overuse.	Drought	Water and Sanitation/ Urban Planning	Year 0-2: Define setback lines Year 3-5: Monitoring and evaluation programme implemented	Medium	Conduct a groundwater vulnerability assessment and develop and enforce land-use planning and zoning regulations.	Implement and monitor.	Implement and monitor	

Develop a Information Management System for Groundwater Data to Provide Accurate and Timely Information to Water Users, Decision-Makers, and The Public.	Drought	Water and Sanitation	Year 0-2: Partner with DWS to establish system. Year 2-5: Maintain	Low	Develop and update a database and web-based portal for storing and accessing groundwater data, including water levels, quality, and other relevant information.	Maintain	Maintain	
Climate Change Goal 2: To prioritise the health and safety of communities in the face of a changing climate.								
Programme 5: Promote Public Health and Safety in the Face of Climate Change and Extreme Climate Events in Collaboration with the Department of Health								
Promoting public health and safety in the face of climate change and extreme weather events, in collaboration with the Department of Health, is a fundamental climate change response programme for Capricorn DM.	All	Disaster Management/ Health	Year 0-2: Develop and implement public health programmes and emergency response plans. Conduct a health risk assessment. Year 3 – 5: Implement.	Medium	Conduct a health risk assessment and develop and implement public health programmes. Develop and implement emergency response plans for extreme weather events.	Implement	Implement	High
Adaptation Programme 6: Innovative Urban and Township Design and Development								
Innovative urban and township design and development is an essential component of	Flooding	Urban Planning	Year 0-2: Developing guidelines for innovative township design and encouraging	Medium	Developing guidelines in collaboration with reliant government departments for	Implement	Implement	High

climate change response, as it helps to minimise the risk and impact of climate change on urban areas.			the use of green infrastructure in urban design. Year 3-5: Implement.		innovative township design. Encouraging the use of green infrastructure in urban design.			
Harnessing the potential of open spaces to absorb and mitigate the impacts of climate change.	Flooding	Environmental Management	Year 0-2: Develop a plan to integrate green infrastructure practices into new development Year 2-5: Implement.	Medium	Conduct a green infrastructure assessment and develop a plan to integrate green infrastructure practices into new development.	Implement the green infrastructure.	Implement green infrastructure.	High
Adaptation Programme 7: Public Awareness Campaigns – Involve Communities in, Raise Awareness of and Conduct Training on Climate Change								
Comprehensive Community Engagement and Public Awareness Initiative on Climate Change. This initiative aims to raise awareness, educate, and involve the community in addressing climate change. community.	All	Environmental Management	Year 0-2: Climate change awareness raising. Year 3-5: Climate change awareness raising.	Low	Designing and distributing educational materials on climate change and holding educational workshops and seminars.	Developing a comprehensive public awareness campaign.	Continue with awareness raising.	High
Climate Change Goal 3: Reduce the vulnerability and exposure of human and natural systems to climate change and extreme events								
Programme 8: Conserve, Protect and Restore Natural Open Spaces, Ecosystems and Natural Resources.								
Assessing natural resources and	Flooding/Drought / Wildfires	Environmental Health	Year 0-2: Identify high ecological value areas	Medium	Develop conservation plans and management	Integrate into SDF	Review.	Medium

ensuring that natural open spaces, ecosystems, and resources are conserved, protected and restored.			Year 3 – 5: Integrate into SDF on review.		strategies for high-conservation value areas			
Harnessing the potential of open spaces to absorb and mitigate the impacts of climate change.	Flooding	Environmental Health	Year 0-2: Ecosystem service supply and demand assessment including status quo.	Medium	Compile natural resources inventory and ecosystem services assessment.	Implement maintenance and restoration projects.	Establish new protected areas.	High
Implementing programmes focused on mitigating the impact of climate change and severe weather, particularly in climate-risk zones.	Flooding	Environmental Health	Year 0-2: Develop an Ecosystem-Based Adaptation Plan. Year 3-5: Resource Plan and Implement	Medium	EBA Plan	Implement	Implement	High
Programme 9: Enhanced Natural Resource Management								
Ensuring the quality of water resources is critical to the sustainable development of CDM, as they play a vital role in maintaining the health of ecosystems, human health,	Health	Water and Sanitation	Year 0-2: Water quality monitoring sites identified and monitored.	Low	Conducting regular water quality monitoring to track the levels of various pollutants, including pathogens, nutrients, and chemicals, in water bodies.	Conducting regular water quality monitoring to track the levels of various pollutants, including pathogens, nutrients, and chemicals, in water bodies.	Conducting regular water quality monitoring to track the levels of various pollutants, including pathogens, nutrients, and chemicals, in water bodies.	High

