Adaptation Action Plan for uMhlathuze PHSHDAs

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Contents

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
DHS	Department of Human Settlements
DRR	Disaster risk reduction
HDA	Housing Development Agency
IPCC	Intergovernmental Panel on Climate Change
LRT	Let's Respond Toolkit
PHSHDA	Priority Human Settlement and Housing Development Area
PHS	Priority Human Settlement
PHDA	Priority Housing Development Area
PLM	Polokwane Local Municipality
SPLUMA	Spatial Planning and Land Use Management Act, 2013 (Act No.16 of 2013)

Glossary of Terms

Adaptation actions	A range of planning and design actions that can be taken by local government to adapt to the impacts of climate change, reduce exposure to hazards, and exploit opportunities for sustainable development (CSIR, 2019).
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, 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 uMhlathuze Municipality (ULM) 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 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 Local Municipality, with a specific focus on Priority Human Settlements or Priority Housing Development Areas (PHSDAs).
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 uMhlathuze Local Municipality with a comprehensive strategy to navigate the complexities of climate change, reduce vulnerability and exposure, and champion sustainable development.

The Adaptation Action Plan briefly outlines the policies constituting the framework for adaptation 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 the uMhlathuze LM by aligning it with adaptation goals, programmes, and actions designed to address priority risks. Finally, the document concludes with recommendations aimed at facilitating the integration of the proposed actions into broader initiatives, ensuring their effective mainstreaming.

2. 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 of 2015, the Spatial Planning and Land Use Management Act, i.e., Act No. 16 of 2013 (SPLUMA), the Climate Change Bill (B9 of 2022), the 2011 National Climate Change Response White Paper, as well as the 2019 National Climate Change Adaptation Strategy.

While the Disaster Management Amendment Act requires each organ of state, as well as provincial and local government to identify measures for, as well as indicate plans to invest in, disaster risk reduction (DRR) and climate change adaptation; SPLUMA identifies the principles of (1) spatial resilience – which 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 (DEA, 2018) sets out requirements for every District Intergovernmental Forum to serve as a Municipal Forum on climate change that coordinates climate response actions and activities in its respective municipality, while also requiring every municipality to report on their climate change response needs and draft resultant climate 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 (DEA, 2019) outlines several actions that 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.

In response to the national call to advance spatial transformation and consolidation in human settlement development, the National Department of Human Settlements (DHS) has identified and gazetted a total of 136 Priority Human Settlements and Housing Development Areas (PHSHDAs). The PHSHDAs were declared to ensure that housing delivery is used to restructure and revitalise towns and cities, strengthen the livelihood prospects of households, and overcome apartheid spatial patterns by fostering integrated urban forms (DHS, 2020). PHSHDAs were designated using national criteria which includes an area or settlement's potential to support sustainable environmental management (which plays a critical role in mitigating the negative impacts of climate change, particularly through nature-based adaptation

solutions), as well as its potential to accommodate the integration of land uses and amenities, i.e., in addition to other criteria.

The DHS has identified two key objectives for PHSHDAs, including (1) targeting and prioritising areas for integrated housing and human settlements development to ensure the delivery of housing for a diverse range of income groups within an integrated mixed-use development, as well as (2) transforming spatial patterns which have historically exacerbated social inequality and economic inefficiency (PLM, 2021). As part of the second objective, this initiative aims to develop post-apartheid cities and city patterns that ensure urban access, as well as achieve a balance between spatial equity, economic competitiveness and environment sustainability (PLM, 2021). As the impacts of climate change become more severe, the latter outcome (i.e., ensuring and maintaining environmental sustainability) will become increasingly important.

Furthermore, as part of the implementation approach for housing and human settlement development in PHSHDAs, the DHS has identified the provision and maintenance of ecological infrastructure to support development in priority areas as a key avenue for integrating climate considerations and mainstreaming climate responses, including climate change adaptation (See Figure 2).

3. Adaptation Principles, Approach, Programmes & Actions

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

Climate change adaptation aims to reduce climate-related risks by adjusting a system to the actual or anticipated climate and seeking "to moderate or avoid harm [and] exploit beneficial opportunities" (IPCC, 2022, p. 2898) that may derive from unavoidable impacts of climate change such as extreme hazards. The climate change adaptation agenda is concerned with adapting species, people, places, assets, and systems, to the impacts of actual or anticipated climate-related risks and implements various measures or actions to achieve this (Behsudi, 2021; C40, 2020).

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

3.1. 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.

3.2. 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.

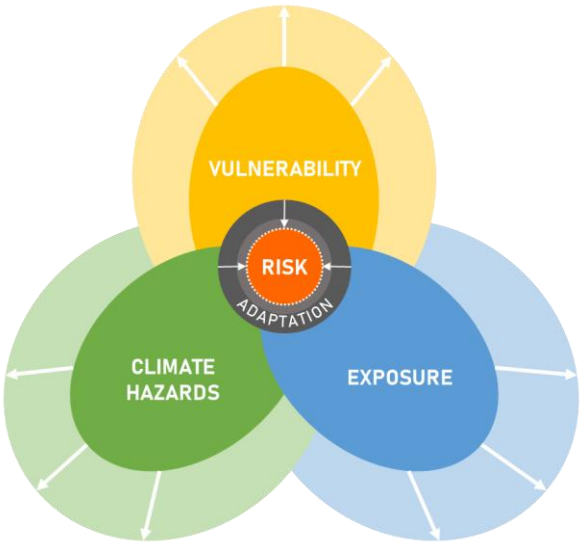

Figure 1 – The interplay between climate hazards, vulnerability and exposure that determines risk (based on IPCC, 2014 and IPCC, 2021)

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.

3.3. Adaptation programmes and actions

An adaptation programme is a structured and systematic set of actions, initiatives, and interventions aimed at local governments adapt 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, 2019).

A spectrum of adaptation actions is at the disposal of local 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, 2019).

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.

4. Summary of Climate Risk Profile

A Climate Risk Profile Report was prepared by the team, designed to complement this Plan. The comprehensive Climate Risk Profile serves as an essential resource for understanding the risks associated with climate change in uMhlathuze Local Municipality. Presented to representatives of the Municipality during a series of nationwide stakeholder engagements in late 2023, these workshops served as forums to not only validate the risks outlined in the report but also to confirm the adaptation goals proposed.

