GREENBOOK
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Ugu District Municipality

Ugu District Municipality
Adaptation Plan

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Title:	Ugu Municipality: Adaptation Plan
Authors:	Melanie Lück-Vogel, Amy Pieterse, Lethabo Chilwane & Willemien van Niekerk
Project lead:	Amy Pieterse (CSIR)
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List of Acronyms and Abbreviations

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

Glossary of Terms

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

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

1. Introduction

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

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

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

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

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

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

The Adaptation Plan briefly outlines the policies constituting the framework for adaptation planning and implementation in South Africa. It then goes on to describe generic adaptation principles, approaches, pathways, and various categories of actions. Subsequently, the plan suggests a specific adaptation strategy for Ugu District Municipality by aligning it with adaptation goals, programmes, and actions designed to address priority risks, as well as an implementation framework, designed to identify appropriate actors and enable the implementation of the strategy. Finally, the document concludes with recommendations aimed at facilitating the integration of the proposed actions into broader initiatives, ensuring their effective mainstreaming.

1.1. Policy Framework

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

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

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

1.2. Outline of the Climate Change Adaptation Plan

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

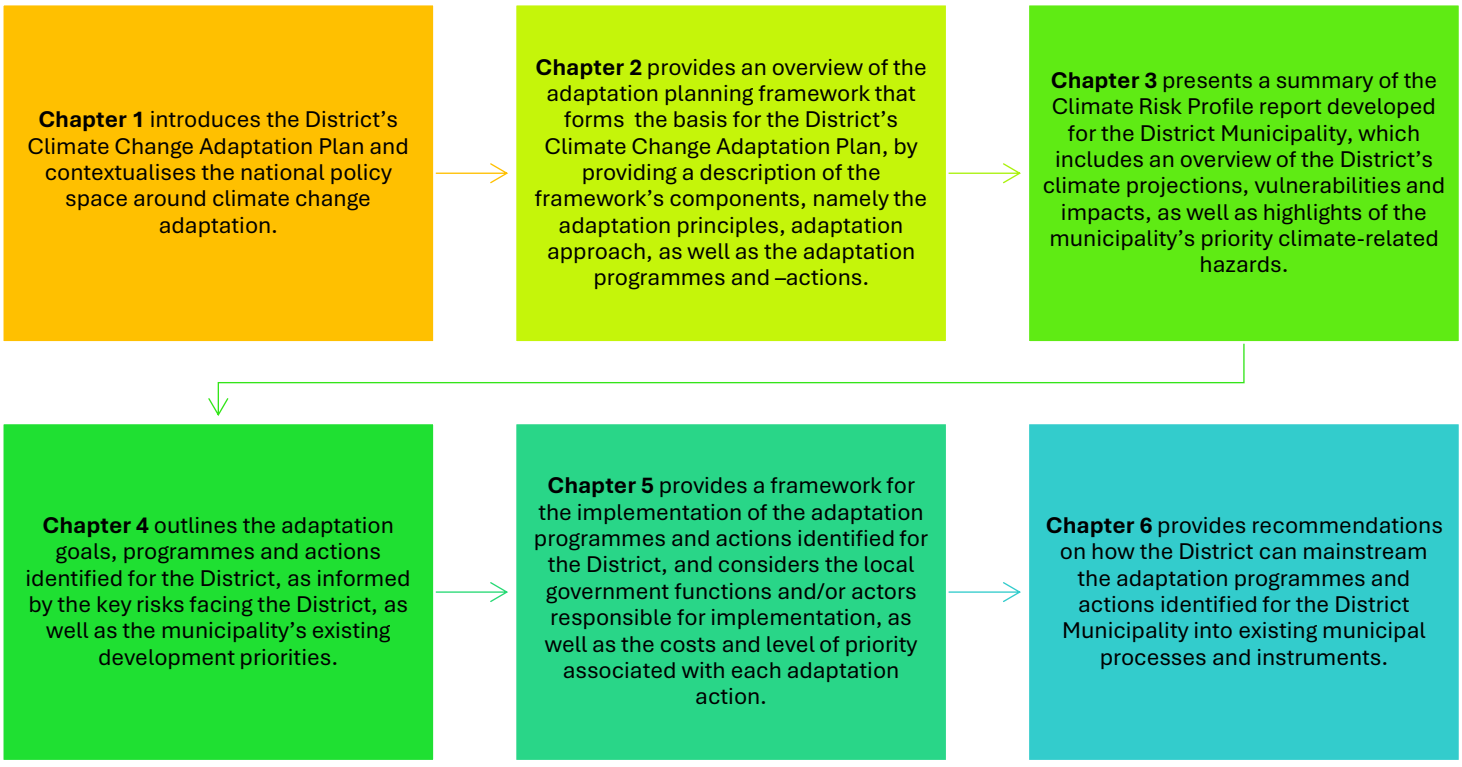

Figure 1: Outline of the Climate Change Adaptation Plan.

2. Adaptation Planning Framework

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

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

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

2.1. Adaptation principles

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

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

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

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

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

2.2. Adaptation approach

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

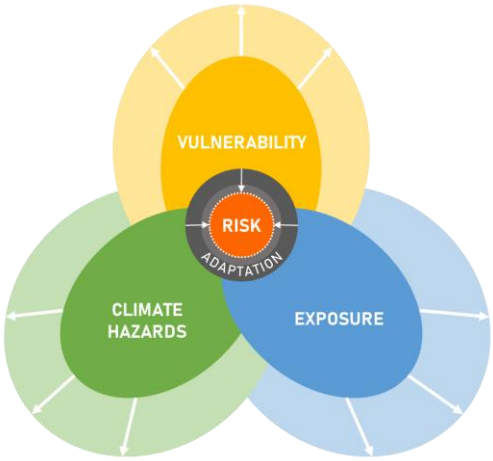

Figure 2: The interplay between hazards, vulnerability and exposure that determines risk (based in IPCC, 2014 and IPCC, 2021)

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

The approach followed in this plan involves the following steps:

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

v. Integrate climate considerations into other sector plans/instruments/strategies.

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

Table 1: The adaptation approach

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

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

2.3. Adaptation programmes and actions

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

Broadly, adaptation actions include anticipatory and reactive measures. Anticipatory adaptation involves proactive measures taken in preparation for anticipated climate change impacts, while reactive adaptation entails responding to climate change effects as they are experienced. Furthermore, it facilitates the integration

and prioritisation of climate change adaptation and resilience measures into various planning mechanisms and processes (CSIR, 2023).

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

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

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

2.4. Stakeholder engagement process

To construct a Climate Change Adaptation Plan resonating with the specific requirements of the Ugu District Municipality, while appropriately addressing its significant risks – a stakeholder engagement component was factored into the adaptation planning process, which gave district municipal officials and practitioners a platform to provide meaningful input on both the Risk Profile report and Adaptation Plan. The first stakeholder engagement focused on the Climate Risk Profile report of the District Municipality, with the aim of validating the climate-related risks identified for the district (as flagged in the Risk Profile report), while securing the District's confirmation of the adaptation goals proposed in response to the identified risks. The second engagement took place after a draft Climate Change Adaptation Plan was developed. As part of this

engagement, each climate change adaptation programme identified under each goal, as well as each of the actions associated with the adaptation programmes, were intensely workshopped with the Provincial, District and relevant local municipal officials/stakeholders, in an effort to gather comprehensive input that would help the project team finalise the document. Municipal officials and practitioners from various sector – particularly those sectors that are either most vulnerable to climate change impacts, or those that are well-positioned to respond to climate change, particularly through adaptation, namely Environmental Management, Environmental Planning, and Climate Change Management – were present during these engagements. This was done in an effort to fulfil section 7.1 (a) of the Climate Change Bill, and to achieve a holistic response to climate change. All engagements took place virtually.