and socio-economic development.								
Monitoring and preventing soil erosion is crucial to ensure the long-term health and productivity of natural ecosystems, as well as to maintain the quality of water resources.	Flooding	Environmental Health	Year 0-2: Erosion Risk Assessment Year 3-5: Develop and implement erosion control plans for high-risk areas.	Medium	Conduct a soil erosion risk assessment on municipal land.	Implement control plans for high priority areas.	Review and maintain.	High
Provide training to municipal staff and stakeholders on biodiversity and natural resource management regulations and guidelines.	Flooding/Drought/ Fire/ Heat Stress	Environmental Health	Year 0-2: Number of officials trained. Year 3-5: Number of officials trained. Monitoring and evaluation. Year 6-10: Number of officials trained. Monitoring and evaluation.	Low	Implement training programme.	Monitor	Monitor	Medium
Establish a District Environmental Management Forum (DEMF) to enhance collaboration and coordination between Sectoral Departments, Conversation	Flooding/Drought/ Fire/ Heat Stress	Environmental Health	Year 0-2: Establish a forum with terms of reference	Low	Conduct regular meetings. Track progress and performance.	Conduct regular meetings. Track progress and performance. Review Terms of Reference.	Conduct regular meetings. Track progress and performance. Review Terms of Reference.	Medium

Organisation and agencies related to natural resource management.								
Programme 8: Integrate Critical Biodiversity Areas and Ecological Support Areas into the Spatial Development Framework								
Ensuring critical biodiversity and ecological support areas are integrated into municipal spatial plans at all scales.	Flooding/Fire/Heat Stress/ Drought	Disaster Management	Year 0-2: Integrate critical biodiversity and ecological support areas into municipal spatial plans Year 3-5: Implement Year	Low	Integrate critical biodiversity and ecological support areas into the municipal spatial plans.	Implement municipal spatial plans.	Implement municipal spatial plans.	High
Identifying and mapping natural open spaces, ecosystems, and natural resources, and integrating inventories in the Spatial Development Framework and the open space framework.	Drought/Flooding/ Heat Stress	Environmental Health	Year 0-2: Integrate and map the inventory information into the SDF Year 3-5: Implement	Low	Integrating the mapping and inventory information into the Spatial Development Framework, open space framework.	Integrate and implement the mapped inventory information from the SDF.	Monitor.	High
Identifying undeveloped open space with potential for green infrastructure.	Flooding	Environmental Health	Year 0-2: Assess the suitability for undeveloped open spaces. Year 3-5: Implement	Low	Assess the suitability of undeveloped open spaces for different types of green infrastructure.	Implement green infrastructure.	Implement green infrastructure.	High
Assessing the value of open spaces and	Health	Water and Sanitation	Year 0-2: Develop policies and regulations to	Low	Develop policies and regulations to protect and	Implement	Implement	High

ecosystem services			assess the value of open spaces. Year 3-5: Implement		manage these areas.			
Programme 11: Identify and Prioritise Climate Change Risks and Develop Response Measures for Settlements.								
Conducting a vulnerability assessment to identify the populations and locations most at risk of climate change impacts.	Flooding, wildfire, drought	Environmental Management	Year 0-2: Assess the vulnerability of infrastructure to climate change. Year 3-5: Implement	Medium	Assess the vulnerability of infrastructure to climate risk	Develop and implement climate-resilient infrastructure.	Implement and maintain.	Medium
Developing and implementing an early warning system to help communities prepare for and respond to climate change risks.	All	Disaster Management	Year 0-2: Install weather monitoring systems. Year 3-5: Enforce early warning system.	Medium	Install weather monitoring systems to provide real-time data on extreme weather events and develop warning protocols.	Enforce early warning system	Enforce early warning system	High
Establishing partnerships with local stakeholders, such as community groups and NGOs, to build local capacity for climate change adaptation and resilience.	Flooding/ Drought	Disaster Management	Year 0-2: Building partnerships. Year 3-5: Implement	Low	Building partnerships with community groups.	Collaborate with local NGOs to implement small-scale adaptation measures.	Implement.	Medium
Developing and implementing land use	Flooding	Urban Planning	Year 0-2: Develop land use and zoning regulations	Medium	Developing land use and zoning regulations to	Implement land use and zoning regulations	Implement	High