This section of the Plan summarises the climate risk profile for the uMhlathuze Local Municipality, drawing from the GreenBook Risk Profile Tool at https://riskprofiles.greenbook.co.za/. Consult the accompanying Climate Risk Profile Report for more detailed information.

4.1. Climate projections, vulnerabilities and impacts

It is expected that by 2050 the uMhlathuze LM will see a slight increase of the average annual temperatures of up to 2°C in the inland and up to 1.5°C in the coastal belt. The total number of very hot days (>35°C) will increase from 0 – 20 days to 10-30 days, with more very hot days experienced particularly in the inland of the LM. 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 LM is relatively low.

Figure 1 below gives an overview of rainfall days with more than 0.1 mm, more than 20 mm, more than 50 mm and more than 100 mm per day as recorded between 1980 and 2022 (Bopape et al. 2024). This Figure shows that in uMhlathuze LM on 10 (inland) to 100 days (coastal zone), daily rainfall exceeded 50 mm and on 10-12 days, daily rainfall exceeded 100 mm in the coastal belt.

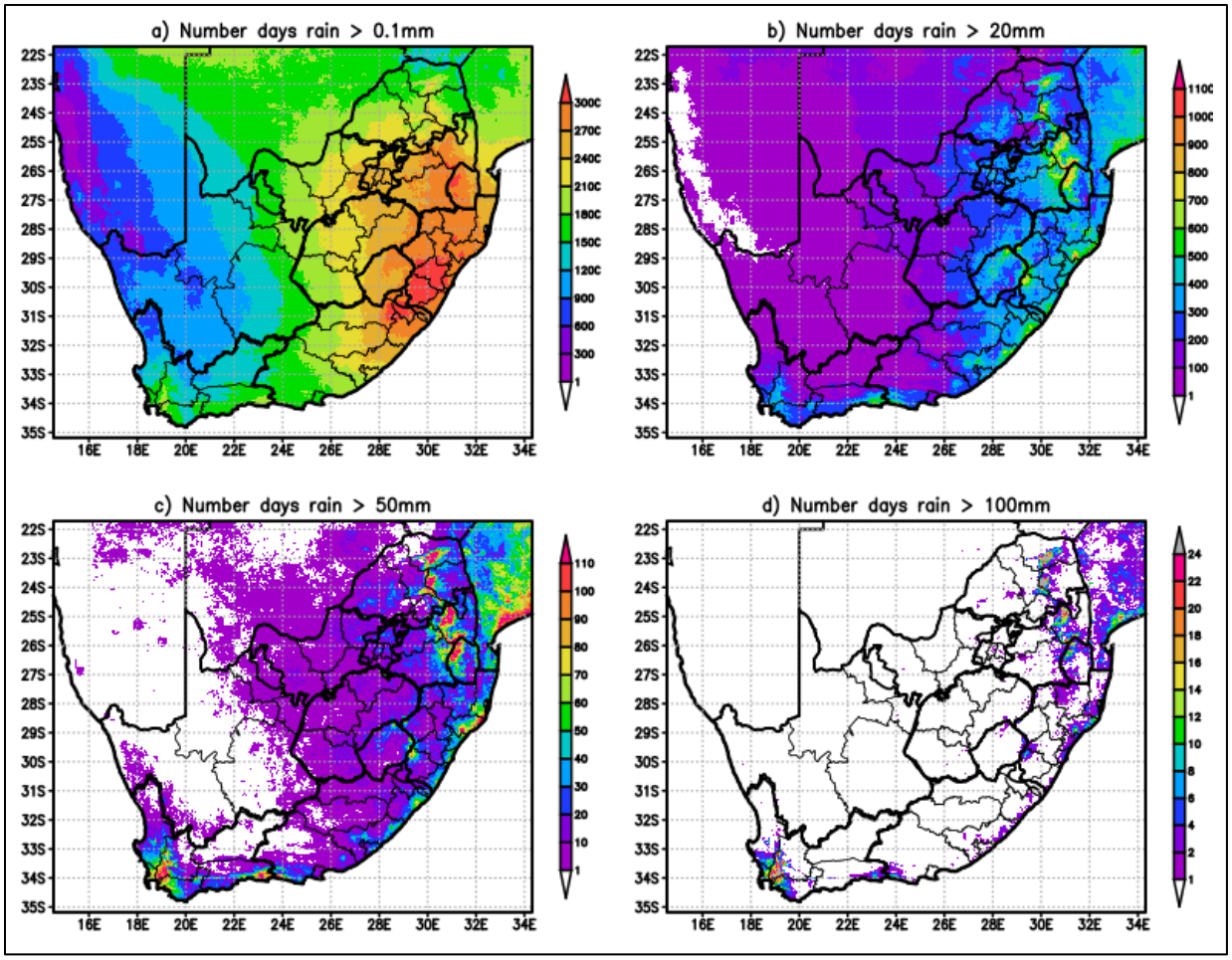

Figure 1: Number of days with respective total rainfall amounts between 1980 - 2022. Source: Bopape et al. 2024.

According to the modelling conducted in the GreenBook, the future average annual rainfall trend is unclear with some scenarios predicting an increase of 43 mm per annum for the LM, others predicting a decrease of 107 mm per annuum. Similarly, the different RCP scenarios range between a 2 day decrease and a 2 day increase of extreme rainfall days by 2050, which means the already frequent occurrence of extreme rainfall and related flood risk, especially in the coastal belt, is remaining a threat.

While this study did not include occurrence and future projections of tropical cyclones, international studies suggest that the frequency and intensity of cyclones will increase, due to higher ocean temperatures.

As for droughts, in the recent past, there was a slight tendency towards less dry spells. Future climate might bring a slight increase in dry spells, with a moderate risk of increase in droughts.

Surface water is the main water resource and is not at risk despite a slight increase in annual evaporation, due to the very high rainfall in the region of 1600-2000 mm/a. Water supply vulnerability is however estimated to increase into the future and is largely driven by failing water and sewage infrastructure and population growth, potential pollution of water sources by industry, agriculture and stormwater infiltration during extreme rainfall events.