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

3. Summary of Climate Risk Profile

This section of the Plan summarises the climate risk profile for Ugu District Municipality, drawing from the GreenBook Risk Profile Tool (available at: https://riskprofiles.greenbook.co.za/). The Risk Profile report builds the foundation for the Response Actions suggested in the subsequent sections. Please consult the accompanying Climate Risk Profile Report for more detailed information.

3.1. Climate projections, vulnerabilities and impacts

It is expected that by 2050 the Ugu DM will see a slight increase of the average annual temperatures of up to 2.0°C in the inland and up to 1.5°C in the coastal belt. Currently, total number of very hot days (>35°C) is with 0 – 20 days very low. A minimal increase by up to 2 days per year is expected by 2050, particularly in the inland of the DM. The number of heatwave days might increase from currently 2 to 4 days in the inland areas. Therefore, the risk of increasing heat by 2050 in the DM is relatively low.

Ugu district currently experiences average annual rainfall amounts ranging from about 1500 mm in some inland areas to 2440 mm in the southern coastal parts. Most of the district's inland has average annual rainfall amounts between 1600–2000 mm, and the coastal zone between 2000-2400 mm. For 2050, it is projected that the district will receive more rainfall. The most eastern and northern areas of the district are expected to see an average increase of 130-200 mm per year, and the other areas between 200-300 mm per year under a low mitigation - high emissions scenario. Furthermore, Engelbrecht (2019) states that the region can expect higher rainfall variability, increased likely intensity and more frequent extreme events, especially in the coastal belt. Between 1980-2022, the district experienced about 5 storm-related disasters (Figure 3).

Between 1980-2022, the district experienced about 5 drought-related disasters (Figure 3). However, in the recent past, there was a slight tendency towards less dry spells. This trend seems to continue in the future, concluding that for all settlements in the district the likelihood of increase in droughts is very low.

Wildfire occurrence on the settlement edges is currently "likely" due to the subtropical climate creating dense and fast vegetation growth in the inland area of the Ugu DM, but "rare" in the more humid coastal belt. Between

1980-2022, the district experienced 4 wildfire related disasters (Figure 3). A “moderate” increase in likelihood of wildfires is predicted in the future for the inland region, but only a “low” likelihood of increase for Ray Nkonyeni’s coast and a “very low” increase for Umdoni’s coast. However, the baseline number of high fire danger days in the region is less than 10 days annually currently and into the future, rendering the overall fire risk in the DM as very low in the national comparison.

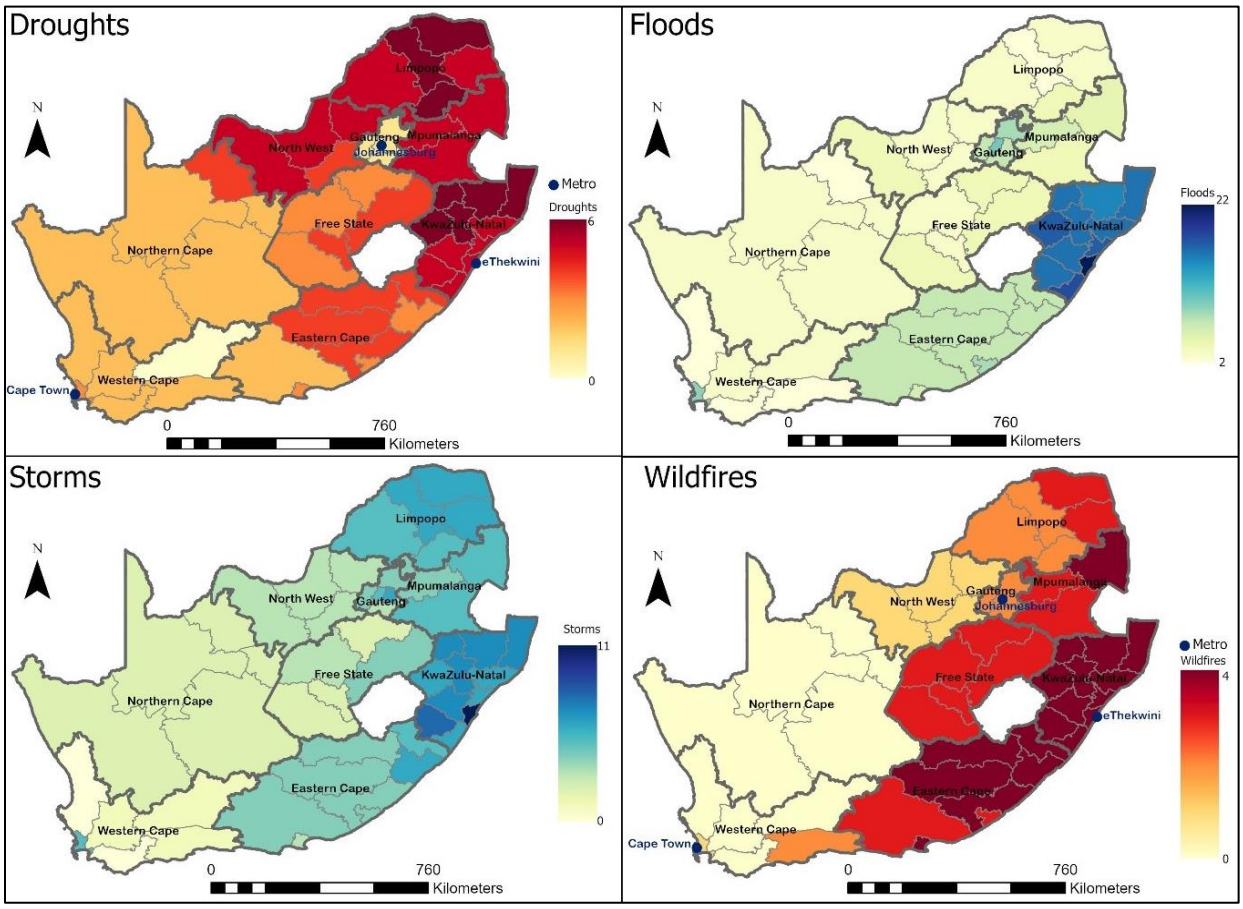

Figure 3: Weather-related disasters in South Africa between 1980-2022. Source: Bopape et al. 2024

Surface water is the main water resource and is not at risk of depletion despite a slight increase in annual temperature and evaporation, due to the very high rainfall in the region of 1600-2400 mm/a. Nevertheless, water supply vulnerability does exist in the LMs of Umzumbe, uMuziwabantu and Ray Nkonyeni, likely related to the low total number of households with access to piped water within their dwellings (36.2%) in the district. Sanitation and waste management services are accessible, but only 37.1% of formal dwellings equipped with flushing toilets connected to sewerage, and 33.1% receiving weekly refuse disposal services.

Agricultural activity is generally confined to the coastal strip and inland to the west of Umzinto and Port Shepstone (Oribi Flats). The tourism sector is well-developed along the coast, but tourism infrastructure and facilities are generally out-dated (developed in the 1960s and 1970s).
However, about 50% of the natural environment has been transformed into cultivated crops, wood plantations and settlement areas (DEA 2018). Large areas in uMuziwabantu have been transformed into forest plantations, while fruit and crop agriculture dominate in the more coastal regions.

Growth pressure is highest in the settlements of Port Shepstone, Hibberdene, Harding, Amangamazi and the traditional areas in Umdoni. However, growth pressure in all LM's is below the provincial growth rate, and Umzumbe's growth rate is negative. This means that under current conditions, growth is not one of the major pressures in this DM.