planning and zoning regulations that take into account the potential impacts of climate change.			Year 3-5: Implement		ensure that settlements are built in safe and sustainable locations.			
Programme 12: Community-Based Adaptation in Communities Most at risk of climate-related hazards								
Conducting granular risk and vulnerability assessments in communities to identify drivers of risk and develop appropriate adaptation measures.	All	Environmental Management	Year 0-2: Develop adaptation measures. Year 3-5: Implement	Low	Develop adaptation measures for populations most at risk.	Implement	Implement	High
Developing and implementing community-based adaptation measures to reduce risks and build resilience falls under the purview of relevant departments.	Flooding/ Drought	Environmental Management	Year 0-2: Develop adaptation measures. Year 3-5: Support and Implement	Low	Support the DFFE and Province and Agriculture extension services to promote the use of climate-smart agricultural practices.	Support and implement sustainable agricultural practices.	Implement and monitor.	High
Providing training and education to build community capacity and promote sustainability.	All	Environmental Management	Year 0-2: Provision of training Year 3-5: Design, implementation and monitoring of adaptation measures.	Low	Providing training and education to community members on climate change impacts and	Design, implement and monitor adaptation measures.	Implement and monitor adaptation measures.	High

					adaptation strategies.			
Programme 13: Climate Resilient Spatial Planning for Climate Resilient Growth and Development								
Ensure that spatial planning frameworks consider a long-term view of climate hazards and incorporate natural infrastructure.	All	Urban Planning	Year 0-2: Develop guidelines for climate-resilient spatial planning. Year 3-5: Implement guidelines	Low	Develop guidelines for climate-resilient spatial planning.	Implement guidelines	Implement and monitor	
Develop local-level climate-resilient planning mechanisms - Precinct Plans.	All	Urban Planning	Year 0-2: Develop climate resilient precinct plans Year 3-5: Implement	Low	Develop climate-resilient precinct plans that incorporate the needs and concerns of the community.	Implement precinct plans	Implement and monitor	
Ensure collaborative strategic planning that incorporates all relevant departments (in both strategic planning and project implementation).	All	Urban Planning	Year 0-2: Develop guidelines for collaboration in strategic planning and project implementation. Year 3-5: Implementation of guidelines.	Low	Develop guidelines for collaboration and coordination in strategic planning and project implementation.	Implement guidelines	Implement and monitor guidelines	
Create mechanisms to strengthen public participation in planning and	All	Urban Planning	Year 0-2: Ensure that public feedback is incorporated into the decision-making process.	Low	Ensure that public feedback is incorporated into the decision-making process.	Ensure that public feedback is incorporated into the decision-making process.	Ensure that public feedback is incorporated into the decision-making process.	

decision-making processes.			Year 3-5: Ensure that public feedback is incorporated into the decision-making process.					
To identify climate risk zones and hotspots that affect vulnerable municipal infrastructure and assets.	All	Urban Planning	Year 0-2: Develop strategies to manage risks. Year 3-5: Implement.	Medium	Develop strategies to manage risks and protect infrastructure and assets from climate change impacts.	Implement strategies.	Implement and monitor strategies.	
Goal 4: To develop climate-resilient, low-carbon, diverse and inclusive rural economies that are socially responsible, environmentally sustainable and that provide job opportunities for unskilled, semi-skilled and skilled local residences.								
Programme 14: Advancing Towards a Climate-Smart Circular Economy								
Shift Towards a Circular Economy	All	Waste Management	0-2 years: Develop and implement a circular economy policy and action plan, conduct waste audit, develop initial circular economy strategies, initiate collaborations with research institutions 3-5 years: Implementation of waste reduction targets, initiation of recycling programs and product stewardship	Medium to High	Circular economy policy and action plan established, comprehensive waste audit completed, initial strategies developed	Waste reduction targets met, recycling programs operational, product stewardship initiatives in place, local businesses adopting circular economy practices, green procurement policies implemented	Ongoing achievement of targets and further refinement of strategies based on evidence and experience, with an established and robust circular economy in place	High

			initiatives, education and outreach programs, promotion of green procurement policies, support to local businesses 6-10 years: Monitor and update circular economy policies and action plans, continue supporting local businesses, expand and refine recycling programs, and continue research collaboration and education programs.					
Climate-Smart Waste Management	Flooding, Heat Stress, Wildfires, Drought.	Waste Management	0-2 years: Conduct feasibility study, develop initial recycling programs 3-5 years: Establish recycling centres, fully implement recycling programs, start monitoring and evaluation 6-10 years: Continue to monitor and adjust recycling programs	Medium to High	Complete feasibility study, design and initiate recycling programs	Recycling centres are established and operational, recycling programs are fully functional, and monitoring systems are in place.	Achieve targeted recycling rates, and show evidence of reduced waste through continued monitoring and evaluation.	High