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 Richards Bay, but "rare" in the swampy coastal belt. A "moderate" increase in likelihood of wildfires is predicted in the future for the Mkhoma region, but only a "very low" likelihood of increase for Richards Bay. However, the baseline number of high fire danger days in the region is less than 10 days annually currently and into the future, which is very low in national comparison.

The socio-economic vulnerability of households in uMhlathuze's households is relatively low, due to the relatively high industrialisation and skilled workforce in the municipality. However, the LM's economic vulnerability has slightly increased (worsened) within the same period, therefore indicating the municipality's susceptibility to being adversely affected by external shocks. The LM's economic vulnerability ranks 110th out of 213 LM nationally and 34th out of 44 LMs in KwaZulu-Natal. This means, its economic vulnerability is comparatively high. uMhlathuze has a relatively high physical vulnerability score; this alludes to some structural vulnerabilities in the LM, particularly when considering the municipality's buildings and infrastructure. uMhlathuze's environmental vulnerability ranks 131st out of 213 nationally and 17th out of 44 in KwaZulu-Natal, but is significantly higher in Empangeni, due to the high settlement growth pressure.

All settlement in uMhlathuze, apart from Mkhoma and uMhlathuze town are facing an extreme growth pressure. Mkhoma, which is part of the Richards Bay PHSHDA, is a traditional settlement with a population of 5,360. The majority of the households (27.4%) do not have formal income. The average settlement vulnerability for Mkhoma is 7.0, which is the second highest of all settlements in uMhlathuze. This is in stark contrast to Richards Bay whose settlement vulnerability is with 2.2 the lowest of all settlements in the uMhlathuze LM.

In Mkhoma, service access and economic vulnerability scoring the highest possible vulnerability of 10, socio-economic and environmental vulnerability are with 7.89 and 7.42 respectively of high concern as well. Growth pressure is with 4.89 moderate and regional connectivity is of least concern, given the proximity to the N2 highway.

4.2. Priority climate-related hazards

Bopape et al. (2024) provided a national overview of weather-related disasters occurred in the country's districts between 1980 and 2022 (Figure 2). The overview shows that KwaZulu-Natal is hit by drought, flood, storm and wildfire-related disasters the most of all provinces. The comparison with Figure 1 above shows that the occurrence of disasters does not necessarily coincide with the occurrence of extreme weather events but is also a result of presence and vulnerability of settlements in the affected areas.

During the observation period, the King Cetshwayo district was hit by about 20 disastrous floods, about 5 droughts and storms and 4 wildfires (Figure 2). This means, floods were the most frequent disastrous weather events in the past, and given the likelihood of only small changes in the total rainfall amount and occurrence of extreme rainfall events, flooding is likely to remain the major threat. On a local scale, the Empangeni PHSDHA and the Vulindlela corridor are expected to face the highest flood risk, and future development, especially in the light of the planned settlement restructuring, should take this into consideration.

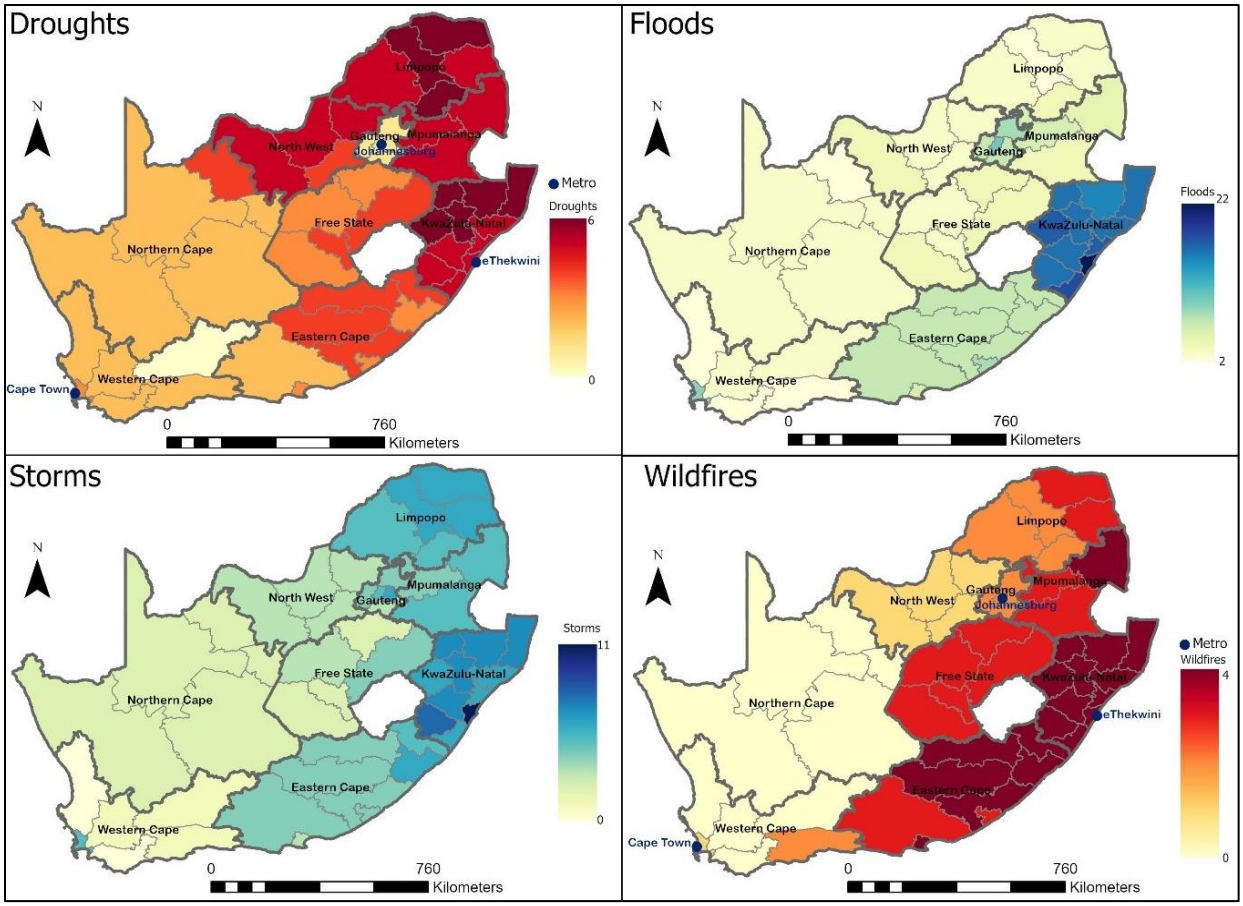

Figure 2: Weather-related disasters in South Africa between 1980-2022. Source: Bopape et al. 2024

Figure 1 above indicates that most extreme rainfall events have been occurring in the coastal zone, which is a major concern, as this area is also likely to face the highest population growth. Coastal storms, related to high wind and wave energy, are also contributing to flood and erosion risk in the coastal zone, especially in the low-lying estuarine and port area of Richards Bay. Future global scenarios foresee an increase in coastal storm frequency and intensity. While most of the uMhlathuze coast currently is protected from coastal flooding by the high dunes, future development and mining activities might pose a risk, if dune stability is compromised and settlements encroach into exposed and low-lying beach areas. Coastal erosion is already a problem, particularly in the Alkantstrand area.