Ugu DM it is also included in the presidential Eastern Seaboard and Smart Cities Development Initiative. National Department of Cooperative Governance and Traditional Affairs (CoGTA) through the Municipal Infrastructure Support Agent (MISA) has embarked on a process to develop the Eastern Seaboard which will ultimately culminate in one or more African coastal smart cities in the region of the OR Tambo, Alfred Nzo, Ugu and Harry Gwala districts across the Eastern Cape – KwaZulu Natal boundary and will include major restructuring of proposed road infrastructure, agricultural and urban development priority areas (COGTA 2023). Figure 4 provides an overview of the proposed changes, indicating that the coastal area between Port Edward and Pennington is foreseen to become a continuous, highest order settlement.

3.2. Priority climate-related hazards

Section 3.1 highlighted the following climate trajectories which are of greatest concern:

- By 2050, the district will receive more average annual rainfall
- The district can also expect higher rainfall variability, increased likely intensity and more frequent extreme events, especially in the coastal belt

The most important circumstances relating to existing and future settlements and infrastructure are as follows:

- Most economic activities like agriculture and tourism take place in the coastal belt
- About 50% of the natural environment has been transformed into cultivated crops, wood plantations and settlement areas
- Only 36 % of households have access to piped water
- only 37.1% of formal dwellings are equipped with flushing toilets connected to sewerage,
- and 33.1% receiving weekly refuse disposal services
- the planned Eastern Seaboard Development is foreseeing the development of highest order settlements in the coastal zone between Port Shepstone and Pennington

From this combination of climate and development trends the following climate related hazards evolve:

Increased risk of infrastructure and population exposure to rainfall-related flooding:
The increase in rainfall, especially the predicted increase in extreme events, might threaten agricultural, traffic, economic and other infrastructure and livelihoods, specifically in low-lying areas such as estuaries and on steep slopes. The high transformation rate of natural land cover into agriculture and settlements reduces the rate at which the land can absorb storm water, leading to increased surface run-off thus contributing to flood risk.

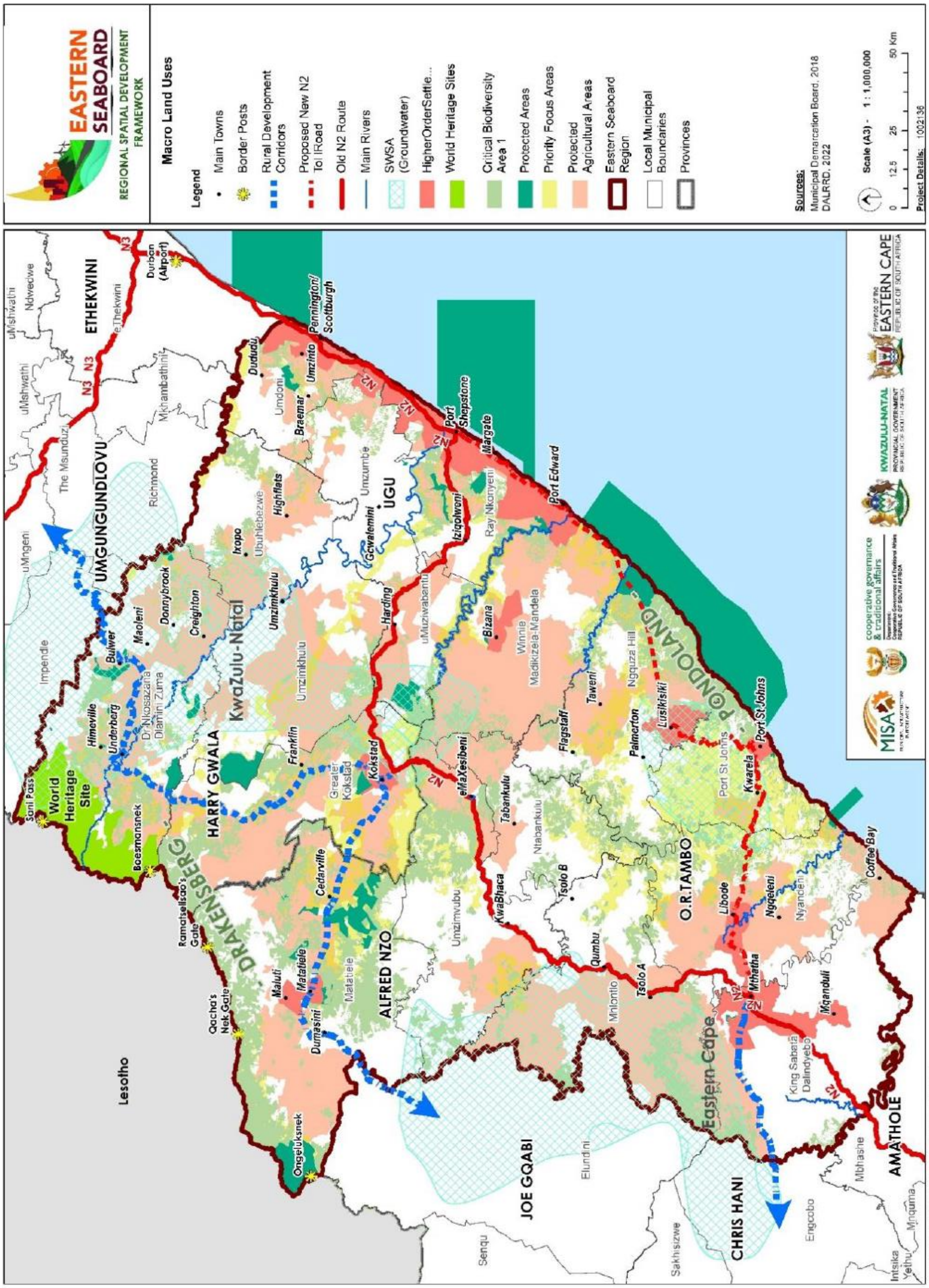

Figure 4: Proposed macro land use in the Eastern Seaboard Spatial Development Framework (COGTA 2023).

Extreme rainfalls, causing surface run-off and flooding, might also lead to soil erosion and landslides in steep terrain and might lead to pollution of surface water bodies and freshwater sources.
Extreme events are the biggest challenge for the Wholesale and retail trade, catering and accommodation sector, which is, after governance, the second most important sector in Ugu, as they cause damage to economic infrastructure and might lead to service disruption and blocked accessibility, if roads and other traffic infrastructure are affected.

Increased risk of stormwater pollution:
The low rate of households connected to flushing toilets and sewerage systems and the low rate of weekly refuse disposal service provision, in connection with the expected increase in extreme rainfall events is likely leading to sewerage and solid waste being flushed away with storm water. This leads to the pollution of urban, natural and agricultural environments, which might lead to water-borne diseases.
As most of the households in the DM currently receive their fresh water from surface water (rivers), this threat is of concern, as sewerage and solid waste are likely to pollute freshwater sources contributing to health-risks as well.

Increased water supply vulnerability:
Apart from threats to fresh water by sewerage and solid waste pollution, industry and agriculture are other contributors to water pollution. Additional major factors contributing to increased water supply vulnerability in the DM are a failing water and sewage infrastructure and population growth. The district is aware of the shortage of water supply, as indicated by the first strategic priority of the Climate Change Response Strategy for the Ugu District Municipality: “to provide access to sustainable quality drinking water and sanitation services” (Ugu, 2017).
The pressure on water supply and sanitation is however going to increase extremely, should the Eastern Seaboard Development come into fruition.

Increased exposure of future development to coastal flooding and erosion:
The coastal zone historically experienced the highest amount of extreme rainfall and wind and wave impact during coastal storms, adding to the already high annual rainfall amount. High rainfall over the inland leads to high water levels and flooding in coastal estuaries. High wave energy and storm surges lead to erosion of the generally unconsolidated, sandy shore of the district. Again, the coastal zone of Ugu is a major contributor to the district’s economy, and the spatial co-incidence of economic activity and climate threats are already a situational concoction prone to disaster. The Eastern Seaboard Development foresees urban and industrial development in the high-risk coastal zone which is likely to exacerbate exposure and risk to coastal and climate risks, if not managed proactively.