			for maximum effectiveness, expand as necessary					
Staff Training and Capacity Building	Flooding, Environmental Health, Heat Stress, Wildfires, Drought.	Waste Management	0-2 years: Identify key areas of knowledge, develop and start implementing the training program 3-5 years: Fully implement the training program, provide ongoing support, start regular reviews and updates 6-10 years: Continue providing ongoing support, regular reviews, and updates, assess the overall impact and adjust as necessary	Low to Medium	Key knowledge areas identified, initial version of the training program developed, start of implementation	Training program fully operational, ongoing support provided, regular review process established	Continued implementation, review, and updating of the training program, demonstrated improvement in staff skills and effectiveness	High
Improved Waste Collection and Transportation	Flooding, Environmental Health, Heat Stress, Wildfires, Drought	Waste Management	0-2 years: Assessment completed, upgrade plan developed 3-5 years: Commence the implementation of the upgrade plan 6-10 years: Continued	High	Conduct the assessment, develop the upgrade plan	Begin implementation of the upgrade plan, and monitor its effectiveness	Continue implementation, routine maintenance, monitoring, and adjustments	High

			implementation, maintenance, and effectiveness monitoring, demonstrating improved efficiency and reliability					
Public Awareness and Illegal Dumping Reduction	Flooding, Environmental Health, Heat Stress, Wildfires, Drought	Environmental Health	0-2 years: Develop and launch a public awareness campaign, begin organizing community clean-up events, collaborate with law enforcement 3-5 years: Continue with these activities while beginning to monitor and evaluate effectiveness, adjust strategies as necessary 6-10 years: Ongoing activities, monitoring and evaluation, and continuous adjustments as necessary	Medium	Successful launch of the public awareness campaign and community clean-up events, agreements with law enforcement in place	Observable reduction in illegal dumping incidents, higher public awareness levels	Sustainable reduction in illegal dumping incidents, maintenance of high public awareness, ongoing effectiveness of law enforcement	High
Programme 15: Climate-Smart Transport Strategy for Resilience and Efficiency								

Establish a Baseline and Assess Vulnerability	Flooding, Environmental Health issues, Heat Stress, Wildfires, and Drought.	Infrastructure	Create the group and gather data in the first 2 years. Complete the assessment in 3-5 years.	Low-High	Have a working group and data within 2 years..	Complete the assessment within 5 years		High
Develop and Implement a Low-Carbon, Inclusive Transport Plan	Environmental Health, Heat Stress.	Infrastructure	Vision and goals ready within 2 years. Low-carbon options identified and efficiency improvements in place within 5 years. Accessibility and equity ensured within 10 years.	Low-High	Develop vision and goals in the first 2 years.	Identify low-carbon options and improve efficiency in 3-5 years.	Ensure accessibility and social equity in 6-10 years.	High
Enhance the Resilience of Local Transport Infrastructure to Climate Shocks	Flooding, Environmental Health, Heat Stress, Wildfires, Drought.	Infrastructure	Risk assessments done within 2 years. Resilience plans developed and maintenance programmes initiated within 5 years. Investments in resilience technologies made within 10 years.	Medium-High	Conduct risk assessments in 0-2 years.	Develop resilience plans and start maintenance programmes in 3-5 years.	Invest in resilience technologies in 6-10 years.	High
Monitor, Evaluate, and Continually Improve the Transport Plan and Infrastructure Resilience	Flooding, Environmental Health, Heat Stress, Wildfires, Drought.	Infrastructure	Establish a monitoring and evaluation system within 1 year. Complete evaluation of resilience strategies within 2 years. Implement	Medium-High	Monitoring and evaluation to be started immediately and conducted regularly over 0-10 years. Evaluation of resilience strategies in 0-2 years.	Development and implementation of action plans in 3-5 years.		High