Indeed, uMhlathuze's 5th Generation SDF (uMhlathuze 2022a) lists the following climate events that stood out in recent years as follows:

- Prolonged drought from 2013-2017 which led to Level 4 water restrictions and in fact, our water situation still regarded as a scarce resource. Drought and supplies running dry render tremendous risk in the uMhlathuze context for Industry, communities, livestock and agriculture that are dependent on water;
- Intense sea swells and increased coastal storm events that have resulted in severe beach erosion, particularly on the northern shores of Richards Bay. The erosion has led to loss of coastal property; placing current and future coastal development at risk of slumping into the sea; Increased flood events, which has seen stormwater systems being tested in the urban centres. In

the unplanned settlements, vulnerable communities living in flood prone areas are at risk of losing property and lives;

- Summer temperatures in particular will soar to extents where there will be higher dependency on cooling and air-conditioning, thus increasing energy costs. Alternatively, productivity is lowered through unfavourable working conditions; and
- Increased wind activity will be particularly problematic for uMhlathuze that is noted for poor air quality from industry stockpiles of commodities/materials.

The Climate Risk Profile Report provides an overview of impacts that an increase in rainfall, inland flooding, and coastal flooding; increased temperatures and heat extremes, as well as drought and decreased rainfall can have on Stormwater, Sanitation, Ecosystem services, Information and communication technology, Transport and mobility, Energy, Solid waste, Human health and Culture and heritage.

5. Adaptation Goals, Programmes and Actions

Based on the identification and presentation of the main climate risks in the uMhlathuze LM, local stakeholders were engaged to identify the priority adaptation goals for the LM. This section builds on the previous stakeholder engagement, augmented by the project team's climate adaptation expertise. The resulting plan was developed as a starting point for a proactive strategy to mitigate these risks and enhance resilience in the uMhlathuze LM. This section has to be read in conjunction with the King Cetshwayo District Municipality's Climate Change Vulnerability Assessment and Response Plan (KCDM 2018) which provides sector-based vulnerability assessments and response plans. There, emphasis is also on agriculture which will therefore not be expanded on here, as the focus of this report is on the PHSHDAs in the LM and the intended settlement restructuring thereof.

The following goals and actions also have to be read in context of the Climate Adaptation goals of the uMhlathuze Integrated Development Plan 2024/25 (uMhlathuze 2024) which provides more sequential structure on the climate adaptation steps to be taken. It is important to note that in that IDP the eSikhaleni PHSHDA (specific attention to uMzingwenya and Lake Cubhu communities) was identified as being most prone to flooding.

5.1. 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 uMhlathuze LM were identified, prioritising those risks with the highest potential impact. These goals were validated by stakeholders during the engagements with local stakeholders:

Goal 1: To protect communities and increase the resilience of critical municipal infrastructure
Climate awareness and preparedness starts at a household and community level. Identification of vulnerable communities and infrastructure and promotion of infrastructure adaptation and community response are needed to increase climate response and disaster risk reduction at community level.

Goal 2: To protect urban infrastructure and settlements from impact of extreme rainfall related flooding
Flooding due to extreme rainfall and coastal storms is the most imminent climate hazard in the municipality. Effective stormwater management and adaptation of critical road and other public infrastructure will reduce damage and economic downtimes.

Goal 3: To provide sustainable water and sanitation services
Potable water and sanitation are the most essential services for thriving settlements and healthy communities. Flooding, as well as droughts negatively impact these services, potentially increasing the health risk. Actions to reduce these risks are therefore urgently needed.

Goal 4: To protect coastal infrastructure from erosion and flooding
Coastal storms already causing significant flood and erosion damage on the uMhlathuze coast, are expected to increase in severity and frequency in the future. Protection of coastal green infrastructure and climate-wise coastal development will reduce coastal risk to communities and economy.

Goal 5: To maintain good air quality in urban areas
Air quality is negatively impacted by wildfires, agricultural burning practises and industrial dust especially in the Richards Bay port area. Fire risk and dust pollution are expected to increase with future increased wind events.

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

5.2. Adaptation programmes for Goal 1: To protect communities and increase the resilience of critical municipal infrastructure

Climate awareness and preparedness starts at a household and community level. Identification of vulnerable communities and infrastructure, and promotion of infrastructure adaptation and community response are needed to increase climate response and disaster risk reduction at community level.

Programme 1.1: Identify and protect vulnerable communities
This programme aims to identify vulnerable communities and important public infrastructure which might be threatened by exposure to climate events.

Actions:

i. Conduct detailed assessments to identify public infrastructure (such as hospitals and schools, healthcare facilities, water supply systems, and emergency shelters) and communities most susceptible to climate hazards.
ii. Prioritize infrastructure and communities facing the most severe risks and those with limited capacity to adapt.
iii. Develop and implement an early warning system to help communities prepare for and respond to climate change risks.
iv. Establish partnerships with local stakeholders, such as traditional leaders, community groups and NGOs, to build local capacity for climate change adaptation and resilience.
v. Facilitate participatory planning processes. In this action participatory planning processes that empower communities to co-design and implement adaptation measures that address their specific needs and priorities will be facilitated.
vi. Organise community-led vulnerability assessments. In this action community-led vulnerability assessments will be organised to identify priority areas and vulnerable populations in need of support.