Increased vulnerability of traditional settlements:

The Umzumbe local municipality, whose population is almost entirely living in traditional settlements, has the highest poverty levels at 19% in the district (COGTA, 2019). Consequently, the socio-economic vulnerability at household level is highest in Umzumbe, indicating that Umzumbe’s population is extremely vulnerable to external shocks such as climate extreme events.

4. Adaptation Goals, Programmes and Actions

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

4.1. Adaptation goals

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

- **Goal 1: To ensure water security for human consumption in the face of climate change**
- **Goal 2: Improved stormwater management** to reduce the quantity, improve the quality, and slow the flow of stormwater runoff from developed areas, and to identify suitable areas for managing water runoff.
- **Goal 3: To protect and rehabilitate ecological infrastructure** to be able to support climate change response.
- **Goal 4**: **To increase the adaptive capacity of communities and** settlements to climate change and extreme events

The adaptation programmes below identify the overarching programmes and associated actions, necessary to achieve each one of the goals. Specific timeframes and responsibilities are allocated in the subsequent implementation framework (section 5).

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

Section 3 indicated that to date only about a third of Ugu's households have access to piped water. Usage of "natural" surface water sources bears health risks and is reliant on sufficient rainfall which might cause water shortage in the drier winter months and during extended droughts. From that perspective, a more complete and equitable provision of piped freshwater is desirable. On the other hand, even with currently only a small fraction of households receiving piped water, water supply in the DM is already constrained.
Projected population growth and worsening extreme rainfall will put further pressure on the district's water supply if infiltration and pollution of surface water is not avoided. However, increasing average rainfall also offers opportunities for alternative water resource exploration.

Programme 1.1: Protect, Maintain and Improve Water Services Infrastructure
This programme aims to increase the resilience of water services to climate change and expected increased water demand, by improving infrastructure reliability, reducing downtime, and minimising service interruptions, thereby addressing water reticulation losses and ensuring sustainable water supply for municipalities. The following actions would contribute to this programme:

- **Regular maintenance and inspection:** Implement regular maintenance schedules for water infrastructure, including pipelines, treatment plants, reservoirs, and pumping stations. Conduct

routine inspections to identify and address potential issues before they escalate into larger problems and to reduce water losses through leakages. All water provision infrastructure should be maintained to ensure that it will be able to deal with extreme events such as flooding and drought, and remain in functioning condition.

- **Prioritise repairs based on the condition and criticality of infrastructure components:** This includes the installation of technology that can detect leaks in water supply reticulation and send notifications and alarms to relevant personnel. Retrofit existing infrastructure to withstand extreme weather events, such as floods, storms, and droughts.

- **Infrastructure upgrading and expansion towards more equitable freshwater provision and anticipating future growth:** Invest in upgrading infrastructure to improve reliability, efficiency, and resilience to climate change impacts and more equitable and healthier freshwater access and increased water demands in the near future.
- **Climate-resilient design:** Incorporate climate-resilient design principles into new infrastructure projects to future-proof against climate risks, particularly extreme rainfall and droughts. This action should be obligatory for all infrastructure to be developed in the Eastern Seaboard Development.
- **Continual water demand side management** to increase preparedness for dry periods (incl. replication of successful water conservation programmes).

Programme 1.2 Reduce water usage

Extending and upgrading the freshwater supply network is likely to put burden on the local municipalities. However, promoting the "wise" use of available freshwater and avoidance of water wastage can take burden from water providers and users. The following actions are proposed:

- **Promote and implement water conservation practices to households and communities** through the adoption of water-saving behaviours and technologies to reduce water wastage and optimize water use efficiency This includes providing information and resources to the public. Schools are good starting points to implement *water-wise citizenship* from an early age.
- **Raising awareness and education at businesses, and public institutions: Implement** public awareness campaigns to encourage water-saving practices. Educate and raise awareness among stakeholders about the importance of reducing water demand as a climate change adaptation strategy. This includes providing information and resources to businesses and policymakers about the benefits of water conservation, as well as offering training and outreach programs to promote water-saving behaviours and practices.
- **Make use of smart metering and steep block tariff schemes** ('more you use the more you pay per unit') for water to increase/incentivise water saving efforts
- **Water-efficient landscaping:** Encourage water-efficient landscaping practices in urban, suburban, and rural areas to reduce outdoor water demand. This could include promoting drought-tolerant native plants, mulching, soil moisture retention techniques, and efficient irrigation systems, as well as implementing landscaping ordinances and incentives to support water-wise landscaping practices. Encourage the adoption of water-smart urban planning practices like rainwater harvesting and greywater reuse.

Programme 1.3: Diversification of water sources

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

alternative water sources which can substitute the use of freshwater to varying degrees. Many actions can be implemented at household level which will also reduce the financial burden on the municipality. The following actions are suggested.

- **Conduct feasibility studies, hydrogeological assessments, and environmental impact assessments** to evaluate the potential of alternative water sources and determine the most suitable options for local conditions.
- **Rainwater harvesting:** Promote the collection and storage of rainwater households, businesses and public spaces for later use. Encourage individuals, communities, and municipalities to collect rainwater from rooftops and other surfaces. This can be done through the installation of rain barrels or more extensive rainwater harvesting systems for larger-scale applications like agriculture or municipal use. Harvested rainwater can be used for various non-potable purposes, thus reducing pressure on freshwater sources.
- **Improve stormwater retention systems** to use flooding events to store water against future drought periods. This will contribute to flood attenuation as well as increased drought resilience
- **Wastewater recycling and reuse:** Implement systems to treat and reuse wastewater for non-potable purposes such as irrigation, industrial processes, and toilet flushing.
- **Re-using greywater from kitchen and bathroom sinks, showers and baths:** Divert greywater into above ground tanks or underground cisterns, providing water for industrial usage, gardens & parks and some household usage (e.g. toilet flushing). Combined grey- and rainwater systems are thinkable. Greywater is available all year round while rainwater is largely provided in the rainy summer season, so a combination of both can alleviate pressure on fresh water sources especially in the dry months. This not only conserves water but also reduces the burden on wastewater treatment plants.
- **Change building regulation to demand by default separate grey and blue water systems** (as is done in parts of Namibia, for example).
- **Investigate alternative water storage options** (e.g. underground or dam expansion) where appropriate. Underground storage minimises losses through evaporation. This will increase water security and drought resilience
- **Seawater desalination:** Having the advantage of bordering the ocean, investigate water desalination options which can run on non-fossil energy e.g. using wave power to create the pressure needed for desalination or using solar/wind to generate the necessary energy for desalination

Programme 1.4: Building Institutional Capacity and Stakeholder Engagement

This programme focuses on strengthening institutional capacity and fostering stakeholder collaboration to support effective water management under climate change. It includes improving coordination among agencies, providing training for water professionals, and promoting public participation and awareness in water management and climate adaptation efforts. The adaptation actions under this programme include:

- **Enhancing coordination among government agencies:** This involves establishing multi-stakeholder committees to improve coordination and communication among government agencies, NGOs, and community groups involved in water management. Protocols should be developed for data sharing and joint decision-making.
- **Providing training on climate resilience for water professionals:** This involves developing and delivering training programs on climate resilience, water management, and disaster preparedness

for local water professionals, planners, and decision-makers. The district and its municipalities can partner with educational institutions to integrate climate resilience into their curricula.