			action plans within 5 years.					
Programme 16: Climate-Resilient Agricultural Innovation								
Invest in research and development for drought-resistant and climate-resilient crop varieties.	Drought		Partner identification in 0-2 years. Resource allocation for research in 0-2 years. Workshops and conferences in 3-5 years. Field trials coordination in 3-5 years.	Low-High	Establish R&D partnerships within 2 years. Set up research laboratories within 2 years.	Conduct the first workshop or conference within 5 years. Begin field trials of drought-resistant crops within 5 years.		High
Establish Agri-Parks as hubs of innovation for climate-resilient agricultural techniques, offering training, logistics support, and marketing assistance.	Environmental Health, Drought.		Location identification and partnership establishment in 0-2 years. Delivery of training programs and logistics infrastructure setup in 3-5 years. Implementation of marketing initiatives in 3-5 years.	Low-High	Location identification and partnership establishment in 0-2 years.	Delivery of training programs and logistics infrastructure setup in 3-5 years.	Implementation of marketing initiatives in 3-5 years.	High
Develop and implement water conservation strategies, such as efficient irrigation techniques and rainwater harvesting, to mitigate water	Drought		Surveys and guidelines development in 0-2 years. Rainwater harvesting system installation and awareness campaigns in 3-5 years. Monitoring and assessment in 6-10 years.	Low-Medium	Complete surveys and develop guidelines within 2 years.	Install rainwater harvesting systems and launch awareness campaigns within 5 years.	Monitor and assess strategies within 10 years.	High

scarcity in agriculture.								
Programme 17: Low-Carbon Rural Economy Transformation								
Promote the use of renewable energy technologies in agricultural, mining, and local industries to reduce carbon emissions.	Environmental Health.		Complete seminars, workshops, and partnerships establishment within 2 years. Launch awareness campaign and implement pilot projects within 5 years.	Seminars and workshops: Low. Partnerships: Medium. Awareness campaign: Low. Pilot projects: High.	Seminars, workshops, and partnerships in 0-2 years.	Awareness campaign and pilot projects in 3-5 years.		High
Establish incentives for businesses in the district to switch to low-carbon operations, such as subsidies or tax reductions for green technology adoption.	Environmental Health.		Establish incentive scheme and platform within 2 years. Conduct regular assessments and publicize success stories within 5 years.	Investigation and platform establishment: Low. Regular assessments: Medium. Publicization of success stories: Low.	Investigation and platform establishment in 0-2 years.	Regular assessments and publicization in 3-5 years.		
Introduce sustainable mining techniques that minimize environmental impact and carbon footprint.	Environmental Health.		Complete collaboration, training programs, and set regulations within 2 years. Implement site inspections, audits, and assessment system within 5 years.	Collaboration and training programs: Medium. Regulations and guidelines: Low. Site inspections and audits: Medium. Assessment and reporting	Collaboration, training programs, and regulations in 0-2 years.	Site inspections, audits, and assessment system in 3-5 years.		High

				system: Medium.				
Programme 17: Inclusive and Diverse Economic Development								
Implement skills training programs aimed at different levels (unskilled, semi-skilled, skilled) to facilitate diverse job creation in agriculture, mining, tourism, and other sectors.	Environmental Health, Heat Stress, Drought.		Identification of skill gaps, partnership, and promotion in 0-2 years. Implementation of training programs and establishing pathways in 3-5 years.	Identification of skill gaps: Low. Partnership: Medium. Promotion: Low. Implementation of training programs: High. Establishing pathways: Medium.	Complete identification of skill gaps, establish partnerships, and start promotion within 2 years.	Implement training programs and establish pathways within 5 years.		High
Develop policies to support the growth of Small and Medium-sized Enterprises (SMEs) in sectors such as agricultural value addition, mining services, and tourism.	Environmental Health, Heat Stress, Drought.		Research, policy development, and stakeholder engagement in 0-2 years. Policy formalization, communication, and evaluation in 3-5 years.	Research: Low. Policy development: Medium. Stakeholder engagement: Low. Policy formalization and communication: Medium. Policy evaluation: Low.	Complete research, policy development, and stakeholder engagement within 2 years.	Formalize, communicate, and evaluate policies within 5 years.		High
Introduce economic diversification initiatives that can create new industries, such as eco-tourism, renewable	Environmental Health, Heat Stress, Drought.		Market research, plan development, and stakeholder engagement in 0-2 years. Initiative launch and using results to attract	Market research: Low. Plan development: Medium. Stakeholder engagement: Low. Initiative	Complete market research, plan development, and stakeholder engagement within 2 years.	Launch initiatives and use results to attract investment within 5 years.		High