5.3. Adaptation programmes for Goal 2: To protect urban infrastructure and settlements from impact of extreme rainfall-related flooding

Flooding due to extreme rainfall and coastal storms is the most imminent climate hazard in the municipality. Effective stormwater management and adaptation of critical road and other public infrastructure will reduce damage and economic downtimes.

Programme 2.1: Improved stormwater management and reduced run-off

This programme specifically targets actions needed to improve stormwater management at ground-level built stormwater infrastructure but also at the level of key public infrastructure such as healthcare centres, power substations and emergency shelters. Harnessing of existing and additional green infrastructure should also be considered.

Actions:

i. Identify existing storm water infrastructure that is vulnerable to the impacts of climate change.
ii. Implement regular inspection, and maintenance programs for stormwater and road infrastructure.
iii. Upgrade stormwater drainage systems to accommodate increased stormwater runoff.
iv. Explore opportunities to enhance the resilience of existing infrastructure using low-cost, resource-efficient measures, such as retrofitting buildings with locally sourced materials, improving drainage systems using community labour, and repurposing underutilized spaces for emergency shelters.
v. Protect and re-establish wetlands to function as natural storm water buffer and filtration systems.
vi. Identify suitable sites for infiltration of rainwater runoff.
vii. Create additional green buffer zones around critical storm water infrastructure for protection and enhancement of infrastructure.
viii. Develop Green Infrastructure Plans: Integrate green infrastructure principles into urban planning and development, promoting the incorporation of natural elements into the urban landscape. This can include creating green corridors, parks, and recreational areas.
ix. Adopt water-sensitive urban design principles and practices such as permeable pavements, green roofs and rain gardens to enhance water quality and mitigate urban heat island effects.
x. Promote Community-Based Restoration Projects: Engage local communities in restoration efforts, fostering a sense of ownership and promoting environmental stewardship.
xi. Develop partnerships. In this action efforts will be made to seek partnerships with local businesses, NGOs, and community groups to leverage additional resources and expertise for infrastructure upgrades.

Programme 2.2: Protect and maintain road and public transport infrastructure

Functional roads and public transport infrastructure are crucial during extreme weather and climate events as evacuation ways and for emergency services. Traffic infrastructure that can withstand extreme weather events unharmed will reduce economic downtimes and related damages to livelihoods and industries.

Actions:

i. Elevate roadways to protect them from floods.
ii. Maintain roads and public transport infrastructure.

iii. Use new technologies for road construction, operations and maintenance.
iv. Limit infrastructure development in high-risk areas/climate risk zones and hotspots.
v. Climate proof existing developments within climate risk zones or hotspots, where possible.

5.4. Adaptation programmes for Goal 3: To provide sustainable water and sanitation services

Potable water and sanitation are the most essential services for thriving settlements and healthy communities. Flooding, as well as droughts negatively impact these services, potentially increasing the health risk. Actions to reduce these risks are therefore urgently needed. Fields of action include maintenance of freshwater provision infrastructure, water conservation and water source diversification, prevent contamination from wastewater and stormwater sources, and proactive response to water-borne diseases.

Programme 3.1: Protect, maintain and diversify freshwater provision services.
This programme focusses on the maintenance and protection of municipal freshwater infrastructure against extreme weather impacts and related service interruptions. It further aims to contribute towards water security through leveraging on non-public, alternative water sources.

Actions:

i. Maintain water provision infrastructure regularly.
ii. Install water leakage detection technologies.
iii. Protect surface water sources (natural lakes and dams) from pollution.
iv. Develop an overarching water conservation and water demand plan for the Municipal Area.
v. Develop Integrated Water Resource Plan to guide the diversification of the water supply and enhance water security.
vi. Identify new potential water sources.
vii. Encourage the use of alternative water sources such as rainwater tanks, stormwater and recycled waste.
viii. Design stormwater and rainwater harvesting systems for new developments or employ retrofitting.

Programme 3.2: Protect and conserve water across the municipality.
This programme focussed on measures that can be taken to reduce water wastage in public, commercial and private households.

Actions:

i. Include water conservation strategies in housing and settlement planning.
ii. Design systems to recycle water.
iii. Undertake water awareness campaigns around water conservation technologies and techniques.
iv. Design a water pressure management system.

Programme 3.3: Protect and maintain sanitation systems.
This programme focusses on the protection and climate adaptation of wastewater infrastructure to prevent service and infrastructure failures which can also lead to pollution of freshwater, ground and ocean water and which can pose a health risk during climate extreme events.

Actions:

i. Increase the maintenance of tanks and pipes.
ii. Commission new wastewater plants for rural and new township developments.
iii. Elevate sanitation facilities to protect them from floods.
iv. Identify appropriate and sustainable sanitation solutions.
v. Consider re-routing collection, processing and disposal systems.

Programme 3.4: Reduce risk of water-borne diseases through the supply of safe drinking water and safe disposal of wastewater.
This programme bundles actions relating to the prevention of water-borne diseases as a consequence of climatic extreme events such as storms.

Actions:

i. Develop and adopt improved maintenance and asset management plans of stormwater systems and wastewater treatment works, to ensure optimum function.
ii. Upgrade stormwater drainage systems, to accommodate increased stormwater runoff.
iii. Improve the capacity of wastewater treatment plants.
iv. Enforce legal connections to stormwater system.
v. Reduce contamination of stormwater runoff.
vi. Identify access to health services during extreme climate events.
vii. Incorporate an access plan into the Early Warning System (EWS) so health facilities in high-risk areas are alerted before an event.
viii. Develop a Community Services Plan to comprehensively dovetail municipal health needs and their climate change risks into the LM development planning.
ix. Increase capacity and resources at health facilities for climate change related impacts

5.5. Adaptation programme for Goal 4: To protect coastal infrastructure from erosion and flooding

Coastal storms already causing significant flood and erosion damage on the uMhlathuze coast, are expected to increase in severity and frequency in the future. Pro-active integrated coastal management can alleviate much of the expected climate risk. Protection of coastal green infrastructure and climate-wise coastal development will reduce coastal risk to communities and economy.

Programme 4.1: Protection and management of coastal risk zones
This programme suggests actions to protect the District's settlements and infrastructure in the coastal zone, based on coastal management actions which are already in place in the District and the Province.