- **Conducting public awareness campaigns on water management:** This entails organising public forums, workshops, and media campaigns to educate residents about the importance of water conservation, climate risks, and adaptation strategies. Community involvement should be encouraged in water management initiatives.
- **Developing and implementing water conservation education programmes:** This involves integrating water conservation and climate resilience topics into school curricula and community education programmes. Workshops, fieldtrips, and hands-on activities should be organised to engage students and residents.

4.3. Adaptation programme Goal 2: Improved stormwater management

Programme 2.1: Improving Stormwater Management Infrastructure
This programme focuses on upgrading and maintaining formal stormwater management infrastructure to handle increased rainfall variability and intensity. It includes measures to enhance the capacity and resilience of drainage systems, reduce runoff and destructive flooding, and protect freshquality. The adaptation actions under this programme include:

- **Regular inspection, and maintenance of stormwater and road infrastructure**, in particular storm water culverts and bridges to detect and remove blockages and damages.
- **Upgrading drainage systems:** This, including culverts, channels, and retention ponds, to accommodate increased stormwater runoff resulting from extreme weather events. includes assessing and upgrading existing drainage systems to increase their capacity and resilience to extreme rainfall events. Sustainable drainage systems (SuDS) should be implemented to enhance water infiltration and reduce flood risks.
- **Constructing retention and detention basins:** This entails building retention and detention basins in strategic locations to temporarily store stormwater during heavy rainfall events. These basins help to control the flow of water, reduce peak discharge, and improve water quality through sedimentation. A co-benefit is enhanced groundwater recharge and improved water quality. Systems which combine stormwater retention with creation of water- and wetland ecosystem functions are thinkable (artificial wetlands provide other co-benefits such as habitat provision and for recreation).
- **Implementing check dams and terracing:** This entails constructing check dams and terracing in hilly and sloped areas to slow down waterflow, reduce erosion, and increase water infiltration. These structures help to manage stormwater runoff and protect downstream water sources. A co-benefit is improved soil health and enhanced water retention in the landscape.
- **Promoting rainwater harvesting systems:** This involves encouraging the installation of rainwater harvesting systems in homes, schools, and public buildings to capture and store rainwater for non-potable uses such as irrigation and flushing toilets. Incentives and technical support should be provided for implementation. A co-benefit is reduced water bills.
- **Water Sensitive Urban Design (WSUD):** Adopt water-sensitive urban design principles and practices to integrate stormwater management with urban planning and design, incorporating features such as water-sensitive streetscapes, green corridors, and sustainable drainage systems to enhance water quality and mitigate urban heat island effects.

Programme 2.2: Enhancing Green Infrastructure and Natural Water Management

As pointed out above, about 50 % of Ugu's land is in a non-natural condition and has lost its stormwater-retention, infiltration and purification capabilities. Protecting existing natural areas and restoring degraded ones strengthens the landscape's capacity to buffer against climate change effects. E.g. Wetlands provide natural stormwater retention services, as they can absorb excess rainfall, reduce runoff, and mitigate the risk of urban flooding—a threat exacerbated by climate-induced extreme weather events. Reduced surface run-off reduces the risk of (arable) soil erosion and landslides. Reduced spillage of storm water into natural water bodies will also improve water quality and support the health of downstream water sources to better provide other ecosystem services (e.g. fish as food source).

Main sources of pollution are urban and industrial sources, agriculture (run off of fertilisers and pesticides) and insufficient stormwater management and sewage overflows during extreme rainfall events. Another risk to dams is loss of storage volumes by silting up by river sediments, especially during extreme events. This programme aims to manage stormwater in an Ecosystem-based Adaptation (EbA) approach. The suggested activities to protect surface water sources are as follows:

- **Protect, restore and increase natural ecological infrastructure** to slow, spread and sink storm and floodwater run-off. This can include creation/restoration of natural wetland and riverbank vegetation, renaturalisation of concrete stormwater swales into soft-surface, meandering, vegetated streamlets.
- **Construction of hard infrastructure** where appropriate e.g. gabions to protect freshwater from storm- and flood-water intrusion. This will also allow more water infiltration into soil and groundwater, as well as decrease flood impacts.
- **Promote farming practises that prevent surface run-off and soil erosion**, e.g. contour farming and in-between crops to avoid fallow, erosion-prone soils
- **Review (and adopt, if necessary) standard environmental approval processes** linked to agricultural use to take the impact of climate change into account. This will prevent the development of climate-inappropriate agriculture, as well as improve water demand planning.
- **Plan for increased river sediment loads** during extreme rainfall events and its effect on dam infrastructure and storage capacity (e.g. riverbank stabilisation to prevent erosion leading to sediment build-up in water storage structures). This will prevent the loss of water storage capacity, which will improve drought resilience.
- **Expand urban green infrastructure** to improve water infiltration, flood attenuation and thus reduce polluted run-off. This will also contribute to carbon sequestration and decreased urban heat island effect while also improving air quality.
- **Implementing permeable pavements:** This includes replacing traditional impermeable surfaces (e.g., asphalt, concrete) with permeable materials in public spaces, parking lots, and walkways to allow water infiltration and reduce runoff. Pilot projects should be conducted in key areas to demonstrate effectiveness. A co-benefit is enhanced groundwater recharge.
- **Establishing rain gardens and bioswales:** This involves creating rain gardens and bioswales in parks, along streets, and in residential areas to capture and filter stormwater. These features use indigenous plants and engineered soil to enhance water infiltration and pollutant removal. A co-benefit is enhanced biodiversity and improved urban aesthetics.

- **Expanding urban tree canopy:** This involves increasing tree planting initiatives in the urban areas of the district to provide shade, reduce runoff, and improve air quality. Indigenous and drought-resistant species that can withstand climate variability and high temperatures should be used.
- **Developing green roofs and walls:** This includes promoting the installation of green roofs and walls on public and private buildings to capture rainwater, reduce runoff, and provide insulation. Incentives and technical support should be offered for property owners.

Programme 2.3: Community Engagement and Capacity Building
This programme focuses on engaging the community and building capacity to manage stormwater and adapt to climate impacts. It includes public awareness campaigns, education initiatives, and stakeholder collaboration to foster a culture of water conservation and resilience. The adaptation actions under this programme include:

- **Providing training for local authorities and stakeholders:** This involves offering training programmes for local authorities, planners, and community leaders on stormwater management, green infrastructure, and climate resilience. The district and its municipalities can partner with educational institutions and NGOs for capacity-building initiatives.
- **Conducting public awareness campaigns**: This includes launching campaigns to educate residents about the importance of stormwater management, water conservation, and climate adaptation. The health risks arising from untreated sewage and solid waste polluting freshwater sources should be included as well as household-based options to reduce health risks from contaminated water. Various media channels and community events should be used to disseminate information and promote best practices.
- **Establish Community-Based Monitoring Programmes:** This includes involving local communities in monitoring stormwater runoff, water quality, and the effectiveness of green infrastructure projects. Training and resources should be provided for citizen science initiatives to gather data and inform adaptive management. Monitoring programmes will lay the foundation for detection of long-term trends.

4.4. Adaptation programme Goal 3: Preserving ecological resilience, maintaining biodiversity, and safeguarding ecosystem services essential for human well-being

The district's natural environment is an asset to its tourism industry and plays an important role in buffering and mitigating the impacts of climate change, such as extreme rainfall events and coastal storm impacts. However, it is under severe pressure due to rapid urbanisation and land-use change (and will be even more so with the Eastern Seaboard Development), leaving the district's natural environment and resources, as well as biodiversity, very vulnerable and reducing the provision of valuable ecosystem services. It is thus necessary to protect and restore these natural environments in order to maintain their key functions.
The first step towards this goal is therefore the identification of critical ecological infrastructure (open spaces) within municipal boundaries/property that need to be protected/rehabilitate. The following programmes and activities provide guidance on how to tackle identified ecological infrastructure challenges.