energy, and organic farming, while reducing dependence on any single sector.			investment in 3-5 years.	launch: High. Using results to attract investment: Low.				
Programme 19: Social Responsibility and Environmental Stewardship								
Develop and implement environmental protection regulations to safeguard natural resources, biodiversity, and ecosystems.	Flooding, Environmental Health, Heat Stress, Wildfires, Drought.		Task force establishment, research, drafting, and public consultations in 0-2 years. Formalization, communication, and compliance monitoring in 3-5 years.	Establishment of a task force: Low. Research and drafting: Medium. Public consultations: Low. Formalization and communication of regulations: Medium. Compliance monitoring: Medium.	Complete task force establishment, research, drafting, and public consultations within 2 years.	Formalize, communicate, and monitor compliance within 5 years.		High
Launch community awareness campaigns to highlight the importance of environmental sustainability and responsible practices in agriculture, mining, and tourism.	Flooding, Environmental Health, Heat Stress, Wildfires, Drought.		Identification of key messages, development of campaign materials, and campaign deployment in 0-2 years. Measurement and adjustment in 3-5 years.	Identification of key messages: Low. Development of campaign materials: Medium. Campaign deployment: Medium. Campaign effectiveness measurement: Low. Adjustment of	Complete identification of key messages, development of materials, and campaign deployment within 2 years.	Measure effectiveness and adjust future campaigns within 5 years.		High

				future campaigns: Low.				
Establish partnerships with local communities, businesses, and NGOs to engage in socially responsible initiatives such as reforestation, cleanup drives, and community-based tourism.	Flooding, Environmental Health, Heat Stress, Wildfires, Drought.		Complete identification of partners, outreach, and agreements development within 2 years. Implement initiatives and assess impact within 5 years.	Identification of potential partners: Low. Outreach: Low. Development of partnership agreements: Medium. Joint planning and execution of initiatives: High. Regular review and assessment: Low.	Identification of potential partners, outreach, and development of agreements in 0-2 years.	Joint planning, execution, and review/assessment in 3-5 years.		High

5.1. Enabling Mechanisms for Implementation

5.1.1. Institutional Arrangements

Climate change, a pressing global issue, presents substantial environmental and economic challenges. The Capricorn District Municipality (CDM) will be significantly impacted by these challenges, especially given the uncertainty around long-term projections of climate change impacts at a local level, exacerbated by a lack of institutional capacity and budgetary limitations. However, local government has a pivotal role to play in enhancing climate change resilience by effectively executing its duties. The Capricorn District, like other municipalities, must plan and respond appropriately to fulfil its objective of sustainable and equitable service provision, socio-economic development, and the creation of a safe and healthy environment for all residents.

Human-induced climate changes have already affected South Africa's weather, with the Capricorn District being amongst the areas most susceptible to current and future climate impacts. The projected future climate change will have significant implications for agriculture, livelihoods, and the sustainable growth and development of our communities. Increased global atmospheric concentration of greenhouse gases, including Carbon Dioxide (CO2), Methane (CH4), and Nitrous Oxide (N2O), primarily due to transport and industrial processes dependent on fossil fuels, significantly alters thermodynamic exchanges that shape long-term climate patterns. These climate impacts have an inequitable global distribution, and when paired with varied community resilience, it results in uneven localised risk.

To assess and address the risk of climate change, CDM has developed a comprehensive Climate Change Response Strategy. This strategy guides CDM's approach to climate change response, aiming to bolster the district's social, economic, and environmental resilience. It provides a detailed assessment of the current state of affairs within the Capricorn District and its strategic context; an analysis of current and projected future climate impacts; the vulnerability, capacity, and risk profiles of local municipalities with respect to climate; and an implementation framework detailing response options. The strategy is currently under review and will be updated with current data and new projections.

The Strategy adheres to the principles laid out in the Constitution, Bill of Rights, the National Environmental Management Act, and the National Climate Change Response White Paper. It takes into account several cross-cutting focus areas with respect to the CDM and its local municipalities, including:

- Energy efficiency and demand side management;

- Renewable energy;
- Infrastructure projects, including transport, buildings, water management, wastewater treatment, and waste management;
- Economic development;
- Natural resource management, including agriculture;
- Disaster management;
- Water resource management.

In response to the impacts of climate change, CDM has initiated a pilot renewable energy programme by constructing biodigesters in the Polokwane (Ga-Makgoba village) and Blouberg municipalities (Indermark and Avon village). The District Climate Change Response Strategy is currently under review, and it will be updated with the most recent data and projections to better guide the region in climate adaptation and mitigation efforts.