Actions:

i. Develop a municipal Coastal Management Plan.
ii. Integrate existing coastal risk lines into Spatial Development Framework.
iii. Implement beach nourishment of the shore at Alkantstrand in Richards Bay (uMhlathuze 2024, p. 112).
iv. Enforce the Province's Coastal Management Lines.
v. Protect and restore coastal natural infrastructure (dunes, vegetation) as erosion and flood buffers.
vi. Increase public awareness of value and vulnerability of intact coastal vegetation.

5.6. Adaptation programmes for Goal 5: To maintain good air quality in urban areas

Air quality is negatively impacted by wildfires, agricultural burning practises and industrial dust especially in the Richards Bay port area. Fire risk and dust pollution are expected to increase with future increased wind events. The City of uMhlathuze considers air quality in their recent IDP (uMhlathuze 2024, p.111). They suggest immediate actions, as well as intermediate and long-term actions. This document integrates their immediate and intermediate actions, while Programme 5.3 introduces adaptation actions based on green infrastructure which were not included in the IDP.

Programme 5.1: Climate-wise air quality governance and education
This programme suggests actions towards better air quality on a policy, legislation & enforcement and public awareness level.

Actions:

i. Develop an Air Quality Management Plan. City of uMhlathuze appointed Mamadi & Company SA to develop an Air Quality Management Plan (AQMP)
ii. Develop Air Quality Management By-laws. Draft AQMB. Discussion of admission of guilt fines with the Chief Magistrate is in progress
iii. Develop stricter Air Quality Management Standards. To be developed after implementation of by-laws and Air Quality Management Plan
iv. Ensure that industries with air emissions licences adhere to emissions parameters as set out in the air emissions licences.
v. Educate communities about the importance of not burning waste and making save open fires.
vi. Educate the sugar cane farming communities around the LM about the appropriate times to burn sugar cane to reduce air pollution.
vii. Control and clear alien invasive species in ordered to prevent wildfires.

Programme 5.2: Increase air quality knowledge base through research
This programme addresses potential research gaps towards the development of effective air pollution reduction and treatment.
Actions:

i. Conduct Baseline Studies- to assist in the expansion of air quality monitoring network
ii. Conduct Dispersion Modeling

Programme 5.3: Green infrastructure-based air quality actions
This programme suggests ecosystem-based options for air quality improvement.

Actions:

i. Include green infrastructure (parks, trees, etc.) in areas most affected from air pollution, as identified in the SDF.
ii. Implement public stewardship programmes to green public and private spaces, which could include the public in greening city and private spaces, e.g. by sponsoring / adopting / planting indigenous trees

Expanding urban green infrastructure, specifically with indigenous vegetation, can help to widen buffer areas and linkage corridors for environmental conservation areas as well (uMhlathuze 2022, p. 105).

Greening settlements will make them more “permeable” for species and compensate for buffer zone losses which might result from the planned restructuring of the municipality, particularly in the area of the planned Vulindlela – eSikhaleni Corridor.

6 Implementation Framework

The implementation framework summarises the adaptation plan and indicate responsibilities, and priorities, actioned as short term (<5 years), medium term (5-10 years) or long term (10+ years) interventions.

6.1 Implementation framework for Goal 1: To protect communities and increase the resilience of critical municipal infrastructure

Adaptation programme 1.1: Identify and protect vulnerable communities

Adaptation Actions	Key risk or vulnerability addressed	Responsible entity	Timeframe	Priority level
i. Conduct detailed assessments to identify infrastructure and communities most susceptible to climate hazards	Extreme wind, flooding, heat stress, drought and wildfires	Human settlements	Short term	High
ii. Prioritize infrastructure and communities facing the most severe risks and those with limited capacity to adapt.	Extreme wind, flooding, heat stress, drought and wildfires	Human settlements	Medium term	High
iii. Develop and implement an early warning system to help communities prepare for and respond to climate change risks.	Extreme wind, flooding, heat stress, drought and wildfires	Human settlements, Disaster Risk management	Medium term	Medium
iv. Establish partnerships with local stakeholders, such as traditional leaders, community groups and NGOs, to build local capacity for climate change adaptation and resilience.	Extreme wind, flooding, heat stress, drought and wildfires	Human settlements, COGTA	Short term	Medium
v. Facilitate participatory planning processes that empower communities to co-design and implement adaptation measures that address their specific needs and priorities	Extreme wind, flooding, heat stress, drought and wildfires	Municipal Community Development Department, environmental department, and community leaders	Medium term	High
vi. Organise community-led vulnerability assessments.	Extreme wind, flooding, heat stress, drought and wildfires	Municipal Community Development Department in collaboration with Environmental Department and Local NGOs	Short term	Medium

6.2. Implementation framework for Goal 2: To protect urban infrastructure and settlements from impact of extreme rainfall related flooding

Adaptation programme 2.1: Improved stormwater management and reduced run-off

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Identify existing storm water and critical public infrastructure that is vulnerable to the impacts of climate change.	Flooding	Transport, Roads & Stormwater	Short term	High
ii. Implement regular inspection, and maintenance programs for stormwater and road infrastructure.	Flooding	Transport, Roads & Stormwater	Short term	High
iii. Upgrade stormwater drainage systems to accommodate increased stormwater runoff	Flooding	Transport, Roads & Stormwater in collaboration with local businesses, NGOs and community groups	Medium term	Medium
iv. Explore opportunities to enhance the resilience of existing infrastructure using low-cost, resource-efficient measures, such as retrofitting buildings with locally sourced materials, improving drainage systems using community labour, and repurposing underutilized spaces for emergency shelters.	Flooding	Transport, Roads & Stormwater in collaboration with local businesses, NGOs and community groups	Medium term	Medium
v. Protect and re-establish wetlands.	Drought, Surface Water Depletion, and Groundwater Depletion	Environmental Management	Medium term	Medium
vi. Develop natural buffer zones around critical storm water infrastructure.	Flooding and erosion	Transport, Roads & Stormwater	Medium term	Medium
vii. Identify suitable sites for infiltration of rainwater runoff.	Flooding and Groundwater Depletion	Transport, Roads & Stormwater, Environmental Planning	Short term	High
viii. Develop Green Infrastructure Plans: Integrate green infrastructure principles into urban planning and development.	Flooding, heat stress, drought	Community Services	Short term	High

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
ix. Adopt water-sensitive urban design principles and practices such as permeable pavements, green roofs and rain gardens to enhance water quality and mitigate urban heat island effects.	Flooding, heat stress, drought, air quality	Land use management & Building control (?)	Long term	Medium
x. Promote Community-Based Restoration Projects: Engage local communities in restoration efforts, fostering a sense of ownership and promoting environmental stewardship.	Flooding, heat stress, drought	Community Services	Short term	High
xi. Develop partnerships with local businesses, NGOs, and community groups to leverage additional resources and expertise for infrastructure upgrades.	Flooding	Municipal Manager, Communications, Transport, Roads & Stormwater	Medium term	Medium

Adaptation programme 2.2: To protect and maintain road and public transport infrastructure.