Programme 3.1: Preserving and restoring wetlands and riparian buffer zones
The programme aims to preserve, restore and re-create the buffer function of wetlands and water bodies to absorb stormwater and purify water. Further, wetlands are endangered hotspots of biodiversity and teal

carbon sinks, thus directly acting towards climate mitigation. The following actions towards restoring and protecting them are suggested:

- **Inventory of water bodies and wetlands in the DM:** Assess the location and condition of rivers, streams and standing water bodies regarding their ecological condition. Identify and map valuable ecosystems: conduct comprehensive surveys to identify and map critical natural areas, biodiversity hotspots, and ecosystem service providers within the municipality.
- **Enforce Environmental Regulations:** Effectively enforce existing environmental regulations to prevent illegal activities like deforestation, pollution, and overexploitation of natural resources.
- Identify and prioritise interventions needed to improve ecosystem health and to enhance/maintain ecosystem service delivery such as stormwater retention and purification, nursery function for species etc.
- **Develop Conservation Plans:** Create and implement local conservation plans that prioritize the protection of sensitive ecosystems and endangered species.
- **Implement monitoring** of ecosystem condition and functioning over time. To establish effectiveness of restoration measures undertaken and detect negative impacts and degradation at an early stage.
- **Provide training** to municipal staff and stakeholders on biodiversity and natural resource management regulations and guidelines.

Programme 3.2: Alien invasive vegetation control

Invasive alien vegetation is a threat to natural ecosystems as it can replace indigenous biodiversity. This can lead to a loss of ecosystem functioning and service provision, such as stormwater retention and purification, and soil stabilisation, and will reduce the natural environment's appeal for eco-tourism. Further, specifically woody alien species such as pines and eucalypts are increasing the loss of water and are a severe fire hazard. Floating aliens can block watercourses and suffocate indigenous fauna and flora. This programme therefore proposes the following actions to control the expansion and damage caused by alien invasive vegetation:

- **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.
- **Targeted alien plant clearing and alien control plan development:** This would prevent conversion of naturally highly ecosystems into monotonous dense stands. Clearing of alien acacia, pina and eucalypts will reduce fire risk, as well as improving water availability
- **Control invasion of alien fauna** to prevent threat of indigenous fauna and flora, e.g. gun-shot borer beetles which can lead to devastating mortality of trees.
- **Develop/ implement catchment management strategies** to reduce invasion of aquatic alien vegetation such as water hyacinth etc.
- **Promote beneficiation of extracted alien biomass**, such as use alien woody biomass for energy generation: this will decrease IAPs with associated improvements in water-related issues (CC adaptation) and decrease energy generation from fossil fuels; use of leather of invasive fish (e.g. carp) for clothing and bags; use of water hyacinth for furniture and homeware. This might create new markets for marginalised communities in the DM.

- **Consider public or private stewardships** for sensitive environments, e.g. wetlands and river sections to give the public or industry "ownership" and responsibility for conservation and maintenance.

4.5. Adaptation programme Goal 4: To enhance resilience of communities and settlements, specifically to climatic extreme events

This programme embraces municipal activities which can reduce climate risks for communities and settlements more broadly. It considers risk assessments and disaster and spatial planning response, regulations to promote climate-wise buildings and infrastructure and education and awareness rising for the public.

Programme 4.1: Risk assessments and public response
Largely within the responsibility of local government is the identification of climate risks and the implementation of response measures for settlements, including rural and informal settlements. The following actions would contribute to this programme:

- **Conduct local-scale assessment of climate hazard risks**, as well as inherent vulnerability of the location assessed: Conducting a spatially explicit and detailed vulnerability assessment to identify the populations and locations most at risk of climate change impacts: This assessment would help identify and prioritise 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.
- **Land use planning and zoning regulations:** Developing and implementing land use planning and zoning regulations that consider 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. The Coastal Management Lines developed for the district are another valuable spatial planning tool for the district's coastal areas.
- **Develop early warning systems:** Developing and implementing an early warning system (EWS) to help communities prepare for and respond to climate change risks. EWSs need to have three components, firstly, a weather and/or environmental observation and forecasting component, secondly, a component that analyses these data and extracts and packages information that can lead to hazardous extreme events and thirdly, an information distribution component. The 3rd component can be IT based but should also consider mouth-to-mouth snowball-system information chains to reach technologically impaired communities and environments. 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, hailstorms, and floods that are predicted to become more common due to climate change.
- **Facilitate improved cellular communication networks.** This will decrease reliance on landline phone infrastructure networks which may be heavily impacted during disaster events
- **Partnerships:** Establishing partnerships with local stakeholders, such as community groups and NGOs, to build local capacity for climate change adaptation and resilience

Programme 4.2: Climate-wise buildings and infrastructure
While spatial and development plans can be used to keep people and infrastructure out of hazardous areas, such as zones at risk of flooding, other climate hazards can affect a municipality uniformly, e.g. extreme heat or cold, or can hit at any place. It is therefore important to use the built environment and infrastructure to reduce the potential impact of climate hazards. Suggestions for creating climate-wise buildings and infrastructure are as follows:

- **Develop building and construction guidelines for better protection against climate events:** these could include building insulation against cold and heat, greywater and rainwater harvesting and re-use, protection against flood impact (e.g. building on stilts or locate main switchboards higher above ground level), measures for fire-proofing, especially for buildings on the urban-wildland interface.
- **Develop municipal support structures for Small Scale Embedded Generation** (SSEG) / mini-grids – feed-in tariffs in place, applicable bylaws, Incentives etc. to create independence from the public grid which might fail during extreme events, and which will reduce reliance on fossil fuels (climate mitigation)
- **Implement rainwater collection systems also for low-cost housing.** This will reduce pressure on public water sources and can help in storm water retention and reduce flooding in already vulnerable communities.
- **Design and construct traffic infrastructure** in expectance of more likely and extreme rainfall events.
- **Climate proof and/or relocate critical service infrastructure** such as sewage treatment works, electricity substations, hospitals, police stations, retirement centres etc.
- **Inspect local social facilities** and recommend / demand improvements from personnel in charge to reduce risks, e.g. to fire and flooding.

Programme 4.3: Education of the public
Climate adaptation starts at a household level and at personal behaviour. The general public therefore plays an important role in adapting to a new climate future. This programme aims to raise more awareness on how climate change will affect the public and which measures each person can take to prepare for a more extreme climate, how individual habits and resource use (e.g. water) can impact the wellbeing of the community and how to protect themselves. Further, a changing climate can also provide opportunities for new economies. The goal should be to promote a culture of valuing natural resources, by incentives/disincentives for responsible water and electricity usage, protection of water bodies etc. The activities proposed for education and guiding the general public are as follows:

- **Lead by example!:** Climate-proof public buildings and infrastructure
- **Increase public awareness** on the impacts of climate change and benefits of best practice environmental management through flyers, posters, info boards, short videos etc. This will assist with building an accountable and responsible community, as well as increasing community resilience.
- **Conduct (interactive?) roadshows targeting the most vulnerable groups.** Visit the district's care centres, primary and secondary schools to inform the elderly and children in an age-appropriate format about climate risks and steps they can take to protect themselves, e.g. from veldfires, flooding or heatwaves and others, and to use scarce natural resources responsibly.

- **Create a green information hub** for collection of all data and info to avoid duplication, provide coordination etc.; identify gaps; raise funds. Find ways to engage private sector in this process, including households, and local farmers.