5.1.2. Governance Considerations

It is recommended that the Capricorn District Municipality (CDM) establish clear responsibilities for each department regarding climate change mitigation and adaptation, linking these responsibilities to Key Performance Indicators (KPIs) to measure progress towards achieving climate objectives. This can be achieved by integrating climate change goals into existing plans and policies and tracking the outcomes through specific KPIs. For instance, the Department of Economic Development and Strategic Services within CDM can align its strategies, including the Integrated Development Plan (IDP), Spatial Development Framework, and Local Economic Development Strategy, with the overarching climate change objectives.

Additionally, the department can establish KPIs such as the count of local enterprises adopting sustainable practices or the volume of renewable energy produced within the district, to monitor advancements towards climate goals. It is also crucial that the municipality prepares to respond to climate-related disasters, including floods and wildfires, whose frequency and intensity are projected to increase with climate change. By aligning climate change objectives with existing plans and policies and keeping track of progress using KPIs, the CDM can ensure the incorporation of climate change considerations into every aspect of its municipal operations. This approach will not only facilitate progress towards a sustainable future but also equip the district with the necessary resources to effectively respond to the impacts of climate change.

5.1.3. Information Management

Implementing the climate change response plan in Capricorn District Municipality (CDM) effectively necessitates the cultivation of a risk avoidance mindset among all stakeholders. This entails empowering officials, politicians, residents, and other participants through comprehensive education, training, and public awareness campaigns, underpinned by scientific research. By enhancing awareness and understanding of climate change impacts and responses, a sense of responsibility and ownership among stakeholders can be fostered.

To achieve this, CDM can execute the following actions:

- Firstly, the municipality can create and execute an integrated education and training programme on climate change and its implications for the district. This should target officials, politicians, and residents, ensuring a shared understanding of climate change and the urgency of taking action.
- Secondly, CDM can leverage scientific research and data to inform education and training materials, guaranteeing that stakeholders receive precise and current information. This can also help pinpoint critical risk areas and locations where intervention is most urgently needed.
- Thirdly, the municipality can advance public awareness campaigns on climate change and its effects. This can be propagated through various channels, such as social media, community workshops, and public events. Such campaigns can heighten public awareness and understanding of climate change and the need for action, providing practical advice on measures individuals can take to reduce their impact. ▪ Fourthly, the municipality can advocate for the participation of residents, civil society organizations, and the private sector in climate change mitigation and adaptation actions by offering opportunities for engagement and collaboration. This can encompass the establishment of partnerships with relevant stakeholders to design and execute joint initiatives and supplying resources and support to individuals and organizations undertaking action.
- Lastly, CDM can form partnerships with academic institutions and research organizations to ensure continual access to the latest research and expertise in the field of climate change. This can aid in keeping the municipality abreast of the newest developments in the field and facilitate the utilization of the latest knowledge and tools to inform decision-making and actions.

By fostering a culture of risk avoidance and capacitating all role players, CDM can create a conducive environment for effective implementation of the climate change response plan, ultimately contributing to a more resilient and sustainable district. This will necessitate an enduring commitment and effort, alongside continuous engagement with stakeholders to ensure their needs and viewpoints are incorporated into climate change policies and initiatives.

5.1.4. Funding Mechanisms

Climate change is an increasingly pressing challenge for local municipalities in South Africa, and addressing it requires significant funding. Various funding mechanisms are available to support climate change response initiatives, including national and international grants, public-private partnerships, and municipal budgets. However, local municipalities may face issues such as insufficient funds, limited capacity to manage funds effectively, and limited access to funding sources.

One such mechanism is the Municipal Infrastructure Grant (MIG). The MIG provides funding to municipalities for the development of basic infrastructure such as water, sanitation, and solid waste management. The MIG can be used to fund climate change response projects that are related to these infrastructure needs. However, the MIG is limited in scope, and municipalities may struggle to fund all necessary climate change projects using this mechanism alone.

Another funding mechanism available to municipalities is the Green Fund. The Green Fund is a national funding mechanism that provides financing for green initiatives. The Green Fund can be used to finance projects related to renewable energy, energy efficiency, and climate change adaptation and mitigation. However, the Green Fund has limited resources, and there is significant competition for funding from other municipalities and organisations.

Municipalities can also access funding from international organisations such as the Global Environment Facility (GEF) and the Green Climate Fund (GCF). These organisations provide financing for climate change response programmes in developing countries. However, accessing funding from these organisations can be challenging, as there are stringent requirements that municipalities must meet to be eligible for funding.