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Elevate roadways to protect them from floods.	Economic and physical vulnerability	Transport, Roads & Stormwater	Medium	High
ii. Maintain roads and public transport infrastructure.	Economic and physical vulnerability	Transport, Roads & Stormwater	Short term	High
iii. Use new technologies for road construction, operations and maintenance.	Economic and physical vulnerability	Transport, Roads & Stormwater	Long term	Low
iv. Limit infrastructure development in high-risk areas/climate risk zones and hotspots	Flooding	Transport, Roads & Stormwater, Spatial & Environmental Planning	Long term	High
v. Climate proof existing developments within climate risk zones or hotspots, where possible.	Flooding	Transport, Roads & Stormwater, Spatial & Environmental Planning	Medium term	High

6.3. Implementation framework for Goal 3: To provide sustainable water and sanitation services

Adaptation programme 3.1: Protect, maintain and diversify freshwater provision services.

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Maintain water provision infrastructure regularly	Drought and flood impact	Water & Sanitation	Short term	High
ii. Install water leakage detection technologies	Drought and flood impact	Water & Sanitation	Short term	High
iii. Protect surface water sources (natural lakes and dams) from pollution	Water quality	Water & Sanitation, Environmental Services	Medium term	High
iv. Develop an overarching water conservation and water demand plan for the municipal area.	Drought (affecting water supply, stormwater) Waste and sewage infiltration	Infrastructure and Technical Services Water	Short term	High
v. Develop Integrated Water Resource Plan to guide the diversification of the water supply and enhance water security.	Drought and Surface Water Depletion, pollution by stormwater	Water & Sanitation	Short term	High
vi. Identify new potential water sources for sanitation.	Drought and Surface Water Depletion or pollution	Water & Sanitation	Short term	High
vii. Encourage the use of alternative water sources such as rainwater tanks, stormwater and recycled waste.	Drought	Water & Sanitation	Short term	High
viii. Design stormwater and rainwater harvesting systems for new developments or employ retrofitting.	Flooding Drought, and Surface Water Depletion	Water & Sanitation	Short term	High

Adaptation programme 3.2: Protect and conserve water across the municipality.

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Include water conservation strategies in housing and settlement planning.	Drought	Spatial Planning, Human settlement	Medium term	Medium
ii. Design systems to recycle water.	Drought	Water & Sanitation	Medium term	Medium
iii. Undertake water awareness campaigns around water conservation technologies and techniques.	Drought	COM Water & Sanitation, and COM Environmental Management and Planning.	Medium term	Low

		Division: Fleet Management		
iv. Design a water pressure management system.	Drought, Groundwater Depletion, and Surface Water Depletion	Transport, Roads & Stormwater	Short term	High

Adaptation programme 3.3: Protect and maintain sanitation systems.

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Increase the maintenance of tanks and pipes.	Drought, Flood, water pollution and Health risks	Water & Sanitation	Short term	High
ii. Commission new wastewater plants for rural and new township developments.	Health risks	Water and Sanitation	Medium term	Medium
iii. Elevate sanitation facilities to protect them from floods.	Flood, water pollution and Health risks	Water & Sanitation, Building control	Long term	Low
iv. Identify appropriate and sustainable sanitation solutions.	Drought, and Health risks	Water & Sanitation	Medium term	Medium
v. Consider re-routing collection, processing and disposal systems.	Health risks	Water & Sanitation, Spatial Planning	Medium term	Medium

Adaptation programme 3.4: Reduce risk of water-borne diseases through the supply of safe drinking water and safe disposal of wastewater.

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Develop and adopt improved maintenance and asset management plans of stormwater systems and wastewater treatment works, to ensure optimum function.	Health risks	Water and Sanitation	Medium term	Low
ii. Upgrade stormwater drainage systems, to accommodate increased stormwater runoff	Floods	Transport, Roads & Stormwater	Medium term	Medium
iii. Improve the capacity of wastewater treatment plants	Flooding, Health risks	Water and Sanitation	Short term	High
iv. Enforce legal connections to stormwater system	Floods	Transport, Roads & Stormwater	Short term	High

v. Reduce contamination of stormwater runoff.	Flooding, Health risks, Health	Water and Sanitation	Short term	High
vi. Identify access to health services during extreme climate events	Flooding, heat stress, health risks	Disaster Management, Public Health	Short term	High
vii. An access plan should be incorporated into the Early Warning System (EWS) so health facilities in high-risk areas are alerted before an event.	Flooding, heat stress, health risks	Disaster Management, Public Health, Community Services & Public Safety	Short term	High
viii. Develop a Community Services Plan to comprehensively dovetail municipal health needs and their climate change risks into the LM development planning.	Flooding, heat stress, health risks	Disaster Management, Public Health, Community Services & Public Safety	Medium term	Medium
ix. Increase capacity and resources at health facilities for climate change related impacts	Flooding, heat stress, health risks	Community Services & Public Safety	Long term	Medium

6.4. Implementation framework for Goal 4: To protect coastal infrastructure from erosion and flooding

Adaptation programme 4.1: Protection and management of coastal risk zones

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Develop municipal Coastal Management Plan	Coastal flooding and erosion	Coastal management, Spatial & environmental planning, Disaster management	Short term	High
ii. Integration of existing coastal risk lines into SDP	Coastal flooding and erosion	Spatial & Environmental Planning	<2 years	High (legal requirement)
iii. Beach nourishment of the shore at Alkantstrand in Richards Bay (uMhlathuze 2024, p. 112)	Coastal flooding and erosion	City and TNPA	<2 years	high
iv. Enforcement of the Province's Coastal Management Lines	Coastal flooding and erosion	Spatial & Environmental Planning (?)	ongoing	high
v. Protection and restoration of coastal natural infrastructure (dunes, vegetation) as erosion and flood buffer	Coastal flooding and erosion	Coastal Management	<2 years	High
vi. Increase public awareness of value and vulnerability of intact coastal vegetation	Coastal flooding and erosion	Coastal management, Environment &	<2 years	medium