5. Implementation Framework

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

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

Adaptation programme 1.1: Protect, maintain and improve water services infrastructure				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Regular maintenance and inspection of water infrastructure, including pipelines, treatment plants, reservoirs, and pumping stations.	Drought, Flooding, water source vulnerability	Ugu Distict and relevant Local Municipalities: Water and Sanitation, and Technical/Engineering Services functions	Immediate and ongoing	High
ii. Prioritise repairs based on the condition and criticality of infrastructure components	Drought, Flooding, water source vulnerability	Ugu Distict and relevant Local Municipalities: Water and Sanitation, and Technical/Engineering Services functions	Immediate and ongoing	High
iii. Infrastructure upgrading and expansion towards more equitable freshwater provision and anticipating future growth	Drought, Flooding, water source vulnerability	Ugu Distict and relevant Local Municipalities: Water and Sanitation, Technical/Engineering Services, and Strategic Planning functions	Short term	High
iv. Climate-resilient design of new infrastructure projects	Drought, Flooding, water source vulnerability	Ugu Distict and relevant Local Municipalities: Water and Sanitation, and Technical/Engineering Services functions	Long term	high
v. Continual water demand side management to increase preparedness for dry periods	Drought, water source vulnerability	Ugu Distict and relevant Local Municipalities: Water and Sanitation function	Immediate and ongoing	high

Adaptation programme 1.2: Reducing water demand				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Promote and implement water conservation practices to households and communities through the adoption of water-saving behaviours and technologies to reduce water wastage and optimize water use efficiency	Drought, Flooding, water source vulnerability	National and Provincial departments of Water and Sanitation *Water Wise* Programme Ugu Distict and relevant Local Municipalities: Water and Sanitation, as well as Community Services functions Residents	Immediate and ongoing	high
ii. Raising awareness and education at businesses, and public institutions: Implement public awareness campaigns, providing information and resources to businesses and policymakers, as well as offering training and outreach programs	Drought, Flooding, water source vulnerability	National and Provincial departments of Water and Sanitation: Water Wise Programme Ugu Distict and relevant Local Municipalities: Water and Sanitation, and Community Services functions Private sector	Short term	high
iii. Make use of smart metering and steep block tariff schemes	Drought, Flooding, water source vulnerability	Ugu Distict and relevant Local Municipalities: Water and Sanitation function and Finance department	Short to medium	high
iv. Water-efficient landscaping: Encourage water-efficient landscaping practices in urban, suburban, and rural areas	Drought, Flooding, water source vulnerability	Ugu Distict and relevant Local Municipalities: Water and Sanitation,	Medium	medium

		Environmental Management, Spatial Planning, as well as Parks and Recreation functions		

Adaptation programme 1.3: Diversification of water sources				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct feasibility studies, hydrogeological assessments, and environmental impact assessments	Drought, Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Water and Sanitation, as well as Environmental Management functions	medium	high
ii. Rainwater harvesting: Promote the collection and storage of rainwater by households, businesses and in public spaces for later use	Drought, Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Water and Sanitation, Environmental Management, Roads and Stormwater, Building Regulations, as well as Parks and Recreation functions	Short term	Medium
iii. Improve stormwater retention systems to use flooding events to store water against future drought periods.	Drought, Flooding, water source vulnerability		Medium term	medium
iv. Wastewater recycling and reuse: Implement systems to treat and reuse wastewater for non-potable purposes such as irrigation, industrial processes, and toilet flushing.	Drought, Flooding, water source vulnerability		Long term	medium
v. Re-using greywater from kitchen and bathroom sinks, showers and baths: Combined grey- and rainwater systems are thinkable.	Drought, Flooding, water source vulnerability		Short term	medium

vi. Change building regulation to demand by default separate grey and blue water systems	Drought, Flooding, water source vulnerability		Long term	medium
vii. Investigate alternative water storage options (e.g. underground or dam expansion) where appropriate.	Drought, Flooding, water source vulnerability		Long term	Medium (as yet)
viii. Consider seawater desalination	Drought, Flooding, water source vulnerability		Long term	Low (as yet)

Adaptation programme 1.4: Building Institutional Capacity and Stakeholder Engagement				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Enhancing coordination among government agencies: Protocols should be developed for data sharing and joint decision-making.	Drought, Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management function	Immediate and ongoing	high
ii. Providing training on climate resilience for water professionals: This involves developing and delivering training programs on climate resilience, water management, and disaster preparedness for local water professionals, planners, and decision-makers.	Drought, Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, Water and Sanitation and Disaster Management functions	Short to medium term	high
iii. Conducting public awareness campaigns on water management. Community involvement should be encouraged in water management initiatives.	Drought, Flooding, water source vulnerability	National and Provincial departments of water and sanitation *Water Wise* programme Ugu District and relevant Local Municipalities: Water and Sanitation and Community Services function	Medium	medium

iv. Developing and implementing water conservation education programmes into school curricula and community education programmes. Workshops, fieldtrips, and hands-on activities	Drought, Flooding, water source vulnerability	National and Provincial departments of water and sanitation *Water Wise* programme National and Provincial departments of Education Ugu District and relevant Local Municipalities: Water and Sanitation and Community Services function	Medium	high

5.2. Implementation framework: Goal 2: Improved stormwater management

Adaptation programme 2.1: Improving Stormwater Management Infrastructure				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Regular inspection, and maintenance of stormwater and road infrastructure	Drought, Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, as well as Roads and Stormwater functions	Immediate and ongoing	High
ii. Upgrading drainage systems towards Sustainable drainage systems (SuDS)	Drought, Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, Roads and Stormwater, Water and Sanitation, as well as Parks and Recreation functions	Medium term	high

iii. Constructing retention and detention basins	Drought, Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, Roads and Stormwater, Water and Sanitation, as well as Parks and Recreation functions	Long term	medium
iv. Implementing check dams and terracing	Drought, Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Water and Sanitation, Technical/Engineering Services and Environmental Management functions	Long term	medium
v. Promoting rainwater harvesting systems	Drought, Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Water and Sanitation, Environmental Management, Spatial Planning and Building Regulations functions	Short term	high
vi. Water Sensitive Urban Design (WSUD): Adopt water-sensitive urban design principles and practices	Drought, Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, Water and Sanitation, Spatial Planning, Building Regulations, Engineering/Technical Services, as well as Parks and Recreation functions	Long term	high

Adaptation programme 2.2: Enhancing Green Infrastructure and Natural Water Management				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**

i. Protect, restore and increase natural ecological infrastructure	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, as well as Water and Sanitation functions	Long term	High
ii. Construction of hard infrastructure where appropriate e.g. gabions	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Water and Sanitation, Roads and Stormwater, Environmental Management, as well as Engineering/Technical Services functions	Medium	high
iii. Promote farming practises that prevent surface run-off and soil erosion	Drought, Flooding, water source vulnerability	National and Provincial departments of Rural Development and Agriculture	Short to medium term	high
iv. Review (and adopt, if necessary) standard environmental approval processes linked to agricultural use	Flooding, water source vulnerability	National and Provincial departments of Rural Development and Agriculture Ugu District and relevant Local Municipalities: Spatial Planning and Environmental Management functions	Medium	Medium
v. Plan for increased river sediment loads during extreme rainfall events and its effect on dam infrastructure and storage capacity	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Water and Sanitation, as well as Environmental Management functions	Long term	high
vi. Expand urban green infrastructure to improve water infiltration, flood attenuation and thus reduce polluted run-off.	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Water and Sanitation, Environmental Management, Roads and	Medium term	high

		Stormwater. Engineering/Technical Services, as well as Parks and Recreation functions		
vii. Implementing permeable pavements	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, Water and Sanitation, Roads and Stormwater, Engineering/Technical Services, as well as Parks and Recreation functions	Medium	Medium
viii. Establishing rain gardens and bioswales	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, Water and Sanitation, Engineering/Technical Services, Roads and Stormwater, as well as Parks and Recreation functions	Medium	Medium
ix. Expanding urban tree canopy	Extreme heat, flooding	Ugu District and relevant Local Municipalities: Environmental Management, Spatial Planning and Urban/Landscape Design, Engineering/Technical Services, Roads and Stormwater, as well as Parks and Recreation functions	Medium	Medium
x. Developing green roofs and walls	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental	Medium	Medium