In addition to these funding mechanisms, municipalities can explore public-private partnerships (PPPs) as a means of financing climate change response programmes. PPPs involve collaboration between the public and private sectors to finance and implement infrastructure projects. PPPs can provide municipalities with access to additional funding sources, as well as 164 private sector expertise in project management and implementation. However, municipalities must ensure that the terms of the partnership are equitable and that the private sector partner is committed to the project's goals.

There are several issues that municipalities may face when accessing funding for climate change response programmes. One challenge is the lack of technical expertise within municipalities to develop and implement climate change projects. This can make it

difficult for municipalities to access funding from organisations such as the Green Fund, as these organisations often require detailed project proposals and technical expertise.

Another issue is the limited resources available to municipalities for climate change response. Many municipalities in South Africa are already facing significant financial constraints, and funding climate change response programmes may be seen as a lower priority than other basic service delivery needs. This can make it challenging for municipalities to allocate resources to climate change response programmes.

To overcome these challenges, municipalities should focus on building technical capacity in-house and forming partnerships with private sector organisations to access additional funding sources. Municipalities should also explore innovative financing mechanisms such as green bonds and crowdfunding, which have been successful in other jurisdictions.

In conclusion, funding mechanisms are available for local municipalities in South Africa to finance their climate change response programmes. However, municipalities must navigate a complex landscape of funding sources and ensure that they have the technical expertise and capacity to develop and implement successful projects. Municipalities can access the resources they need to build more resilient and sustainable communities by exploring innovative financing mechanisms and forming partnerships with private sector organisations.

5.2. Recommendations for Mainstreaming

Mainstreaming climate adaptation within the Capricorn District Municipality (CDM) necessitates a multifaceted approach that takes into account the current institutional structures, processes, and instruments within the district. This comprehensive strategy should aim to integrate climate-responsive thinking into all aspects of the municipality's work, making it a standard consideration rather than a separate concern.

1. Opportunities for Mainstreaming: There exist various opportunities for mainstreaming within CDM. For instance, the District Development Model (DDM), with its integrated approach to planning and delivery across different spheres of government, provides an excellent platform for embedding climate adaptation into existing strategies. Climate adaptation considerations can be introduced into the joint "*One Plan*" approach that the DDM utilises.
2. Leveraging Existing Decision-making Structures: Existing decision-making structures, like the Project Management Unit (PMU), can be harnessed for climate adaptation. For example, the PMU's framework for assessing and approving projects can be updated to incorporate climate responsiveness/adaptation/sustainability, thereby ensuring that all new initiatives are climate-friendly.
3. Targeting Planning Instruments for Mainstreaming: Key planning instruments such as the Integrated Development Plan (IDP), Spatial Development Framework, and Local Economic Development Strategy can be targeted for mainstreaming climate adaptation. These documents can be revised to include climate evidence and adaptation actions.

Some specific mainstreaming recommendations include:

- Key Performance Indicators (KPIs): Climate response/adaptation/sustainability outcomes should be included in the KPIs of all departments, ensuring that progress towards climate goals can be tracked and measured.
- Raising Awareness: Conducting awareness training with groups like the Project Management Unit, Strategic Procurement, Councillors, and other relevant entities can facilitate mainstreaming. By improving their understanding of climate change and the need for adaptation, these groups can better integrate climate considerations into their work.
- Policy and Plan Updates: Existing policies and plans should be updated to reflect the climate risk profile and adaptation actions. This could include incorporating climate change considerations into land use plans, infrastructure development strategies, and emergency management plans.
- Funding: CDM should explore existing and new revenue streams to support climate adaptation/response efforts. This could include applying for grants from government agencies, engaging in public-private partnerships, and incorporating climate adaptation into budget planning processes.
- Capacity Building: There is a need for ongoing training and capacity building of officials in all departments to enhance their understanding of climate change and their ability to incorporate climate considerations into their work.

- Establishing Networks or Partnerships: CDM should consider establishing networks or partnerships with civil society organisations, the private sector, government, and other relevant entities to bolster climate adaptation efforts.

Underpinning all these strategies is the DDM, which can serve as the backbone of these efforts. By adopting a "*One District, One Plan, One Budget*" approach, CDM can ensure that all development initiatives in the district are climate-friendly. The DDM's objectives of breaking down silos, maximising impact, narrowing the distance between people and government, and ensuring sustainable development align well with the goal of mainstreaming climate adaptation.

To conclude, mainstreaming climate adaptation in CDM requires a comprehensive, integrated approach that leverages existing structures and processes, builds capacity, and involves all stakeholders. By taking these steps, CDM can ensure a more sustainable and resilient future for its people and the environment.

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