		Recreation, Communications		

6.5. Implementation framework for Goal 5: To maintain good air quality in urban areas

Adaptation programme 5.1: Climate-wise air quality governance and education (partly adapted from uMhlathuze 2024, p. 111)

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Development of and Air Quality Management Plan. City of uMhlathuze appointed Mamadi & Company SA to develop an Air Quality Management Plan (AQMP)	Air quality	Air Quality	Short term Draft AQMP in place. Final AQMP to be completed June 2023	High
ii. Development of Air Quality Management By-laws. Draft AQMB. Discussion of admission of guilt fines with the Chief Magistrate is in progress	Air quality	Air Quality	Short term Draft Air Quality Management By-laws in place, awaiting comments from Legal Services and then serve at By-law Committee	High
iii. Develop stricter Air Quality Management Standards. To be developed after implementation of by-laws and Air Quality Management Plan	Air quality		2-3 years	High
iv. Ensure that industries with air emissions licences adhere to emissions parameters as set out in the air emissions licences.	Air quality	Air Quality	Long term	High
v. Educate communities about the importance of not burning waste and making save open fires	Air quality, fire	Air Quality, Community Services	Long term	Medium
vi. Educate the sugar cane farming communities around the LM about the appropriate times to burn sugar cane to reduce air pollution.	Air quality, fire	Air Quality, Agricultural Extension Offices	Long term	Medium

vii. Controlling and clearing alien invasive species in ordered to prevent wildfires	Air quality, fire	Air Quality, Environmental management, Working for Water	Short term (ongoing: WfW)	Medium

Adaptation programme 5.2: Increase air quality knowledge base through research (adapted from uMhlathuze 2024, p. 111)

Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Conduct Baseline Studies- to assist in the expansion of air quality monitoring network. Passive sampling devices were deployed at seven (7) different sites within the jurisdiction of uMhlathuze. These seven sites include eNseleni, eMpangeni, Dlangezwa, Alton CoU Clinic, ZCBF, Melomed Hospital and vicinity of Habour.	Air quality	City of uMhlathuze	Completed	High
ii. Conduct Dispersion Modeling	Air quality		2-3 years (funding was requested)	High

Adaptation programme 5.3: Green infrastructure-based air quality actions

Adaptation programme 5.3: Green infrastructure-based actions				
Adaptation Actions	Key risk or vulnerability addressed	Responsible department	Timeframe	Priority level
i. Include green infrastructure (parks, trees, etc.) in SDF in areas most affected from air pollution	Air quality, flooding, heat	Spatial & environmental Planning	Short term	Medium
ii. Include the public in greening city and private spaces, e.g. by sponsoring / adopting / planting indigenous trees	Air quality, flooding, heat	Spatial & environmental Planning, Communications	Short term	Medium

7. Implications for the Empangeni, eSikhaleni and Richards Bay PHSHDAs

Predictions for an increase in the intensity and frequency of extreme weather events, especially heavy rainfall and storms will pose significant threats to settlements in uMhlathuze. Rising sea levels coupled with storm surges will lead to more frequent and severe coastal flooding. This can inundate low-lying areas, damage infrastructure such as the Richars Bay Port, and displace residents. Erosion of beaches and dunes, natural buffers against storm surges, will worsen flooding risks.

Storms with extreme rainfall and stronger winds has been damage infrastructure, including roads, bridges, buildings, and power grids. These impacts can further lead to loss of property and economic disruption in the PHSHDAs. Damage to homes and businesses from flooding and erosion can lead to significant economic losses and disrupt port operations, mining and tourism, the major sources of income in the LM. Increased flooding and erosion can also force people to relocate, disrupting communities and straining social services. Floods can also lead to health risks such as waterborne diseases due to contaminated water sources.

Addressing these risks requires a collaborative effort from local and district municipalities, public works programmes, coastal communities, engineers, and environmental scientists. The focus should be on prioritizing long-term resilience and implementing a combination of both "hard" and "green" infrastructure solutions.

Improved drainage systems and stricter building codes that consider coastal and extreme rainfall related flood risks can minimize inland flooding and ensure new structures are more resilient. Regular infrastructure maintenance and upgrading to cater for the predicted extreme population growth in the municipality remain critical components of adaptation to climate change. Regular maintenance keeps infrastructure in good working order, ensuring it can continue to function during and after extreme weather events. Neglected infrastructure is more prone to sudden and catastrophic failures during extreme weather events.

These efforts need to be complemented by "soft" solutions that work with nature. Investing in natural buffers like restored wetlands, dunes and mangrove forests can provide a cost-effective and ecologically sensitive way to absorb excess storm water, dampen wave energy and reduce erosion. Furthermore, community education, early warning systems, and relocation plans for particularly high-risk areas empower residents to prepare for and respond to extreme weather events. The planned restructuring of the uMhlathuze land use zoning offers the opportunity to pro-actively integrate these concepts into future development.

The projected extreme population increase makes the PHSHDAs in uMhlathuze vulnerable to water shortages in future. Water-sensitive urban design principles should be integrated into neighbourhood planning to maximize water efficiency and reduce reliance on centralized water supply systems. Rainwater harvesting, greywater recycling, and sustainable landscaping practices should be promoted to conserve water and enhance resilience to droughts and water shortages. Settlements should be designed to withstand climate-related hazards, such as floods and storms, through resilient infrastructure, and disaster risk reduction measures.

8. 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 climate change involves several key elements:

- 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.
- Establishing networks and partnerships: Establishing networks or partnerships with civil society organisations, research councils, the private sector, different spheres of government, and other relevant entities could bolster climate adaptation efforts.
- Monitoring and evaluation: Establishing systems for monitoring and evaluating the effectiveness of mainstreaming efforts and tracking progress towards climate-related goals and targets. This helps ensure accountability and facilitates learning and adaptation over time.

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

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