		Management, Land Use Management, Building Regulations, as well as Roads and Stormwater and/or Water and Sanitation functions		

Adaptation programme 2.3: Community Engagement and Capacity Building				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Providing training for local authorities and stakeholders	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management function	Medium	high
ii. Conducting public awareness campaigns: Various media channels and community events should be used to disseminate information and promote best practices.	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management and Community Services functions	Short term	high
iii. Establish Community-Based Stormwater Monitoring Programmes	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, Community Services, Disaster Management, as well as Water and Sanitation and/or Roads and Stormwater functions	Medium term	medium

5.3. Implementation framework Goal 3: Preserving ecological resilience, maintaining biodiversity, and safeguarding ecosystem services essential for human well-being

Adaptation programme 3.1: Preserving and restoring wetlands and riparian buffer zones				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Inventory of water bodies and wetlands in the DM: Identify and map valuable ecosystems and map critical natural areas, biodiversity hotspots, and ecosystem service providers within the municipality.	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, Spatial Planning, as well as Water and Sanitation functions	Medium term	high
ii. Enforce Environmental Regulations	All climate threats	Ugu District and relevant Local Municipalities: Environmental Management functions	Immediate and ongoing	high
iii. Identify and prioritise interventions needed to improve ecosystem health and to enhance/maintain ecosystem service delivery such as stormwater retention and purification, nursery function for species etc.	All climate threats	Ugu District and relevant Local Municipalities: Environmental Management, Roads and Stormwater, Water and Sanitation, Parks and Recreation, as well as Spatial Planning functions	Medium	high
iv. Develop Conservation Plans	All climate threats	Ugu District and relevant Local Municipalities: Environmental Management function	Medium	high
v. Implement monitoring of ecosystem condition and functioning over time.	All climate threats	Ugu District and relevant Local Municipalities: Environmental Management function	Medium	medium
vi. Provide training to municipal staff and stakeholders on biodiversity and natural resource management regulations and guidelines.	All climate threats	Ugu District and relevant Local Municipalities: Environmental Management function	Short term	medium

Adaptation programme 3.2: Alien invasive vegetation control

Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
i. Alien invasive species clearing initiatives in catchment areas	Water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, as well as Water and Sanitation functions	Medium	high
ii. Targeted alien plant clearing and alien control plan development	Water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, as well as Water and Sanitation functions	Medium	high
iii. Control invasion of alien fauna to prevent threat of indigenous fauna and flora	Water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, as well as Water and Sanitation functions	Medium	medium
iv. Develop/ implement catchment management strategies	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Environmental Management, as well as Water and Sanitation functions	Medium	high
v. Promote beneficiation of extracted alien biomass	water source vulnerability, diversification of small-scale economy	Ugu District and relevant Local Municipalities: Environmental Management, Water and Sanitation, as well as IDP and LED functions	Medium	medium
vi. Consider public or private stewardships for sensitive environments	All climate threats	Ugu District and relevant Local Municipalities: Environmental Management and	Short term	medium

		Community Services functions		

5.4. Implementation framework: Goal 4: To enhance resilience of communities and settlements, specifically to climatic extreme events

Adaptation programme 4.1: Risk assessments and public response				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct local-scale assessment of climate hazard risks, as well as inherent vulnerability of the location assessed	All climate threats	Ugu District and relevant Local Municipalities: Environmental Management, Spatial Planning and Disaster Management functions	Short term	high
ii. Land use planning and zoning regulations: Developing and implementing land use planning and zoning regulations that consider the potential impacts of climate change, including flooding	All climate threats, especially extreme events	Ugu District and relevant Local Municipalities: Spatial Planning and Environmental Management functions	Medium	high
iii. Develop early warning systems: Developing and implementing an early warning system (EWS) to help communities prepare for and respond to climate change risks	All climate threats, especially extreme events	Ugu District and relevant Local Municipalities: Disaster Management and Environmental Management functions	Long term	medium
iv. Facilitate improved cellular communication networks.	All climate threats, especially extreme events	Ugu District and relevant Local Municipalities: Disaster Management, Spatial Planning, as well as Telecommunications and/or Technical/Engineering Services functions	Long term	medium
v. Partnerships: Establishing partnerships with local stakeholders, such as community groups and NGOs, to build	All climate threats, especially extreme events	Ugu District and relevant Local Municipalities: Environmental	Medium term	High

local capacity for climate change adaptation and resilience		Management and Disaster Management functions, as well as Corporate Services departments		

Adaptation programme 4.2: Climate-wise buildings and infrastructure				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Develop building and construction guidelines for better protection against climate events	Flooding, extreme temperatures	Ugu District and relevant Local Municipalities: Environmental Management, Disaster Management, as well as Building Regulations functions	Medium term	Medium
ii. Develop municipal support structures for Small Scale Embedded Generation (SSEG) / mini-grids – feed-in tariffs in place, applicable bylaws, Incentives etc. to create independence from the public grid which might fail during extreme events, and which will reduce reliance on fossil fuels (climate mitigation)	All climate threats, especially extreme events	Ugu District and relevant Local Municipalities: Environmental Management, as well as Technical/Engineering Services	Medium term	high
iii. Implement rainwater collection systems also for low-cost housing.	Flooding, water source vulnerability	Ugu District and relevant Local Municipalities: Human Settlements/Housing, Water and Sanitation and/or Roads and Stormwater, as well as Environmental Management functions	Short term	high
iv. Design and construct traffic infrastructure in expectance of more likely and extreme rainfall events.	Flooding	Ugu District and relevant Local Municipalities: Environmental	Medium	High

		Management, as well as Water and Sanitation and/or Roads and Stormwater functions		
v. Climate proof and/or relocate critical service infrastructure such as sewage treatment works, electricity substations, hospitals, police stations, retirement centres etc.	Flooding, wildfires	Ugu District and relevant Local Municipalities: Environmental Management, Disaster Management, Spatial Planning and Technical/Engineering Services functions	Medium to long term	High
vi. Inspect local social facilities and recommend / demand improvements from personnel in charge to reduce risks	Flooding, wildfires	Ugu District and relevant Local Municipalities: Environmental Management and Disaster Management functions	Short term	high

Adaptation programme 4.3: Education of the public				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Lead by example!: Climate-proof public buildings and infrastructure	Flooding, heat, wildfire	Ugu District and relevant Local Municipalities: Environmental Management, Disaster Management, Building Regulations and Technical/Engineering Services functions	Short term	Medium
ii. Increase public awareness on the impacts of climate change and benefits of best practice environmental management	All climate risks	Ugu District and relevant Local Municipalities: Environmental Management, Disaster Management and	Short term	High

		Community Services functions		
iii. Conduct (interactive?) roadshows targeting the most vulnerable groups.	All climate risks	Ugu District and relevant Local Municipalities: Environmental Management, Disaster Management and Community Services functions	Medium term	High
iv. Create a green information hub for collection of all data and info	All climate risks	Ugu District and relevant Local Municipalities: Environmental Management, Disaster Management, Spatial Planning, Water and Sanitation, as well as Community services (communication) functions	Long term	medium

6. Recommendations for Mainstreaming

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

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

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

Climate change mainstreaming is essential for building resilience and promoting sustainable development in the face of climate change. By integrating climate considerations into decision-making processes and actions across sectors, mainstreaming helps minimise future risks, maximise opportunities for adaptation and mitigation, and enhance overall resilience to climate change impacts.
Some of the response actions suggested for the individual adaptation programmes above, already include mainstreaming activities. Further recommendations related to the DM can be discussed during the stakeholder engagements.

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